

10

Mathematics

Teacher's Guide Unit 4

This book was collaboratively developed and reviewed by educators from public and private schools, colleges, and/or universities. We encourage teachers and other education stakeholders to email their feedback, comments, and recommendations to the Department of Education at action@deped.gov.ph.

We value your feedback and recommendations.

**Department of Education
Republic of the Philippines**

Mathematics – Grade 10
Teacher’s Guide
First Edition 2015

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Introduction

This Teacher's Guide has been prepared to provide teachers of Grade 10 Mathematics with guidelines on how to effectively use the Learner's Material to ensure that learners will attain the expected content and performance standards.

This book consists of four units subdivided into modules which are further subdivided into lessons. Each module contains the content and performance standards and the learning competencies that must be attained and developed by the learners which they could manifest through their products and performances.

The special features of this Teacher's Guide are:

- A. Learning Outcomes.** Each module contains the content and performance standards and the products and/ or performances expected from the learners as a manifestation of their understanding.
- B. Planning for Assessment.** The assessment map indicates the type of assessment and categorized the objectives to be assessed into knowledge, process/skills, understanding, and performance
- C. Planning for Teaching-Learning.** Each lesson has Learning Goals and Targets, a Pre-Assessment, Activities with answers, What to Know, What to Reflect on and Understand, What to Transfer, and Summary / Synthesis / Generalization.
- D. Summative Test.** After each module, answers to the summative test are provided to help the teachers evaluate how much the learners have learned.
- E. Glossary of Terms.** Important terms in the module are defined or clearly described.
- F. References and Other Materials.** This provides the teachers with the list of reference materials used, both print and digital.

We hope that this Teacher's Guide will provide the teachers with the necessary guide and information to be able to teach the lessons in a more creative, engaging, interactive, and effective manner.

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K to 12 Curriculum Guide

MATHEMATICS

(Grade 10)

December 2013

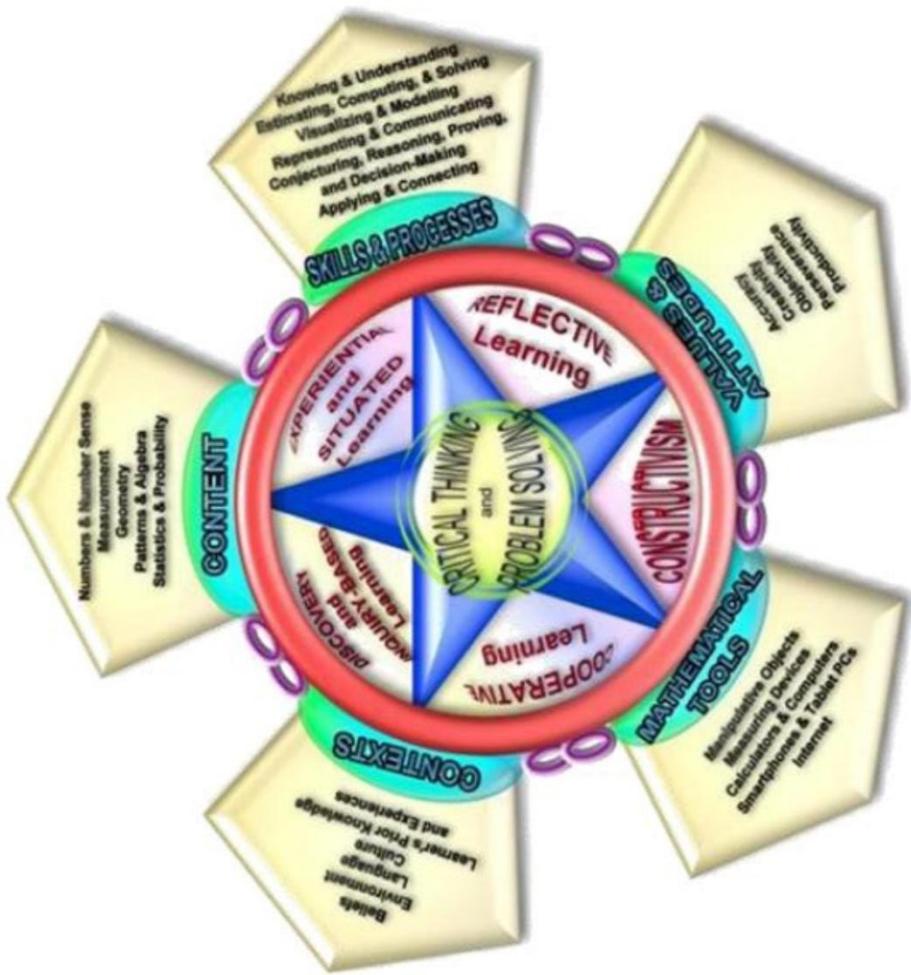


Figure 1.The Conceptual Framework of Mathematics Education

K to 12 BASIC EDUCATION CURRICULUM

CONCEPTUAL FRAMEWORK

Mathematics is one subject that pervades life at any age and in any circumstance. Thus, its value goes beyond the classroom and the school. Mathematics as a school subject, therefore, must be learned comprehensively and with much depth.

The twin goals of mathematics in the basic education levels, K-10, are the development of Critical Thinking and Problem Solving skills.

Critical thinking, according to Scriven and Paul (1987) is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action.

On the other hand, according to Polya (1945 & 1962), mathematical problem solving is finding a way around a difficulty, around an obstacle, and finding a solution to a problem that is unknown.

These two goals are to be achieved with an organized and rigorous curriculum content, a well-defined set of high-level skills and processes, desirable values and attitudes, and appropriate tools, taking into account the different contexts of Filipino learners.

There are five content areas in the curriculum, as adopted from the framework prepared by MATH-TED and SEI (2010): Numbers and Number Sense, Measurement, Geometry, Patterns and Algebra, and Probability and Statistics.

The specific skills and processes to be developed are: knowing and understanding; estimating, computing and solving; visualizing and modelling; representing and communicating; conjecturing, reasoning, proving and decision-making; and applying and connecting.

The following values and attitudes are to be honed as well: accuracy, creativity, objectivity, perseverance, and productivity.

