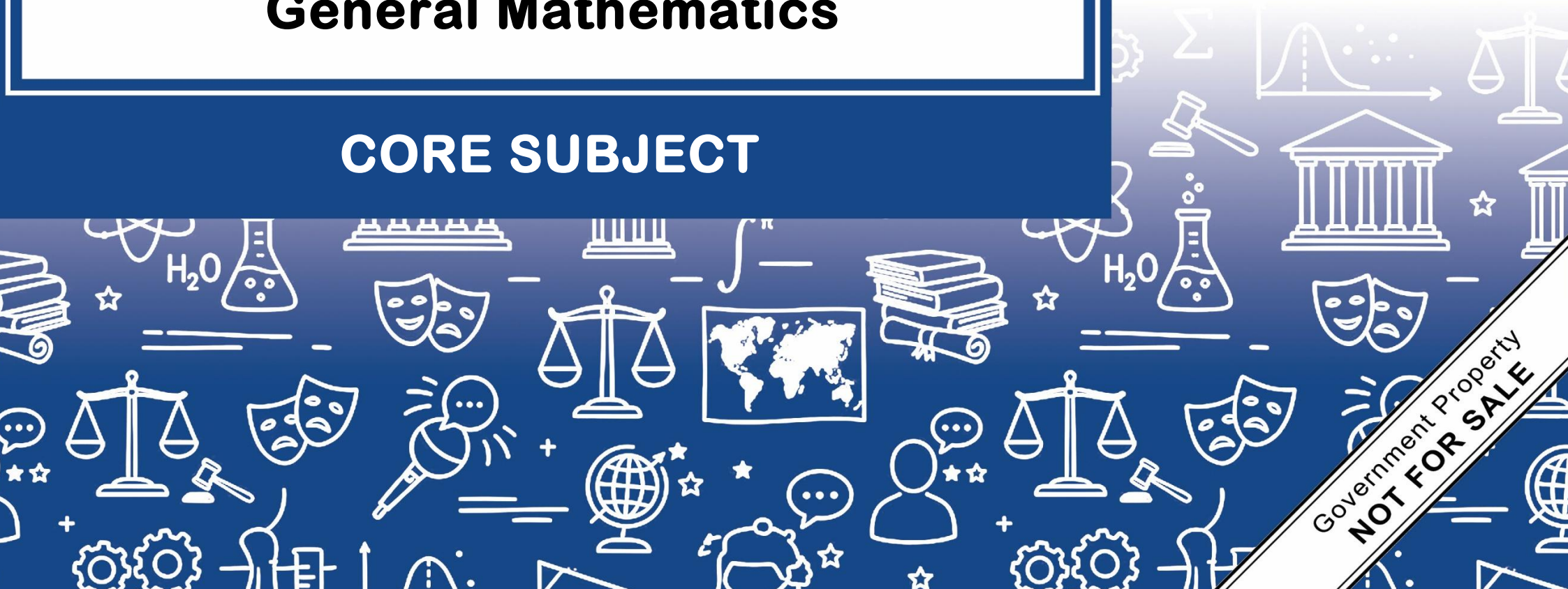
Strengthened Senior High School

DepED
DEPARTMENT OF EDUCATION

Lesson Exemplars for General Mathematics

CORE SUBJECT



Government Property
NOT FOR SALE

Lesson Exemplars for General Mathematics **Term 2**

This material is intended exclusively for the use of Senior High School teachers participating in the implementation of the **Strengthened Senior High School Curriculum**. It aims to assist in delivering the curriculum content, standards, and lesson competencies. Any unauthorized reproduction, distribution, modification, or utilization of this material beyond the designated scope is strictly prohibited and may result in appropriate legal actions and disciplinary measures.

Borrowed content included in this material are owned by their respective copyright holders. Every effort has been made to locate and obtain permission to use these materials from their respective copyright owners. The publisher and development team do not represent nor claim ownership over them.

Development Team

Writers: Raffy U. Fanuncio, Daniel C. Geraldez Jr., Jean A. Julio, Ella Mae P. Betito, Kwenie A. Paje, Jean L. Bataller, Nessa S. Loveres, Ethyl Lydz B. Baclaan, Mac Donald L. Dalugdog, Lovely Maiden A. Campos, James Rey G. Saludares, Niezy Mae Postero, Wilson R. Santiago, Elenita L. Nocidal, Richel L. Lozano, Juan A. Lapay Aljon S. Bucu

Validators: Allen James R. Barlis , Arnel B. Viernes, Jeremiah A. Atenta, Jerlyn A. Fernandez, Marites M. Lalogo, Radly R. Magno , Roegen C. Rivera, Rola, Corazon C. Manaligod, Roveinna S. Salting, Ruel D. Licanto

Consultants: **Allan M. Canonigo**
University of the Philippines, National Institute for Science and Mathematics Education

Learning Area Specialist: **Wilson R. Santiago**
Senior Education Program Specialist, BLD

Bureau of Learning Delivery
Bureau of Curriculum Development
Bureau of Learning Resources

Every care has been taken to ensure the accuracy of the information provided in this material. For queries or clarifications, you may contact the Bureau of Learning Resources – Office of the Director at blr.od@deped.gov.ph or via telephone at (02) 8634-1072.

If you have feedback on the LAS, please accomplish this form, which may be accessed through the following link**:**
https://bit.ly/Feedback_LE_LAS_Core

FEATURES OF THE SENIOR HIGH SCHOOL LESSON EXEMPLAR

The **Senior High School Lesson Exemplar (LE)** is designed to support teachers in delivering meaningful, engaging, and standards-based instruction that responds to the diverse needs of Senior High School learners. Anchored on the **Senior High School Instructional Design Framework (SHSIDF**), the LE ensures constructive alignment among curriculum standards, teaching and learning experiences, and assessment practices. Through this alignment, learners are provided with opportunities to develop the knowledge, skills, and competencies necessary for higher education, skills development, employment, and entrepreneurship.

At the heart of the LE is the **AID** Instructional Flow, a structured approach to teaching and learning composed of three interconnected phases: Activating Prior Knowledge, Instituting New Knowledge, and Demonstrating Knowledge and Skills. This instructional flow guides teachers in creating coherent learning experiences that build from what learners already know, deepen understanding through meaningful engagement, and provide opportunities for authentic application and assessment.

The **Activating Prior Knowledge** phase serves as the entry point of the lesson. It helps learners connect prior experiences and existing knowledge to new concepts, making learning more relevant and meaningful. This phase also establishes the purpose of the lesson by clarifying learning goals, highlighting real-life applications, and motivating learners to actively engage in the learning process.

The **Instituting New Knowledge** phase focuses on the development of understanding and mastery of concepts. Learners are introduced to new ideas through carefully selected examples, guided exploration, and explicit instruction. Through discussions, collaborative activities, and structured practice, learners progressively deepen their understanding and develop the skills necessary to achieve the intended learning outcomes.

The **Demonstrating Knowledge and Skil**ls phase provides opportunities for learners to apply, synthesize, and showcase their learning. Through practical applications, reflective activities, evaluations, and differentiated follow-up tasks, learners demonstrate their understanding while teachers gather evidence of learning. This phase also ensures that learners receive appropriate support through remediation, reinforcement, or enrichment activities based on their individual learning needs.

To further enhance learning experiences, the LE incorporates several key program integrations. **Integrative Performance Tasks (IPTs**) are embedded and scaffolded throughout the lessons to ensure that learners gradually develop the competencies required to successfully complete authentic and interdisciplinary performance assessments. Rather than being treated as isolated end-of-quarter projects, IPTs are woven into classroom instruction, allowing learners to build the necessary knowledge and skills over time.

Recognizing the demands of a rapidly evolving digital world, the LE also promotes **EdTech Integration**. Educational technologies are strategically incorporated to enrich instruction, foster collaboration, encourage creativity, and provide learners with engaging and interactive learning experiences.

In addition, the LE strengthens **Literacy and Numeracy** by embedding literacy and numeracy skills across learning activities and assessments. This integration ensures that learners continuously develop the competencies needed to interpret information, communicate effectively, solve problems, make informed decisions, and navigate real-life situations confidently.

Through these features, the Senior High School Lesson Exemplar serves as a practical and comprehensive guide for teachers, supporting the delivery of high-quality instruction that is learner-centered, inclusive, relevant, and responsive to the aspirations of Senior High School learners and the demands of the 21st century.

GUIDE FOR FACILITATING INTEGRATIVE PERFORMANCE TASKS (IPT)

The **Integrative Performance Task (IPT)** is designed to serve as authentic demonstrations of learning that synthesize competencies across learning areas. To ensure that an IPT becomes the natural culmination of classroom instruction rather than a stand-alone project assigned at the end of a grading period, teachers are encouraged to observe the following principles in the development and implementation of IPT.

First, the Performance Standard should be translated into a concrete, authentic, and real-world product, performance, or solution. Clearly defining the expected output enables teachers and learners to understand the purpose of instruction and maintain focus on the desired end goal throughout the learning cycle.

Second, the accomplishment of the IPT should be developmental and cumulative. Learning Competencies (LCs), technical skills, and disciplinary knowledge required for the final output should be strategically distributed across learning areas and taught within the appropriate lessons. Each lesson should contribute a meaningful component toward the completion of the IPT.

Third, when establishing the purpose of the lesson, teachers should draw from the same real-world context or scenario presented in the IPT. Introducing the scenario early in the learning cycle helps learners recognize the relevance of each lesson and encourages them to continually connect newly acquired knowledge and skills to the final task. The IPT should be presented at the beginning of the quarter and revisited regularly as a reference point throughout instruction.

Fourth, in Finding Practical Applications part of the lesson, teachers should design learning activities that mirror the thinking processes, skills, or performance requirements of the IPT. These formative tasks serve as opportunities for practice and feedback. Whenever possible, teachers should use criteria aligned with the IPT rubric to help learners understand expectations and improve their performance progressively.

Fifth, any digital platforms, educational technologies, mathematical procedures, research methods, laboratory techniques, or other tools required for the successful completion of the IPT should be explicitly taught during the discussion, guided practice, and mastering the concept. Learners should have sufficient opportunities to practice using these tools before they are expected to apply them independently in the IPT.

Sixth, summative assessments should contribute directly to the development of the IPT. Rather than functioning as isolated evaluation activities, these assessments should require learners to produce or refine components of the final output of IPT. This approach strengthens the coherence between instruction, assessment, and performance expectations.

Lastly, the final Lesson Exemplar in the learning cycle should provide opportunities for learners to consolidate, refine, and complete their IPT outputs. This stage may include peer review, consultation, revision, rehearsal, and final polishing of outputs before formal presentation or submission. Teachers should facilitate reflection and feedback to ensure that learners demonstrate both mastery of competencies and meaningful application of learning.

TABLE OF CONTENTS

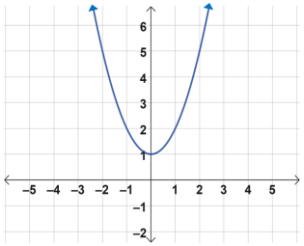
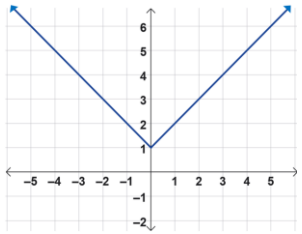
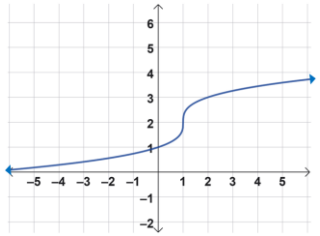
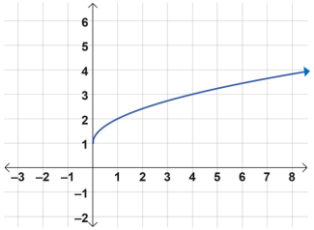
Lesson No.	Title	Pages
Unit 6. Piecewise Functions		
6	Illustrating a Piecewise Function in Practical Contexts	**1**
Unit 7. Data and Measures of Central Tendency		
7.1	Data and Its Level of Measurement	**27**
7.2	Understanding Measures of Central Tendency	**45**
7.3	Measures of Variability	**67**
Unit 8. Right and Oblique Triangles		
8.1	Trigonometric Ratios in a Right-Angled Triangle Using a Real-Life Object or Figure	**91**
8.2	Area of Oblique Triangles	**107**
8.3	Triangles and Navigation	**121**
Unit 9. Measurement and Geometry in Real-Life Applications		
9.1	Estimating and Measuring Lengths and Distances	**140**
9.2	Calculating Area and Perimeter for Practical Purposes	**155**
9.3	Volumes, Capacity, and Cost Estimation	**173**
Unit 10. Random Variable and Sampling		
10.1	Discrete Random Variable	**193**
10.2	The Normal Distribution	**222**
10.3	Sampling	**249**
Teachers Notes		https://bit.ly/4eXc6XL

Unit 6. Piecewise Functions

I. LEARNING GOALS	
Content Standard	The learners should have knowledge and understanding of piecewise functions.
Performance Standard	By the end of the term, the learners are able to model and represent real-world situations using piecewise functions, and solve practical problems while explaining the reasonableness of results.
Learning Competencies	The learners … 1. illustrate a piecewise function in practical contexts (i.e., fare rates, purchasing, and income tax); and 2. solve practical problems involving piecewise functions.
II. REFERENCES and MATERIALS	
Textbook and Modules	Department of Education (DepEd) General Mathematics Learner's Material (First Edition, 2016), Chapter 1: Functions and Their Graphs (pp. 1–15). DepEd Self-Learning Module (SLM) Quarter 1 – Module 1: Representing Real-Life Situations Using Functions, Including Piecewise Functions. *General Mathematics* by Oronce, O. A. (Rex Book Store).
Websites	● Desmos Graphing Calculator: www.desmos.com (for graphing piecewise functions with domain restrictions) ● Khan Academy: www.khanacademy.org – *Piecewise Functions: Evaluation, Graphing, and Real-World Applications* ● Math is Fun: www.mathsisfun.com/sets/functions-piecewise.html
Video Lessons	● Khan Academy YouTube: *Introduction to Piecewise Functions & Evaluating Piecewise Functions* ● The Organic Chemistry Tutor (YouTube): *Piecewise Functions - How To Graph & Evaluate* ● DepEd TV/Knowledge Channel: *General Mathematics: Piecewise Functions and Real-World Applications* ● Wow Math in YouTube: *Piecewise Functions || Grade 11 General Mathematics Q1*
Materials and EdTech	Printed/Physical Materials: ● Learning Activity Sheets ● Enhancement Task Cards– Graphing paper, rulers, and colored pens/markers (for graphing open vs. closed boundary endpoints). Software/EdTech Tools: Desmos / GeoGebra interactive graphing tools, MS Word / Google Docs (for assessment printing), TV/Projector or Interactive Whiteboard.
AI Declaration	Most parts of the Lesson Exemplar were counter-checked using Google AI, Gemini, and NotebookLM, including the grammar and content.
III. CONTENT	**Lesson 6. Illustrating a Piecewise Function in Practical Contexts**
IV. OBJECTIVES	At the end of the lesson, learners should be able to: 1. define what a piecewise function is and explain why it is necessary for certain real-world scenarios; 2. identify the domain intervals and corresponding sub-functions in each real-life situation; 3. identify and interpret the correct graph of a piecewise function by analyzing boundary points (open and closed circles) and interval behaviors; 4. evaluate a piecewise function $f(x)$ for specific given values of x by first determining which interval the input belongs to; and 5. formulate a piecewise function mathematical model $f(x)$ from a word problem involving fare rates, bulk purchasing, or income tax brackets.

<table>
<tr><th>V. PROCEDURES</th><th>LEARNERS ACTIVITIES</th><th>ANNOTATION</th></tr>
<tr><td rowspan="2">A. Activating Prior Knowledge</td><td colspan="2">A.1. Eliciting Prior Knowledge</td></tr>
<tr><td>Activity A.1. Leveling Learner Readiness

A.1.1. Matching Functions to its Graphs

Instructions: Identify the graphs of the four functions below. Write the letter of the graph that corresponds to each function.
<table><tr><th>Functions</th><th></th><th>Graphs</th></tr><tr><td>1. $f(x) = |x| + 1$</td><td>⟶</td><td>_____</td></tr><tr><td>2. $f(x) = x^2 + 1$</td><td>⟶</td><td>_____</td></tr><tr><td>3. $f(x) = \sqrt{x} + 1$</td><td>⟶</td><td>_____</td></tr><tr><td>4. $f(x) = \sqrt[3]{x-1} + 2$</td><td>⟶</td><td>_____</td></tr></table>
A

B

C

D</td><td>Activity A.1. Leveling Learner Readiness

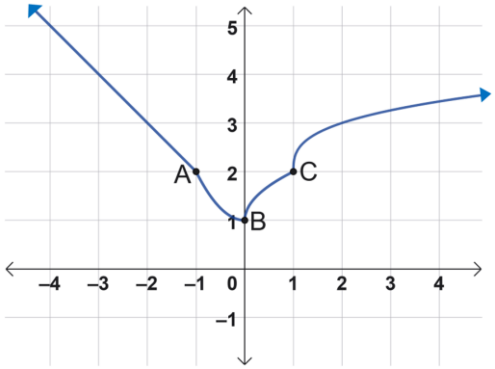
A.1.1. Matching Functions to its Graphs
Learners are presented with four algebraic equations representing distinct parent functions (absolute value, quadratic, square root, and cube root) and must match them to four separate, individual graphs. This acts as a diagnostic and retrieval step. It activates prior knowledge, so students recall what individual functions look like structurally and geometrically before things get complicated.

A.1.2. Function Mash-Up
Learners look at a single, continuous path on a coordinate plane that changes its behavior dramatically at specific boundary points. They must identify which parent function from the previous activity occupies for each segment of the graph. This serves as the conceptual "hook." It creates cognitive dissonance by showing a single line that cannot be defined by one simple equation. It visually bridges the gap between single-rule functions and the necessity of piecewise functions.

To facilitate these activities,
1. Distribute Activity A.1.1 as a quick, silent individual warm-up. This ensures every student independently tests their memory of graph shapes before hearing answers from peers.
2. Quickly project the answer key for Activity A..11. Have students check their work instantly so misconceptions about parent shapes are cleared up before moving forward.
3. Reveal the "Function Mash-Up" graph on the board. Tell students: "The separate graphs you just looked at have been stitched together into a single continuous path." Pass out Activity A.1.2 and have students work in pairs to analyze the four segments.
4. Call on different pairs to identify the segments. Use the 3 processing questions to transition the discussion away from just "matching shapes" and toward defining intervals, boundaries, and real-world thresholds.</td></tr>
</table>

A.1.2. Function Mash-Up

Instructions: Look at the single continuous path on the coordinate plane below. This path is a "mash-up" made of pieces from the four functions you identified in Activity A.1. Answer the following questions with your partner.



1. **Segment 1 (Left of Point A):** Look at the path when $x < -1$. Which parent function shape from Activity A.1 does this straight, sloped line belong to?
2. **Segment 2 (Between Points A and B):** Look at the curve between $x = -1$ and $x = 0$. Which parent function creates this U-shaped curvature?
3. **Segment 3 (Between Points B and C):** Look at the curve between $x = 0$ and $x = 1$. Which parent function starts at a point and curves gently upward like this?
4. **Segment 4 (Right of Point C):** Look at the path when $x \geq 1$. Which parent function creates this curve that continues to flatten out as x increases?

Processing Questions:

1. How did you break down and identify the different segments within the combined graph?
2. Why is it impossible to describe the entire continuous 'Mash-Up' path using just one single algebraic equation?
3. What is a real-world scenario where a cost, rate, or rule changes abruptly once you cross a specific boundary or limit?

Suggested Teaching Strategies

1. Think-Pair-Share (For Activity A.1.2)

Let students look at the combined mash-up graph individually first (Think). Then, have them turn to a seatmate to debate which graph is which and identify where the points change (Pair). Finally, have pairs share their justifications with the class (Share). Graph segments can look deceptive when cut off. Discussing it aloud helps students articulate *why* a curve is quadratic versus a square root based on its curvature.

2. Guided Discovery Learning

Avoid defining the term "piecewise function" at the start of the lesson. Let students struggle with Processing Question 1 (*"Why can't we use just one equation?"*). Allow them to discover the problem on their own. When students realize a single formula fails, they become naturally receptive to the new notation ($f(x) =\ldots$) because they see it as a necessary solution to a problem.

3. Dynamic Visualization (GeoGebra/Desmos)

Project the mash-up function using a graphing tool. Color-code each sub-function differently so students can visually track where the absolute value line stops, and the quadratic curve begins. You can toggle individual pieces on and off to show how the "pieces" are extracted from the original complete parent functions.

<table>
<tr><td></td><td colspan="2">A.2. Establishing the Purpose of the Lesson</td></tr>
<tr><td></td><td>Activity A. 2. Appreciating Lesson Relevance

Jeepney Fare

Instructions: Read the "Jeepney Fare" scenario below and complete the tasks.

Scenario: A local jeepney charges a minimum base fare of ₱13.00 for the first $4km$ or less. For every kilometer traveled after that first boundary, an additional fee of ₱2.00 is added to the fare.

Tasks
A. Try to write a single, standard algebraic equation $C(x)$ to calculate the total fare for any trip distance x in kilometers.
B. Use your equation to calculate the fare for the following three passengers:
1. Passenger A travels $2\ km$
2. Passenger B travels $4\ km$
3. Passenger C travels $6\ km$

Processing Questions:
1. Did your single equation give the correct fare of ₱13.00 for Passenger A ($2\ km$) and ₱17.00 for Passenger C ($6\ km$)? If it failed for one of them, why did it fail?
2. Why is it impossible to create a single, standard formula that handles both "flat-rate" distances ($x \leq 4$) and "extra-distance" rates ($x > 4$) at the same time?
3. Instead of one standard formula, how could we write a "two-rule rulebook" in plain words to accurately explain how to calculate the fare for any distance?</td><td>Activity A.2. Appreciating Lesson Relevance

Jeepney Fare

This activity serves as a conceptual bridge. By asking students to draft a single linear equation (like $C(x) = 13 + 2x$ or $C(x) = 2x + 5$), they quickly discover that standard single-rule formulas cannot accommodate conditional changes.

Facilitation Strategy:
1. Let individual or pairs try writing an equation for 2 minutes.
2. Have them test their formula on Passenger A ($2\ km$). They will notice that $13 + 2(2) = 17$, which overcharges the passenger!
3. Guiding them to state the rule in plain words (e.g., "If distance is 4 or less, pay ₱13. If distance is over 4, pay ₱13 + ₱2 per extra km") sets up the exact logic required when you formally reveal the piecewise brace notation {… in the next part of the lesson.</td></tr>
<tr><td>B. Instituting New Knowledge</td><td colspan="2">B.1. Presenting Examples</td></tr>
<tr><td></td><td>Activity B.1. Exploring Key Concepts

Navigating the Piecewise Functions

Instructions: A mathematical system uses three different rules depending on the value of x you input. For each given $x-$value, complete the two-step task:</td><td>Activity B.1 Exploring Key Concepts

Navigating the Piecewise Functions

Activity B.1 transitions learners from purely visual recognition into the analytical and operational mechanics of piecewise mathematics. Instead of translating a real-world word problem,</td></tr>
</table>

	I. Identify which interval condition is true for x and write down the corresponding sub-function rule. II. Evaluate the value of $f(x)$ by plugging the number into that chosen rule. **Rule 1:** $f(x) = 2x^2 - 3x + 5$ if $x < -3$ **Rule 2:** $f(x) = \|3x - 1\| - 4$ if $-3 \leq x < 2$ **Rule 3:** $f(x) = \sqrt{3x + 1} + 2$ if $x \geq 2$ 1. Given $x = 5$ a. Which interval does $x = 5$ satisfy? _____ b. Which rule will you use? $f(x)$ = _____ c. Solve: $f(5)$ = _____ 2. Given $x = 2$ a. Which interval does $x = 2$ satisfy? _____ b. Which rule will you use? $f(x)$ = _____ c. Solve: $f(2)$ = _____ 3. Given $x = -3$ a. Which interval does $x = -3$ satisfy? _____ b. Which rule will you use? $f(x)$ = _____ c. Solve: $f(-3)$ = _____ 4. Given $x = 1$ a. Which interval does $x = 1$ satisfy? _____ b. Which rule will you use? $f(x)$ = _____ c. Solve: $f(1)$ = _____ 5. Given $x = -5$ a. Which interval does $x = -5$ satisfy? _____ b. Which rule will you use? $f(x)$ = _____ c. Solve: $f(-5)$ = _____	they deal directly with multi-rule functions paired with explicit domain restrictions (x −intervals). The primary purpose of Activity B.1 is to decouple function evaluation from the intimidation of formal piecewise notation (the large grouping bracket). It trains students to execute a two-step logical sequence: 1. The Condition Check: Read the input value, check it against the inequalities, and find the *one* true interval. 2. The Substitution: Execute the corresponding sub-function math. This activity isolates the exact analytical logic required to evaluate a piecewise function. By separating the rules into independent lines before merging them in Activity B.2, you show students that a piecewise function isn't a complex, single mathematical formula; it is simply a logical file system where every input has a single assigned formula destination. To facilitate this activity: 1. Step 1: Set the Stage (The "Doorman" Analogy) Before handing out the task, prime the class with a quick mental anchor: *"Imagine you are a doorman at a venue with three distinct VIP rooms, each with its own strict dress code. If someone walks up to you, you can't let them into all three rooms at once. You have to check their outfit (x-value), find the single room they qualify for, and send them inside."* 2. Step 2: Supervised Execution (Modeling the First Problem) Walk through $x = 5$ as a whole class. Explicitly highlight how you look at the conditions first ($5 < -3$ is False; $-3 \leq 5 < 2$ is False; $5 \geq 2$ is True) before your pencil even touches the calculation step. 3. Step 3: Monitor the "Boundary Traps" As students work through task 2: ($x = 2$), and task 3: ($x = -3$), actively circulate the room. These values are the exact boundary points where the rules "switch." Ensure students don't plug $x = 2$ into both Rule 2 and Rule 3; point them back to the strict structural meaning of the inequality bars ($\leq$ or $<$).

	Processing Questions: 1. Before you can plug a number into an equation to calculate an answer, what must you check or look first? 2. Why is it impossible for a single input value, like $x = 2$, to be calculated using both Rule 2 and Rule 3 at the same time? 3. Look closely at the signs in the intervals ($\leq, <, \geq$). If your input value is exactly $x = -3$, how do you know which rule is the correct one to use?	**Suggested Teaching Strategies** *1. Color-Coded Domain Mapping* Have students use three different colored highlighters (e.g., Yellow for Rule 1, Green for Rule 2, Pink for Rule 3). Have them highlight the inequality interval and its matching equation in the same color. When given an input number, they must first highlight that number with the color of the interval it belongs to before doing any math. It prevents cognitive overload by visually chunking the function. It trains the brain to realize that once an interval is picked, the other two rules completely disappear from relevance. *2. Peer-to-Peer Error Analysis (The "Debugging" Strategy)* Instead of just grading final values, have partners swap papers specifically to check each other's step-by-step responses to *"Which interval does x satisfy?"* Misunderstandings of inequality signs (like thinking -3 fits into $x < -3$) are the number one cause of calculation failure in piecewise evaluation. Forcing students to critique a peer's interval selection targets this exact mistake early. *3. Concrete Number Line Proximity* Draw a giant number line on the board divided into your three domain zones ($x < -3$, $[-3,2)$, and $x \geq 2$). For concrete learners who struggle to instantly process analytical inequality symbols, physically tracking where the point $x = -5$ sits on a visual number line makes identifying the correct conditional rule instantaneous.
	B.2. Discussing the Concept	
	Activity B.2. Deepening Conceptual Understanding *Instructions*: Read and understand how piecewise functions are structured, graphed, and applied to real-life scenarios. Pay close attention to the worked-out examples and step-by-step solutions.	**Activity B.2. Deepening Conceptual Understanding** This activity involves four core parts: 1. *Anatomy & Rules*: Understanding domain constraints and mutual exclusivity. 2. *Graphical Analysis*: Reading boundary points, continuity, and jump breaks.

What is a Piecewise Function?

A piecewise function is a unique type of mathematical function that does not use a single, uniform formula for its entire graph. Instead, it is a "hybrid" function composed of multiple distinct equations (called ***sub-functions***), each of which applies only to a specific part of the domain (called an ***interval*** or ***sub-domain***).

In other words, the rule or formula changes depending on the value of the input $\boldsymbol{x}$.

The Anatomy of a Piecewise Function

When written out formally, a piecewise function uses a large grouping bracket ($\{$) to bundle all of its rules together. It looks like this:

$$f(x) = \begin{cases} 2x + 1, & \text{if } x < 0 \\ x^2, & \text{if } x \geq 0 \end{cases}$$

To read and understand this structure, think of it as a set of logical "**If-Then**" instructions:

- ***The Domain Condition (The "If"):*** Your eyes must always look at the right side first. If your input number is less than 0, you must send it to the top formula. If it is greater than or equal to 0, you send it to the bottom formula.
- ***The Rule (The "Then"):*** Once you've found the correct interval, you perform the math on the left side.

Rules of Piecewise Functions

1. *The Intervals Cannot Overlap (Mutually Exclusive)*
   A fundamental rule of any mathematical function is that one input (x) can only produce exactly one output (y). Therefore, the intervals on the right side must never overlap. For instance, you will never see $x \leq 2$ and $x \geq 2$ as two separate rules because if you plugged in $x = 2$, the math system would break down trying to give you two different answers.
2. *The Graph Can Be Disconnected*
   Because a piecewise function is stitched together from different equations, its graph often features sudden breaks, jumps, or steps. A graph that breaks apart is called

3. *Mathematical Modeling*: Translating real-life tiers (tricycle fares, tax brackets, wholesale pricing) into piecewise functions.
4. *Algebraic Evaluation & Processing*: Practicing proper sub-function routing and reflecting on logical steps.

Guide to implement the Activity:

1. *Purpose & Lesson Timing:* Use this *after* students have been briefly introduced to basic functions, but *before* you give them standalone practice worksheets or quizzes. Shift students' mindset from viewing piecewise functions as "scary, fragmented equations" to seeing them as structured, real-world "If-Then" decision trees.

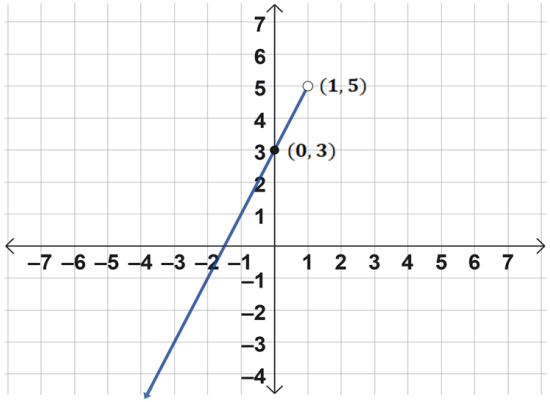
2. *Step-by-Step Delivery Plan*
   Phase 1: Orienting & Highlighting (10 Mins).
   Direct students to read the Anatomy section. Tell students to use two colors of highlighters on the document:
   Yellow: Highlight all Domain Conditions (the inequalities on the right).
   Green: Highlight all Sub-Functions (the algebraic expressions on the left).
   Emphasize the "Right-to-Left" Reading Rule: Students must train their eyes to read the Yellow condition *first* before looking at the Green math.

   Phase 2: Graphing Walkthrough & Endpoints (15 Mins)
   Walk through Examples 1 & 2 on a board or projector. Enforce the "Pencil Up, Pencil Down" technique:
   a. Plot the boundary coordinate lightly.
   b. Stop and inspect the inequality symbol.
   c. Draw a closed circle (·) if included (≤ or ≥) or an open circle (∘) if excluded (< or >).
   d. Trace the curve/line *only* within the allowed domain interval.

	discontinuous, while a piecewise graph where the segments perfectly touch at the boundaries is called *continuous*. **Graph of Piecewise Functions** To graph a piecewise function accurately, follow these three core steps: *Step 1: Identify the Boundary Lines (The "Switch" Values)* Look at the inequalities on the right side of the function. These values indicate where one rule ends, and another begins. It is often helpful to lightly sketch vertical dashed lines at these x-values on your coordinate plane as temporary guidelines. *Step 2: Plot Each Segment Using a Table of Values* Treat each sub-function as an independent graphing problem but *only calculate points within its allowed interval*. Always calculate the exact boundary value for the equation, even if the inequality uses a strict less-than (<) or greater-than (>) sign. This tells you exactly where the line terminates. *Step 3: Apply Open and Closed Circles at the Transitions* This is the most critical step to ensure your graph remains a valid function passing the *Vertical Line Test*: • **Closed Circle (●):** Used when the endpoint is included in the interval. Look for the "or equal to" symbols (≤ or ≥). • **Open Circle (○):** Used when the endpoint is *not* included. Look for strict inequalities (< or >). **Examples** *1. Graphing a Two-Part Function* Let's look at how to graph this system: $$f(x) = \begin{cases} 2x + 3, & \text{if } x < 1 \\ -x^2 + 4, & \text{if } x \geq 1 \end{cases}$$ To graph the linear subfunction where $x < 1$, first identify its basic properties. The graph is a straight line with a slope of 2 and a y−intercept at $(0, 3)$. Next, find the boundary value by substituting $x = 1$ into the function. This gives a value of 5,	*Phase 3: Real-World Modeling (15 Mins).* Have students analyze the Tricycle Fare and Textile Discount examples. Ask the class: *"What is the exact breakpoint where the pricing rule changes?"* (e.g., $x = 4$ for tricycle distance; $x =$ 20,50,100 for shirt orders). Show them how real-world conditional rates map directly into mathematical sub-domains. *Phase 4: Processing & Reflection (10 Mins)* Have students answer the three Processing Questions individually or in pairs. Use their answers as a quick formative assessment to gauge if they understand *why* domain checking prevents algebraic errors. Recommended Teaching Strategies *a. The "Traffic Cop" Metaphor:* Frame the domain condition as a traffic sign directing the input x to its designated lane (sub-function). An input cannot travel down two lanes at once. *b. Think-Pair-Share for Modeling:* When working through the tax bracket model, give students 2 minutes to identify the switch points independently before sharing their reasoning with a partner. c. *Processing Questions as Exit Tickets:* Collect Question 3 as an Exit Ticket to verify if students can transfer the "If-Then" logic to other everyday systems like mobile data caps or parking meters.

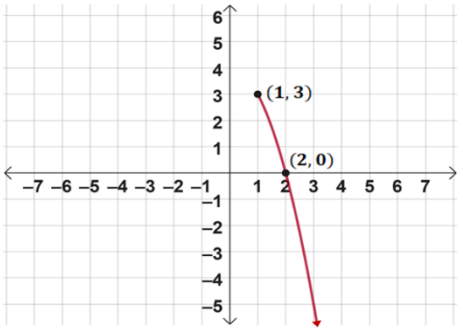
so plot an open circle at $(1, 5)$. Use an open circle because the inequality is strictly less than.

After that, pick a few x −values smaller than 1 to find supporting points. Plugging in $x = 0$ gives $(0, 3)$, and plugging in $x = -1$ gives $(-1, 1)$. Finally, draw a straight line starting from the open circle at $(1, 5)$. Pass the line through your supporting points and extend it downward to the far left with an arrow.

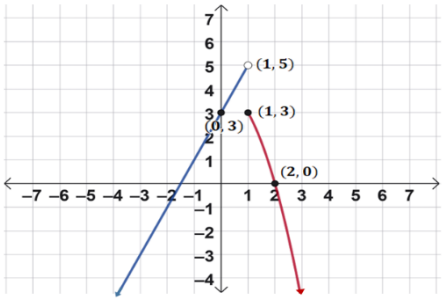


To graph the quadratic subfunction for $x \geq 1$, first identify its shape. The graph is a downward-opening parabola. Normally, its peak vertex is at $(0, 4)$. However, only draw the portion where $x \geq 1$. Next, find the boundary by substituting $x = 1$ into the formula. This gives a value of 3. Plot a closed circle at $(1, 3)$. Use a closed circle because the inequality is "greater than or equal to."

After that, choose x −values larger than 1 for supporting points. Plugging in $x = 2$ gives the point $(2, 0)$. Finally, draw a smooth, curved parabolic arc. Start at the closed circle $(1, 3)$. Bend the curve downward through $(2, 0)$. Extend it to the right with an arrow.



Hence, the graph of the piecewise function $f(x)$ is

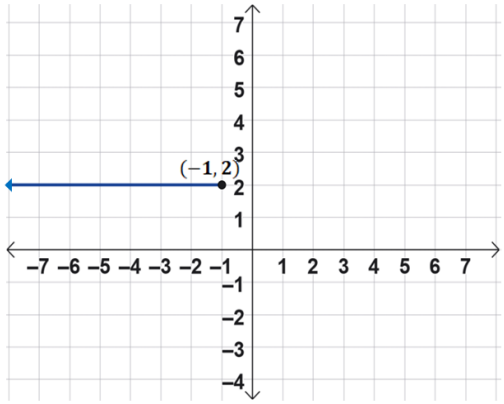


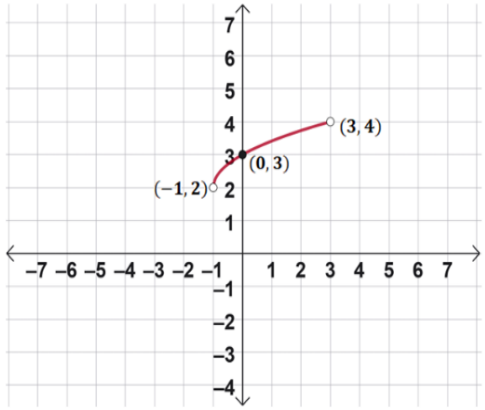
To check for a jump discontinuity, look closely at the boundary line where $x = 1$. Determine if the linear and quadratic parts connect perfectly. They do not meet because the linear graph ends at a height of $y = 5$. Meanwhile, the quadratic graph starts lower down at a height of $y = 3$. This visible gap or vertical break means the two lines fail to touch. Therefore, this graph represents a *discontinuous* piecewise function.

2. Graphing a Three-Part Function

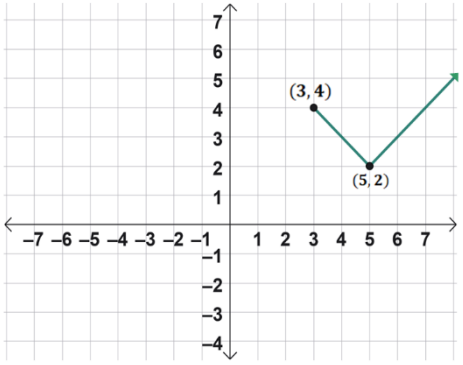
Let's look at how to graph this system:

$$(x) = \begin{cases} \mathbf{2}, & \textbf{if } \boldsymbol{x \leq -1} \\ \boldsymbol{\sqrt{x+1}+2}, & \textbf{if } \boldsymbol{-1 < x < 3} \\ \boldsymbol{|x-5|+2}, & \textbf{if } \boldsymbol{x \geq 3} \end{cases}$$

	To graph this three-part piecewise function accurately, it is best to break the system down and visualize each subfunction independently, along with its boundary points. Next, we will look at the separate components labeled as graphs a, b, and c to see how each individual equation behaves before they are combined. First, graph a represents the constant subfunction $f(x) = 2$ for the interval $x \leq -1$, which ends at the solid critical point $(-1, 2)$. Next, graph b illustrates the square root subfunction $f(x) = \sqrt{x+1} + 2$ for the interval $-1 < x < 3$, bounded between the open critical points $(-1, 2)$ and $(3, 4)$ while passing through the y-intercept at $(0, 3)$. Finally, graph c displays the absolute value subfunction $f(x) = \|x - 5\| + 2$ for the interval $x \geq 3$, which begins at the solid critical point $(3, 4)$ and dips down to its vertex at $(5, 2)$.  a	

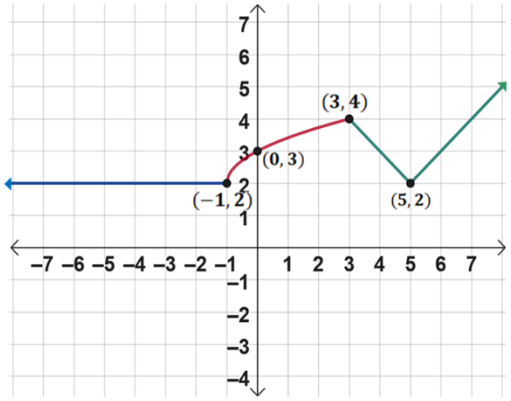


b



c

Layering the subfunctions onto one plane creates graph *d*. This graph proves that $f(x)$ is a *continuous piecewise function*. It is continuous because it forms an unbroken line with no gaps or jumps. The solid endpoints from the outer pieces perfectly plug into the open holes of the middle piece. You can trace the entire path without lifting your pencil.



d

Representing Real-Life Situation using Piecewise Functions

To represent any real-world scenario into a mathematically sound piecewise function, we use a systematic 4-step process:

1. Define the Variables (Identify your input $'x'$ and output $'y'$)
2. Pinpoint the Breakpoints (Identify exactly where the rules change)
3. Construct the Domain Intervals (Build the mathematical inequalities)
4. Formulate the Sub-functions (Write the algebraic equations)

Example 1.

A local tricycle driver charges a fixed minimum fare of ₱15.00 for the first *4 km* or less. For any distance beyond *4 km*, the passenger pays the base ₱15.00 plus an additional ₱2.00 per kilometer for the extra distance traveled. Represent the total tricycle fare for the distance traveled using the function $f(x)$, where x is the number of distances traveled.

Step 1: Define the Variables

Input (x): Distance traveled (in kilometers)
Output $(f(x))$: Total tricycle fare (in Pesos)

Step 2: Pinpoint the Breakpoints

The payment structure shifts gears exactly at $x = 4$.

Step 3: Construct the Domain Intervals

Interval 1 (Minimum Fare): Distance from 0 up to 4 kilometers is $0 < x \leq 4$

Interval 2 (Over-distance Fare): Distance strictly greater than 4 kilometers is $x > 4$

Step 4: Formulate the Sub-functions

For $0 < x \leq 4$: The rate is fixed at ₱15.00

For $x > 4$: The base fare (₱15.00) plus ₱2.00 for every kilometer exceeding 4, which is written as $(x - 4)$,

$$15 + 2(x - 4) = 15 + 2x - 8$$

$$= 2x + 7$$

The Piecewise Model

$$f(x) = \begin{cases} \mathbf{15}, & \textbf{if } \mathbf{0 < x \leq 4} \\ \mathbf{15 + 2(x - 4)}, & \textbf{if } \mathbf{x > 4} \end{cases}$$

or

$$f(x) = \begin{cases} \mathbf{15}, & \textbf{if } \mathbf{0 < x \leq 4} \\ \mathbf{2x + 7}, & \textbf{if } \mathbf{x > 4} \end{cases}$$

Example 2.

For employees receiving monthly compensation, the Bureau of Internal Revenue determines tax withholding based on specific gross monthly earnings brackets. Monthly earnings up to ₱20,833.33 are completely tax-free. Earnings above ₱20,833.33 and up to ₱33,333.33 are taxed at a rate of 15% of the amount exceeding ₱20,833.33. For individuals earning above ₱33,333.33 and up to ₱66,666.67, the tax consists of a flat, fixed amount of ₱1,875.00 plus an additional 20% of the amount exceeding ₱33,333.33. Represent the total monthly income tax $f(x)$, as a piecewise function of an employee's gross monthly earnings x.

Step 1: Define the Variables

Input (x): Employee's gross monthly earnings (in Pesos)

Output ($f(x)$): Total monthly income tax withholding (in Pesos)

Step 2: Pinpoint the Breakpoints

The tax rules switch gears at two explicit income thresholds:

First switch: $x = 20{,}833.33$

Second switch: $x = 33{,}333.33$

Upper limit mentioned: $x = 66{,}666.67$

Step 3: Construct the Domain Intervals

Interval 1: Gross earnings up to ₱20,833.33 is

$$0 \leq x \leq 20{,}833.33$$

Interval 2: Earnings above ₱20,833.33 up to ₱33,333.33 is

$$20{,}833.33 < x \leq 33{,}333.33$$

Interval 3: Earnings above ₱33,333.33 up to ₱66,666.67 is

$$33{,}333.33 < x \leq 66{,}666.67$$

Step 4: Formulate the Sub-functions

For $0 \leq x \leq 20{,}833.33$: Tax is 0.

For $20{,}833.33 < x \leq 33{,}333.33$: Taxed at 15% (0.15) of the amount exceeding ₱20,833.33:

$$0.15(x - 20{,}833.33) = 0.15x - 3{,}125$$

For $33{,}333.33 < x \leq 66{,}666.67$: A flat fixed amount of ₱1,875.00 plus 20% (0.20) of the amount exceeding ₱33,333.33:

$$1{,}875 + 0.20(x - 33{,}333.33) = 1{,}875 + 0.20x - 6{,}666.67$$

$$= 0.20x - 4{,}791.67$$

The Piecewise Model

$$f(x) = \begin{cases} \mathbf{0}, & \textbf{if } \mathbf{0 \leq x \leq 20{,}833.33} \\ \mathbf{0.15(x - 20{,}833.33)}, & \textbf{if } \mathbf{20{,}833.33 < x \leq 33{,}333.33} \\ \mathbf{1{,}875 + 0.20(x - 33{,}333.33)}, & \textbf{if } \mathbf{33{,}333.33 < x \leq 66{,}666.67} \end{cases}$$

or

$$f(x) = \begin{cases} \mathbf{0}, & \textbf{if } \mathbf{0 \le x \le 20,833.33} \\ \mathbf{0.15x - 3,125}, & \textbf{if } \mathbf{20,833.33 < x \le 33,333.33} \\ \mathbf{10.20x - 4,791.67}, & \textbf{if } \mathbf{33,333.33 < x \le 66,666.67} \end{cases}$$

Example 3.
A custom textile manufacturer offers bulk discounts for printing institutional shirts. The cost per shirt is ₱250 for orders of 1 to 20 shirts, ₱220 for 21 to 50 shirts, ₱190 for 51 to 100 shirts, and ₱150 for orders of more than 100 shirts. Express the total cost $f(x)$, as a piecewise function of the number of shirts ordered x.

Step 1: Define the Variables
Input (x): The number of shirts ordered
Output ($f(x)$): The total purchase cost of the entire order (in Pesos)
Step 2: Pinpoint the Breakpoints
The wholesale unit pricing drops at three explicit milestone adjustments:
First switch: After 20 shirts
Second switch: After 50 shirts
Third switch: After 100 shirts
Step 3: Construct the Domain Intervals
Interval 1: Orders from 1 to 20 shirts is $1 \le x \le 20$
Interval 2: Orders from 21 to 50 shirts is $21 \le x \le 50$
Interval 3: Orders from 51 to 100 shirts $51 \le x \le 100$
Interval 4: Orders of more than 100 shirts is $x > 100$
Step 4: Formulate the Sub-functions
For $1 \le x \le 20$, cost is $250x$.
For $21 \le x \le 50$, cost is $220x$.
For $51 \le x \le 100$, cost is $190x$.
For $x > 100$, cost is $150x$.

The Piecewise Model

$$f(x) = \begin{cases} \mathbf{250x}, & \textbf{if } \mathbf{1 \le x \le 20} \\ \mathbf{220x}, & \textbf{if } \mathbf{21 \le x \le 50} \\ \mathbf{190x}, & \textbf{if } \mathbf{51 \le x \le 100} \\ \mathbf{150x}, & \textbf{if } \mathbf{x > 100} \end{cases}$$

Evaluating Piecewise Functions

When we evaluate a standard algebraic function like $f(x) = 3x + 1$, the process is straightforward: no matter what number we choose for x, we always plug it into that single expression.

However, evaluating a piecewise function requires a bit of detective work first. Because a piecewise function is made up of different sub-functions, you cannot just plug your input value into any formula you see. You must first look at the **domain restrictions** (the "if" conditions on the right side) to determine which specific sub-function rules are in that territory.

Example.

1. Given the piecewise function $f(x)$:

$$\boldsymbol{f(x)} = \begin{cases} \boldsymbol{2x + 7}, & \textbf{if } \boldsymbol{x < 0} \\ \boldsymbol{\sqrt[3]{x} + 4}, & \textbf{if } \boldsymbol{x \geq 0} \end{cases}$$

a. evaluate $f(-5)$.

Solutions:

$$f(x) = 2x + 7$$
$$f(-5) = 2(-5) + 7$$
$$= -10 + 7$$
$$= -3$$

b. evaluate $f(8)$.

Solutions:

$$f(x) = \sqrt[3]{x} + 4$$
$$f(8) = \sqrt[3]{8} + 4$$
$$= 2 + 4$$
$$= 6$$

2. Given the piecewise function $g(x)$:

$$(\boldsymbol{x}) = \begin{cases} \boldsymbol{|x + 3|}, & \textbf{if } \boldsymbol{x \leq -1} \\ \boldsymbol{x^2 - 4x + 1}, & \textbf{if } \boldsymbol{-1 < x < 4} \\ \boldsymbol{\sqrt{x - 4} + 2}, & \textbf{if } \boldsymbol{x \geq 4} \end{cases}$$

a. evaluate $g(3)$.

Solutions:

$$g(x) = x^2 - 4x + 1$$
$$g(3) = (3)^2 - 4(3) + 1$$
$$= 9 - 12 + 1$$
$$= -2$$

b. evaluate $g(4)$.

Solutions:

$$g(x) = \sqrt{x-4} + 2$$
$$g(4) = \sqrt{4-4} + 2$$
$$= \sqrt{0} + 2$$
$$= 0 + 2$$
$$= 2$$

c. evaluate $g(-6)$.

Solutions:

$$g(x) = |x + 3|$$
$$g(-6) = |-6 + 3|$$
$$= |-3|$$
$$= 3$$

3. Given the piecewise function $h(x)$:

$$(\boldsymbol{x}) = \begin{cases} \mathbf{-5}, & \textbf{if } \boldsymbol{x \leq -3} \\ \mathbf{3x + 1}, & \textbf{if } \mathbf{-3 < x < 1} \\ \mathbf{\sqrt{x-1} - 2}, & \textbf{if } \mathbf{1 \leq x \leq 5} \\ \mathbf{(x-5)^2 + 2}, & \textbf{if } \boldsymbol{x > 5} \end{cases}$$

a. evaluate $h(-10)$.

Solutions:

$$h(x) = -5$$
$$h(-10) = -5$$

b. evaluate $h(0)$.

Solutions:

$$h(x) = 3x + 1$$
$$h(0) = 3(0) + 1$$
$$= 0 + 1$$
$$= 1$$

c. evaluate $h(5)$.

Solutions:

$$h(x) = \sqrt{x - 1} - 2$$
$$h(5) = \sqrt{5 - 1} - 2$$
$$= \sqrt{4} - 2$$
$$= 2 - 2$$
$$= 0$$

d. evaluate $h(7)$.

Solutions:

$$h(x) = (x - 5)^2 + 2$$
$$h(7) = (7 - 5)^2 + 2$$
$$= (2)^2 + 2$$
$$= 4 + 2$$
$$= 6$$

Processing Questions:

1. When graphing or evaluating a piecewise function, why is it critical to look at the domain conditions (the inequalities on the right side) before doing any algebraic calculations? What error occurs if a student skips this step?
2. Explain how you determine whether to use an open circle (○) or a closed circle (●) on a graph, and how this translates to choosing the correct sub-function when evaluating the function algebraically.
3. Now that you know how to break down, graph, and evaluate multi-part piecewise systems, how can you apply this same structured "If-Then" logic to interpret real-world systems outside of math class—such as tax brackets, cell phone data plans, or shipping cost tiers? What strategy will you use next time you encounter a brand-new, complex function to ensure you don't mix up the rules?

	*B.3. Developing Mastery (*For complete instructions, please refer to the Learning Activity Sheet.)
	Activity B.3. Practicing Learned Skills The primary objective of Activity B.3 is to transition learners from conceptual discovery to procedural fluency, mathematical modeling, and multi-disciplinary synthesis. By breaking mastery into four distinct sub-activities, students approach piecewise functions through multiple modalities: algebraic evaluation, real-world scenario representation, visual graphing, and literacy-based text analysis. **B.3.1. Practicing Learned Skills: Evaluating Piecewise Function** The purpose of this activity is to build computational accuracy and enforce the "Condition First, Formula Second" routing rule. It trains students to check domain inequalities before executing algebraic calculations, with a heavy emphasis on handling boundary values correctly. *Suggested Teaching Strategies*: 1. *Traffic Light Highlighting:* Have students highlight the domain conditions ($x < 1$, $x \geq 1$) in yellow. Force them to state verbally: *"Where does my x-value fit?"* before writing down any math. 2. *Boundary Point Checkpoint:* Call attention to items where x lands directly on a breakpoint (e.g., $f(1)$ or $h(3)$). Prompt students to identify which sub-function holds the inclusive inequality ($\leq$ or $\geq$). **B.3.2. Practicing Learned Skills: Representing Real-Life Situations** The purpose of this activity is to demonstrate the practical utility of piecewise functions as real-world decision models. Students learn to identify breakpoints, translate verbal conditions into domain intervals, and express tiered rates (fares, bulk pricing, tax brackets) mathematically. *Suggested Teaching Strategies* 1. *Deconstruction Strategy:* Teach students to break down word problems into two components: Base Condition vs. Incremental Condition. 2. *Think-Pair-Share Modeling:* Allow students 3 minutes to independently identify the "switch point" (e.g., *4 km* in the jeepney problem or 25 *shirts* in the order problem) before comparing equations with a partner. **B.3.3. Practicing Learned Skills: Graphing Piecewise Function** The purpose of this activity is to bridge algebraic inequalities with spatial/visual representations. Students practice plotting endpoints accurately using open circles (∘) and closed circles (·), as well as analyzing graphs for continuity vs. jump discontinuities. **Educational Technology Integration** (GeoGebra / Desmos) a. *Teacher Demonstration*: Use Desmos or GeoGebra on a projector to dynamically show how domain restrictions clip functions.

b. *Desmos Syntax Tip*: Show students how Desmos plots piecewise functions using conditional syntax:

$$Example:\ f(x) = \{x < 1 : x + 3, x \geq 1 : x^2 + 3\}$$

c. *Interactive Exploration*: Have students verify their hand-drawn graphs against Desmos/GeoGebra. Use the tool's slide feature or point-checker to highlight how open circles (○) and closed circles (●) define continuity at boundary jump gaps.

B.3.4. Practicing Learned Skills: Reading Integration

This activity explicitly integrates **reading literacy** into the mathematics curriculum. It assesses students' ability to comprehend technical/informational text and maps reading skills across *four cognitive reading dimensions*:

Reading Dimension	Targeted Test Items	Literacy & Mathematical Objective
Vocabulary	Items 1 & 2	Decoding domain-specific terminology (demarcation points, mutates) using context clues.
Literal	Items 3 & 4	Extracting explicitly stated data and factual details directly from the text structure
Inferential	Items 5, 6, & 7	Synthesizing underlying meanings, such as why non-overlapping intervals ensure single-valued outputs.
Knowledge Construction	Items 8, 9, & 10	Applying critical abstract thinking to connect text concepts with formal mathematical notation.

Suggested Teaching Strategies

1. *Reciprocal Teaching / Active Annotation*: Have students perform a "first pass" reading to highlight key numerical thresholds and vocabulary words before attempting the multiple-choice questions.
2. *Literacy Discussion*: Prompt a brief class discussion on Question 6: *"Why would an overlapping interval in a utility bill cause customer service problem?"* (Connects the math concept of a function to consumer rights).

C. Demonstrating Knowledge and Skills

C.1. Finding Practical Application

Activity C.1. Making Real-World Connections

Instructions: Read the scenario below. Apply your knowledge of piecewise functions to complete Tasks A through E. Write your responses and sketch your graph clearly on a separate sheet of paper (or in your activity notebook).

Activity C.1. Making Real-World Connections

This activity is an applied, authentic performance task where learners step into the role of a "pricing consultant." Rather than solving static textbook problems, students select an existing tiered service from their daily lives (or propose a new policy for a local

	Scenario: You have been hired as a pricing consultant by a local business, utility provider, school canteen, or transport group. Many consumer services use tiered pricing (piecewise systems) to balance fairness, cover operational costs, and encourage specific customer behaviors. Your mission is to identify an existing real-world tiered system (or design a new policy for a local entity), model it as a formal piecewise function, and evaluate its impact. *Tasks:* A. Choose **ONE** real-life scenario from your immediate community or daily routine. You may pick an existing service or create a new tiered policy for one of the following: 1. *Local Transport/Courier:* Tricycle, jeepney, or delivery app (Grab/Lalamove) fare structures. 2. *School Canteen/Local Cafe:* A loyalty discount tier based on monthly customer spending or bulk snack orders. 3. *Mobile Data/Fiber Internet:* Broadband plans with data rollover, throttling limits, or overage charges. 4. *Local Gym/Sports Complex:* Membership pricing based on hours trained per week or peak vs. off-peak hours. 5. *Internet Cafe/Co-Working Space:* Tiered hourly rental rates for gaming or study booths. B. Briefly describe the business/service and explain *why* a multi-part (piecewise) rule is necessary instead of a single flat rate. C. Write the complete piecewise function $f(x)$ representing the total cost or fee in pesos, clearly defining input x with its units (e.g., kilometers, hours, gigabytes) and specifying non-overlapping domain conditions. D. Sketch the graph of your piecewise function. Clearly mark all breakpoints, open circles (○), and closed circles (●). State whether your system is continuous or discontinuous.	entity) such as transport fares, cafe loyalty tiers, broadband plans, gym memberships, or internet cafe rates. Learners complete a 1-page consultant brief requiring them to: 1. Contextualize why a piecewise (multi-rule) structure is necessary over a flat rate. 2. Formulate the formal algebraic piecewise function $f(x)$ with non-overlapping domain conditions. 3. Graph the model on a Cartesian plane, highlighting boundary points (○ vs. ●) and identifying graph continuity. 4. Evaluate the social/economic impact through critical reflection of questions on fairness and consumer behavior. This activity bridges abstract algebraic concepts (sub-functions, domain restrictions, breakpoints) with real-world financial and social systems (pricing structures, utility tiers, tax brackets). By offering choice across various daily scenarios (transport, gym, internet, food), the activity guarantees varied, non-duplicative, and meaningful student output. The activity also moves beyond routine computation ($f(x) = y$) to policy evaluation - asking *why* breakpoints exist, *how* they affect low-income vs. heavy users, and *what* behavior they encourage. **Suggested Teaching Strategies** *1. The "Consultant Mindset" Framing (Hook & Orientation)* • Launch the activity by presenting a real local receipt or bill (e.g., a local water bill or a food delivery receipt with distance surcharges). Ask the class: *Why doesn't this service just charge one simple flat rate?* • Frame the submission as a professional recommendation brief for a business client. This elevates student effort and encourages clean, presentable formatting. *2. Scaffolding the "Exceeding Baseline" Formula* • Students often struggle with setting up expressions for tiered rates that charge only for amounts *exceeding* a

E. Answer the following two consultant reflection questions:
1. How does this tiered structure protect low-usage customers while ensuring the provider stays profitable?
2. What happens if a customer lands right at a breakpoint? How does this piecewise rule encourage or change consumer behavior?

Rubric for Scoring

Criteria	Exemplary 4 points	Proficient 3 points	Developing 2 points	Beginning 1 point
Real-World Context	Highly realistic, local scenario with a clear rationale for tiered pricing.	Clear real-world scenario with a basic rationale.	Vague scenario; rationale is superficial.	Unrealistic or incomplete scenario.
Mathematical Modeling	Piecewise function $f(x)$ is perfectly formatted with correct domain conditions and simplified sub-functions.	Function is correct with minor algebraic or boundary symbol errors.	Function has incorrect domain intervals or missing pieces.	Incorrect notation; fails to represent a valid function.
Graphical Blueprint	Accurate graph with clearly labeled axes, breakpoints, and correct endpoint notation (○/●).	Graph is mostly accurate with minor scaling or endpoint errors.	Graph missing key boundary markers or continuity status.	Inaccurate graph; does not match the algebraic model.

threshold (e.g., writing $1.80x$ instead of $13 + 1.80(x - 4)$). Provide a quick 3-minute mini-lesson on constructing excess formulas before students work independently:

Total Fee = Base Fee + Rate . ((Input – Threshold)

3. Peer Review & Boundary Verification (The Edge-Case Test)

- Before final submission, have students swap briefs with a partner to run an Edge-Case Test.
- Have the peer evaluator pick a value right on a breakpoint (e.g., $x = 4$ or $x = 25$) and verify that:
  1. The input fits into only one domain interval (no overlapping $\leq$ and $\geq$ on the same number).
  2. The output cost makes a logical economic sense.

4. Integrating Ed-Tech Verification

- Encourage students to plot their derived piecewise function in Desmos or GeoGebra prior to drawing their final graph on paper.
- Instruct students to zoom in on the breakpoints in the digital tool to visually confirm whether their system creates a continuous line/curve or a discontinuous jump gap.

5. Post-Task Reflection Discussion (Debrief)

- Allocate 10 minutes at the end of the session for a few students to share their scenarios.
- Use the three processing questions to guide class discussion, highlighting how piecewise functions fundamental tools are used by societies to balance corporate profit with consumer equity.

Policy Evaluation	Insightful analysis connecting mathematical breakpoints to economic fairness and consumer behavior.	Sound explanation of fairness and behavior with minor depth gaps.	Brief, superficial responses to reflection questions.	Incomplete or missing policy evaluation.

Processing Questions:

1. How did you determine the exact input variable (x) and output variable ($f(x)$) for your chosen scenario, and what strategy did you use to set up the boundary values without overlapping intervals?
2. Was the graph of your piecewise function continuous or discontinuous? Describe what a "jump" or gap on your graph actually means in terms of money or service for a real customer.
3. As a "pricing consultant," what was the most challenging part of translating a real-life pricing policy into formal algebraic notation ($f(x)$)?

C.2. Making Generalization

Activity C.2. Wrapping-Up the Lesson

3-2-1 Snapshot Prompt

Instructions: Complete the 3-2-1 Snapshot below in your notebook or on an exit slip to summarize your learning in this unit.

- ***3 Essential Terms***
  Write 3 key mathematical terms related to piecewise functions that you used today. *(Hint: think about domains, graph features, or billing systems!)*
- ***2 Core Rules***
  State 2 golden rules you must always remember when evaluating or graphing piecewise functions. *(Hint: what do you check first? What do open/closed circles mean?)*

Activity C.2. Wrapping-Up the Lesson

3-2-1 Snapshot Prompt

The activity serves as a low-stakes, formative consolidation tool for the end of the lesson unit. It is designed to take 5 to 7 minutes and allows learners to synthesize mathematical terminology, procedural rules, and real-world connections before engaging in metacognitive reflection via three simple processing questions.

	• ***1 Real-World Connection*** Name 1 everyday scenario where piecewise logic is used and briefly state why a single formula wouldn't work. *Processing Questions* 1. Looking back at today's lesson, what was your biggest "aha!" moment when working with piecewise functions? 2. If you had to explain the single most important rule about piecewise functions to a classmate who missed today's lesson, what would you tell them? 3. What is one strategy or habit you will use in our next math topic to make sure you don't fall into the same tricky traps or common mistakes?	
	C.3. Evaluating Learning (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity C.3: Assessing Learning Outcomes This activity must be completed individually by each learner within 20 to 30 minutes. Its completion is essential for assessing their level of mastery across key piecewise function concepts, including basic properties, algebraic evaluation, graphical identification, and real-world modeling. Review their work promptly so you can provide timely and appropriate intervention or remediation for those who require additional support before moving to the next unit.	
	C.4. Additional Activities (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity C.4. Extending and Reinforcing Learning This additional exercise may be given as a homework assignment. Remediation should be provided to learners who have not yet achieved mastery of the lesson, while enrichment activities should be offered to those who are ready for further learning.	
V. ASSESSMENT	For the summative assessment and performance task, please refer to the Teacher's Notes, which can be accessed through the link in the Table of Contents.	
VI. REFLECTION	For your reflection, you may use the Reflection Guide provided in the Teacher's Notes to help guide your responses.	