We recognize that the use of appropriate tools is necessary in teaching mathematics. These include: manipulative objects, measuring devices, calculators and computers, smart phones and tablet PCs, and the Internet.

We define context as a locale, situation, or set of conditions of Filipino learners that may influence their study and use of mathematics to develop critical thinking and problem solving skills. Contexts refer to beliefs, environment, language and culture that include traditions and practices, as well as the learner's prior knowledge and experiences.

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The framework is supported by the following underlying learning principles and theories: Experiential and Situated Learning, Reflective Learning, Constructivism, Cooperative Learning and Discovery and Inquiry-based Learning. The mathematics curriculum is grounded in these theories.

Experiential Learning as advocated by David Kolb is learning that occurs by making sense of direct everyday experiences. Experiential Learning theory defines learning as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (Kolb, 1984, p. 41). Situated Learning, theorized by Lave and Wenger, is learning in the same context in which concepts and theories are applied.

Reflective Learning refers to learning that is facilitated by reflective thinking. It is not enough that learners encounter real-life situations. Deeper learning occurs when learners are able to think about their experiences and process these, allowing them the opportunity to make sense of and derive meaning from their experiences.

Constructivism is the theory that argues that knowledge is constructed when the learner is able to draw ideas from his/her own experiences and connect them to new ideas.

Cooperative Learning puts premium on active learning achieved by working with fellow learners as they all engage in a shared task. The mathematics curriculum allows for students to learn by asking relevant questions and discovering new ideas. Discovery Learning and Inquiry-based Learning (Bruner, 1961) support the idea that students learn when they make use of personal experiences to discover facts, relationships, and concepts.

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BRIEF COURSE DESCRIPTION

Mathematics from K-10 is a skills subject. As such, it is all about quantities, shapes and figures, functions, logic, and reasoning. Mathematics is also a tool of science and a language complete with its own notations and symbols and “grammar” rules, with which concepts and ideas are effectively expressed.

The contents of mathematics include Numbers and Number Sense, Measurement, Geometry, Patterns & Algebra and Statistics and Probability.

Numbers and Number Sense as a strand include concepts of numbers, properties, operations, estimations, and their applications.

Measurement as a strand includes the use of numbers and measures to describe, understand, and compare mathematical and concrete objects. It focuses on attributes such as length, mass and weight, capacity, time, money, and temperature, as well as applications involving perimeter, area, surface area, volume, and angle measure.

Geometry as a strand includes properties of two- and three-dimensional figures and their relationships, spatial visualization, reasoning, and geometric modeling and proofs.

Patterns and Algebra as a strand studies patterns, relationships, and changes among shapes and quantities. It includes the use of algebraic notations and symbols, equations, and most importantly, functions, to represent and analyze relationships.

Statistics and Probability as a strand is all about developing skills in collecting and organizing data using charts, tables, and graphs; understanding, analyzing and interpreting data; dealing with uncertainty; and making predictions about outcomes.

The K to 10 Mathematics Curriculum provides a solid foundation for Mathematics at Grades 11 to 12. More importantly, it provides necessary concepts and life skills needed by Filipino learners as they proceed to the next stage in their life as learners and as citizens of the Philippines.

K to 12 BASIC EDUCATION CURRICULUM

LEARNING AREA STANDARD: The learner demonstrates understanding and appreciation of key concepts and principles of mathematics as applied - using appropriate technology - in problem solving, critical thinking, communicating, reasoning, making connections, representations, and decisions in real life.

KEY STAGE STANDARDS:

K – 3	4 – 6	7 – 10
<p>At the end of Grade 3, the learner demonstrates understanding and appreciation of key concepts and skills involving numbers and number sense (whole numbers, number theory, fractions, decimals, ratio and proportion, percent, and integers); measurement (time, speed, perimeter, circumference and area of plane figures, volume and surface area of solid/space figures, temperature and meter reading); geometry (parallel and perpendicular lines, angles, triangles, quadrilaterals, polygons, circles, and solid figures); patterns and algebra (continuous and repeating patterns and number sentences); statistics and probability (data collection and representation in tables, pictographs and bar graphs and outcomes) as applied - using appropriate technology - in critical thinking, problem solving, reasoning, communicating, making connections, representations, and decisions in real life.</p>	<p>At the end of Grade 6, the learner demonstrates understanding and appreciation of key concepts and skills involving numbers and number sense (whole numbers, number theory, fractions, decimals, ratio and proportion, percent, and integers); measurement (time, speed, perimeter, circumference and area of plane figures, volume and surface area of solid/space figures, temperature and meter reading); geometry (parallel and perpendicular lines, angles, triangles, quadrilaterals, polygons, circles, and solid figures); patterns and algebra (continuous and repeating patterns, number sentences, sequences, and simple equations); statistics and probability (bar graphs, line graphs and pie graphs, simple experiment, and experimental probability) as applied -using appropriate technology - in critical thinking, problem solving, reasoning, communicating, making connections, representations, and decisions in real life.</p>	<p>At the end of grade 10, the learner demonstrates understanding and appreciation of key concepts and skills involving numbers and number sense (sets and real numbers); measurement (conversion of units); patterns and algebra (linear equations and inequalities in one and two variables, linear functions, systems of linear equations, and inequalities in two variables, exponents and radicals, quadratic equations, inequalities, functions, polynomials, and polynomial equations and functions); geometry (polygons, axiomatic structure of geometry, triangle congruence, inequality and similarity, and basic trigonometry); statistics and probability (measures of central tendency, variability and position; combinatorics and probability) as applied - using appropriate technology - in critical thinking, problem solving, communicating, reasoning, making connections, representations, and decisions in real life.</p>

K to 12 BASIC EDUCATION CURRICULUM

GRADE LEVEL STANDARDS:		GRADE LEVEL STANDARDS
GRADE LEVEL	GRADE LEVEL	GRADE LEVEL STANDARDS
K		The learner demonstrates understanding and appreciation of key concepts and skills involving numbers and number sense (whole numbers up to 20, basic concepts on addition and subtraction); geometry (basic attributes of objects), patterns and algebra (basic concept of sequence and number pairs); measurement (time, location, non-standard measures of length, mass and capacity); and statistics and probability (data collection and tables) as applied - using appropriate technology - in critical thinking, problem solving, reasoning, communicating, making connections, representations and decisions in real life.
	GRADE 1	The learner demonstrates understanding and appreciation of key concepts and skills involving numbers and number sense (whole numbers up to 100, ordinal numbers up to 10 th , money up to PhP100, addition and subtraction of whole numbers, and fractions 1/2 and 1/4) geometry (2- and 3-dimensional objects); patterns and algebra (continuous and repeating patterns and number sentences); measurement (time, non-standard measures of length, mass, and capacity); and statistics and probability (tables, pictographs, and outcomes) as applied - using appropriate technology - in critical thinking, problem solving, reasoning, communicating, making connections, representations, and decisions in real life.
	GRADE 2	The learner demonstrates understanding and appreciation of key concepts and skills involving numbers and number sense (whole numbers up to PhP1000, ordinal numbers up to 20 th , money up to PhP100, the four fundamental operations of whole numbers, and unit fractions); geometry (basic shapes, symmetry, and tessellations); patterns and algebra (continuous and repeating patterns and number sentences); measurement (time, length, mass, and capacity); and statistics and probability (tables, pictographs, and outcomes) as applied - using appropriate technology - in critical thinking, problem solving, reasoning, communicating, making connections, representations, and decisions in real life.
	GRADE 3	The learner demonstrates understanding and appreciation of key concepts and skills involving numbers and number sense (whole numbers up to 10 000; ordinal numbers up to 100 th ; money up to PhP1 000; the four fundamental operations of whole numbers; proper and improper fractions; and similar, dissimilar, and equivalent fractions); geometry (lines, symmetry, and tessellations); patterns and algebra (continuous and repeating patterns and number sentences); measurement (conversion of time, length, mass and capacity, area of square and rectangle); and statistics and probability (tables, bar graphs, and outcomes) as applied - using appropriate technology - in critical thinking, problem solving, reasoning, communicating, making connections, representations, and decisions in real life.

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GRADE 4 <p>The learner demonstrates understanding and appreciation of key concepts and skills involving numbers and number sense (whole numbers up to 100 000, multiplication and division of whole numbers, order of operations, factors and multiples, addition and subtraction of fractions, and basic concepts of decimals including money); geometry (lines, angles, triangles, and quadrilaterals); patterns and algebra (continuous and repeating patterns and number sentences); measurement (time, perimeter, area, and volume); and statistics and probability (tables, bar graphs, and simple experiments) as applied - using appropriate technology - in critical thinking, problem solving, reasoning, communicating, making connections, representations, and decisions in real life.</p>
GRADE 5 <p>The learner demonstrates understanding and appreciation of key concepts and skills involving numbers and number sense (whole numbers up to 10 000 000, order of operations, factors and multiples, fractions and decimals including money, ratio and proportion, percent); geometry (polygons, circles, solid figures); patterns and algebra (sequence and number sentences); measurement (time, circumference, area, volume, and temperature); and statistics and probability (tables, line graphs and experimental probability) as applied - using appropriate technology - in critical thinking, problem solving, reasoning, communicating, making connections, representations, and decisions in real life.</p>
GRADE 6 <p>The learner demonstrates understanding and appreciation of key concepts and skills involving numbers and number sense (divisibility, order of operations, fractions and decimals including money, ratio and proportion, percent, integers); geometry (plane and solid figures); patterns and algebra (sequence, expression, and equation); measurement (rate, speed, area, surface area, volume, and meter reading); and statistics and probability (tables, pie graphs, and experimental and theoretical probability) as applied - using appropriate technology - in critical thinking, problem solving, reasoning, communicating, making connections, representations, and decisions in real life.</p>
GRADE 7 <p>The learner demonstrates understanding of key concepts and principles of numbers and number sense (sets and real number system); measurement (conversion of units of measurement); patterns and algebra (algebraic expressions and properties of real numbers as applied in linear equations and inequalities in one variable); geometry (sides and angles of polygons); and statistics and probability (data collection and presentation, and measures of central tendency and variability) as applied - using appropriate technology - in critical thinking, problem solving, reasoning, communicating, making connections, representations, and decisions in real life.</p>

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GRADE LEVEL STANDARDS	
GRADE LEVEL	
GRADE 8	The learner demonstrates understanding of key concepts and principles of patterns and algebra (factors of polynomials, rational algebraic expressions, linear equations and inequalities in two variables, systems of linear equations and inequalities in two variables); geometry (axiomatic structure of geometry, triangle congruence, inequalities in a triangle, and parallel and perpendicular lines); and statistics and probability (probability of simple events) as applied - using appropriate technology - in critical thinking, problem solving, reasoning, communicating, making connections, representations, and decisions in real life.
GRADE 9	The learner demonstrates understanding of key concepts and principles of patterns and algebra (quadratic equations and inequalities, quadratic functions, rational algebraic equations, variations, and radicals) and geometry (parallelograms and triangle similarities and basic concepts of trigonometry) as applied - using appropriate technology - in critical thinking, problem solving, reasoning, communicating, making connections, representations, and decisions in real life.
GRADE 10	The learner demonstrates understanding of key concepts and principles of patterns and algebra (sequences, series, polynomials, polynomial equations, and polynomial functions); geometry (circles and coordinate geometry); and statistics and probability (combinatorics and probability, and measures of position) as applied - using appropriate technology - in critical thinking, problem solving, reasoning, communicating, making connections, representations, and decisions in real life.