Unit 7. Data and Measures of Central Tendency

I. LEARNING GOALS	
Content Standard	The learners should have knowledge and understanding of statistical variables.
Performance Standard	By the end of the term, the learners can collect, analyze, and interpret data to make decisions using spreadsheets, graphs, and statistical visualizations.
Learning Competencies	The learners… 1. identify different types of data. 2. classify a given set of data according to its level of measurement. 3. identify the appropriate measure of central tendency and measures of variability of a given data setfor different purposes. 4. use appropriate technologies (e.g., calculator, Excel, Jamovi, Geogebra, etc.) to calculate measures of central tendency and variability. 5. interpret the computed measures of central tendency and variability.
II. REFERENCES and MATERIALS	
Textbook and Modules	Belecina, R. R., Baccay, E. S., and Mateo, E.B. (2016). *Statistics and Probability, 1st Edition*. Quezon City: Rex Book Store, Inc. pp. 21-45 Bluman, A. (2015). *Elementary Statistics: A Step-by-Step Approach.* London: McGraw-Hill Education - Europe. pp. 258-274 Brase, C. H. and Brase, C. P. (2004, 2019). *Understanding Basic Statistics 3rd and 8th editions*. Boston, USA: Cengage Learning. pp. 246-258 Dela Cruz, E. O., et al. (2016). *Soaring 21st Century Mathematics: Statistics and Probability (K to 12).* Quezon City: Phoenix Publishing House, Inc. pp. 16-25 Department of Education (2013). *Mathematics 8: Module 10 – Measures of Central Tendency and Measures of Variability*. DepEd. https://lrmds.deped.gov.ph/detail/4772 Sternstein, M. (2007). *Barron's AP Statistics 4th edition.* New York: Barron Educational Series. pp. 189 – 219 Triola, M. F. (2010). *Elementary Statistics Technology Update 11th edition.* USA: Pearson Education, Inc. pp. 208 – 218
Websites	Bhandari, P. (2023, June 21). *Variability | Calculating Range, IQR, Variance, Standard Deviation.* Scribbr. https://www.scribbr.com/statistics/variability/ Bhandari, P. (2023, June 21). *How to Calculate Variance | Calculator, Analysis & Examples.* Scribbr. https://www.scribbr.com/statistics/variance/ Illowsky, Barbara, and Susan Dean. 2018. *Introductory Statistics*. Houston, TX: OpenStax. https://openstax.org/books/introductory-statistics/pages/1-introduction. Laerd Statistics (2018). *Measures of Spread.* Laerd Statistics https://statistics.laerd.com/statistical-guides/measures-of-spread-range-quartiles.php Laerd Statistics (2018). *Absolute Deviation and Variance.* Laerd Statistics https://statistics.laerd.com/statistical guides/measures-of-spread-absolute-deviation-variance.php Laerd Statistics (2018). *Standard Deviation.* Laerd Statistics https://statistics.laerd.com/statistical-guides/measures-of-spread standard-deviation.php

<table>
<tr><td></td><td colspan="2">Pennsylvania State University (2025). Measures of Variability. Open.Ed@PSU.
https://online.stat.psu.edu/stat500/lesson/1/1.5/1.5.3
Weather Atlas. (2024, February 7). Climate and monthly weather forecast - Pag-asa, Philippines. Weather Atlas
https://www.weather-atlas.com/en/philippines/pag-asa-climate</td></tr>
<tr><td>Video Lessons</td><td colspan="2">(https://www.youtube.com/watch?v=t0tQcs-E5Z4&list=PLvYqRUmlLZUMJ0EUxuTAA1f407wmBQ1QX) t</td></tr>
<tr><td>Materials and EdTech</td><td colspan="2">● Learning Activity Sheet
● calculator, Excel, Jamovi, Geogebra</td></tr>
<tr><td>AI Declaration</td><td colspan="2">Most parts of the Lesson Exemplar were counter-checked using Google AI, Gemini, and NotebookLM, including the grammar and content.</td></tr>
<tr><td>III. CONTENT</td><td colspan="2">Lesson 7.1. Data and Its Levels of Measurement</td></tr>
<tr><td>IV. OBJECTIVES</td><td colspan="2">At the end of the lesson, the learners should be able to:
1. identify types of data;
2. classify data according to its type;
3. identify levels of measurement; and
4. classify data according to its level of measurement.</td></tr>
<tr><td>V. PROCEDURES</td><td>LEARNERS ACTIVITIES</td><td>ANNOTATION</td></tr>
<tr><td rowspan="2">A. Activating Prior Knowledge</td><td colspan="2">A.1. Eliciting Prior Knowledge</td></tr>
<tr><td>Activity A.1. Leveling Learners Readiness

Data Around Us

This activity aims to help learners recognize the different types of data encountered in everyday life and classify them based on whether they can be measured, counted, or ranked.

Materials:
Activity worksheet or notebook
Pen or pencil
Mobile phone or online sources (optional)

Instructions:
1. Think about the different types of information or data you encounter every day at school, at home, in the community, or online.
2. List at least five (5) examples of data.</td><td>Activity A.1. Leveling Learners Readiness

Data Around Us

This activity aims to help learners recognize different types of data encountered in everyday life and classify them according to whether they are expressed as numbers or words and whether they can be measured, counted, ranked, or described. It develops learners' awareness of how data is used in daily decision-making and problem-solving.

Strategy 1: Think–Pair–Share Classification Activity

Materials:
Activity worksheet or notebook
Pen or pencil
Sample data examples written on the board or flashcards

Instructions:</td></tr>
</table>

3. Identify whether each example is expressed in numbers or words.
4. Determine whether the data can be ranked, measured, counted, or simply described.
5. Record your answers in a table similar to the format below.
6. Be prepared to explain your answers during class discussion.

Data Encountered	**Numbers or Words?**	**Can it be Ranked or Measured?**
Example: Quiz Scores	Numbers	Yes
Example: Favorite Food	Words	No

Process Questions:

1. What types of data do you commonly encounter every day?
2. Which examples were easier to classify as numbers or words? Why?
3. How can numerical data help in making decisions?
4. Why is it important to identify whether data can be measured or ranked?
5. What are examples of data that are descriptive rather than measurable?
6. How does data help people understand situations and solve problems in everyday life?

1. Ask learners to think of different types of data they encounter at school, home, community, or online.
2. Instruct learners to list at least five examples individually.
3. Guide learners to classify each example as numbers or words.
4. Ask learners to determine whether the data can be measured, counted, ranked, or simply described.
5. Pair learners to compare and discuss their classifications.
6. Facilitate sharing of answers during class discussion.
7. Clarify misconceptions and emphasize differences between numerical and descriptive data.

Strategy 2: Digital Data

Materials:

Smartphones, tablets, or computers
Internet access
Google Forms / Mentimeter / Padlet / Jamboard
Digital table template for responses

Instructions:

1. Create a shared online form or collaborative board where learners can input examples of daily data.
2. Instruct learners to submit examples and classify them as numerical or descriptive.
3. Guide learners to indicate whether the data can be ranked, measured, counted, or described.
4. Display responses in real time for class viewing and analysis.
5. Facilitate discussion by comparing patterns and similarities in learners' answers.
6. Encourage learners to explain why certain data is measurable while others are descriptive.
7. Summarize how data classification supports understanding and decision-making.

		Additional Notes: ● Encourage learners to use examples from their own experiences to make learning more meaningful. ● Emphasize the distinction between quantitative (numerical) and qualitative (descriptive) data. ● The EdTech strategy promotes active participation, collaborative analysis, and real-time visualization of responses, increasing engagement, and understanding. ● This activity serves as a foundational task for lessons involving statistics, data analysis, and interpretation.
	A.2. Establishing the Purpose of the Lesson	
	Activity A. 2. Appreciating Lesson Relevance **Why Data Matter?** *Materials:* Activity worksheet or notebook Pen or pencil Sample survey form (optional) *Instructions:* 1. Read and understand the given scenario about improving the school canteen through a student survey. Scenario: Imagine you are part of the Student Council, and your task is to create a survey to help improve the school canteen. You want to ask learners questions such as: ● What food do you usually buy? ● How much do you spend? ● How often do you go to the canteen? ● From 1 to 5, where 1 is the lowest and 5 is the highest, how would you rate the service. 2. Think about the different types of information needed from learners to help improve canteen services. 3. List the needed data or information in a table. 4. For each piece of information, identify whether it is expressed in: ○ words or numbers	**Activity A.2. Appreciating Lesson Relevance** **Why Data Matter?** This activity aims to help learners understand the importance of data in decision-making by identifying, classifying, and analyzing information needed to improve services in the school community. It develops learners' ability to distinguish between qualitative and quantitative data and recognize how data supports evidence-based decisions. **Strategy 1: Scenario-Based Collaborative Inquiry (Student Council Simulation)** *Materials:* Activity worksheet or notebook Pen or pencil Sample survey form (optional) *Instructions:* 1. Present and explain the scenario about improving the school canteen through a student survey. 2. Instruct learners to carefully read and understand the situation. 3. Guide learners to identify the types of information needed for decision-making. 4. Ask learners to list the needed data in a table format.

	○ data that can be ranked or measured 5. Explain briefly why the collected data is important for the Student Council's task. 6. Be prepared to share and explain your answers during class discussion. *Suggested Table Format:* **Information Needed** / **Words or Numbers?** / **Can it be Ranked or Measured?** Favorite food / Words / No Amount spent daily / Numbers / Yes Frequency of canteen visits / Numbers / Yes Service rating / Numbers / Yes *Process Questions:* 1. What information is important to gather in improving the school canteen? 2. Which data are best represented using numbers? Why? 3. Which information is better expressed using words? 4. Why is it important to know whether data can be measured or ranked? 5. How can the collected data help the Student Council make better decisions?	5. For each item, learners classify whether it is expressed in words or numbers. 6. Instruct learners to determine whether each data type can be ranked, measured, or described. 7. Facilitate group or class discussion on how each type of data contributes to decision-making. 8. Summarize how data supports planning and improvement of services. **Strategy 2: Digital Survey Design (Interactive Data Collection Simulation)** *Materials:* Smartphones, tablets, or computers Internet access Google Forms / Microsoft Forms / Mentimeter / Padlet Digital table or survey template *Instructions:* 1. Provide learners with access to a digital survey-building tool. 2. Instruct learners to create sample survey questions for improving the school canteen. 3. Guide learners to categorize each question by collecting numerical or descriptive data. 4. Ask learners to label whether each question produces measurable or ranked data. 5. Allow learners to share their survey outputs with the class through screen sharing or links. 6. Facilitate discussion on how survey data can be used for decision-making. 7. Highlight the importance of choosing the right type of data for specific objectives. *Additional Notes:* ● Emphasize the connection between data collection and real-life decision-making in school governance. ● Encourage learners to think like researchers or planners when designing survey questions.

<table>
<tr><td></td><td></td><td>

The EdTech strategy promotes interactive survey design, collaboration, and real-time data visualization, making learning more authentic and engaging.
Reinforce the idea that effective decisions are based on accurate and well-classified data.

</td></tr>
<tr><td rowspan="2">B. Instituting New Knowledge</td><td colspan="2">B.1. Presenting Examples</td></tr>
<tr><td>
Activity B.1. Exploring Key Concepts

Every Pay Has a Story

Materials:
Activity worksheet or notebook
Pen or pencil
Teacher-provided examples or visual presentation

Instructions:
1. Your teacher will present and explain real-life examples of different ways workers earn income and how related data are measured.
a. Eye Colors of Students in a Class
Data: Brown, Black, Hazel, Black, Blue
b. Speed of Vehicles on a Highway
Data: 60 km/h, 80 km/h, 75 km/h, 90 km/h
c. Time of Day Recorded on a Clock
Data: 7:00 AM, 12:00 PM, 3:00 PM, 6:00 PM
d. Number of Books Borrowed from Library
Data: 2, 5, 0, 3, 7
e. Types of Mobile Phone Brands Used by Students
Data: Samsung, Apple, Xiaomi, Oppo, Apple
2. For each example, identify the type of data (qualitative or quantitative) and the level of measurement (Nominal, Ordinal, Interval, or Ratio).
3. Study the given explanations for each case carefully.
4. Answer the guide questions based on your understanding of the examples.
5. Think of and share your own real-life examples related to workers and earnings for each type of data and level of measurement.
</td><td>
Activity B.1. Exploring Key Concepts
.
Every Pay Has a Story

This activity helps learners understand and distinguish qualitative and quantitative data and identify the levels of measurement (nominal, ordinal, interval, and ratio) using real-life examples related to workers, jobs, and income. It strengthens learners' ability to classify data and apply statistical concepts in everyday contexts.

Strategy 1: Guided Concept Exploration (Example-Driven Discussion and Classification)

Materials:
Activity worksheet or notebook
Pen or pencil
Teacher-provided examples or visual presentation

Instructions:
1. Present real-life examples related to the eye colors of the students in a class, speed of vehicles on a highway, time of the day recorded on a clock, the number of books borrowed from the library, and the types of mobile phone brands used by students.
2. Guide learners in analyzing each example carefully.
3. For each example, instruct learners to identify:
o Type of data (qualitative or quantitative)
o Level of measurement (Nominal, Ordinal, Interval, or Ratio)
4. Facilitate class discussion to explain why each classification is correct.
</td></tr>
</table>

	Example 1: Student Favorite Subjects Data: Math, Science, Filipino, English, Math ● Type of Data: Qualitative ● Level of Measurement: Nominal ● Reason: These are categories with no order or numerical meaning. *Example 2: Class Standing Based on Grades* Data: 1st Honor, 2nd Honor, 3rd Honor, With Honors ● Type of Data: Qualitative ● Level of Measurement: Ordinal ● Why? The data has a clear order but no exact a measurable difference between the ranks. *Example 3: Daily Temperatures* Data: 28°C, 30°C, 32°C, 27°C ● Type of Data: Quantitative ● Level of Measurement: Interval ● Reason: The numbers have meaningful differences, but zero does not mean the absence of temperature. *Example 4: Student Heights* Data: 150 cm, 160 cm, 155 cm, 170 cm ● Type of Data: Quantitative ● Level of Measurement: Ratio ● Reason: Heights are measurable, and zero height means no height; comparisons using ratios are meaningful. *Processing Questions:* 1. How do you determine whether data is qualitative or quantitative in real-life situations? 2. What makes job positions or ratings ordinal instead of nominal? 3. Why is income considered ratio data while satisfaction ratings are not? 4. How can understanding data types help workers or companies make better decisions?	5. Ask learners to justify their answers using characteristics of each data type. 6. Encourage learners to give additional real-life examples from employment or community settings. 7. Clarify misconceptions about overlapping data types and measurement levels. **Strategy 2: Interactive Classification Activity (Digital Sorting and Quiz Platform)** *Materials:* Smartphones, tablets, or computers Internet access Google Forms / Kahoot / Quizizz / Wordwall / Padlet Digital classification template or quiz set *Instructions:* 1. Prepare a digital quiz or sorting activity containing examples of real-life data (eye colors of the students in a class, speed of vehicles on a highway, time of the day recorded on a clock, the number of books borrowed from library, and the types of mobile phone brands used by students. etc.). 2. Instruct learners to classify each item as qualitative or quantitative and identify its level of measurement. 3. Allow learners to complete the activity individually or in pairs using mobile devices. 4. Display real-time results for immediate feedback and discussion. 5. Review commonly missed items and explain correct classifications. 6. Encourage learners to create one example for each and submit it through the platform. 7. Summarize key differences among nominal, ordinal, interval, and ratio of data using the results. *Additional Notes:* ● Emphasize that data classification is essential in research, business, and workforce management.

	5. Can you think of other examples of data related to workers' pay or jobs for each level of measurement?	● Highlight real-world relevance by connecting examples to employment, salaries, and workplace evaluation. ● The EdTech strategy promotes interactive classification, instant feedback, and learner-generated examples, improving engagement and retention. ● Reinforce clear distinctions among the four levels of measurement, especially interval vs. ratio.
	B.2. Discussing the Concept	
	Activity B.2. Deepening Conceptual Understanding **Getting to Know Me Through Data** To help learners understand the concepts of qualitative and quantitative data and correctly identify the four levels of measurement (nominal, ordinal, interval, and ratio) using familiar real-life examples for better appreciation and application in statistics. *Materials:* Lesson handout or printed discussion guide Notebook Pen or pencil Board presentation or visual aids from the teacher *Instructions:* 1. Study the provided discussion about types of data and levels of measurement. 2. Read and understand each definition and example carefully. 3. Take note of key differences between qualitative and quantitative data. 4. Analyze how each level of measurement is used in real-life examples. 5. Prepare for a class discussion by reviewing the guide questions and being ready to share your ideas. **Types of Data and Levels of Measurement** In statistics, *data* refers to any collection of facts, figures, or information gathered for the purpose of analysis. These data are essential because they help us understand patterns, make decisions,	**Activity B.2. Deepening Conceptual Understanding** **Getting to Know Me Through Data** This activity aims to deepen learners' understanding of *qualitative and quantitative data* and the *four levels of measurement (nominal, ordinal, interval, and ratio)* by analyzing familiar real-life examples. It strengthens learners' ability to classify data correctly and apply statistical concepts in meaningful contexts. **Strategy 1: Guided Concept Analysis and Structured Discussion (Teacher-Led Concept Building)** *Materials:* Lesson handout or printed discussion guide Notebook Pen or pencil Board presentation or visual aids from the teacher *Instructions:* 1. Present and explain the lesson on types of data and levels of measurement. 2. Instruct learners to read and study each definition and example carefully. 3. Guide learners in identifying key differences between qualitative and quantitative data. 4. Facilitate discussion on how each level of measurement is applied in real-life situations. 5. Ask learners to take notes on important concepts and examples.

	and draw meaningful conclusions. Before analyzing data, it is important to first identify its *type* and its *level of measurement*, since these determine the appropriate statistical tools and methods to use. **I. Types of Data** Data are generally classified into two main types: *qualitative data* and *quantitative data*. **A. Qualitative Data (Categorical Data)** *Qualitative data* describe characteristics, qualities, or categories. These data are not expressed in numbers and cannot be used for mathematical computations. Instead, they are used to group or label information. ***Definition:*** Qualitative data are non-numerical data that represent attributes, labels, or categories. ***Key Features:*** ● Descriptive in nature ● Expressed using words, symbols, or labels ● Used for classification ● Cannot be meaningfully added, subtracted, multiplied, or divided ***Examples:*** ● Hair color: black, brown, blonde ● Gender: male, female ● Type of school: public, private ● Marital status: single, married, widowed ● Favorite food: rice, pizza, noodles **B. Quantitative Data (Numerical Data)** *Quantitative data* involve numbers that represent counts or measurements. These data can be analyzed using mathematical operations such as addition, subtraction, multiplication, and division.	6. Encourage learners to ask questions for clarification during discussion. 7. Reinforce understanding by summarizing key ideas at the end of the lesson. **Strategy 2: Interactive Concept Mapping (Digital Organizer and Collaborative Board)** *Materials:* Smartphones, tablets, or computers Internet access Google Jamboard / Padlet / Canva Whiteboard / MindMeister Digital concept map template *Instructions:* 1. Provide learners access to a shared digital concept-mapping tool. 2. Instruct learners to create a concept map showing the relationship between: ● Qualitative vs Quantitative Data ● Nominal, Ordinal, Interval, and Ratio levels 3. Ask learners to input definitions, examples, and keywords into the map. 4. Encourage collaborative editing and peer feedback in real time. 5. Guide learners to use color coding or grouping for better organization. 6. Allow selected groups to present their concept maps to the class. 7. Facilitate discussion comparing different representations and correcting misconceptions. 8. To check learners' understanding, facilitate the processing questions. *Processing Questions:* 1. How do you differentiate qualitative data from quantitative data in real-life situations? 2. What makes nominal data different from ordinal data?

	Definition: Quantitative data are numerical values that represent measurable quantities. ***Key Features:*** ● Expressed in numbers ● Can be measured or counted ● Allows mathematical computation ● Used for statistical analysis ***Examples:*** ● Age: 16 years old ● Number of learners in a class: 45 ● Weight: 52.5 kg ● Income: ₱25,000 per month ● Number of books read: 10 **II. Levels of Measurement** After identifying whether data is qualitative or quantitative, the next step is to determine their *level of measurement*. This is important because it tells us how data can be organized, compared, and analyzed statistically. There are *four levels of measurement*, arranged from the simplest to the most advanced: *nominal, ordinal, interval, and ratio*. **A. Nominal Level (Categorical Level)** ***Definition:*** The nominal level classifies data into distinct categories without any order or ranking. ***Key Features:*** ● Used for labeling or naming ● No meaningful order ● No mathematical operations possible ● Purely categorical	3. Why is interval data considered numerical but without a true zero? 4. What makes ratio data more informative compared to interval data? 5. How can understanding types of data and levels of measurement help you in everyday decision-making or research?

	Examples: ● Blood type: A, B, AB, O ● Type of fruit: apple, banana, mango ● Region: NCR, CAR, Region IV-A ● Eye color: brown, black, blue **B. Ordinal Level (Ranked Data)** ***Definition:*** The ordinal level involves data that can be arranged in a meaningful order or ranking, but the differences between ranks are not equal or measurable. ***Key Features:*** ● Shows order or ranking ● Differences between ranks are not exact ● No precise measurement of distance between values ***Examples:*** ● Survey rating: satisfied, neutral, dissatisfied ● Class ranking: 1st place, 2nd place, 3rd place ● Socioeconomic status: low, middle, high ● Academic honors: with honors, with high honors, with highest honors **C. Interval Level** ***Definition:*** The interval level includes numerical data with meaningful differences between values. However, it has *no true zero point*, meaning zero does not represent the absence of the quantity. ***Key Features:*** ● Numerical data ● Equal intervals between values ● No true zero ● Addition and subtraction are meaningful	

Examples:

- Temperature in Celsius: 20°C, 30°C
- Calendar years: 2000, 2010, 2020
- IQ scores: 90, 100, 110

D. Ratio Level

Definition:

The ratio level is the highest level of measurement. It has all the characteristics of the interval level, but with a *true zero*, which means zero represents the absence of the quantity.

Key Features:

- Numerical data
- Equal intervals
- Has a true zero point
- Allows meaningful ratios (e.g., twice as much)

Examples:

- Height: 160 cm
- Weight: 60 kg
- Age: 18 years old
- Income: ₱30,000 per month
- Number of students: 0, 25, 50

Understanding the *type of data* (qualitative or quantitative) and the *level of measurement* (nominal, ordinal, interval, or ratio) is essential in statistics. These classifications guide researchers and students in selecting appropriate methods for organizing, analyzing, and interpreting data accurately.

B.3. Developing Mastery (For complete instructions, please refer to the Learning Activity Sheet.)

Activity B.3. Practicing Learned Skills

Classifying Real-Life Data: Scenario Analysis

This activity develops learners' ability to identify and classify real-life data as qualitative or quantitative and determine the correct level of measurement (nominal, ordinal, interval, or ratio) through scenario-based analysis. It strengthens learners' critical thinking and application of statistical concepts in real-world contexts.

Strategy 1: Guided Scenario Analysis (Structured Table Classification)

	Materials: Scenario worksheet (table format) Pen or pencil Notebook (optional for scratch work) Lesson notes on types of data and levels of measurement *Instructions:* 1. Present the table containing real-life scenarios to the learners. 2. Instruct learners to carefully read each scenario before answering. 3. Guide learners to determine whether each scenario represents qualitative or quantitative data. 4. Ask learners to identify the correct level of measurement for each item (nominal, ordinal, interval, or ratio). 5. Instruct learners to write a brief reason for each classification in the table. 6. Encourage learners to use lesson notes as references while answering. 7. Facilitate discussion after completion to compare and justify answers. 8. Clarify misconceptions, especially in distinguishing ordinal vs interval and interval vs ratio data. **Strategy 2: Interactive Classification Drill (Digital Quiz and Instant Feedback)** *Materials:* Smartphones, tablets, or computers Internet access Google Forms / Quizizz / Kahoot / Wordwall Digital version of the scenario table *Instructions:* 1. Convert the scenario table into a digital quiz or interactive classification activity. 2. Instruct learners to answer individually or in pairs using their devices. 3. Require learners to select the type of data and level of measurement for each item. 4. Provide instant feedback after each response or at the end of the activity. 5. Display class results and identify common errors for discussion. 6. Revisit difficult items and explain correct classifications. 7. Encourage learners to improve answers based on feedback. *Additional Notes:* ● Emphasize careful reading of keywords such as ranking, measurement, quantity, and categories. ● Highlight common misconceptions, especially between ordinal vs interval and interval vs ratio. ● The EdTech strategy promotes interactive learning, immediate feedback, and self-correction, improving mastery of concepts. ● Reinforce that correct data classification is essential for accurate analysis and interpretation in real-world situations.

<table>
<tr><td rowspan="2">C. Demonstrating Knowledge and Skills</td><td colspan="2">C.1. Finding Practical Application</td></tr>
<tr><td>Activity C.1. Making Real-World Connections

Surveying Our School Life
Materials:
Notebook or survey worksheet
Pen or pencil
Prepared survey questions (by group)
Table/chart for data recording
Calculator (optional for summarizing results)

Instructions:
1. Work in small groups with at least five (5) members.
2. Create 4–5 survey questions related to student life (e.g., study habits, food preferences, screen time, academic performance, or school satisfaction).
3. Ensure that your questions represent different types of data (qualitative and quantitative) and levels of measurement (nominal, ordinal, interval, ratio).
4. Conduct the survey by asking at least ten (10) classmates.
5. Record all responses carefully in a table.
6. Identify the type of data and level of measurement for each question.
7. Organize and present your findings in a clear table.
8. Reflect on how understanding data types helps in analyzing and interpreting results.

Process Questions:
1. What challenges did you encounter while creating and conducting your survey?
2. How did you decide whether each question represents qualitative or quantitative data?
3. What helped you identify the correct level of measurement for each survey item?
4. How does organizing data make it easier to interpret survey results?
5. How can surveys like this help improve decisions in school or daily life?</td><td>Activity C.1. Making Real-World Connections

Surveying Our School Life

This activity applies to learners' understanding of qualitative and quantitative data and the four levels of measurement (nominal, ordinal, interval, and ratio) through designing, conducting, and analyzing a simple survey. It develops learners' skills in data collection, classification, organization, and interpretation in real-life contexts.

Strategy 1: Collaborative Survey Design and Field Data Collection (Group-Based Inquiry)

Materials:
● Notebook or survey worksheet
● Pen or pencil
● Prepared survey questions (by group)
● Table/chart for data recording
● Calculator (optional for summarizing results)

Instructions:
1. Form small groups with at least five members.
2. Guide each group to design 4–5 survey questions related to student life (e.g., study habits, food preferences, screen time, academic performance, school satisfaction).
3. Ensure that survey questions represent both qualitative and quantitative data and cover different levels of measurement.
4. Instruct learners to conduct the survey by asking at least ten classmates.
5. Record responses systematically in a prepared table or worksheet.
6. Identify the type of data and level of measurement for each survey question.
7. Organize results clearly for presentation.
8. Facilitate group sharing and discussion of findings.</td></tr>
</table>

		9. Emphasize accuracy, clarity, and proper classification of data. **Strategy 2: EdTech-Enhanced Digital Survey and Real-Time Data Visualization** *Materials:* ● Smartphones, tablets, or computers ● Internet access ● Google Forms / Microsoft Forms / Mentimeter / Padlet ● Spreadsheet tool (Google Sheets / Excel) for data summary *Instructions:* 1. Instruct groups to create a digital survey using an online form tool. 2. Design questions that capture both qualitative and quantitative data with different measurement levels. 3. Distribute the survey link to classmates for responses. 4. Automatically collect and organize responses using the platform's summary features or a linked spreadsheet. 5. Guide learners to categorize each item by type of data and level of measurement. 6. Use charts or summary tables to visualize collected data. 7. Facilitate discussion on trends, patterns, and interpretations from the data. 8. Reflect on how digital tools improve efficiency and accuracy in data collection and analysis. *Additional Notes:* ● Emphasize the importance of proper survey design and ethical data collection (respectful questioning and accurate recording). ● Highlight how different levels of measurement affect data analysis and interpretation**.** ● The EdTech strategy promotes real-time data gathering, automatic organization, and visual interpretation**,** making learning more authentic and efficient.

		● Reinforce that surveys are powerful tools for evidence-based decision-making in school and community contexts**.**
	C.2. Making Generalization	
	Activity C.2. Wrapping-Up the Lesson *Materials:* ● Notebook or writing paper ● Pen or pencil ● Lesson notes on types of data and levels of measurement *Instructions:* **A. Dear Data… (Creative Letter Writing)** 1. Write a short creative letter addressed to *"Data"* as if it were a person. 2. In your letter, include the following: ● What you have learned about Data today ● Why Data is important in everyday life ● How you plan to apply your learning about types of data and levels of measurement ● One question you still want to ask Data **B. A Day in Data (Reflection Activity)** 1. Think about your day from morning until now. 2. List at least five (5) pieces of data you encountered or generated (e.g., hours of sleep, food eaten, mood, temperature, screen time, steps taken). 3. For each data, identify: ● Whether it is *qualitative or quantitative* ● Its *level of measurement* (nominal, ordinal, interval, or ratio) ● How it can be useful in decision-making 4. Write your responses in paragraph form with the title: *"How Data Shapes My Day"* *Process Questions:* 1. What did you realize about the role of data in your daily life? 2. How does identifying qualitative and quantitative data help you understand information better?	**Activity C.2. Wrapping-Up the Lesson** **Dear Data… & A Day in Data** This activity aims to help learners deepen their conceptual and personal understanding of qualitative and quantitative data and the four levels of measurement (nominal, ordinal, interval, and ratio) through reflective writing and real-life data identification. It also develops learners' ability to connect statistical concepts to daily experiences and decision-making. **Strategy 1: Creative Reflection (Dear Data Letter Writing)** *Materials:* Notebook or writing paper Pen or pencil Lesson notes on types of data and levels of measurement *Instructions:* 1. Introduce the activity by explaining that learners will "personify" data to express understanding in a creative way. 2. Instruct learners to write a letter addressed to *"Data"***.** 3. Remind learners to include the required elements: ● What they learned about data ● Importance of data in daily life ● Application of data types and levels of measurement ● One question they still have 4. Encourage originality, clarity, and honesty in reflection rather than grammatical perfection. 5. Circulate and provide scaffolding questions such as: ● "What kind of data do you see in your daily life?" ● "Why do you think data helps people make decisions?"

	3. Which level of measurement appears most often in your daily experiences? Why? 4. How can data help you make better personal or academic decisions? 5. What new questions do you still have about data after doing this activity?	**Strategy 2: Experiential Learning (A Day in Data Reflection)** *Materials**:*** Notebook or writing paper Pen or pencil Lesson notes *Instructions:* 1. Ask learners to recall their activities from morning until the present day. 2. Instruct them to list at least *five (5)* data points they encountered or generated. 3. Guide learners to classify each data point by: ● Type of data (qualitative or quantitative) ● Level of measurement (nominal, ordinal, interval, ratio) ● Usefulness in decision-making 4. Emphasize real-life relevance (e.g., sleep hours, mood, temperature, food intake, screen time). 5. Allow learners to organize their answers into a structured paragraph titled *"How Data Shapes My Day."* ***Additional Notes:*** ● This activity integrates affective (reflection), cognitive (classification), and real-life application skills**.** ● The teacher should emphasize that there is no single correct narrative style in the letter-writing task; assessment focuses on understanding concepts. ● Encourage learners to use examples from their actual daily routine to make responses authentic. ● This activity may also be used as a performance task for formative assessment**.** ● For learners who struggle, provide guiding prompts or sample entries for "A Day in Data."

	C.3. Evaluating Learning (For complete instructions, please refer to the Learning Activity Sheet.)
	Activity C.3. Assessing Learning Outcomes **Assessing Learning Progress: Classifying Real-World Data** This activity assesses learners' understanding of *qualitative and quantitative data* and their ability to correctly identify the *levels of measurement (nominal, ordinal, interval, and ratio)* using real-life scenarios. It evaluates learners' conceptual knowledge and application skills in data classification and interpretation. **Strategy 1: Individual Scenario-Based Assessment (Structured Table Analysis)** *Materials:* Assessment worksheet (table format) Pen or pencil Notebook (optional for computation or notes) Lesson guide on types of data and levels of measurement *Instructions:* 1. Distribute the assessment worksheet containing real-life scenarios. 2. Instruct learners to carefully read each scenario before answering. 3. Guide learners to determine whether each item represents qualitative or quantitative data. 4. Ask learners to identify the correct level of measurement (nominal, ordinal, interval, or ratio). 5. Require learners to record answers clearly in the table provided. 6. Remind learners to review their responses before submission. 7. Ensure independent work to accurately measure individual understanding. 8. Collect outputs for checking and evaluation. **Strategy 2: Digital Assessment (Online Quiz with Auto-Grading and Feedback)** *Materials:* Smartphones, tablets, or computers Internet access Google Forms / Quizizz / Kahoot / Microsoft Forms Digital version of the assessment table *Instructions:* 1. Convert the assessment into a digital quiz or form-based worksheet. 2. Instruct learners to answer individually using their devices. 3. Require classification of each scenario as qualitative or quantitative and its level of measurement. 4. Enable auto-check or immediate feedback for each item where possible. 5. Monitor learner progress through the platform's analytics dashboard.

	6. Review commonly missed items after completion. 7. Provide clarification and reteaching for misunderstood concepts. *Additional Notes:* ● Ensure learners answer independently to properly measure learning outcomes. ● Emphasize careful analysis of keywords such as ranking, measurement, quantity, and categories. ● The EdTech strategy provides immediate feedback and performance tracking, supporting both assessment and remediation. ● Reinforce the importance of correct data classification in research, statistics, and everyday decision-making**.**
	C.4. Additional Activities (For complete instructions, please refer to the Learning Activity Sheet.)
	Activity C.4. Extending and Reinforcing Learning **Improving Understanding in Types of Data and Level of Measurement** This activity strengthens learners' understanding of qualitative and quantitative data and the four levels of measurement (nominal, ordinal, interval, and ratio) through remediation exercises and research-based application. It develops learners' ability to classify data correctly and apply these concepts in both simple and research contexts. Strategy 1: Guided Remediation and Scaffolded Practice *Materials:* Remediation and enrichment worksheet Pen or pencil Notebook Lesson guide on types of data and levels of measurement *Instructions:* *A. Remediation Task* 1. Instruct learners to read each scenario carefully. 2. Guide learners to identify whether each scenario represents qualitative or quantitative data. 3. Ask learners to determine the correct level of measurement (nominal, ordinal, interval, or ratio). 4. Require learners to record answers in the provided table. 5. Facilitate brief checking and clarification after completion. 6. Address common errors, especially in distinguishing ordinal, interval, and ratio of data. Strategy 2: Research-Based Classification Task *Materials:* Smartphones, tablets, or computers Internet access Google Docs / Google Forms / Microsoft Forms / Padlet Digital table template for responses

	Instructions: 1. Present the research title and statement of the problem to learners. 2. Instruct learners to identify possible data to be collected for each research question. 3. Guide learners to classify each data as qualitative or quantitative. 4. Ask learners to determine the correct level of measurement for each variable. 5. Let learners input answers into a shared digital table or online form. 6. Allow peer comparison of responses through shared outputs. 7. Facilitate discussion on how correct data classification supports valid research design. 8. Provide feedback and corrections where necessary. *Additional Notes:* ● Emphasize that data classification is a foundation of valid research design and statistical analysis. ● Reinforce the difference between remediation (basic mastery) and enrichment (application in research context). ● The EdTech strategy supports collaborative digital learning, research simulation, and real-time feedback, enhancing deeper understanding. ● Encourage learners to see data classification as essential in both academic research and real-world decision-making.	
III. CONTENT	**Lesson 7.2. Understanding Measures of Central Tendency**	
IV. OBJECTIVES	By the end of the lesson, learners will be able to: 1. identify the appropriate measure of central tendency of a given data set for different purposes; 2. use appropriate technologies (e.g. calculator, Excel, Jamovi, Geogebra, etc.) to calculate measures of central tendency; and 3. interpret the computed measures of central tendency.	
V. PROCEDURES	**LEARNERS ACTIVITIES**	**ANNOTATION**
A. Activating Prior Knowledge	*A.1. Eliciting Prior Knowledge*	
	Activity A.1: Leveling Learners Readiness **Getting Ready with 3Ms** ***Instructions:*** 1. Look at the weekly rice sales table provided by your teacher.	Activity A.1: Leveling Learners Readiness **Getting Ready with 3Ms** This activity reintroduces the foundational concepts of central tendency—**Mean, Median, and Mode**—through a practical business scenario (tracking weekly rice sales in kilograms). Students will look at real-world data to identify different ways to define the "middle" or "most typical" value in a dataset. **Purpose:** **Statistical Literacy:** To help students calculate, differentiate, and understand the specific roles of Mean

Day	Sales (in Kilogram)
Monday	150
Tuesday	120
Wednesday	140
Thursday	120
Friday	110
Saturday	120
Sunday	140
Average sale	

Scenario 1 (First M): A learner helps his father by selling rice every after-school hour. As a curious student, he wants to know the average number of kilos he can sell in a week by recording his sales in kilos from Monday to Sunday as shown above. Based on the table above, what should be the average sale?

Scenario 2 (Second M): Making use of the sales of the student in the first situation, arrange the sales from least to greatest.

What sale appears to be in the middle?

Scenario 3 (Third M): Referring to the table of sales in Scenario 1, which sales occurred most often?

2. Calculate the mathematical average (Mean), find the exact middle number after rearranging the list from least to greatest (Median), and identify the most frequent daily sales number (Mode).
3. Enter your results into the class digital polling link or collaborative spreadsheet.
4. Work with your peer or group to answer the 3 simple questions below.

Processing Questions:

1. Using the rice sales data table, what are your quick answers for the mean (average sale), median (middle value), and mode (most frequent sale)?
2. What specific word or clue in each scenario helped you know which "M" to find?

(average), Median (middle value), and Mode (most frequent value).

Integrated Literacy: To build **financial and business literacy** by connecting abstract statistical metrics to daily sales performance and inventory tracking.

EdTech Integration: Using interactive digital polling tools and spreadsheet calculators to visualize how changing a single day's sales affects all three measures instantly.

Materials

1. The 7-day rice sales data table (Monday to Sunday).
2. Devices (phones, tablets, or laptops) with access to a shared spreadsheet or an interactive polling app (e.g., **Mentimeter**, **Kahoot**, or **Google Forms**).
3. Notebooks and basic calculators.

Note to Teachers:

Interactive Form Setup: Create a quick 3-question digital poll or quiz (using Google Forms or Mentimeter) labeled: *1. What is the Average? 2. What is the Middle Value? 3. What number repeats the most?*

Live Spreadsheet: Prepare a simple Google Sheet showing the rice sales data. Include pre-set formulas for =AVERAGE (), =MEDIAN (), and =MODE () hidden or ready to reveal student work.

Strategy 1: "Digital Rotating Stations"

1. Divide the class into small teams of 4 to 5 members.
2. Instead of physical paper stations, set up a digital choice board or QR codes leading to three specific virtual workspaces: Station 1 (Mean Challenge), Station 2 (Median Sorting Challenge), and Station 3 (Mode Frequency Tracker).

	3. If you were the student helping your father sell rice, which of the 3Ms would be most useful to help you predict how many kilograms of rice to stock up on for next week?	3. Direct groups to solve the scenario at their station digitally, log their collective consensus in their notebooks, and rotate when a central timer sounds. 4. Send all groups to a final online link (Station 4) containing the general reflection questions. 5. After calculating the answers, tell students: *"Imagine a massive rush on Friday where rice sales jumped from 110kg to 500kg."* 6. Have students change that number in the live spreadsheet to observe how the Mean shifts dramatically, while the Median and Mode remain completely stable. **Strategy 2: "Think-Pair-Share with EdTech"** 1. **Think:** Display the rice sales table on the board. Instruct students to work individually for 5 minutes to compute the 3Ms in their notebooks. 2. **Pair:** Have students turn to their seatmate to compare their answers, double-check math calculations, and discuss the clues that helped them identify each "M." 3. **Share:** Instead of manual hand-raising, open the live class poll (e.g., Mentimeter). Have pairs submit their calculated numbers simultaneously. Project the live results onto the board to instantly highlight variations or errors across the class. 4. After calculating the answers, tell students: *"Imagine a massive rush on Friday where rice sales jumped from 110kg to 500kg."* 5. Have students change that number in the live spreadsheet to observe how the Mean shifts dramatically, while the Median and Mode remain completely stable.

	A.2. Establishing the Purpose of the Lesson	
	Activity A. 2. Appreciating Lesson Relevance **Student Quiz Scores: A Fair Representation** *Instructions:* 1. Look at the 15 quiz scores shown on the board. Notice how most students scored very high, but one student scored a 10. The list of 15 quiz scores: 50, 49, 50, 47, 50, 45, 50, 42, 10, 50, 38, 48, 44, 50, 33. 2. Decide on your own whether the Mean, Median, or Mode gives the most honest description of how this class performed overall. 3. Follow your teacher's instructions to either share your thoughts with a seatmate (Strategy 1) or move to your chosen data corner (Strategy 2). 4. Look at the live projector screen (poll results or word cloud) to see how your individual thoughts compare with the rest of the class. . *Processing Questions**:*** 1. Which measure of central tendency (mean, median, or mode) did you choose to represent the class's performance? 2. How did the unusually low score of 10 influence your decision? 3. How did seeing the whole class's choices change instantly on a digital screen help us identify if the class agreed or disagreed on what counts as a "fair" average? 4. Imagine you are a student in this class trying to convince your parents that the quiz was very difficult. Which of the 3Ms would you show them? 5. What if you were the teacher trying to show the principal that the class mastered the lesson?	**Activity A.2. Appreciating Lesson Relevance** This activity sets out the purpose of the lesson by presenting a realistic classroom dilemma. Students evaluate a set of quiz scores containing a severe outlier (a score of 10) to discover that calculating an average isn't just about math formulas—it's about choosing the measure that paints the most honest picture of data. **Purpose:** **Statistical Literacy:** To build conceptual awareness of how extreme scores (outliers) distort the Mean, and to recognize when the Median or Mode provides a fairer representation. **Integrated Literacy:** To develop **critical media and data literacy** by helping students understand how choosing different statistical measures can intentionally or unintentionally bias a report. **EdTech Integration:** To use digital interactive word clouds or live numeric sliders to show how a single student's score shifts the class average in real time. **Materials** ● The list of 15 quiz scores: 50, 49, 50, 47, 50, 45, 50, 42, 10, 50, 38, 48, 44, 50, 33. ● A projector, smartboard, or board to display the scores. ● Access to a live digital interactive poll (e.g., **Mentimeter**, **Slido**, or **Google Forms**). **Strategy 1: Think-Pair-Share (EdTech Framework)** 1. Project the 15 quiz scores on the screen. Introduce the scenario: *A teacher wants to report the class's typical performance on a 50-item quiz, but isn't sure whether the Mean, Median, or Mode gives the fairest, most accurate picture.*

		2. Instruct students to sit silently for 2 minutes and look at the numbers. Ask them: *"Which M best represents this class, and how does that single score of 10 affect your choice?"* * **Pair:** Tell students to pair up with their seatmate. Have them compare choices and try to convince each other which measure is the fairest. 3. Instruct each pair to submit their final choice on the live online poll (Mentimeter/Slido). Project the live class results onto the board. Point directly to the score of 10 and ask: *"This 10 is called an outlier. If we calculate the mathematical average (Mean), does it pull the score down unfairly? If we use the Mode (50), does it make the class look too perfect?"* Conclude by stating that today's lesson will teach them exactly when and why to use each measure. **Strategy 2: Four Corners (Kinesthetic & Digital Hybrid)** 1. Assign three physical corners of the classroom to represent **Mean**, **Median**, and **Mode**. Assign the fourth corner as **"Undecided."** 2. Show the 15 quiz scores on the board and read the teacher's dilemma aloud. 3. Instruct students to physically walk to the corner that represents the measure they think provides the most honest picture of the class's performance. 4. Give each corner 2 minutes to huddle and elect a speaker to defend their stance to the rest of the class. Use a phone or tablet to type key phrases from their defenses into a live **digital word cloud** (like WordArt or Mentimeter) projected on the screen. Connect the prominent words in the word cloud (like *"skewed," "outlier,"* or *"most common"*) to establish the purpose of the upcoming lesson.
B. Instituting New Knowledge	*B.1. Presenting Examples*	
	Activity B.1. Exploring Key Concepts **Introducing Mean, Median, and Mode**	**Activity B.1. Exploring Key Concepts** **Introducing Mean, Median, and Mode** This activity is an interactive, collaborative learning module designed to transition students from mechanical calculation to conceptual decision-making. By analyzing three distinct

	Instructions: Read and understand the following examples and answer the questions provided. **Scenario 1:** A farmer harvested the number of mangoes from his trees for 7 consecutive days. The recorded harvests (in kilos) were: 20, 22, 24, 21, 23, 25, 22. **Scenario 2:** A teacher gave a 50-item test. Here are the scores of her 15 learners: 50, 49, 50, 47, 50, 45, 50, 42, 10, 50, 38, 48, 44, 50, 33. **Scenario 3:** A shoe store recorded the shoe sizes of 30 customers who bought shoes in one day. The most frequently purchased size was size 8, which appeared 10times, while other sizes appeared only 1–3 times each. *Processing Questions**:*** 1. If the farmer wants to know his average daily harvest for the week to estimate how much he can supply regularly, which measure of central tendency should he use? Why? 2. If the teacher wants to represent the typical performance of her class, which measure of central tendency should she use? Why? 3. If the store manager wants to decide which shoe size to restock more frequently based on customer demand, which measure of central tendency should be used? Why?	real-world situations—a farmer's mango harvest, a set of quiz scores with a severe outlier, and a retail shoe store's inventory—students learn to look at the behavior of data to determine whether the mean, median, or mode provides the most accurate and useful representation of the center. **Purpose** To develop critical thinking skills by requiring students to justify their choice of central tendencies based on dataset characteristics. To recognize the practical impact of outliers on the mean and understand when the median is a superior alternative. To apply statistical concepts to real-world business and agricultural scenarios (e.g., inventory management and yield tracking). To foster collaborative mathematical communication and academic discourse through structured peer discussion. *Materials* ● **Station Cards / Activity Sheets:** Three printed sets containing the data and guiding questions for each scenario (Station 1: Mango Harvest, Station 2: Quiz Scores, Station 3: Shoe Sizes). ● **Timer or Stopwatch:** For managing the rotation intervals during the Rotating Stations strategy ● **Large Manila Paper / Marker Pens:** For student groups to jot down their consensus answers at each station. ● **Projector / Slide Deck (Optional):** For displaying the scenarios during the Think-Pair-Share plenary review.

		Strategy 1: Rotating Stations 1. Before class, the teacher sets up three stations around the classroom, each with one of the three scenarios: ● Station 1: Mean scenario (Farmer's mango harvest) ● Station 2: Median scenario (Quiz scores with an outlier) ● Station 3: Mode scenario (Shoe store sizes) 2. Each station includes the scenario, a guiding question, and space for learners to write or discuss their group response. 3. Learners are divided into small groups, at least 5 members, and assigned to a starting station. 4. At each station, the group reads the scenario and answers the guiding question. After all groups have visited all three stations, the class reconvenes for a plenary discussion. **Strategy 2: Think-Pair-Share** 1. Begin by briefly reviewing the concepts of mean, median, and mode. Then, the three scenarios are presented one at a time, either via slides, printed handouts, or read aloud. 2. For each scenario, learners are first asked to think silently and independently about which measure of central tendency is most appropriate and why. 3. After a minute or two of individual thinking, the teacher instructs the class to pair up with a seatmate and discuss their reasoning. 4. Once pairs have had time to discuss, the teacher leads a whole class sharing where several pairs are invited to share their conclusions. 5. Ensures that the class identifies the reasoning behind each appropriate measure—e.g., the mean is used when data is balanced, the median when outliers exist, and the mode when frequency is key.

	B.2. Discussing the Concept	
	Activity B.2. Deepening Conceptual Understanding **Understanding Each Measure of Central Tendency** The discussion is divided into two (2) parts: Deep understanding of each measure of central tendency (With interpretation of the result), and Computation of Measures of Central tendency using Excel and Jamovi. ***Overview:*** Measures of central tendency are statistical tools used to describe the center or typical value of a set of data. They provide a single value that represents the entire distribution, allowing us to make generalizations, comparisons, and informed decisions based on data. The three most common measures are: ● Mean – also called the average ● Median – the middle value when data is ordered ● Mode – the most frequently occurring value Each has specific uses depending on the nature and distribution of the data. ***Definition and Application of Each Measure*** ***A. Mean (Average)*** *Definition:* ● The mean is the sum of all values divided by the number of values. *Application:* ● Used when data is uniform and free from extreme values (outliers). It is commonly used in computing averages like grades, temperatures, and performance scores. *Strengths:* ● Uses all data values, providing a balanced summary. ● Widely understood and accepted.	**Activity B.2. Deepening Conceptual Understanding** **Understanding Each Measure of Central Tendency** This activity bridges foundational concept theory with hands-on computer lab application using industry-standard tools (Microsoft Excel and Jamovi). By guiding students through direct software mirroring and collaborative peer coaching, the lesson uncovers how software calculations interpret numerical properties. It specifically emphasizes data cleaning concepts, such as why the mean changes when outliers are added while the median remains steady, and why the mode is essential for processing categorical labels like words and sizes. **Purpose** ● To transition students from manual arithmetic to professional digital computation via Excel formulas and Jamovi analytical modules.To visually demonstrate data sensitivity by tracking how extreme values (outliers like 97 and 100) physically alter summary parameters in real-time software displays. ● To distinguish between quantitative and qualitative data constraints, reinforcing why the mode is uniquely suited for categorical analysis. ● To foster 21st-century collaborative workplace habits through technical peer-coaching, data cross-validation, and digital artifact sharing. *Materials* ● Computer lab access with Microsoft Excel (or Google Sheets) and Jamovi desktop software pre-installed. ● A shared practice dataset file containing the target student score vectors (including the 97 and 100 outliers) and a text column for clothing sizes. ● Teacher workstation connected to a projector or smart display for live interface mirroring.

	Weaknesses: ● Sensitive to outliers; extreme values can distort the result. ● May not represent the typical value in a skewed distribution. A **skewed distribution** is a lopsided data set. Instead of forming a perfectly balanced, symmetrical bell curve where most data sit right in the middle, the data is pulled or stretched toward one extreme side, creating a long "tail." **The Two Types** **1. Right-Skewed (Positive)** ● **The Shape:** A big clump on the left; the long tail stretches to the **right**. ● **Example:** Housing prices. Most houses are average-priced, but a few multi-million-dollar mansions pull the **Mean** way up. ● **Order: Mean > Median > Mode** **2. Left-Skewed (Negative)** ● **The Shape:** A big clump on the right; the long tail stretches to the **left**. ● **Example:** Age at retirement. Most people retire in their 60s or older, but a few people retire very early to pull the **Mean** down. ● **Order: Mean < Median < Mode** *Example:* The quiz scores of 8 learners in a 10-item quiz are: **9, 8, 7, 10, 9, 8, 6, 10** Mean: **8.375** *Interpretation:* The mean score is 8.375, which suggests that, on average, learners performed well on the quiz. Since the scores are fairly close to each other and there are no extreme outliers, the mean effectively represents the central performance of the group. Most of the individual scores (6, 7, 8, 9, and 10) revolve around or are near the mean, indicating a consistent level of achievement among the learners.	● Access to a collective digital display wall platform (e.g., Padlet, Google Jamboard, or a shared Canvas board) for student artifact submissions. ● A 1-page "Data Pilot" printed reference infographic detailing software navigation paths and formula syntax rules. **Strategy 1: Live Mirroring** 1. Walk through the definitions of the 3Ms using the text definitions. Contrast the balance of the Mean against the outlier-resistance of the Median. Use the shirt-size tally example to illustrate why the Mode is the only option for words and categories. 2. Project your desktop screen onto the board. Open the practice spreadsheet file. Tell students to click on cell B2, type =AVERAGE (A2:A16), and press Enter. Ensure that every student's screen matches your result (8.375). Repeat this identical live-mirroring loop for the Median and Mode formulas. 3. Demonstrate how to highlight the column in Excel, copy it (Ctrl+C), and paste it into Jamovi. Click on Analyses $\rightarrow$ Exploration $\rightarrow$ Descriptives. Model how to drag the "Scores" variable into the right panel and check the boxes for Mean, Median, and Mode. Have students confirm their side panel updates instantly with the identical statistical parameters. **Strategy 2: Peer-Coaching** 1. Provide students with a printed or digital 1-page quick infographic checklist showing the data paths for Excel and Jamovi. Briefly point out the main interface differences. 2. Assign students to work in pairs, strategically placing a student with strong computer skills next to a peer who needs assistance. Task the pairs by running the entire computational routine at their own speed (Excel formula generation first, then validating those exact values inside Jamovi).

	B. Median *Definition:* ● The median is the middle value of an ordered data set. If there's an even number of values, the median is the average of the two middle values. *Application:* ● Best used when data is skewed or has outliers, such as income distributions or test scores with very low or high extremes. *Strengths:* ● Unaffected by outliers, making it a reliable measure in skewed data. ● Useful when the exact value at the center is important. *Weaknesses:* ● Does not use all values, so some information may be ignored. ● Not suitable for nominal data. *Example:* Consider the scores of 9 learners: **45, 48, 50, 50, 50, 52, 55, 97, 100** Median: **50** *Interpretation:* Although one student scored 97 and the other one scored 100, the median score is 50, meaning that half of the learners scored below 50 and half scored above 50 and half scored above 50. The median gives a better representation of the overall performance because it is not affected by the two unusually high scores. ***C. Mode*** *Definition:* ● The mode is the value that appears most frequently in a data set.	3. Direct each pair to screenshot their final Jamovi analytical table panel and upload it to a collective class wall (e.g., Padlet). They must append a single sentence explaining why the median score stayed at \$50\$ despite the outlier scores of 97 and 100. For temperature check, facilitate the processing questions *Processing Questions:* 1. How does the process of manual formula generation in Excel (=AVERAGE, =MEDIAN, =MODE) differ from the menu-driven click path in Jamovi (Analyses → Exploration → Descriptives)? Which approach did your pair find more intuitive for analyzing a complete dataset, and why? 2. Look at your Jamovi descriptive panel and your Padlet submissions. When the dataset introduces extreme outlier scores like 97 and 100, why does the mathematical calculation for the Mean shift upward while the Median remains anchored at 50? What does this tell us about the structural "weakness" of the Mean versus the "robustness" of the Median? 3. During the concept lecture, we discussed shirt-size tallies as an example where the Mode is the only option. Why can we not calculate a mathematical Mean or Median for qualitative, categorical data (like words, colors, or clothing sizes)? How does the software handle data types differently based on this rule? 4. During the "Data Pilot" workshop, how did cross-check your Excel formula results against your Jamovi analytical tables to help your team catch input errors or syntax mistakes? How does learning to validate data using two different digital tools prepare you for modern, tech-driven professional environments?

Application:

- Best used with categorical or nominal data (e.g., favorite color, shoe size) or when identifying the most common item is important.

Strengths:

- The only measure that can be used with qualitative data.
- Easy to identify and interpret.

Weaknesses:
A data set may have no mode, one mode, or multiple modes, which can complicate interpretation.
Ignores most data values; may not reflect the center well.

Example:
The shirt sizes sold in a store in one week: M, L, M, XL, M, S, L, M
Step 1: Tally the frequencies:

S = 1
M = 4
L = 2
XL = 1

Mode = M

Interpretation:
The mode is M, indicating that medium-sized shirts were the most commonly sold. This is useful for inventory planning, as it reveals customer preference.

Computation of Measures of Central tendency using Excel and Jamovi

Measures of central tendency—mean, median, and mode—are essential tools in understanding and interpreting data. With the availability of modern statistical tools, computing these measures has become more efficient, accurate, and manageable, especially when dealing with large datasets. There are different appropriate technologies that can be used (e.g. calculator, Excel, Jamovi, Geogebra, etc.) and for this discussion, two commonly used tools in education and research, Microsoft Excel and Jamovi, will be introduced.

Using Excel

Microsoft Excel is a powerful spreadsheet tool commonly used in data analysis due to its accessibility, simplicity, and built-in functions for statistical computations. It is especially useful for:

- Organizing raw data
- Calculating mean, median, and mode quickly using functions
- Generating visual aids (charts, tables, and graphs)
- Automating repetitive computations

.

Computation Process Using Excel

Assume your data is listed in column A (from A2 to A16).

A. Mean

Step 1: Click on an empty cell where you want the result to appear.
Step 2: Type the formula: =AVERAGE (A1:A15)
Step 3: Press Enter. The cell will display the mean of the data.

B. Median

Step 1: Click on another empty cell.
Step 2: Type the formula: =MEDIAN (A1:A15)
Step 3: Press Enter. The cell will display the median of the data.

C. Mode

Step 1: Click on another empty cell.
Step 2: Type the formula: =MODE.SNGL(A2:A16)
(or =MODE.MULT(A2:A16) for multiple modes)
Step 3: Press Enter. The cell will display the most frequently occurring value.
Note: If no value repeats, Excel will return a #N/A error for the mode.

Using Jamovi

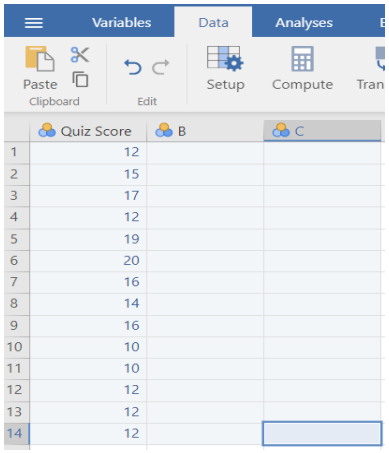
Jamovi is a free and user-friendly statistical software designed for educators, learners, and researchers. Built on top of the statistical language, it combines the power of advanced analytics with an intuitive interface similar to spreadsheet applications. This makes it accessible even to beginners while being robust enough for professional research.
It can be downloaded at https://www.jamovi.org/download.html

Step-by-Step: Computing Mean, Median, and Mode in Jamovi

Step 1: Prepare Your Data in Excel

Quize Scores
12
15
17
12
19
20
16
14
16
10
10
12
12
12

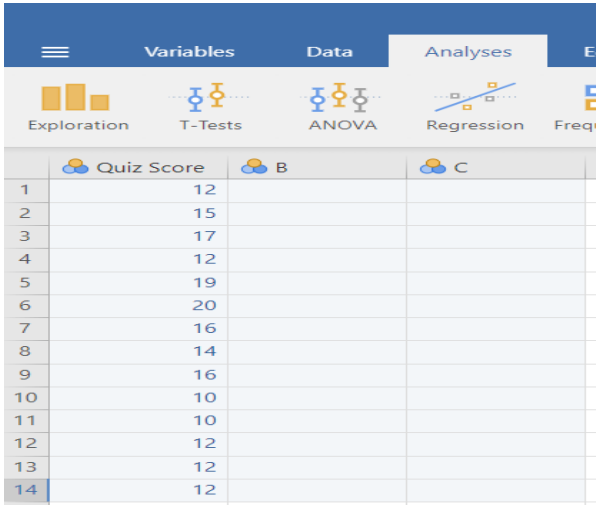
Step 2: Copy and Paste Data into Jamovi

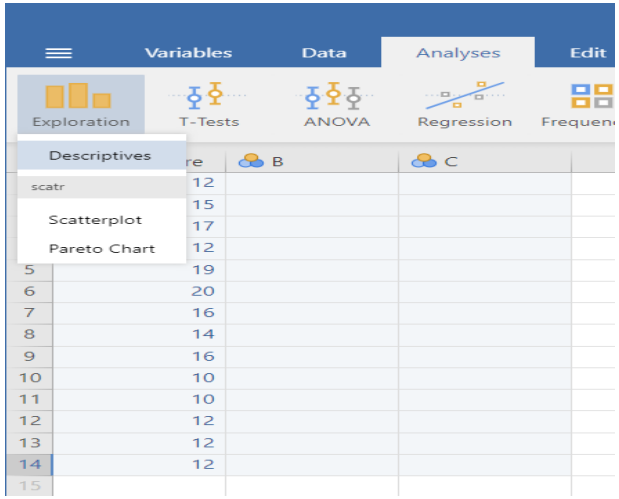


Step 3: Compute Mean, Median, and Mode

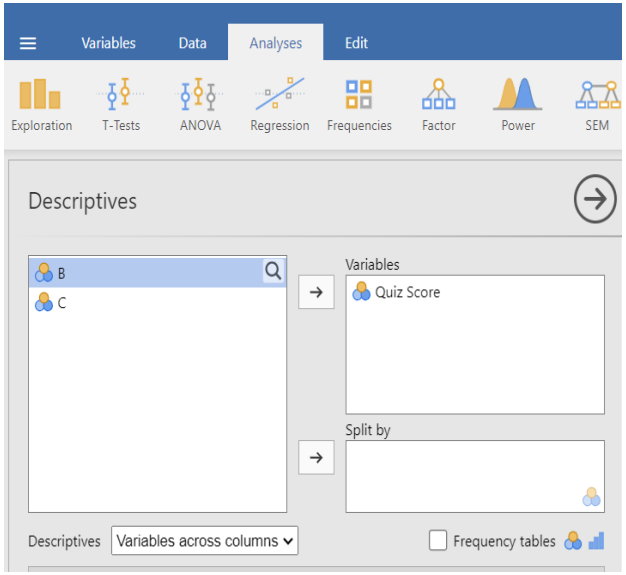
- Click on the 'Analyses' tab at the top.
- Under Exploration, click Descriptives.
- Move the variable (Scores) to the right panel under Variables.

In the Statistics section, check out the boxes for Mean, Median, and Mode.

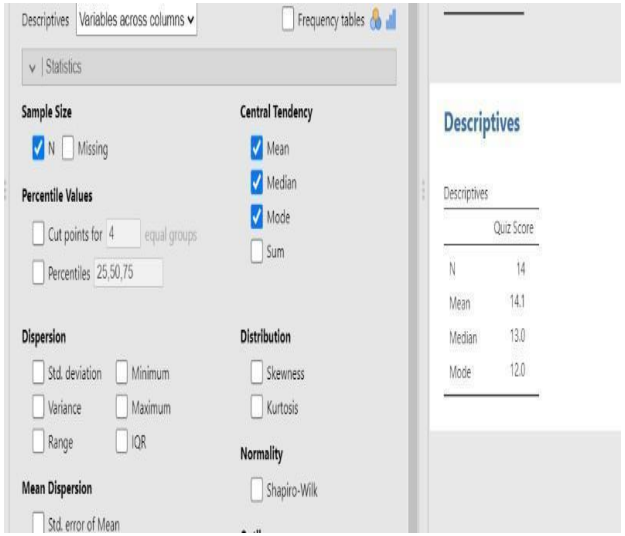
1. 

2. 

3.



4.



Note: The results for mean, median, and mode are presented in the side panel

	B.3. Developing Mastery (For complete instructions, please refer to the Learning Activity Sheet.)
	Activity B.3. Practicing Learned Skills **Practicing the Skills on Measures of Central Tendency** This activity serves as the independent practice phase of the lesson. Students run diagnostic analytics on three distinct datasets (test scores, family income with a major outlier, and retail/shoe sizes) to prove they can choose, calculate, and interpret the correct measure using **Microsoft Excel** or **Jamovi**. **Purpose** ● **Statistical Literacy:** To choose the correct measure of central tendency based on the shape and traits of a dataset, compute the value accurately using tech, and write data-backed summaries. ● **Integrated Literacy:** To expand **socio-economic, health, and consumer literacy** by evaluating real-life scenarios like income disparity and physical inventory needs. ● **EdTech Integration:** To seamlessly transition raw datasets into computational engines (Excel/Jamovi) and use syntax or drop-down panels to generate statistical metrics. *Materials* ● Learning Activity Sheet ● Student worksheets or computers loaded with the 3 problem datasets. ● Student access to Microsoft Excel (or Google Sheets) and Jamovi. ● A shared digital class spreadsheet or projection screen for displaying final solutions. **Strategy 1: The Data Consultant Rotation** 1. Frame the activity as a corporate training module. Tell students they are now "Data Consultants" hired to solve three separate department issues (Academic, Financial, and Athletic). 2. Instruct students to open Practice_Datasets.xlsx individually. They must use Excel formulas or import the data into Jamovi (Analyses -> Exploration -> Descriptives) to complete sections (a) through (d) for each problem on their digital sheets. 3. While walking around, provide guidance on coding issues (e.g., reminding them to look out for the #N/A error in Excel if a dataset has multiple modes, or showing them how the median handles outliers in Jamovi). Have students upload their completed reports to the school platform. **Strategy 2: The Three-Room Analytics Panel** 1. Divide the classroom into three large analytical squads: Team 1 (Science Examiners), Team 2 (Economic Analysts), and Team 3 (Retail Planners). 2. Assign each squad to focus specifically on their designated problem. They must work together to run the numbers in Excel or Jamovi, reach a group consensus on the fairest "M" choice, and draft a collective interpretation sentence.

<table>
<tr><td></td><td colspan="2">3. Have each squad present their final screen output (Excel formula view or Jamovi summary grid) to the entire class using the projector. The teacher facilitates a final class review to ensure the remaining students copy the correct metrics for all three problems.</td></tr>
<tr><td rowspan="2">C. Demonstrating Knowledge and Skills</td><td colspan="2">C.1. Finding Practical Application</td></tr>
<tr><td>Activity C.1. Making Real-World Connections

Climate Watch PH: A Barangay Environmental Awareness Campaign

Project Scenario
As part of the Climate Watch PH initiative, your multidisciplinary team has been tasked with launching an environmental awareness campaign across three local barangays. To design targeted waste-management and climate mitigation strategies, your team gathered data on the amount of non-recyclable plastic waste (in kilograms) disposed of by sample households per week:
● Barangay A: 12, 15, 14, 16, 13, 60 kg
● Barangay B: 10, 11, 9, 12, 11, 50 kg
● Barangay C: 18, 20, 17, 19, 21, 75 kg
To build a campaign that resonates with the community and influences local government policy, you must look beyond the raw numbers to understand the systemic stories they tell.

Processing Questions:
1. How can we use statistical software to show how just a few heavy-wasting households (the 50, 60, and 75 kg outliers) distort a barangay's true ecological footprint, and why does the median give us a scientifically more accurate baseline for monitoring environmental degradation?
2. Which barangay throws away the least amount of trash when using the fairer median measure, and how does the historical background, local lifestyle, and socio-cultural habits of that specific community contribute to their lower waste production?
3. How does using digital tools like Excel or Jamovi to analyze all three barangays simultaneously prepare us for modern 21st-century careers—such as data science, environmental engineering, or public administration—and how does it make our team faster at solving community problems?</td><td>Activity C.1. Making Real-World Connections

Climate Watch PH: A Barangay Environmental Awareness Campaign

This activity is a real-world, project-based data analysis module that connects environmental statistics to community-level public policy. By evaluating weekly plastic waste data from three local barangays under the Climate Watch PH initiative, students explore how statistical software (Excel/Jamovi) uncovers data distortions caused by ecological outliers. This allows them to assess the socio-economic and ethical impacts of data-driven local governance.

Purpose
● To train students to identify structural data distortions (outliers) using statistical software tools.
● To contrast the practical utility of the mean versus the median when creating data-driven community interventions.
● To analyze how cultural habits, socio-economic standing, and municipal histories influence municipal waste profiles.
● To evaluate the systemic, human consequences of policy errors stemming from flawed data interpretation.