Time Allotment:

Grade	1	2	3	4	5	6	7	8	9	10
Daily	50 min									
Weekly							4 hours	4 hours	4 hours	4 hours

GRADE 10

CONTENT	CONTENT STANDARDS	PERFORMANCE STANDARDS	LEARNING COMPETENCY		CODE
			The learner...	The learner...	
Grade 10- FIRST QUARTER			<p>is able to formulate and solve problems involving sequences, polynomials and polynomial equations in different disciplines through appropriate and accurate representations.</p>	<ol style="list-style-type: none"> generates patterns. *** illustrates an arithmetic sequence determines arithmetic means and nth term of an arithmetic sequence. *** finds the sum of the terms of a given arithmetic sequence. *** illustrates a geometric sequence. differentiates a geometric sequence from an arithmetic sequence. differentiates a finite geometric sequence from an infinite geometric sequence. determines geometric means and nth term of a geometric sequence. *** finds the sum of the terms of a given finite or infinite geometric sequence. *** illustrates other types of sequences (e.g., harmonic, Fibonacci). solves problems involving sequences. performs division of polynomials using long division and synthetic division. proves the Remainder Theorem and the Factor Theorem. factors polynomials. illustrates polynomial equations. 	M10AL-Ja-1 M10AL-Jb-1 M10AL-Jc-1 M10AL-Jc-2 M10AL-Jd-1 M10AL-Jd-2 M10AL-Jd-3 M10AL-Je-1 M10AL-Je-2 M10AL-Jf-1 M10AL-Jf-2 M10AL-Jg-1 M10AL-Jg-2 M10AL-Jh-1 M10AL-Ji-1

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CONTENT	CONTENT STANDARDS	PERFORMANCE STANDARDS	LEARNING COMPETENCY	CODE
Grade 10- SECOND QUARTER	The learner...	The learner...	The learner...	
Patterns and Algebra	demonstrates understanding of key concepts of polynomial function.	is able to conduct systematically a mathematical investigation involving polynomial functions in different fields.	16. proves Rational Root Theorem. 17. solves polynomial equations. 18. solves problems involving polynomials and polynomial equations.	M10AL-ii-2
Geometry	demonstrates understanding of key concepts of circles and coordinate geometry.	1. is able to formulate and find solutions to challenging situations involving circles and other related terms in different disciplines through appropriate and accurate representations. 2. is able to formulate and solve problems involving geometric figures on the rectangular coordinate plane with perseverance and accuracy.	19. illustrates polynomial functions. 20. graphs polynomial functions. 21. solves problems involving polynomial functions. 22. derives inductively the relations among chords, arcs, central angles, and inscribed angles. 23. proves theorems related to chords, arcs, central angles, and inscribed angles. 24. illustrates secants, tangents, segments, and sectors of a circle. 25. proves theorems on secants, tangents, and segments. 26. solves problems on circles. 27. derives the distance formula. 28. applies the distance formula to prove some geometric properties. 29. illustrates the center-radius form of the equation of a circle. 30. determines the center and radius of a circle given its equation and vice versa.	M10AL-ii-a-1 M10AL-ii-a-b-1 M10AL-ii-b-2 M10GE-ii-c-1 M10GE-ii-d-1 M10GE-ii-e-1 M10GE-ii-e-f-1 M10GE-ii-f-2 M10GE-ii-g-1 M10GE-ii-g-2 M10GE-ii-h-1 M10GE-ii-h-2

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CONTENT	CONTENT STANDARDS	PERFORMANCE STANDARDS	LEARNING COMPETENCY	CODE
Grade 10- THIRD QUARTER	The learner...	The learner...	The learner...	
Statistics and Probability	demonstrates understanding of key concepts of combinatorics and probability.	is able to use precise counting technique and probability in formulating conclusions and making decisions.	31. graphs a circle and other geometric figures on the coordinate plane.*** 32. solves problems involving geometric figures on the coordinate plane.	M10GE-III-1 M10GE-III-j-1
			33. illustrates the permutation of objects. 34. derives the formula for finding the number of permutations of n objects taken r at a time. 35. solves problems involving permutations. 36. illustrates the combination of objects. 37. differentiates permutation from combination of n objects taken r at a time. 38. derives the formula for finding the number of combinations of n objects taken r at a time 39. solves problems involving permutations and combinations. 40. illustrates events, and union and intersection of events. 41. illustrates the probability of a union of two events. 42. finds the probability of $(A \cup B)$.	M10SP-IIIa-1 M10SP-IIIa-2 M10SP-IIIb-1 M10SP-IIIc-1 M10SP-IIIc-2 M10SP-IIId-1 M10SP-IIIe-1 M10SP-IIIf-1 M10SP-IIIg-1 M10SP-IIIh-1

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CONTENT	CONTENT STANDARDS	PERFORMANCE STANDARDS	LEARNING COMPETENCY	CODE
Grade 10- FOURTH QUARTER	The learner...	The learner...	The learner...	
Statistics and Probability	demonstrates understanding of key concepts of measures of position.	is able to conduct systematically a mini-research applying the different statistical methods.	43. illustrates mutually exclusive events. 44. solves problems involving probability.	M10SP-III-i-1 M10SP-III-j-1
			45. illustrates the following measures of position: quartiles, deciles and percentiles.*** 46. calculates a specified measure of position (e.g. 90th percentile) of a set of data. 47. interprets measures of position. 48. solves problems involving measures of position. 49. formulates statistical mini-research. 50. uses appropriate measures of position and other statistical methods in analyzing and interpreting research data.	M10SP-IVa-1 M10SP-IVb-1 M10SP-IVc-1 M10SP-IVd-e-1 M10SP-IVf-g-1 M10SP-IVh-j-1

*** Suggestion for ICT enhanced lesson when available and where appropriate

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Code Book Legend

Sample: M7AL-1g-2

LEGEND		SAMPLE	DOMAIN/ COMPONENT	CODE
First Entry	Learning Area and Strand/ Subject or Specialization	Mathematics	Number Sense	NS
	Grade Level	Grade 7	Geometry	GE
Uppercase Letter/s	Domain/Content/ Component/ Topic	Patterns and Algebra	Patterns and Algebra	AL
				-
Roman Numeral <i>*Zero if no specific quarter</i>	Quarter	Second Quarter		
		II		
Lowercase Letter/s <i>*Put a hyphen (-) in between letters to indicate more than a specific week</i>	Week	Week seven		
		g		
Arabic Number	Competency	Solves problems involving algebraic expressions	Statistics and Probability	SP
				2

Module 8: Measures of Position

A. Learning Outcomes

Content Standard:

The learner demonstrates understanding of key concepts of measures of position.

Performance Standard:

The learner is able to investigate thoroughly the mathematical relationship in various situations, formulate real-life problems involving measures of position and, solve them using a variety of strategies.

Unpacking of Standards for Understanding

Subject: Mathematics Grade 10	Learning Competencies	
	Essential Understanding: Students will understand that there are real-life problems that involve quantiles, the statistical measures, which can be useful tools in making decisions.	Essential Question: How can real-life problems involving quantiles be solved efficiently using statistical measures of position?
Quarter: Fourth Quarter	Transfer Goals: Students will be able to recognize real-life problems that can be represented using the concepts of measures of position and apply these concepts in making decisions based on the statistical solutions obtained.	
Topic: Measures of Position		
LESSONS: Measures of Position for Ungrouped Data Measures of Position for Grouped Data		
WRITER: Jerry Dimla Cruz		

B. Planning for Assessment

Product/Performance

The following are products and performances that students are expected to come up with in this module.

1. Compute the different measures of position such as quartiles, deciles, and percentiles
2. Interpret measures of position in real-life situations
3. Organize a flowchart in finding the position/location in a given set of data.
4. Construct a rubric for evaluating the cleanest classroom
5. Make a reflection journal about the concepts and applications of measures of position learned
6. Complete the Cross Quantile Puzzle
7. Interpret the result of the computed quantiles
8. Conduct a statistical mini-research applying the concepts of measures of position

Assessment Map

TYPE	KNOWLEDGE	PROCESS/SKILLS	UNDERSTANDING	PERFORMANCE
Pre-Assessment/ Diagnostic	Pre-test: Part I Identifying and defining quantiles such as quartiles, deciles, and percentiles	Pre-test: Part I Solving the indicated quantiles	Pre-test: Part I Interpret the data and the result obtained in solving the three quantiles	
				Pre-test: Part II Conduct a mini-research on the students' performance based on the number of minutes it took them to reach the finish line. (Run- for- a- Cause activity)
Formative	Determining the prior knowledge of the students about quantiles			

TYPE	KNOWLEDGE	PROCESS/SKILLS	UNDERSTANDING	PERFORMANCE
	Writing the initial definition of quartiles, deciles and percentiles			
			Interpreting the result of the computed quartile	
		Solving for quartiles of a set of data		
		Finding the lower and upper quartiles		
		Computing the deciles of a set of data		
		Determining quartiles and deciles		
		Solving for the percentiles of a set of data		
		Solving for the percentile of the given data	Interpreting the percentile of the given data	
		Completing the Cross Quantile Puzzle		
	Writing the procedure in finding the position of the given data			
		Solving for quantile of a set of data		
				Creating criteria for judging the cleanest classroom
		Solving for the percentile of a set of data		
		Solving for the percentile of a set of data using calculator		

TYPE	KNOWLEDGE	PROCESS/SKILLS	UNDERSTANDING	PERFORMANCE
		Solving for the quantiles of a set of data		
		Solving for the quantiles of a set of data		
		Solving for the quantiles of a set of data		
		Completing the table by identifying the required data such as lower boundaries and less than cumulative frequency Solving the quantiles of the given set of data	Interpreting the results of the computed quantiles	
			Completing the 1-4-3 chart by answering the questions	
				Writing a reflection journal
				Conducting a mini-research study on students' performance in the final examination in Mathematics
		Constructing a frequency distribution of grouped data Solving the indicated quantiles	Interpret the results of computed quantiles	
	Writing the final definition of quantiles			

TYPE	KNOWLEDGE	PROCESS/SKILLS	UNDERSTANDING	PERFORMANCE
Summative	Post-test: Part I Identifying and defining quantiles such as quartiles, deciles, and percentiles	Post-test: Part I Solving the indicated quantiles	Post-test: Part I Interpret the data and the results obtained in solving the three quantiles	
				Post-test: Part II Conduct a mini-research on the students' performance based on the number of minutes to reach the finish line (Run-for-a-Cause activity)
Self-Assessment	Journal Writing Expressing understanding of measures of position Expressing understanding on determining quantiles and its application in daily life			

Assessment Matrix (Summative Test)

Levels of Assessment	What will I assess?	How will I assess?	How will I score?
Knowledge 15%	The learner demonstrates understanding of key concepts of measures of position. Identify and define quantiles such as quartiles, deciles, and percentiles	Paper and pencil Test Part I: Items 1, 3, 4, 8, 9, 20	1 point for every correct response
Process/Skills 25%	Solve for the measures of position: a. Quartiles b. Deciles c. Percentiles	Part I: Items 5, 6, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19	1 point for every correct response

Levels of Assessment	What will I assess?	How will I assess?	How will I score?
Understanding 30%	Analyze and interpret the result of the computed quantiles of a set of data	Part I: Items 2, 7,	1 point for every correct response
Product/ Performance 30%	The learner is able to investigate thoroughly mathematical relationships in various situations, formulate real-life problems involving measures of position, and solve them using a variety of strategies.	Part II: Mini-research	Rubric for explanation Criteria: Understanding of Task Completion of Task Communication of Findings Group Process

C. Planning for Teaching-Learning

The module covers the key concepts on measures of position. Students are given practical tasks to utilize their prior knowledge and skills in learning measures of position in a deeper perspective. The students must always be informed in advance the materials needed in performing activities given in the module. They shall undergo a series and a variety of activities to process the knowledge and skills learned and reflect to understand such concepts to further develop their critical thinking and problem solving skills.

Objectives:

After the learners have gone through the key concepts contained in this module, they are expected to:

1. illustrate the following measures of position: quartiles, deciles, and percentiles;
2. calculate specified measure of position (e.g. 90th percentile) of a set of data;
3. interpret measures of position;
4. solve problems involving measures of position;
5. conduct statistical mini-research; and
6. use appropriate measures of position and other statistical methods in analyzing and interpreting research data.

PRE-ASSESSMENT:

To begin this module, check students' prior knowledge, skills, and understanding of mathematics concepts involving measures of position by giving the pre-assessment test. The results of this assessment will be your basis for planning the learning experiences to be provided for the students

Answer Key

Part I

- | | | | | |
|------|------|------|-------|-------|
| 1. B | 4. D | 7. B | 10. C | 13. D |
| 2. A | 5. A | 8. A | 11. B | 14. C |
| 3. B | 6. C | 9. B | 12. B | |

Part II

Performance task of the students may be assessed using the suggested rubric.