Materials
● Computers with Excel, Google Sheets, or Jamovi installed
● Projector or smart TV for software demonstrations
● Student worksheet containing the Climate Watch PH dataset</td></tr>
</table>

	4. If our campaign relies on skewed data and targets the wrong barangay, how does this policy mistake worsen the environmental injustices, health hazards, and socio-economic struggles of vulnerable families in these communities?	**Strategy 1:** **Real-Time Outlier Filtering and Dynamic Charting** *Instructions*: 1. **Load the Data:** Have all student teams open Excel or Jamovi and input the raw waste values for Barangays A, B, and C into three adjacent columns. 2. **Build a Visual baseline:** Instruct students to generate a side-by-side **Box and Whisker Plot** or a **Bar Chart** of the raw data. Have them point out the extreme spikes at the end of each dataset 60kg, 50kgand, 75kg 3. **The "Delete the Outlier" Drill:** Instruct students to temporarily delete the extreme outlier values from their software sheets and watch the metrics recalculate automatically. 4. **Observe the Metrics Shift:** Point out to the students that when the outlier is deleted, the *Mean* plummets dramatically, while the *Median* stays almost the same. 5. **Synthesize the Lesson:** Guide students to realize that because the median stands against extreme data points, it serves as a more reliable metric for planning ongoing municipal waste strategies. **Strategy 2: Socio-Cultural Character Profiling** *Instructions:* 1. **Isolate the True Performer:** Based on their calculations, have the class identify **Barangay B** as the community with the lowest median waste output 11kg 2. **Assign Persona Profiles:** Instead of viewing Barangay B as just a column of digits, divide the students into small brainstorming groups. analytical Challenge them to build a realistic cultural profile of this community. 3. **Prompt the Investigation:** Ask questions to guide their character profiles: ● *What kind of local economy keeps plastic waste low? (e.g., active traditional public markets using banana*

<table>
<tr><td></td><td></td><td>leaves or net bags vs. supermarkets wrapping items in single-use plastics).
● What traditional, historic habits might the elders be practicing here? (e.g., strong indigenous zero-waste values, home-level backyard composting, or strict municipal enforcement of eco-bricking).
4. Connect Numbers to People: Have each group present their theories. This teaches students that every data point represents a real human habit, a lifestyle choice, or a local policy of victory.</td></tr>
<tr><td></td><td colspan="2">C.2. Making Generalization</td></tr>
<tr><td></td><td>Activity C.2. Wrapping-Up the Lesson

Option 1. Rock-Paper-Scissors Reflections
Instructions:
1. Learners will reflect on their learning using Rock-Paper-Scissors metaphor to organize their thoughts.
2. Learners will write their answer on the reflection table:
● Rock section- the most challenging part of the lesson (the concept that requires more effort to understand)
● Paper section - the main idea or the key takeaway from the lesson
● Scissors - less important details or extra information
<table><tr><th>Reflection Area</th><th>Answer</th><th>Explanation</th></tr><tr><td>ROCK</td><td></td><td></td></tr><tr><td>PAPER</td><td></td><td></td></tr><tr><td>SCISSORS</td><td></td><td></td></tr></table>3. Be specific and honest. Your answer will help your teacher understand what stood out to you.

Option 2. Dear Central Tendency...
Instructions:
1. On a short bond paper or reflection sheet, write a creative letter addressed to Central Tendency as if it were a person.
2. In your letter, include the following as guides:
● What you learned about mean, median, and mode today.</td><td>Activity C.2. Wrapping-Up the Lesson

For the summary, you may select and facilitate one of the activities provided.

Option 1. Rock-Paper-Scissors Reflections

This activity serves as reflection and lesson wrap-up. Instead of another math test, students express what they learned creatively by writing a letter to "Central Tendency" as a person, followed by a quick, honest exit ticket to check their understanding.

Purpose
● Statistical Literacy: To help students review and summarize the core meanings, real-life value, and remaining questions they have about Mean, Median, and Mode.
● Integrated Literacy: To build creative writing and self-reflection literacy by translating cold math concepts into personal, real-world stories.
● EdTech Integration: To use digital pinboards or online journals so students can publish their reflections and learn from their classmates' ideas.

Materials
● Short bond paper or reflection sheets.
● Index cards or small sticky notes.</td></tr>
</table>

	• Why are these measures important in understanding data. • A situation in your life where you think you could apply what you learned. • One question you still have about data or central tendencies. **Option 3. One Thing I Learned, One I Can Apply** *Instructions*: 1. On a sheet of paper, write down the following: 2. One thing you learned from today's lesson (e.g., concepts of measures of central tendency). 3. One way you can apply it in real life (e.g., track my quiz scores and see how I'm improving). 4. Be specific and honest. Your answer will help your teacher understand what stood out to you. *Processing Questions:* 1. How did reading your classmates' letters on the shared digital board or wall help you discover new ways to use the 3Ms in everyday life that you hadn't thought of yourself? 2. Why does writing a creative letter or an honest reflection help you remember math concepts better than just memorizing formulas for a quiz?	• Optional EdTech: A shared digital board (e.g., **Padlet**, **Google Jamboard**, or **Canvas Discussions**). **Option 2. Dear Central Tendency...** *Instructions*: 1. Tell students to imagine "Central Tendency" is a wise old friend who helps make sense of messy data. They must write a personal letter to this friend. 2. Give students 15 minutes to write their letters on a short piece of paper or type it directly into Column 1 of the class Padlet. The letter must cover what they learned, why it matters, a personal life application, and one lingering question. 3. If using paper, tape the letters around the room. If using tech, project the Padlet board. Let students walk around or scroll to read their peers' letters. **Option 3. One Thing I Learned, One I Can Apply** *Instructions:* 1. To quickly wrap up the class, hand out small sticky notes or open a fast digital form (like Google Forms). 2. Ask students to quickly and honestly write down just two things: (1) One specific concept that clicked today, and (2) One exact way they can use it in their own life (like tracking their basketball stats or budgeting allowance). 3. Have students stick their notes on the classroom door as they leave or click "Submit" on their phones. Use these quick notes to see what is stuck and what needs to be retaught next time. *Note to Teachers:* If you are going paperless, create a Padlet board with two virtual columns: *Column 1: Letters to Central Tendency* and *Column 2: My 1-Minute Exit Ticket*.

		Keep the four-letter guide points clearly visible on the main screen, so students don't forget what to include.
	C.3. Evaluating Learning (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity C.3. Assessing Learning Outcomes This formative test activity, "**Assessing Learning Outcomes,**" functions as the formal check for mastery. Students work independently with three distinct datasets (call center response times, weekly allowances with an outlier, and classroom participation counts) using **Microsoft Excel** or **Jamovi** to verify they can analyze data, run software commands, and justify their answers. **Strategy 1: The Paper-Pencil Test** 1. Instruct students to clear their desks completely, leaving only a pen, pencil, and their computer mice. Distribute a physical, printed test booklet containing the three problem scenarios and the blank answer slots for sections (a) through (d). 2. Students use their computers *only* as an advanced calculation engine—opening the pre-loaded data file in Excel or Jamovi to process the metrics. They are strictly prohibited from saving text or answers on the device. Instead, they must manually write down their final structural choices, calculated values, and complete interpretation of sentences directly onto the physical test paper. 3. This strategy maintains the highly secure, quiet atmosphere of a traditional paper exam. It ensures individual learning is evaluated fairly, making it easy to see their step-by-step thinking by looking at their physical handwriting and preventing copy-pasting code between student monitors. **Strategy 2: Completely Digital-Based Framework** 1. Instruct students to clear their desks of all loose paper and pens. Project the three problem blocks on the main board or send them digitally to student screens. 2. Provide a restricted, password-protected digital link via your school's LMS or a testing platform (like Google Forms or Microsoft Forms). Students open Excel or Jamovi on one side of their screen to run the datasets. On the other side of the screen, they open the live form and type their selected measures, calculated values, and short interpretations directly into the required online form fields. 3. This method provides a centralized, automatically organized dashboard for grading. By forcing students to type out their precise inputs and text explanations into an online form, you can immediately spot which individuals can independently navigate statistical software workflows without relying on physical handouts.	
	C.4. Additional Activities (For complete instructions, please refer to the Learning Activity Sheet.)	
	C.4. Additional Activities **Improving Understanding** This activity serves as a differentiated assessment tool designed to reinforce students' understanding of the measures of central tendency (mean, median, and mode). It features two distinct components: **Remediation** (focusing on selecting, computing, and interpreting the most appropriate measure of central tendency based on the nature of given datasets) and **Enrichment** (challenging students to compare comparative datasets and discover the properties of data transformations on central values).	

Purpose

- To evaluate students' ability to recognize the impact of outliers on the mean and shift to the median when necessary.
- To master identifying the mode in heavily repeated, discrete data.
- To explore the mathematical behavior of central tendency measures under linear transformations (addition and multiplication).
- To apply data analysis to practical decision-making scenarios.

Materials

- Activity sheets containing the problem sets
- Scientific calculators
- Whiteboard and markers for strategy demonstrations

Strategy 1: Data Visualization and Filtering (For Remediation)

Instructions:

1. **Distribute and Project:** Provide students with the worksheet and project the first dataset (Restaurant Daily Sales) onto the board.
2. **Scan Before Computing:** Explicitly command students to put down their pencils and calculators. Give them 30 seconds to quietly scan the numbers from left to right.
3. **Isolate the Outliers:** Ask the class, *"Is there any number in this list that looks like it belongs to a completely different story?"* Have a student come to the board and draw a red box around the outlier (e.g., PHP 25,000).
4. **Run a Mental Simulation:** Ask the students what would happen if you averaged everyone's pocket money, but one student in the room was a billionaire. This anchors the concept that the mean would lie to them.
5. **Establish the Filter Rule:** Introduce a two-step decision rule on the board:
    - *Presence of severe outliers?* **Use Median.**
    - *Massive repetition of a single value?* **Use Mode.**
    - *Fairly balanced/no extreme jumps?* **Use Mean.**

Strategy 2: Conceptual Mapping of Transformations and Comparative Analysis (For Enrichment)

Instructions:

1. Set Up the Comparison Matrix (Enrichment Problem 1)

- Draw a two-column table on the blackboard labeled **Company A** and **Company B**.
- Instead of letting students compute everything individually, assign the left half of the classroom to calculate the mean, median, and mode for Company A, and the right half for Company B.
- Write their findings on the board. Point out the conflict: *Both companies have a mean of 16. How do we break the tie?*
- Guide them to look at the **Median** (16.5 vs 16). Explain that looking at alternative measures of central tendency helps us see which company is more consistent when the means are identical.

2. Anchor with the Baseline (Enrichment Problem 2 - Part I)

- Move to the data transformation questions. Have the students write down the original baseline dataset: 2, 4, 4, 6, 8.
- Instruct them to calculate the baseline metrics first: Mean = 4.8, Median = 4, Mode = 4. Write these inside a box labeled "**Original Center**".

	3. The "What If" Concept Check ● Before letting them write down the new transformed numbers, ask the class a conceptual question: *"If every single plant in our garden suddenly grows exactly 3 inches taller, what should naturally happen to the average height of the whole garden?"* ● Draw an arrow from the "**Original Center**" box to a new box labeled "**Shifted Center (+3)**". **4. Parallel Verification (The Hard Way vs. The Smart Way)** ● Divide the classroom into two teams to test their hypothesis: ○ **Team Hard Way:** Instruct them to manually add 3 to every single data point to create the new set [5, 7, 7, 9, 11] and recalculate the mean, median, and mode from scratch. ○ **Team Smart Way:** Instruct them to bypass the dataset entirely. Have them simply add +3 directly to the original baseline metrics ● Mean: 4.8 + 3 = 7.8, ● Median: 4 + 3 = 7 ● Mode: 4 + 3 = 7. ● Have both sides compare answers on the board to prove the shortcut works. **5. Scale to Multiplication (Enrichment Problem 2 - Part II)** ● Immediately challenge them with the final dataset: 1, 3, 3, 5, 7. ● Have them find the baseline metrics Mean = 3.8 Median = 3 Mode = 3. ● Apply the transformation rule: *Multiplying by 2*. Instruct the entire class to use the "Smart Way" shortcut by multiplying the baseline answers by 2, proving that properties of central tendency scale perfectly with multiplication New Mean = 7.6 New Median} = 6 New Mode= 6.

III. CONTENT	**Lesson 7.3. Measures of Variability**	
IV. OBJECTIVES	At the end of the lesson, learners will be able to: 1. differentiate the different measures of variability (i.e. range, interquartile range, variance, and standard deviation) 2. compute the different measures of variability that include solving real-life applications using open-source statistical software (e.g. MS Excel, Jamovi) 3. interpret the computed measures of variability.	
V. PROCEDURES	**ACTIVITIES**	**ANNOTATION**
A. Activating Prior Knowledge	*A.1. Eliciting Prior Knowledge*	
	Activity A.1. Leveling Learners Readiness **Comparing the Spread of Examination Scores**	**Activity A.1. Leveling Learners Readiness** **Comparing the Spread of Examination Scores** The following strategies are suggested:

Instructions:

1. Collect and organize the data for the First Term scores of your classmates in General Mathematics.
2. Work with your group to examine and compare the distribution of scores in each data set. Observe how spread out or closely grouped the scores are.
3. Determine the data sets with the largest and smallest spread and discuss the observations and evidence that justify your conclusions.
4. Answer the processing questions as a group:
   - Which data set shows the greatest dispersion?
   - What evidence or measure helped you identify this?
   - Which data set has the least spread?
   - What does this suggest about the learners' scores in that section?
   - How does the spread of scores help us better understand learners' performance aside from the mean?
   - Suppose two sections took the same test and obtained the same mean score. Can you conclude that both sections performed equally well? Why or why not?
   - Why is it important to consider both the mean and the spread of scores when interpreting test results?

Human Bingo Data Collection (Individual)

1. Let the students begin by preparing two 3x3 bingo cards containing different statements. Sample cards are given below.

CARD 1

CARD 2

Mobile Legend Player	Loves singing	Loves reading books
Loves math/science	Loves dancing	officer of a student organization
uses AI tools	enjoys solving puzzles	can play musical instrument

2. Each learner will move around the classroom to find classmates who match the statements written on the card. Note: A learner may fill in only one box on the card. No learner should fill in two or more boxes, even if multiple statements describe the same learner.
3. Instead of writing names in the boxes, learners will record the score obtained by their classmates in the First Term Examination in General Mathematics.
4. Once completed, the learner will compare now the spread of the two sets of data collected.

		Collecting and Comparing Examination Scores Using Menti meter Application 1. The teacher will provide the Menti meter access link or code for the activity. 2. Using a mobile phone, tablet, or computer, each learner will join the Mentimeter activity. 3. Once connected, each learner will enter his/her score obtained in the First Term Examination in General Mathematics in the designated Mentimeter response field. 4. Learners should submit only one response and ensure that the score entered is accurate. 5. After all responses have been submitted, the class will observe the generated Mentimeter results showing the distribution of examination scores. 6. Based on the collected data, learners will analyze and compare the spread of the examination scores by identifying patterns such as clustering, variation, highest and lowest scores, and overall distribution. 7. Learners will then participate in a class discussion to interpret the results and explain what the spread of the data reveals class performance.
	A.2. Establishing the Purpose of the Lesson	
	Activity A.2. Appreciating Lesson Relevance **Reading Comprehension Integration** *Instructions:* Read the short passage below about how the Department of Education uses learner data. Then answer the questions that follow. The Department of Education (DepEd) regularly collects information about learners, including grades in different subjects, National Achievement Test (NAT) results, Body Mass Index (BMI), attendance records, and literacy and numeracy assessment results. These data help schools monitor learners' academic performance, health, and overall development. Although averages provide a summary of learner performance, they do not always show how different or similar the learners are. For	**Activity A.2. Appreciating Lesson Relevance** **Reading Comprehension Integration** The primary goal of this activity is Literacy Integration, helping learners understand how measures of variability are used in real-life educational settings. By reading the passage, learners identify important information, make inferences, and explain why measures such as the range, variance, standard deviation, and interquartile range (IQR) are useful in describing how data are spread out. This activity helps learners connect reading comprehension with statistical reasoning. Use the "Educational Data Analyst" Roleplay as the strategy. In this activity, learners act as educational data analysts who interpret learner data and explain why understanding variability

	example, two classes may have the same average Mathematics score, but one class may have scores that are very close to one another, while the other class may have scores that vary widely. By examining the variability or spread of the data using measures such as the range, variance, standard deviation, and interquartile range (IQR), teachers can better understand learners' needs, identify those who may require additional support, and develop more effective interventions and instructional strategies. *Processing Questions*: 1. Which of the following learner information is collected by the Department of Education? a. Grades, attendance records, and BMI only b. Grades, attendance records, BMI, literacy and numeracy assessments, and National Achievement Test results c. Family income and household expenses d. Social media activity and internet usage 2. According to the passage, why is calculating only the average not enough to describe learner performance? a. Because averages cannot be calculated for educational data. b. Because averages do not show how spread out or varied the learners' results are. c. Because averages are always higher than the median. d. Because averages can only be used for attendance records. 3. What can you infer if two classes have the same average Mathematics score but different standard deviations? a. Both classes have exactly the same scores. b. One class has scores that are more spread out than the other. c. Both classes have the same level of variability. d. Standard deviation has no relationship with the average. 4. Which measure would be most useful if a teacher wants to know how to spread out the learners' scores around the mean? a. Mean b. Median c. Standard deviation d. Mode	is important in making educational decisions. Begin by asking a learner to read the passage aloud while the class follows silently. Briefly discuss the types of learner data mentioned in the passage. Let the learners answer the guide questions, which cover different levels of reading comprehension: ● **Literal Level** (Questions 1–2): Identify the learner data collected by DepEd and explain why averages alone are not enough. ● **Inference or Interpretation Level** (Questions 3–4): Infer what different standard deviations talk about learner performance and identify the appropriate measure of variability. ● **Knowledge Construction Level** (Question 5): Explain how teachers can use measures of variability to improve instruction and provide appropriate interventions. Conclude asking: "Why is it important to study the variability of data instead of relying only on average?" **Predicting Variability**: **How Do We Measure Up?** *Instructions*: 1. Group the learners with 4-6 members. Each group will have 2 learners (with codes A and B) to have their height and weight be measured. 2. Distribute the meta cards to be used in writing about the height and weight measures of the two learners of each group. The sample card is given below. 3. Once the measuring height and weight of the considered learners from the group complete, they will compare the spread of the data and will start to process the questions.

5. Why is understanding variability important for teachers and school administrators?
   a. It helps them identify learning differences and plan appropriate interventions.
   b. It determines the number of classrooms in a school.
   c. It replaces the need to compute the average.
   d. It guarantees that all learners will have the same performance.

Processing Question:
Why is it important to study the variability of data instead of relying only on average?

Predicting Variability

Manually gathering of Data
Suppose your teacher assigns you to collect real-world data by measuring the height and weight of two groups of learners. Each group consists of five (5) learners. Using a meterstick or tape measure for height and a weighing scale (mechanical or digital) for weight, record all measurements accurately and systematically on a sheet of paper. Organize your data clearly to prepare it for later analysis of variability.

Processing Questions:
1. Which group has the largest spread in terms:
   a. height; and
   b. weight?
2. Which group has the smallest spread in terms:
   a. height; and
   b. weight?
3. What will happen with the spread of the data:
   a. remove one data point?
   b. add one data point?
4. Why is it important to know how varied or dispersed the data are?

Group Number	**Learners A**		**Learners A**	
	Height	**Weight**	**Height**	**Height**
1				
2				
3				
4				
5				

Traffic Light Variability
1. Prepare 3 cards (red, yellow, green) with datasets on the height (cm) and weight (kg) of learners. Sample datasets are given below.

Red card: H = {90, 92, 93, 95, 96}
W = {70, 72, 73, 75, 76}

Yellow card: H = {80, 85, 90, 95, 100}
W = {70, 75, 80, 85, 90}

Green card: H = {75, 85, 90, 100, 120}
W = {65, 75, 80, 90, 100}

2. Divide the class into 10 groups with at least 5 members.
3. Provide each group with the 3 cards with different numerical data.
4. Each group will now compare the spread of the data given to them and answer the process question

1. provide the Google Forms link or QR code for the activity for the students
2. Each learner will access the form using a mobile phone,

	EdTech Integration: Electronically gathering of Data Your teacher will provide a Google Forms link or QR code for this activity. Using your device, access the form and carefully enter the required information: your name, height (in centimeters, as instructed), and weight (in kilograms). Make sure that all entries are accurate before submitting. Each learner is allowed to submit the form only once. After all responses have been collected, your teacher will organize and display the class data for discussion and analysis. *Processing Questions:* 1. Which group has the largest spread in terms: a. height; and b. weight? 2. Which group has the smallest spread in terms: a. height; and b. weight? 3. What will happen with the spread of the data: a. remove one data point? b. add one data point? 4. Why is it important to know how varied or dispersed the data are?	tablet, or computer. 3. Learners will input their own height and weight accurately in the required fields provided in the form: ● Height (in centimeters or meters, as instructed) ● Weight (in kilograms) 4. Learners must ensure that the data entered is complete, correct, and properly labeled according to the required unit of measurement. 5. Each learner is allowed to submit the form only once. 6. After all responses are collected, group the data in 5 groups and present the google sheets and to the class. 7. Let the group process the questions that will lead to discussion.

B. Instituting New Knowledge

B.1. Presenting Examples

Activity B.1. Exploring the Key Concepts

Data Visualization Activity

Instructions:

1. Carefully observe the grouped datasets presented by your teacher using tables, bar graphs, or dot plots.
2. Work with your group and examine the distribution of the height and weight data.
3. Compare the datasets and discuss how the values are arranged.
4. Record your observations by completing the table below:

Group	Values Close Together?	Values Spread Farther Apart?	Observation on Distribution
A			
B			
C			
D			
E			

Processing Questions:

1. Which groups have values that are closely clustered?
2. Which groups have values that are more widespread?
3. Are all groups distributed in the same way? Explain your answer.

Activity B.1. Exploring the Key Concepts

Data Visualization Activity

To deliver this activity, you may use any of the following strategies:

Data Recording and Organization Strategy

1. Explain the purpose of the table.
2. Model how to complete one row.
3. Guide learners during individual/group work.
4. Encourage learners to discuss within their groups before writing final responses to ensure shared understanding and agreement.
5. Check the completeness and accuracy.
6. Let the group process the questions that will lead toward a discussion of the key terms and concepts needed to understand the lesson.

Think Pair Share Activity

1. Share your individual answers with your partner or group members.
2. Compare your observations and check if you agree on each dataset.
3. Discuss differences in your answers and justify your reasoning using the data shown in the graphs or tables.
4. Collaboratively complete and finalize your observation table
5. Let the group process the questions that will lead toward a discussion of the key terms and concepts needed to understand the lesson

B.2. Discussing the Concept

Activity B.2. Deepening Conceptual Understanding

Understanding Measures of Variability

a. *Range (R)*

Range tells the spread of data that involves the lowest and highest value. It is the simplest measure of variability by calculating

Activity B.2. Exploring the Key Concepts

Understanding Measures of Variability

To facilitate learners' understanding of the different measures of variability, the teacher may use the Scaffolding

	the difference between the highest and lowest values in a dataset. It is particularly helpful in situations where understanding extreme values is important. Formula: R = Highest Value (HV) – Lowest Value (LV) *Example 1*: In a certain test in General Mathematics, the 40 Grade 11 learners scored from 14 to 39. Hence, the **range is 25** (i.e. R = 39 – 14 = 25). *Example 2*: Given the following data on the number of minutes to solve a math problem: {23, 10, 18, 19, 43, 16}. The **range is 33** (i.e. R = 43 – 10 = 33). **Note:** While range is easy to compute, it does not account for how values are distributed across a dataset. b. *Interquartile Range (IQR)* The interquartile range represents the spread of the middle 50% of the data. It is obtained by computing the difference between the third quartile (Q3) and first quartile (Q1) or between the 75^{th} percentile and 25^{th} percentile. It is useful when we find it to measure the variability while minimizing the impact of extreme values. Formula: IQR = Third quartile (Q3) – First quartile (Q1) = 75^{th} percentile – 25^{th} percentile *Example 3*: Given the following sample test scores of 10 Grade 11 learners in General Mathematics: {35, 32, 37, 45, 15, 23, 26, 26, 39, 40}. *Solution*: Step 1: Arrange the data in ascending order.: {15, 23, 26, 26, 32, 35, 37, 39, 40, 45}. Step 2: Determine Q1and Q3. (Q1 is 26 and Q3 is 38.5) Step 3: IQR = Q3−Q1 = 39-26= 12.5 Thus, the Interquartile Range (IQR) is 13. This means that the middle 50% of learners' test scores in General Mathematics are spread across 12.5 points. While test scores do vary, they are not	Strategy, gradually moving learners from guided instruction to independent practice. The following activities are suggested: **A. Compare the Spread Activity** 1. Begin with the Range as the simplest measure of variability. 2. Guide learners in identifying the highest and lowest values before computing the range. 3. Introduce the Interquartile Range (IQR) by reviewing how to determine the first quartile (Q1) and third quartile (Q3). Demonstrate how to compute the IQR and explain why it is less affected by outliers. 4. Present the Variance and Standard Deviation using the worked example. Explain each step clearly and discuss what the computed values reveal about the spread of the data. 5. Explain the difference between sample and population variance and standard deviation, emphasizing when each measure should be used. 6. Gradually reduce teacher support by allowing learners to solve a similar dataset independently. 7. Process the guide questions to help learners compare the measures of variability and determine when each measure is most appropriate. **B. Match the Measure Activity** 1. Divide the class into small groups. 2. Provide each group with cards containing: ● the names of the measures of variability; ● their formulas; ● their definitions; and ● situations where each measure is most appropriate. 3. Ask each group to match each measure with its corresponding formula, definition, and application. 4. Let each group explain the reasons for their answers. 5. Conclude by discussing the characteristics, strengths, and limitations of each measure of variability. **C. Which Measures Fits? Activity** 1. Present different datasets or real-life situations. 2. Ask learners to determine whether Range, IQR, Variance, or Standard Deviation is the most appropriate measure to use.

extremely scattered.

Note: Since IQR is not affected by extreme values, it is a resistant measure of variability. It tells us how to spread out the central portion of the data, without being affected by the outliers.

c. Variance and Standard Deviation

Variance represents the mean of squared differences from the average, while **Standard Deviation (SD)** is the square root of the variance. Both measures on how to spread the data are from the mean.

There are two types of Variance/Standard deviation: *sample variance* (s^2) and *population variance* (σ^2); *sample Standard Deviation* (s) and *population standard deviation* (σ); A higher variance or standard deviation means the data are more spread out, while a lower variance means they are closer to the average.

Sample Variance and Sample Standard Deviation

$$s^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}$$

$$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$

where n is the sample size and $\underline{x}$ is the sample mean.

Population Variance and Population Standard Deviation

$$\sigma^2 = \frac{\sum_{i=1}^{N}(x_i - \mu)^2}{N-1}$$

$$\sigma = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \mu)^2}{N-1}}$$

where N is the population size and μ is the population mean.

3. Let learners justify their choices with a partner or within their group.
4. Facilitate a class of discussion to compare responses.
5. Summarize when each measure of variability should be used in practical situations.

D. Which Dataset is More Consistent? Activity

1. Present two datasets with similar averages but different distributions.
2. Ask learners to predict which dataset is more consistent before performing any computations.
3. Compute the Range, IQR, Variance, and Standard Deviation.
4. Compare the computed measures and discuss which dataset shows greater consistency.
5. Let learners justify their conclusions using statistical evidence.

Computation Process Using Open-Source Statistical Software Tools

To strengthen learners' computational and digital skills, the teacher may integrate Microsoft Excel and Jamovi in computing measures of variability. The following activities are suggested.

Jamovi Navigation Viewing Activity

1. Before the hands-on activity, facilitate a guided viewing of the Jamovi navigation tutorial. https://www.youtube.com/watch?v=t0tQcs-E5Z4&list=PLvYqRUmlLZUMJ0EUxuTAA1f407wmBQ1QX).
2. Instruct learners to observe the location and function of the menu bar, data view, analysis options, variable panel, and output panel.
3. Ask learners to take note of the steps for entering data and generating descriptive statistics.
4. Conduct a brief discussion to clarify the basic features of the software before proceeding to the hands-on activities.

Note: Use **sample variance and sample standard deviation** when the data represent only a sample of a larger population. Use **population variance and population standard deviation** when the data include every member of the population being studied.

Example 4: Given the following sample test scores of 10 Grade 11 learners in General Mathematics in Example 3: {35, 32, 37, 45, 15, 23, 26, 26, 39, 40},

X	$X-\mu$	$(X-\mu)^2$
35	3.2	10.24
32	0.2	0.04
37	5.2	27.04
45	13.2	174.24
15	-16.8	282.24
23	-8.8	77.44
26	-5.8	33.64
26	-5.8	33.64
39	7.2	51.84
40	8.2	67.24
$\mu = \frac{\sum_i^N X}{N} = \frac{318}{10}$=31.8	$\sum_{i=1}^{N}(x_i - \mu)^2$	757.6
$\sigma = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \mu)^2}{N-1}}$		$= \sqrt{\frac{757.6}{9}} = 9.17$

The standard deviation of the given population is 9.17. This indicates that the performance of learners in General Mathematics varies moderately from the average score. Test scores are somewhat scattered, meaning learners didn't perform identically. Some learners scored higher or lower than others.

A. Demonstration with Guided Hands-on Practice

1. Demonstrate how to organize data correctly in Microsoft Excel.
2. Model the formulas for computing the Range, IQR, Variance, and Standard Deviation.
3. Guide learners as they perform the same procedures on their own computers.
4. Demonstrate how to transfer the dataset into Jamovi and generate the same descriptive statistics.
5. Let learners compare the software-generated results with their manual computations.
6. Process the guide questions by interpreting the computed measures.

B. Verify the Variability Activity

1. Encode the given dataset in Microsoft Excel.
2. Compute the Range, IQR, Variance, and Standard Deviation using Excel formulas.
3. Enter the same dataset into Jamovi.
4. Generate descriptive statistics.
5. Compare the results from manual computation, Excel, and Jamovi.
6. Record observations and explain any differences.

C. Digital Statistics Lab

1. Let learners work in pairs or small groups.
2. Assign one learner to perform the computations in Excel while another uses Jamovi.
3. Compare the outputs from both applications.
4. Discuss which software is more efficient and why.
5. Present the group's findings to the class.

D. Find the Error Activity

1. Provide learners with a worksheet containing incorrect formulas or statistical computations.
2. Ask them to identify and correct the errors.
3. Explain why each correction is necessary.
4. Verify the corrected results using Microsoft Excel or Jamovi.

	Computation Process Using Open-Source Statistical Software Tools **A. MS Excel** Suppose there are 30 data points in a certain situation. Input the data in column A and rows 2 to 31 (i.e. cells A2 to A31). Cell A1 (column A, row 1) will be used for the name of the data. 1. **Range** Step 1: Click on an empty cell where you want the result to appear. Step 2: Type the formula: =MAX (A2:A31)-MIN (A2:A31) Step 3: Press Enter. The cell will display a range of data. 2. **Interquartile Range** Step 1: Click on an empty cell where you want the result to appear. Step 2: Type the formula: =QUARTILE (A2:A31,3)- QUARTILE (A2:A31,1) Step 3: Press Enter. The cell will display a range of data. 3. **Variance** Step 1: Enter the appropriate formula in the desired cell. ● For Sample Variance, type: =VAR.S(A2:A31) ● For Population Variance, type: =VAR.P(A2:A31) Step 2: Press Enter. The cell will display the variance results of the data. 4. **Standard Deviation** Step 1: Enter the appropriate formula in the desired cell. ● For Sample Standard Deviation, type: = STDEV.S (A2:A31) ● For Population Standard Deviation, type: = STDEV.P(A2:A31) Step 2: Press Enter. The cell will display the variance results of the data. **Note:** In most statistical software and calculator functions, *sample variance and sample standard deviation* are the default calculations.	5. Discuss common mistakes encountered when computing measures of variability.

B. JAMOVI

Before beginning the hands-on activity, your teacher will present a short tutorial video on Jamovi navigation. The demonstration will introduce the Jamovi interface and its key features, including the Data View, Variable Editor, Analyses tab, and Output Panel. This will help you become familiar with the software and prepare you to perform statistical computations with confidence.

Now, let's apply what you have learned using the following dataset.

The sample test scores of 10 Grade 11 learners in General Mathematics are: {35, 32, 37, 45, 15, 23, 26, 26, 39, 40}

Step 1. Prepare/input the data in MS Excel.

	A
1	Test Scores
2	35
3	32
4	37
5	45
6	15
7	23
8	26
9	26
10	39
11	40

Step 2. Select the data on test scores (e.g. cells A2:A11) and paste it into Jamovi.

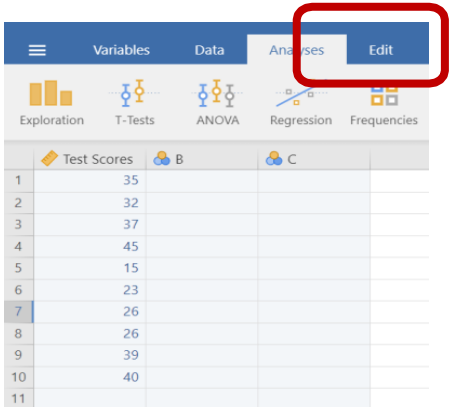
To rename a variable, double-click the column header (variable name) in the Data tab. This opens the "Variable Editor" where you can change the variable name, data type, and other properties. In this example, variable A renamed to **Test Scores**, measure type: **continuous**.



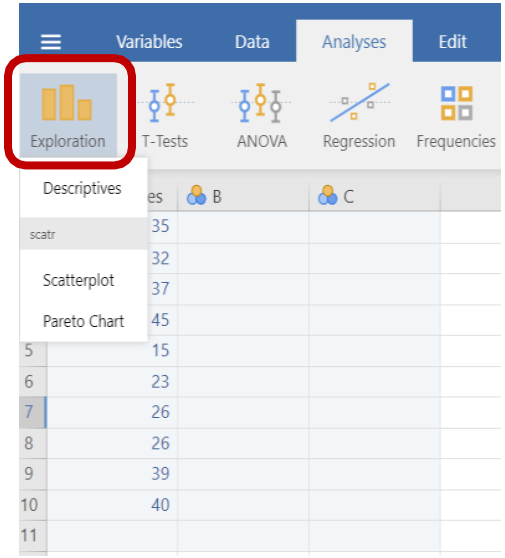


Step 3: Compute the range, interquartile range, variance, and standard deviation.

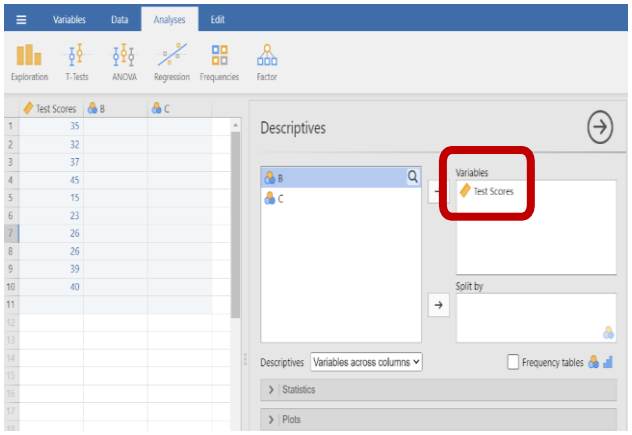
a. Click on the Analyses tab at the top.



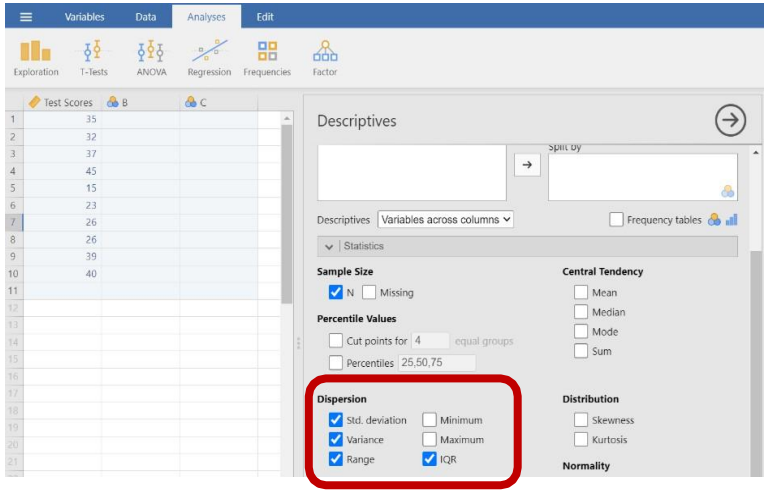
b. Under the Exploration tab, click Descriptive.



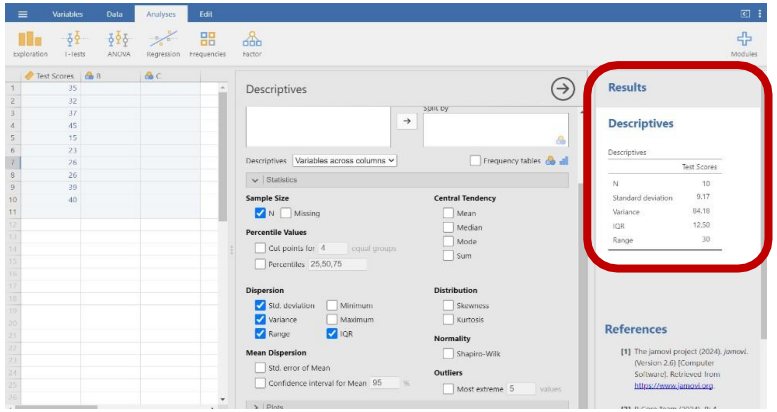
c. Move the variable (Test Scores) to the right panel under variables.



d. In the Statistics section, check the boxes for Range, IQR, Variance, and Standard Deviation.



e. The computed range, interquartile range, variance, and standard deviation of the given data set will automatically be displayed in the side panel.



	Processing Questions: 1. Which measure of variability is most appropriate when the dataset contains extreme values (outliers)? Why? 2. What does a large standard deviation tell you about a set of data? 3. How did Microsoft Excel or Jamovi help you compute and analyze the measures of variability?	
	B.3. Developing Mastery (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity B.3. Practicing Learned Skills **Reading Comprehension Integration** This activity integrates reading comprehension, mathematical reasoning, and digital literacy by engaging learners in a real-life classroom scenario involving the analysis of quiz results. Learners read a contextualized passage, identify essential information, compute the Range, Interquartile Range (IQR), Sample Variance, and Sample Standard Deviation using manual computation, Microsoft Excel, and Jamovi, and interpret the results to compare the consistency of learner performance in two Grade 11 sections. Let the learners answer the guide questions, which cover different levels of reading comprehension: ● **Literal Level** (Questions 1–3): Learners identify explicit information from the passage, such as the assessment administered, the sample size, the statistical measures to be computed, and the tools used in the activity. ● **Inference or Interpretation Level** (Questions 4–7): Learners interpret the meaning of the computed measures of variability by comparing the performance of the two sections. They explain why the class average alone cannot describe learner consistency and infer what the Range, IQR, Variance, and Standard Deviation reveal about the spread of the scores. ● **Knowledge Construction Level** (Question 8-10): Learners apply their understanding by evaluating the results obtained through manual computation, Microsoft Excel, and Jamovi. They justify which section demonstrates more consistent performance and explain how measures of variability can help teachers make instructional decisions, such as providing remediation or enrichment activities. Suggested teaching strategies are the following: **Data Analyst Team Strategy** 1. Divide the class into small groups and assign roles such as reader, recorder, calculator, encoder, and presenter. 2. Ask the reader to read the passage aloud while the group identifies important information needed to solve the problem. 3. Guide learners in completing the computations manually, then verify their answers using Microsoft Excel and Jamovi. 4. Let the group compare the measures of variability of Section A and Section B and discuss which section demonstrates more consistent with learner performance. 5. Ask the groups to answer the guide questions beginning with the Literal Level, followed by the Inference or Interpretation Level, and finally the Knowledge Construction Level. 6. Allow each group to present and justify their conclusions using the computed measures of variability.	

<table>
<tr><td></td><td colspan="2">Compare and Justify Strategy
1. Present the two sets of quiz scores and ask learners to predict which section is more consistent before performing any computations.
2. Guide learners in computing the measures of variability manually, then verify the results using Microsoft Excel and Jamovi.
3. Ask learners to compare the computed measures of variability of the two sections.
4. Encourage each group to justify its conclusion using statistical evidence rather than opinion.
5. Conduct a class discussion to compare the groups' interpretations and explain how variability provides information beyond the class average.
6. Conclude the activity by asking learners how measures of variability can help teachers make informed instructional decisions.

Think–Compute–Share Strategy
1. Allow learners to read the passage individually and answer the Literal Level questions.
2. Pair learners to compute the measures of variability manually and verify their answers using Microsoft Excel and Jamovi.
3. Ask each pair to compare the variability of the two sections and discuss their interpretations.
4. Invite pairs to share their findings with the class and explain the statistical evidence supporting their conclusions.
5. Facilitate a whole-class discussion on the importance of using measures of variability in analyzing learner performance.</td></tr>
<tr><td rowspan="2">C. Demonstrating Knowledge and Skills</td><td colspan="2">C.1. Finding Practical Application</td></tr>
<tr><td>Activity C.1. Making Real-World Connections

Investigating the Variations in Household Electricity Bills

Problem:
A certain electric cooperative wants to determine and analyze the variability in household electricity bills (in pesos) in one town to identify patterns in energy consumption. The collected data on the monthly electricity bills of 50 households are given below:
1550 1450 1350 1500 1800
750 1550 1200 1300 1200
2500 1500 1600 1700 1500
2500 3000 3500 4000 3500
2300 3400 2300 2450 2000
2000 2100 1250 1300 1100
950 850 800 900 950
1250 1300 1200 1500 850
875 900 1350 750 780
550 450 1230 600 3600</td><td>Activity C.1. Making Real-World Connections

Investigating the Variations in Household Electricity Bills

This activity allows learners to apply their understanding of measures of variability in a real-world context. By analyzing household electricity bills, learners use statistical tools to compute and interpret the Range, Interquartile Range (IQR), Variance, and Standard Deviation. Through collaborative data analysis, learners develop critical thinking, data literacy, and decision-making skills by explaining how variability can support informed decisions on electricity consumption and pricing.

The teacher may use any of the following strategies in delivering the activity.

Data Investigation Strategy
1. Divide the class into small groups and assign roles such as reader, encoder, calculator, recorder, and presenter.
2. Ask each group to examine the given household electricity bill data and identify the information needed to solve the problem.
3. Guide learners in entering the data into Microsoft Excel or Jamovi.</td></tr>
</table>

	Instructions: 1. Using available technology tools (e.g. MS Excel, Jamovi), input the data on the monthly electricity bills of 50 households. 2. Compute for the following measures of variability: a. Range b. Interquartile Range c. Variance d. Standard Deviation 3.Analyze and interpret the results 4. Answer the following questions: a. What patterns do you notice? Are household electricity bills clustered or spread out? b. Which measures of variability best captures stability and instability in the household electricity bills? c. How can variability inform better pricing structures for household electricity bills?	4. Let each group compute the Range, Interquartile Range (IQR), Variance, and Standard Deviation. 5. Encourage learners to interpret the computed values and discuss what they reveal about the variability of household electricity bills. 6. Allow each group to present their findings and justify their interpretations using statistical evidence. **Technology-Assisted Data Analysis** 1. Instruct learners to input the electricity bill data into Microsoft Excel or Jamovi. 2. Guide them in computing the measures of variability using the appropriate formulas or software commands. 3. Ask learners to compare the results generated by the software with their manual computations, if applicable. 4. Encourage learners to identify any differences and explain possible reasons. 5. Facilitate a discussion on how technology improves the efficiency and accuracy of statistical analysis. 6. Let learners answer the guide questions using the computed results.

5	6	3	9	5	7
4	10	8	6	6.5	7.5
8.5	9	7.5	6.5	5.5	4.5
9	8	7.5	7.5	8	10
9	3	4	4.5	5.5	10.5

C.2. Making Generalization

Activity C.2.: Wrapping-Up the Lesson **Rock-Paper-Scissors Reflections** *Instructions*: 1. Learners will reflect on their learning using Rock- Paper-Scissors metaphor to organize their thoughts. 2. Learners will write their answer on the reflection table: O Rock section- the most challenging part of the lesson (the concept that requires more effort to understand) O Paper section - the main idea or the key takeaway from the lesson O Scissors - less important details or extra information	**Activity C.2. Wrapping-Up the Lesson** **Rock–Paper–Scissors Reflections** Facilitates a reflective activity using the Rock–Paper–Scissors metaphor to help learners organize and synthesize their understanding of the lesson on measures of variability. The teacher instructs learners to complete the reflection table by identifying: Rock as the most challenging concept that requires further understanding, Paper as the key idea or most important learning gained from the lesson, and Scissors as supporting or less essential details. Learners are encouraged to provide specific and honest responses and explain their answers to deepen reflection and inform instructional support.

Reflection Area	Answer	Explanation
ROCK		
PAPER		
SCISSOR		

3. Be specific and honest. Your answer will help your teacher understand what stood out to you.

Traffic Light Reimagining

Instructions:
1. Think about what you learned, what you are pondering upon, and what you are struggling today related to measures of variability.
2. Learners will reflect on their comfort level with each measure and classify their understanding using:

Red Light - Need Help
I struggle with this concept and need further explanation.

Yellow Light - Somewhat Confident
I understand the basics but need more practice.

Green Light – Confident
I can explain it to a peer and apply it to different real-life situations.

3. Pair up with peers and compare your traffic light results.
4.Listen to how others connect the topic to their experiences.

Clear or Cloudy Exit Ticket

Instructions:
1. Learners will take a moment to complete the exit ticket:
-Clear (one concept or skill from today's lesson that you understand well)
-**Cloudy** (one concept or skill that is still confusing or unclear)

Traffic Light Reimagining

Guide learners in reflecting on their level of understanding of the measures of variability through the Traffic Light Reimagining activity. Learners classify their understanding using the traffic light system: Red Light for concepts needing further clarification, Yellow Light for concepts partially understood but requiring more practice, and Green Light for concepts they can confidently explain and apply. The teacher then encourages peer sharing and discussion to allow learners to compare insights, articulate their understanding, and learn from others' experiences and perspectives.

Clear or Cloudy Exit Ticket

Administers the Clear or Cloudy Exit Ticket as a closing reflective activity to assess learners' understanding of the lesson. Learners are instructed to identify one concept or skill they understand clearly (Clear) and one concept they still find confusing or challenging (Cloudy), along with a possible step or strategy (Ways Forward) to improve their understanding. The teacher emphasizes honest and specific responses to help guide future discussions, clarification, and review sessions.

c. **Advance learning**

For enrichment and additional practice, encourage learners to watch the assigned video tutorial at home to reinforce their understanding of measures of variability and the use of Jamovi in statistical analysis.

Recommended video: Measures of Variability in Jamovi – Video Tutorial
(learning:https://www.bing.com/videos/riverview/relatedvideo?q=variance%20in%20jamovi&mid=840B5349651D6B386A5F840B5349651D6B386A5F&ajaxhist=0)

2. Learners will write their answers on a piece of paper using the following template:

Name	Answer
Clear	*(Something you fully understand)*
Cloudly	*Something you need more practice or clarification on)*
Ways Forward	*(Step can you take to make your "cloudy" concept clearer)*

3. Be specific and honest. Your responses will help guide future discussions and review sessions

C.3. Evaluating Learning (For complete instructions, please refer to the Learning Activity Sheet.)

Activity C.3. Assessing Learning Outcomes

To facilitate this activity, the teacher may apply any of the following strategies.

Variability Group Collaboration

Instructions:

1. Divide the class into four groups. Assign each group with one scenario involving measures of variability. Ensure each group has access to available technology tools (e.g. MS Excel, Jamovi) to compute and visualize data.
2. Each group inputs the data in the available technology tools to compute the measures of variability.
3. Each group analyzes and interprets the results. Discuss insights within the group before presenting the findings.
4. Each group presents their output to the class. Encourage questions and feedback from the class
5. Teacher facilitates a synthesis on when each measure is best used and how to interpret the result. Summarize key takeaways for practical application of measures of variability.

Technology-driven Problem Solving

Instructions:

1. Learners select or are assigned one of the four problem sets.
2. Learners solve the problem using available technology tools (e.g., MS Excel, or Jamovi) computing for the given measures of variability.
3. While working or having independent exploration, ask questions or offer feedback to deepen their reasoning skills.
4. Learners analyze and interpret the results. Explain what the variability measures revealed by the data.
5. Compare results between the four problem sets and discuss real-world applications, which variability measure was most useful in each scenario.

	C.4. Additional Activities (For complete instructions, please refer to the Learning Activity Sheet.)
	Activity C.4. Enhancing the Skills on Measures of Variability This additional exercise may be given as an assignment or homework. Remediation should be provided to learners who have not yet achieved mastery of the lesson, while enrichment activities should be offered to those who are ready for further learning. The teacher may use any of the following strategies in delivering the activity. **A. Remediation Activities** **Compute and Interpret Activity** 1. Let learners solve the given problems individually or in pairs. 2. Guide learners in computing the Range, Interquartile Range (IQR), Variance, and Standard Deviation. 3. Ask learners to compare their answers with a partner. 4. Discuss the correct solutions and explain each computation. 5. Let learners interpret the meaning of the computed measures. 6. Provide immediate feedback and clarify misconceptions before proceeding to the next problem. **Step-by-Step Computation Activity** 1. Provide learners with partially completed solutions. 2. Ask them to complete the missing steps in the computation. 3. Discuss the purpose of each step. 4. Let learners solve a similar problem independently. 5. Review and process the answers as a class. **Pair-and-Coach Activity** 1. Pair learners who need additional support with classmates who have mastered the lesson. 2. Let partners compute the measures together. 3. Encourage peer coaching during the computation process. 4. Discuss the answers in a class. **B. Enrichment Activities** **Compare and Recommend Activity** 1. Divide learners into small groups. 2. Compute the Range, IQR, Variance, and Standard Deviation for each milk tea flavor. 3. Compare the variability of the three datasets. 4. Identify which flavor has the most and least consistent sales. 5. Recommend business strategies based on the results. 6. Present and justify the group's recommendations.

	Predict the Effect Activity 1. Compute the measures of variability of the original dataset. 2. Predict what will happen if: ● 5 is added to every observation. ● Every observation is multiplied by 2. 3. Verify the predictions through computation. 4. Discuss how data transformations affect measures of variability **Business Decision Challenge** 1. Assume you are the owner of the milk tea shop. 2. Analyze the sales variability. 3. Decide which flavor requires: ● more inventory, ● promotional strategies, ● production adjustments. 4. Support your recommendations using computed measures. 5. Share your conclusions with the class. **What-If Investigation** 1. Investigate how adding more days of sales data would affect the measures of variability. 2. Predict whether the Range, IQR, Variance, and Standard Deviation would increase, decrease, or remain the same. 3. Explain your reasoning. 4. Compare your predictions with those of your classmates.
V. ASSESSMENT	For the summative assessment and performance task, please refer to the Teacher's Notes, which can be accessed through the link in the Table of Contents.
VI. REFLECTION	For your reflection, you may use the Reflection Guide provided in the Teacher's Notes to help guide your responses.

Unit 8. Right and Oblique Triangles

I. LEARNING GOALS	
Content Standard	The learners demonstrate knowledge and understanding of basic trigonometry.
Performance Standard	By the end of the quarter, the learners are able to apply trigonometry and geometric concepts to estimate measurements and construct three-dimensional objects, understanding their shapes, and volumes for practical uses like product packaging, furniture and construction.
Learning Competencies	The learners… 1. illustrate the trigonometric ratios in a right-angled triangle using a real-life object or figure. 2. illustrate the area of oblique triangles (i.e Heron's Formula and the rule Area=½ abSinC.) 3. solve practical problems involving: a. right and oblique triangles b. angles of elevation and depression c. the use of bearings in navigation.
II. REFERENCES and MATERIALS	
Textbook and Modules	Bacani, J., et. al. *Pre-calculus book Grade 11.* Sunshine Interlinks Publishing House, Inc. 2016 Alferez, Merle. *MSA Trigonometry*, MSA Academic Advancement Institute, 2001. Weimerskirch, M., & Pride, S. (Eds.). (2022). *Trigonometry*. University of Minnesota Board of Regents. https://open.lib.umn.edu/trigonometry/ Moyer, E. *Schaum's Outline of Trigonometry*. McGraw Hill, 2018 Department of Education (DepEd). General Mathematics Learner's Material (SHS Core Subject) Department of Education (DepEd). Teaching Guide for General Mathematics (Senior High School) Baldor, A. (or any SHS-approved reference). Trigonometry and Analytic Geometry OpenStax. Precalculus Textbook (Trigonometry Sections) https://openstax.org/details/books/precalculus
Websites	https://www.claytonschools.net/cms/lib/MO01000419/Centricity/Domain/204/11_12chapter06.pdf https://coachgriffin.weebly.com/uploads/2/4/6/5/24656764/day_3_-_word_problem_hw_-_key.pdf [Chilimath. (n.d.). *Heron's formula.* https://www.chilimath.com/lessons/geometry-lessons/herons-formula-practice-problems-with-answers/ Cuemath. (n.d.). *Area of Right Triangle.* https://www.cuemath.com/measurement/area-of-right-triangle/ Cuemath. (n.d.). https://www.cuemath.com/measurement/area-of-triangle/ [https://www.jmap.org/Worksheets/G.MG.A.3.HeronsFormula.pdf Mathlobby. (n.d.) https://www.mathlobby.com/post/finding-the-area-of-a-triangle-using-1-2absinc Study.com (n.d.). https://study.com/skill/practice/finding-area-of-a-triangle-using-herons-formula-questions.html Peterson, D., *Solving an Oblique Triangle Part I.* (2020, March) Retrieved May 26, 2026, from https://www.themathdoctors.org/solving-an-oblique-triangle-part-i/

	OpenStax. *Algebra and Trigonometry* (2012). Retrieved May 26, 2026, from https://openstax.org/books/algebra-and-trigonometry/pages/10-key-concepts Oblique Triangle Application. (2024, March) Retrieved May 26, 2026, from https://www.cliffsnotes.com/study-notes/6258008 Hughes,B. et. al, CK-12 Trigonometry Concepts (2026, May 02) Retrieved May 26, 2026 from https://flexbooks.ck12.org/cbook/ck-12-trigonometry-concepts/section/5.5/primary/lesson/herons-formula-trig
Video Lessons	https://www.youtube.com/watch?v=ljxkJHplMZU https://www.youtube.com/watch?v=n4BEwESmzQw https://www.youtube.com/watch?v=AyiRdl38aT4 https://www.youtube.com/watch?v=U74R8j4QFMA https://study.com/academy/lesson/video/angles-of-elevation-depression-practice-problems.html https://www.youtube.com/watch?v=uyKvSe6Ltgs https://www.youtube.com/watch?v=ndCmnpoP76M https://www.youtube.com/watch?v=Z1A4fNfSfXM https://www.youtube.com/watch?v=cSKAqfGXOPI https://www.youtube.com/watch?v=TfrUy3fbgII https://www.youtube.com/watch?v=vPt6j5e_uhE https://www.youtube.com/watch?v=J8f18nWaIHE
Materials and EdTech	**Materials** ● Protractor ● Calculator ● Measuring tape ● Clinometer ● Worksheets ● LED screen ● Cellphone ● Tablet ● Laptop **Application Software** ● GeoGebra. *GeoGebra Graphing Calculator*. Geogebra, https://www.geogebra.org/graphing. Accessed 2 October 2024. ● CANVA PowerPoint: https://canva.link/fnxjdpy0jnnxikv ● Spreadsheet or Microsoft Excel ● GeoGebra Activity Link: https://www.geogebra.org/m/vmkw7zpu/preview ● Padlet Reflection: https://padlet.com/maamcampos28/trigonometric-ratios-wrapping-up-drr3fw0wirn7qb4u
AI Declaration	AI was utilized to rephrase, organize, and refine the lesson content, ensuring that the educational objectives and pedagogical strategies aligned with the standardized lesson exemplar.

<table>
<tr><td>III. CONTENT</td><td colspan="2">Lesson 8.1. Trigonometric Ratios in a Right-Angled Triangle Using a Real-Life Object or Figure</td></tr>
<tr><td>IV. OBJECTIVES</td><td colspan="2">At the end of the lesson, the learners are able to:
1. define the six trigonometric ratios (sine, cosine, tangent, cosecant, secant, cotangent) in terms of the sides of a right triangle;
2. illustrate the trigonometric ratios using real-life objects or figures that form right triangles; and
3. apply trigonometric ratios to solve practical problems involving right triangles.</td></tr>
<tr><td>V. PROCEDURES</td><td>LEARNERS ACTIVITIES</td><td>ANNOTATION</td></tr>
<tr><td rowspan="2">A. Activating Prior Knowledge</td><td colspan="2">A.1. Eliciting Prior Knowledge</td></tr>
<tr><td>Activity A.1. Leveling Learners Readiness

Activity A.1.1. Quick Sketch
Instructions:
1. On a sheet of paper or in your notebook, draw a right triangle.
2. Choose one acute angle (either of the two smaller angles).
3. Label the sides of the triangle relative to your reference angle:
● Hypotenuse – the longest side, opposite the right angle.
● Opposite side – the side directly across from the reference angle.
● Adjacent side – the side next to the reference angle (but not the hypotenuse).
4. Check that all three sides are properly labeled.
5. Compare your sketch with a partner or groupmate and discuss any differences in labeling.

A.1.2. Digital Navigation Using Geogebra

Instructions:
Step 1: Open the GeoGebra Activity
● Open the provided GeoGebra link using your smartphone, tablet, or laptop.
● Explore the interactive right triangle shown on the screen.
Step 2: Observe the Triangle
● Identify the right angle in the triangle.
● Choose one acute angle (θ) as your reference angle.
Step 3: Identify and Label the Sides
Using the GeoGebra activity, determine the following relative to angle θ:</td><td>Activity A.1. Leveling Learners Readiness

Activity A.1.1. Quick Sketch

Learners will develop a conceptual understanding of trigonometric side relationships by constructing and labeling their own diagram of a right triangle.

Instructions:
1. Ask the learners to prepare materials:
2. Present the task and guide learners.
3. Facilitate a brief discussion using the reflection questions.

A.1.2. Digital Navigation Using Geogebra

Learners will develop a conceptual understanding of trigonometric side relationships by exploring and labeling parts of a right triangle using a GeoGebra interactive activity.

Instructions:
Before the Activity
● Test the GeoGebra link before class.
● Ensure learners have internet access and devices.
● Prepare a digital or printed activity sheet for responses.</td></tr>
</table>

	● Hypotenuse ● Opposite Side ● Adjacent Side **Step 4: Manipulate the Triangle** ● Drag the points or sliders in the activity. ● Observe how the triangle changes shape and size. ● Notice how the hypotenuse remains the same relative to the right angle while the opposite and adjacent sides depend on the chosen angle. **Step 5: Record Your Observations** Complete the digital activity sheet or notebook with: ● The identified sides ● Observations about changes in the triangle ● Answers to the reflection questions **Step 6: Pair or Group Discussion** Discuss your observations with a partner or groupmate: ● Did your labels match? ● What changed when the angle changed? ● What remained constant? *Processing Questions:* 1. How did you determine which side the hypotenuse was? 2. What is the difference between the opposite and adjacent sides? 3. Why is it important to identify sides relative to the chosen angle? 4. How do these sides relate to the trigonometric ratios' sine, cosine, and tangent?	**During the Activity** ● Guide learners in navigating the GeoGebra interface. ● Encourage learners to manipulate the triangle multiple times. ● Ask guiding questions to deepen understanding. **Assessment Suggestions** Evaluate learners based on: ● Correct identification of triangle sides ● Participation in the activity ● Quality of observations and explanations ● Understanding of trigonometric relationships GeoGebra Activity Link: https://www.geogebra.org/m/vmkw7zpu/preview
	A.2. Establishing the Purpose of the Lesson	
	Activity A. 2. Appreciating Lesson Relevance **Option 1.** **Discovering Trigonometric Ratios in Real-Life Triangles** *Instructions: (Option 1)* 1. Form small groups (2–3 members). 2. Study the given real-life scenarios:	**Activity A.2. Appreciating Lesson Relevance** **Option 1.** **Discovering Trigonometric Ratios in Real-Life Triangle** In this activity, learners will explore how trigonometric ratios (sine, cosine, and tangent) apply to real-life situations.

a. A 5-meter ladder is leaning against a vertical wall. The base of the ladder is 3 meters away from the wall.
b. A flagpole stands upright on level ground. At a certain time of the day, it casts a shadow on the ground.
c. A child is flying a kite. The kite string is stretched tightly and forms an angle with the ground.

3. Draw the right triangle for each scenario and label the sides relative to the chosen angle θ as:
   - Opposite (O)
   - Adjacent (A)
   - Hypotenuse (H)
4. Measure or assign values (your teacher may provide measurements, or you may assume reasonable ones).
5. Calculate the following ratios for each triangle:
   - Opposite ÷ Hypotenuse (O/H)
   - Adjacent ÷ Hypotenuse (A/H)
   - Opposite ÷ Adjacent (O/A)
6. Complete the activity table:

Scenario	Opposite Side	Adjacent Side	Hypotenuse	O/H	A/H	O/A
Ladder						
Flagpole						
Kite						

Processing Questions:

1. What do you notice about the ratios when the angle or triangle changes?
2. Which real-life situation gave the largest tangent ratio? Why?
3. How are the sine, cosine, and tangent ratios related to the sides of the triangle?
4. How can you use these ratios to solve real-world measurement problems?

Instructions:

1. Ask the learners to prepare the necessary materials.
2. Present the task and guide the learners in accomplishing it.
3. Facilitate a brief discussion using the reflection questions.
4. Explain that the activity serves as an application of the lesson in real-life situations.
5. Emphasize that the skills learned in this lesson will be used in the performance task.
6. Present the performance task to the learners.

	Option 2 **Discovering Trigonometric Ratios in Real-Life Triangles** **(Integration of Literacy and EdTech Using Canva)** *Instructions*: **Step 1: Form Small Groups** ● Form groups with 2–3 members. ● Assign roles: o Researcher o Recorder o Designer/Presenter **Step 2: Analyze the Real-Life Situations** Study the following situations: ● A ladder leaning against a wall ● A flagpole casting a shadow ● A kite flying with a string **Reading Literacy Focus** ● Carefully read and analyze each situation. ● Identify how each example forms a right triangle. **Step 3: Create the Triangle in Canva** Using Canva: ● Draw or insert a right triangle for each scenario. ● Label the following relative to angle θ: o Opposite Side (O) o Adjacent Side (A) o Hypotenuse (H) **Digital Literacy Focus** ● Use Canva shapes, lines, text boxes, and labels properly. ● Organize visuals clearly and creatively. **Mathematical Literacy Focus** ● Interpret the meaning of each ratio in the real-life situation. ● Compare how the ratios differ among the scenarios.	**Option 2** **Discovering Trigonometric Ratios in Real-Life Triangles** **(Integration of Literacy and EdTech Using Canva)** Learners will explore how trigonometric ratios (sine, cosine, and tangent) apply in real-life situations while developing mathematical, digital, reading, and communication literacy using digital presentation tools. *Notes for Teachers*: **Before the Activity** ● Prepare a Canva template or sample output. ● Ensure learners have access to devices and internet connection. ● Demonstrate basic Canva tools such as shapes, text boxes, and tables. **During the Activity** ● Guide learners in identifying triangle sides correctly. ● Encourage collaboration and creativity. ● Monitor learners' participation and digital engagement. **Teacher's Role** ● Facilitate discussion and reflection. ● Provide technical assistance when needed. ● Encourage learners to explain mathematical relationships clearly. **Assessment Suggestions** Assess learners based on: ● Accuracy of triangle labeling ● Correct computation of trigonometric ratios ● Clarity and creativity of Canva presentation ● Demonstration of literacy skills ● Collaboration and participation https://canva.link/real-life-application-trigo-ratio

Step 6: Complete the Digital Activity Table in Canva

Scenario	Opposite Side	Adjacent Side	Hypotenuse	O/H	A/H	O/A
Ladder						
Flagpole						
Kite						

Step 7: Create a Digital Presentation
In Canva, include:

- Drawings of the triangles
- Measurements and ratios
- Explanations of observations
- Real-life applications of trigonometric ratios

Communication Literacy Focus

- Present mathematical ideas clearly and confidently.
- Use correct mathematical terms during reporting.

Processing Questions:

1. What do you notice about the ratios when the angle or triangle changes?
2. Which real-life situation gave the largest tangent ratio? Why?
3. How are the sine, cosine, and tangent ratios related to the sides of the triangle?
4. How can these ratios help solve real-world problems?
5. How did Canva help you understand and present the lesson better?

SCAN ME

B. Instituting New Knowledge

B.1. Presenting Examples

Activity B.1 Exploring Key Concepts

Measuring and Calculating Ratios in Right Triangles

Materials:

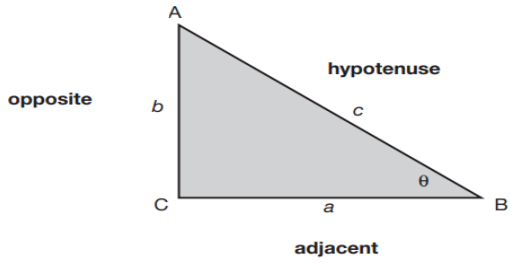
- Ruler or tape measure
- Protractor

Activity B.1 Exploring Key Concepts

Measuring and Calculating Ratios in Right Triangles

Learners will develop a conceptual understanding of trigonometric side relationships by constructing and labeling their own diagram of a right triangle.