LEARNING GOALS AND TARGETS:

Students are expected to demonstrate understanding of the key concepts of measures of position. They are also expected to investigate, analyze, and solve problems involving measures of position through appropriate and accurate representation and to justify the usefulness of quantiles in dealing with real-life situations.

Rubric in Assessing Students' Performance (Group Task)

Standards	4	3	2	1
Understanding of Task	Demonstrated substantial understanding of the content, processes, and demands of the task	Demonstrated understanding of the content and task, even though some supporting ideas or details may have been overlooked or misunderstood	Demonstrated gaps in their understanding of the content and task	Demonstrated little understanding of the content

Standards	4	3	2	1
Completion of Task	Fully achieved the purpose of the task, including thoughtful, insightful, interpretations and conjectures	Accomplished the task	Completed most of the task	Attempted to accomplish the task, but with little or no success
Communication of Findings	Communicated their ideas and findings effectively, raised interesting and provocative questions, and went beyond what was expected	Communicated their findings effectively	Communicated their ideas and findings	Did not finish the research study and/or were not able to communicate ideas very well
Group Process	Used available time productively Everyone was involved and contributed to the group process and product.	Worked well together most of the time Members usually listened to each other and used each other's ideas.	Worked together some of the time Not everyone contributed equal efforts to the task.	Did not work very productively as a group Not everyone contributed to the group effort.

To formally start the discussion about measures of position, ask the following questions:

1. Did you take the National Career Assessment Examination (NCAE) when you were in Grade 9? If so, what was your score? Did you know your rank?
2. Have you thought of comparing your academic performance with that of your classmates?
3. Have you wondered what score you need for each subject area to qualify for honors?
4. Whenever your teacher asks you to form a line according to your height, what is your position in relation to your classmates?
5. Have you asked yourself why a certain examinee in any national examination gets a higher rank than the other examinees? Some state colleges and universities are offering scholarships for graduating students who belong to the upper 5%, 10%, or even 25%. What does this mean to you?

What to KNOW

Before doing Activity 1, give the students an overview of the lessons to be discussed in this module using the module map and ask the question *How useful are quantiles in dealing with real-life situations like problem solving?* Through this, the students will have the insights of what they will learn as they go through this module.

Lesson 1: Measures of Position for Ungrouped Data

Activity 1: Find your Center

Present the illustrations in Activity 1 and let the students answer the questions presented. This entails guided discussion.

After doing Activity 1, lead the students in reviewing first the concepts on computing the measures of central tendency especially the **median**, which is one of the skills needed in the study of this module.

Answer Key

1. Q_1 is the midpoint of A and B , therefore the distance from A to Q_1 and from Q_1 to B are equal. Hence, the coordinates of Q_1 can be determined by taking half of the sum of the coordinates of A and B .

$$\frac{x+3y}{4}$$

2. Q_2 is the midpoint of B and C and its coordinates can be determined by taking half of the sum of the coordinates of B and C .

$$\frac{x+3y}{4}$$

3. In the given example, \overline{AC} represents a distribution, one-half of it lies below B and one-half lies above it.

Hence, **B** represents the **median**.

Activity 2: RG² Worksheet

Prepare copies of the **RG² Worksheet**. Give each student a copy of the worksheet and let them be guided by the given directions. Let the students answer it individually.

Below is the RG² worksheet which will determine your prior knowledge about the main question of the topic.

Answer the main question: *What are the ways to determine the position of a score in the given set of data?* Write your answer in the Ready part of the RG² Worksheet.

RG ² Worksheet
Ready:
Get set:
Go:

Students may write their own ideas on determining the position in the given set of data.

Activity 3: What's the Meaning of This?

The teacher shall inform the students on what shall be done in learning the entire module. There will be different activities which shall serve as their guide as they learn, discover, and prove the key concepts on quantiles. Let the students do the activity **What's the meaning of this?** Make sure that they are doing it correctly. Emphasize that they shall revisit the same table later on.

Write your initial definition on the different Measures of Position.

My Definition Table

Measures of Position	My Initial Definition
• Quartile	
• Decile	
• Percentile	

The students may give their own or initial definition of the different measures of position.

What to PROCESS

In this part of the module, the teacher will present and discuss the activities and guide the students in accomplishing and answering the said activities. These activities will lead the students to discover the process of determining the measures of position of the given set of ungrouped data. After accomplishing the activities, ask the question, “What are the ways to determine the measures of position in the given set of data?” In this manner, the students to form or establish the proper way of determining quartiles, deciles, and percentiles for ungrouped data.

ACTIVITY 4: Watch This!

In this activity, you may ask students to form a group of 10 and let the group fall in line according to their height. See to it that all students are participating actively. Ask them to answer the questions based on their activity. They must be able to defend their answers using quartiles.

Answer Key

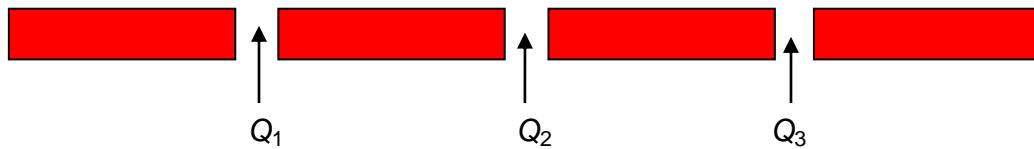
1. It means that 2 or 20% of the students are shorter than you.
2. Middle quartile is also the median.
 - a. The first quartile, 3, is obtained by observing the position of 3 which is in the middle of the numbers from 1 to 5.
 - b. The second quartile, 5, is obtained by observing the position of 5 which is in the middle of the numbers from 1 to 9.
 - c. The third quartile, 8, is obtained by observing the position of 8 which is in the middle of the numbers from 6 to 9.
3. Discuss with your group mates.
Discuss well with them their answers to the questions presented. Make sure that they use the quartiles as reasons.

Discuss the Quartiles for ungrouped data.

The Quartiles for Ungrouped Data

The quartiles are the score-points which divide a distribution into four equal parts. Twenty-five percent (25%) of the distribution are below the first quartile, fifty percent (50%) are below the second quartile, and seventy-five percent (75%) are below the third quartile. Q_1 is called the lower quartile and Q_3 is the upper quartile. $Q_1 < Q_2 < Q_3$, where Q_2 is the median. The difference between Q_3 and Q_1 is the interquartile range.

Since the second quartile is equal to the median, the steps in finding the median are the same as the steps in finding the Q_1 and the Q_3 .



- a. 25% of the data has a value $\leq Q_1$
- b. 50% of the data has a value $\leq Md$ or Q_2
- c. 75% of the data has a value $\leq Q_3$

Example 1:

The owner of a coffee shop recorded the number of customers who came into his café each hour in a day. The results were 14, 10, 12, 9, 17, 5, 8, 9, 14, 10, and 11. Find the lower quartile and upper quartile of the data.

Solution:

- The ascending order of the data is 5, 8, 9, 9, 10, 10, 11, 12, 14, 14, 17
- The least value in the data is 5 and the greatest value in the data is 17.
- The middle value in the data is 10.
- The lower quartile is the value that is between the middle value and the least value in the data set.
- So, the lower quartile is 9.
- The upper quartile is the value that is between the middle value and the greatest value in the data set.
- So, the upper quartile is 14

Example 2:

Find the average of the lower quartile and the upper quartile of the following data.

Component	Quantity
Hard disk	290
Monitors	370
Keyboards	260
Mouse	180
Speakers	430

Solution:

- The increasing order of the data is 180, 260, 290, 370, 430.
- The least value of the data is 180 and the greatest value of the data is 430.
- The middle value of the data is 290.

- The lower quartile is the value that is between the least value and the middle value.
- So, the lower quartile is 260.
- The upper quartile is the value that is between the greatest value and the middle value.
- So, the upper quartile is 370.
- The average of the lower quartile and the upper quartile is equal to 315.

Example 3:

The lower quartile of a data set is the 8th data value. How many data values are there in the data set?

Solution:

- The lower quartile is the median data value of the lower half of the data set.
- So, there are 7 data values before and after the lower quartile.
- So, the number of data values in the lower half is equal to $7 + 7 + 1$.
- The number of values in the data set is equal to lower half + upper half + 1.
- The number of values in the lower and upper halves are equal.
- Formula: $15 + 15 + 1 = 31$.
- So, the data set contains 31 data values.

Another solution:

$$\begin{aligned}\frac{1}{4} (n + 1) &= 8 \\ n + 1 &= 32 \\ n &= 31\end{aligned}$$

Example 4:

In this example, the teacher shall discuss the method in finding the value of a quartile formulated by Mendenhall and Sincich. In their text titled *Statistics for Engineering and the Sciences*, Mendenhall and Sincich presented a different method of finding quartile values.

Using this method, the upper quartile (Q_3) and lower quartile (Q_1) values are always two of the data elements.

Activity 5: Try It?

Answer key

$$\begin{aligned}Q_1 &= 6 \\ Q_2 &= 8.5 \\ Q_3 &= 11\end{aligned}$$

Discuss what interpolation is? Also, the teacher shall explain the steps to follow in interpolation.

Interpolation is an estimation of a value within two known values in a sequence of values. Using interpolation method sometimes (but not always) produces the same results.

Activity 6: Find Me

Answer key

$$Q_1 = 5.75$$

$$Q_2 = 8.5$$

$$Q_3 = 11.25$$

Activity 7: How Old Are You?

In this activity, post the situation on the board, ask the questions presented and guide the students as they give their answers based on their computations.

Answer Key

1. $Q_1 = 11.75$; $Q_2 = 13$; $Q_3 = 14.25$
2. Q_1 - 3 students; Q_2 - 6 students; Q_3 - 9 students
3. Guide the students to realize and understand the process of finding quartiles.

Activity 8: Aqua Running

This activity shall test the students' ability to reason out and explain how to compute the quartile of ungrouped data. The students must be able to give the formula in solving the quartile of an ungrouped data.

Answer Key:

The lower quartile is 87.75 and the upper quartile is 98.

ACTIVITY 9: Non-Smoking Area

Consider the following nicotine levels of 40 smokers:

0	87	173	253	1	103	173	265	1	112
198	266	3	121	208	277	17	123	210	284
32	130	222	289	35	131	227	290	44	149
234	313	48	164	245	477	86	167	250	491

Find the quartiles.

First, note that before we start our computations, we must sort the data - computing percentiles for non-sorted data is the most common mistake so, please avoid it. Here is the same data again, this time sorted:

0	1	1	3	17	32	35	44	48	86
87	103	112	121	123	130	131	149	164	167
173	173	198	208	210	222	227	234	245	250
253	265	266	277	284	289	290	313	477	491

Now we can do our calculations, where $N = 40$ (number of values in our data set).

- Lower Quartile: $0.25 \times 40 = 10$, so we need to take the value midway between the 10th value, which is 86, and the 11th value, which is 87. Hence, the lower quartile is 86.5
- Upper Quartile: $0.75 \times 40 = 30$, so we need to take the value midway between the 30th value, which is 250, and the 31st value, which is 253.

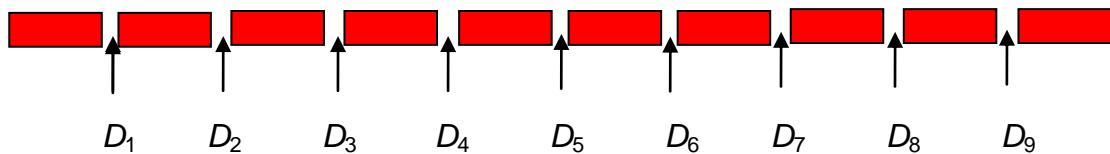
Hence, the upper quartile is $\frac{250+253}{2} = 251.5$

Discuss the Deciles for ungrouped data.

The Deciles for Ungrouped Data

The deciles are nine score-points which divide a distribution into ten groups. Deciles are denoted as $D_1, D_2, D_3, \dots, D_9$. They are computed in the same way as the quartiles are calculated.

The 1st decile is the 10th percentile (P_{10}). It means 10% of the data is less than or equal to the value of P_{10} or D_1 , and so on.



Example 6:

Compare the values of deciles to that of quartiles.