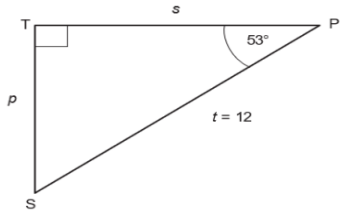
	● Right triangle cut-outs (paper, cardboard, or drawn on the board) of different sizes ● Calculator ● Activity sheet *Instructions*: 1. Form groups of 3–4. ● Each group will be given at least two right triangles of different sizes. 2. Identify the parts of the triangle: ● Choose one acute angle θ in the triangle. ● Label the sides relative to θ as Opposite, Adjacent, and Hypotenuse. 3. Measure the sides: ● Use a ruler/tape measure to find the lengths of the three sides of the triangle. ● Record your measurements in the activity sheet. ● Calculate the ratios using a calculator: 4. Compute: a. Opposite ÷ Hypotenuse b. Adjacent ÷ Hypotenuse c. Opposite ÷ Adjacent 5. Spreadsheet Integration ● Encode the measurements in Microsoft Excel or Google Sheets. ● Use formulas to automatically calculate ratios. Example: ● `=A2/C2` for Opposite ÷ Hypotenuse ● `=B2/C2` for Adjacent ÷ Hypotenuse ● `=A2/B2` for Opposite ÷ Adjacent 6. Check consistency: ● Use a protractor to measure angle θ. ● Compare your calculated ratios 7. Discuss: ● Are the values or measurements almost equal? ● Why is there a slight difference in their measurements?	*Instructions***:** 1. Ask the learners to prepare the materials. 2. Present the activity and guide learners in performing the task. Apply any of the following strategies: *Strategy 1:* **Hands-on Measurement and Discovery Activity** Learners actively explore the relationship between the sides and angles of right triangles by measuring and computing trigonometric ratios. This promotes conceptual understanding of sine, cosine, and tangent as consistent ratios in similar triangles. *Strategy 2:* **Discovery Approach** Learners are guided to discover the concept of trigonometric ratios (sine, cosine, and tangent) through measurement, observation, and analysis of right triangles. Instead of being told the formulas, they infer the consistent relationships between side ratios and angles through hands-on exploration and discussion *Strategy 3:* **Technology-Enhanced Collaborative Learning** Learners collaborate using shared spreadsheets and interactive simulations. This promotes digital literacy, teamwork, and mathematical reasoning. 3. Call a representative from each group to present their output and explain their observations. 4. Wrap up the activity by facilitating the reflection questions.

	8. Presentation: A representative from each group will present: ● Their measurements ● Computed ratios ● Observations using the EdTech tool *Processing Questions*: 1. What did you notice about the ratios of sides for triangles that have the same acute angle? 2. How do these ratios relate to the trigonometric functions' sine, cosine, and tangent? 3. Why do small differences in measurement occur when calculating ratios? 4. How does this activity help you understand trigonometric ratios better?	
	B.2. Discussing the Concept	
	Activity B.2. Deepening Conceptual Understanding **Re-building the Concept of Six Trigonometric Ratios** *Instructions*: To summarize and establish what you have learned from the previous activities, listen to and participate in the discussions. In a right triangle, we can define six trigonometric ratios. Consider the right triangle of ABC below. In this triangle we let θ represent ∠B. Then the leg denoted by a is the side adjacent to θ, and the leg denoted by b is the side opposite to θ.  	**Activity B.2. Deepening Conceptual Understanding** **Re-building the Concept of Six Trigonometric Ratios** *Instructions*: In discussing the concept of trigonometric functions, you can do the following: **1. Setting the Context** ● Begin by reminding learners of the triangles they measured and the ratios they computed. Say: "Earlier, you worked with opposite/hypotenuse, adjacent/hypotenuse, and opposite/adjacent. These are just three of six possible ratios in a right triangle." ● Emphasize the naming convention: Angles = capital letters (A, B, C), sides opposite them = lowercase (a, b, c). This builds mathematical discipline in notation. **2. Introducing the First Three Ratios (Primary)** ● Write sin θ, cos θ, tan θ clearly with their definitions. ● Use SOH-CAH-TOA as a mnemonic. Say: "Think: Sine = Opposite over Hypotenuse (SOH), Cosine = Adjacent over Hypotenuse (CAH), Tangent = Opposite over Adjacent (TOA)."

	We will use the convention that angles are symbolized by capital letters, while the side opposite each angle will carry the same letter symbol, in lowercase. $$sin\ of\ \theta = sin\ \theta = \frac{opposite}{hypotenuse}$$ $$cos\ of\ \theta = \theta = \frac{adjacent}{hypotenuse}$$ $$tan\ of\ \theta = tan\ \theta = \frac{opposite}{adjacent}$$ $$\text{csc}\ of\ \theta = csc\ \theta = \frac{hypotenuse}{opposite}$$ $$sec\ of\ \theta = sec\ \theta = \frac{hypotenuse}{adjacent}$$ $$\text{cot}\ of\ \theta = cot\ \theta = \frac{adjacent}{opposite}$$ SOH-CAH-TOA is a mnemonic used for remembering the equations. Notice that the three new ratios at the right are reciprocals of the ratios on the left. Applying algebra shows the connection between these functions. $$csc\ \theta = \frac{hypotenuse}{opposite} = \frac{1}{\frac{opposite}{hypotenuse}} = \frac{1}{sin\ \theta}$$ $$sec\ \theta = \frac{hypotenuse}{adjacent} = \frac{1}{\frac{adajacent}{hypotenuse}} = \frac{1}{cos\ \theta}$$ $$cot\ \theta = \frac{adajacent}{opposite} = \frac{1}{\frac{opposite}{opposite}} = \frac{1}{tan\ \theta}$$	● Reinforce by pointing to a triangle drawing on the board and labeling sides relative to θ. **3. Extending to the Other Three Ratios (Reciprocals)** ● Introduce csc θ, sec θ, cot θ as reciprocals. ● Stress that they are not new ratios but simply the inverse forms of sin, cos, and tan. ● Use algebra step-by-step to show how csc θ = 1/sin θ, sec θ = 1/cos θ, cot θ = 1/tan θ. **4. Highlighting Connections** ● Point out patterns: ➢ "Every trigonometric function has a reciprocal." ➢ "When sin theta is small, csc theta is large, and vice versa." ● This helps learners understand why calculators sometimes show very large values for reciprocal functions. **5. Common Misconceptions to Address** ● Learners often confuse opposite vs. adjacent. Remind them that these depend on the chosen angle. ● Some may think csc θ, sec θ, cot θ are completely different functions. Clarify that they are just reciprocals of the first three. ● Learners might forget that the hypotenuse never changes—it's always opposite the right angle. **6. Teaching Tips** ● Visual Aid: Keep a labeled triangle (ABC) on the board throughout the discussion. ● Memory Aid: Use SOH-CAH-TOA chant as a class activity. ● Reinforcement: After presenting the reciprocals, ask learners to pair each function with its reciprocal partner (sin ↔ csc, cos ↔ sec, tan ↔ cot). ● Extension: Challenge learners to compute both sin θ and csc θ for an angle to confirm they are reciprocal. **7. Closure** ● Summarize by saying: "We now have six trigonometric ratios. Three are primary (sin θ, cos θ, tan θ), and three are their reciprocals (csc, sec, cot). These ratios let us connect

Showing a formula for the Missing Parts of a Right Triangle

Example 1: Determine the equation or formula to find a missing part of the triangle.



a. Solve s in figure 1 above.
Solution: ∠P is an acute angle, t is the hypotenuse, s is the side adjacent to ∠P. Use CAH, that is

$$cos\ \theta = \frac{adajacent}{hypotenuse}$$

$$cos\ P = \frac{s}{t}$$

$$cos\ 53° = \frac{s}{t} = \frac{s}{12}$$

$$s = 12\ cos\ 53°$$

By using scientific calculator, key in 12 cos 53°

s = 7.2218

b. Solve for p in the figure above.
Solution: ∠P is an acute angle, t is the hypotenuse, s is the side adjacent to ∠P.
Use SOH, that is

$$sin\ \theta = \frac{opposite}{hypotenuse}$$

$$P = \frac{p}{t}$$

$$sin\ 53° = \frac{p}{t} = \frac{p}{12}$$

$$s = 12\ sin\ 53°$$

By using scientific calculator, key in 12 sin 53°

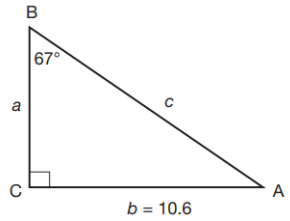
s = 9.5836

angles and sides of any right triangle—and they're the foundation for solving real-world problems."

Note:

1. *Teach the learners using their scientific calculators.*
2. *Provide additional examples if necessary.*

c. Solve for a in the figure below:



Solution: ∠B is an acute angle, b is the opposite side, and a is the side adjacent to ∠B. Use TOA, that is

$$\theta = \frac{opposite}{adjacent} = \frac{b}{a}$$

$$B = \frac{10.6}{a}$$

$$tan\ 67\ ° = \frac{10.6}{a}$$

$$a = \frac{10.6}{tan\ 67°}$$

By using scientific calculator, key in 10.6 divided by tan 67°

a = 4.4994

$a \approx 4.5$ (a is approximately 4.5)

d. Solve for c in figure above.

Solution: ∠B is an acute angle, b is the opposite side and c is the hypotenuse of the given acute angle.

Use SOH, that is

$$sin\ \theta = \frac{opposite}{hypotenuse}$$

$$B = \frac{b}{c}$$

$$sin\ 67° = \frac{10.6}{c}$$

$$c\ sin\ 67° = 10.6$$

$$c\ sin\ 67° = 10.6$$

$$c = \frac{10.6}{sin\ 67°}$$

	By using scientific calculator, key in 10.6 divided by sin 67° $c = 11.5154$ $c \approx 11.52$ (c is approximately 11. 52) *Example 2*: Using the Calculator to Find Trigonometric Ratios As presented in the previous sections, the values of the trigonometric ratios for any angle are constant, regardless of the length of the sides. These values can also be found using a calculator. Also, you can use a calculator to find an angle when you are given a trigonometric ratio. a. Finding a ratio given the angle *Example 3*: To find the value of sin 38°, ensure that your calculator is operating in degrees. *Solution:* Press sin 38 = 0.615661475 The calculator should give sin 38° = 0.616, correct to three decimal places. b. Finding an angle given the ratio In finding the size of the angle to the nearest minute, given the value of the trigonometric ratio, just follow the steps in the examples below. *Example 4*: sin θ = 0.725, find θ to the nearest minute *Solution*: Press 2ndF sin 0.725 = 46.46884783 To convert this to degrees/minutes/seconds mode, Press 2ndF D°M'S The calculator gives you 46° 28' (nearest minute) c. Degrees and minutes So far, all angles have been to whole degrees. However, one degree can be divided equally into 60 minutes. Further, one minute can be divided equally into 60 seconds. Angle measurement can also be	

expressed in degree/minutes form. We can use a calculator to convert a degree measure from decimal form to degree, minute, and second form.

Example 5: Write 54.46° in degrees and minutes, giving an answer correct to the nearest minute.

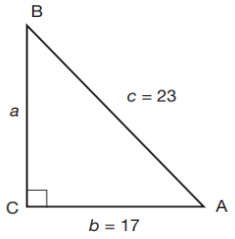
Solution: Press 54.46° 2ndF D°M'S

The calculator gives 54°27'36", or 54°28'. (nearest minute)

In solving the right triangles, it means finding the remaining parts. The following are the conditions for the given parts of right triangles:
Example 6: Triangle BCA is right-angled at C. If c = 23 and b = 17, find ∠A, ∠B and a. Express your answers up to two decimal places.

The is solving a right triangle given the measure of the two parts: the length of the hypotenuse and the length of one leg.

Solution:
Sketch the figure:
a. Side b is the adjacent side of ∠A; c is the hypotenuse of right triangle BCA. Use CAH, that is



$$cos\ cos\ \theta = \frac{adjacent}{hypotenuse}$$

$$cos\ A = \frac{b}{c}$$

$$cos\ A = \frac{17}{23}$$

$$cos\ A = 0.7391$$

Use a scientific calculator to find an angle whose cosine value is 0.7391. Using a scientific calculator, A = 42.340°

b. Since in part (a), it was already found that ∠A = 42.34°, then

∠B = 90° – 42.34°

∠B = 47.66°

<table>
<tr><td></td><td colspan="2">c. Using the Pythagorean theorem:
$a^2 + b^2 = c^2$
$a^2 + (17)^2 = (23)^2$
$a^2 + 289 = 529$
$a^2 = 529 - 289$
$a^2 = 240$
$a = \sqrt{240}$
$a = 15.49$</td></tr>
<tr><td></td><td colspan="2">B.3. Developing Mastery (For complete instructions, please refer to the Learning Activity Sheet.)</td></tr>
<tr><td></td><td colspan="2">Activity B.3. Practicing Learned Skills

Practicing Your Skills in Trigonometric Ratios

This activity will help learners to better understand evaluating trigonometric ratios. This can be done by individual, pair, or group. After accomplishing the activity, allow the learners to present their work. Wrap-up the activity by asking the reflection questions.</td></tr>
<tr><td>C. Demonstrating Knowledge and Skills</td><td colspan="2">C.1. Finding Practical Application</td></tr>
<tr><td></td><td>Activity C.1. Making Real-World Connections

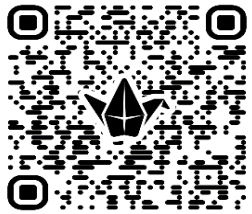
Estimating the Height Using Trigonometric Ratios
Instructions:
1. Form a group of 5 members.
2. Prepare the materials:
● Protractor (or smartphone with angle-measuring app)
● Measuring tape
● String or stick (to help sight the angle)
● Calculator
3. Stand a known distance (e.g., 10 meters) from the base of the tree or flagpole.
4. Use the protractor to measure the angle of elevation from your eye level to the top of the tree.
5. Record your eye-level height (e.g., 1.6 meters).
6. Use appropriate trigonometric ratio, to find the height of the tree.
7. Answer the following questions:
● Which trigonometric ratio did you use to solve this problem, and why?
● How does the angle of elevation affect the height of the kite?
● What real-life factors could make your calculation slightly different from the actual height?</td><td>Activity C.1. Making Real-World Connections

Estimating the Height Using Trigonometric Ratios

In this activity, learners will apply the trigonometric ratios to measure the height of a real object using indirect measurement. This hands-on activity connects trigonometric concepts with real-world observation and measurement. To facilitate, follow the suggested steps provided.
1. Present the activity.
2. Ask learners to form groups.
3. Distribute the task sheet.
4. Ask learners to prepare the materials.
5. Guide learners in performing the task.
6. Facilitate the presentation to be followed by reflection questions:</td></tr>
</table>

	In what other real-life situations can you use the same trigonometric principle?	
	C.2. Making Generalization	
	Activity C.2. Wrapping-Up the Lesson **What Have I Discovered** *Instructions*: Answer the following questions to summarize what you have learned from the lesson. Write your answers neatly and completely. 1. In your own words, how would you define trigonometric ratios? 2. Why do we use sine, cosine, and tangent in solving the right triangles? 3. How can trigonometric ratios be applied in real-life situations? Give one example. 4. Complete the statement below: "I realized that trigonometric ratios are important because _____." **Padlet Integration:** In this activity, you will reflect on what you have learned about trigonometric ratios and share your ideas using **Padlet**. **Step 1: Access the Padlet Link** ● Open the Padlet link provided by your teacher using your phone, tablet, or computer. **Step 2: Create Your Post** ● Click the **"+" (Add Post)** button. ● Write your answers to the following guide questions: 1. In your own words, how would you define trigonometric ratios? 2. Why do we use sine, cosine, and tangent in solving the right triangles? 3. How can trigonometric ratios be applied in real-life situations? Give one example. 4. Complete the statement: *"I realized that trigonometric ratios are important because _____."*	**Activity C.2. Wrapping-Up the Lesson** **What Have I Discovered** This activity allows learners to reflect on and summarize what they have learned about trigonometric ratios and their applications. It promotes conceptual understanding and encourages learners to express their learning in their own words. By answering open-ended questions, learners summarize key ideas, recognize the purpose of sine, cosine, and tangent in solving right triangles, and identify practical applications of trigonometry in everyday life (such as measuring heights, distances, or angles). This reflective generalization fosters critical thinking, self-awareness, and retention of concepts, preparing learners for higher mathematical applications. **Note to Teacher:** Encourage learners to share their reflections aloud after writing. Use this activity to assess their understanding of both the *conceptual meaning* and *practical applications* of trigonometric ratios. Connect their answers to the next topic or performance task for continuity of learning. **Teacher's Guide: Using Padlet for Reflection Activity** **Before the Activity** ● Create a Padlet board (use *Wall* or *Stream format*). ● Title it: **"Activity C.2: What Have I Discovered – Trigonometric Ratios"** ● Set privacy settings (e.g., "Secret" or "School only" depending on school policy).

	Step 3: Post Your Reflection
	● Make sure your answers are clear, complete, and written in your own words.
	● You may add emojis, images, or diagrams to support your explanation (optional).
	Step 4: Respond to Classmates
	● Read at least **two posts** from your classmates.
	● Give a short and respectful comment such as:
	  ○ "I agree because…"
	  ○ "I learned from your example that…"
	  ○ "Your explanation helped me understand…"
		● Enable:
		  ○ Comments (for peer feedback)
		  ○ Attachments (optional for images/diagrams)
		● Copy and share the Padlet link with learners (via LMS, Messenger, or printed QR code).
		During the Activity
		● Guide learners on how to access and post on Padlet.
		● Demonstrate how to:
		  ○ Create a post
		  ○ Edit text
		  ○ Add comments to classmates
		● Remind learners to use:
		  ○ Clear and respectful language
		  ○ Correct mathematical terms
		● Monitor posts in real time and give immediate feedback if needed.
		After the Activity
		● Review learner responses to assess understanding of:
		  ○ Meaning of trigonometric ratios
		  ○ Application in real life
		  ○ Conceptual clarity
		● Highlight strong student answers during class discussion.
		● Address common misconceptions.
		Assessment Focus
		Evaluate learners based on:
		● Completeness of responses
		● Correct understanding of concepts
		● Clarity of explanation
		● Quality of peer interaction
		● Proper use of digital platform
		Teacher Note
		Use this Padlet activity as a **formative assessment tool** and bridge it to the next lesson or performance task to strengthen conceptual continuity in trigonometry.

		Sample Padlet Activity: https://padlet.com/maamcampos28/trigonometric-ratios-wrapping-up-drr3fw0wirn7qb4u 
	C.3. Evaluating Learning (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity C.3: Assessing Learning Outcomes **Checking Understanding on Trigonometric Ratios** At this point, you will assess learners' understanding and application of trigonometric ratios in solving right triangles and real-life problems. To facilitate this activity, follow the instructions below: 1. Introduce the activity by explaining that learners will work independently to apply trigonometric ratios in solving right triangles and related real-life problems. 2. Ensure that learners understand the task directions and have access to all required materials, including calculators and worksheets. 3. Remind learners to identify the reference angle and label the triangle sides correctly as opposite, adjacent, and hypotenuse. 4. Instruct learners to choose and apply the appropriate trigonometric ratio or the Pythagorean theorem based on the given information. 5. Remind them to perform step-by-step solutions and to check their calculator settings (degree mode and rounding). 6. Encourage learners to visualize or sketch each problem to aid in identifying sides and angles. 7. Direct learners to verify the reasonableness of their answers, ensuring that the hypotenuse is the longest side and that angle measures are consistent. 8. Remind them to include correct units (e.g., meters, degrees) in their final answers. 9. Allow learners to explore alternative methods or verify results using another trigonometric ratio. 10. Facilitate the activity by monitoring silently, ensuring focus, and collecting outputs for checking and discussion afterward. 11. Synthesize the activity by asking reflection questions.	

	C.4. Additional Activities (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity C.4. Extending and Reinforcing Learning **More Problems on Trigonometric Ratios** These trigonometry activities are designed to help learners apply sine, cosine, and tangent ratios to solve real-life problems involving right triangles. The remediation tasks focus on reinforcing foundational skills in identifying sides, selecting the correct ratio, and calculating missing sides or angles, while the enhancement tasks challenge learners to apply trigonometric concepts in more complex, multi-step scenarios. Through these activities, learners develop problem-solving skills, logical reasoning, and the ability to relate trigonometric principles to practical situations. For learners needing remediation, give problems 1–5, and for those needing enhancement, give problems 6–10. *Notes for Teachers*: **Remediation Group** ● Provide guided examples and scaffolding. ● Review triangle side identification. ● Allow calculator-assisted practice. **Enhancement Group** ● Encourage independent analysis and reasoning. ● Promote technology integration and presentation of solutions. ● Challenge learners with real-world applications.	
III. CONTENT	**Lesson 8.2. Area of Oblique Triangles**	
IV. OBJECTIVES	At the end of the lesson, learners should be able to: 1. illustrate an oblique triangle. 2. compute area of oblique triangles using Heron's Formula and the rule $Area = \frac{1}{2}absinC$ 3. solve problems involving the area of oblique triangles.	
V. PROCEDURES	**LEARNERS ACTIVITIES**	**ANNOTATION**
A. Activating Prior Knowledge	*A.1. Eliciting Prior Knowledge*	
	Activity A.1. Leveling Learners Readiness *Instructions:* 1. Observe the different triangles presented by your teacher carefully. Take note of their side lengths and angles.	**Activity A.1. Leveling Learners Readiness** This activity will determine learners' prior understanding of triangle properties and their existing knowledge of finding the area of triangles, especially right triangles.

	2. Identify and clearly label the parts of each triangle on your worksheet, including the base, height, sides, and included angle. 3. Recall the formula for finding the area of a right triangle and write it on your paper: $$A = \frac{1}{2}bh$$ 4. Determine which side represents the base and which represents the height in each given triangle. 5. Using the given measurements, compute the area of each right triangle step by step, showing complete solutions. 6. Write your final answer with the correct unit (square centimeters or square meters). 7. Be ready to compare your answers with your classmates and explain how you identified the base and height. *Processing Questions:* 1. What will you do if the triangle is not a right triangle? 2. Can you still find its area? Explain your answer.	Materials: - Paper or worksheet with triangle drawings - Ruler and calculator - Protractor (optional for angle identification) To facilitate this activity, the teacher may apply one of the following strategies below: **Strategy 1: Guided Discovery Learning Strategy** 1. Present different types of triangles (right, acute, obtuse, scalene). 2. Ask learners to: ● Identify the parts of each triangle (sides, included angle, base, height). ● Recall and write the formula for the area of a right triangle. ● Compute the area of a given right triangle using $A = \frac{1}{2}bh$. 3. Facilitate a short discussion by asking the guide questions. **Strategy 2: ICT integrated Strategy** 1. Divide the class into small groups and ensure each group has access to a device (cellphone, tablet, or computer). 2. Open a dynamic geometry or graphing application such as GeoGebra or similar digital tool. 3. Present different types of triangles (right, acute, obtuse, and scalene) using the application or prepared digital visuals. 4. Instruct learners to explore each triangle by: ● Identifying and labeling the sides ● Marking the base and height ● Observing the included angles 5. Ask learners to recall and input the formula for the area of a right triangle: $$A = \frac{1}{2}bh$$

		6. Provide a sample right triangle and let learners use the digital tool to measure base and height, then compute its area. 7. Facilitate group discussion where learners explain how they identified the base and height and how technology helped them solve the problem. 8. Ask guide questions to deepen understanding: ● How does the shape of the triangle affect the location of the height? ● What did you notice using the digital tool compared to manual drawing? ● Why is accurate identification of base and height important? 9. Summarize key concepts and highlight how technology supports better visualization and understanding of geometric properties. **Expected Output:** Learners' responses will reveal whether they can recall the basic area formula for right triangles and understand triangle parts, this will serve as a foundation for introducing the area of oblique triangles using Heron's and sine formulas.
	A.2. Establishing the Purpose of the Lesson	
	Activity A. 2. Appreciating Lesson Relevance *Instructions:* Read the problem and do the indicated task. *Scenario***:** A farmer owns a triangular plot of land that he wants to fence and plant crops in. The plot is not a right triangle, and he knows the lengths of the three sides: 40 meters, 55 meters, and 60 meters. He needs to figure out how much space he has in the field, but he realizes that the usual area formula for right triangles cannot be used because there is no perpendicular height.	**Activity A.2. Appreciating Lesson Relevance** This activity will help learners realize that not all real-world triangles are right triangles and that there are ways to find their area even without perpendicular height. To facilitate this activity, the teacher may apply one of the following strategies below: **Strategy 1: Problem-Based Collaborative Inquiry Strategy** *Instructions:* 1. Prepare the Materials: Ensure each learner or group has paper, pencils, and a ruler. Optionally, display a diagram of a triangular field on the board or projector.

	Task: Draw the triangular field and label the sides with the given measurements. *Processing Questions:* 1. How can the farmer determine the area of his triangular land if the height is not directly given? 2. What mathematical strategies or formulas can be used to find the area of a triangle when the height is unknown? 3. What solution or strategy did your group agree on, and how does it apply to real-life situations like land measurement?	2. Present the Scenario: Read the "Farmer's Triangular Field" scenario aloud to the class. Emphasize that the triangle is not a right triangle, and the farmer wants to know the area. 3. Guide Learners to Draw: Ask learners to draw the triangle and label the sides with the given measurements (40 m, 55 m, 60 m). 4. Facilitate Discussion: Encourage learners to discuss in pairs or small groups how the farmer might find the area without knowing the height. Walk around to monitor participation and prompt ideas. 5. Ask Reflective Questions: ● Why can't we use the usual right-triangle area formula? ● What strategies could we use to find the area of this triangle? 6. Have Groups Share: Invite each group to share their thoughts and possible methods. Summarize the discussion, highlighting that special formulas (Heron's or sine formula) are needed for oblique triangles. 7. Conclude: Reinforce that this activity connects to real-world applications and prepares learners to learn new methods for finding the area of oblique triangles in the next lesson and then present the performance task. **Strategy 2: ICT Integrated Strategy** *Instructions:* 1. Present the "Farmer's Triangular Field" problem and ensure learners understand the given side lengths (40 m, 55 m, 60 m). 2. Divide the class into small groups and assign each group access to a device (tablet, smartphone, or computer). 3. Instruct learners to open an interactive geometry or graphing tool such as GeoGebra. 4. Let learners input or construct the triangle using the given side lengths and explore its shape digitally. 5. Guide learners to observe the triangle's properties, including angles, base, and possible height, using the ICT tool. 6. Ask learners to discuss within their group how the area might be computed even without a directly given height.

<table>
<tr><td></td><td></td><td>7. Facilitate exploration by prompting learners to test or consider alternative methods (e.g., dividing the triangle, using formulas).
8. Have groups present their findings and explain how the digital tool helped them understand the problem.
9. Synthesize responses and introduce the idea of using Heron's formula or trigonometric methods for finding the area of oblique triangles.
10. Conclude by highlighting how ICT tools improve visualization, problem-solving, and understanding of real-world mathematical applications.</td></tr>
<tr><td rowspan="2">B. Instituting New Knowledge</td><td colspan="2">B.1. Presenting Examples</td></tr>
<tr><td>Activity B.1. Exploring Key Concepts

Exploring Triangular Plots
Instructions:
1. Study the three triangles to be shown by your teacher. Each triangle has different side lengths and included angles.
● Triangle A: sides 8 cm and 10 cm, included angle 90°
● Triangle B: sides 8 cm and 10 cm, included angle 60°
● Triangle C: sides 8 cm and 10 cm, included angle 30°
2. Using your knowledge of finding the area of a right triangle, compute the area of Triangle A.
3. Observe Triangles B and C. Without using any formula, predict:
● Which triangle will have the largest area?
● Which will have the smallest?
4. Discuss in pairs or groups what might cause the difference in area among the three triangles even though they have the same sides.
5. Share your observations with the class.

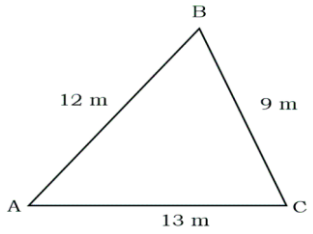
Processing Questions:
1. What is the area of Triangle A if you use the formula for the area of a right triangle? Show your solution.
2. How did you determine the area of Triangle A using the given sides and included angle?
3. Based on observation, which triangle (B or C) do you think has the largest area? Which has the smallest? Explain your reasoning.</td><td>Activity B.1. Exploring Key Concepts

Exploring Triangular Plots

The "Exploring Triangular Plots" activity synthesizes learners' understanding of triangle properties and area computation by engaging them in a real-world problem involving a non-right triangular land. Through guided inquiry and collaborative discussion, learners analyze given measurements, identify relevant geometric features, and explore alternative strategies for finding the area when height is not directly provided. The activity strengthens conceptual understanding by connecting mathematical concepts such as triangle classification and area formulas to practical applications like land measurement.

Strategy 1: Guided Inquiry and Comparative Analysis
Instructions:
1. Prepare visuals of the three triangles (drawn to scale or printed).
2. Ask probing questions while learners are comparing the triangles, such as:
● "What do you notice about the included angle and the area?"
● "How does changing the angle affect the size of the triangle?"</td></tr>
</table>

	4. Even though all three triangles have the same side lengths (8 cm and 10 cm), what factor causes their areas to be different? 5. What relationship can you infer between the included angle of a triangle and its area?	3. Guide learners to conclude that the area of a triangle depends not only on the lengths of its sides but also on the size of the included angle. 4. Transition by saying: "In our next activity, we will learn how to compute the exact area of any triangle like these even if it isn't a right triangle." **Strategy 2: ICT-Integrated Strategy** *Instructions:* 1. Divide the class into small groups and assign each group a device (smartphone, tablet, or computer). 2. Open a dynamic geometry application such as GeoGebra or a similar interactive graphing tool. 3. Guide learners to construct or view the three triangles with the given measurements: ● Triangle A: sides 8 cm and 10 cm, angle 90° ● Triangle B: sides 8 cm and 10 cm, angle 60° ● Triangle C: sides 8 cm and 10 cm, angle 30° 4. Instruct learners to use the tool to adjust or visualize the included angles while keeping the side lengths constant. 5. Ask learners to observe and record how the shape and area of the triangle change as the angle changes. 6. Facilitate group discussion using guiding questions: ● What happens to the area when the included angle decreases? ● Which triangle appears to have the largest/smallest area? Why? 7. Let each group present their observations and explanations based on digital exploration. 8. Synthesize responses and emphasize the relationship between included angle and area of a triangle. 9. Conclude by connecting the activity to the next lesson on solving the exact area of any triangle using formulas.
	B.2. Discussing the Concept	
	Activity B.2. Deepening Conceptual Understanding **Computing the Area of Non-right Triangles**	**Activity B.2. Deepening Conceptual Understanding** In this activity, learners will study how to find the area of oblique triangles using two different methods: the trigonometric

	Instructions: Listen attentively and take part actively in the discussion. **Definition**: Oblique triangle **-** An oblique triangle is simply a triangle without a right angle. It may be acute (all angles < 90°) or obtuse (one angle > 90°). Area of Triangle Formula The area triangle can be calculated using various formulas. For example, Heron's formula calculates the triangle's area when we know the length of all three sides. Trigonometric functions are also used to find the area of a triangle when we know two sides and the angle formed between them. **The Heron's Formula (SSS)** Finding the Area of a Triangle Using Heron's Formula When all three sides of a triangle are known and no angle is given, we can find its area using Heron's Formula. This method does not require the height or any angles — only the side lengths. The formula is: $A = \sqrt{s(s-a)(s-b)(s-c)}$ where: ● A= area of the triangle ● a, b, c= lengths of the three sides ● s= semi perimeter of the triangle, calculated as $s = \frac{a+b+c}{2}$ Example 1: Mang Lito's farm plot has sides of 12 meters, 9 meters, and 13 meters. What is the area of his plot? Solutions: 1. Given triangle sides: a = 9m, b = 13 m, and c =12 m, we can illustrate the triangle plot.  	rule and Heron's formula. Through guided examples and problem-solving tasks, they will further understand how these formulas apply. The activity aims to help learners connect geometric concepts with real-life applications, such as finding the area of triangular fields, roofs, or lots where measuring height directly is not possible. By comparing both methods, learners will develop a deeper understanding of when and how to use each formula effectively To facilitate this activity, follow these steps: 1. Begin by connecting the earlier activities: Start by asking learners how they would find the area of a triangle if it were not a right triangle. Encourage them to recall the basic formula for the area of a right triangle and identify what is missing in an oblique one (the height). 2. Introduce the concept: Explain that even if a triangle has no right angle, specifically the oblique triangle, its area can still be found using special formulas derived from trigonometry and geometry. 3. Present the two methods: First Method: When all three sides are known, introduce Heron's Formula $A = \sqrt{s(s-a)(s-b)(s-c)}, where\ s = \frac{a+b+c}{2}$ Explain how this formula works even without knowing any angles. Second Method: When two sides and their included angle are known, introduce the formula $A = \frac{1}{2}absin\ C$ Discuss how the sine function helps find the height indirectly. 4. Present examples: Provide additional examples if necessary.

	2. Calculate semi-perimeter (s): $$s = \frac{a+b+c}{2}$$ $$s = \frac{9+13+12}{2}$$ $$s = \frac{34}{2}$$ $$s = 17\,m$$ 3. Apply Heron's Formula: $$A = \sqrt{s(s-a)(s-b)(s-c)}$$ $$A = \sqrt{17(17-9)(17-13)(17-12)}$$ $$A = \sqrt{17(8)(4)(5)}$$ $$A = \sqrt{2720}$$ $$A = \sqrt{2720}$$ $$A \approx 52.15\,m^2$$ Therefore, the area of △ABC is about 52.15 square meters. **The Trigonometric Rule** When a triangle is not the right triangle, its height is not easily measured. However, if two sides and the included angle are known, we can find its area using a trigonometric rule. The formula is: $$A = \frac{1}{2}absin\ C$$ where: ● A= area of the triangle ● a and b= lengths of the two sides ● C= included angle between sides $a$and b This rule comes from the idea that the sine of an angle relates the height of the triangle to one of its sides. It works for both acute and obtuse triangles and is particularly useful in real-life applications such as land measurement, navigation, and construction when the perpendicular height cannot be measured directly. Using Trigonometric Rule *Example 2:* Mang Pedro is building a triangular roof beam. He measures two sides: ● Side a = 15 meters ● Side b = 20 meters	Apply any of the following strategies: Strategy: Guided Problem Solving *Instructions:* ● Present a step-by-step problem involving an oblique triangle. ● Work through the first steps together, asking learners to calculate each stage. ● Gradually release responsibility, letting learners complete the rest of the problem individually or in small groups. ● Ask learners to present their solutions Strategy: Think-Pair Share *Instructions:* ● Ask learners to individually solve a problem. ● Next, have them pair up to share their ideas and compare approaches. ● Finally, invite pairs to share their findings with the whole class. Note: Provide more examples if necessary. 5. Encourage conceptual understanding: Ask learners to compare the two methods and identify which situations each is best suited for. Allow them to discuss how these formulas can be applied in real-life scenarios such as land measurement or construction.

	The angle between these two sides is 70°. Question: Find the area of the triangular roof beam. Solutions: Given: a = 15 m, b = 20 m, C = 70^0 $$A = \frac{1}{2}absinC$$ $$A = \frac{1}{2}(15)(20)sin(70^0)$$ $$A = 150sin(70^0)$$ $$A \approx 140.96\, m^2$$ Therefore, the area of the triangle is approximately 140.96 square meters.	
	B.3. Developing Mastery (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity B.3. Practicing Learned Skills **Enhancing Skills in Finding the Area of Oblique Triangles** This activity is designed to help learners master the application of triangle area formulas particularly the Heron's Formula and ½ absinC in real-world contexts. By solving practical problems involving triangular structures such as fish pens, roofs, fields, and stages, learners will strengthen their understanding of geometry and its relevance to engineering, agriculture, and community planning. To facilitate this activity, the teacher may apply one of the following strategies below: **Strategy 1: Scaffolded Practice** *Instructions:* 1. Start Problem 1 together — teacher provides cues (e.g., *"What is the semi-perimeter?"*). 2. For Problem 2, guide only formula selection, then let learners do calculations. 3. For Problem 3–5, learners solve independently; teacher only intervenes if needed. 4. Summarize by asking reflection questions. **Strategy 2: Distributed Practice with Immediate Feedback** *Instructions:* 1. Assign Problems 1–5 for independent solving. 2. As learners work, walk around and check for: ● Incorrect formula choice ● Missing units ● Wrong calculator mode (radians vs. degrees)	

<table>
<tr><td></td><td colspan="2">3. Provide quick corrections: “Remember, divide by 2 to get s.” or “Always use the included angle.”
4. Collect 1–2 answers from volunteers after each problem to verify with the whole class.
5. Facilitate the reflection questions.

Strategy 3: Error Analysis and Peer Teaching
Instructions:
1. Prepare a sample solution containing common errors (e.g., forgetting to apply the square root in Heron’s Formula or using the incorrect included angle in the Sine Formula)
2. Present the incorrect solution on the board or screen and ask learners:
● “Can you identify the error?”
● “What part of the solution was done incorrectly?”
● “How can the solution be corrected?”

3. Facilitate a short discussion allowing learners to analyze and explain the mistakes observed in the solution.
4. Pair learners and instruct them to peer-check each other’s solutions for Problems 3–5, focusing on accuracy of formulas, substitutions, and computations.
5. Invite volunteers to present and explain the correct step-by-step solution on the board.
6. Facilitate the reflection and processing questions to reinforce understanding and correct misconceptions.</td></tr>
<tr><td rowspan="2">C. Demonstrating Knowledge and Skills</td><td colspan="2">C.1. Finding Practical Application</td></tr>
<tr><td>Activity C.1. Making Real-World Connections

Applying Triangles in Real-Life Design

Instructions:
Analyze the scenario and perform the indicated tasks.

Scenario:
Your barangay is planning community improvement projects: a small plaza, a new evacuation center, and optimizing local rice fields. Many of these projects involve triangular spaces: triangular garden plots in the plaza, triangular roof trusses for typhoon-resistant buildings, and irregular triangular-shaped rice fields.

Your group will act as community planners, engineers, or agricultural advisors to model these triangles, calculate their areas, and make practical decisions, including estimating the amount of materials needed and the cost involved.</td><td>Activity C.1. Making Real-World Connections

This activity engages learners in applying triangle geometry to realistic community projects: a plaza garden, an evacuation center roof, or a rice field. Learners will calculate areas of oblique triangles, estimate required materials and compute total costs. The activity promotes critical thinking, problem-solving, and real-life application of mathematics in community planning, construction, and agriculture.

Strategy: Collaborative Mathematical Modeling
Instructions:
1. Introduce the Scenario
● Explain the context: the barangay plans triangular spaces.
● Highlight the real-life applications: landscaping, construction, and agriculture.
● Emphasize the importance of calculating area accurately to plan materials and budget.</td></tr>
</table>

	Plaza Garden Plot: ● Each triangular garden plot needs soil, grass, or paving stones. ● Assume 1 bag of soil covers 2 m² and costs ₱350 per bag. ● Calculate how many bags are needed for your triangle and the total cost. **Evacuation Center Roof Truss:** ● Each triangular truss covers a portion of the roof. ● Assume 1 sheet of roofing material covers 2 m² and costs ₱500 per sheet. ● Calculate how many sheets are needed for your truss and the total cost. ● Discuss how the triangle shape affects stability during typhoons. **Rice Field Plot:** ● Farmers need fertilizers for their triangular rice fields. ● Assume 1 kg of fertilizer covers 10 m² and costs ₱50 per kg. ● Calculate how much fertilizer is needed and the total cost for your triangle. Your task is to measure, calculate, and interpret these triangles to make real-life recommendations for your barangay. *Instructions*: 1. Form Your Group ● Work in a group of 3–5 members. ● Your teacher will provide a triangle data card (two sides and the included angle) representing a plaza plot, roof truss, or rice field. 2. Model the Triangle ● Option A: Draw the triangle on the ground using chalk, masking tape, or measuring tape. ● Option B: Use a simulation tool like GeoGebra, Desmos, or a map app to model the triangle. ● Label all sides and angles clearly.	2. Form Groups ● Divide learners into groups of 3–5. ● Assign each group for a triangle scenario from the prepared data table (plaza, roof, or rice field). 3. Demonstrate the Process ● Model one example on the board or projector: ○ Show how to use the formula $Area = \frac{1}{2}absin\ C$. ○ Show how to convert the area into material needs and total cost. ● Explain how to label sides and angles clearly when modeling triangles. 4. Monitor and Support Group Work ● Allow groups to model their triangle either physically (chalk, tape, measuring tape) or digitally (GeoGebra, Desmos, map app). ● Check that learners correctly identify sides, angles, and units of measurement. ● Circulate to guide calculation of area, material needs, and total cost without giving answers directly. 5. Presentation and Sharing ● Each group presents their triangle model, area calculation, materials, and cost analysis. ● Encourage learners to explain their reasoning and how their calculations help in real-life planning. 6. Reflection and Discussion ● Lead a discussion using reflection questions: ○ What did you learn about applying triangle geometry in real-life situations? ○ How can these calculations help in budgeting, planning, or resource allocation? ○ Why is knowing triangular spaces important for efficiency, safety, and cost management? 7. Closure ● Summarize key takeaways: connecting geometry with practical decision-making. ● Highlight accuracy in calculations and how math informs real-life planning.

	3. Calculate the Area ● Use the formula. ● Record your calculations on the worksheet. 4. Estimate Materials and Cost ● Use the scenario's material coverage and costs to compute: o Plaza: Number of soil bags and total cost. o Roof: Number of roofing sheets and total cost. o Rice Field: Kilograms of fertilizer and total cost. 5. Present Your Work ● Share your triangle model, area calculation, material estimates, and costs with the class. ● Explain how your calculations help in planning, construction, or agriculture. *Processing Questions:* 1. What did you learn about applying triangle geometry in real-life situations? 2. How can these calculations help in budgeting, planning, or resource allocation? 3. Why is knowing triangular spaces important for efficiency, safety, and cost management?	Strategy 2: Station Rotation Learning Strategy Instructions: 1. Present the barangay improvement context involving triangular spaces in: ● plaza development ● evacuation center construction ● agricultural rice fields Explain learners rotate through stations to solve parts of real-world math. 2. Divide the class into small groups. Assign each group to a starting station. 3. Station Setup **Station 1: Understanding the Problem** ● Learners read and analyze the scenario. ● Identify given values (sides, angles, and context). ● Determine what is being asked (area, materials, cost). **Station 2: Mathematical Modeling** ● Learners draw or model the triangle. ● Identify correct formula: $A = \frac{1}{2}absin\ C$ ● Label sides and included angle properly. **Station 3: Computation Station** ● Learners compute the area step-by-step. ● Convert results into material requirements: o soil bags o roofing sheets o fertilizer kilograms **Station 4: Cost and Interpretation Station** ● Learners compute total cost based on given unit prices. ● Interpret results in terms of real-life planning (budget, efficiency, resource use).

		4. **Rotation Process.** Groups rotate through all stations after a set time limit (e.g., 8–10 minutes per station). Ensure smooth transitions and task completion at each station. 5. Each group shares one key insight or solution from any station. Compare strategies used across groups**.**
	C.2. Making Generalization	
	Activity C.2. Wrapping-Up the Lesson **The Triangle Detective – Which Formula Fits?** *Instructions:* 1. Examine the three triangle evidence cards below: ● Evidence A: A triangular rice field has sides of 24 m, 30 m, and 18 m. (Only three sides are given.) ● Evidence B: A barangay solar panel has two beams measuring 15 m and 20 m with an included angle of 45°. ● Evidence C: A flood control dike forms a triangle with all three sides given: 10 m, 14 m, and 12 m. 2. For each evidence card: ● Circle or write the correct formula: Heron's Formula or $\frac{1}{2}absinC$. ● Write a one-sentence justification: *"I chose this because…"* 3. After matching all evidence cards, complete the Detective's Final Report: Detective's Generalization: ● Use Heron's Formula when _____ ● Use $\frac{1}{2}absinC$ when _____. Share your "Final Report" with a partner, then be ready to read your rules aloud in class.	**Activity C.2. Wrapping-Up the Lesson** **The Triangle Detective – Which Formula Fits?** In this activity, learners act as "triangle detectives" to determine which formula is appropriate for finding the area of different triangles. They will analyze evidence cards representing real-life situations (rice fields, solar panels, and flood control dikes), justify their formula choice, and develop a general rule for when to use each formula. This activity strengthens conceptual understanding of triangle area formulas, critical thinking, and reasoning skills. **Strategy: Guided Inquiry with Cooperative Reasoning** *Instructions:* 1. Introduce the Activity ● Explain the detective theme: learners are tasked with figuring out the "correct formula" for each triangle scenario. ● Briefly review the two formulas. 2. Distribute Evidence Cards ● Provide each learner with the three evidence cards (Evidence A, B, and C). ● Ensure each student has a worksheet to record formula choices and justifications. 3. Individual Analysis ● Learners examine each card and decide which formula to use. ● They must write a one-sentence justification for each choice: ● "I chose this because…" ● Encourage learners to consider what information is given (sides, angles) before choosing a formula.

		4. Complete Detective's Final Report ● Learners generalize the rule for formula use: ● Circulate to check for understanding and provide guidance if a student is confused. 5. Partner Sharing ● Have learners pair up to share their Final Report. ● Encourage discussion and comparison of reasoning. 6. Reporting ● Invite a few learners to read their general rule aloud. ● Summarize correct generalizations on the board. 7. Closure ● Reinforce the importance of analyzing given information before choosing a formula. ● Highlight the practical applications in real-life scenarios (e.g., agriculture, construction, engineering).
	C.3. Evaluating Learning (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity C.3: Assessing Learning Outcomes This activity allows learners to demonstrate their understanding of computing the area of oblique triangles using both Heron's Formula and the trigonometric rule $A = \frac{1}{2}absin\ C$. The activity combines concept recall, real-life applications, and reasoning tasks to assess both procedural fluency and analytical thinking. In part I, learners review key concepts and differentiate when to use each formula. In part II, learners solve practical problems involving community-related scenarios such as construction, land surveying, and engineering projects, showing complete step-by-step solutions. In part III, learners justify formula choices and evaluate problem-solving approaches, reinforcing conceptual understanding and critical reasoning. Through this activity, learners apply mathematics to realistic situations, interpret results meaningfully, and strengthen their ability to choose appropriate methods for solving problems involving oblique triangles. Each learner should complete this activity on their own. It plays a key role in evaluating how well they understand the lesson. Be sure to check their work right away so you can offer quick and suitable help to those who may need extra support or reinforcement.	
	C.4. Additional Activities (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity C.4. Extending and Reinforcing Learning This extra activity can be assigned as homework. Provide remediation for learners who haven't fully mastered the lesson and offer enrichment tasks to those who are ready to advance their learning further.	

<table>
<tr><td>III. CONTENT</td><td colspan="2">Lesson 8.3 Triangles and Navigation</td></tr>
<tr><td>IV. OBJECTIVES</td><td colspan="2">By the end of this module, learners will be able to:
1. apply the Law of Sines and the Law of Cosines to calculate unknown sides and angles in non-right triangles;
2. calculate unknown heights and distances using angles of elevation and depression; and
3. use true and compass bearings to map positions and directions in real-world scenarios.</td></tr>
<tr><td>V. PROCEDURES</td><td>LEARNERS ACTIVITIES</td><td>ANNOTATION</td></tr>
<tr><td rowspan="2">A. Activating Prior Knowledge</td><td colspan="2">A.1. Eliciting Prior Knowledge</td></tr>
<tr><td>Activity A.1. Leveling Learner Readiness

Direction Detective Challenge
Materials:
● Mini whiteboard/illustration board and marker (or paper and pen)
● Prepared answer cards labeled: A, B, C, D

Instructions:
1. The class will be grouped into 4 – 5 groups.
2. Each group will prepare their answer cards.
3. The teacher flashes a picture or situation on the screen.
4. Each group has 10 seconds to discuss and raise the correct answer card.
5. One point is awarded for every correct answer.

Processing Questions:
1. What mathematical concepts did you recognize during the activity?
2. Which situation seemed most familiar to you? Why?
3. How are directions and angles used in everyday life?
4. What challenges did you encounter while answering the tasks?
5. How do you think today's lesson will help solve real-world problems involving measurement and navigation?</td><td>Activity A.1. Leveling Learner Readiness

Direction Detective Challenge

This activity is designed to activate learners' prior knowledge and assess their readiness for the lesson on solving practical problems involving right and oblique triangles, angles of elevation and depression, and bearings. Through engaging and interactive tasks, learners will recall previously learned concepts related to measurement, geometry, and direction, identify connections between mathematics and real-life situations, and reveal any misconceptions that may need clarification. The activity also encourages active participation, collaboration, and critical thinking, providing the teacher with valuable information about learners' existing understanding to effectively guide the lesson.

Materials:
● PowerPoint slides or printed situation cards
● Scoreboard
● Bell or buzzer

Instructions:
1. Divide the class into groups of 4–5 members.
2. Present five real-life situations related to triangles, elevation, depression, and bearings.</td></tr>
</table>

		Situation 1: A ladder is leaning against a wall. *Question:* What mathematical figure is formed? A. Circle B. Right Triangle C. Rectangle *Situation 2***:** A student looks up at the top of a flagpole. *Question*: What angle is involved? A. Angle of Elevation B. Angle of Depression C. Bearing *Situation 3:* A lighthouse observes a ship below sea level from its viewing deck. *Question:* What angle is formed? A. Acute Angle B. Angle of Depression C. Right Angle *Situation 4:* A pilot travels N 45° E. *Question:* What concept is used to describe the direction? A. Slope B. Bearing C. Altitude *Situation 5:* Two sides and one angle of a triangle are given. *Question:* What can be used to solve the triangle? A. Trigonometry B. Statistics C. Algebraic Expressions 3. Give groups 10 seconds to discuss each item. 4. Groups raise the answer card corresponding to their chosen answer. 5. Award one point for each correct answer. 6. Briefly discuss the correct answer after each item. 7. Announce the highest-scoring group and transition to the lesson.

		8. Ask learners to show through hand signals with the concepts encountered in the activity. 👍 = Very familiar 👌 = Somewhat familiar ✋ = Need more help **Option 2. Human Compass Kinesthetic Learning** *Materials*: ● Compass direction cards (North, South, East, West) ● Situation cards ● Projector or visual aids *Instructions*: 1. Label the four corners of the classroom as North, South, East, and West. 2. Present a short scenario related to direction or navigation. 3. Ask students to move to the corner representing the correct answer. Examples: "A ship travels due east. Which direction is it heading?" "A person looks upward to the top of a tower. What angle is involved?" 4. Randomly ask students to explain their choice. 5. Provide immediate feedback. 6. Connect their responses to the lesson objectives.
	A.2. Establishing the Purpose of the Lesson	
	Activity A. 2. Appreciating Lesson Relevance **Mission Possible: Can You Find It?** *Materials*: ● Mini whiteboards or sheets of paper ● Marker or pen	**Activity A.2. Appreciating Lesson Relevance** **Mission Possible: Can You Find It?** This activity aims to help learners appreciate the relevance of trigonometry and geometry in solving real-life problems involving measurement, navigation, and construction. Through analyzing practical situations, learners will recognize how right

	Instructions: 1. Read the following scenario displayed on the screen: Scenario*:* *A rescue team received a distress signal from a stranded hiker on a mountain. They need to determine the hiker's location and estimate the distance to reach him. However, they only know the angle at which they can see the hiker and the direction from their current location.* 2. Think individually about the question: 3. "What mathematical knowledge or skills might help the rescue team locate the hiker?" 4. Pair up with a classmate and discuss your ideas. 5. Write your answers on your paper or mini whiteboard. 6. Volunteer pairs share their responses. 7. The teacher lists key ideas on the board. *Processing Questions:* 1. What real-life problem or situation was presented in the activity? 2. What mathematical concepts might help solve these problems? 3. Why is accuracy important when solving these kinds of problems? 4. Where do you think these mathematical concepts are commonly used? 5. How can today's lesson help you understand or solve similar real-life situations?	and oblique triangles, angles of elevation and depression, and bearings are used in various professions and everyday activities. The activity also motivates learners to see the importance of the lesson and prepares them to connect mathematical concepts with real-world This activity helps learners recognize the importance of trigonometry and geometry in solving real-life problems involving distance, height, direction, and navigation. By analyzing a realistic rescue scenario, learners appreciate how mathematical concepts can be used to make informed decisions in situations that require accuracy and problem-solving. *Materials*: ● PowerPoint slides or printed scenario card ● Projector/TV screen ● Timer ● Paper and pen or mini whiteboard and marker *Instructions*: 1. Present the scenario. 2. Ask learners to think individually for 30 seconds about how the rescue team can solve the problem. 3. Let learners discuss their ideas with their partner. 4. Call on volunteers to share their answers. 5. Write key ideas on the board (angles, triangles, distance, direction, bearings). 6. Connect learners' responses to the lesson on practical applications of trigonometry.
B. Instituting New Knowledge	*B.1. Presenting Examples*	
	Activity B.1. Exploring Key Concepts **Trig in Action: Read, Analyze, Solve!** *Materials*: ● Activity worksheet ● Scientific calculator ● Ruler	**Activity B.1. Exploring Key Concepts** **Trig in Action: Read, Analyze, Solve!** This activity aims to help learners explore and discover the practical applications of right and oblique triangles, angles of elevation and depression, and bearings through real-life situations. By reading, analyzing, and solving contextualized

	• Pencil and paper • Highlighter or colored pen *Instructions:* 1. Form groups consisting of 4–5 members. 2. Assign the following roles: • Reader • Problem Analyzer • Calculator • Recorder • Presenter 3. Read the assigned situation carefully. 4. While reading: • Highlight important numerical information. • Underline words that provide clues about the concept involved. Examples: • "looks up" → Angle of Elevation • "looks down" → Angle of Depression • "N 40° E" → Bearing • "distance across a river" → Triangle Application 5. As a group, discuss: • What is being asked? • What mathematical concept is involved? • What information is given? • What information needs to be found? Record answers on the worksheet. 6. Use appropriate mathematical tools and strategies to solve the problem. 7. Show complete solutions. 8. Prepare a brief explanation of your answer. Each group presents: • The situation • The identified concept • Their solution • How the concept applies in real life	problems, learners develop mathematical reasoning, communication, and literacy skills while recognizing the relevance of trigonometry and geometry in measurement, navigation, surveying, and design. The activity also prepares learners for the performance task of applying trigonometry and geometry in designing and constructing three-dimensional objects and models. Materials: • Situational problem cards • PowerPoint presentation or printed worksheets • Manila paper/cartolina • Marker *Instructions*: 1. Distribute a real-life problem involving trigonometry. *Right Triangle Application*: A 20-meter ladder leans against a wall. The foot of the ladder is 12 meters from the wall. *Question*: How high up the wall does the ladder reach? *Angle of Elevation*: A student stands 25 meters from a flagpole. The angle of elevation to the top of the pole is 40°. *Question*: Find the height of the flagpole. *Angle of Depression*: A lighthouse keeper observes a ship at an angle of depression of 35°. The lighthouse is 60 meters high. *Question*: How far is the ship from the base of the lighthouse? *Bearing*: A plane travels 80 km on a bearing of N 60° E.

	Processing Questions: 1. What keywords helped you identify the mathematical concept needed to solve the problem? 2. How did highlighting important information help you understand the problem? 3. Which trigonometric concept was used in your group's problem? 4. How can similar problems be encountered in real-life situations? 5. Why is it important to understand the relationship between angles, distances, and directions?	*Question*: Describe the direction of the plane and explain how bearings help in navigation. *Oblique Triangle*: Two sides of a triangular lot measure 60 m and 75 m with an included angle of 50°. *Question*: Find the length of the third side using the Law of Cosines. 2. Give learners time to read and analyze the problem. Guide them to identify important information, highlight keywords, and numerical data. and determine what is being asked. 3. Let learners discuss possible solutions within their group. They choose the appropriate trigonometric concept and solve the problem. 4. Encourage learners to explain the reasoning behind their answers. Facilitate a short discussion comparing strategies used by different groups.
	B.2. Discussing the Concept	
	Activity B.2. Deepening Conceptual Understanding Instructions: To apply your skills in solving problems involving right and oblique triangles in real-world situations, study each problem carefully. Analyze the given information, determine the appropriate trigonometric concept or formula, and solve each problem systematically. Your active participation and careful analysis will help you strengthen your problem-solving skills and deepen your understanding of the lesson. **Part I. Worded Problems in Trigonometry** **A. Applying the Law of Sines and Law of Cosines** *Problem 1***:** A surveyor measuring a triangular piece of land. Two points on the boundary are 10 meters apart from a third point, and the angle between the two measured sides is 30°. If one side	**Activity B.2. Deepening Conceptual Understanding** To deepen learners' understanding of the lesson, facilitate the discussion using any of the provided strategies. The strategies are designed to guide learners in analyzing trigonometric problems, explaining their mathematical reasoning, collaborating with peers, and connecting the concepts to real-life situations. Teachers may select the strategy that best suits the learners' needs, the complexity of the problems, and the available time. **Strategy 1: Think–Sketch–Solve** 1. **Read the Problem** – Ask learners to identify what the problem is about and what is being asked. 2. **Identify the Given Information** – Have learners list the known sides, angles, distances, and directions. 3. **Draw a Diagram** – Ask learners to represent the situation using a labeled triangle or appropriate diagram.

	measures 10 meters and the opposite angle is 30°, determine the length of the side opposite a 45° angle. *Solution*: Using the Law of Sines: $\frac{10}{sin\ 30°} = \frac{x}{sin\ 45°}$ $x = \frac{10\ sin\ 45°}{sin\ 30°}$ x ≈ 14.14 m *Answer*: The unknown side is approximately 14.14 meters. *Problem 2*: Two roads meet at an intersection and form an angle of 60°. A delivery truck travels 8 km along one road, while another truck travels 12 km along the other road. How far apart are the two trucks? *Solution*: Using the Law of Cosines: $c^2 = a^2 + b^2 - 2ab \cos C$ $c^2 = 8^2 + 12^2 - 2(8)(12) \cos 60°$ $c^2 = 64 + 144 - 192(0.5)$ $c^2 = 112$ $c = \sqrt{112}$ c ≈ 10.58 km Answer: The trucks are approximately 10.58 km apart. *Problem 3:* A rescue team needs to locate a stranded hiker. From the rescue station, the hiker is observed at an angle of 40° from a reference direction. The second observation point is 65° from the same reference direction. If the distance from the station to the first observation point is 15 km, determine the remaining sides of the triangular search area.	4. **Choose and Apply the Formula** – Guide learners in selecting the appropriate trigonometric concept and solving the problem. 5. **Check and Explain the Answer** – Ask learners to determine whether their answer is reasonable and explain how they obtained it. **Strategy 2: Collaborative Problem-Solving Stations** 1. **Form Small Groups** – Divide the class into groups and assign each group to a set of problems. 2. **Assign the Problems** – Give each group problems involving Laws of Sines and Cosines, heights and distances, or bearings. 3. **Solve Collaboratively** – Let learners discuss, draw diagrams, select formulas, and solve the assigned problems together. 4. **Share and Check Solutions** – Have groups present or exchange their solutions and check one another's work. 5. **Discuss the Solutions** – Facilitate a class discussion about the different methods, errors, and important ideas learned. **Strategy 3: Real-Life Scenario Discussion and Mathematical Reflection** 1. **Read the Passage** – Ask learners to read the literacy integration passage carefully. 2. **Answer the Questions** – Let learners answer the literal, inference, and application questions based on the passage. 3. **Discuss the Answers** – Ask learners to explain and justify their answers using information from the text. 4. **Connect to Real Life** – Invite learners to identify situations where trigonometry, angles, distances, and bearings are used. 5. **Reflect and Generalize** – Ask learners to explain what they learned and how these concepts can help solve real-world problems.

	Solution: First, determine the third angle: C = 180° − 40° − 65° C = 75° Using the Law of Sines: $\frac{15}{sin\ 40°} = \frac{x}{sin\ 65°}$ $x = \frac{10\ sin\ 65°}{sin\ 40°} x \approx 21.52$ *km For the other side*: $\frac{15}{sin\ 40°} = \frac{y}{sin\ 75°}$ $y = \frac{15\ sin\ 75°}{sin\ 0°}$ y ≈ 22.40 km Answer: The remaining sides are approximately 21.52 km and 22.40 km. **B. Heights and Distances Using Angles of Elevation and Depression** *Problem 4***:** Maria is standing 20 meters away from the base of a flagpole. She looks up at the top of the flagpole and measures an angle of elevation of 30°. Assuming Maria's eye level is at the ground, how tall is the flagpole? *Solution*: Using tangent: tan 30° = $\frac{h}{20}$ h = 20 tan 30° h = 20(0.5774) h ≈ 11.55 m *Answer*: The flagpole is approximately 11.55 meters high. *Problem 5***:** A student standing on the ground observes the top of a school building at an angle of elevation of 45°. The student is 35 meters away from the building. How high is the building?	For synthesis, facilitate the processing questions: *Processing Questions:* 1. How do you identify whether a problem involves a right triangle or an oblique triangle? 2. When solving the right triangle problem, how do you decide which trigonometric ratio (sin, cos, or tan) to use? 3. What is the difference between an angle of elevation and an angle of depression? Give a real-life example of each. 4. Why is drawing a diagram important when solving problems involving triangles, angles, and bearings? 5. In what real-life situations do people use trigonometry and bearings to solve problems? Explain how these concepts are applied.

	Solution: tan 45° = $\frac{h}{35}$ Since tan 45° = 1: h = 35 *Answer*: The school building is 35 meters high. *Problem 6*: A surveyor wants to determine the height of a communication tower. From one location, the angle of elevation to the top of the tower is 35°. The surveyor then moves 20 meters closer to the tower, and the angle of elevation becomes 50°. How high is the tower? *Solution:* Let x represent the distance from the second observation point to the tower. From the second position: h = x tan 50° From the first position: h = (x + 20) tan 35° Equating: x tan 50° = (x + 20) tan 35° 1.1918x = 0.7002x + 14.004 0.4916x = 14.004 x ≈ 28.49 Now find the height: h = 28.49 tan 50° h ≈ 33.96 m *Answer*: The communication tower is approximately 33.96 meters high.	

C. True and Compass Bearings

*Problem 7***:** A fishing boat leaves the shore and travels 20 kilometers on a true bearing of 090°. In what direction does the boat travel, and where is it located relative to the shore?

Solution:
A bearing of 090° indicates due east.

Therefore, the boat travels:
20 km east

Answer: The boat is 20 kilometers east of the shore.

*Problem 8***:** A rescue team travels 15 kilometers from its base camp on a true bearing of 060°. How far north and how far east of the base camp is the team?
Solution:
For a bearing of 060°:
N = 15 cos 60°
N = 7.5 km

Eastward distance:
E = 15 sin 60°
E ≈ 12.99 km

Answer: The rescue team is approximately 7.5 km north and 12.99 km east of the base camp.

*Problem 9***:** A cargo ship leaves a port and travels 40 kilometers on a true bearing of 030°. It then changes direction and travels another 30 kilometers on a true bearing of 120°. Determine the ship's approximate distance and true bearing from the port.
Solution:
For the first journey:

$N_1 = 40 \cos 30° \approx 34.64$ km
$E_1 = 40 \sin 30° = 20$ km

	For the second journey: $N_2 = 30 \cos 120° = -15$ km $E_2 = 30 \sin 120° \approx 25.98$ km Total northward displacement: $N = 34.64 - 15 = 19.64$ km Total eastward displacement: $E = 20 + 25.98 = 45.98$ km Resultant distance: $d = \sqrt{(19.64^2 + 45.98^2)}$ $d \approx 50.00$ km Determine the bearing: $\theta = \tan^{-1}(45.98/19.64)$ $\theta \approx 66.9°$ Thus, the true bearing is approximately 067°. Answer: The ship is approximately 50 km from the port on a true bearing of 067°. **Part II. Literacy Integration** Instructions: Read the short passage carefully and answer the questions that follow. During emergency situations such as floods, landslides, or mountain rescues, search and rescue teams rely on trigonometry to locate people and navigate safely. Rescue personnel use the angle of elevation to estimate the height of hills, buildings, or trees where stranded individuals may be located. They also use bearings to determine the exact direction of travel when navigating through unfamiliar areas. By combining distance, angles, and direction, rescuers can plan the safest and fastest route to reach those in	

	need. These mathematical concepts are also widely used by drone operators, engineers, pilots, surveyors, and architects in their daily work. *Questions*: **Items 1–2: Literal Level** *(Identifying explicitly stated information in the text.)* 1. According to the passage, what mathematical concept is used to estimate the height of hills, buildings, or trees? A. Statistics B. Algebra C. Trigonometry D. Geometry 2. Aside from an angle of elevation, what other concept does rescuers use to determine the direction of travel? A. Ratio B. Bearing C. Perimeter D. Probability **Items 3–4: Inference/Interpretation Level** *(Drawing conclusions and making interpretations based on the text.)* 3. Why is it important for rescue teams to know the bearing of their destination? A. To measure the temperature B. To estimate rainfall C. To travel in the correct direction safely and efficiently D. To calculate the weight of rescue equipment 4. Based on the passage, what would likely happen if rescuers ignored angle measurements during a rescue mission? A. They could easily locate victims faster. B. They might take an incorrect route or miscalculate distances and heights. C. Their equipment would become lighter. D. The weather would improve.	

	Items 5–6: Knowledge Construction Level *(Applying information and connecting it to real-life situations.)* 5. A drone operator uses an angle of elevation to determine the height of a building before delivering emergency supplies. How does trigonometry help in this situation? A. It helps estimate the building's height accurately without climbing it. B. It measures the building's color. C. It predicts tomorrow's weather. D. It determines the building owner's name. 6. Imagine you are part of a rescue team responding to an emergency in your community. Explain in **two to three sentences** how understanding **angles of elevation and bearings** can help your team perform the rescue more effectively.	
	B.3. Developing Mastery (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity B.3. Practicing Learned Skills **Solve It to Survive: Trig Practice Challenge** This activity aims to strengthen learners' skills in solving problems involving right triangles, angles of elevation and depression, bearings, and oblique triangles by applying trigonometric ratios and laws in structured, real-life situational problems. It also develops accuracy, problem-solving fluency, and confidence in selecting appropriate formulas and interpreting solutions correctly. **Strategy 1: Collaborative Problem-Solving** To allow learners to apply trigonometric concepts through teamwork, encouraging discussion, peer teaching, and shared problem-solving while practicing accuracy in computation and reasoning. Materials ● Problem cards (situational word problems) ● Answer sheet per group ● Calculator ● Pencil and ruler ● Manila paper (optional for solutions)	

	Instructions: 1. Divide learners into small groups (3–4 members). 2. Assign each group a set of problems with varying difficulty. **Strategy 2: Station Rotation Drill (Skill Stations)** To develop fluency and flexibility in solving different types of trigonometry problems by exposing learners to multiple structured problem types in a timed rotation setup. *Materials*: ● 4–5 station task cards: ● Right triangle problems ● Elevation/depression ● Bearings ● Oblique triangles ● Timer ● Answer sheets ● Calculator *Instructions:* 1. Set up stations around the classroom. 2. Group learners and assign starting stations. 3. At each station, learners: Solve 1–2 problems Show complete solution steps 4. Rotate every 3–4 minutes. 5. After completing all stations, discuss answers as a class. 6. The teacher highlights correct strategies and common errors.	
C. Demonstrating Knowledge and Skills	*C.1. Finding Practical Application*	
	Activity C.1. Making Real-World Connections **Design It Like a Pro!** *Materials*: ● Activity worksheet ● Calculator	**Activity C.1. Making Real-World Connections** **Design It Like a Pro!** This activity allows learners to connect the concepts of right and oblique triangles, angles of elevation and depression, and bearings to real-world professions and situations. By analyzing authentic scenarios in engineering, architecture, surveying, navigation, and construction, learners will recognize how

	● Pen or pencil *Instructions:* 1. Work in groups of 4–5 members. 2. Pick a Scenario Card 3. Each group will receive one real-world scenario. *Scenario A*: An architect is designing a roof and needs to determine the length of support beams and roof angles. *Scenario B*: An engineer must determine the height of a cell tower without climbing it. *Scenario C*: A surveyor needs to find the distance across a river where direct measurement is impossible. *Scenario D*: A pilot follows a bearing of N 45° E to reach a destination. *Scenario E*: A lighthouse keeper uses the angle of depression to estimate the distance of a ship from the shore. 4. Discuss as a Group Answer the following questions: ● What profession is involved in the scenario? ● What measurement problems must be solved? ● Which mathematical concept is being used? Right Triangle Oblique Triangle Angle of Elevation Angle of Depression Bearing ● Why is accuracy important in this situation? ● How can trigonometry help solve the problem? ● Record your answers on the worksheet. 5. On a sheet of paper: ● Draw a simple diagram of the situation.	trigonometry and geometry are used to make accurate measurements, determine locations and directions, and design structures. The activity also prepares learners for the performance standard of applying trigonometry and geometry in designing and constructing 3D models or prototypes. **Strategy: Career Connection Gallery Walk** *Instructions*: 1. Post five scenarios around the classroom. 2. Groups rotate and analyze each scenario. 3. Learners record the mathematical concept used. 4. Conduct a synthesis discussion highlighting how trigonometry is applied in various professions. 5. Connect the discussion to the future performance

- Label the important measurements, angles, or directions.
- Indicate the trigonometric concept involved.

6. Each group presents:
    - The scenario
    - The concept involved
    - The importance of trigonometry in solving the problem

Processing Questions:

1. What mathematical concept was used in your scenario, and how
2. Did you identify it?
3. Why is it important for professionals to make accurate measurements?
4. How do trigonometry and geometry help solve problems that cannot be measured directly?
5. Which profession do you think relies most on these concepts? Why?
6. How can the concepts learned today help you when designing a model or prototype?

For Activity ("Design It Like A Pro!"), it is best to use a simple analytic rubric, so learners know exactly how they will be graded. Since the activity focuses on understanding concepts and connecting them to real-life situations, you may use a 10-point rubric.

Indicator	**Points**
Correct concept identified	2
Accurate explanation	2
Correct diagram	2
Real-life connection explained	2
Group participation	2
Total	**10**

C.2. Making Generalization

Activity C.2. Wrapping-Up the Lesson

Trig Quest: Escape the Challenge

Instructions:

1. Prepare your device and connect to the internet.
   *If no device or internet is available, use the metacards provided by your teacher***.**
2. Join the online activity using the link or game code provided by your teacher (Quizizz, Kahoot, Mentimeter, or Nearpod).
3. Read and analyze each question carefully.
4. Answer the questions *individually and honestly***.** The questions will cover:
   - Right and oblique triangles
   - Trigonometric ratios (sin, cos, and tan)
   - Angles of elevation and depression
   - Bearings and navigation
5. Check your answer before submitting it. For metacards, raise or show the card that corresponds to your answer**.**
6. Observe the results and listen to the teacher's feedback and explanation.
7. Be ready to explain your answer when called.
8. Share the concept you remember most from the lesson.
9. Complete the statement: **"***One important thing I learned today is* _____*."*

Activity C.2. Wrapping-Up the Lesson

Trig Quest: Escape the Challenge

This activity allows learners to summarize and generalize the key concepts learned about right and oblique triangles, trigonometric ratios, angles of elevation and depression, and bearings through an interactive technology-based challenge. It promotes active participation, immediate feedback, and collaborative reflection while helping learners consolidate their understanding of how trigonometry and geometry are used in solving real-world measurement and navigation problems.

Materials:

- Laptop
- Projector/TV
- Internet connection
- Prepared Quizizz/Kahoot/Mentimeter activity
- Metacard (if there is no available gadgets or internet connectivity)
- Marker

Instructions:

1. Launch the Quiz ask learners to login using game code/Distribute metacard.
2. Learners answer questions individually.
3. After each question, discuss the correct answer and its connection to the lesson.
4. Synthesize learners responses.

C.3. Evaluating Learning (For complete instructions, please refer to the Learning Activity Sheet.)

Activity C.3. Assessing Learning Outcomes

*Instructions***:**

1. Distribute the learning activity sheet and instruct learners to work **i***ndependently***.**
2. Ask learners to read and analyze each trigonometric problem carefully before solving.
3. Instruct learners to identify the given information, determine what is being asked, and select the appropriate formula or trigonometric ratio.
4. Let learners solve each problem and show their complete solutions for computation items.
5. After completing the activity, provide selected correct and incorrect sample solutions for learners to examine.

	6. Ask learners to identify any errors, determine the incorrect step, and explain how the solution can be corrected. 7. Instruct learners to revise the incorrect solutions and write the correct process. 8. Provide feedback and clarify common misconceptions, particularly in selecting trigonometric ratios, applying formulas, and performing calculations. 9. Ask learners to review their own work and make necessary corrections.
	C.4. Additional Activities (For complete instructions, please refer to the Learning Activity Sheet.)
	Activity C.4. Extending and Reinforcing Learning Instructions: 1. Analyze the learners' assessment results and identify their learning needs. 2. Classify learners into **Intervention** or **Enhancement** groups based on their performance. 3. Provide **remediation activities** to learners who need intervention. 4. Provide **enhancement activities** to learners who have demonstrated mastery. These activities are provided in the Learning Activity Sheet (LAS). 5. Assist and monitor learners who need intervention as they complete the remediation activities. 6. Provide appropriate feedback and additional support based on learners identified difficulties. 7. Allow learners who demonstrate mastery to work independently on the enhancement activities. 8. Monitor learners' progress and adjust the support or activities as needed
V. ASSESSMENT	For the summative assessment and performance task, please refer to the Teacher's Notes, which can be accessed through the link in the Table of Contents.
VI. REFLECTION	For your reflection, you may use the Reflection Guide provided in the Teacher's Notes to help guide your responses.

Unit 9. Measurement and Geometry in Real-Life Applications

I. LEARNING GOALS	
Content Standard	The learners should have knowledge and understanding of practical applications of measurements
Performance Standard	By the end of the term, the learners are able to apply trigonometry and geometry to design and construct 3D objects, showing models or prototypes.
Learning Competencies	The learners… 1. estimate and measure lengths and distances (e.g. floor dimensions measuring fabric for clothing). 2. calculate the area and perimeter of residential spaces (e.g., room renovations, garden layouts). 3. calculate the volume and capacity of three-dimensional objects (e.g., water tanks, rice storage containers, balik-bayan box). 4. apply volume and capacity in cost estimation (e.g., amount of flour needed for bread production, paint needed for walls).
II. REFERENCES and MATERIALS	
Textbook and Modules	Carter, James, Gloria Cuevas, Roger Day, Carol Malloy, Gwendolyn Kersaint, Beatrice Luchin, Kay McClain, et al. Tennessee Math Connections Course 3. New York: McGraw-Hill Companies, 2012. Hake, Richard R. Saxon Math Course 1. Orlando, FL: Houghton Mifflin Harcourt Achieve Inc., 2007. Oxford University Press. Oxford Insight Maths Preliminary: Units of Measurement and Applications. Oxford: Oxford University Press, 2025.
Websites	ARC State of Victoria. "*Connecting Volume and Capacity*." ARC Education. Accessed June 10, 2026. ARC Education Jaen, C., et al. "Measurement – Definition, Examples, Practice Problems, FAQs." SplashLearn, 2011. Accessed June 10, 2026. SplashLearn Resource Center for CareerTech Advancement. "*Math Series Measurement: Measuring Lengths and Distances*." Oklahoma CareerTech Resource, 2019. Accessed June 10, 2026. Oklahoma CareerTech Resource Raveendran, B., and D. Gokulnath. "Volume and Capacity." BYJU'S, 2025. Accessed June 10, 2026. BYJU'S Siyavula Education. "Estimating and Measuring Length and Distance." 2025. Accessed June 10, 2026. Siyavula Education Jeffrey, J. "The Wren – 2 Bedroom House 6×9m." Free House Designs, 2014. Accessed June 10, 2026. Free House Designs Palmer, Mary. "The Perimeter: Extending Your Living Spaces to the Outdoors." Dargan Garden Design, 2014. Accessed June 10, 2026. Dargan Garden Design
Video Lessons	Century Tech. "Solving Problems with Volume and Capacity | Mathematics." YouTube video, 2023. Accessed June 10, 2026. YouTube SmileRoad. "LVII P1 Volume and Capacity in Cost Estimation | GR11 SHS | Gen Math | Q3 MG." YouTube video, 2025. Accessed June 10, 2026. YouTube Unknown. "Finding the Perimeter and Area of a Room." YouTube video. Accessed June 10, 2026. YouTube

<table>
<tr><td>Materials and EdTech</td><td colspan="2">Materials:
● Calculators
● Visual aids/PowerPoint presentation
● Ruler
● Tape measure
● Worksheets
● Task Cards
● Pencil
● Graphing/Grid Paper
● Eraser
● Manila Paper/Cartolina

EdTech:
● Laptop/Computer
● LCD Projector/Smart TV
● Cellphones
● Canva Presentation
● YouTube Video Lessons</td></tr>
<tr><td>AI Declaration</td><td colspan="2">This lesson exemplar was developed with the assistance of Artificial Intelligence (AI) tools such as ChatGPT and Canva AI for organizing content, refining instructional activities, generating interactive learning tasks, formatting references, and enhancing the clarity and presentation of instructional materials. Interactive activities and visual presentations were also created using Canva AI features to support learner engagement and participation. All AI-generated outputs were carefully reviewed, validated, and contextualized by the teacher to ensure accuracy, appropriateness, and alignment with curriculum standards and learning competencies.</td></tr>
<tr><td>III. CONTENT</td><td colspan="2">Lesson 9.1. Estimating and Measuring Lengths and Distances</td></tr>
<tr><td>IV. OBJECTIVES</td><td colspan="2">At the end of the lesson, learners should be able to:
1. estimate at least five classroom objects within a reasonable margin of error,
2. measure selected objects using appropriate tools and correct units, and
3. explain at least two practical uses of estimation and measurement based on the activity outputs.</td></tr>
<tr><td>V. PROCEDURES</td><td>LEARNERS ACTIVITIES</td><td>ANNOTATION</td></tr>
<tr><td></td><td>Activity A.1. Leveling Learner Readiness: Guess It Right!

Instructions:
1. The class will be divided into five groups.
2. Five objects will be shown by the teacher.
3. For each object, write down your best guess of its length, height, or width in centimeters or meters.
a. Length of the chalk
b. Width of the notebook</td><td>Activity A.1. Leveling Learner Readiness: Guess It Right!

1. Description and Purpose of the Activity
“Guess It Right!” is an activating prior knowledge activity where learners estimate the lengths, widths, or heights of familiar classroom objects without using measuring tools. The activity develops learners’ estimation skills, observation abilities, and awareness of standard measurement units such as centimeters and meters. It also prepares learners for</td></tr>
</table>

	c. Height of the student d. Width of the box e. Length of the cellphone 4. Do not use any measuring tools, just rely on your observation and estimation skills. 5. After all guesses are written, the actual measurements will be revealed. 6. Compare your guesses with the actual measurements and find out how close you were. 7. Reflect on your activity by answering the questions below. *Processing Questions:* 1. Which of your group's guesses was closest to the actual measurement? 2. What strategy did you use to make your estimates? 3. Which object was the most difficult to estimate accurately? Why? 4. How did your group decide on the final estimate for each object? 5. What did you learn about the importance of estimation in measurement?	accurate measurement activities by helping them recognize the importance of estimation in daily life. **2. Pedagogy and Strategies Used** The activity uses Game-Based Learning and Collaborative Learning strategies. Learners work in groups to discuss and justify their estimates before comparing them with actual measurements. The strategy encourages participation, critical thinking, communication, and cooperative learning while building confidence in making reasonable estimates. **3. Integration Components** a. Educational Technology (EdTech): ● Canva presentation ● LCD projector/Smart TV ● Digital display of actual measurements b. Literacy: ● Reading and interpreting instructions ● Oral discussion and explanation of estimation strategies ● Reflective questioning c. Scaffolded Integrative Performance Task (IPT): ● Learners begin with simple estimation tasks before progressing to actual measurement activities and real-world applications. **4. Facilitation Guide** a. Prepare the objects for estimation: ● chalk ● notebook ● cellphone ● box ● student height b. Divide the class into five groups. c. Present one object at a time and ask learners to estimate its measurement without using tools. d. Allow groups to discuss and record their answers. e. Reveal the actual measurements using measuring tools.

		f. Facilitate discussion using processing questions. g. Emphasize that estimation is a practical skill used in everyday situations. *You may access the activity online using the QR code.* https://kuyzztesting.my.canva.site/c9mf329q7bsmwgec *(Important Note: If the QR code is not working, please generate a new one using the link provided.)*
	A.2. Establishing the Purpose of the Lesson	
	Activity A.2. Appreciating Lesson Relevance **Designer's Dilemma** *Instructions* 1. Observe the Scenario: Look at the picture showing a real-life situation where correct measurement is essential. a. An interior designer fits a sofa into a small living room. b. A tailor measures a person for a custom-fit suit. c. A construction worker figuring out the flooring needed for a room. d. A product packager designing a box for a new item. 2. Think About the Dilemma: Imagine what problems could happen if the measurements in the scenario are wrong. a. What would happen if the sofa was too long? b. What if the tailor used the wrong body measurements? c. What if the worker ordered the wrong amount of wood? 3. Discuss and Share: Talk to your group or classmates about the possible consequences. Be ready to share your ideas with the class.	**Activity A.2. Appreciating Lesson Relevance** **Designer's Dilemma** **1. Description and Purpose of the Activity** "Designer's Dilemma" is an appreciating learning relevance activity where learners analyze real-life situations that require accurate measurement and estimation. Learners observe different professional scenarios involving interior design, tailoring, construction, and product packaging, then identify possible problems caused by incorrect measurements. Through group discussion, learners connect mathematical concepts on measurement to practical everyday applications and decision-making. The purpose of this activity is to help learners appreciate the importance of precision in measurement and understand how mathematical accuracy affects real-world tasks, safety, quality, cost-efficiency, and customer satisfaction. **2. Pedagogy and Strategies Used** This activity uses contextualized and collaborative learning strategies to deepen learners' understanding of practical measurement applications. By analyzing authentic scenarios, learners develop critical thinking and problem-

		solving skills while relating mathematical concepts to real-life professions and experiences. The activity also applies: ● **Inquiry-Based Learning** through guided questioning; ● **Collaborative Learning** through group discussion and sharing; ● **Experiential Learning** by connecting mathematical concepts to practical situations; ● **Constructivist Approach** where learners build understanding from observed scenarios and personal insights. **3. Integration Components** a. Educational Technology (EdTech) The teacher may present the scenarios using slides, digital images, interactive presentations, or short video clips to enhance visualization and engagement. Learners may also use online collaboration tools or digital discussion boards to share responses.  https://kuyzztesting.my.canva.site/c9mgzrrp9kzszpe1 b. Literacy The activity strengthens learners' comprehension, oral communication, and reasoning skills as they analyze situations, explain consequences, and articulate ideas during group discussions and class sharing. c. Scaffolded Integrative Performance Task (IPT) This activity prepares learners for future performance tasks involving real-life applications of measurement, estimation, design, budgeting, construction planning, and product development by emphasizing the importance of accuracy and precision.

		4**. Facilitation Guide** a. Present the scenarios using pictures, slides, or printed illustrations. b. Ask learners to carefully observe each situation and identify the role of measurement in completing the task successfully. c. Guide learners in imagining possible consequences of inaccurate measurements by asking probing questions such as: ● "What problems may occur if measurements are incorrect?" ● "How can wrong measurements affect time, cost, or safety?" d. Organize learners into small groups for discussion. e. Allow each group to share their insights and examples with the class. f. Synthesize learner responses by emphasizing the importance of precision, estimation, and measurement in everyday life and various professions. g. Relate the discussion to the lesson objective on practical applications of measurement. **Teacher's Note:** Encourage learners to provide examples from their own experiences, such as fitting furniture at home, buying clothes, or helping with construction or repairs. This strengthens relevance and learner engagement. **General Insight:** Accurate measurement is important because it ensures efficiency, safety, proper fitting, cost-effectiveness, and quality output in everyday tasks and professional work.

B. Instituting New Knowledge

B.1. Presenting Examples

Activity B.1. Exploring Key Concepts:

Measuring Station Tour Activity

Instructions:

1. Look at each object or space listed in the table.
2. Estimate its length, width, or height (choose the most reasonable dimension to measure) without using any measuring tool. Write your estimate in the Estimated Measurement column.
3. Use the appropriate measuring tool (ruler, meter stick, or tape measure) to find the Actual Measurement of the same object or space. Record it in the Actual Measurement column.
4. Find the Difference. Write the result in the last column.

Object/ Space	Estimated Measurement (cm)	Actual Measurement (cm)	Difference
Teacher's Table			
Blackboard			
Door			
Classroom Floor			
Window Jamb			

Processing Questions:

1. Which of your estimates came closest to the actual measurement? Why do you think you were able to estimate it accurately?
2. Which object or space was most difficult to estimate? What made it challenging?
3. What did you learn about the use of measurement tools (ruler, tape measure, meter stick)? Which tool was most useful for this activity, and why?

Activity B.1. Exploring Key Concepts:

Measuring Station Tour Activity

1. Description and Purpose of the Activity

The "Measuring Station Tour Activity" allows learners to estimate and measure actual classroom objects and spaces using appropriate measuring tools. The activity helps learners compare estimated and actual measurements and understand the importance of accuracy, proper tool use, and standard units in measurement.

2. Pedagogy and Strategies Used

The activity uses Rotational Learning and Experiential Learning strategies. Learners move through stations where they estimate, measure, compute differences, and reflect on their findings. Peer feedback and revision are incorporated to strengthen understanding and improve accuracy.

3. Integration Components

a. Educational Technology (EdTech):
- Canva presentation
- QR code activity guide

https://kuyzztesting.my.canva.site/c9mk5cm3ynctt73j

- Digital instructions through projector or Smart TV

b. Literacy:
- Reading tables and instructions
- Recording measurements and observations

Error Correction Cycle
Learners will follow this process:
1. Attempt. Learners estimate and measure each object independently or in groups.
2. Peer Feedback. Learners exchange outputs with a partner or nearby group and evaluate using a checklist.
3. Revise. Learners correct their estimates or measurements based on feedback.
4. Final Answer. Learners record a revised and improved final output.

Learners will check:
a. Is the estimate reasonable for the object size?
b. Is the correct unit used (cm or m)?
c. Was the measuring tool used correctly?
d. Is the difference computed accurately?
e. What suggestions can improve accuracy?

Peer Response Statement
Each learner will complete:
"My partner's estimate is _____. I agree/disagree because _____. A suggestion for improvement is _____."

- Explaining reasoning during peer discussion

c. Scaffolded Integrative Performance Task (IPT):
   - Learners progress from estimation to actual measurement and data comparison, preparing them for more complex real-life applications.

4. Facilitation Guide
a. Prepare measuring stations with the following objects/spaces:
   - teacher's table
   - blackboard
   - door
   - classroom floor
   - window jamb
b. Provide rulers, meter sticks, and tape measures.
c. Divide learners into groups and assign starting stations.
d. Instruct learners to estimate first before measuring.
e. Let learners record estimated and actual measurements and compute the difference.
f. Facilitate peer feedback and revision.
g. Conduct processing questions and reflection after all rotations.

B.2. Discussing the Concept

Activity B.2. Deepening Conceptual Understanding

Lesson Discussion on Estimate and Measure of Lengths and Distances

https://kuyzztesting.my.canva.site/c9mm9czq6kpt6vw9

	Instructions: 1. Prepare the Classroom Gather measuring instruments: ruler, measuring tape, trundle wheel, and odometer readings (or printouts). Arrange students in groups of 3-4. 2. Present the Concepts (Slides 1-3) Walk through estimation definition, body measurement examples, and measuring instruments. Ask: "Which instrument would you use to measure your desk?" Encourage predictions. 3. Interactive Practice (Slide 4) Let students solve estimation problems in groups before revealing answers. Have them discuss their strategies. Click to show answers and compare results. 4. Real-World Applications (Slides 5-6) Solve trundle wheel and odometer problems together. Demonstrate step-by-step solutions. Have students explain each calculation step. 5. Hands-On Activity Have groups measure classroom objects using different tools. Compare accuracy of body measurements vs. actual measurements. Discuss findings. *Teacher's Note:* • Encourage students to estimate BEFORE measuring • Ask why estimates differ from actual measurements • Connect to real-world scenarios (construction, travel, etc.)
	B.3. Developing Mastery (For complete instructions, please refer to the Learning Activity Sheet.)
	Activity B.3. Practicing the Skills on Estimating and Measuring Lengths and Distances **1. Description and Purpose of the Activity** "Practicing the Skills on Estimating and Measuring Lengths and Distances" provides learners with differentiated opportunities to apply estimation and measurement skills using real classroom objects. Through estimation, actual measurement, comparison, and reflection, learners strengthen their understanding of accuracy, standard units, and the importance of proper measuring techniques. **2. Pedagogy and Strategies Used** The activity uses Differentiated Instruction, Guided Discovery Learning, and Experiential Learning strategies. Learners are grouped according to readiness levels and perform tasks suited to their needs. Peer feedback, collaboration, and reflection are integrated to improve understanding and accuracy. **3. Integration Components** a. Educational Technology (EdTech): ● Canva activity sheets ● QR-coded digital activity guide

<table>
<tr><td></td><td colspan="2">

https://kuyzztesting.my.canva.site/c9mpax2jqw3t2h1y

● LCD projector or Smart TV for instructions

b. Literacy:
● Reading and interpreting instructions and tables
● Writing observations and reflections
● Explaining estimation strategies and measurement results

c. Scaffolded Integrative Performance Task (IPT):
● Learners move from estimation using nonstandard references to precise measurement using standard tools and analysis of accuracy and percentage error.

4. Facilitation Guide
a. Divide learners according to readiness levels:
● Tier 1: Learners needing support
● Tier 2: On-level learners
● Tier 3: Advanced learners
b. Provide the required activity sheets and measuring tools.
c. Instruct learners to:
● estimate measurements first,
● measure actual dimensions,
● compare results,
● compute differences or percentage errors.

d. Monitor learners and provide guidance during measurement and computation.
e. Facilitate peer feedback using the checklist provided.
f. Conduct reflection and discussion after the activity.</td></tr>
<tr><td rowspan="2">C. Demonstrating Knowledge and Skills</td><td colspan="2">C.1. Finding Practical Application</td></tr>
<tr><td>Activity C.1. Making Real-World Connections</td><td>Activity C.1. Making Real-World Connections

1. Description and Purpose of the Activity
“Making Real-World Connections” develops learners’</td></tr>
</table>

	Instructions: Work in groups or pairs. You will estimate first, then compare it with actual or provided measurements. Choose the appropriate participation option based on your learning needs: 1. Option A (Hands-on): Perform actual estimation and measurement in the classroom/school area. 2. Option B (Supported Data Use): Use teacher-provided pre-measured values and focus on estimation of comparison and analysis. 3. Option C (Digital/Simulation): Use digital measurement simulations or recorded videos/data provided by the teacher. Large-print visuals or step guides may be used when needed. Pair assistance is encouraged. ***Task 1: Measuring the Whiteboard*** ***1. Option A (Hands-on)*** a. Estimate the width of the whiteboard using your arm span or handspan. b. Count how many arm spans/handspans cover the whiteboard. c. Measure the actual width using a ruler or meter stick. ***2. Option B (Provided Data)*** a. Use the given estimate and actual measurement: ● Estimated: _____ arm spans ● Actual: _____ centimeters *b.* Compare and analyze the difference. ***3. Option C (Digital/Simulation)*** a. Watch the provided classroom video or simulation showing whiteboard measurement. b. Record estimated vs actual values. ***Processing Questions*** 1. Was your estimate close to the actual length? 2. What factors may have caused differences?	understanding of estimation and measurement through practical school-based tasks such as measuring the whiteboard, classroom door, and distance to the flagpole. The activity strengthens learners' ability to compare estimated and actual measurements while recognizing the importance of accuracy in real-life situations. **2. Pedagogy and Strategies Used** The activity uses Differentiated Instruction, Collaborative Learning, and Experiential Learning strategies. Learners participate through hands-on measurement, provided data analysis, or digital simulations depending on their learning needs and available resources. **3. Integration Components** a. Educational Technology (EdTech) ● Digital simulations/videos ● Canva presentation ● Cellphones or laptops for viewing measurement demonstrations b. Literacy ● Reading measurement data ● Explaining results and reflections ● Answering processing questions using mathematical vocabulary c. Scaffolded Integrative Performance Task (IPT) ● Learners apply estimation and measurement skills to authentic real-world contexts while analyzing accuracy and reflecting errors. **4. Facilitation Guide** a. Organize learners into groups or pairs. b. Allow learners to choose or assign participation modes: ● Hands-on ● Provided data ● Digital simulation c. Guide learners through the three measurement tasks: ● whiteboard measurement

	Task 2: Measuring the Distance to the Flagpole ***1. Option A (Hands-on)*** a. Estimate the distance from the classroom door to the flagpole using footsteps. b. Count natural walking steps. c. Compare with actual measured distance using tape measure. ***2. Option B (Provided Data)*** a. Estimated distance: _____ steps b. Actual distance: _____ meters c. Compute and compare accuracy. ***3. Option C (Digital/Simulation)*** a. Use provided map/video with step-count simulation or recorded walking data. ***Processing Question*** 1. How accurate was your estimation using footsteps? ***Task 3: Measuring the Classroom Door*** ***1. Option A (Hands-on)*** a. Estimate door height using handspan or notebook length. b. Count how many handspans/notebooks fit the height. c. Measure actual height using a meter stick. ***2. Option B (Provided Data)*** a. Estimated height: _____ handspans/notebooks b. Actual height: _____ cm c. Analyze the differences. ***3. Option C (Digital/Simulation)*** a. Use provided labeled image or measurement simulation. ***Processing Question*** 1. Which tool gave a more accurate result: a handspan or notebook? Why?	• flagpole distance • classroom door measurement d. Monitor learners during estimation and measurement. e. Provide scaffolds such as visual guides and peer support when necessary. f. Facilitate reflection and discussion after the activity. **6. Answer Key or Expected Responses** Possible learner responses: a. Estimates may differ due to varying handspan or step length. b. Standard measuring tools provide more accurate and consistent results. c. Estimation becomes more accurate when familiar references are used. d. Measurement is important in construction, design, travel, and everyday activities.

Final Reflection

1. What did you learn about estimation and measurement?
2. Why is it important to compare estimates with actual measurements in real life?

Rubrics:

Criteria	4 – Excellent	3 – Proficient	2 – Developing	1 – Beginning
Accuracy of Estimation and Measurement	Estimates are highly accurate and very close to actual measurements (difference of less than 5%). Shows clear understanding of measurement concepts.	Estimates are mostly accurate and close to actual measurements (difference of 5–10%). Demonstrates a good understanding of measurement concepts.	Estimates show partial accuracy but significant differences from actual measurements (difference of 10–20%). Shows developing understanding.	Estimates are far from actual measurements (difference greater than 20%). Shows minimal understanding of measurement concepts.
Use of Appropriate Tools and Techniques	Consistently uses suitable tools (arm length, footsteps, notebook, etc.) effectively and records data neatly and correctly.	Use appropriate tools correctly most of the time and records measurements with minor errors.	Uses tools inconsistently or with some errors in measurement or recording.	Uses inappropriate tools or fails to record measurements accurately.
Group Collaboration and Participation	All members actively participate, share ideas, and cooperate effectively throughout the task.	Most members participate and cooperate with minimal prompting.	Some members participate, but others are passive or less involved.	Little to no collaboration; task is completed by one or two members only.

Data Recording and Presentation	Data is complete, well-organized, and clearly presented with accurate comparisons and neat work.	Data is mostly complete and organized with minor inaccuracies or untidy presentations.	Data is incomplete or disorganized with noticeable inaccuracies.	Data is missing, unclear, or poorly presented.
Reflection and Analysis	Responses to processing questions are insightful, clearly explaining accuracy, differences, and real-life application of estimation.	Responses show clear understanding with some reflection on accuracy and differences.	Responses show limited reflection or partial understanding of results.	Responses are minimal, unclear, or missing.

Scoring Guide:
16–20 points: Excellent understanding and application
11–15 points: Proficient performance
6–10 points: Developing skills and understanding
1–5 points: Beginning stage; needs significant improvement

C.2. Making Generalization

Activity C.2. Wrapping Up the Lesson

What Have We Learned?

Instructions:
Read the guide questions below and complete the sentences.

1. What do we mean by estimation measurements?
   Estimation is_____.
2. Why do we need to estimate before measuring?
   Estimation helps us _____.
3. What does measurement mean in mathematics?
   Measurement is _____.

Activity C.2. Wrapping Up the Lesson

What Have We Learned?

This activity serves as a reflective consolidation exercise where learners summarize and articulate their understanding of estimation, measurement, tools, and accuracy. By completing guided sentence prompts, learners actively construct their own generalizations based on prior activities (estimation of games, measuring stations, problem-solving, and practical applications).

	4. What are some tools we use in measuring lengths and distances? The tools I learned are _____. 5. Why is accuracy important when measuring? Accuracy is important because _____.	This activity is to help learners consolidate and articulate their understanding of estimation and measurement concepts. By completing the guide questions, learners will: Reflect on what they have learned about estimation, measurement, and accuracy. Summarize key mathematical ideas using their own words. Demonstrate comprehension of when and why estimation and accurate measurement are important in daily life. Strengthen their ability to use appropriate mathematical vocabulary in expressing their understanding. Connect classroom learning to real-world applications, promoting deeper conceptual understanding. To facilitate this activity, you may apply one of the strategies below. **Strategy 1: Guided Reflection Questions** *Instructions:* 1. Tell learners to pause and reflect on what we have learned about estimation and measurement. 2. Present the guide questions and incomplete sentences on the board or projector. 3. Answer these prompts based on your own understanding and experiences from our activities. 4. Ask learners to work silently for a few minutes to complete each sentence. 5. Highlight similarities and differences in responses. 6. Work with the class to build a collective summary for each prompt. 7. Write down key points on the board as the "class generalization."

		Strategy 2: Guided Discovery Learning Strategy *Instructions:* 1. Begin by saying: "Let's recall what we experienced in our previous activities about estimating and measuring. Think about what you did and what you discovered." 2. Show incomplete sentences/questions (estimation, measurement, tools, and accuracy). 3. Tell learners to construct your own meaning by answering these prompts using your experiences. 4. Group learners into pairs or small groups. 5. Ask them to discuss and complete the sentences together. 6. Encourage them to explain their reasoning and use examples from the activities. 7. Let groups present their completed sentences. 8. Record their answers on the board Together, synthesize the responses into a class-agreed generalization for each question.
	C.3. Evaluating Learning (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity C.3. Assessing Learning Outcomes **Assessing Mastery** This activity assesses whether learners have mastered key concepts of estimation, measurement, and practical applications. Through multiple-choice questions, learners demonstrate their ability to choose appropriate tools, perform calculations, and apply estimation and measurement in real-life contexts. It reinforces the connection between classroom learning and everyday tasks while providing a quick and effective way to evaluate understanding. Overall, it ensures that learners can reason, apply, and reflect on what they have learned	
	C.4. Additional Activities (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity C.4. Extending and Reinforcing Learning **More Real-Life Problems on Measurement** This activity supports both enrichment and remediation by engaging learners in real-life problem-solving that applies estimation, measurement, and computation skills. It helps struggling learners strengthen their understanding through guided practice and concrete examples, while providing advanced learners with opportunities for higher-order thinking and real-world application.	

	Overall, the task enhances mathematical reasoning, accuracy, and problem-solving skills through meaningful and practical contexts. The purpose of this activity is to enable learners to apply their understanding of estimation, measurement, and basic mathematical operations to solve real-life problems. Through these tasks, learners will: ● Demonstrate the ability to use estimation and precise measurement in practical situations. ● Apply problem-solving strategies involving length, distance, and cost computation. ● Strengthen their skills in converting real-world contexts into mathematical expressions. ● Recognize the importance of accuracy and estimation in everyday decision-making. ● Develop logical reasoning and analytical thinking through step-by-step problem-solving. For remediation, provide learners with simpler one- or two-step problems that focus on basic estimation, measurement, and computation skills. For learners who need enrichment, assign more complex, multi-step problems that require analysis, reasoning, and the extended application of estimation and measurement in practical contexts. The remediation and enrichment activities may access here: https://kuyzztesting.my.canva.site/c9mrfcddg12c835z	
III. CONTENT	**Lesson 9.2. Calculating Area and Perimeter for Practical Purposes**	
IV. OBJECTIVES	At the end of the lesson, the learners are able to: 1. calculate the area and perimeter of rectangular, square, triangular, circular and composite residential spaces; 2. solve contextual problems involving room renovation and garden lay-outing; and 3. Explain in writing or orally at least two uses of area and perimeter in home improvement and budgeting tasks based on the performance activity.	
V. PROCEDURES	**LEARNERS ACTIVITIES**	**ANNOTATION**
A. Activating Prior Knowledge	*A.1. Eliciting Prior Knowledge*	
	Activity A.1. Leveling Learners Readiness **Everyday Objects Around Us – Measuring Real-Life Shapes** *Instructions:* 1. Group Formation and Role Assignment a. Learners will be grouped into 3–4 members.	**Activity A.1. Leveling Learners Readiness** **Everyday Objects Around Us: Measuring Real-Life Shapes** **1. Description and Purpose of the Activity** This activity activates learners' prior knowledge on estimation and measurement through the identification and measurement

	b. Each member will assume a specific role in ensuring active participation: ● Measurer – uses ruler or tape measure to get accurate measurements ● Recorder – writes all collected data in the table provided ● Sketch Artist – draws the selected objects neatly and correctly labeled ● Checker/Reporter – verifies the accuracy of measurements and presents group output to the class 2. Object Identification a. Each group will explore the classroom and identify real-life objects representing the following shapes: ● Rectangle – (e.g., table, book, window, whiteboard) ● Square – (e.g., tile, notebook, sticky note) ● Circle – (e.g., wall clock, plate, lid, fan cover) b. Choose ONE object per shape (total of 3 objects only). 3. Estimation and Measurement Process For each selected object: a. Estimate the measurement before using any tool. b. Use a ruler or tape measure to obtain actual measurements: ● Rectangle: measure length and width ● Square: measure one side ● Circle: measure diameter c. Compare estimated and actual measurements.	of common classroom objects representing basic geometric shapes (rectangle, square, and circle). Learners are engaged in comparing estimated and actual measurements to strengthen their understanding of measurement accuracy, spatial reasoning, and the real-world application of geometry. The activity also develops teamwork, communication, and observation skills as learners collaborate in small groups. **2. Pedagogy and Strategies Used** The activity employs Experiential Learning, Collaborative Learning, and Inquiry-Based Learning strategies. Learners actively explore their immediate environment, estimate measurements based on prior knowledge, and verify results using measuring tools. Role assignments promote responsibility and active participation, while reflection questions encourage metacognitive thinking about estimation accuracy and teamwork dynamics. **3. Integration Components** a. Educational Technology (EdTech) ● Optional use of mobile phones for documenting objects through photos Canva or worksheet templates for recording and presenting outputs b. Literacy ● Reading and interpreting measurement tables ● Writing clear comparisons between estimated and actual values ● Using appropriate mathematical vocabulary (length, width, diameter, accuracy, difference) ● Expressing reflections in complete and coherent sentences c. Scaffolded Integrative Performance Task (IPT) ● Learners integrate estimation, measurement, sketching, and data comparison in a single performance task ● Encourages application of mathematical concepts in real-life classroom contexts

4. Recording Data
Complete the table below:

Shape	Object Identified	Estimated Measurement	Actual Measurement	Unit Used	Difference (Estimate vs Actual)
Rectangle		Length: ____ Width: ____	Length: ____ Width: ____	cm / m	
Square		Side: ____	Side: ____	cm / m	
Circle		Diameter: ____	Diameter: ____	cm / m	

5. Sketching and Labeling
   a. Draw each object in the space provided in your worksheet.
   b. Label the dimensions clearly (length, width, side, or diameter).
   c. Ensure drawings are neat and proportional.

6. Presentation
   a. The Reporter will present the group's findings.
   b. Include:
      - Objects chosen
      - Estimated vs actual measurements
      - What they observed about estimation accuracy

7. Reflection
   a. Which was easier: estimating or measuring? Why?
   b. How important is measurement in real-life situations?
   c. What did your group learn about teamwork during the activity?

- Promotes accuracy analysis and reflective thinking based on observed errors

4. Facilitation Guide

a. Organize learners into groups of 3–4 and assign specific roles (Measurer, Recorder, Sketch Artist, Checker/Reporter).
b. Guide learners identify classroom objects that represent rectangle, square, and circle.
c. Ensure availability of measuring tools such as rulers or tape measures before starting the activity.
d. Monitor learners during estimation and measurement to ensure accuracy and proper use of tools.
e. Provide scaffolding support for learners who struggle with estimation or measurement (e.g., modeling one example first).
f. Encourage collaboration and equitable participation among group members.
g. Facilitate discussion during presentation and guide learners in comparing estimation vs actual results.
h. Lead reflection by asking learners to connect the activity to real-life applications of measurement.

A.2. Establishing the Purpose of the Lesson

Activity A.2. Appreciating Lesson Relevance

Why Measures Matter: Renovation Challenge

Part 1: Observe & Compare

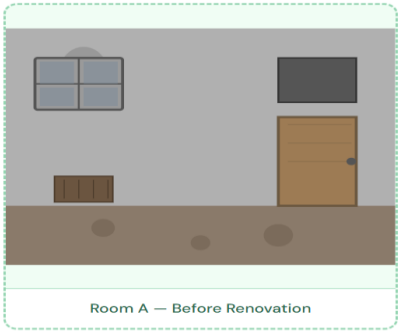
1. Look carefully at the pictures provided.

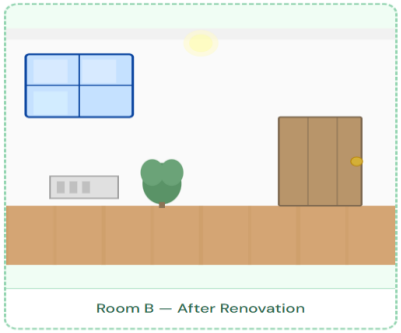
Activity A.2. Appreciating Lesson Relevance

Why Measures Matter: Renovation Challenge

1. Description and Purpose of the Activity

This activity develops learners' understanding of area and perimeter through real-life renovation contexts. Learners analyze visual differences, identify appropriate measurements for materials, and solve practical scenarios involving painting,





2. Complete the following:
   a. List 3 differences you notice between the images.
   b. Imagine you are renovating these spaces. Identify 2 items you would need to buy. For each item, write:
      - The item name
      - Which measurement you need: area or perimeter

Part 2: Renovation Scenarios

1. Your teacher will present real-life renovation scenarios.
   - You want to paint a rectangular wall in your classroom that is 4 meters high and 6 meters wide.
   - Your kitchen floor measures 3 meters by 5 meters, and you need to buy tiles to cover the entire floor.
   - You want to build a fence around your rectangular backyard that measures 8 meters by 12 meters.
   - You have a rectangular flower bed 2 meters wide and 5 meters long, and you want to put a decorative border around it.
   - A living room measures 4 meters by 7 meters, and you plan to cover the floor with a carpet.
2. In your group, discuss and decide:
   - Is this an area or perimeter problem?
   - Which formula will you use?
3. Try to estimate the measurement before calculating. Discuss why estimation is useful in real life.

flooring, fencing, and decorating. The activity strengthens conceptual understanding of measurement, estimation skills, and decision-making in choosing the correct mathematical approach for real-world problems. It also encourages learners to reflect on how measurement supports planning, budgeting, and efficient resource use.

2. Pedagogy and Strategies Used

The activity applies to Problem-Based Learning (PBL), Collaborative Learning, and Inquiry-Based Learning strategies. Learners engage in meaningful tasks that simulate real-life renovation decisions, requiring them to interpret situations, justify mathematical choices, and apply formulas correctly. Estimation before computation promotes a number of sense and practical reasoning, while group discussion enhances communication and shared understanding.

3. Integration Components

a. Educational Technology (EdTech)
   - Use of printed visuals or digital images of renovation spaces
   - QR code access to scenario-based learning materials (if available)
   - Optional use of mobile devices for viewing examples or checking formulas
   - Canva or presentation tools for group reporting outputs

b. Literacy
   - Reading and interpreting real-life mathematical scenarios
   - Explaining reasoning in choosing area or perimeter
   - Writing structured responses in observation and reflection tasks
   - Using appropriate mathematical vocabulary (area, perimeter, estimate, measurement, formula)

	Part 3: Reflection Answer the following: 1. What helped you decide whether to use an area or perimeter? 2. How can knowing these measurements help you at home, at school, or in other real-life situations? 3. What questions do you have that you want your teacher to answer during the lesson?	b. Scaffolded Integrative Performance Task (IPT) • Learners integrate visual analysis, estimation, and mathematical reasoning • Application of area and perimeter concepts in authentic renovation situations • Encourages justification of decisions and reflection on real-life usefulness of measurement **4. Facilitation Guide** a. Present clear and engaging visuals for the observation task before discussion begins. b. Group learners and assign roles if needed to ensure active participation. c. Guide learners in identifying differences between images and linking them to measurement concepts. d. Facilitate discussion in Part 1(b) by prompting learners to justify why an item requires an area or perimeter. e. Present renovation scenarios clearly and allow group discussion before answering. f. Emphasize correct identification of formulas: • Area = length × width • Perimeter = 2(l + w) for rectangles g. Encourage estimation before solving to build practical reasoning and real-world understanding. h. Monitor group discussions and provide scaffolding support when needed. i. Facilitate reflection and connect learning to real-life applications such as home improvement and budgeting.
B. Instituting New Knowledge	*B.1. Presenting Examples*	
	Activity B.1. Exploring Key Concepts **Measure It Right!** *Instructions:* The problems are examples of real-life scenarios where area and perimeter apply. Study each problem and answer the questions provided.	**Activity B.1. Exploring Key Concepts** **Measure It Right!** **1. Description and Purpose of the Activity** This activity strengthens learners' conceptual understanding of area and perimeter through structured real-life examples involving rectangular, triangular, and circular shapes. Learners

	Example 1. **The Classroom Bulletin Board** The Grade 11 learners are decorating a rectangular bulletin board that measures 2 meters long and 1.5 meters wide. They plan to: 1. Paste colored paper to cover the whole board, and 2. Put a ribbon border around the edges. **Formula Bank & Guided Steps** **Area Formulas:** Rectangle: Triangle: Circle: **Perimeter / Circumference:** Rectangle: Triangle: **Guided Support (For Learners Who Need Help)** 1. What shape is the bulletin board? _____ 2. Which measurement is for covering the surface? _____ 3. Which measurement is for the edge? _____ 4. Formula hint: a. Area = l × w b. Perimeter = 2(l + w) **Questions:** 1. What quantity do they need to find if they want to know how much colored paper to buy? 2. What quantity do they need to find if they want to know how long the ribbon should be? **Computation (for checking):** Area = 2 × 1.5 = 3 m² Perimeter = 2(2 + 1.5) = 7 m *Example 2***. Designing a Triangular Metal Sign Plate** The TechPro learners at Agay National High School -Senior High School are asked to make a triangular warning sign plate for the welding area. The triangular plate has a base of 40 cm and a height	analyze practical situations such as decorating a bulletin board, designing a metal sign plate, and repainting a sports facility. The activity develops learners' ability to distinguish between area and perimeter, apply appropriate formulas, and interpret measurement results in real-world contexts. It also reinforces problem-solving, estimation, and mathematical reasoning skills. **2. Pedagogy and Strategies Used** The activity employs Direct Instruction with Guided Discovery, Scaffolded Learning, and Inquiry-Based Problem-Solving strategies. Guided support questions assist struggling learners in identifying correct concepts, while structured examples gradually build complexity. Fast finishers are challenged with extension questions to promote higher-order thinking and conceptual generalization. **3. Integration Components** a. Educational Technology (EdTech) ● Use of visual aids or projected diagrams of shapes (rectangle, triangle, circle) ● Optional digital simulations or GeoGebra demonstrations for area and perimeter ● Presentation slides (PowerPoint/Canva) for step-by-step problem breakdown ● Calculator use for checking computations (especially for π-based problems) b. Literacy ● Reading and interpreting multi-step mathematical problems ● Understanding instructional verbs (find, determine, compute, compare) ● Explaining reasoning in distinguishing area vs perimeter ● Writing complete mathematical statements in answers and reflections c. Scaffolded Integrative Performance Task (IPT) ● Learners progress from guided questions → structured examples → independent reasoning

	of 30 cm. Each side of the triangle measures 40 cm, 50 cm, and 60 cm. Before attaching the sign to the wall, they must: ● Paint the front surface of the metal plate, and ● Weld a thin metal border around its sides for protection. **Questions**: 1. What quantity should the learners find to know how much paint to use? 2. What quantity should they find to know how long the welded border should be? **Computation (for checking**): Area = ½ × base × height = ½ × 40 × 30 = 600 cm² Perimeter = 40 + 50 + 60 = 150 cm **Therefore:** ● The area of the triangular sign plate is 600 cm², which represents the surface to be painted. ● The perimeter is 150 cm, which represents the total length of the welded border. *Example 3.* **Designing a Shot Put Circle** The athletics coordinator of Agay National High School asks the Grade 11 learners to help repaint the shot-put throwing area in preparation for the school's sports fest. The shot-put circle is circular with a radius of 1.5 meters. The learners must repaint the entire surface of the circle and mark the boundary line around it with white paint. *(Round answer to the nearest hundredths.)*	● Integration of formula application, computation, and interpretation of results ● Encourages conceptual transfer across different geometric shapes **4. Facilitation Guide** a. Present each example one at a time to ensure clear understanding of concepts. b. Begin with guided support questions before proceeding to computation tasks. c. Emphasize the distinction between area (surface coverage) and perimeter (boundary length). d. Encourage learners to use formulas correctly: • Rectangle: $A = l \times w$, $P = 2(l + w)$ • Triangle: $A = \frac{1}{2}bh$, $P = sum\ of\ all\ sides$ • Circle: $A = \pi r^2$, $C = 2\pi r$ e. Allow peer discussion before confirming answers to promote collaborative learning. f. Provide scaffolding for learners who struggle with formula recall or substitution. g. Challenge fast finishers using the extension questions to deepen conceptual understanding. h. Summarize each example by explicitly linking it to real-life applications.

	Questions: 1. What quantity should the learners find to know how much area of the circle needs to be repainted? 2. What quantity should they find to determine how long the white boundary line should be? **Expected Answers**: Repainting → Area Boundary line → Perimeter (Circumference) **Computation (for checking)**: Given: r=1.5m Area = πr^2 = 3.14 × (1.5m) ² = 3.14 × 2.25m^2 = 7.065 m^2 = 7.07 m^2 Perimeter (Circumference) = 2πr = 2 × 3.14 × 1.5m = 9.42 m **Therefore:** The area of the shot-put circle is 7.07 m^2, representing the surface to repaint. The circumference is 9.42 m, representing the total length of the boundary line to mark. **Challenge Prompt (For Fast Finishers)** 1. What would happen to the area if the length is doubled? 2. How will the perimeter change if both dimensions increase?	
	B.2. Discussing the Concept	
	Activity B.2. Deepening Conceptual Understanding **Discussing Concepts: Design, Measure, Decide** *Instructions:* 1. Choose ONE problem based on your group's readiness level. 2. Solve the problem collaboratively. 3. Answer the processing questions after solving. 4. Present your solution and explanation.	**Activity B.2. Deepening Conceptual Understanding** **Discussing Concepts: Design, Measure, Decide** **1. Description and Purpose of the Activity** This activity develops learners' conceptual understanding of area, perimeter, and real-life spatial reasoning through differentiated problem-solving tasks. Learners work collaboratively to solve contextual problems involving room

	LEVEL 1: BASIC Problem: Small Room Makeover A rectangular room measures 4 m by 3 m. The owner wants to: ● Install tiles on the floor ● Put a fence-like trim around the room edges for design Tasks: 1. Find the area of the floor. 2. Find the perimeter of the room. 3. Identify what measurement is used for tiles and for trim. Processing Questions: 1. What does area represent in this problem? 2. Why is perimeter important for the trim? 3. What units were used for area and perimeter? 4. What shape is the room? **LEVEL 2: MODERATE** Problem: House Extension + Garden Layout A homeowner plans: ● Living room: 5 m × 4 m ● Adjacent garden: 3 m × 2 m ● Fence will surround the garden only ● Tiles will be installed in the living room Tasks: 1. Compute the area of the living room 2. Compute the perimeter of the garden 3. Sketch a simple layout of both spaces *Processing Questions*: 1. Why do we use area for flooring but perimeter for fencing? 2. What shapes are involved in this problem? 3. How do dimensions help in planning spaces? 4. What could happen if measurements are incorrect?	design, garden planning, and space optimization. The activity emphasizes decision-making by requiring learners to choose appropriate mathematical concepts and justify their solutions. It also strengthens learners' ability to interpret measurements in practical situations such as construction, landscaping, and resource planning. **2. Pedagogy and Strategies Used** The activity applies to Differentiated Instruction, Collaborative Learning, and Inquiry-Based Problem-Solving strategies. Learners select tasks based on readiness levels (Basic, Moderate, Advanced), allowing for personalized learning pathways. Through group discussion and guided questions, learners construct understanding of when to use area or perimeter and apply estimation skills in real-life scenarios. **3. Integration Components** a. Educational Technology (EdTech) • Optional use of drawing tools (Canva, PowerPoint, or paper sketches) for layout design • Projected visuals of room and garden setups • Calculator use for circular computations in advanced tasks • Possible GeoGebra simulation for shape visualization b. Literacy • Reading and interpreting multi-step mathematical problems • Explaining reasoning in selecting area or perimeter • Writing structured responses during processing questions • Using mathematical vocabulary such as area, perimeter, radius, estimate, and optimization c. Scaffolded Integrative Performance Task (IPT) • Learners progressively engage in problem-solving from basic shapes to complex optimization tasks • Integration of geometry concepts with real-life decision-making

LEVEL 3: ADVANCED

Problem: Outdoor Cooking & Space Optimization

A circular grill has a radius of 20 cm. A family wants to cook:

- Fish (100 cm^2 each)
- Chicken (150 cm^2 each)

They want to maximize food while ensuring proper cooking space.

Tasks:

1. Compute the area and circumference of the grill
2. Estimate how many fish and chicken pieces can fit
3. Decide a balanced combination of fish and chicken

Processing Questions:

1. What does the area of the grill represent in real life?
2. Why is overcrowding not recommended in cooking?
3. How does estimation help in real-life situations?
4. What decisions did your group make to optimize space?

- Encourages justification of answers and interpretation of spatial efficiency

4. Facilitation Guide

a. Divide learners into groups of 3–5 and assign readiness-based task levels (Basic, Moderate, Advanced).
b. Ensure each group understands their assigned problem before starting.
c. Encourage collaborative discussion before computations.
d. Guide learners in distinguishing between area (surface) and perimeter (boundary).
e. Require sketches for Level 2 to support spatial understanding.
f. Monitor group discussions and provide scaffolding when necessary.
g. Facilitate presentation of solutions and encourage clear mathematical explanations.
h. Lead a class discussion focusing on how measurement supports real-life decisions.

B.3 Developing Mastery (For complete instructions, please refer to the Learning Activity Sheet.)

Activity B.3. Practicing Learned Skills

Practice Problems on Area and Perimeter

1. Description and Purpose of the Activity

This activity provides learners with structured practice in solving real-life problems involving area and perimeter. Through a home improvement context, learners apply formulas for rectangles, triangles, and circles to compute measurements needed for tiling, gardening, and installing fixtures. The activity strengthens procedural fluency, conceptual understanding, and the ability to interpret mathematical results in practical budgeting and planning situations.

2. Pedagogy and Strategies Used

The activity uses Guided Practice, Problem-Based Learning (PBL), and Application-Based Learning strategies. Learners independently solve contextual problems after reviewing earlier concepts, reinforcing mastery through repeated application. Real-life scenarios promote meaningful learning and help learners connect geometry concepts to household decision-making.

<table>
<tr><td></td><td colspan="2">3. Integration Components
a. Educational Technology (EdTech)
• Use of calculators for computation accuracy
• Optional GeoGebra or visual geometry tools for shape illustration
• Digital worksheets or Canva templates for answering
• Projected visuals of kitchen, garden, and fountain for contextual understanding
b. Literacy
• Interpreting multi-part word problems
• Explaining solutions using complete sentences
• Using correct mathematical vocabulary (area, perimeter, circumference, radius, base, height)
• Justifying answers in relation to real-life applications
c. Scaffolded Integrative Performance Task (IPT)
• Learners integrate formulas for multiple shapes in a single real-life scenario
• Application of reasoning across different geometric contexts
• Emphasis on interpreting results for budgeting and home improvement decisions

4. Instructions for Teachers / Facilitation Guide
a. Review key formulas before starting the activity:
● Rectangle: $A = l \times w$, $P = 2(l + w)$
● Triangle: $A = \frac{1}{2}bh$, $P = sum\ of\ sides$
● Circle: $A = \pi r^2$, $C = 2\pi r$
b. Encourage learners to solve step-by-step and show complete solutions.
c. Allow learners to work individually or in pairs depending on readiness level.
d. Provide scaffolding support for learners who need help with formula substitution.
e. Remind learners to include correct units in all answers (m², m, cm²).
f. Facilitate checking of answers and discuss common errors after completion.
g. Emphasize the importance of accuracy in real-life budgeting and construction planning.</td></tr>
<tr><td rowspan="2">C. Demonstrating Knowledge and Skills</td><td colspan="2">C.1. Finding Practical Application</td></tr>
<tr><td>Activity C.1. Making Real-World Connection

Home Makeover

Instructions:
Groups will be assigned or may select a level based on readiness. Teacher may adjust grouping to ensure balanced collaboration. Support tools such as formula charts, sample layouts, and guided computation sheets will be provided for Level 1 learners.
1. Work in groups of 3–4 learners. Each group will act as a mini home renovation team.</td><td>Activity C.1. Making Real-World Connection

Home Makeover

1. Description and Purpose of the Activity
This culminating performance task engages learners in designing, analyzing, and budgeting a real-life home or garden renovation project. Learners apply their understanding of area and perimeter to create layouts, compute measurements, and estimate costs for materials such as paint, tiles, fencing, and flooring. The activity promotes deeper conceptual mastery by</td></tr>
</table>

	2. Choose Your Project Select ONE project based on your group's level: a. Level 1 – Basic ● Rectangular room renovation only ● Simple rectangular garden layout b. Level 2 – Intermediate ● Room with 2–3 connected rectangles ● Garden with two sections (e.g., lawn + flower bed) c. Level 3 – Advanced ● Irregular layout combining different shapes (rectangle, triangle, or circle section) ● Mini house or complex garden design with multiple zones and features 3. Design Stage a. On manila paper or graphing paper, create a simple floor plan or garden layout. Label all sides with correct measurements (length and width). b. Digital Alternative (Accessibility Option): You may also design using: ● Canva ● PowerPoint / Google Slides ● Mobile drawing apps c. Submit a draft layout for teacher checking BEFORE final computations 4. Measurement Stage Follow these steps carefully: a. Identify Shapes ● What shapes are present in your design? b. Find the Perimeter ● Use for fences, borders, and wall moldings c. Find the Area ● Use for tiles, paint, grass, or flooring d. Show complete solutions with correct units	integrating geometry, estimation, and financial literacy in a collaborative and authentic context. It also develops learners' creativity, critical thinking, and decision-making skills through real-world problem solving. **2. Pedagogy and Strategies Used** The activity is anchored on Project-Based Learning (PBL), Differentiated Instruction, and Collaborative Learning strategies. Learners work in teams to design, compute, and justify their renovation plans. Differentiation is embedded through leveled task options (Basic, Intermediate, Advanced), allowing learners to engage based on readiness. The task promotes inquiry, creativity, and application of mathematical concepts in authentic situations while encouraging teamwork and communication. **3. Integration Components** a. Educational Technology (EdTech)• Canva, PowerPoint, ● Google Slides for digital layout design ● Mobile drawing applications for sketching floor plans ● Optional GeoGebra or digital graphing tools for shape construction ● Spreadsheet tools (Excel/Google Sheets) for budgeting and cost computation b. Literacy ● Reading and interpreting task instructions and price lists ● Writing clear explanations for design and budgeting decisions ● Using mathematical vocabulary (area, perimeter, cost per square meter, layout, budget) ● Presenting and defending group outputs orally c. Scaffolded Integrative Performance Task (IPT) ● Learners integrate geometry (area and perimeter), estimation, and financial computation

	5. Budget Stage a. Apply Price List ● Use the price list provided by your teacher (e.g., cost per meter or per square meter). b. Compute Total Cost ● Fence/border cost = perimeter × cost per meter ● Material cost = area × cost per square meter ● Add all costs for total budget c. Submit a draft budget computation BEFORE final presentation 6. Final Output & Presentation Each group will: a. Present final layout b. Show all computations (area, perimeter, cost) c. Explain design and budgeting decisions d. Discuss real-life importance of measurement 7. Extension Task (Advanced Learners) For Level 3 or fast finishers: a. Redesign your layout to reduce total cost b. Compare two possible designs and choose the most cost-efficient one c. Explain why your final design is better in terms of budget and function 8. Reflection Questions a. How are area and perimeter used in real-life home planning? b. What challenges did your group face in budgeting? c. How did your group decide on the final design?	● Progression from planning → designing → computing → budgeting → presenting ● Encourages real-life application of mathematical reasoning in home planning and resource management **4. Facilitation Guide** a. Organize learners into groups of 3–4 and assign collaborative roles (designer, measurer, recorder, presenter). b. Guide learners in selecting appropriate task levels (Basic, Intermediate, Advanced) based on readiness. c. Ensure learners understand the difference between area (surface coverage) and perimeter (boundary measurement). d. Require submission of draft layout and budget computation before final presentation for feedback and revision. e. Provide scaffolding tools such as sample layouts, formula guides, and price lists. f. Monitor group progress during design and computation stages to ensure accuracy and participation. g. Facilitate presentation and encourage learners to explain design choices and budgeting decisions. h. Lead reflection discussion focusing on real-life applications of measurement in planning and construction.

Criteria	Outstanding (5)	Very Satisfactory (4)	Satisfactory (3)	Needs Improvement (2)	Beginning (1)
1. Accuracy of Computations (Area, Perimeter, Budget)	All computations are correct; correct formulas used consistently; no errors in area, perimeter, and budget.	Minor errors in computation but the correct method is evident.	Some correct answers but with noticeable errors in computation or formula use.	Frequent errors; incomplete or incorrect solutions.	No correct computations or no solution is shown.
2. Design Quality and Completeness of Layout	Layout is complete, accurate, well-labeled, and highly organized; realistic and easy to interpret.	Layout is complete with minor labeling or measurement errors.	Layout is present but lacks clarity or has missing labels/measurements.	Layout is incomplete or unclear; difficult to interpret.	No layout submitted or output is not related to task.
3. Budgeting and Real-Life Application	Budget is accurate, complete, and logically computed; strong real-life application.	Budget is mostly correct with minor computational errors.	Budget is partially correct but incomplete or unclear.	Budget is incorrect or missing key components.	No budget is submitted.
4. Creativity, Practicality, and Innovation	Highly creative, practical, and well-planned design.	Some creativity shown but lacks strong practicality or detail.	Basic design with limited creativity or effort.	Minimal creativity; design lacks effort.	No creativity or irrelevant output.
5. Collaboration and Presentation	All members actively participated; presentation is clear and well-organized.	Most members participated; presentation is generally clear.	Uneven participation; presentation lacks clarity in some parts.	Poor participation; unclear presentation.	No presentation or collaboration is observed.

Scoring Guide:

- 23–25 → Outstanding
- 19–22 → Very Satisfactory
- 14–18 → Satisfactory
- 8–13 → Needs Improvement
- 1–7 → Beginning

	C.2. Making Generalization	
	Activiti C.2. Wrapping-up the Lesson **Complete the Builder's Guide** *Instructions* 1. Divide the class into groups with 4–5 members. Each group will collaborate as a mini construction and design team. 2. Each group will receive a worksheet titled: "Builder's Guide: Area & Perimeter in Real Life" The guide contains incomplete statements based on lessons about: ● Room renovation ● Garden layout design ● Real-life measurement applications 3. Discuss within your group and complete each statement. Your answers must include: ● Understanding of area and perimeter ● Correct use of mathematical ideas ● Real-life applications (e.g., tiling, fencing, painting, budgeting) 4. Before presenting, your group must check the following: ☐ We understand the difference between area and perimeter ☐ We completed all statements correctly ☐ We explained answers using real-life situations ☐ All members contributed to the discussion ☐ We reviewed our answers for accuracy Only groups who complete this checklist may proceed to the presentation. 5. Each group will: a. Present their completed Builder's Guide b. Explain their answers clearly c. Share how area and perimeter apply to real-life situations	**Activiti C.2. Wrapping-up the Lesson** **Complete the Builder's Guide** **1. Description and Purpose of the Activity** This activity serves as a culminating generalization task that reinforces learners' understanding of area and perimeter through collaborative completion of concept-based statements. Learners synthesize key ideas from previous lessons and apply them to real-life contexts such as renovation, gardening, and budgeting. The activity strengthens conceptual mastery by requiring learners to explain mathematical ideas in their own words and connect them to practical situations. It also promotes peer learning and evaluation to deepen understanding and communication skills. **2. Pedagogy and Strategies Used** The activity utilizes Collaborative Learning, Peer Instruction, and Constructivist Learning strategies. Learners actively construct knowledge by completing incomplete statements and discussing their reasoning within groups. Peer assessment encourages critical thinking and reflective evaluation of mathematical understanding. The checklist system promotes accountability and ensures readiness before presentation. **3. Integration Components** a. Educational Technology (EdTech) • Digital or printed "Builder's Guide" worksheets • Optional use of presentation tools (PowerPoint/Canva) for group reporting • Mobile devices for reference images or formula checking • Interactive rubric tools (if available) for peer assessment recording b. Literacy • Completing structured mathematical statements using correct terminology

6. After each presentation, groups will assess ONE other group using the criteria below:

Peer Assessment Guide (1–5 Scale)

Criteria	5	4	3	2	1
Understanding of Area & Perimeter	☐	☐	☐	☐	☐
Accuracy of Answers	☐	☐	☐	☐	☐
Real-Life Application	☐	☐	☐	☐	☐
Clarity of Explanation	☐	☐	☐	☐	☐
Team Collaboration	☐	☐	☐	☐	☐

Provide short comments:

- One strength: _____
- One suggestion: _____

7. Reflection Question

Answer briefly after all presentations:

a. How do area and perimeter help in real-life construction and planning?

- Explaining reasoning in clear, coherent sentences during presentations
- Writing constructive peer feedback (strengths and suggestions)
- Using vocabulary such as area, perimeter, measurement, budget, and application

c. Scaffolded Integrative Performance Task (IPT)

- Learners integrate conceptual understanding and real-life application of measurement
- Emphasis on explanation, justification, and synthesis of prior learning
- Encourages metacognitive reflection on how mathematical concepts are used in everyday contexts

4. Facilitation Guide

a. Organize learners into groups of 4–5 and assign clear collaborative roles if needed.
b. Provide each group with the "Builder's Guide" worksheet containing incomplete statements.
c. Encourage group discussion before writing final answers to promote shared understanding.
d. Remind learners to use correct mathematical concepts and real-life examples in their responses.
e. Monitor group progress and ensure all members actively participate in completing the task.
f. Require completion of the readiness checklist before presentation to ensure quality output.
g. Facilitate group presentations and guide class discussion on key concepts.
h. Supervise peer assessment and ensure fairness and constructive feedback.
i. Conclude with reflection discussion emphasizing real-life applications of measurement.

	C.3. Evaluating Learning (For complete instructions, please refer to the Learning Activity Sheet.)
	Activity C.3. Assessing Learners Outcomes **1. Description and Purpose of the Activity** This assessment activity measures learners' mastery of area, perimeter, and real-life applications of measurement concepts. Learners solve contextual problems involving budgeting, tiling, fencing, and space allocation in home and garden settings. The task evaluates procedural fluency, conceptual understanding, and problem-solving skills, particularly in multi-step word problems that integrate geometry and financial computation. It also assesses learners' ability to interpret real-life situations and apply appropriate mathematical strategies accurately. **2. Pedagogy and Strategies Used** The activity uses Summative Assessment, Problem-Based Learning (PBL), and Real-Life Application Strategy. Learners independently demonstrate their understanding of key concepts through structured problem-solving tasks. The assessment emphasizes accuracy, logical reasoning, and proper use of formulas, while also encouraging visualization through sketches for spatial understanding. **3. Integration Components** a. Educational Technology (EdTech) • Optional calculator uses for computation accuracy • Digital drawing tools (for learners with access) to illustrate layouts • Projected visual aids for clarification of word problems • Spreadsheet tools for budget computation (optional extension) b. Literacy • Reading and interpreting multi-step mathematical problems • Writing complete solutions with proper mathematical reasoning • Using appropriate vocabulary (area, perimeter, radius, cost per square meter, total cost) • Explaining reasoning in structured solution formats c. Scaffolded Integrative Performance Task (IPT) • Integration of geometry concepts (area, perimeter, circle area) with financial literacy • Multi-step problem solving involving computation and interpretation • Application of mathematics in real-life budgeting and space management **4. Facilitation Guide** a. Ensure learners understand each problem before starting the assessment. b. Remind learners to show complete solutions and include correct units (m^2, m, ₱). c. Allow sketching for visualization, especially for composite shape problems. d. Monitor time and ensure independent work to maintain assessment integrity. e. Encourage learners to organize solutions step-by-step for clarity. f. Use a rubric or answer key for consistent scoring.

g. After checking, discuss common errors to reinforce learning.

C.4. Additional Activities (For complete instructions, please refer to the Learning Activity Sheet.)

Activity C.4. Extending and Reinforcing Learning

Additional Activities: More Exercise on Area and Perimeter

1. Description and Purpose of the Activity

This activity provides differentiated practice exercises designed to strengthen learners' mastery of area and perimeter concepts. It is divided into remediation tasks for learners who need additional support and enhancement tasks for learners who are ready for more complex, multi-step problems. The activity reinforces procedural fluency, conceptual understanding, and real-life application of measurement in contexts such as construction, gardening, renovation, and budgeting.

2. Pedagogy and Strategies Used

The activity applies Differentiated Instruction, Guided Practice, and Problem-Based Learning (PBL) strategies. Remediation tasks focus on foundational skills in computing area and perimeter, while enhancement tasks involve composite shapes, cost analysis, and percentage-based reasoning. This structure ensures inclusivity while promoting higher-order thinking for advanced learners.

3. Integration Components

a. Educational Technology (EdTech)
   - Use of calculators for multi-step computation accuracy
   - Optional GeoGebra or digital geometry tools for composite shapes
   - Visual aids or projected diagrams of rooms and gardens
   - Spreadsheet tools for cost computation and budgeting tasks

b. Literacy
   - Reading and interpreting multi-step mathematical word problems
   - Writing complete solutions with clear reasoning and correct units
   - Explaining mathematical decisions (area vs perimeter, inclusion/exclusion of shapes)
   - Using appropriate vocabulary (semicircle, composite figure, wastage, perimeter, cost)

c. Scaffolded Integrative Performance Task (IPT)
   - Integration of geometry concepts with financial literacy and real-life planning
   - Progression from basic computation (remediation) to complex problem-solving (enhancement)
   - Encourages analysis of composite shapes and practical decision-making in budgeting and design

4. Instructions for Teachers / Facilitation Guide

a. Identify learners who need remediation and those ready for enhancement tasks.
b. Provide step-by-step guidance for remediation group, especially in identifying formulas.
c. Encourage independent problem-solving for enhancement group with minimal scaffolding.
d. Remind learners to show complete solutions and include correct units in all answers.

<table>
<tr><td></td><td colspan="2">e. Use visual aids or sketches to help learners understand composite shapes (especially semicircles).
f. Monitor progress and provide feedback during activity implementation.
g. Encourage peer collaboration where appropriate, especially for struggling learners.
h. Conduct post-activity discussion to clarify misconceptions and reinforce learning.</td></tr>
<tr><td>III. CONTENT</td><td colspan="2">Lesson 9.3. Volumes, Capacity, and Cost Estimation</td></tr>
<tr><td>IV. OBJECTIVES</td><td colspan="2">At the end of the lesson, learners should be able to:
1. distinguish between volume and capacity;
2. calculate the volume of various 3D shapes and convert between common units of volume and capacity to solve practical problems; and
3. apply their knowledge of volume and capacity to solve cost estimation problems by first calculating the required amount of a material and then determining the total cost based on the material's unit price.</td></tr>
<tr><td>V. PROCEDURES</td><td>LEARNERS ACTIVITIES</td><td>ANNOTATION</td></tr>
<tr><td rowspan="2">A. Activating Prior Knowledge</td><td colspan="2">A.1. Eliciting Prior Knowledge</td></tr>
<tr><td>Activity A.1. Leveling Learners Readiness

Which Container Holds More?

Option 1. Worksheet
In this activity, you will explore how different containers hold different amounts of liquids or objects. You will identify common containers used in daily life, connect them to geometric shapes, and compare their capacities.

Materials:
Pictures or actual containers
Activity sheet
Pen or pencil
Optional: ruler or measuring tape

Instructions:
1. Examine the containers and items given by your teacher.
2. Identify a suitable container for each item.
3. Determine the geometric shape of the container.
4. Compare the containers and rank them from smallest to largest capacity.
5. Discuss with your group why the container is appropriate for the item.</td><td>Activity A.1. Leveling Learners Readiness

Which Container Holds More?

This activity introduces learners to the concepts of volume and capacity using familiar containers found in everyday Filipino settings. Through observation, estimation, and discussion, learners connect geometric shapes to real-life objects and develop readiness for solving volume problems using formulas.

Strategy 1.
Before the Activity
1. Prepare actual containers or printed/digital pictures;
2. Organize learners into pairs or small groups;
3. Distribute activity sheets;

During the Activity
1. Ask learners:
“Which container at home usually holds the most?”
“Why do some containers hold more even if they look similar?”

Allow learners to share experiences related to water containers, rice sacks, paint cans, LPG tanks, and beverage bottles.</td></tr>
</table>

Item	Common Container in the Philippines	Shape of Container	Estimated Capacity	Reason for Choice
Drinking Water	5-gallon container ("blue container")	Cylinder	Very Large	Easy to refill, store, and dispense
Rice (Bigas)	Sack of rice	Rectangular prism	Very Large	Holds large quantity, durable
Cooking Oil	Plastic pouch or bottle	Rectangular prism / Cylinder	Medium	Easy to store and pour
Soft Drinks	Plastic bottle or aluminum can	Cylinder	Small to Medium	Sealed and portable
Sardines	Tin can	Cylinder	Small	Airtight and easy to stack
Toblerone Chocolate	Triangular box	Triangular prism	Small	Protects contents and easy to recognize
LPG	Gas tank	Cylinder	Large	Strong, durable, and safe for storage
Paint	Can	Cylinder	Medium to Large	Prevents leakage and easy to seal

2. Explain that learners will:
   a. identifies containers,
   b. determines their geometric shapes,
   c. compares capacities,
   d. and justifies why the container fit the item.

Emphasize:
"At this stage, learners are only estimating and comparing capacities—not yet solving using formulas."

3. Ask learners to complete the table.
While performing the activity, circulate around the room, ask probing questions, guide learners who struggle identifying shapes, encourage reasoning instead of guessing.

4. Facilitate sharing of answers.
Highlight:
   containers with larger dimensions generally hold more;
   shape affects storage efficiency and capacity;
   real-life objects can represent geometric solids.
Connect learner responses to the lesson on:
   volume,
   capacity,
   and geometric solids.

Strategy 2: EdTech Integration

Teacher Preparation
The teacher should:
   ensure internet connection and device availability;
   provide QR codes or shortened links;
   test the Canva activity before class;
   orient learners on how to navigate the activity.

	Option 2. Canva Interactive Activity *Instructions*: "Today, you will explore an interactive Canva activity about volume and capacity. Analyze the containers shown, answer the tasks carefully, and apply the mathematical ideas discussed in class. Participate actively and collaborate respectfully with your classmates." *Processing Questions:* 1. Which containers can hold the most? the least? 2. How does the shape affect the capacity of a container? 3. Can one container be used for different items? Explain. 4. What measurements are needed to compute capacity or volume?	**Option 2. Canva Interactive Activity** *Instructions:* 1. Ask learners to scan the qr code https://reyinandnoreen.my.canva.site/c9hvmf8cgpvbtfp7 2. Monitor learner participation. 3. Pause occasionally for discussion; 4. Ask learners to justify their answers; 5. Encourage comparison between different containers. 6. Facilitate the processing questions.
	A.2. Establishing the Purpose of the Lesson	
	Activity A.2. Appreciating Lesson Relevance **How Much Will It Cost to Fill It Up?** In this activity, you will explore how the concepts of volume and capacity are used in real-life situations involving cost estimation and budgeting. You will analyze a practical situation about repainting a room and estimate how much paint is needed and how much it will cost. This activity will help you develop your critical thinking, estimation, and mathematical reasoning skills while applying mathematics to everyday financial decisions. *Instructions*: 1. Read the Scenario Carefully *Your family plans to repaint a room. The paint shop sells:* *4-liter can → ₱650* *1-liter can → ₱190* *You estimate that the room needs about 6 liters of paint.*	**Activity A.2. Appreciating Lesson Relevance** **How Much Will It Cost to Fill It Up?** This activity introduces learners to the practical importance of volume and capacity in cost estimation. Learners are given a real-life scenario (repainting a room) and asked to estimate how much paint to buy and the total cost. This encourages critical thinking, discussion, and application of mathematical reasoning in everyday financial decisions. **Strategy 1: Classroom-Based Activity** *Materials*: Pictures or actual examples of paint cans labeled with volume and price Calculator (optional) Paper and pen/pencil

	2. Analyze and Estimate Decide how many cans of each size you should buy to make at least 6 liters of paint. Compute and compare the total cost of different possible combinations. Determine which option is the most practical and cost-effective. 3. Discuss with a Partner Compare your answers and strategies with your partner. Explain how you estimated the volume and total cost. Decide together which option gives the best value and explain why. 4. Share Your Ideas Be prepared to present your solution and reasoning to the class. *Processing Questions:* 1. How did you estimate the total amount of paint needed? 2. How did knowing the volume help you estimate the cost? 3. Which option was the most practical? Why? 4. Why is it important to estimate costs before buying materials?	*Instructions*: 1. Present the scenario and show actual containers or images with corresponding volumes and prices. 2. Individual Thinking and Estimation Ask learners to estimate possible combinations of paint cans that will provide at least 6 liters of paint. Let learners compute and compare the total cost of each option. 3. Pair or Group Discussion Allow learners to compare their solutions with a partner or small group. Encourage discussion on which option is more economical and practical. 4. Class Sharing Invite selected learners or groups to present their strategies and computations. Highlight different approaches in estimating volume and cost. 5. Conclude the activity by emphasizing: "Understanding volume and capacity helps us make informed and practical decisions in daily life, especially when estimating costs and budgeting expenses." **Strategy 2: EdTech Integration** **Teacher Reminders** The teacher should: Ensure a stable internet connection. Provide QR codes or links for easier learner access. Guide learners in navigating the interactive activity. **Interactive Canva Activity** "Interactive Canva Activity on Volume, Capacity, and Cost Estimation"

		https://reyinandnoreen.my.canva.site/c9j7ac6am7gnjvdp "Today, you will explore an interactive Canva activity about volume, capacity, and cost estimation. You will analyze real-life situations, estimate how much material is needed, compute costs, and apply the mathematical concepts discussed in class. Work carefully, think critically, and collaborate respectfully with your classmates while making practical financial decisions based on everyday situations." ***Teacher Facilitation*** 1. Allow learners to explore the activity individually or in pairs. 2. Encourage learners to explain their answers and justify their computations. 3. Monitor learner participation and provide guidance when necessary. 4. Use learners' responses to connect mathematical concepts to real-life financial decision-making.
B. Instituting New Knowledge	*B.1. Presenting Examples*	
	Activity B.1. Exploring Key Concepts **Volume, Capacity, and Cost Challenge** In this activity, you will explore real-life situations involving **volume**, **capacity**, and **cost estimation**. You will apply measurement concepts to everyday examples such as water storage, painting, packaging, and filling containers. This activity will help you connect mathematical calculations to practical decision-making involving money, measurements, and	**Activity B.1. Exploring Key Concepts** **Volume, Capacity, and Cost Challenge** This activity allows learners to explore real-life examples of volume and capacity and use them to estimate costs, developing practical understanding of measurements in everyday contexts. By applying the concept of volume and capacity to real-life situations, learners connect mathematical calculations to financial decisions, enhancing their practical math skills and critical thinking.

	problem-solving. It will also strengthen your critical thinking and practical mathematics skills. *Instructions*: **1. Work in Small Groups** Listen carefully as your teacher assigns or explains the different real-life scenarios. **2. Analyze the Given Scenario** Your group will solve one or more of the following situations: Water Tank Filling Painting a Wall Juice Packaging Buying Rice Swimming Pool Filling **3. For Each Scenario** Identify the shape of the container or object. Determine the appropriate formula needed. Calculate the volume, capacity, or area required. Use the given prices to estimate the total cost. Discuss any assumptions made during the computation, such as rounding measurements or estimating quantities. **4. Record Your Work** Write your complete solutions, computations, and final answers on the activity sheet provided. **5. Present Your Findings** Each group will present one scenario to the class. Explain your computations, reasoning, and cost estimation clearly. **6**. **Observe and Compare** During the presentations, listen carefully and compare how different groups solved the problems. *Processing Questions***:** 1. How did the shape of the object affect the formula you used? 2. Why is it important to measure volume or capacity accurately? 3. How did mathematics help you estimate the total cost? 4. Which scenario required the greatest amount of material or cost? Why? 5. Where do you encounter similar situations in everyday life?	*Materials*: Sample containers or pictures of containers Price list Calculator Ruler or measuring tape Activity sheet Pen/pencil **Instructions:** **1. Prepare the Materials** Prepare pictures or actual examples of containers and objects such as: Bottles Water tanks Rice sacks Paint cans Swimming pools Boxes or storage containers Prepare price lists for water, paint, packaging materials, or products. **2. Organize the Learners** Divide the class into small groups. Assign or distribute one or more scenarios to each group. **3. Facilitate Problem Solving** For each scenario, instruct learners to: Identify the shape of the object or container. Select and apply the appropriate formula. Compute the volume, capacity, or area. Estimate the total cost using the given prices. Discuss assumptions or estimation strategies used during the activity. **4. Group Presentation** Allow each group to present one completed scenario. Encourage learners to explain their mathematical reasoning and cost estimation process clearly. **Conclude the activity by emphasizing:** "Volume and capacity are important mathematical concepts used in everyday life. Understanding how to measure and

		estimate them helps people make informed financial and practical decisions." **Strategy 2: EdTech Integration** **Teacher Reminders** The teacher should: Ensure a stable internet connection. Provide QR codes or links for easier learner access. Guide learners in navigating the interactive activity. Monitor learner participation and provide support when needed. **Interactive Canva Activity** Interactive Canva Activity on Volume, Capacity, and Cost Challenge https://reyinandnoreen.my.canva.site/c9j96nhw5q3zr1be "Today, you will explore an interactive Canva activity involving volume, capacity, and cost estimation. You will analyze practical situations, identify appropriate formulas, solve measurement problems, and estimate costs based on real-life examples. Work carefully, collaborate with your classmates, and explain your reasoning clearly while making practical mathematical decisions." **Teacher Facilitation** 1. Allow learners to work individually, in pairs, or in groups while exploring the activity. 2. Encourage learners to justify their computations and explain their problem-solving strategies.

		3. Use the activity responses to connect mathematical concepts with real-life applications involving budgeting, storage, construction, and packaging.
	B.2. Discussing the Concept	
	Activity B.2. Deepening Conceptual Understanding To better understand the volume and capacity and its application to cost estimation, you will engage with different activities. **Part 1. Understanding Volume, Capacity, and Cost Estimation** **Key Concepts** **Volume** refers to the amount of space occupied by a three-dimensional object. **Capacity** refers to how much a container can hold. **Common units used**: cubic centimeters (cm^3) cubic meters (m^3) liters (L) milliliters (mL) The following conversion relationships shall be used for estimation. $1000\ cm^3 = 1\ L$ $1\ m^3 = 1000\ L$ *Example 1*. **Balik-Bayan Box** A balik-bayan box measures **0.8 m × 0.6 m × 0.5 m** and will be filled with liquid soap sold at **₱40.00 per liter**. Find the volume and estimated total cost of liquid soap. *Solution:* Volume: $V = 0.8 \times 0.6 \times 0.5 = 0.24\ m^3$	**Activity B.2. Deepening Conceptual Understanding** Volume and Capacity in Real Life and Cost Estimation This activity is designed as a teacher-led discussion to deepen learners' understanding of volume, capacity, unit conversion, and their practical applications in real-life cost estimation. Through guided explanations, demonstrations, and real-world examples, learners will understand how mathematical concepts are connected to everyday financial and practical decisions. You may begin the discussion by saying: "Now that we know how to calculate volume and convert units, let us explore how these concepts help people estimate costs and make practical decisions in everyday life." **Understanding Volume, Capacity, and Cost Estimation** *Instructions:* 1. Introduce the volume and capacity. 2. Discuss the common units used: 3. Present examples and solve them step-by-step with the learners observing the process. 4. Facilitate the processing question. *Processing Questions*: 1. Why is accurate measurement important in real-life situations? 2. How does unit conversion help in estimating costs? 3. What might happen if incorrect units are used? 4. How can understanding volume and capacity help families manage expenses? 5. In what other situations are these concepts useful?



Convert cubic meters to liters:

$$0.24\ m^3 = 240\ L$$

Compute the cost:

$$240 \times 40 = 9600$$

Therefore, the estimated cost is **₱9,600**.

Example 2. **Cylindrical Water Tank**
A cylindrical water tank has a diameter of **2 m** and a height of **4 m**. Water costs **₱35.00 per kiloliter**. Find the volume and estimated total cost of water.



Solution:
The radius is half of the diameter:
Radius = 1 m
Volume of cylinder:
Substitute the given values:

$$V = \pi(1)^2(4)$$

Simplify:

$$V = 4\pi\ m^3$$

(Capacity) Convert to Kiloliters
Since:

$$1\ m^3 = 1\ kL$$

then:

$$4\pi\ m^3 = 4\pi\ kL$$

Compute the Cost

$$35(4\pi) = 140\pi$$

Thus, the total cost is:

$$140\pi \approx 439.82$$

Therefore, the estimated cost to fill the tank is approximately **₱440.00**.

Example 3. **Rice Container**
A rice container measures 40 cm × 30 cm × 50 cm. If the container is completely filled with rice and the density of rice is approximately 0.85 kg/L, and rice costs ₱55.00 per kilogram, determine the estimated cost of the rice.



*Solution***:**
Volume of rectangular prism:

$$V = lwh$$

Substitute the values:

$$V = 40 \times 30 \times 50 = 60000\ cm^3$$

(Capacity) Convert to liters:

$$60000\ cm^3 = 60\ L$$

Estimate the mass of rice:

$$60\ \text{L} \times 0.85\ \text{kg/L} = 51\ \text{kg}$$

Compute the total cost:

$$51 \times 55 = 3300$$

Therefore, the estimated cost is **₱2,805.00**.

Example 4. Estimating the Cost of Painting a Room

A rectangular room is 5 meters long, 4 meters wide, and 3 meters high. The four walls will be painted, but the door (2 m × 0.9 m**)** and two windows (1.5 m × 1 m each**)** will not be painted. One liter of paint can cover approximately 10 square meters, and paint costs ₱350.00 per liter. Determine the estimated cost of the paint needed to paint the room**.**

	Solution 1. Find the total area of the four walls. Two walls measure 5 m × 3 m: $2(5)(3) = 30$ m² Two walls measure 4 m × 3 m: $2(4)(3) = 24$ m² Total wall area: $30 + 24 = 54$ m² 2. Subtract the areas of the door and windows. Door: $2(0.9) = 1.8$ m² Two windows: $2(1.5)(1) = 3$ m² Area to be painted: $54 - 1.8 - 3 = 49.2$ m² 3. Estimate the amount of paint needed. Since 1 liter covers 10 m²: $49.2 \div 10 = 4.92$ L Because paint is purchased by the liter, round up to 5 liters. 4. Calculate the estimated cost. 5 × ₱350 = ₱1,750 Answer The estimated cost of paint is ₱1,750.00.	
	B.3. Developing Mastery (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity B.3. Practicing Learned Skills **Be a Contractor** This activity uses Collaborative Problem-Solving, with EdTech or pen-and-paper options, to help learners apply their knowledge of volume, surface area, capacity, unit conversion, and cost estimation to real-life situations.	

	Instructions: 1. Divide the class into groups of 4–5 members. Assign the following roles: • Solver • Writer • Checker • Presenter 2. Give each group a practical project involving home improvement, school facilities, business, or construction and design. The activity may be completed through either of the following: • Digital Option: Use the interactive "Be a Contractor" Canva activity through a QR code or link.  https://reyinandnoreen.my.canva.site/c9mj3c7ddqa1mc64 • Pen-and-Paper Option: Provide the corresponding printed problem set or activity sheet for learners to solve manually. 3. Guide learners to: • Identify the appropriate mathematical concepts and formulas. • Perform necessary unit conversions. • Calculate volume, surface area, or capacity. • Estimate materials and costs. • Explain and justify their solutions. 4. Encourage group members to discuss and verify their computations. Have the Checker review another group's work and provide constructive feedback. Groups should make corrections when necessary. 5. Let each group present its solution and explain the strategy used. Encourage other groups to compare their approaches and ask questions. 6. Discuss the following questions: • Why are accurate measurements important in construction and business? • How do volume and surface area help estimate materials and costs? • Why is correct unit conversion important? • What could happen if calculations are inaccurate? • How can material waste affect project expenses? • How can costs be reduced while maintaining quality? • Why is teamwork important in solving real-life problems?

C. Demonstrating Knowledge and Skills	*C.1. Finding Practical Application*	
	Activity C.1. Making Real World Connection **Mini Measurement Challenge** In this activity, you will apply your understanding of volume, capacity, unit conversion, and cost estimation to real-life objects and spaces. You will measure or use given dimensions, calculate volume, convert units, and estimate costs based on practical situations. *Materials*: • Measuring tape, ruler, or meter stick • Calculator or mobile calculator • Notebook or data sheet • Local prices of materials or products • Conversion chart (e.g., $cm^3 \rightarrow L$, $m^3 \rightarrow L$) *Instructions*: 1. Select a suitable container or space, such as a water drum, box, aquarium, bottle, or tabletop area. For digital activity, choose one of the containers provided. 2. Measure or Identify the Dimensions • For rectangular objects, measure or identify the length, width, and height. • For cylindrical objects, measure or identify the radius and height. • Record all measurements with the correct units. 3. Identify the shape and use the correct formula to calculate its volume. 4. Substitute the measurements into the appropriate formula and solve them. Show your solution clearly. 5. Convert the volume to an appropriate capacity unit, such as liters. Reminder: 1,000 cm^3 = 1 L 6. Use the given local price to estimate the cost of filling, storing, or covering the object or space. 7. Write your complete solution in your notebook or data sheet. Draw and label a simple sketch when working with a real object.	**Activity C.1. Making Real World Connection** **Mini Measurement Challenge** This activity allows learners to apply measurement, volume, capacity, unit conversion, and cost estimation to familiar real-life situations. Learners may use actual measuring tools and record their work on paper or use an interactive digital activity when devices and internet access are available. 1. Provide the materials needed for the activity: • Measuring tape, ruler, or meter stick • Calculator or mobile calculator • Notebook or data sheet • Conversion chart (e.g., $cm^3 \rightarrow L$, $m^3 \rightarrow L$) • Sample local prices for water, paint, rice, storage materials, tiles, cement, or similar products If available, prepare the corresponding digital or interactive activity and provide its QR code or link. 2. Explain to learners that they will apply mathematics to real-life situations by measuring objects, calculating volume and capacity, converting units, and estimating costs. Emphasize that the activity demonstrates how mathematics helps people make practical and informed decisions in everyday life. 3. Assist learners as they: • Select the appropriate formula. • Measure objects accurately. • Record measurements with correct units. • Convert measurements when necessary. • Use available prices to estimate costs. • Check the reasonableness of their answers. 4. Learners may complete the activity through either: • Experiential/Pen-and-Paper Option: Measure actual objects using available tools and record computations in their notebooks or data sheets. • Digital Option: Use the interactive activity through a provided QR code or link.

	For the interactive activity, enter your answers and click “Check My Work.” Use “Show Hint” if needed and “Reset” to try another container. 8. Compare your answers and strategies with your classmates. Discuss how different measurements or prices can affect the estimated cost. Helpful Reminders • Use π = 3.14159 when needed. • Always include the correct units. • Check your unit conversions carefully. • Make sure your measurements and computations are reasonable. • When using digital activity, follow the instructions shown on the screen. *Processing Questions*: 1. How did you determine the correct formula? 2. Why is unit conversion important? 3. Which object had the greatest capacity? 4. How can volume and capacity help estimate expenses? 5. How can changes in prices affect the estimated cost? 6. Why is accurate measurement important in budgeting and planning? *Reflection*: Think about how people use measurement and estimation when buying water, storing goods, filling containers, painting spaces, or planning construction projects. How can these mathematical skills help people make practical and cost-effective decisions?	https://reyinandnoreen.my.canva.site/c9mqh367xnav7q1c If devices or internet connectivity are unavailable, proceed with the hands-on and pen-and-paper option. 5. Observe learners as they measure, calculate, and estimate. Check their use of formulas, units, conversions, and computations. Provide clarification and corrective feedback without immediately giving the answers. 6. Ask learners to share: • Their estimated costs • Challenges encountered during measurement or computation • Strategies they used to obtain accurate results • Differences between their estimates and those of other groups 7. Discuss how the same skills can be used when estimating the amount and cost of water, paint, rice, tiles, cement, storage materials, and other household or construction materials. 8. Explain that the skills developed in the activity will prepare learners for Project Bahay at Paaralan, where they will apply measurement, volume, capacity, and cost estimation to larger real-life spaces and situations. 9. Emphasize that accurate measurement, appropriate unit conversion, and mathematical estimation help people plan projects, manage resources, control expenses, and make practical decisions in everyday life.

	C.2. Making Generalization	
	Activity C.2. Wrapping-up the Lesson **Exit Ticket: Volume, Capacity, and Cost Estimation** In this activity, you will reflect on what you learned about volume, capacity, and cost estimation by connecting the lesson to real-life situations found at home or in your community. This short activity helps you summarize your understanding and apply mathematical concepts to practical everyday situations. *Instructions*: 1. **Read the Prompt Carefully** "Name one item at home or in your community whose volume or capacity you can measure and estimate the cost for. Explain how you would calculate it." 2. **Write Your Response** Write your answer in 2–3 complete sentences on the provided exit ticket sheet or in your notebook. 3. **Include the Following** The item or container you selected Its estimated volume or capacity A brief explanation of how you would calculate the cost 4. **Use Mathematical Ideas** Mention the formula, measurement, or unit conversion you would use when appropriate. 5. **Share Your Ideas** Be prepared to briefly present or explain your response to the class if asked. *Processing Questions*: 1. What real-life item did you choose? 2. How can volume or capacity help estimate costs? 3. Why is measurement important in everyday life? 4. How can this lesson help you make practical decisions at home or in your community?	**Activity C.2. Wrapping-up the Lesson** **Exit Ticket: Volume, Capacity, and Cost Estimation** This activity provides learners with an opportunity to reflect on their understanding of volume, capacity, unit conversion, and cost estimation and apply these concepts to familiar real-life situations. *Instructions*: 1. Provide learners with an exit ticket sheet or instruct them to use their notebooks. Alternatively, prepare a digital response using an available platform such as Google Forms, Google Classroom, Padlet, or Canva. 2. Ask learners to respond to the following: "Name one item at home or in your community whose volume or capacity you can measure and estimate the cost for. Explain how you would calculate it." 3. Clarify the Expected Response Remind learners to include: • The item or container • Its estimated volume or capacity • The appropriate unit of measurement • A brief explanation of how the cost could be estimated 4. Give learners approximately 3–5 minutes to complete their responses individually. 5. Move around the classroom and provide clarification when needed. Help learners identify appropriate real-life examples or explain their measurement and cost-estimation process without providing the response for them. 6. Collect the paper-based exit tickets or review digital submissions. Check whether learners: • Understand volume and capacity • Use appropriate units or conversions • Can connect measurement to cost estimation • Clearly explain their reasoning 7. Invite selected learners to share their examples. Use the following questions to deepen the discussion:

		• How can volume or capacity help us estimate expenses? • Why is unit conversion important in cost estimation? • How do measurements help people make practical decisions? • What household items require volume or capacity measurement? • How can these skills help families manage resources wisely? • Why is mathematics important in everyday budgeting? 8. Highlight practical and creative examples shared by learners. Connect their responses to everyday applications such as buying water, rice, paint, fuel, food, and construction materials. 9. Emphasize that volume and capacity are important mathematical concepts used in many real-life situations. Understanding how to measure, convert units, and estimate costs help people make practical, informed, and cost-effective decisions in everyday life. *Implementation Options*: • Pen-and-Paper: Learners write their responses on an exit ticket or in their notebooks. • Digital: Learners submit their responses using an available platform such as Google Forms, Google Classroom, Padlet, or Canva. • No-Device Option: If devices or internet connectivity are unavailable, use the notebook or printed exit ticket format.
	C.3. Evaluating Learning (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity C.3. Assessing Learning Outcomes This activity assesses learners' understanding of volume, capacity, unit conversion, and cost estimation through an individual assessment. Learners may complete the assessment using either a printed quiz or an interactive digital assessment. **1. Explain the assessment.** Inform learners that the assessment will measure their understanding and application of volume, capacity, unit conversion, and cost estimation. Remind them to work individually and show their solutions clearly. **2. Provide the assessment.** Use either of the following options: • Pen-and-Paper Option: Distribute the printed assessment or present the questions on the board. • Digital Option: Provide the QR code or link to the interactive Canva assessment on Volume, Capacity, and Cost Estimation.	

https://reyinandnoreen.my.canva.site/c9mrf4k20fhn7fnm

3. Set the time.
Give learners approximately 10–15 minutes to complete the five items. Remind them to include necessary calculations, units, and explanations.
4. Monitor learners.
Observe learners as they work. For the digital option, monitor their progress and provide technical assistance when needed. Provide clarification about instructions without giving direct answers.
5. Check solutions.
Remind learners to review their computations, units, conversions, and reasoning before submitting their work.
6. Review the assessment.
Collect the completed paper-based assessments or review the digital responses using the prepared answer key. Discuss the correct answers and ask selected learners to explain their reasoning.
7. Address misconceptions.
Highlight common errors and clarify misconceptions related to volume, capacity, unit conversion, and cost estimation.
8. Connect learning to real life.
Discuss how these skills are used in everyday situations, such as estimating the cost of water, rice, paint, construction materials, and other products sold by volume, capacity, or quantity.
9. Facilitate reflection.
Ask learners:

- Which item was easiest for you?
- Which item was most challenging?
- What strategy helped you solve the problems?
- How can you use these skills in everyday life?

Teacher Reminder
For the digital option, ensure that the internet connection is available, provide the QR code or link before the activity, and assist learners with accessing the interactive assessment as needed. The pen-and-paper option should be used when devices or internet connectivity are unavailable.

	C.4. Additional Activities (For complete instructions, please refer to the Learning Activity Sheet.)
	Activity C.4. Extending and Reinforcing Learning **More Exercises on Volume and Capacity** These problem sets are designed to reinforce and extend learners' understanding of volume, capacity, unit conversions, and cost estimation. The remediation set focuses on building confidence and strengthening foundational skills through simpler, straightforward problems. The enhancement sets challenges learners to apply their knowledge to multi-step, real-life scenarios, promoting higher-order thinking, reasoning, and practical application. Both sets align with the earlier activities on problem-solving, guided discovery, and real-life cost estimation, allowing learners to consolidate their skills and prepare independent application. Instructions: 1. Explain the purpose: remediation strengthens basic skills, enhancement challenges of learners with complex, real-life problems. 2. Distribute the appropriate problem sets and ensure learners have calculators or measuring tools. 3. Give learners 10–15 minutes for remediation and 15–20 minutes for enhancement and monitor their progress. 4. Ask learners to show their steps and reasoning, especially for cost estimation and unit conversions. 5. Review answers, clarify misconceptions, and encourage connections to real-life applications.
V. ASSESSMENT	For the summative assessment and performance task, please refer to the Teacher's Notes, which can be accessed through the link in the Table of Contents.
VI. REFLECTION	For your reflection, you may use the Reflection Guide provided in the Teacher's Notes to help guide your responses.

Unit 10. Random Variable and Sampling

I. LEARNING GOALS	
Content Standard	The learners demonstrate knowledge and understanding of random variables and sampling. Contextualized: *The learners demonstrate knowledge and understanding of random variables and sampling in everyday situations and activities, enabling them to make informed decisions and interpret data effectively.*
Performance Standard	Learners propose statistical investigations identifying and justifying the sample size and sampling techniques; and draw conclusions from given data using normal distribution and expected values. Contextualized: *Learners are able to design and conduct simple statistical studies such as surveys on learner habits or preferences, by selecting suitable samples,* calculating *expected values based on appropriate sample size, applying normal distribution, and presenting their findings clearly for decision-making.*
Learning Competencies	The learners… 1. differentiate between discrete and continuous random variables and describe their uses; 2. calculate the expected value, variance, and standard deviation of discrete random variables; 3. illustrate a normal random variable and its characteristics; 4. convert a normal random variable to a standard normal variable and vice versa; 5. compute probabilities and percentiles involving standard normal distribution using a Z-distribution table or appropriate technologies; 6. define random sampling and its types; 7. recommend appropriate sample size for a given investigation; 8. differentiate between a parameter and a statistic; and 9. compare probability and non-probability sampling techniques based on their characteristics and application.
II. REFERENCES and MATERIALS	
Textbook and Modules	Lane, D. M. (2017). *Normal distribution. In Online Statistics Education: A Multimedia Course of Study*. Rice University. https://onlinestatbook.com/ OpenStax. (2019). *Introductory statistics*. OpenStax CNX. https://openstax.org/details/books/introductory-statistics University of West Georgia. (n.d.). *The normal distribution notes*. University of West Georgia. Wasserman, L. (2004). *All of statistics: A concise course in statistical inference*. Springer. Department of Education. (n.d.). Statistics and probability: Normal distribution (Grade 11, Quarter 3 module). Department of Education Philippines. Dela Cruz, A. (2021). *Chapter II: Normal distribution* [Self-learning module]. Gordon College. (2021). *EDUMATH05: Module 6 – Normal distribution* [Learning module]. Belecina, R. R., & E. S. (2016). *RBS statistics and probability* (1st ed., pp. 200–210). Rex Book Store, Inc.

	Department of Education. (n.d.). *Senior high school statistics and probability modules*. Department of Education Philippines.
Websites	Department of Education. (n.d.). Learning Resource Management and Development System (LRMDS): Statistics and Probability Modules. https://lrmds.deped.gov.ph/ Hanover Community School Corporation. (2017). Statistics lesson 6.3 notebook. https://www.hanover.k12.in.us/cms/lib/INO1001361/Centricity/Domain/104/Stats%206.3.pdf Khan Academy. (n.d.). Normal distributions review. https://www.khanacademy.org/math/statistics-probability/modeling-distributions-of-data/normal-distributions-library/a/normal-distributions-review Lane, D. M. (n.d.). Normal distribution. Online Statistics Education. https://onlinestatbook.com/lms/normal_distribution/normal_distribution.pdf National Center for Biotechnology Information (NCBI). (n.d.). StatPrimer: Normal distributions in public health applications. https://www.ncbi.nlm.nih.gov/pmc/ OpenStax. (2013). Introductory statistics. OpenStax CNX. https://assets.openstax.org/oscms-prodcms/media/documents/IntroductoryStatistics-OP_i6tAI7e.pdf Rice University. (n.d.). Normal distribution case studies. Online Statistics Education Project. https://onlinestatbook.com/2/normal_distribution/normal_distribution.html University of West Georgia. (n.d.). The normal distribution notes. https://www.westga.edu/academics/research/vrc/assets/docs/the_normal_distribution_notes.pdf Wasserman, L. (2004). All of statistics: A concise course in statistical inference. Springer. https://www.stat.cmu.edu/~brian/valerie/617-2022/0%20-%20books/2004%20-%20wasserman%20-%20all%20of%20statistics.pdf
Video lessons	DepEd TV: Statistics and Probability – Sampling Techniques (https://www.youtube.com/watch?v=5PsF5MsrCOo)
Materials and EdTech	● Calculators ● Flashcards ● Z-table ● Dice ● Normal distribution curves ● Colored pens or crayons, pencils ● Bond papers ● Graphing papers ● Printed activity sheets / scenario cards ● Manila paper or chart paper ● Markers ● Slips of paper or name cards (for simulation activities)
AI Declaration	This lesson exemplar was developed with the assistance of artificial intelligence tools, specifically Microsoft Copilot and ChatGPT, to generate structured learning activities, practice worksheets, and summative assessment items aligned with the Department of Education (DepEd) General Mathematics learning standards. The teacher maintained full editorial control, rigorously reviewing and editing all content to verify that all formulas, probabilities, and real-world scenarios are mathematically accurate, pedagogically sound, and appropriate for Grade 11 learners.

<table>
<tr><td>III. CONTENT</td><td colspan="2">Lesson 10.1. Discrete Random Variables</td></tr>
<tr><td>IV. OBJECTIVES</td><td colspan="2">At the end of the lesson, the learners are expected to:
1. define the concepts of random variables, discrete random variables, continuous random variables, expected value, variance, and standard deviation of a discrete random variable.
2. differentiate discrete random variables from continuous random variables based on their characteristics.
3. identify examples of real-life situations that can be modeled using discrete and continuous random variables.
4. apply formulas to compute the expected value, variance, and standard deviation of a discrete random variable.</td></tr>
<tr><td>V. PROCEDURES</td><td>LEARNERS ACTIVITIES</td><td>ANNOTATION</td></tr>
<tr><td>A. Activating Prior Knowledge</td><td colspan="2">A.1. Eliciting Prior Knowledge</td></tr>
<tr><td></td><td>Activity A.1. Leveling Learners Readiness

Instructions:
1. Work in pairs.
2. Identify the following variables as countable or measurable.
● Countable means the quantity can be determined by simply counting, without the use of any measuring devices.
● Measurable means that the quantity must be determined using measuring tools or instruments.
3. Write your answer to the space provided.
<table><tr><th>Variable</th><th>Countable or Measurable</th></tr><tr><td>Height of a learner</td><td></td></tr><tr><td>Number of text messages sent</td><td></td></tr><tr><td>The weight of a newborn child</td><td></td></tr><tr><td>Time it takes to finish an examination</td><td></td></tr><tr><td>Distance from home to school</td><td></td></tr><tr><td>Number of books in a library</td><td></td></tr><tr><td>The speed of a moving car</td><td></td></tr><tr><td>Number of pencils in a box</td><td></td></tr><tr><td>Number of teachers in a school</td><td></td></tr><tr><td>Temperature of a room</td><td></td></tr></table></td><td>Activity A.1. Leveling Learners Readiness

This diagnostic task establishes an intuitive foundation for understanding quantities before formal mathematical labels are introduced. By sorting 10 real-world variables based on how they are observed (by counting vs. by measuring), students build the schema required to seamlessly differentiate between Discrete and Continuous Random Variables later in the lesson.

Pedagogy and Strategies
● Think–Pair–Check: Students reason through the classification independently, validate their logic with a peer, and confirm accuracy during a whole-class review.
● Gradual Release (I Do – We Do – You Do): The teacher models the classification for items 1 and 2, guides the entire class through items 3 to 5, and releases ownership to student pairs for items 6 to 10.

Integration Components
● Educational Technology (EdTech): Real-time web-polling tools (such as Mentimeter, Kahoot, or Google Forms) can be utilized to aggregate and display the students' initial sorting choices instantly.
● Literacy: Structural vocabulary decoding; students actively unpack about the semantic differences between things that are "countable" (isolated integers) and things that are "measurable" (intervals on a scale).</td></tr>
</table>

	Processing Questions: 1. What did you observe about variables you classified as countable? 2. How are measurable variables different from countable ones? 3. Why is it important in statistics to distinguish between things we count and things we measure?	• **Scaffolded Integrative Performance Task (IPT):** Acts as the foundational data-sorting milestone, training students to classify baseline research variables for their upcoming community-based data profiles. ***Facilitation Guide*** 1. Write two clear column headings on the board: **Countable** and **Measurable**. Define them simply: countable means found via counting whole items; measurable means found using an instrument or tool. 2. Hand out the 10-item list and give students 3 minutes to complete the classifications individually ("Think"). 3. Signal students to compare their answers with an elbow partner for 2 minutes and resolve discrepancies ("Pair"). 4. Direct student pairs to check their work as you reveal the answer key ("Check"). Ask: *"If an item can logically have a decimal point in real life, like 5.5, which column does it belong to?"* 5. Read the transition script smoothly to bridge this activity into the concept of Random Variables.
	A.2. Establishing the Purpose of the Lesson	
	Activity A.2. Appreciating Lesson Relevance *Instructions*: 1. Form groups with 4–5 members each. You will work in these permanent teams to complete the simulation activity. 2. Your group will be given a customized simulation cup containing 5 historical scenario tokens. 3. Carefully read the operational context provided below and execute the simulation tasks strictly following the rules. 4. Record your experimental tracking logs and summary charts clearly on a piece of manila paper or in your group notebook. 5. Appoint a presenter to share your group's findings and reflections during the whole class of debriefing. **Context:** **The Local Tricycle Cooperative Fleet Yield** Imagine you are transport system planners managing a local tricycle cooperative. Due to variable weather and local market events, the	**Activity A.2. Appreciating Lesson Relevance** This activity uses a simulated local economic scenario—The Tricycle Cooperative Fleet Yield—to introduce the concept of chance and sample spaces. By drawing tokens from a cup, tallying outcomes, and creating empirical frequencies, students see firsthand that while a single trial is completely unpredictable, repeated trials reveal stable, long-run distribution patterns that businesses can use to plan effectively. ***Pedagogy and Strategies*** • **Cooperative Group Simulation:** Uses tactile, low-cost physical objects (labeled tokens and cups) to turn abstract probability theories into a concrete, shared experience.

	number of passenger roundtrips completed by a driver during a peak afternoon shift varies randomly. **Simulation Rules:** Each group receives a cup with 5 customized tokens representing historical operational scenarios. The values on the tokens are: • **1** *(Heavy rain, low demand)* • **2** *(Normal weekday operation)* • **2** *(Normal weekday operation)* • **3** *(Market day peak traffic)* • **4** *(Barangay festival high demand)* **Group Execution Protocol:** 1. Have one team member draw a single token at random from the cup, record the numeric value in your data log, and return the token back inside the cup. 2. Mix the cup thoroughly and repeat this random drawing process **exactly 30 times** to build your experimental operational data collection log. 3. Count the total tallies and organize your 30 raw observations into a clean relative frequency table showing how often each trip count (1, 2, 3, or 4) appeared. Processing Questions: 1. Why is it impossible to predict which exact token you will draw on any single turn, even though you already know all the possible outcomes (1, 2, 3, and 4) inside the cup? 2. How does listing the entire sample space (1, 2, 3, 4) serve as the first essential step before a statistician can analyze or track real-world random events? 3. Based on what you observed about "countable" vs "measurable" data in our previous activity, why do completed passenger trips fall under a counted category, and how does this help us describe an unpredictable situation? 4. Did your group's 30 random draws match the exact proportion of tokens originally placed in the cup (where '2' has a higher chance)? Why do experimental results often vary from theoretical probabilities in small samples?	• **Data-Driven Inquiry:** Empowers students to act as data analysts, transforming 30 raw, randomized outcomes into clean, organized frequency charts. ***Integration Components*** • **Educational Technology (EdTech):** Teams can post their final frequency tallies onto a shared class like Google Sheet or Padlet board to compare variations across the different groups. • **Literacy:** Promotes descriptive data entry by requiring teams to carefully build relative frequency columns and document their tracking logs. • **Scaffolded Integrative Performance Task (IPT) Milestone 1:** Formative SIPT Project Setup. Student groups select their specific community data topic (e.g., store sales or local crop yields) and explicitly define whether their primary variable is discrete or continuous. ***Facilitation Guide*** 1. Group students into stable teams of 4–5 and give each team a cup containing 5 tokens labeled: **1, 2, 2, 3, 4**. 2. Set the business context: These numbers represent daily passenger trips per tricycle in a local transport cooperative. 3. Instruct the teams to run the simulation exactly 30 times: draw one token, record its number, return it to the cup, shake, and repeat. 4. Have the students summarize their 30 raw data points into a tally chart on manila paper, calculating the experimental percentage for each number. 5. Call group presenters to share their charts, then use the processing questions to highlight why small-sample outcomes fluctuate.

<table>
<tr><td></td><td>5. Imagine you are the manager of this transport cooperative. How does looking at this probability distribution help you mathematically plan driver for fuel subsidies or fleet schedules before a busy afternoon shift even begins?</td><td></td></tr>
<tr><td>B. Instituting New Knowledge</td><td colspan="2">B.1. Presenting Examples</td></tr>
<tr><td></td><td>Activity B.1. Exploring Key Concepts

Option 1: Variable Detectives: Classifying the Clues

Instructions:
1. Examine and study the table below, which shows some variables which are grouped according to their types and reasons.
<table>
<tr><th>Variables</th><th>Type</th><th>Reason</th></tr>
<tr><td>Number of children in the park</td><td>Discrete</td><td>Countable, Whole numbers only, no fractions</td></tr>
<tr><td>Weight of luggage</td><td>Continuous</td><td>Measurable with infinite precision</td></tr>
<tr><td>Speed of a fighter jet</td><td>Continuous</td><td>Any value possible within interval, measured</td></tr>
<tr><td>Number of dogs in the neighborhood</td><td>Discrete</td><td>Countable with no intermediate values</td></tr>
<tr><td>Temperature in Baguio City</td><td>Continuous</td><td>Smooth range of values, infinitely many possibilities</td></tr>
<tr><td>Time to finish a 100-meter dash</td><td>Continuous</td><td>Any fractional value possible, infinitely many values</td></tr>
<tr><td>Height of a basketball player</td><td>Continuous</td><td>Infinite possible values within a range, measurable with decimals</td></tr>
<tr><td>Distance from church to school</td><td>Continuous</td><td>Infinite possible values within a range, measurable with decimals</td></tr>
<tr><td>Number of senior citizens in a barangay</td><td>Discrete</td><td>Countable whole numbers and finite</td></tr>
<tr><td>Number of teachers in school</td><td>Discrete</td><td>Countable, Whole numbers only, no fractions</td></tr>
</table></td><td>Activity B.1. Exploring Key Concepts

This activity provides a comparative framework to define terms. By offering two distinct delivery tracks (Option 1: Direct Table Comparison or Option 2: Active Scenario Sorting), it allows teachers to choose how students deduce structural rules based on data behavior. Working in groups, students apply these rules to new items and practice writing their own examples, solidifying their schema before tackling formulas.

Pedagogy and Strategies
● Deductive Concept Attainment (Option 1): Students examine a completed reference model to discover underlying mathematical rules on their own.
● Inductive Sorting & Classification (Option 2): Students actively categorize active real-world scenarios to build the definitions from scratch.
● Peer Verification and Refinement: Collaborative sorting allows students to question each other's reasoning, which helps fix conceptual misunderstandings early.

Integration Components
● Educational Technology (EdTech): Teachers can display the classification tables using interactive Google Slides or Jamboard, letting students drag and drop variables into correct categories.
● Literacy: Enhances logical reasoning and writing skills as students formulate clear rationales for their classifications.
● Scaffolded Integrative Performance Task (IPT): Teaches students how to select appropriate statistical</td></tr>
</table>

	2. Answer the following questions: ● In your own words, what does 'discrete variable' mean? ● Can you explain what a continuous variable is? ● How do discrete and continuous variables differ? 3. Form groups of five learners each. 4. Printed worksheets with variables will be given by your teacher in each group. 5. Classify each variable as discrete or continuous and write your reasons. 6. Your group will present your classifications and explain your reasons. 7. Create your own ten (10) examples of discrete and ten (10) continuous variables. Identify the reasons why it is discrete or continuous. *Processing Questions:* 1. In what ways are you distinguishing discrete variables from continuous variables? 2. In what ways are you connecting the importance of understanding variables to real-world data collection and research? 3. How would you explain the difference between discrete and continuous random variables to a friend? **Option 2: Exploring Discrete and Continuous Random Variables** *Instructions:* **1. Study the Table** Analyze the information in the tables below. Notice the **situation**, the **random variable** (X), and the **possible values of** X.	tools based on whether a variable is discrete or continuous. ***Instructions for Teachers / Facilitation Guide*** 1. Choose the path that best fits your classroom setup: ● **If executing Option 1**: Present the reference table on the board. Ask the class to look for patterns: *"Look closely at the units used. What do you notice about the numbers in the discrete column versus the numbers in the continuous column?"* ● **If executing Option 2**: Hand out the scenario cards. Instruct groups to sort them physically into two mystery piles based on their properties before defining the terms. 2. Distribute the 10-item practice worksheet to small groups. 3. Instruct groups to write down a specific mathematical reason for every classification they choose. 4. Have teams share their choices, and challenge each group to write down 10 brand-new, original examples for each category.

Discrete Random Variables

Situation / Experiment	Random Variable (X)	Possible Values of X
Rolling a fair six-sided die	Number that appears on the die	{1, 2, 3, 4, 5, 6}
Tossing 3 coins	Number of heads	{0, 1, 2, 3}
Counting learners in a class	Number of learners present	{0, 1, 2, 3, …, 50}
Customer arrivals in a shop	Number of customers entering per hour	{0, 1, 2, 3, …}
Exam results	Number of correct answers out of 20	{0, 1, 2, …, 20}

Continuous Random Variables

Situation / Experiment	Random Variable (X)	Possible Values of X
Measuring height	Height of a learner (cm)	Any value in a range (e.g., 140.5–190.2)
Recording travel time	Time to go to school (minutes)	Any positive real number
Measuring weight	Weight of a person (kg)	Any value in a range
Measuring temperature	Temperature outside (°C)	Any value in a range
Measuring voltage	Electrical voltage (V)	Any value in a range

Classify the Variables

1. Work in pairs or small groups.
2. For each situation in the tables, identify:
   - The **random variable**
   - Whether it is **discrete** or **continuous**
3. Write down your classification and be ready to explain your reasoning.

	Processing Questions: 1. What clues helped you identify whether a variable is discrete or continuous? 2. Can you give a real-life example of each type of random variable (not in the table)? 3. How would you explain the difference between discrete and continuous random variables to a friend?	
	B.2. Discussing the Concept	
	Activity B.2. Deepening Conceptual Understanding *Instructions:* 1. Carefully read the lesson notes on random variables. 2. Take note of important terms. 3. Work through the step-by-step examples provided 4. Be ready to answer questions or share your thoughts during discussions. 5. Raise questions if any concept is confusing. **Random Variables** A **random variable** is a variable whose value is determined by chance. It may take numerical values depending on the outcome of the experiment. Random variables are usually denoted by capital letters such as X, Y, or Z, and they represent the set of possible outcomes of a random experiment. *Example 1*. A coin is tossed 3 times. Let X be the random variable denote the number of heads. Find the values of the random variable X. *Solutions:* To accomplish this, first identify all possible outcomes of the given statistical experiment, and then determine the specific random variable defined in the problem.	**Activity B.2. Deepening Conceptual Understanding** This segment provides clear, direct instruction on the math mechanics of discrete distributions. It guides students through the step-by-step processes of listing sample spaces, building probability tables, plotting vertical histograms, and calculating the long-run expected value ($E(X)$), variance ($Var(X)$), and standard deviation ($SD(X)$). This ensures students can connect statistical variations directly to risk management. ***Pedagogy and Strategies*** ● **Guided Step-by-Step Problem Solving:** Breaks down complex, multi-stage statistical formulas into clear, digestible, sequential operations. ● **Differentiated Scaffolding Directives:** Uses simple mental tests for identifying variables and clear, color-coded visual guides to teach formula steps. ***Integration Components*** ● **Educational Technology (EdTech):** Teachers can use pre-formatted spreadsheet templates (Excel/Google Sheets) to show how calculations change in real time and use Desmos to display probability graphs. ● **Literacy:** Teaches students how to translate abstract notation $(\Sigma, X, E(X))$ into clear, written risk descriptions. ● **Scaffolded Integrative Performance Task (IPT) Milestone 2:** SIPT Distribution Modeling. Student groups take their community dataset, organize it into a formal

Outcomes	TTT	TTH	THT	THH	HTT	HTH	HHT	HHH
x = no. of heads	0	1	1	2	1	2	2	3

Therefore, the possible values of the random variable X are 0, 1, 2, and 3.

Example 2.
The random variable Y denotes whether the outcome is even in a die roll (1 if even, 0 if odd). Find the possible values of Y.

Die Outcome	Is it Even?	Y = Number of Even Numbers
1	No	0
2	Yes	1
3	No	0
4	Yes	1
5	No	0
6	Yes	1

From the table, Y can take the values (0, 1).

More examples of random variables:

1. The number of hearts obtained when drawing five cards from a standard deck, the number of hearts drawn (0, 1, 2, 3, 4, or 5).
2. The number of heads or tails obtained when flipping a coin. (0,1)
3. The number obtained when rolling a die (1, 2, 3, 4, 5, or 6).
4. The number of heads that will appear in tossing a coin three times. (0, 1, 2, 3)
5. The sum of dots in rolling a pair of dice.

The importance of random variables lies in their ability to help us understand and predict uncertain real-world events. Each random variable has an underlying probability distribution, which specifies probability table, and calculate its long-run expected value ($E(X)$).

Facilitation Guide

1. Demonstrate Examples 1 and 2 on the board to show how a sample space is converted into a functioning discrete probability distribution table.
2. Introduce the "**Count vs. Clock Test**" to assist struggling learners: *"If you find the value by counting individual items one by one on your fingers, it is discrete. If you must look at an instrument like a clock, scale, tape measure, or thermometer, it is continuous."*
3. Map out the variance formula using a 4-step color-coded system on the board:
   - **Step 1 (Blue):** Calculate deviations by subtracting the mean from each value: $\big(X - E(X)\big)$.
   - **Step 2 (Yellow):** Square those deviations:$\big(X - E(X)\big)^2$.
   - **Step 3 (Green):** Multiply those squared deviations by their probabilities: $\big(X - E(X)\big)^2 \cdot P(X)$.
   - **Step 4 (Red):** Sum the entire column to get the variance.
4. Pause after Example 2 to run **Formative Checkpoint 1** (90-Second Challenge):
   If a random variable has values $1, 2,$ *and* 3, *and* $P(1) = 0.40$ *and* $P(2) = 0.45$, *find the exact value of* $P(3)$ *to make it valid.*
   Have all students write their answer on paper and hold it up at the count of three.
5. Use **Formative Checkpoint 2** after Example 4: Ask the class if a variance or standard deviation can ever be a negative number and have them explain why.

Processing Questions:

1. What is a random variable based on the examples given?
2. How did listing all possible outcomes help identify the values of the random variable?

the likelihood of each possible value occurring. This allows us to estimate the probabilities of different outcomes and make informed decisions based on this information.

Random variables are widely used in fields where risk assessment and decision-making are crucial, such as finance, engineering, and medicine. For example, in finance, random variables model investment returns, helping investors allocate resources wisely and manage risk effectively.

Types of Random Variables

A **discrete** random variable is a type of variable that takes values you can count.

Example 3.
A local agricultural trading hub inspects standard crates of native cardava bananas arriving from nearby farms. Let the discrete random variable X represent the exact number of under-ripe or bruised banana hands found per sample crate. Based on records from previous deliveries, the probability distribution is modeled as follows:

Number of Bruised Hands (X)	0	1	2	3
Probability $P(X)$	0.40	0.35	0.15	0.10

Other real-world examples include:

- The number of coins in your pocket.
- The number of learners in a classroom.
- The number of calls received at the help desk.
- The number of tricycle passengers picked up on a single trip.

A **continuous** random variable is one whose values are obtained through measurement.

Example 4.

1. The time it takes for a runner to finish a race.
2. The height of each learner in a classroom.
3. The exact amount of milk in a carton.
4. The temperature recorded at noon in a city.

3. What does the expected value tell us about an experiment?
4. Why are variance and standard deviation important in real-life situations?

5. The volume of water in a swimming pool.

Probability of a Discrete Random Variable

A **discrete random variable** is one that can take on countable values (e.g., 0, 1, 2, …). Each possible value has an associated probability, which satisfies:

1. $0 \leq P(X = x_i) \leq 1$ for each value x_i
2. $\sum \quad P(X = x_i) = 1$

The probability distribution of a discrete random variable lists all possible values and their probabilities.

Graph of a Probability Distribution of a Discrete Random Variable

A **graph of a probability distribution** for a discrete random variable is a **probability histogram** or a **stick graph** (vertical line graph) that shows each possible value of the variable along with its probability.

Because the variable is *discrete*, the graph has **separate bars or lines**, not a continuous curve.

How to Graph a Discrete Probability Distribution

1. List the values of the random variable (e.g., 0, 1, 2, 3 heads).
2. List the probability of each value.
3. Draw the x-axis labeled with the values of the random variable.
4. Draw the y-axis labeled with "Probability".
5. Draw bars or vertical lines whose heights correspond to the probability of each value.
6. Make sure the bars do not touch, since the data is discrete.

Example 5.

Construct a probability distribution showing the number of heads that will appear when tossing a coin three times and draw the graph.

Solutions:

- **Step 1:** Identify the random variable
  Let X = number of heads in 3-coin tosses.
  Possible values of X are: 0,1,2,3

- **Step 2:** List all possible outcomes
  There are $2^3 = 8$ outcomes when tossing a coin three times:

$$TTT, TTH, THT, THH, HTT, HTH, HHT, HHH$$

- **Step 3:** Count the number of heads for each outcome

Outcome	Number of Heads (X)
TTT	0
TTH	1
THT	1
THH	2
HTT	1
HTH	2
HHT	2
HHH	3

- **Step 4:** Determine probabilities

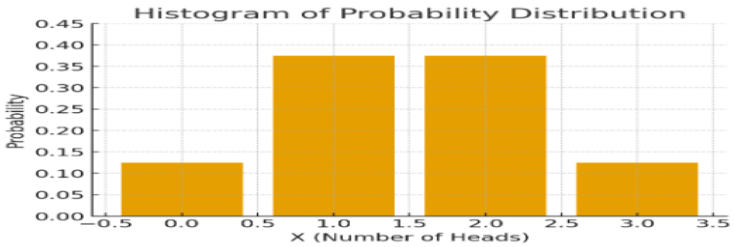
X (Number of Heads)	Number of Outcomes	Probability $P(X)$
0	1	1/8 = 0.125
1	3	3/8 = 0.375
2	3	3/8 = 0.375
3	1	1/8 = 0.125

- **Step 5:** Probability Distribution Table

Heads (X)	0	1	2	3
$P(X)$	0.125	0.375	0.375	0.125

Check: $0.125 + 0.375 + 0.375 + 0.125 = 1$ ✔

Graph:



Example 6.

Construct a probability distribution table showing the probability of the number of even numbers in a single die roll, draw the graph.

Solutions:

- **Step 1:** Define the random variable

  Let Y = number of even numbers in one roll of a standard six-sided die.

  Possible values of Y are: 0,1

- **Step 2:** List possible outcomes

Die Outcome	Is it Even?	Y
1	No	0
2	Yes	1
3	No	0
4	Yes	1
5	No	0
6	Yes	1

- **Step 3:** Determine probabilities

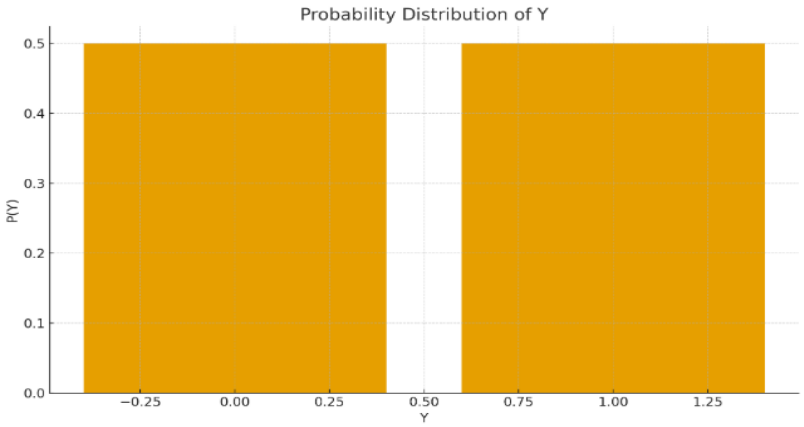
Y (Number of Even Numbers)	Number of Outcomes	Probability $P(Y)$
0	3	3/6 = 0.5
1	3	3/6 = 0.5

- **Step 4:** Probability Distribution Table

Y	$P(Y)$
0	0.5
1	0.5

Check: $0.5 + 0.5 = 1$ ✔

Graph:



Expected Value

The **expected value** or **mean** (denoted as *E(X)* or μ) of a random variable *X* is the average or mean value that ***X*** will take over many repetitions of an experiment. It represents the long-run average outcome.

Expected value of Discrete Random Variable

For a discrete random variable with values $x_1, x_2, x_3, \dots, x_n$ and probabilities $p_1, p_2, p_3, \dots, p_n$:

$$E(X) = \sum\big(X \cdot P(X)\big)$$

where:
$E(X)$ = expected value or mean
X = random variable
$P(X)$ = probability of the random variable.

Example 7.
A fair six-sided die is rolled. Let X be the number that appears. Find the expected value of X.

Solutions:
A fair die has outcomes: 1, 2, 3, 4, 5, 6.

$$E(X) = \sum\big(X \cdot P(X)\big)$$

$$E(X) = 1 \cdot \frac{1}{6} + 2 \cdot \frac{1}{6} + 3 \cdot \frac{1}{6} + 4 \cdot \frac{1}{6} + 5 \cdot \frac{1}{6} + 6 \cdot \frac{1}{6}$$

$$E(X) = \frac{1 + 2 + 3 + 4 + 5 + 6}{6}$$

$$E(X) = \frac{21}{6}$$

$$E(X) = 3.5$$

Answer: $E(X) = 3.5$

Example 8:
A game costs ₱10 to play. A player draws a card from a box with 5 cards: 2 cards give ₱0, 2 cards give ₱20, and 1 card gives ₱50. Let X be the net gain (prize minus cost). Find the expected value of the game.

Solutions:
Possible net gains:

₱0 prize $\rightarrow X = -10$ $(probability\ 2/5)$

₱20 prize $\rightarrow X = 10$ $(probability\ 2/5)$

₱50 prize $\rightarrow X = 40$ $(probability\ 1/5)$

$$E(X) = \left((-10) \cdot \frac{2}{5}\right) + \left(10 \cdot \frac{2}{5}\right) + \left(40 \cdot \frac{1}{5}\right)$$

$$E(X) = -4 + 4 + 8$$

$$E(X) = 8$$

Answer: Expected gain = ₱8.00

Example 9.
A survey shows the number of books learners read in a month as follows. Find the expected number of books a learner reads.

Number of books (X)	0	1	2	3	4
Probability $P(X)$	0.1	0.2	0.4	0.2	0.1

Solutions:

$$E(X) = \sum\big(X \cdot P(X)\big)$$
$$E(X) = 0 \cdot 0.1 + 1 \cdot 0.2 + 2 \cdot 0.4 + 3 \cdot 0.2 + 4 \cdot 0.1$$

$$E(X) = 0 + 0.2 + 0.8 + 0.6 + 0.4 = 2$$

Answer: Expected number of books = 2

Variance and Standard Deviation of Discrete Random Variable

Variance is a measure of how much the values of a random variable deviate from the mean (expected value). It gives an idea of the spread or dispersion of the data. For a discrete random variable X with expected value $E(X)$, the variance is calculated as:

$$Var(X) = \sum[(X - E(X))^2 \cdot P(X)]$$

where:
X = possible value of the random variable
$E(X)$ = expected value (mean) of X
$P(X)$ = probability of X

A higher variance indicates that the values are more spread out from the mean, while a lower variance indicates that they are closer to the mean.

Standard deviation is the square root of the variance. It is expressed in the same units as the random variable, making it easier to interpret.

$$SD(X) = \sqrt{Var(X)}$$

Like variance, a higher standard deviation means the data is more spread out, while a lower standard deviation means the data is more concentrated around the mean.

In short:
Variance measures spread in squared units.
Standard deviation measures spread in original units, making it easier to understand and compare.

Example 10.
Determine the variance and standard deviation of Example 7, 8, and 9.

Solutions:

- *Variance and Standard Deviation of Example 7*

Problem Recap:
Let X = number appearing on a fair six-sided die.

- **Step 1.** Expected Value (Mean)

$$E(X) = 3.5$$

- **Step 2.** Variance Formula

$$Var(X) = \sum[(X - E(X))^2 \cdot P(X)]$$

- **Step 3.** Calculate Variance

X	$P(X)$	$X - E(X)$	$(X - E(X))^2$	$(X - E(X))^2 \cdot P(X)$
1	$1/6$	-2.5	6.25	$6.25 \cdot 1/6 \approx 1.0417$
2	$1/6$	-1.5	2.25	$2.25 \cdot 1/6 \approx 0.3750$
3	$1/6$	-0.5	0.25	$0.25 \cdot 1/6 \approx 0.0417$
4	$1/6$	0.5	0.25	$0.25 \cdot 1/6 \approx 0.0417$
5	$1/6$	1.5	2.25	$2.25 \cdot 1/6 \approx 0.3750$
6	$1/6$	2.5	6.25	$6.25 \cdot 1/6 \approx 1.0417$

$$Var(X) = 1.0417 + 0.3750 + 0.0417 + 0.0417 + 0.3750 + 1.0417$$

$$Var(X) = 2.9168$$

$$Var(X) \approx 2.92$$

Step 4. Standard Deviation

$$SD(X) = \sqrt{Var(X)}$$

$$SD(X) = \sqrt{2.9168}$$

$$SD(X) \approx 1.71$$

Answer: Variance ≈ 2.92
SD ≈ 1.71

- *Variance and Standard Deviation of Example 8*

Problem Recap:
Net gain $X = -10, 10, 40$ with probabilities $2/5, 2/5, 1/5$

Step 1. Expected Value

$$E(X) = \left((-10) \cdot \frac{2}{5}\right) + \left(10 \cdot \frac{2}{5}\right) + \left(40 \cdot \frac{1}{5}\right) = 8$$

Step 2. Variance Formula

$$Var(X) = \sum[(X - E(X))^2 \cdot P(X)]$$

Step 3. Calculate Variance

X	$P(X)$	$X - E(X)$	$(X - E(X))^2$	$(X - E(X))^2 \cdot P(X)$
-10	$2/5$	-18	324	$324 \cdot 2/5 = 129.6$
10	$2/5$	2	4	$4 \cdot 2/5 = 1.6$
40	$1/5$	32	1024	$1024 \cdot 1/5 = 204.8$

$$Var(X) = 129.6 + 1.6 + 204.8$$

$$Var(X) = 336$$

Step 4. Standard Deviation

$$SD(X) = \sqrt{336}$$

$$SD(X) \approx 18.33$$

Answer: Variance = 336
SD ≈ 18.33

Variance and Standard Deviation of Example 9

Step 1. Expected Value

Number of books (X)	0	1	2	3	4
Probability $P(X)$	0.1	0.2	0.4	0.2	0.1

$$E(X) = (0 \cdot 0.1) + (1 \cdot 0.2) + (2 \cdot 0.4) + (3 \cdot 0.2) + (4 \cdot 0.1)$$

$$E(X) = 2$$

Step 2. Variance Formula

$$Var(X) = \sum[(X - E(X))^2 \cdot P(X)]$$

Step 3. Calculate Variance

X	$P(X)$	$X - E(X)$	$(X - E(X))^2$	$(X - E(X))^2 \cdot P(X)$
0	0.1	-2	4	$4 \cdot 0.1 = 0.4$
1	0.2	-1	1	$1 \cdot 0.2 = 0.2$
2	0.4	0	0	$0 \cdot 0.4 = 0$
3	0.2	1	1	$1 \cdot 0.2 = 0.2$
4	0.1	2	4	$4 \cdot 0.1 = 0.4$

$$Var(X) = 0.4 + 0.2 + 0 + 0.2 + 0.4$$

$$Var(X) = 1.2$$

Step 4. Standard Deviation

$$SD(X) = \sqrt{1.2}$$

$$SD(X) \approx 1.095$$

$$SD(X) \approx 1.10$$

Answer: Variance = 1.2
SD ≈ 1.10

Data Analysis Using Expected Value, Variance and Standard Deviation

Example 11.
A player plays a simple board game where they can win or lose money based on the roll of a spinner. The outcomes are:

X (Net Gain in ₱)	-20	0	10	30
$P(X)$	0.2	0.3	0.4	0.1

Find the expected value, variance, and standard deviation of the net gain. Interpret the results.

*Solutions**:***

Step 1. Expected Value (Mean)

$$E(X) = \sum\big(X \cdot P(X)\big)$$

$$E(X) = (-20)(0.2) + (0)(0.3) + (10)(0.4) + (30)(0.1)$$

$$E(X) = -4 + 0 + 4 + 3$$

$$E(X) = 3$$

Interpretation:
On average, a player can expect to win ₱3.00 per game.

Step 2. Variance

$$Var(X) = \sum[(X - E(X))^2 \cdot P(X)]$$

X	$P(X)$	$X - E(X)$	$(X - E(X))^2$	$(X - E(X))^2 \cdot P(X)$
-20	0.2	-23	529	$529 \cdot 0.2 = 105.8$
0	0.3	-3	9	$9 \cdot 0.3 = 2.7$
10	0.4	7	49	$49 \cdot 0.4 = 19.6$
30	0.1	27	729	$729 \cdot 0.1 = 72.9$

$$Var(X) = 105.8 + 2.7 + 19.6 + 72.9 = 201$$

Step 3. Standard Deviation

$$SD(X) = \sqrt{Var(X)}$$

$$SD(X) = \sqrt{201}$$

$$SD(X) \approx 14.18$$

Step 4. Interpretation

Expected value: On average, the player wins ₱3.00 per game.
Variance: The variance of 201 indicates that there is a high spread in possible outcomes; meaning results can vary widely.

Standard deviation: The standard deviation of ≈₱14.18 implies that most of the game outcomes typically deviate around ₱14.00 from the mean, so the game is quite risky.

It can be concluded that, while the player expects a small profit on average, the large standard deviation indicates high variability, meaning they could either lose significantly or win much more than the average.

Example 12.
A community-based cooperative plans to invest surplus funds into one of two local startup projects: an Eco-Tourism Transport Service (Venture Alpha) or a Community Cold-Storage Facility (Venture Beta). Let's use our complete toolkit to complete a comparative risk evaluation.
Solutions:
Step 1: Identify the Distribution Profiles
Venture Alpha Table Analysis:

Return (X_A)	**20**	**50**	**100**
Probability $P(X_A)$	0.3	0.5	0.2

Venture Beta Table Analysis:

Return (X_B)	**10**	**60**	**90**
Probability $P(X_B)$	0.1	0.7	0.2

Step 2: Calculate Expected Values (Means)
Venture Alpha: $E(X_A) = (20)(0.3) + (50)(0.5) + (100)(0.2) = 6 + 25 + 20$ = ₱51.0 thousand

- **Venture Beta:** $E(X_B) = (10)(0.1) + (60)(0.7) + (90)(0.2) = 1 + 42 + 18$ = ₱61.0 thousand

Step 3: Calculate Variances and Standard Deviations

Venture Alpha Spread Sheet $E(X_A) = 51$**:**

X_A	$P(X_A)$	$X_A - E(X_A)$	$(X_A - E(X_A))^2$	$(X_A - E(X_A))^2 \cdot P(X_A)$
20	0.3	-31	961	$961 \cdot 0.3 = 288.3$
50	0.5	-1	1	$1 \cdot 0.5 = 0.5$
100	0.2	49	2401	$2401 \cdot 0.2 = 480.2$

$$Var(X_A) = 288.3 + 0.5 + 480.2 = 769.0$$

$SD(X_A) = \sqrt{Var(X_A)} = \sqrt{769.0} \approx 27.73$ thousand

Venture Beta Spread Sheet $E(X_B) = 61$**:**

X_B	$P(X_B)$	$X_B - E(X_B)$	$(X_B - E(X_B))^2$	$(X_B - E(X_B))^2 \cdot P(X_B)$
10	0.1	-51	2601	$2601 \cdot 0.1 = 260.1$
60	0.7	-1	1	$1 \cdot 0.7 = 0.7$
90	0.2	29	841	$841 \cdot 0.2 = 168.2$

$$Var(X_B) = 260.1 + 0.7 + 168.2 = 429.0$$

$SD(X_B) = \sqrt{Var(X_B)} = \sqrt{429.0} \approx 20.71$ thousand

Step 4: Strategic Recommendation
The cooperative should select **Venture Beta**. It delivers a higher long-run expected return ₱$61.0K$ vs. ₱$51.0K$ and carries a lower operational risk profile, as proven by its smaller standard deviation ₱$20.71K$ vs. ₱$27.73K$. This makes Venture Beta appear to be both less risky and more profitable on average for cooperative management.

<table>
<tr><td></td><td colspan="2">Remember:
Understanding random variables and how to measure their average and variability helps us make sense of uncertainty in everyday life. By applying these concepts, we can better analyze situations, make informed decisions, and even predict outcomes in games, experiments, and real-world events.</td></tr>
<tr><td></td><td colspan="2">B.3. Developing Mastery (For complete instructions, please refer to the Learning Activity Sheet.)</td></tr>
<tr><td></td><td colspan="2">Activity B.3. Practicing Learned Skills

This formative practice section transitions students from watching examples to working through calculations independently. Students practice three core skills: identifying variable types, converting sample spaces into discrete tables and bar charts, and calculating means, variances, and standard deviations for five real-life scenarios. This practice acts as a diagnostic checkpoint before students move on to advanced applications.

Pedagogy and Strategies
● Scaffolded Board Warm-Up: Uses individual row checks to build confidence before students tackle large data tables.
● Formative Diagnostic Assessment: Monitors students' step-by-step calculation mechanics to spot and fix formula errors early.

Integration Components
● Educational Technology (EdTech): Students can use Excel spreadsheet formulas (such as =SUMPRODUCT) to instantly check their manual table calculations.
● Literacy: Requires students to write short narrative summaries that explain what statistical metrics mean for daily operations.
● Scaffolded Integrative Performance Task (IPT): Directly prepares students for the Micro-Enterprise Risk Management Study in Section C.1 by building solid table calculation skills.

Facilitation Guide
1. Before students begin working on Part C, write a simple baseline profile on the board $E(X) = 3.0$ to practice single-row operations together.
2. Run a quick board practice: "If $X = 5$ and $P(5) = 0.20$, what is the calculation for the variance column?" (Answer: $(5 - 3.0)^2 \cdot 0.20 = 0.80$).
3. Set a clear time limit for students to complete the practice problems individually or in pairs.
4. Move around the room during the activity to check students' work, prompting them with questions like: "Look at your probability column for this problem. Does it add up to exactly 1.0?"
5. Have students swap papers to check answers and display the reference bar charts on the screen so they can check their graphs</td></tr>
<tr><td>C. Demonstrating Knowledge and Skills</td><td colspan="2">C.1. Finding Practical Application</td></tr>
<tr><td></td><td>Activity C.1: Making Real-World Connections

Part A: Group Business Consultation Report</td><td>Activity C.1: Making Real-World Connections

This final application task asks students to work as small business development consultants. Teams choose a local</td></tr>
</table>

	Instructions: Analyze the scenario and options below, then select one scenario option to investigate with your permanent group of four. Perform all the indicated tasks accurately to complete your business consultation report. **Scenario**: You are working in groups of 4 to act as small business development consultants. Your task is to evaluate the financial risk and sustainability profiles of a common neighborhood micro-retail venture under uncertain daily demand conditions. Choose **one** of the following options from the assignment matrix to analyze: ● **Scenario Option A (Sari-Sari Store Inventory):** Model the daily demand for 5-gallon purified drinking water refills ($X = 0, 1, 2, 3, 4$ jugs with probabilities $0.1, 0.2, 0.4, 0.2, 0.1$). Each refill costs ₱15 to stock and sells for ₱35. Unsold water incurs no loss, but missed sales represent lost revenue. Assume the owner stocks exactly 2 jugs each morning. ● **Scenario Option B (Agricultural Perishables):** Model the daily demand for premium local mango baskets ($X = 0,1,2,3$ baskets with probabilities $0.2,0.4,0.3,0.1$). Baskets cost ₱150 to source and sell for ₱300. Because they are perishable, unsold baskets at the end of the day are written off as a total loss of investment. Assume the owner sources exactly 2 baskets each morning. **Definition of the Variable:** The random variable X in this investigation is the daily demand (in units or baskets) for the chosen product. This is a discrete random variable because the items are distinct, countable units.	micro-retail scenario—either a stable Sari-Sari Store Inventory or a risky Agricultural Perishables vendor—and perform a complete risk and profit evaluation. Individually, students also complete a career-track task tailored to their post-graduation plans (Entrepreneurship or Technical Skills). ***Pedagogy and Strategies*** ● **Case-Based Contextualized Learning:** Connects classroom statistics directly to local business choices and career paths. ● **Differentiated Assessment Design:** Provides tailored assignment paths to match students' diverse goals and career tracks after graduation. ***Integration Components*** ● **Educational Technology (EdTech):** Teams can design their consulting reports using Canva or use spreadsheet functions to organize their financial tables. ● **Literacy:** Requires writing a professional, 3-sentence risk advisory that uses calculated data to provide clear business recommendations. ● **Scaffolded Integrative Performance Task (IPT) Milestone 3:** SIPT Risk Assessment. Student groups calculate the variance and standard deviation of their community dataset and write a risk management proposal for their final project portfolio. ***Facilitation Guide*** 1. Instruct students to gather into their permanent teams of 4 and choose either Scenario Option A (Water Refills) or Option B (Mango Baskets). 2. Explain the grading rubric columns carefully, emphasizing that the final risk of advice must be exactly 3 sentences long and backed up by their calculated math. 3. Have groups calculate their daily net profits for each demand level based on their chosen scenario cost and waste rules.

	Task: 1. **Build a formal probability table** for your chosen scenario option, listing the demand values, their probabilities, and the calculated net daily profit for each. 2. **Calculate the exact Expected Value** of net daily profit $E(Profit)$ by multiplying the profit outcomes by their probabilities and adding them up. 3. **Compute the variance and standard deviation** of the daily earnings to measure the commercial risk and variation. 4. **Write a 3-sentence risk management advisory** to the store owner. Use your calculated expected value and standard deviation to explain whether they should expand their inventory or keep it the same. **Part B: Differentiated Career-Track Matrix (Individual Exit Task)** *Instructions:* Select and solve the specific problem block below that directly matches your planned Senior High School (SHS) graduation exit pathway. Show your complete mathematical computations clearly. **Block 1: Entrepreneurship Exit (Micro-Business Risk Modeling)** You plan to launch a small community internet cafe after graduation. Let X be the number of workstation hardware repairs needed each month ($X = 0, 1, 2, 3$ with probabilities $0.5, 0.3, 0.1, 0.1$ respectively). Each physical repair costs your business a flat rate of ₱1,200. **Task:** 1. Compute your expected number of monthly repairs, $E(X)$. 2. Compute your expected monthly maintenance cost ($E(X) \cdot$ ₱1,200). 3. Write a short explanation explaining how this calculated monetary value helps you set aside an accurate emergency operating cash reserve rather than just guessing.	4. Once the group reports are finished, have students work individually on the career-track task that matches their post-graduation path (Block 1 or Block 2). 5. Collect both the group consulting reports and individual exit slips for grading.

Block 2: Middle-Level Technical Skills Exit (Equipment Maintenance Analytics)

As a solar maintenance technician at a local renewable energy facility, you track weekly inverter circuit failures (X). The discrete probability distribution shows $P(0) = 0.7, P(1) = 0.2$, and $P(2) = 0.1$.

Task:

1. Calculate the expected number of weekly circuit failures, $E(X)$.
2. Calculate the variance $Var(X)$ and standard deviation $SD(X)$ of the failures.
3. Write a brief comment on how tracking these specific metrics helps your engineering team schedule preventative maintenance before catastrophic system failures occur.

Your work will be scored using the rubric below:

Rubric:

Criteria	Excellent (3)	Good (2)	Needs Improvement (1)
Data & Profit Setup	All daily net profit outcomes are correctly calculated based on the chosen scenario rules.	Profit calculations are mostly correct with minor errors.	Profit setup is incomplete or incorrect.
Table Organization	The probability distribution and profit table are neat, clear, and fully filled out.	The table is mostly organized and easy to read.	The table is messy, confusing, or incomplete.
Computations	Mean (Expected Value), variance, and standard deviation are mathematically correct.	Most computations are correct with minor math mistakes.	Computations are incorrect or missing.
Risk Advisory & Clarity	Gives clear, 3-sentence advice to the owner backed up by the calculated math. Work is neat and easy to read.	Gives advice, but it lacks numerical proof or misses the 3-sentence rule. Work is mostly neat.	Advice is missing or unclear, and the overall work is messy.

	Processing Questions: 1. What is the discrete random variable X in your chosen scenario, and why is it considered "discrete"? 2. In simple business terms, what does the Expected Value $E(Profit)$ tell the store owner? 3. How do the variance and standard deviation help explain business risk? 4. Looking at both options, why can selling perishable items (like mangoes) be riskier than selling items that do not spoil (like water refills)? Use the expected value and standard deviation to support your answer.	
	C.2. Making Generalization	
	Activity C.2. Wrapping-Up the Lesson **Option 1: Complete the Rule** *Instructions:* Fill in the missing ideas to complete the generalization statements: 1. A probability distribution lists all possible values of a random variable and their _____. 2. The sum of all probabilities in a probability distribution must equal _____. 3. The expected value represents the long-term or average outcome and is computed by the formula: _____. 4. The variance measures how to spread out the values are from the mean and is computed using: _____. 5. The standard deviation is the _____ of the variance. **Option 2: 3–2–1 Quick Wrap-Up** *Instructions*: Write your responses to the following: ● **3 – Three things you learned** (Example: how to construct a probability distribution, what expected value means, how variance shows variability.)	**Activity C.2: Wrapping-Up the Lesson** This closing component serves as a metacognitive and structural review to cement student learning before the final evaluation. By providing two separate pathways, it allows teachers to choose between an objective rule of consolidation (Option 1) or a reflective self-assessment (Option 2). This activity forces students to summarize how individual probabilities shape the long-run expected value and how standard deviation measures volatility, ensuring all formulas and concepts are organized in their minds. ***Pedagogy and Strategies*** ● **Cloze Retrieval Exercise (Option 1):** Uses sentence completion to pull out structural rules, mathematical definitions, and formulas directly from memory, reinforcing mathematical accuracy. ● **Metacognitive Self-Reflection (Option 2):** Uses a structured 3-2-1 prompt framework to help students audit their own learning progress, make personal connections between topics, and call out areas where they still feel confused. ● **Think-Share-Consolidate:** Students work on their summary individually, double-check their concepts with a seatmate, and confirm the big picture during a quick whole-class wrap-up.

	• **2 – Two connections you made** (Example: how probability affects expected value; how variance and standard deviation relate.) • **1 – One question you still have** (Anything you still find confusing or want to explore more.) *Processing Questions*: 1. What is the difference between a discrete and a continuous random variable? 2. Why is probability important in studying random variables? 3. How do expected value and standard deviation help describe data? 4. How can random variables help in real-life decision-making?	***Integration Components*** • **Educational Technology (EdTech):** Teachers can use digital reflection walls like **Padlet** or interactive polling on **Mentimeter** to gather and display individual 3-2-1 responses on the projector board in real-time. • **Literacy:** Builds analytical reading skills by requiring students to match abstract math to written, real-world descriptions. • **Scaffolded Integrative Performance Task (IPT):** Directly maps out the exact checklist of statistical metrics ($E(X), Var(X), SD(X)$) that student groups must present and defend in their final community data portfolios. ***Facilitation Guide*** 1. Choose the closing activity path that best fits your remaining classroom time: • **If delivering Option 1:** Hand out the cloze worksheet or write the 5 statements on the board. Tell students: *"Fill in the blanks using the exact terms and formulas we derived today without looking at your notes."* • **If delivering Option 2:** Write the 3-2-1 prompts on the board. Tell students: *"Be honest about what you learned and what still confuses you. Use your own words in your notebooks."* 2. Give students 4–5 minutes of quiet, independent writing time. 3. Have students do a 2-minute turn-and-talk with an elbow partner to compare responses and clear up basic formulas. 4. Call on a few volunteers around the room to share their insights, and handle the specific questions raised in the "1" part of the 3-2-1 reflection. 5. Use the 4 processing questions to smoothly transition the class into the individual quiz.

C.3. Evaluating Learning (For complete instructions, please refer to the Learning Activity Sheet.)

Activity C.3. Assessing Learning Outcomes

This individual summative assessment is designed to measure how well students can build discrete probability distributions and compute statistical parameters. Across five varied scenarios—covering coins, dice, playing cards, multiple-choice testing, and lotteries—the test evaluates whether students can perform math steps accurately and interpret results correctly within context.

Pedagogy and Strategies

- **Summative Assessment Evaluation:** Measures individual mastery of the unit's core learning targets.
- **Contextual Interpretive Modeling:** Moves past simple arithmetic by requiring students to write out what their final answers mean regarding risk.

Integration Components

- **Educational Technology (EdTech):** Teachers can create online versions of the quiz using tools like Google Forms or Quizizz to grade submissions and track performance metrics automatically.
- **Literacy:** Measures how well students read complex math problems and write short, accurate risk assessments.
- **Scaffolded Integrative Performance Task (IPT):** Serves as the final academic test to ensure students can handle data math independently.

Facilitation Guide

1. Clear the desks and distribute the 5-problem assessment sheets to each student.
2. Remind students to show all their work clearly, including building tables and using formulas for each problem.
3. Move around the room to monitor the class, answering questions with guiding hints rather than direct solutions.
4. Collect papers right when the session ends.
5. Review the final problem as a class on the board, demonstrating the correct steps, and showing how to interpret the lottery risk accurately.

*C.4. Additional Activities (*For complete instructions, please refer to the Learning Activity Sheet.)

Activity C.4. Extending and Reinforcing Learning

This final section provides differentiated practice tasks based on how students performed the evaluation. Students who need extra help receive five simplified remediation problems focused on basic tables and calculations. Students who show strong mastery receive five enrichment problems featuring larger sample spaces and complex profit setups.

Pedagogy and Strategies

- **Tiered Differentiated Instruction:** Targets specific follow-up tasks to match individual student mastery levels.
- **Remedial Scaffolding & Enrichment Extension:** Helps struggling students fill in learning gaps while keeping advanced students challenged.

Integration Components

- **Educational Technology (EdTech):** Teachers can use Learning Management Systems like Google Classroom to share assignments, track submissions, and provide individual feedback.
- **Literacy:** Continues to build skills in explaining numerical variability and risk in written form.
- **Scaffolded Integrative Performance Task (IPT):** Provides targeted practice to help students refine their final project data portfolios before submission.

Facilitation Guide

1. Review the scores from the C.3 quiz to divide students into support tiers.
2. Assign Problems 1–5 as remediation for students who struggled with core formulas.
3. Assign Problems 6–10 as enrichment for students who scored highly and are ready for more complex problems.
4. Allow students to work independently or in study pairs, providing direct assistance to the remediation tier.
5. Provide answer keys for self-checking or collect the worksheets during the next session to record final completion.

III. CONTENT — **Lesson 10.2. The Normal Distribution**

IV. OBJECTIVES

At the end of the lesson, the learners are expected to:

1. describe and illustrate the shape, properties, and characteristics of a normal distribution curve.
2. apply the z-score formula to convert a normal random variable to a standard normal variable and vice versa.
3. determine probabilities and percentiles using the standard normal distribution table (z-table) or appropriate technologies (e.g., calculator, software).
4. solve and interpret real-life problems involving normal distribution.

V. PROCEDURES

LEARNERS ACTIVITIES	**ANNOTATION**
A.1. Eliciting Prior Knowledge	
Activity A.1. Leveling Learners Readiness **Option 1:** **Self-Rating Scale of Understanding on Normal Distribution** *Instructions:* 1. Read each statement below.	**Activity A.1. Leveling Learners Readiness** This diagnostic activity is strategically positioned at the beginning of the lesson to assess learners' understanding of core statistics prerequisites. It targets discrete random variables, continuous data, central tendency, and standard deviation before moving to the normal distribution. Cognitively, it activates schemas and allows the teacher to identify knowledge gaps. Metacognitively, it prompts self-reflection, transitioning learners from discrete variables to continuous probability distribution models.

Statement	Rating (1–4)
I understand what a random variable is.	
I can determine the probability distribution of a discrete random variable.	
I can interpret graphs of discrete probability distributions (bar graph/histogram).	

I understand the idea of a continuous random variable.	
I know what a bell-shaped distribution looks like.	
I can describe what mean and standard deviation talk about a set of data.	
I have encountered the term normal distribution before.	

2. Rate your level of understanding using this scale:
   Rating

   4 – I can explain this clearly to others.

   3 – I understand this but need a bit more review.

   2 – I have heard of this, but I am not confident.

   1 – This is new to me, or I do not understand it.

3. Place your rating in the box next to each statement.
4. After rating, choose one item you rated 3 or 4 and write a short example or situation showing your understanding.
5. Choose one item you rated 1 or 2 and write a question you want to clarify.

Processing Questions:
1. Which items did you rate the highest? What helped you learn these concepts before?
2. Which items received the lowest rating? Why do you think these topics are difficult for you?
3. How do you think these ideas relate to real-life situations involving measurement, scores, or natural variations?

Option 2: Short, Targeted Quiz on Normal Distribution

Instructions:
- Answer the following questions to the best of your ability.
- Each question can be multiple-choice, true/false, or a short calculation.

Pedagogy and Strategies
- **Self-Regulated Metacognitive Assessment (Option 1):** Learners score their own knowledge using a 4-point scale, which builds self-monitoring skills.
- **Targeted Formative Assessment (Option 2):** A low-stakes quiz checks discrete knowledge vs. continuous concepts to guide upcoming instruction.
- **Bridging Techniques:** The teacher uses learner feedback to connect real-life measurements with the smooth curve of the normal distribution.

Integration Components
- **EdTech:** Administer the quiz or self-rating scale via *Google Forms, Quizizz, or Mentimeter* to get instant visual analytics of class misconceptions.
- **Literacy:** Builds mathematical literacy as students define terms and express math reasoning through personal text examples or questions.
- **Scaffolded Integrative Performance Task (IPT):** Acts as the foundation for the unit performance task. It helps students check if they can distinguish continuously from discrete variables before running their own community's health or screen-time surveys.

Facilitation Guide
1. **Preparation (2 mins):** Project the self-rating scale or distribute the low-stakes diagnostic slips. Inform the class: *"This is a formative checkpoint to map our starting line, not a graded exam"*.
2. **Execution (8 mins):** Give learners 5–7 minutes to complete the scale or quiz independently. Circulate to assist students who feel stuck.
3. **Reflective Prompting (5 mins):** Have students complete the processing questions. Ask volunteers to share their ratings and questions.
4. **Bridging Delivery (3 mins):** Deliver the standard transition script: *"Many of you know how discrete data varies. Today we explore the normal distribution to handle continuous real-world data."*

	● Do not worry if you cannot answer all questions—this is to help you and the teacher understand what you already know. ● After completing the quiz, you will review your answers and note which items you feel confident about and which need clarification. 1. Which of the following is a continuous random variable? a. Number of heads in 3-coin tosses b. Height of learners in your class c. Number of books on a shelf d. Number of cars in a parking lot 2. True or False A probability distribution can be represented using a histogram. □ True □ False 3. Short Answer Write one example of a situation where data might form a bell-shaped distribution. 4. Which statement best describes the mean of a data set? a. The difference between the largest and smallest values b. The middle value when data are arranged in order c. The sum of all values divided by the number of values d. The value that appears most frequently 5. True or False The normal distribution is always symmetric around its mean. □ □ True □ False 6. Short Answer (Optional for advanced learners) What does the standard deviation tell you about a set of data? *Processing Questions:* 1. Which questions did you answer confidently? Why? 2. Which questions were difficult for you? What made them challenging? 3. How can understanding normal distribution help in real-life situations?	

A.2. Establishing the Purpose of the Lesson

Activity A.2. Appreciating Lesson Relevance

Comparing Discrete and Continuous Data

Instructions:
1. Work in groups of 4-5 learners.
2. Solve the two problems together.
3. Answer the questions and discuss your observations.

Problem 1: Rolling a Die
What to do:
Roll one die 20 times and write down each result.
Count how many times each number (1 to 6) appears.

Tasks:
1. Determine the random variables and the probability.
2. Construct probability distribution table and draw its graph.
3. Find the expected value, variance and standard deviation
4. Answer the questions:
   - Which number appeared most?
   - Is the graph symmetric?
   - How spread out are the results?

Problem 2:
Local Community Health Simulation (Infant Birth Weights)

What to do:
Imagine your team is working with the Barangay Health Center. Analyze these simulated birth weights (in kilograms) of 12 infants born in your local community over the past quarter:

2.4, 2.8, 3.0, 3.2, 3.2, 3.4,
3.5, 3.6, 3.8, 3.8, 4.1, 4.5

Activity A.2. Appreciating Lesson Relevance

This activity establishes the lesson's real-world relevance by contrasting counted discrete data with measured continuous data. Problem 1 tracks countable outcomes from die rolls, while Problem 2 models real community health measurements using infant birth weights. This shift shows students that continuous data forms a smooth, bell-shaped curve, making new area-based calculus models necessary since individual points have a probability of zero.

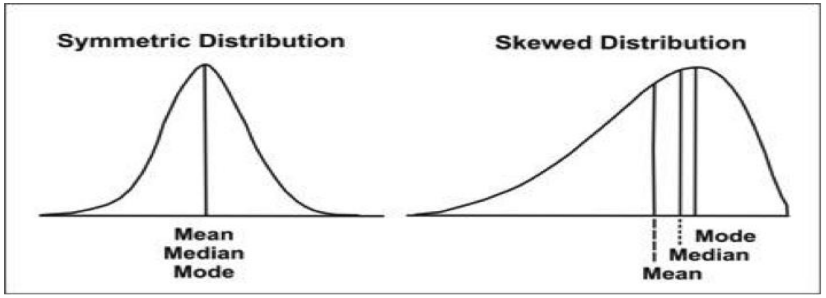
Pedagogy and Strategies
- **Comparative Case Analysis:** Students compare two problem types to discover structural differences between discrete and continuous variables.
- **Collaborative Small-Group Learning:** Learners work in groups of 4–5 to pool math skills and build shared insights.
- **Inductive Discovery Learning:** Students graph continuous data points, discovering the natural bell-shape on their own before the formal lesson begins.

Integration Components
- **EdTech:** Have groups input data into *Google Sheets* or *Desmos/GeoGebra* to quickly plot graphs and contrast flat discrete distributions with curved continuous histograms.
- **Literacy:** Builds contextual literacy by embedding math calculations within a real-world community health scenario.
- **Scaffolded Integrative Performance Task (IPT):** Directly connects to the performance task. It teaches students how to use data for community decisions, like setting health center resource triggers for low birth-weight infants.

	Tasks: 1. Draw a smooth dot plot or frequency histogram of the birth weights. 2. Calculate the sample mean (μ) and standard deviation (σ). 3. Answer these analytical questions: ● Can you assign exact, separate probabilities to a decimal weight (e.g., exactly 3.257 kg) the same way you can for an exact face on a die? ● Does the graph look balanced or symmetric around the average weight? Is it bell-shaped? ● If healthcare resources are automatically deployed to infants weighing in the bottom 10% or top 10% of this distribution, how does understanding this continuous pattern help the Barangay Health Center manage its limited medical supplies? *Processing Questions*: 1. What is the difference between the dice results and the heights? 2. Why can't heights be treated the same way as dice results? 3. What pattern did you notice in the graph of heights? 4. Why is normal distribution important in real-life data?	***Instructions for Teachers / Facilitation Guide*** 1. **Grouping Setup (3 mins):** Divide the class into teams of 4–5 and hand out the dice and scenario cards. 2. **Problem 1 Execution (10 mins):** Have teams roll a die 20 times, record the distribution, and find the mean. 3. **Problem 2 Execution (12 mins):** Have teams sketch a smooth plot of the 12 infant weights and calculate the sample parameters. 4. **Guiding Analysis (10 mins):** Walk around and ask: *"Can you measure the probability of an exact infant weight like 3.257 kg?"* Show how probabilities represent intervals under a smooth curve. 5. Synthesis (5 mins): Share the core objectives and connect the curve to the upcoming lesson on normal distribution.
	B.1. Presenting Examples	
	Activity B.1: Exploring Key Concepts **Watch — Digest — Summarize** *Instructions:* 1. Watch the video to be presented by the teacher. 2. As you watch, take quick notes: ● What is a normal distribution (shape, mean, standard deviation)? ● What does "standardizing" to a Z-score mean? ● How do you use a Z-table (or calculator) to find probabilities or percentiles? ● Did the video show any real-life data examples (e.g. heights, test scores)? 3. After watching, work individually or in **pairs** to write a short summary (~5 lines) answering: ● What did you understand about normal and standard normal distributions?	**Activity B.1: Exploring Key Concepts** This activity uses multimedia modeling to introduce the core components of the normal distribution. It provides a visual guide for abstract concepts like the standard normal distribution, Z-scores, and the Z-table. By summarizing the video, students anchor new technical terms before starting manual calculations. **Pedagogy and Strategies** ● **Active Audiovisual Literacy:** Multi-sensory learning where students take structured notes rather than watching passively. ● Think-Pair-Share (Collaborative Summarization): Students process information on their own, refine it with a partner, and present it to the class.

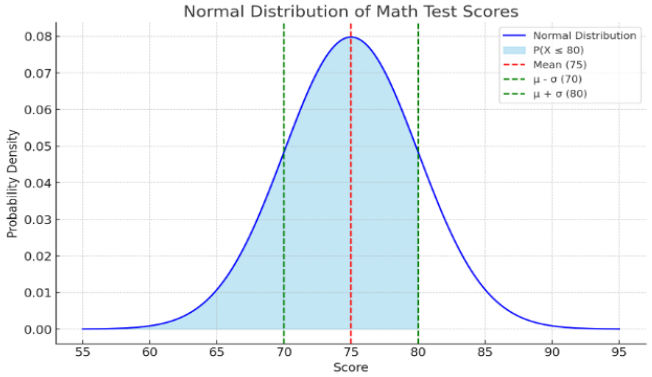
	● When and why do we convert raw scores to Z-scores? ● How can probabilities or percentiles help in real-life decisions (give one example, which questions were difficult for you? What made them challenging? ● exam scores, health data)? 4. Answer one “thinking question”: “If I get a Z-score of +1.5, what does that tell me about where I stand compared to an average person in a normally distributed group?” *Processing Questions*: 1. What are the important characteristics of a normal distribution? 2. Why are the mean, median, and mode equal in a normal distribution? 3. What does the area under the normal curve represent? 4. Why is the normal curve useful in analyzing real-life data?	● **Cognitive Dissonance Framework:** The "thinking question" forces students to explain what a *Z*-score of +1.5 means relative to a population average. ***Integration Components*** ● **EdTech:** Embed questions directly into the video using *Edpuzzle* or *YouTube* to check comprehension in real time. ● **Literacy:** Enhances vocabulary decoding by asking students to translate statistical concepts into a concise 5-line summary. ● **Scaffolded Integrative Performance Task (IPT):** Connects to the milestone of converting raw local community data into standard Z-scores for accurate comparisons. ***Facilitation Guide*** 1. **Set the Stage (2 mins):** Launch the selected instructional video. Instruct students: *"Take notes on how standardizing data into Z-scores lets us compare completely different datasets."* 2. **Video Playback (8 mins):** Run the video stream, pausing briefly at key milestones to point out visual markers like the symmetry of the curve. Suggested videos https://youtu.be/rzFX5NWojp0 https://youtu.be/2tuBREK_mgE https://youtu.be/CjF_yQ2N638 3. **Pair-Share Step (7 mins):** Give pairs 5 minutes to write their 5-line summary and answer the Z-score critical thinking question. 4. **Public Processing (5 mins):** Call on 2–3 volunteer pairs to write their conclusions on the board. Use this to explain how standardization works across different fields.

	B.2. Discussing the Concept	
	Activity B.2. Deepening Conceptual Understanding **Understanding Normal Random Variables and the Standard Normal Distribution** *Instructions*: 1. Carefully read the lesson notes on normal distribution. 2. Take note of important terms. 3. Work through the step-by-step examples provided 4. Be ready to answer questions or share your thoughts during discussions. 5. Raise questions if the concepts are confusing. Before diving into the history, let us define our core tools: ● **Continuous Random Variable:** A variable that can assume an infinite number of values within a specified interval (e.g., time, weight, or distance). ● **Asymptotic:** A geometric property where a curve approaches a baseline (the horizontal axis) closer and closer but never actually touches or intersects it. ● **Parameters**(μ, σ)**:** Fixed values that define the location (Mean) and the spread (Standard Deviation) of a specific probability distribution. **The Normal Distribution** The **normal distribution**, also called the **Gaussian distribution**, is one of the most important probability distributions in mathematics and statistics. It was formally developed in the 18th–19th century by mathematicians **Abraham de Moivre** and later **Carl Friedrich Gauss** while studying natural errors in measurements. It is a continuous probability distribution that is symmetric about the mean (μ). It is known for its **bell-shaped, symmetric curve**, where: ● Most values cluster around the **mean** (average), ● The probabilities decrease evenly as values move away from the mean,	**Activity B.2. Deepening Conceptual Understanding** This section provides direct instruction on the formal attributes of the normal distribution, the Empirical Rule, and the Z-score formula. It transitions students from intuitive descriptions to rigorous mathematical proofs. It defines key parameters (μ, σ) and the curve's asymptotic nature to show how any normal distribution can be transformed into the standard normal distribution $Z \sim N(0,1)$. ***Pedagogy and Strategies*** ● **Explicit Direct Instruction:** A step-by-step approach to teaching the parts of the standard normal distribution equation. ● **Visual Spatial Anchoring:** Shading areas under the curve to help students link abstract probabilities with geometric space. ● **Immediate Formative Response Loops:** Short check-ins used during direct instruction to catch errors early before they affect independent practice. ***Integration Components*** ● **EdTech:** Use *GeoGebra or Desmos Normal Distribution apps* to let students drag slider bars and watch how changing μ and σ alters the curve. ● **Literacy:** Builds technical literacy by unpacking specialized Greek variables (μ, σ) and academic terms like *asymptotic*. ● **Scaffolded Integrative Performance Task (IPT):** Provides the mathematical tools students need to calculate exact population percentiles for their upcoming data research projects. ***Instructions for Teachers / Facilitation Guide*** 1. **Direct Instruction (15 mins):** Draw the normal curve on the board. Define its core properties: symmetry, unimodal structure, and asymptotic baselines.

	● The **mean, median, and mode are equal**. The normal distribution appears naturally in many real-life situations such as: ● Heights and weights of people ● Test scores ● Measurement errors ● Natural and social phenomena  Because many random processes tend to form this pattern (especially with large data sets), the normal distribution became a foundation of probability theory, statistics, and data analysis, and it is widely used in education, science, economics, and quality control. Consequently, the normal distribution helps us describe, analyze, and predict patterns in data that exhibit natural variation. **Characteristics of a Normal Distribution** A normal random variable has the following key characteristics: **1. Bell-shaped and Symmetric** ● The graph looks like a bell. ● The left side is a mirror image of the right side. This implies that the values are equally likely on both sides of the average. **2. Mean = Median = Mode** ● The mean (average), median, and mode are all at the center of the distribution; it means that the most common value and the average are the same. **3. Single Peak (Unimodal)** ● The curve has one highest point. This means that there is one most frequent or typical value.	Introduce the Empirical Rule percentages ($\pm 1\sigma \approx 68\%, \pm 2\sigma \approx 95\%, \pm 3\sigma \approx 99.7\%$). 2. **Formula Breakdown (10 mins):** Introduce the Z-score formula: $Z = \frac{X-\mu}{\sigma}$. Explain that subtracting μ centers the curve at 0, and dividing by σ rescales the standard deviation to 1. 3. **Formative Interventions (5 mins):** Conduct a quick check-in: *"If your score has a Z-score of -2.1, did you score above or below the group average? Raise a green card for above, red for below."* **[Answer: Red / Below]**. 4. **Table Modeling (10 mins):** Project a standard cumulative Z-table. Show students how to find a Z-score by matching the row and column headers, reminding them that the table reads from left to right.

	4. Asymptotic to the Horizontal Axis ● The curve never touches the x-axis**.** ● It extends infinitely in both directions, which means that the extreme values are possible but very unlikely. **5. Defined by Two Parameters** A normal random variable is described using: ● Mean (μ) – the center of the distribution ● Standard Deviation (σ) – the spread or variability **Area Under the Normal Curve** 1. The area under the curve represents the probability that a random variable (X) falls within a certain range. 2. The total area under the normal curve is equal to one (1). 3. The mean divides the normal distribution curve into two equal parts. 4. The area between two points is probability that X falls at that interval. **Steps to Sketch the Area Under the Normal Curve** 1. **Draw the normal curve**: ● Draw a smooth, bell-shaped curve symmetric about the mean (μ). ● Mark the mean μ on the horizontal axis. 2. **Label key points**: ● Mark $\mu \pm \sigma$ (one standard deviation away from the mean). 3. **Shade the area of interest**: ● Identify the range for which you want the probability. ● Shade the region under the curve corresponding to this range. 4. **Interpret the shaded area**: ● The shaded area represents the probability of the random variable falling within that range.	

Example 1. Suppose the math test scores of a large group of learners are normally distributed. Mean score $(\mu) = 75$ Standard deviation $(\sigma) = 5$



Draw the normal distribution showing that the learners' scores are lower than 80.

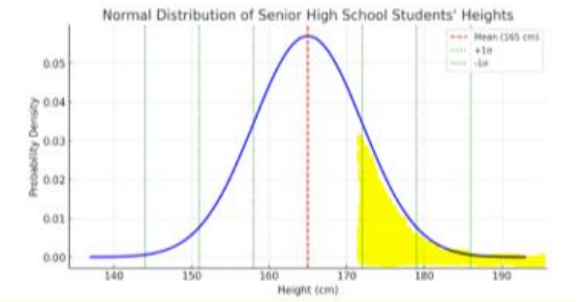
The illustration above is the normal distribution curve for the math test scores:

- The mean (75) is marked with a red dashed line at the center.
- One standard deviation from the mean (70 and 80) is marked with green dashed lines.
- The shaded area represents $P(X \leq 80)$, the probability of a learner scoring 80 or less.

Example 2.
Let the heights of senior high school learners be normally distributed.

- Mean height = 165 cm
- Standard deviation = 7 cm

Draw the normal distribution showing that a learner's height is greater than 170 cm

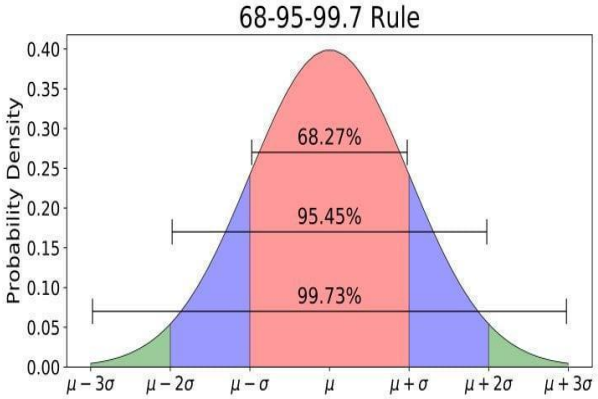


The illustration above is the normal distribution curve for the heights of senior high school learners:

- Mean (μ): 165 cm (red dashed line at the peak)
- Standard deviations (σ): 7 cm, shown as green dotted lines at $\pm 1\sigma, \pm 2\sigma, \pm 3\sigma$
- The curve is symmetric, with most learners' heights concentrated near the mean.
- The shaded area represents $P(X \geq 170)$, the probability that a learner's height is 170 cm or taller.

The Empirical Rule (68–95–99.7 Rule)

This rule helps describe how values are spread in a normal random variable.



Using the test score in Example 1

- About **68%** of learners scored between **70 and 80** ($\mu \pm 1\sigma$)
- About **95%** scored between **65 and 85** ($\mu \pm 2\sigma$)
- About **99.7%** scored between **60 and 90** ($\mu \pm 3\sigma$)

The Standard Normal Distribution

A normal random variable X has:

- Mean: μ
- Standard deviation: σ

Its probability distribution is called a normal distribution.

A **standard normal distribution denoted by** Z is a special case of the normal distribution with:

- Mean: $\mu = 0$
- Standard deviation: $\sigma = 1$

Why convert?

Converting X to Z allows us to use standard normal tables (Z-tables) to find probabilities easily.

Formula for Conversion

Converting X to Z

$$Z = \frac{X - \mu}{\sigma}$$

- X= value of the normal random variable
- μ= mean
- σ= standard deviation
- Z= corresponding standard normal value

Interpretation:
Z tells how many **standard deviations X is away from the mean**.

➢ **Converting Z to X**

$$X = Z \cdot \sigma + \mu$$

- Z= standard normal value
- μ= mean
- σ= standard deviation
- X= value of the original normal variable

*Example 3***. Converting X to Z**

The heights of learners are normally distributed with $\mu = 165\,cm, \sigma = 7\,cm$.
Find the standard normal variable Z corresponding to a learner with **a height of 172 cm**.

Solution:

$$Z = \frac{X - \mu}{\sigma}$$

$$Z = \frac{172 - 165}{7}$$

$$Z = \frac{7}{7}$$

$$Z = 1$$

Interpretation:
The height 172 cm is 1 standard deviation above the mean.

Example 4. Converting Z to X
Find the height of a learner corresponding to $Z = -1.5$.

Solution:

$$X = Z \cdot \sigma + \mu$$

$$X = (-1.5)(7) + 165$$

$$X = -10.5 + 165$$

$$X = 154.5\, cm$$

Interpretation:
A learner with $Z = -1.5$ has a height 1.5 standard deviations below the mean, which is 154.5 cm.

The Z-Table

A Z-**table** (or standard normal table) shows the area (probability) under the standard normal distribution curve to the left of a given Z-value.

Recall:

- A Z-value tells how many standard deviations a value is from the mean.

- The standard normal distribution has:
  - Mean = 0
  - Standard deviation = 1
- The total area under the curve = 1.00 (100%)

The Z-table helps us answer probability questions once we convert a normal random variable X into a standard normal variable Z.

Structure of the Z-Table
The Z-table is usually arranged as follows:

- **Left column**: the whole number and first decimal of the Z-value
- **Top row**: the second decimal of the Z-value
- **Body of the table**: the area to the left of that Z-value

How to Read the Z-Table
Example 5: Find the value corresponding to $Z = 1.23$.
Step 1: **Identify the Z-value**

$$Z = 1.23$$

Step 2: **Locate the row**

$$\text{Row} = 1.2$$

Step 3: **Locate the column**

$$\text{Column} = 0.03$$

Step 4: **Read the value**

$$\text{Table value} \approx 0.8907$$

Interpretation: $P(Z \leq 1.23) = 0.8907$

This means 89.07% of the values lies **below** $Z = 1.23$.

Understanding Areas Using the Z-Table
A. Probability to the Left

Directly read from the Z-table.

Example 6. $P(Z \leq 0.50) = 0.6915$

B. Probability to the Right

Since total area $= 1$:

$$P(Z > a) = 1 - P(Z \leq a)$$

Example 7. $P(Z > 1.25) = 1 - 0.8944 = 0.1056$

C. Probability Between Two Z-Values

$$P(a < Z < b) = P(Z \leq b) - P(Z \leq a)$$

Example 8. Find $P(0.50 < Z < 1.50)$
From the table:

- $P(Z \leq 1.50) = 0.9332$
- $P(Z \leq 0.50) = 0.6915$

$$P = 0.9332 - 0.6915 = 0.2417$$

About 24.17% of the values lie between $Z = 0.50$ *and* $Z = 1.50$.

Z-Table with Negative Z-Values
The standard normal curve is **symmetric** about 0.

Key idea: $P(Z \leq -a) = 1 - P(Z \leq a)$

Example 9. Find $P(Z \leq -1.20)$

From table:

$$P(Z \leq 1.20) = 0.8849$$

$$P(Z \leq -1.20) = 1 - 0.8849$$

$$P(Z \leq -1.20) = 0.1151$$

About 11.51% lie below $Z = -1.20$.

Word Problems

Example 10.
The heights of learners are normally distributed with $\mu = 165"\text{ cm}"$, $\sigma = 7"\text{ cm}"$. What is the probability that a learner is taller than 172 cm?

Step 1: **Convert to Z**

$$Z = \frac{172 - 165}{7} = 1$$

Step 2: **Use the Z-table**

$$P(Z \leq 1) = 0.8413$$

Step 3: **Probability taller**

$$P(X > 172) = 1 - 0.8413 = 0.1587 \approx 16\%$$

Example 11.
Test scores are normally distributed with $\mu = 75$, $\sigma = 5$.
Find the probability that a learner scores above 80.
Step 1: **Convert X to Z**

$$Z = \frac{80 - 75}{5} = 1$$

Step 2: **Use the Z-table**

$$P(Z \leq 1.00) = 0.8413$$

Step 3: **Find probability above**

$$P(X > 80) = 1 - 0.8413$$

$$P(X > 80) = 0.1587$$

About 15.87% of learners scored above 80.

Example 12.
Suppose the math test scores of a large group of senior high school learners are normally distributed.

Mean score (μ) = 75

Standard deviation (σ) = 5

The school wants to know the proportion of learners whose scores are neither too low nor too high, specifically those who scored between 72.5 and 81 points.

Solutions:

Step 1: **Convert the scores to Z-values**

For 72.5:

$$Z = \frac{72.5 - 75}{5} = -0.5$$

For 81:

$$Z = \frac{81 - 75}{5} = 1.2$$

Step 2: **State the probability in terms of** Z

$$P(72.5 \leq X \leq 81) = P(-0.5 \leq Z \leq 1.2)$$

Step 3: **Use the** Z**-table**

From the Z-table:

$$P(Z \leq 1.2) = 0.8849 P(Z \leq -0.5) = 0.308$$

Step 4: **Compute the probability**

$$P(-0.5 \leq Z \leq 1.2) = 0.8849 - 0.3085 = 0.5764$$

Interpretation:
About 57.64% of the learners scored between 72.5 and 81 on the math test. This means more than half of the learners fall within this "average to above-average" score range.

Deepening Question:
Suppose a school administrator looks at this 57.64% average score band and decides to cancel all remedial math classes, arguing that the majority are 'doing fine. Evaluate the validity of this decision based on the remaining areas under the curve. What risk does this present to the learners in the tails?

Example 13.
A local SHS entrepreneurial cooperative produces banana chip. The net weight of the packs is normally distributed with a mean (μ) of 150 grams and a standard deviation (σ) of 8 grams. Distributors reject packages that are under-filled or over-filled, demanding packs only between 142 grams and 162 grams.

Tasks
A. Compute the percentage of production accepted by distributors.
B. Analyze the financial impact on the cooperative if the standard deviation fluctuates to 12 grams due to poor packaging machinery maintenance.

Solution:
Task A
Step 1. **Convert the salaries to Z-values**
For 142 **grams**:

$$Z = \frac{142 - 150}{8} = \frac{-8}{8} = -1.0$$

For 162 **grams**:

$$Z = \frac{162 - 150}{8} = \frac{12}{8} = 1.5$$

Step 2. **Express the probability in terms of Z**

$$P(142 \leq X \leq 162) = P(-1.0 \leq Z \leq 1.5)$$

Step 3. **Use the Z-table**
From the Z-table:

$$P(Z \leq 1.5) = 0.9332$$

$$P(Z \leq -1.0) = 0.1587$$

Step 4. **Compute the probability**

$$P(-1.0 \leq Z \leq 1.5) = 0.9332 - 0.1587$$

$$P(-1.0 \leq Z \leq 1.5) = 0.7745$$

Interpretation:
About 77.45% of the banana chip production is accepted by the distributors. This means that under optimal machinery maintenance, approximately 22.55% of the produced packs are rejected as defective waste (either under-filled or over-filled).

Task B
Step 1. **Convert the salaries to Z-values**
For 142 **grams**:

$$Z = \frac{142 - 150}{12} = \frac{-8}{12} \approx -0.67$$

For 162 **grams**:

$$Z = \frac{162 - 150}{12} = \frac{12}{12} = 1.0$$

Step 2. **Express the probability in terms of Z**

$$P(142 \leq X \leq 162) = P(-0.67 \leq Z \leq 1.0)$$

Step 3. **Use the Z-table**
From the Z-table:

$$P(Z \leq 1.0) = 0.8413$$

$$P(Z \leq -0.67) = 0.2514$$

	Step 4. **Compute the probability** $$P(-0.67 \leq Z \leq 1.0) = 0.8413 - 0.2514$$ $$P(-0.67 \leq Z \leq 1.0) = 0.5899$$ *Interpretation*: When machine maintenance is neglected, the product weight varies too much. This causes the standard deviation to expand from 8g to 12g, and the percentage of accepted products drops heavily from 77.45% down to 58.99%. **Financial Risk Assessment**: This shift forces the cooperative waste or rejection rate to spike from 22.55% to 41.01%. Nearly half of the factory's output will now be turned away by distributors. In a student business setup, losing this much inventory leads directly to a drain on capital. The cooperative will not be able to recover basic raw material costs (bananas, oil, sugar, and packaging) and could face bankruptcy due to poor quality control. This shows why keeping variance (σ) as small as possible is critical to keeping a business alive. By completing these activities, you now understand how normal random variables help describe real-world data, how to use the standard normal distribution to calculate probabilities, and how to interpret results. Remember, these concepts are not just theoretical—they are powerful tools for analyzing patterns in education, science, business, and daily life. *Processing Questions*: 1. What characteristics of the normal distribution did you observe from the examples and graphs? 2. What does the shaded area under the normal curve represent? 3. Why do we convert X-values into Z-values? 4. What does a positive or negative Z-score talk about value? 5. How can normal distribution and probability help in real-life situations?	

	*B.3. Developing Mastery (*For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity B.3: Practicing Learned Skills This section provides independent practice to build proficiency with the Z-score formula, the Empirical Rule, and the Z-table. The problems progress from simple mental math to inverse algebra and real-world scenarios, ensuring students build procedural accuracy along with conceptual understanding. ***Pedagogy and Strategies*** ● **Gradual Release of Responsibility (Scaffolded Independent Work):** The teacher models the initial steps and then transitions students to working independently with checkpoints. ● **Error-Targeted Checkpoints:** The teacher circulates during seatwork to address common mistakes, like forgetting to subtract from 1 for right-tail calculations. ● **Differentiated Tiered Practice:** Uses distinct assessment paths (Remedial vs. Enrichment) to match student learning speeds. ***Integration Components*** ● **EdTech:** Students can use *Microsoft Excel or Google Sheets functions* (such as =NORMSDIST(z)) to verify their manual Z-table lookups. ● **Literacy:** Builds mathematical word decoding skills by teaching students to translate phrases like *"strictly above"* into inequalities $\big(P(Z > z)\big)$. ● **Scaffolded Integrative Performance Task (IPT):** Prepares students for their final project milestone: building a verified math model to evaluate community metrics. ***Facilitation Guide*** 1. **Orientation (3 mins):** Distribute the worksheet or project the practice problems on the board. Remind students to sketch a quick normal curve for every problem. 2. **Execution Phase (25 mins):** Have students work independently or in pairs. Circulate to ensure students plug values into the formula correctly: $Z = \frac{X-\mu}{\sigma}$. 3. **Targeted Clarifications (7 mins):** If multiple students hit the same roadblock, pause the class for a brief reminder on how to look up values in the Z-table. 4. **Correction and Review (10 mins):** Write the step-by-step solutions on the board, highlighting the correct math notation and interpretations.	
C. Demonstrating Knowledge and Skills	*C.1. Finding Practical Application*	
	Activity C.1: Making Real-World Connections *Instructions*: Complete all parts of the activity carefully and show clear, organized solutions for each step. Your work will be assessed using the rubric below.	**Activity C.1: Making Real-World Connections** This contextualized field activity asks students to apply their statistical knowledge to their immediate environment. By gathering authentic data like peer screen time, agricultural yields, or family water use, students build their own datasets.

	Part A. Inclusive Data Selection Track To accommodate different backgrounds and access limits, your group may select ONE of the following data context tracks to analyze: ● **Track 1 (Digital Access Theme):** Hours spent daily on digital screen tools. ● **Track 2 (Agricultural/Socio-economic Theme):** Weekly harvest weight outputs or market stall sales of local vendors. ● **Track 3 (Environmental Theme):** Daily local temperature variations or family water consumption values in liters. Execution Steps for your chosen Track: 1. Conduct a quick survey or data gathering to collect at least 10 data points from your classmates, nearby sections, or family environment based on your chosen track. 2. Record the data in a table. Use whole numbers or nearest 0.5 units for accuracy. **Part B. Data Analysis** 1. Compute the: ● Mean (μ) ● Standard deviation (σ) 2. Make an assumption: *"We assume that the collected data for our chosen track follows a normal distribution."* **Part C. Application of Normal Distribution** 1. Conversion to Standard Normal Variable Choose one data value from your survey and compute its Z-score using $$Z = \frac{X - \mu}{\sigma}$$	They calculate real means and standard deviations, convert values to Z-scores, and find the top 25% threshold to propose practical community wellness guidelines. ***Pedagogy and Strategies*** ● **Authentic Experiential Learning:** Students work with self-collected, real-world data rather than abstract textbook values. ● **Data-Driven Decision Making:** Connects calculations with real actions, like using the top 25% screen-time cutoff to flag students who may need digital wellness guidance. ● **Project-Based Group Collaboration:** Teams divide tasks like data collection, statistical computation, graphing, and final reporting. ***Integration Components*** ● **EdTech:** Use *Google Sheets* or *Excel* to calculate means and standard deviations using =AVERAGE () and =STDEV.S(), and to generate clean histograms. ● **Literacy:** Builds information literacy as students interpret data trends and write a clear, research-backed conclusion for community leaders. ● **Scaffolded Integrative Performance Task (IPT):** This is a key milestone for the unit performance task. It blends data collection, math modeling, and community action into a single project. ***Facilitation Guide*** 1. **Track Assignment (5 mins):** Have student groups choose a data track: Track 1 (Screen Time), Track 2 (Agriculture), or Track 3 (Environment). 2. **Data Gathering (15 mins):** Teams survey at least 10 classmates or look up local records to compile their raw data points. 3. **Statistical Processing (20 mins):** Assist teams as they calculate their dataset's mean ((μ) and standard deviation (σ). Ensure they use the correct sample standard deviation formulas.

2. Probabilities and Percentiles
   Using a Z-table or calculator/app:
   a. Find the probability that a randomly selected learner spends more than X hours on screen (choose X from your data).
   b. Determine the 75th percentile of screen time.
3. Problem Solving & Decision-Making
   Suppose local leaders or school administrators plan an intervention program for individuals scoring in the top 25% of your data track. Determine your data cutoff value. Explain how you obtained this value.

Part D. Presentation of Findings

1. Draw a normal distribution curve.
2. Label the mean (μ) and standard deviation (σ).
3. Shade the region representing the top 25%.
4. Write a short, formal 2-paragraph conclusion addressed to a school or community leader. State the exact cutoff value you calculated for your track and explain how a shifting standard deviation changes how many people get help. Conclude 2–3 sentences explaining how using your exact mathematical boundaries helps the school or community make better decisions, ensuring limited project funds and supplies are not wasted on individuals who do not actually need them.

Complete all parts of the activity carefully and show clear, organized solutions for each step. Your work will be assessed using the rubric below.

Rubric:

Criteria	Points
Data collection & sampling	2
Correct μ and σ	2
Z-score & probability computations	3
Decision-making & justification	2
Graph & clarity of conclusion	1

4. **Cutoff Calculation (15 mins):** Guide students to find the 75th percentile (top 25% $area = 0.7500$, which maps to $Z \approx 0.67$). Have them solve for X using $X = \mu + (0.67 \cdot \sigma)$ to find their action threshold.
5. **Presentation and Synthesis (15 mins):** Have teams present their data charts and conclusions, using the standard 11-point project rubric to grade their work?

	Processing Questions: 1. How did collecting real data from your classmates help you understand normal distribution better? 1. What did you notice about the mean and standard deviation of your data? 2. How did converting a data value into a z-score help you interpret the results? 3. Why is identifying the top 25% of screen time users important for decision-making?	
	C.2. Making Generalization	
	Activity C.2. Wrapping-Up the Lesson **Option 1. Exit Ticket** *Instructions:* 1. Think of a real-life situation where a normal distribution occurs (e.g., test scores, employee salaries, heights). 2. Write down: ● Your example ● One question you still have about the lesson ● One thing you learned today that you found interesting or surprising 3. Submit your responses to the teacher before leaving the class. **Option 2. Expert Talks – Sharing Observations** *Instructions:* 1. Listen carefully as your classmates (experts) share their observations about normal distributions in real life. 2. Take notes on examples, interpretations, and interesting points shared by your peers. 3. Be ready to ask one thoughtful question or share one observation of your own after each talk. *Processing Questions*: 1. What defines a normal distribution? 2. How are the mean and standard deviations used in normal distribution? 3. Why is standardization important in statistics?	**Activity C.2. Wrapping-Up the Lesson** This closing activity serves as a final synthesis step for the lesson. It prompts students to consolidate their understanding of the normal distribution, the purpose of Z-scores, and standardizing data. It functions as a quick formative check, giving the teacher clear feedback on student understanding and any lingering misconceptions before the unit test. ***Pedagogy and Strategies*** ● **Metacognitive Reflection (Option 1):** Students look back on their learning path, identifying what they mastered and what still feels confusing. ● **Peer Expert Modeling (Option 2):** Selected students share their real-world findings, reinforcing key concepts through peer-to-peer learning. ***Integration Components*** ● **EdTech:** Collect student reflections digitally via *Padlet, Mentimeter, or Google Forms* to instantly display questions and ideas on the screen. ● **Literacy:** Encourages written literacy by requiring students to explain mathematical ideas clearly using proper academic vocabulary. ● **Scaffolded Integrative Performance Task (IPT):** Connects the lesson's abstract concepts to practical real-

	4. How can normal distribution help solve real-life problems?	world uses like grading scales, quality control, or health metrics. ***Facilitation Guide*** 1. **Distribute Tickets (2 mins):** Hand out the exit slips or display the digital link on the board. 2. **Reflective Writing (5 mins):** Give students 5 minutes of quiet time to write down their real-world examples, key takeaways, and remaining questions. 3. **Collection (1 min):** Collect all tickets at the door before students leave. 4. **Data Review (Post-Class):** Group the tickets to identify common trouble spots—such as reading negative Z-scores—and address them at the start of the next session.
	C.3. Evaluating Learning (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity C.3. Assessing Learning Outcomes This diagnostic and summative activity is strategically positioned at the culmination of the core instruction block to formally evaluate individual student mastery. It shifts the environment from collaborative group learning to independent performance metrics, checking whether students can apply the Z-score formula, decode standard Z-tables, and translate real-world word problems without assistance. Cognitively, Part I assesses structural visual reasoning and properties of continuous probability models (such as symmetry and asymptotic trends). Part II tests analytical and algebraic precision. Placing this activity here gives the teacher a clear indicator of whether the class has met the learning competencies before moving to high-stakes unit testing. ***Pedagogy and Strategies*** ● **Independent Performance Audit:** Students work entirely on their own, encouraging self-reliance and helping the teacher identify individual cognitive strengths and gaps. ● **Criterion-Referenced Evaluation:** Student outputs are graded against clear structural and mathematical criteria, assigning points for proper variable setup, algebraic execution, correct table matching, and explicit sentence-based conclusions. ● **Error-Targeted Diagnostics:** The teacher monitors the classroom to identify real-time processing struggles, such as inverse calculation mistakes or failing to double table values for symmetrical intervals. ***Integration Components*** ● **EdTech:** Administer this assessment digitally using a **Google Forms Quiz, Quizizz, or Canvas Quiz** with browser-locking activated. This approach compiles automatic item-analysis reports, highlighting which specific problem format caused the most difficulties. ● **Literacy:** Sharpens contextual text decoding. Students must analyze word problems and translate written modifiers (such as *"more than"* or *"middle 90%"*) into precise mathematical inequalities and boundary markers.	

	• **Scaffolded Integrative Performance Task (IPT):** Serves as a vital gatekeeper checkpoint. It guarantees that before students build their final community health or technology survey dashboards, they have the verified calculation skills to process and compute data accurately. ***Facilitation Guide*** 1. **Clear Desks (2 mins):** Direct students to put away all notebooks and group materials. Ensure each student has only a pen, a scientific calculator, a clean sheet of paper, and a standard cumulative Z-table sheet. 2. **Launch & Pacing (20 mins):** Distribute the assessment sheets or project the tasks on the board. Set a timer for 20 minutes and maintain strict exam conditions. 3. **Active Monitoring:** Walk around the room to look for common roadblocks. Check if students are accidentally writing negative Z-scores on the positive side of their drawn axes or getting stuck on the inverse algebra required in Part II, Problem 2. 4. **Collection & Sorting (3 mins):** Collect all papers systematically. Sort them immediately into performance tiers to easily see who needs to be routed to Remediation or Enrichment tracks in the next phase.
	C.4. Additional Activities (For complete instructions, please refer to the Learning Activity Sheet.)
	Activity C.4. Extending and Reinforcing Learning This component completes the educational cycle by implementing tiered differentiation to address varying paces of learning within the Senior High School cohort. The Remediation Track provides structured cognitive scaffolding for learners who show mechanical or algorithmic gaps during the evaluation phase, emphasizing formula identification, variable mapping, and foundational left-to-right area conversions under the curve. The Enhancement Track targets advanced learners with higher-order thinking tasks (HOTS) that expand analytical reasoning. It includes cross-distribution modeling, graphical variance analysis, and multi-step inverse probability boundaries. This design guarantees that every student works productively within their Zone of Proximal Development (ZPD). ***Pedagogy and Strategies*** • **Differentiated Tiered Instruction:** Moves past a one-size-fits-all approach by assigning tasks based on real-time learner capability profiles. • **Scaffolded Procedural Modeling (Remediation):** Implements a direct systematic process requiring explicit listing of given inputs before running calculations, which reduces cognitive overload. • **Comparative Visual and Quantal Analysis (Enhancement):** Employs graphical modeling to demonstrate how shifts in standard deviation change a curve's shape and forces students to defend relative rankings using statistical parameters instead of raw data points. ***Integration Components*** • **EdTech:** Students utilize dynamic visualization tools such as **Desmos or GeoGebra Normal Distribution Graphers** to manipulate variance sliders, connecting mathematical equations with real-time curve movements. • **Literacy and Communicative Fluency:** Enhances math-to-text decoding by training students to translate contextual phrases (e.g., *"more unusual"*, *"cutoff for the top 5%"*) into mathematically structured inequalities. • **Scaffolded Integrative Performance Task (IPT):** Directly strengthens the data analysis skills needed for the upcoming unit project, where students will gather and process local school or community datasets.

	Facilitation Guide 1. **Grouping Execution (3 mins):** Immediately route students to their assigned tracks (Remediation Worksheet or Enhancement Sheet) using the performance data gathered during the C.3 evaluation. 2. **Remediation Track Guidance (15 mins):** Sit with the remediation group. Enforce the prerequisite step of writing down the Z-score equation and extracting the values for X, μ, and σ before using calculators or reading tables. 3. **Enhancement Track Monitoring (15 mins):** Circulate among advanced learners. Prompt them to explain *why* raw score comparisons fail across unequal scales, pushing them to use precise vocabulary like "standardized units" or "relative position." 4. **Synthesis Session (7 mins):** Bring the entire class back together. Draw the two school distributions on the board to visually demonstrate how standard deviation defines the spread and height of data populations.	
III. CONTENT	**Lesson 10.3. Sampling**	
IV. OBJECTIVES	At the end of the lesson, the learners are expected to: 1. define random sampling and its types. 2. recommend an appropriate sample size for a given investigation. 3. differentiate between a parameter and a statistic. 4. Compare probability and non-probability sampling techniques based on their characteristics and applications.	
V. PROCEDURES	**LEARNERS ACTIVITIES**	**ANNOTATION**
A. Activating Prior Knowledge	*A.1. Eliciting Prior Knowledge*	
	Activity A.1: Leveling Learners Readiness **Option 1. Sampling Matters** Scenario: Your school wants to find out what snacks learners prefer to sell in the canteen next semester. Due to time and resource limitations, they cannot survey all learners, so they plan to select a smaller group instead. *Instructions:* 1. In your assigned group (3–5 members), discuss the possible challenges of surveying all learners. 2. List at least three reasons why surveying everyone may not be practical. 3. Propose a fair and logical way to select a smaller group of learners (a sample) whose preferences may be the whole learner's body. 4. Record responses on a sheet of paper or digital slide. 5. Assign a representative to present your group's ideas to the class.	**Activity A.1. Leveling Learners Readiness** This introductory activity presents learners with relatable, real-life scenarios like "Sampling Matters" or "Voices in Focus" to unpack the operational, logistical, and economic challenges of surveying an entire population versus a representative subset. Placed at the absolute beginning of the instructional sequence to function as a diagnostic hook, it leverages constructivist learning theory by activating prior schema regarding fairness and resource constraints. Statistically, it establishes immediate cognitive dissonance—learners naturally want complete data (a census) but quickly realize it is practically impossible due to finite resources, driving the functional need to learn sampling methodologies. ***Pedagogy and Strategies*** • **Collaborative Problem Solving (Option 1):** Implemented by grouping learners into teams of 3 to 5 to co-analyze the canteen snack scenario. This promotes

	Processing Questions: 1. What problems might happen if the school tries to survey all learners? 2. Why is it important that the sample is fair or representative? 3. How can the school choose a good sample of learners? **Option 2. Voices in Focus** *Instructions*: 1. **Reflect quietly on the question:** ● Have you ever participated in a school survey or voted in a learner election? 2. **Quick Poll:** ● Participate in a brief survey conducted by the teacher. For example, the teacher may ask: ● Which school activity do you prefer: sports, arts, or science clubs? ● Respond by raising your hand or using a digital polling tool such as Mentimeter or Google Forms. This poll will provide a snapshot of learner preferences. 3. **Follow-Up Question:** ● Consider the question: Do you think your individual response, or the poll results, accurately represent the opinions of the entire class or student population? Why or why not? 4. **Guided Discussion:** Participate in a teacher-led discussion to explore: ● How surveys are conducted and their purpose. ● Why sampling is often preferred over surveying every individual. ● What makes a sample fair and representative (e.g., randomness, diversity). ● Real-life examples connect these concepts to your own experiences.	peer-to-peer knowledge of construction and distributed cognitive load. ● **Interactive Polling with Metacognitive Reflection (Option 2):** Uses immediate physical or digital polling to collect data on student track preferences, instantly shifting the learners from passive observers to active data points. ● **Structured Argumentation / Mini-Debate (Option 3):** Divides the class into opposing teams (Census vs. Sampling) to enforce deep critical evaluation of the advantages and disadvantages of both methods. ***Integration Components*** ● **EdTech Integration:** Mentimeter or Google Forms for real-time data collection and visualization. This enables immediate graphic analysis of class preferences against global assumptions. ● **Literacy Integration:** Focuses on vocabulary decoding and contextual translation. Learners unpack terms like *practicality*, *fairness*, and *representation* from systemic everyday language into formal statistical concepts. ● **Scaffolded Integrative Performance Task (IPT) Connection:** Serves as the introductory brainstorming phase for a community-based research project. Learners identify demographic parameters within their own school or barangay that would prevent them from running a full census. ***Facilitation Guide*** **1. Setup and Orientation (2 minutes)** ● **If choosing Option 1 (Sampling Matters):** Divide the classroom into heterogeneous teams of 3 to 5 members. Distribute the canteen snack scenario cards or project the prompt on the board. ● **If choosing Option 2 (Voices in Focus):** Project the digital polling link (e.g., Mentimeter/Google Forms) on the screen or instruct learners to prepare a traditional physical hand-raising poll.

	Processing Questions: 1. Do you think your answer to the quick poll represents the whole school? Why or why not? 2. Why do teachers and researchers use surveys or polls? 3. What makes survey results more reliable? **Option 3. Mini-Debate** *Instructions:* 1. Divide the class into two teams: ● Team A argues in favor of using a census (asking everyone). ● Team B argues in favor of using sampling (asking only a selected group). 2. Each team is given 5 minutes to prepare their arguments. 3. Teams take turns presenting (2–3 minutes per team). 4. After both sides have spoken, reflect as a class: Which method seems more practical and effective in most real-life situations? *Processing Questions:* 1. Which method is more practical: census or sampling? Why? 2. When is it better to use a census instead of sampling? 3. What did you learn from hearing both sides of the debate?	● **If choosing Option 3 (Mini-Debate):** Physically split the room down the middle. Assign the left side as **Team A (Census)** and the right side as **Team B (Sampling)**. **2. Execution and Pacing (5 to 10 minutes)** ● **If choosing Option 1 (Sampling Matters):** Launch a visual countdown timer for **7 minutes**. Instruct groups to rapidly brainstorm three practical constraints of a census and propose a valid sampling method. ● **If choosing Option 2 (Voices in Focus):** Allow **1 minute** for quiet personal reflection. Instantly transition into the quick poll, allocating **3 minutes** to gather and display the real-time preference snapshot on screen. ● **If choosing Option 3 (Mini-Debate):** Start a strict **5-minute timer** for preparation. Instruct learners within each team to huddle, pool their arguments, and nominate their primary debaters. **3. Monitoring and Scaffolded Probing (During Activity)** ● **For Option 1:** Circulate around the room and guide struggling teams by asking: *"If you have to buy paper for 1,000 students, how much will it cost versus buying for 50 students?"* ● **For Option 2:** Prompt metacognitive awareness by asking individual voters: *"If our specific section prefers arts clubs, does that automatically mean the engineering or accounting sections feel the exact same way?"* ● **For Option 3:** Intervene in team huddles to sharpen arguments. Ask Team A: *"How will you handle logistics if students are absent during your census?"* Ask Team B: *"How will you defend against accusations that your sample is biased?"* **4. Synthesis and Presentation Handling (5 to 7 minutes)** ● **For Option 1:** Appoint one representative per group to share their ideas. Write recurring keywords (e.g.,

		time, *money*, *fairness*) on the board to build a collective definition of sampling. • **For Option 2:** Transition from the data display directly into a guided discussion. Use the visual results to explain how randomness and diversity alter the accuracy of a research study. • **For Option 3:** Moderate a structured face-off, granting **2 to 3 minutes per team** to present without interruption. Conclude by shifting the class's focus toward evaluating real-world operational practicality.
	A.2. Establishing the Purpose of the Lesson	
	Activity A. 2. Appreciating Lesson Relevance **Option 1. Crash and Learn** *Scenario:* A group of learners wants to know which school event learners like best. They only ask learners from the Academic Track. Everyone says they prefer the Business Fair. The group concludes it's the most loved event in the whole school. ***Instructions:*** 1. In pairs, analyze the scenario. 2. Discuss what went wrong in their sampling method 3. Suggest how to improve it. 4. Record your answers on a half-sheet of paper. 5. Be ready to share your response with the class. *Processing Questions*: 1. If the school plans future events based only on the opinions of Academic Track learners, how might this affect learners from other tracks? 2. What important viewpoints or preferences might have been missed when learners from other tracks were excluded from the survey? 3. Can you think of a real-life situation in your school or community where excluding certain groups from a survey could lead to an unfair decision? Why?	**Activity A. 2. Appreciating Lesson Relevance** Shifting focus from general selection to the consequences of systematic errors and structural biases, this section uses scenarios like "Crash and Learn," "The Sampling Dilemma," or "Survey Fail Detective" to evaluate real-world cases where poor sampling ruined a project's validity. This creates a deliberate cognitive conflict by showcasing how a survey fails when it only samples a single track, highlighting the danger of selection bias and building a logical bridge to the lesson's core objectives: the need for systematic, mathematically sound sampling techniques. ***Pedagogy and Strategies*** • **Scenario Analysis / Case Study Method:** Presenting a narrative-driven failure ("Crash and Learn") where a group generalizes an entire school population based on data from only one track. • **Think-Pair-Share and Consensus Building:** Used in Option 2 to force individual decision-making, peer verification, and team consensus on the most defensive, unbiased sampling approach. • **Inquiry-Based Group Work (Roleplay/Data Detectives):** Learners act as investigators by diagnosing systematic design flaws within mock survey procedures.

	Option 2. The Sampling Dilemma **Scenario-Based Prompts:** Imagine you are a researcher. Your class wants to know what school event to organize next. You have two options for collecting opinions: Prompt 1: Would you rather… 1. Ask 100 random learners from different grade levels and tracks? 2. Ask your 100 closest classmates from the same track? Prompt 2: Would you rather… 1. Ask only the most active learners who usually attend school events? 2. Include both active and non-active learners randomly? *Instructions:* 1. Think individually and write your answers for both prompts on a sheet or digital device. 2. Form a group of 4–5 members and share your answers. 3. As a group, agree on the most effective sampling method for each prompt and explain your reason. 4. Choose one group member to share your group's insights with the class. *Processing Questions*: 1. Which sampling method would provide more reliable information for planning a school event, and why? 2. How would you design a survey that ensures learners from different grade levels, tracks, and backgrounds are fairly represented? 3. How might a school event fail if organizers base their decisions only on the opinions of their friends or the most active learners? **Option 3. Survey Fail Detective** **Scenario:** You're a survey detective! The principal gets three surveys from learners about school uniforms. Each group used a different method: Group A: Asked only Grade 11 boys	***Integration Components*** • **EdTech Integration:** Padlet or Jamboard. Groups post their diagnosed sampling errors under specific headings, allowing the entire class to compare biases simultaneously. • **Literacy Integration:** Focuses on structural decoding. Learners contrast words with nuanced statistical meanings versus common vernacular, such as *bias*, *random*, *exclusion*, and *representative*. • **Scaffolded Integrative Performance Task (IPT) Connection:** Risk Management identification. Learners outline potential biases (e.g., only surveying friends) that could ruin their upcoming community data collection. ***Facilitation Guide*** **1. Setup and Orientation** • **If choosing Option 1 (Crash and Learn):** Present the narrative-driven scenario via slides, printed handouts, or verbal storytelling. Instruct learners that they will be working in pairs. • **If choosing Option 2 (The Sampling Dilemma):** Introduce the core concept of "sampling dilemmas"—where researchers must balance operational limits with data fairness. Project Prompt 1 and Prompt 2 on the board. • **If choosing Option 3 (Survey Fail Detective):** Hand out the three survey design profiles (Groups A, B, and C). Assign the learners to the professional persona of "**Data Detectives**" to spark critical thinking. **2. Group Work and Pacing** • **If choosing Option 1 (Crash and Learn):** Allow **1 minute** for individual reflection before having learners pair up. Teams must diagnose the sampling error and write structural remedies on a half-sheet of paper. • **If choosing Option 2 (The Sampling Dilemma):** Have learners write down their personal choices for both prompts individually. Then, transition them into

	Group B: Randomly picked learners from every section Group C: Only surveyed learners who volunteered Instructions: 1. As a group of "survey detectives," analyze each method. 2. Decide which is the best and which is the worst and explain why. 3. Present your findings using a poster or slide. *Processing Questions:* 1. If the school implements a strict uniform policy based only on data from student volunteers (Group C), how might this negatively affect the rest of the student body? 2. How would you combine different sampling methods to ensure that both outgoing and less vocal learners have an equal chance to share their opinions? 3. How could using a biased sample to address a current issue in your barangay or community lead to ineffective decisions or wasted resources?	groups of 4 to 5 members to debate their choices and build a unified team of consensus. • **If choosing Option 3 (Survey Fail Detective):** Organize learners into investigative teams. Task them by determining the best and worst methods, then preparing a quick, creative visual format (e.g., a digital slide, poster, or short skit). **3. Monitoring and Scaffolded Probing** • **For Option 1:** Circulate and challenge basic responses. If a pair says, *"It is unfair,"* push them deeper by asking: *"What specific student sub-groups are completely invisible in this data pool?"* Guide them to use structural terms like **selection of bias** and **exclusion**. • **For Option 2:** Intervene in group huddles to guide vocabulary decoding. Ask learners: *"What is the statistical difference between the word 'random' and just picking your closest friends?"* Help them contrast common vernaculars with formal statistical definitions. • **For Option 3:** Guide reflections specifically toward the dangers of **volunteer bias**. Ask teams: *"Why might the students who actively volunteer to answer a uniform survey hold completely different views from the quiet, less vocal majority?"* **4. Cross-Examination, and Synthesis,** • **For Option 1:** Conduct a cross-examination by calling on random pairs to share their remedies. Avoid passive listening—have the class critique whether the proposed remedy truly solves the track exclusion issue. • **For Option 2:** Have a representative from selected groups to share their final consensus answers. Highlight the contrast between choosing convenient options versus choosing representative ones. • **For Option 3:** Facilitate the presentations or gallery walk of the detective findings. If using EdTech (like Padlet or Jamboard), display the groups diagnosed

<table>
<tr><td></td><td></td><td>errors side-by-side on the main screen for a fast, comparative analysis.
5. Objective Reveal (All Options) Use the structural flaws uncovered by the learners to smoothly transition into reading the formal lesson objectives. Anchor the upcoming lesson directly to their findings by explaining that they will now learn the exact mathematical tools needed to fix these survey failures.</td></tr>
<tr><td rowspan="2">B. Instituting New Knowledge</td><td colspan="2">B.1. Presenting Examples</td></tr>
<tr><td>Activity B.1. Exploring Key Concepts

Instructions:
Read each scenario and answer the questions that follow. Be prepared to share your thoughts with the class.

Scenario 1. School Survey
The learner council wants to know which school event to organize next semester. They decide to ask only 100 out of 1,000 learners.

Questions:
1. What type of sampling technique could they use to choose fairly?
2. Why didn’t they ask everyone?
3. What could make the results biased?

Scenario 2. Research Project
You are conducting a research project about learners' screen time. You collect data from learners in your own section.

Questions:
1. Is this a good representation of the whole grade level?
2. What type of sampling method is being used in the scenario?
3. How could this sampling method be improved?

Scenario 3: Barangay Health Survey
The barangay health center wants to know the average weight of residents aged 18–60. They select every 5th person in the health registry.</td><td>Activity B.1. Exploring Key Concepts

This segment provides three concrete scenarios (School Survey, Research Project, Barangay Health Survey) to ground abstract statistical variables into recognizable, real-world settings. Following Bruner’s stages of representation, it moves learners from concrete scenarios to abstract definitions, providing structural exemplars that clarify the differences between random and non-random groupings before formally introducing calculations and formulas.

Pedagogy and Strategies
● Case Analysis: Multi-scenario deep dives that require learners to pick apart the details of a case and identify structural elements (identifying populations vs. samples).
● Direct Teacher Modeling and Simulation: The teacher uses a physical token box containing 30 numbered tokens to draw a sample of 5 without looking, visually demonstrating probability sampling in action.

Integration Components
● EdTech Integration: Quizizz or Kahoot. After the teacher's demonstration, a quick interactive quiz checks if students can correctly identify populations versus samples across new scenarios.
● Literacy Integration: Reading comprehension and text isolation. Learners practice scanning word problems to isolate the structural noun phrases that define the</td></tr>
</table>

	Questions: 1. What sampling method is this? 2. Is this considered random sampling? 3. Why might this method be efficient? *Processing Questions:* 1. How did the different scenarios help you understand various sampling methods? 2. Why is it important to choose the right sampling method in a study? 3. What did you learn about bias and representation from these scenarios?	*whole* ("all residents aged 18–60") versus the *part* ("every 5th person"). • **Scaffolded Integrative Performance Task (IPT) Connection:** Defining Project Parameters. Teams define the explicit population boundaries and sample parameters for their chosen community research topic. ***Facilitation Guide*** 1. **Introduce Scenarios:** Present the three scenarios on worksheets or slides. Instruct learners to read them carefully and underline key groups. 2. **Conduct Teacher Demonstration:** Bring out a physical container with 30 items. Read the script: *"Watch as I draw a random sample... I mix them thoroughly to eliminate bias..."* 3. **Guided Analysis:** Walk through Scenario 1 and Scenario 2 with the whole class, prompting individual students to name the population and sample out loud. 4. **Check-in Questions:** Ask students to raise one finger for population and two fingers for sample as you read specific group descriptions.
	B.2. Discussing the Concept	
	Activity B.2. Deepening Conceptual Understanding *Instructions:* 1. Carefully read the lesson notes on sampling. 2. Take note of important terms. 3. Work through the step-by-step examples provided 4. Be ready to answer questions or share your thoughts during discussions. 5. Raise questions if the concepts are confusing. **Sampling** **Sampling** is the process of selecting a subset (called a sample) from a larger group (called a population) to gather information and draw conclusions without examining the entire population. This activity introduces key sampling concepts such as random sampling, sample	**Activity B.2. Deepening Conceptual Understanding** As the core lecture component, this section defines key terms—including population, sample, parameter, statistic, and sample size determinants—while introducing practical constraints, rules of thumb, and Slovin's Formula. It focuses heavily on conceptual integration and mathematical formulation, targeting higher levels of working memory by formalizing raw observations into definitive mathematical properties to equip learners with the tools needed to calculate reliable sample sizes. ***Pedagogy and Strategies Used*** 1. **Explicit Instruction & Lecture-Discussion:** Clear, structured delivery of technical definitions supported by visual slides.

size, parameters vs. statistics, and the comparison between probability and non-probability sampling methods.

Determining Appropriate Sample Size

In sampling, the first thing you must consider is the sample size. In any research, you usually cannot study the entire population because it may be too large, expensive, or time-consuming. Instead, researchers select a sample that represents the population.

You must think:

"How many people or items should you include in your study to obtain useful results? Having enough participants observe trends or patterns should always be considered in an investigation to avoid wasting time or resources."

Factors Affecting Sample Size

Even without statistical formulas, sample size depends on:

Purpose of the study	Are you just exploring opinions, or do you want to compare groups?
Population size	How many people or items exist in total?
Resources available	Time, money, or workforce may limit how many participants you can include
Type of research	Surveys, experiments, or qualitative interviews each have different practical requirements.

Simple Ways to Decide Sample Size

A. Rule-of-Thumb Estimates
These rules-of-thumb are based on experience, simulation studies, and conventional practices in research, rather than a single published formula.

The purpose is to provide quick, practical estimates for researchers and educators, especially for teaching or initial planning, before using formal formulas.

2. **Modeling Step-by-Step Algorithmic Computation:** Direct whiteboard modeling of multi-step algebraic operations using Slovin's Formula.
3. **Tiered Instruction:** Breaking down sampling into clear structural tiers (Probability vs. Non-probability) using an overarching concept hierarchy.

Integration Components

1. **EdTech Integration:** Using sample size calculators like Raosoft or SurveyMonkey alongside spreadsheets to show how changing the margin of error dynamically updates the sample size.

The teacher can also use the video from DepEd TV: Statistics and Probability – Sampling Techniques (https://www.youtube.com/watch?v=5PsF5MsrCOo)

2. **Literacy Integration:** Mathematical symbol decoding. Teaching learners to translate complex notations and parameters into descriptive statistics.
3. **Scaffolded Integrative Performance Task (IPT) Connection:** Mathematical Verification Milestone. Teams compute the exact sample size needed for their community research projects using Slovin's Formula.

Facilitation Guide

1. **Guided Reading & Concept Mapping:** Direct learners to carefully read the provided lesson notes on sampling. Instruct them to take note of important terms (e.g., Population, Sample, Random Sampling) while you visually map these core relationships on the board.
2. **Modeling Sample Size & Slovin's Formula:** Walk the learners through the "Determining Appropriate Sample Size" section, emphasizing the factors and rules of thumb. Fulfilling the instructions to work through the provided examples, write out $n = \frac{N}{1+Ne^2}$ step-by-step on the board. Substitute values for $N =$

Type of Research	Suggested Sample Size
Survey (large population)	200–400 respondents for a general idea
Small group survey	At least 20–50 respondents
Experimental research (2 groups)	15–30 participants per group
Qualitative research (interviews)	10–20 participants, or until no new information emerges (saturation)

B. Using a Simplified Formula

If the population is known and small, you can use a simple "proportion-based" formula:

$$Sample\ size = \frac{Population}{2\ or\ more}$$

Example 1:

A class has 60 learners. A teacher wants to survey class preferences. A simple choice is 30 learners (half of the class). If more precision is needed, you can increase the sample to two-thirds $\left(\frac{2}{3}\right)$ of the population.

C. Using Slovin's Formula

For a more scientific estimate, researchers may use Slovin's Formula.

$$n = \frac{N}{1 + Ne^2}$$

Where:

- $\boldsymbol{n}$ = sample size
- $\boldsymbol{N}$ = population size
- $\boldsymbol{e}$ = margin of error

1000 and $e = 0.05$. Show how $0.05^2 = 0.0025$, then perform the addition and division to arrive at ≈ 286.

3. **Categorizing Sampling Techniques:** Transition to the "Types of Sampling" section. Explicitly explain the structural differences between Probability and Non-probability sampling methods by reviewing the visual examples in the text (e.g., Simple Random, Stratified, Convenience, Snowball).
    - *Integration Note:* The teacher can use the video from DepEd TV: Statistics and Probability – Sampling Techniques during this segment to visually reinforce the methods.
4. **Parameter vs. Statistic & Processing Discussion:** Clearly differentiate between a parameter (population characteristic) and a statistic (sample characteristic). Conclude by facilitating an open class discussion using the four "Processing Questions," reminding learners to share their thoughts and explicitly asking them to raise questions if any concepts remain confusing.

Example 2:
The school has 1,000 learners. The researcher wants a 5% margin of error.

Solution:

$$n = \frac{N}{1 + Ne^2}$$

$$= \frac{1000}{1 + (1000)(0.05)^2}$$

$$= \frac{1000}{1 + 2.5}$$

$$= \frac{1000}{3.5}$$

$$= 285.71$$

$$\approx 286$$

Therefore, the recommended sample size is **286 learners**.

D. Using Technology
You can use online sample size calculators or spreadsheet tools:

Online calculators	Just enter population size and desired margin of error Raosoft Sample Size Calculator SurveyMonkey Sample Size Calculator
Spreadsheet method	Create a column of participants, then randomly select a number based on available resources or rules of thumb.

The Random Sampling

Random sampling means that every individual in the population has an equal chance of being selected. This method is important because it:

a. Reduces bias: No one is unfairly favored or left out.
b. Increases representativeness: The sample better reflects the diversity of the whole population.

c. Improves reliability of results: Conclusions drawn from a random sample are more likely to be valid for the whole population.

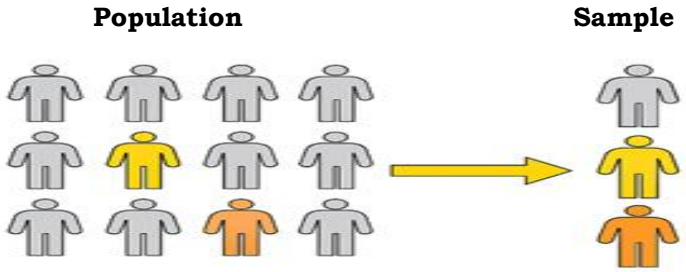
Example 1:
If you have 500 learners and want to select 50 randomly, you might use a computer to generate 50 random numbers representing learner IDs.

Types of Sampling

I. Probability Sampling
Every individual has a known chance of being chosen. Probability sampling is generally preferred because it leads to more accurate and generalizable results, while non-probability sampling can lead to bias.

Examples include:

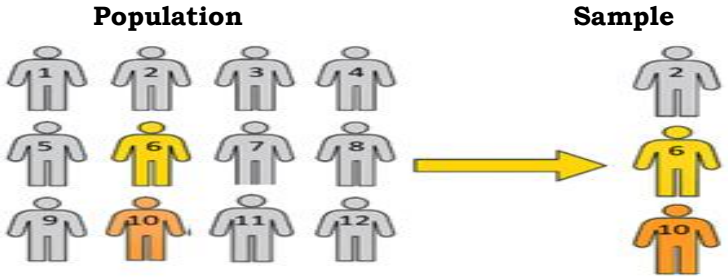
a. Simple Random Sampling:
Everyone is equally likely to be picked (e.g., randomly drawing names or using a random number generator).



For example, in a population of 200 Grade 11 learners, the researcher needs a sample of 40 learners. Using simple random sampling, every learner in the population has an equal chance of being chosen. The researcher assigns numbers from 1 to 200 to all learners and then uses a random method, such as drawing lots or using a random

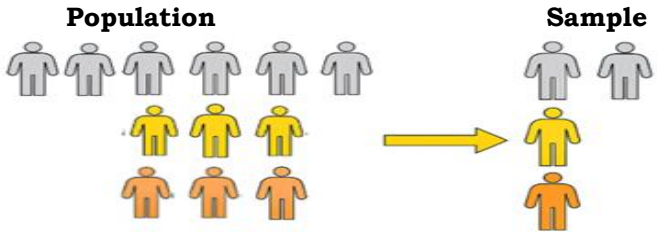
number generator, to select 40 unique numbers. The learners correspond to those numbers from the sample.

b. Systematic Sampling:
Selecting every kth individual from a list (e.g., every 4th learner). The starting point is chosen at random.



For example, in 200 Grade 12 learners, you will choose 50 learners as members of your sample. To select which learners will be part of the sample, divide the population size 200 by the sample size 50, which results in 4. That means every 4th learner among the 200 Grade 12 learners will be included in the sample. You may also start with any randomly selected number from 1 to 4; for instance, if the starting number is 2, then the sample will include learners numbered 2, 6, 10, and so on, until the desired 50 learners are chosen. (Note: Other starting points may also be used.)

c. Stratified Sampling:
The population is divided into subgroups or strata (e.g., by grade level or strand). Samples are randomly selected from each stratum to ensure all groups are represented.

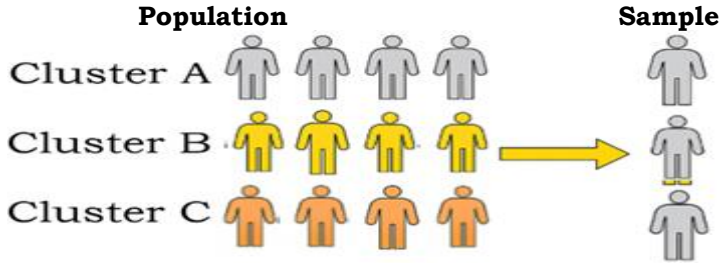


For example, in a population of 300 Grade 11 learners composed of three strands: 150 STEM learners, 90 HUMSS learners, and 60 GAS learners, the researcher needs a sample of 60 learners. To make sure each strand is fairly represented, the researcher uses stratified sampling. First, the proportion of each group is determined: STEM is 150/300 = 50%, HUMSS is 90/300 = 30%, and GAS is 60/300 = 20%. Next, these same proportions are applied to the sample size of 60. Thus, the researcher will select 30 STEM learners (50% of 60), 18 HUMSS learners (30% of 60), and 12 GAS learners (20% of 60).

Finally, the learners are chosen until the required number of learners from each strand is then selected randomly.

d. Cluster Sampling:

The population is divided into clusters, usually based on location or existing groups (e.g., classes or barangays). A few clusters are randomly selected, and all individuals within those clusters are surveyed.



Cluster A is randomly chosen as a sample.

For example, in a population of 150 Grade 11 learners, the researcher needs a sample of 50 learners. The 150 learners are already divided into 3 sections with 50 learners each. Using cluster sampling, the researcher randomly selects 1 section (cluster) out of the 3. All 50 learners in the chosen section automatically become the sample.

II. Non-probability Sampling

Selection is based on convenience or judgment, not chance.

Examples include:

a. Convenience Sampling

Choosing whoever is easiest to access (e.g., the first 50 learners who enter the cafeteria).

b. Purposive (Judgmental) Sampling

Choosing individuals who possess specific characteristics relevant to the study.

Example: Interviewing only science teachers when studying teaching strategies in science.

c. Quota Sampling

The population is divided into groups, and a predetermined number of participants is selected from each group, though the selection is non-random.

Example: Surveying 20 male and 20 female learners to reflect gender balance.

d. Snowball Sampling

This technique relies on existing participants to recruit additional participants, creating a referral chain.

Example: A learner's respondent recommends friends, who in turn recommend others, to join the study.

e. Voluntary Response Sampling

In this type, individuals volunteer or decide by themselves to participate in the research.

Example: Learners who willingly respond to an online survey posted by the school.

Parameter vs. Statistic

These two terms describe similar measurements but at different levels:

- **Parameter**: A value that describes a characteristic of the entire population (e.g., the average snack preference of all 500 learners). This is usually unknown because it's hard to collect data from everyone.

	● **Statistic**: A value that describes the same characteristic but based on the sample (e.g., the average snack preference of the 50 learners surveyed). Statistics are used to estimate parameters. The goal of sampling is to use statistics to make reasonable guesses about parameters. Processing Questions: 1. What is the difference between a parameter and a statistic? 2. Why is sample size important in a study? 3. What factors affect the choice of sample size? 4. How can a sample help estimate information about a population?	
	B.3. Developing Mastery (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity B.3: Practicing Learned Skills This comprehensive practice session features rapid formative checks, parameter identification drills, and specialized group work options like classroom simulations, case challenges, or team debates. It centers on practice and reinforcement, moving learners from guided processing to independent problem-solving while helping them practice differentiating between the eight distinct sub-types of probability and non-probability sampling. ***Pedagogy and Strategies*** ● **Formative Quick Checks:** Using immediate response techniques (Thumbs Up / Thumbs Down) to gauge class understanding in real time. ● **Kinesthetic Classroom Simulation (Option 1):** Learners act out their assigned sampling methods using classmates or name cards. ● **Structured Case Challenges & Card Matching Race (Option 2):** Uses timed matching games to build quick recall of terms and definitions. ● **Academic Face-Off / Debate (Option 3):** Teams present arguments defending the practicality or accuracy of their assigned sampling methods. ***Integration Components*** ● **EdTech Integration:** Google Docs or Google Slides. Groups work together in a shared slide deck to document their sampling scenarios, allowing for immediate peer review. ● **Literacy Integration:** Text-to-context semantic bridging. Learners read short scenarios and translate clues (e.g., *"every 5th name," "all households in two streets"*) into formal sampling terms. ● **Scaffolded Integrative Performance Task (IPT) Connection:** Peer Review Simulation. Groups evaluate each other's sampling plans and offer feedback on potential design flaws or bias risks.	

	Facilitation Guide **1. Quick Check and Setup** • **All Options Opening:** Begin by conducting the *Formative Quick Check* (Thumbs Up/Down) and the *Parameter vs. Statistic Drill* with the whole class to gauge immediate recall. Have learners signal their answers simultaneously. Once completed, immediately transition to your chosen option: • **If choosing Option 1 (Classroom Simulation):** Organize learners into small groups. Distribute whiteboards (or index cards) for Part I and prepare the physical name cards/scenarios for Parts II and III. • **If choosing Option 2 (Sampling Challenge):** Pair up learners immediately. Distribute the two sets of mixed-up cards (Terms and Definitions) face down on their desks for the Matching Race. • **If choosing Option 3 (Sampling Face-Off!):** Place a single chair at the front of the room labeled with the "**Hot Seat.**" Divide the rest of the classroom down the middle into two massive debate blocks: **Team A (Probability)** and **Team B (Non-probability)**. **2. Execution and Pacing** • **If choosing Option 1 (Classroom Simulation):** Run Part I by reading the fill-in-the-blank statements aloud and yelling *"Show!"* for rapid whiteboard reveals. Move into Part II by assigning each group with one specific sampling method to physically act out. Conclude Part III by distributing the scenario cards for chart-paper analysis. • **If choosing Option 2 (Sampling Challenge):** Start a strict **2-minute countdown** for the Matching Race. Once verified, transition to Parts II and III by projecting the case scenarios on the screen. Give pairs 5 minutes to analyze the cases and categorize them into probability vs. non-probability types. • **If choosing Option 3 (Sampling Face-Off!):** Run the rapid-fire Hot Seat game, enforcing a strict **10-second response limit** per participant. Next, launch a **10-minute preparation timer** for the formal debate, instructing teams to construct arguments using real-world scenarios. **3. Monitoring and Scaffolded Probing (During Activity)** • **For Option 1:** As groups act out their sampling methods, inspect their physical layouts. For a group simulating *Systematic Sampling*, check that they are counting mathematically. Ask: *"If your starting point isn't random, does your method still qualify as a probability technique?"* • **For Option 2:** Move between pairs during the case challenges to prompt deep structural decoding. Ask: *"In Scenario B (asthma survey), does every single student in the school have a chance to be picked? If not, what does that tell you about its classification?"* • **For Option 3:** Intervene within the debate huddles to sharpen counter-arguments. Probe Team A: *"How will you defend probability methods if a researcher has zero budget and only two hours to collect data?"* Probe Team B: *"How will you defend convenience data when a principal tries to use it to create a high-stakes, school-wide policy?"* **4. Presentation, Synthesis, and Review** • **For Option 1:** Facilitate the peer presentations of the sampling plans. Have the audience critique whether the proposed sample sizes and methods (e.g., proportional allocation across STEM/HUMSS/GAS) match the specific scenario goals. • **For Option 2:** Finalize the scores from the Matching Race. Call on random pairs to read out a case scenario and defend their classification, resolving any lingering confusion between *quota* and *stratified* sampling methods. • **For Option 3:** Moderate the debate face-off strictly using the **3-2-5-minute template** (Opening, Rebuttals, Q&A). Conclude by providing 5 minutes for individual notebook reflection (Part III), then call on volunteers to share their insights.

<table>
<tr><td></td><td colspan="2">● All Options Summary Note: Conclude the session by drawing a master matrix on the board that contrasts the operational trade-offs of all 8 methods: Accuracy, Generalizability, and Fairness (Probability) versus Speed, Economy, and Accessibility (Non-probability).</td></tr>
<tr><td rowspan="2">C. Demonstrating Knowledge and Skills</td><td colspan="2">C.1. Finding Practical Application</td></tr>
<tr><td>Activity C.1. Making Real-World Connections

Proposing a Statistical Investigation

Introduction
Your school is preparing for a Cultural Celebration Day. To make fair decisions, organizers need to gather opinions from learners in both the Academic Track and TechPro Track. Since surveying all learners may not be practical, your group must design a sampling plan that ensures fair representation.

Part A. Select a Survey Scenario

➢ Choose ONE of the following situations:

Case 1: Talent Show Line-up
The school wants to determine which performances learners prefer for the Talent Show. Surveying only Academic learners may not reflect the preferences of TechPro learners.
Case 2: Limited Time Decision
The organizers have only one week to gather opinions and cannot survey all 600 learners. They plan to survey selected sections instead.
Case 3: Food Fair Preferences
Learners from different tracks may have different food preferences. Surveying only one track may not represent the entire student population.

Part B. Develop Your Sampling Plan

➢ Prepare a Sampling Proposal by completing the following sections.</td><td>Activity C.1: Making Real-World Connections

This hands-on group project requires learners to design a formal sampling proposal for a school event, calculate required sample sizes, and account for demographic representation. Targeting the "Create" and "Evaluate" levels of cognitive processing, it moves beyond textbook exercises by forcing learners to apply their mathematical knowledge to real-world constraints, helping them understand how statistical theory directly informs school and community decision-making.

Pedagogy and Strategies
● Project-Based Learning (PBL): Teams create an authentic, real-world sampling plan from start to finish.
● Inquiry-Based Cooperative Learning: Group work focused on a multi-layered problem (incorporating gender and track constraints into a sample design).

Integration Components
● EdTech Integration: Canva or Google Slides for creating polished, presentation-ready proposal designs.
● Literacy Integration: Technical writing and presentation skills. Students write clear, step-by-step procedures and present their justifications to the class.
● Scaffolded Integrative Performance Task (IPT) Connection: Proposal Submission. This plan serves as the official sampling methodology blueprint for their final community assessment report.

Facilitation Guide
● Set the Stage: Present the Cultural Celebration Day scenario. Clearly explain the requirements for the sampling proposal and review the grading rubric.</td></tr>
</table>

	1. Population Identification Answer the following: ● Who is your target population? ● Who should be included in the study? ● Why is this population appropriate for your chosen case? **2. Selection of Sampling Method** Choose an appropriate sampling method. ● What sampling method will you use? o Simple Random Sampling o Stratified Sampling o Systematic Sampling o Cluster Sampling o Convenience Sampling o Purposive Sampling ● Why is this method appropriate for your case? ● How does it help ensure fair representation? **3. Sample Size Determination** The school has **600 learners**. Use **Slovin's Formula** to determine the required sample size. $n = \frac{N}{1+Ne^2}$ Where: ● $\boldsymbol{n}$ = sample size ● $\boldsymbol{N}$ = population size (600) ● $\boldsymbol{e}$ = margin of error (use 0.05 unless stated otherwise) **Show your complete solution and final answer.** **4. Sampling Procedure** Describe how you will collect your sample. Provide a step-by-step procedure such as: ● Prepare a list of learners. ● Divide learners into groups if necessary. ● Select participants using the chosen sampling method. ● Conduct the survey. ● Record and organize the data.	● **Facilitate Team Project Work:** Circulate to ensure teams are using Slovin's Formula correctly and checking their math for the gender and track allocations. ● **Manage Presentations:** Give each group 2 minutes to present their plan. Use the 18-point rubric to evaluate their proposals. ● **Wrap-Up (2 minutes):** Summarize the key takeaways, highlighting how proper sample sizing helps minimize structural bias.

	5. Fairness and Bias Check Answer the following: ● What possible sources of bias may occur? ● How can these biases be reduced or avoided? ● What makes your sample reliable and representative? **Part C. Data Situation Challenge** ➢ Consider the following school population: *By Gender* ● 300 boys ● 300 girls *By Track* ● 450 Academic Track learners ● 150 TechPro Track learners Answer the following: 1. Will this information affect your sampling method? Explain. 2. Should the sample be adjusted for each group? Why? 3. How can you ensure fair representation of both tracks and genders? **Part D. Final Output Requirements** ➢ Your Sampling Proposal must include: ● Population Description ● Sampling Method and Justification ● Sample Size Computation Using Slovin's Formula ● Step-by-Step Sampling Procedure ● Bias Risks and Solutions ● Representation Plan for Track and Gender Groups	

Your group will be graded based on the given rubric.

Rubric:

Criteria	Excellent (3)	Good (2)	Needs Improvement (1)
Population Identified	Population is clearly and completely identified with an appropriate explanation.	Population is mostly clear and identified.	Population is unclear, incorrect, or incomplete.
Sampling Method Chosen	Sampling method is appropriate, clearly explained, and justified.	Sampling method is chosen with a basic explanation.	Sampling method is inappropriate or lacks explanation.
Sample Size Determined	Sample size is correctly computed and well justified using Slovin's Formula.	Sample size is computed with minor errors or limited justification.	Sample size is incorrect, unrealistic, or not justified.
Sampling Procedure	Procedure is clear, logical, and easy to follow.	Procedure is mostly clear but lacks some details.	Procedure is unclear, incomplete, or difficult to follow.
Fairness and Bias Considered	Possible bias is identified, solutions are provided, and fair representation is addressed.	Some bias and fairness issues are considered.	Bias and fairness issues are not considered.
Clarity of Plan	Plan is well-organized, complete, and easy to understand.	Plan is mostly organized and understandable.	Plan is unclear, disorganized, or difficult to understand.

Total Score: ____ / 18

	Performance Level **Score** **Rating** 16–18 Excellent 13–15 Very Good 10–12 Satisfactory 6–9 Needs Improvement ***Processing Questions*:** 1. How did your group determine the correct population and sample for your investigation? 2. Why is your chosen sampling method appropriate for your selected case? 3. How does your sample ensure fair representation of all learners in the school? 4. Why is it important to have a well-designed sampling plan before collecting data?	
	C.2. Making Generalization	
	Activity C.2. Wrapping-Up the Lesson **Option 1. Reflection** *Instructions:* 1. Answer the following questions in your notebook: a. What is random sampling? Give at least two examples (e.g., simple random sampling, stratified sampling). b. How do researchers determine or compute the appropriate sample size for a study? c. What is the difference between a parameter and a statistic? d. How do probability and non-probability sampling differ in terms of fairness and use? 2. After answering, write a short reflection paragraph (4–5 sentences) explaining how a well-chosen sample helps in making accurate conclusions about a population. **Option 2. Concept Map** *Instructions:* 1. Create a concept map with the title: *"Sampling and Generalization"*	**Activity C.2. Wrapping-Up the Lesson** This synthesis activity requires learners to organize the lesson core concepts using structured writing reflections, comprehensive concept maps, or a 3-2-1 self-monitoring exit ticket. It focuses entirely on retention and consolidation, helping learners connect and organize new terms (sampling types, formulas, parameters vs. statistics) into long-term memory while reinforcing how proper sampling allows researchers to make accurate generalizations about a population. ***Pedagogy and Strategies*** • **Metacognitive Reflection Writing (Option 1):** Prompts independent thinking by having students summarize their personal understanding of data generalizability. • **Concept Mapping (Option 2):** A visual learning strategy where students diagram the connections between different statistical terms. • **3-2-1 Exit Ticket (Option 3):** A quick self-assessment tool used to track individual student confidence and identify any remaining questions.

	2. Draw a central circle and connect four branches: ● *Random Sampling & Types* Include examples: simple random, stratified, cluster, systematic ● *Sample Size* Show how you would determine a sample from a population of 600 learners ● *Parameter vs. Statistic* Give one example: o Parameter: average height of all learners o Statistic: average height of a sample of 50 learners ● *Probability vs. Non-probability Sampling* Include keywords: o Probability: fair, random, unbiased o Non-probability: quick, practical, limited representation 3. Connect all branches back to the main idea of generalization from sample to population. **Option 3. 3-2-1 Self-Monitoring Exit Ticket** ***Instructions:*** 1. Write down: ● **3** types of probability sampling you understand. ● **2** differences between a parameter and a statistic. ● **1** concept you need help with. 2. Self-Rating: On a scale of 1-5, how confident are you in calculating sample size? *Processing Questions*: 1. What is the importance of sampling in statistics? 2. How do sampling methods affect the quality of data? 3. Why should researchers avoid bias in sampling? 4. How can sampling help solve real-life problems?	***Integration Components*** ● **EdTech Integration:** MindMeister, Jamboard, or Padlet for creating and sharing digital concept maps across teams. ● **Literacy Integration:** Synthesis and summary writing. Learner's practice turning complex mathematical processes into a clear, 4 to 5 sentence explanatory paragraph. ● **Scaffolded Integrative Performance Task (IPT) Connection:** Executive Summary Framework. The reflection paragraph helps students practice writing the methodology summaries needed for their final research portfolios. ***Facilitation Guide*** **1. Setup and Orientation** ●**If choosing Option 1 (Reflection):** Project the four specific guide questions and the paragraph prompt on the board. Instruct learners to bring out their notebooks for a silent writing session. ●**If choosing Option 2 (Concept Map):** Distribute blank paper and markers or instruct learners to open their digital mapping tools (e.g., MindMeister, Jamboard). Clearly state the central theme: *"Sampling and Generalization."* ●**If choosing Option 3 (3-2-1 Exit Ticket):** Distribute pre-printed exit ticket slips or write the 3-2-1 framework on the board for students to copy. Emphasize that self-rating (1-5) must be completely honest to help you plan the next lesson. **2. Independent Work Time** ● **For Option 1:** Enforce quiet, independent work. Remind students that their final reflection paragraph must be a cohesive 4–5 sentence, not just bullet points. ● **For Option 2:** Instruct learners to draw the central circle first, then build out the four required branches. Remind them to show a quick calculation or estimate for the $N = 600$ sample size branch.

		• **For Option 3:** Give students a quick 5-minute limit. This is designed to be a rapid recall exercise, not a deep-dive essay. **3. Monitoring and Scaffolded Probing (During Activity)** • **For Option 1:** Walk around and check their definitions. If a student is struggling with the question 'c', ask: *"Which one describes the whole school, and which one describes just your classroom?"* • **For Option 2:** Circulate to check the accuracy of their maps. Ensure they are placing "Simple Random" under Probability and correctly labeling the Parameter vs. Statistic examples. • **For Option 3:** Look over students' shoulders to spot recurring answers for *"1 concept I need help with."* If multiple students write down "Slovin's Formula," note this for an immediate mini-review. **4. Share, Collect, and Synthesize (3 to 5 minutes)** • **For Option 1:** Invite two volunteers to read their 4–5 sentence synthesis paragraphs aloud to the class. • **For Option 2:** Ask students to hold up their concept maps (or display 1-2 digital boards on the screen) to visually celebrate their work. • **For Option 3:** Collect the exit tickets at the door as students leave. **5. All Options (Wrap-Up):** Before dismissing the class, facilitate a rapid whole-class discussion using the general **Processing Questions** to lock in the lesson's relevance.
	C.3. Evaluating Learning (For complete instructions, please refer to the Learning Activity Sheet.)	
	Activity C.3. Assessing Learning Outcomes This 15-item independent summative assessment is split into three key sections: Core Vocabulary Concepts, Sample Size Calculations, and Scenario-Based Applications. Functioning as the formal evaluation phase of the lesson, it measures independent student mastery of designated learning competencies, providing clear diagnostic data to determine if students are ready for advanced statistical topics. ***Pedagogy and Strategies*** • **Independent Objective Assessment:** Standardized multiple-choice questions designed to evaluate individual student mastery.	

	• **Scenario-Based Diagnostic Testing:** Real-world problem setups (e.g., analyzing council surveys or health worker choices) that test a student's ability to apply concepts to practical situations. ***Integration Components*** • **EdTech Integration:** Google Forms, Quizizz, or Socrative for digital testing, automatic grading, and instant item analysis. • **Literacy Integration:** Technical reading comprehension. Students practice parsing detailed question prompts to distinguish between closely related statistical options. • **Scaffolded Integrative Performance Task (IPT) Connection:** Pre-Flight Quality Check. Passing this assessment confirms that students have the technical knowledge required to begin collecting data for their field projects. ***Facilitation Guide*** 1. **Distribute and Start:** Hand out the printed test sheets or open the digital quiz link. Remind students to read all instructions carefully before starting. 2. **Testing Window:** Maintain a quiet testing environment. Circulate to ensure students are working independently and showing their math for the calculation of questions. 3. **Collect and Review:** Collect the test sheets or submit the digital responses. Walk through the answers on the board, focusing on the calculation steps for Slovin's Formula. 4. **Gather Feedback:** Ask students to share which questions they found most challenging to identify any areas that might need a quick review.
	C.4. Additional Activities (For complete instructions, please refer to the Learning Activity Sheet.)
	Activity C.4. Extending and Reinforcing Learning This section offers a set of tailored learning tasks based on student quiz scores, providing targeted remediation drills for students who need extra support alongside advanced policy-writing and project design tasks for those ready for an extra challenge. It focuses purely on differentiation and extension—ensuring struggling students to master the basics while higher-performing students stretch their critical thinking by writing formal data policies for real-world scenarios. ***Pedagogy and Strategies*** • **Differentiated Instruction:** Providing separate, targeted paths for remediation and enrichment based on assessment data. • **Remedial Drill Matching:** Using structural T-charts and scenario matching to reinforce the foundational differences between sampling methods. • **Enrichment Case Analysis & Policy Memo Writing:** Challenges advanced students to apply their knowledge by writing a formal administrative memo to a city mayor. ***Integration Components*** • **EdTech Integration:** Google Classroom or a school LMS platform to distribute tasks and provide personalized feedback on student proposals. • **Literacy Integration:** Advanced professional writing. Students practice writing a formal policy memo, using clear, data-backed arguments suitable for city officials.

	• **Scaffolded Integrative Performance Task (IPT) Connection:** Project Refinement. Advanced students refine their project descriptions into high-quality briefs, while remediation students strengthen their core definitions. ***Facilitation Guide*** 1. **Analyze and Assign:** Review the scores from assessment C.3. Assign the Remediation tasks to students scoring below mastery thresholds, and the Enrichment tasks to those scoring at or above mastery. 2. **Explain the Homework:** Walk through the instructions for both sets of tasks. Clearly explain the expectations for the policy memo and the School Wellness project brief. 3. **Review Submissions (Next Class):** Grade the remediation worksheets for accuracy and select two outstanding policy memos to share as examples of excellent data analysis.
V. ASSESSMENT	For the summative assessment and performance task, please refer to the Teacher's Notes, which can be accessed through the link in the Table of Contents.
VI. REFLECTION	For your reflection, you may use the Reflection Guide provided in the Teacher's Notes to help guide your responses.

INTEGRATIVE PERFORMANCE TASK			
Learning Areas :	**Effective Communication** **General Mathematics** **General Science** **Life and Career Skills** **Mabisang Komunikasyon** **Pag-aaral ng Kasaysayan at Lipunang Pilipino**		
IPT Title :	**Climate Watch PH: A Barangay Environmental Awareness Campaign**	**Duration :**	**First Term**
Overview : What is the brief description and real-world relevance of the Integrative Performance Task (IPT)? What knowledge, skills, values, and 21st-century competencies are expected to be developed through the IPT? How does the IPT promote meaningful, authentic, and lifelong learning experiences for learners?	This Integrative Performance Task (IPT) engages Senior High School learners in **investigating environmental and climate-related issues** affecting their local community and **developing a multimodal environmental awareness campaign** supported by scientific explanations, statistical evidence, civic awareness, and community-centered recommendations. Learners are expected to gather and analyze community data, interpret statistical information, investigate environmental concerns, and communicate evidence-based recommendations through multimodal presentations such as **public service announcements and social media awareness campaigns.** The task is contextualized in Philippine communities where issues such as flooding, improper waste disposal, rising heat index, water pollution, drainage problems, and climate change directly affect people's daily lives, health, livelihood, and safety. Through this IPT, learners examine how environmental challenges require collective action, responsible citizenship, and informed decision-making within the community. The IPT integrates competencies from General Science, General Mathematics, Effective Communication/Mabisang Komunikasyon, Life and Career Skills, and Pag-aaral ng Kasaysayan at Lipunang Pilipino (KLP). Learners apply: 1. scientific investigation in examining environmental issues, 2. data gathering, analysis, and interpretation of community information, oral, written, and multimodal 3. communication in presenting findings and recommendations, 4. civic and historical awareness in understanding environmental advocacy as a contemporary form of pakikibaka and community participation, and 5. career awareness in exploring professions related to environmental protection, governance, communication, research, and community development. Through this integrative performance task, learners develop scientific literacy, mathematical reasoning, communication competence, collaboration, creativity, critical thinking, problem-solving, civic responsibility, environmental stewardship, career readiness, and community engagement.		

	The culminating output is a **Community Investigation Portfolio with a Multimodal Environmental Awareness Campaign and Barangay Assembly Oral Presentation**, where learners present their findings, statistical analyses, reflections, and recommendations as youth environmental advocates and responsible members of the Filipino community.
Area of Integration	
Interdisciplinary Integration : *(Specific skills from identified Learning Areas to be applied in accomplishing the IPT)* What concepts, competencies, or skills from the different learning areas are integrated and applied in accomplishing the Integrative Performance Task (IPT)? How do these interconnected disciplines contribute to deeper understanding, authentic learning, and meaningful task completion?	The task integrates six learning areas in a balanced and meaningful way:

Learning Areas	Learning Competencies	Budget of Work (BOW)
Effective Communication	A. Interpret data represented in multimodal forms (e.g., charts, tables, figures). B. Follow procedures, instructions, or processes in spoken, written, or multimodal forms (e.g., figures, diagrams, charts) to successfully achieve outcomes. C. Explain concepts using appropriate academic and technical vocabulary and language, and multimodal representations (e.g., diagrams, graphs, charts, infographics).	Term 2
General Mathematics	A. Identify the appropriate measure of central tendency of a given data set for different purposes. B. Use appropriate technologies (e.g., Excel, Jamovi, etc.) to calculate measures of central tendency. C. Interpret the computed measures of central tendency.	Term 2 - Week 2
General Science	A. Describe how biological systems respond to climate change and contribute to understanding its effects on living organisms in the Philippines. B. Explain how climate change impacts Philippine ecosystems.	Term 2 - Week 9-10
Life and Career Skills	Demonstrate the ability to incorporate physical activities that promote work-life balance.	Term 2 - Week 9-10
Mabisang Komunikasyon	Paglalahad ng mga resulta ng saliksik o imbestigatibong ulat sa pulong o kumperensiya	Term 2
Pag-aaral ng Kasaysayan at Lipunang Pilipino	Nasusuri ang kolektibong karanasan ng pakikiangkop sa panahon ng pagsasarili gamit ang piling kaso (cases).	Term 2 - Week 6-7

"The Integrative Performance Task (IPT) enable learners to apply scientific investigation in examining local environmental problems, mathematical reasoning, and statistical analysis in organizing and interpreting community data, and oral, written, and multimodal communication in presenting evidence-based findings and recommendations. The task also develops civic and historical awareness by

	helping learners understand environmental advocacy, collective action, and responsible citizenship as expressions of kamalayang Pilipino. In addition, learners explore careers related to environmental protection, communication, governance, research, and community development."
Transdisciplinary Connection : *(How the IPT shall apply in real-world situations for lifelong learning)* How does the Integrative Performance Task (IPT) **connect** to real-life situations, community issues, or future career and lifelong learning needs? Describe how learners can apply the knowledge, skills, values, and attitudes gained beyond the classroom.	This performance task is transdisciplinary because it connects classroom learning to real-life environmental and climate-related issues experienced in Philippine communities. Learners use knowledge and skills from different disciplines to investigate community problems, communicate evidence-based recommendations, understand civic responsibilities, and explore possible future careers related to environmental and social development. Learners apply: 1. scientific investigation in identifying environmental and climate-related problems in the community; 2. mathematical reasoning in gathering, organizing, analyzing, and interpreting data; 3. communication skills in presenting findings and recommendations through oral, written, and multimodal formats; 4. historical and civic awareness in understanding how community action and environmental advocacy strengthen *kamalayang Pilipino* and collective responsibility; and 5. career awareness in recognizing the roles of professionals involved in environmental protection, disaster preparedness, research, governance, and public communication. The task is based on real community situations such as: 1. flooding during typhoon season, 2. improper waste segregation, 3. rising heat index, 4. drainage problems, 5. pollution in waterways, and 6. the effects of climate change on Filipino communities and livelihoods. Through the simulated barangay assembly and environmental awareness campaign, learners practice responsible citizenship by discussing community concerns, presenting data, and proposing realistic environmental actions. This reflects actual community programs and awareness campaigns conducted in Philippine barangays. The IPT also develops important lifelong learning skills such as: 1. critical thinking and problem-solving, 2. collaboration and leadership, 3. civic engagement and environmental responsibility, 4. ethical and respectful communication, 5. data literacy and research skills, and 6. informed career planning.

	Learners are also introduced to **possible careers connected to the task**, including environmental professionals, disaster risk reduction officers, community development workers, researchers, science communicators, media practitioners, planners, public administrators, and educators. By combining scientific inquiry, mathematical analysis, communication, historical awareness, civic responsibility, and career exploration, the IPT promotes meaningful and authentic learning beyond the classroom.
EdTech Integration : *(Use of digital tools and technology to support learning and task completion)* What appropriate EdTech tools or digital platforms can be integrated to support the accomplishment of the IPT? In what ways can EdTech tools help learners improve presentation of outputs?	Learners may use: **Microsoft Excel and/or Jamovi** for organizing and analyzing data using tables, charts, and graphs, **Canva** for infographic and visual campaign design, **PowerPoint** for oral presentations, **Facebook Page Mock Campaign** for social media advocacy simulation. These tools help learners produce organized, data-driven, visually effective, and professional outputs that resemble real-world environmental awareness campaigns.
Goal : What should learners accomplish or produce at the end of the task? What real-world problem, issue, or challenge will learners address? What competencies or standards will the task measure?	Driving Question: Option 1: "How can we launch a data-driven social media campaign that addresses a specific ecological concern in our community, while advocating for the common good and developing the knowledge, skills, and values needed to become responsible and active citizens?" Option 2: "How can we, as Youth Environmental Advocates, investigate a pressing environmental or climate-related issue affecting our community, analyze relevant community data, and develop an evidence-based awareness campaign that promotes sustainable practices, environmental responsibility, and collective community action?" Task Description: You are tasked to develop and present **Climate Watch PH: A Barangay Environmental Awareness Campaign.** Through this task, you will investigate an environmental or climate-related issue affecting your local community, gather and analyze relevant community data, and communicate evidence-based recommendations that can help address the identified concern. Your goal is to

	raise awareness, encourage responsible environmental action, and demonstrate your role as an informed, responsible, and active member of the Filipino community.
Role : What role will the learners assume in completing the task? Who are they pretending to be (e.g., researcher, entrepreneur, scientist, journalist, community leader)? How does this role reflect real-life responsibilities?	You are a **Youth Environmental Advocate** tasked with investigating environmental and climate-related issues affecting your community. In this role, you will gather and analyze community data, examine environmental concerns, communicate evidence-based findings and recommendations, and promote environmental awareness and responsible citizenship through a community-based awareness campaign. As a Youth Environmental Advocate, you will assume responsibilities commonly performed by researchers, communicators, community leaders, and environmental advocates who work collaboratively to address local environmental challenges and encourage informed community action.
Audience : Who is the intended audience or beneficiary of the task? Who will view, use, evaluate, or be affected by the learners' output? How can the audience make the task more authentic and meaningful?	You will present your outputs to: 1. Barangay officials, 2. teachers, 3. students, 4. parents or guardians, 5. community members, and 6. local stakeholders. This audience makes the task authentic because learners create outputs intended to educate and inform real members of the community about environmental and climate-related concerns. The presentation will take place during a community environmental awareness assembly in the Barangay.
Situation : What real-life context or scenario will make the task meaningful? What challenge, issue, or need must learners respond to?	Many Philippine communities experience environmental and climate-related problems that directly affect people's health, safety, livelihood, and quality of life. These include: 1. flooding during heavy rains and typhoon season, 2. improper waste disposal and poor waste segregation, 3. rising heat index and extreme weather conditions, 4. water pollution in rivers, canals, and coastal areas, 5. drainage problems, 6. loss of trees and green spaces, and 7. limited community awareness and disaster preparedness.

Why is the task important or relevant in the given situation?	In response to these concerns, the barangay council has organized a community environmental awareness assembly and invited learners to serve as Youth Environmental Advocates. Learners are tasked to investigate one environmental issue affecting their barangay and develop an evidence-based environmental awareness campaign for the community. Using scientific investigation, community data gathering, statistical analysis, and multimodal communication, learners must present their findings, explain the effects of climate change in the Philippines, and recommend realistic and community-centered solutions during the barangay assembly. The task also encourages learners to understand how collective action, responsible citizenship, and environmental advocacy serve as modern forms of pakikibaka that strengthen kamalayang Pilipino and promote community resilience. Through this authentic learning experience, learners demonstrate how scientific understanding, mathematical reasoning, effective communication, civic responsibility, and career-related competencies can help communities make informed decisions, improve environmental practices, and prepare for future environmental challenges.
Product/ Performance : What output, presentation, or performance will learners create? What evidence will demonstrate learners' understanding and skills? How will learners integrate knowledge and skills from different learning areas? What are the detailed instructions for the learners?	You will produce and present a **Climate Watch PH: A Barangay Environmental Awareness Campaign** that demonstrates scientific investigation, statistical reasoning, effective communication, civic awareness, and career understanding related to environmental and climate issues in Philippine communities. The portfolio must include: 1. Community Environmental Issue Profile 2. Community Survey, Interview, or Observation Results 3. Data Gathering and Statistical Analysis 4. Tables, Graphs, Charts, and Visualizations 5. Environmental Awareness Campaign Material 6. Barangay Assembly Oral Presentation 7. Career and Community Role Reflection 8. Final Recommendations and Reflection **Instructions for the Task** 1. Community Environmental Investigation *(General Science and KLP Integration)* You must identify and investigate **ONE environmental or climate-related issue** affecting your barangay or community such as: a. flooding, b. improper waste disposal, c. water pollution, d. rising heat index, e. drainage problems, f. poor disaster preparedness, or g. loss of green spaces.

	A. Community Investigation 1. Conduct surveys, interviews, observations, or research about the chosen issue. 2. Gather information such as: a. number of affected households, b. frequency of flooding, c. amount of waste collected, d. temperature readings, e. community practices and awareness, or f. effects of the issue on health, livelihood, and daily life. **B. Community and Civic Awareness** 1. Explain how the environmental issue affects Filipino communities and discuss how collective community action and environmental advocacy can help address the problem. 2. Relate your discussion to responsible citizenship, environmental stewardship, and modern forms of pakikibaka that strengthen kamalayang Pilipino. **2. Data Analysis and Mathematical Reasoning** *(General Mathematics Integration)* You must organize, analyze, and interpret gathered data using mathematical and statistical tools. **A. Data Organization** Present your data using: a. tables, b. spreadsheets, c. graphs, d. charts, e. infographics, or f. statistical visualizations. **B. Data Interpretation** Compute and explain: a. measures of central tendencies b. measures of variability c. percentages, d. frequencies, e. comparisons, **C. Mathematical Reasoning** Interpret the meaning of your data and explain how the results support your conclusions and recommendations for the community.

	3. Communication and Environmental Awareness Campaign (Effective Communication / Mabisang Komunikasyon Integration) You must clearly communicate your findings using oral, written, and multimodal communication appropriate for an academic and community audience. **A. Multimodal Campaign Output** Create the following: a. social media awareness campaign, b. public service announcement, **B. Barangay Assembly Oral Presentation** 1. Present your complete environmental awareness campaign during a simulated barangay assembly. 2. Your presentation must: a. explains the environmental issue, b. discusses the effects of climate change in the Philippines, c. presents statistical findings, and d. recommends practical community solutions. **C. Communication Standards** Your output must demonstrate: a. clear and organized ideas, b. effective use of visuals and multimedia, c. proper language, d. evidence-based claims, and e. logical explanation from investigation to recommendations. 4. Career Awareness and Community Engagement *(Life and Career Skills Integration)* Identify and explain at least three careers or professions involved in solving environmental and community issues. These may include: a. environmental scientists, b. disaster risk reduction officers, c. public information officers, d. researchers, e. statisticians, f. community leaders, g. urban planners, h. teachers, i. media practitioners, or j. environmental advocates.

Explain how the knowledge, skills, attitudes, and values demonstrated in this task are important in these professions and in future career development.

Standards :

What criteria will be used to assess the task?

What indicators will show quality performance and mastery?

How will learners know they have successfully completed the task?

The rubric below is used as a unified assessment tool for the six learning areas.

Unified Integrative Performance Task Rubric
Climate Watch PH: ***Barangay Environmental Awareness*** *Campaign*

Criteria	General Science	General Mathematics	Effective Communication / Mabisang Komunikasyon	Life & Career Skills	Pag-aaral ng Kasaysayan at Lipunang Pilipino
	Weights				
Investigation and Content Understanding	**40%**	10%	10%	10%	10%
Data Analysis and Mathematical Reasoning	10%	**40%**	10%	10%	10%
Communication and Presentation	10%	10%	**20%**	10%	10%
Community Awareness and Civic Responsibility	10%	10%	10%	10%	**40%**
Creativity and Use of Multimedia	10%	10%	**20%**	10%	10%
Collaboration and Participation	10%	10%	10%	10%	10%
Reflection on Community Awareness and Career Relevance	10%	10%	10%	**40%**	10%
Total	100%	100%	100%	100%	100%

Rubric:

Criteria	Advanced (4)	Proficient (3)	Developing (2)	Beginning (1)
1. Investigation and Content Understanding	Demonstrates deep and accurate understanding of the environmental issue using relevant evidence and explanations.	Demonstrates clear understanding with mostly accurate explanations and evidence.	Demonstrates partial understanding with some inaccurate or incomplete explanations.	Demonstrates little understanding with unclear or inaccurate explanations.
2. Data Analysis and Mathematical Reasoning	Data are accurate, organized, analyzed correctly, and strongly support conclusions and recommendations.	Data are mostly accurate and support conclusions with minor errors.	Data analysis contains noticeable errors or weak interpretation.	Data analysis is incomplete, inaccurate, or missing.
3. Communication and Presentation	Ideas are clear, organized, engaging, and effectively presented using oral, written, and multimodal communication.	Ideas are generally clear and organized with minor lapses in presentation.	Presentation is somewhat unclear or lacks organization and support.	Presentation is unclear, incomplete, or difficult to understand.
4. Community Awareness and Civic Responsibility	Demonstrates strong awareness of community issues, environmental responsibility, and collective action.	Demonstrates clear awareness of community and environmental concerns.	Demonstrates limited awareness of community concerns and responsibility.	Demonstrates little awareness of community issues or civic responsibility.
5. Creativity and Use of Multimedia	Output is highly creative, visually effective, and enhances audience understanding.	Output shows creativity and appropriate use of multimedia.	Output shows limited creativity or inconsistent multimedia use.	Output lacks creativity and effective multimedia use.
6. Collaboration and Participation	Actively contributes, collaborates respectfully, and participates consistently.	Participates and collaborates appropriately with the group.	Participation and collaboration are inconsistent.	Rarely participate or contribute to the task.
7. Reflection on Community Awareness and Career Relevance	Reflection demonstrates a deep understanding of environmental responsibility, community participation, and the importance of careers related to environmental protection, communication, research, governance, or community development. Clearly explains personal learning, future responsibilities, and possible career interests connected to the task.	Reflection demonstrates clear understanding of community awareness and career relevance with appropriate personal insights.	Reflection demonstrates limited understanding of community issues, personal learning, or career relevance.	Reflection is unclear, incomplete, or shows little understanding of community awareness and career relevance.