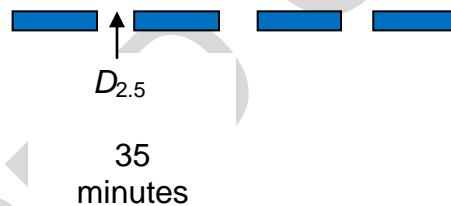
$$Q_1 = D_{2.5}$$

$$Q_2 = D_5$$

$$Q_3 = D_{7.5}$$

Example 7:

1. Mrs. Labonete gave a test to her students in Statistics. The students finished their test in 35 minutes. This time was the lower quartile of the allotted time. What does this mean?



This means that 25% of the learners finished the test in less than 35 minutes, while the remaining 75% finished the test in more than 35 minutes. Giving a low quartile or percentile would be considered good, because the students finished the test earlier than the others who answered their test in a longer time.

2. Anthony is a secretary in a big company in Metro Manila. His salary was in the 70th percentile. Should Anthony be glad or not about his salary? Explain your answer.

Solution:

70% of the employees receive a salary less than or equal to his salary and 30% of the employees receive a salary that is greater than his salary. Anthony should be pleased with his salary.

Activity 10: Time to Record!

This time, instruct students to do the activity “Time To Record.” In this way, the teacher can establish continuity of or strengthen the knowledge and skills they have learned about deciles.

Answer Key

The 2nd decile is 25.60. The 6th decile is 46.60. The 8th decile is 55.

What to REFLECT on and UNDERSTAND:

After having several discussions, examples, and activities, have a closer look once again if there are still aspects which the students find hard and confusing. Now, the students are ready to answer the question “How can the position of data be described and used in solving real – life problems?”

Activity 11: Go, Investigate!

In this activity, the teacher shall post the given ungrouped data and ask the students to solve for the quartiles and deciles. This is to find out if the students really understand the discussion about quartiles and deciles for ungrouped data.

The following are the test scores of 30 students in their 50 multiple choice-item test.

23	38	28	46	22	20	18	34	36	35
45	48	16	22	27	25	29	31	30	25
44	21	18	43	21	26	37	29	13	37

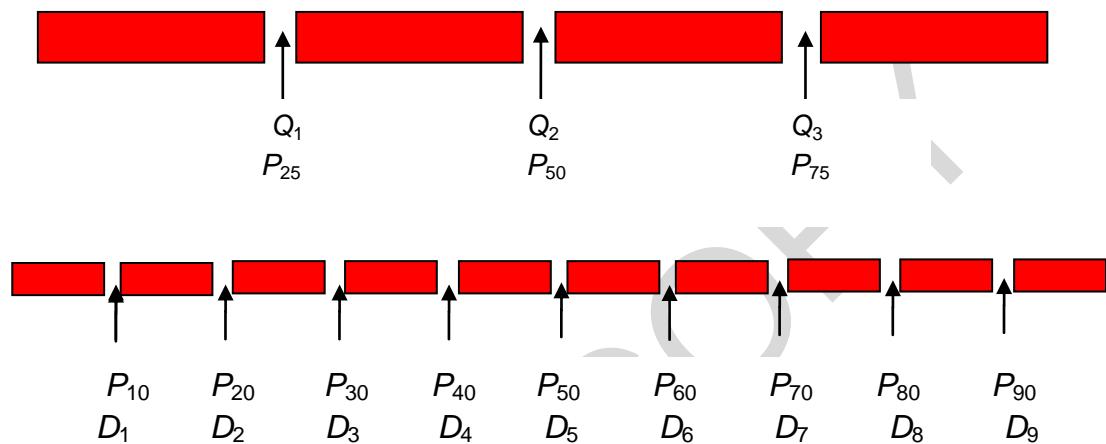
Answer Key

1. $Q_1 = 21.75$	3. $Q_3 = 37$	5. $D_3 = 22.30$
2. $Q_2 = 28.50$	4. $D_2 = 21$	

Discuss the Percentiles for ungrouped data

The Percentiles for Ungrouped Data

The percentiles are the ninety-nine score-points which divide a distribution into one hundred equal parts, so that each part represents the data set. It is used to characterize values according to the percentage below them. For example, the first percentile (P_1) separates the lowest 1% from the other 99%, the second percentile (P_2) separates the lowest 2% from the other 98%, and so on.



The 1st decile is the 10th percentile (P_{10}). It means 10% of the data is less than or equal to the value of P_{10} or D_1 , and so on.

Example 8:

Find the 30th percentile or P_{30} of the following test scores of a random sample of ten students: 35, 42, 40, 28, 15, 23, 33, 20, 18, 28.

Solution:

Arrange the scores from lowest to highest.

15 18 20 23 28 28 33 35 40 42

Steps to find percentile values on a data with n elements:

Find its P_{30} position using the formula $\frac{k(n+1)}{100}$ and round off to the nearest integer.

$$\begin{aligned}\text{Position of } P_{30} &= \frac{30(10+1)}{100} \\ &= \frac{30(11)}{100} \\ &= \frac{330}{100} \\ &= 3.3 \\ &= 3.3 \approx 3\end{aligned}$$

P_{30} is the 3rd element.

Therefore, $P_{30} = 20$.

Therefore, the value of the 30th percentile or P_{30} is 20.9. D_3 is also the P_{30} .

Activity 12: You're My World!

Post the data and ask the questions presented. Students must be able to answer the required percentile. Tell the students that the Activity "You're My World" make them realize and appreciate percentiles.

Answer Key

1. The 60th percentile of the judges' scores is 9.07.
2. The 35th percentile of the judges' scores is 8.65.

Activity 13: Status Check

In this activity, the teacher shall guide students on how to interpret and justify the result obtained on percentiles.

Answer Key

Students should answer correctly at least 15 items to pass the test.

Interpretation: It means 75% of all the scores obtained is less than or equal to the score of 15.

Activity 14: Puzzled? Complete Me

The students are now ready to apply the quantiles formula (quartiles, deciles, and percentiles) for ungrouped data.

Post the puzzle on the board and then roam around to check if they are following the directions. Ask the questions presented. Students must be able to apply the formulas of quantiles for ungrouped data.

Answer Key

1. 2			2. 3	3. 6	6
4. 3	2	7		1	
5				4	
			5. 1		6. 2
7. 2			8. 6	1	4
9. 5	3	4			2
1					8

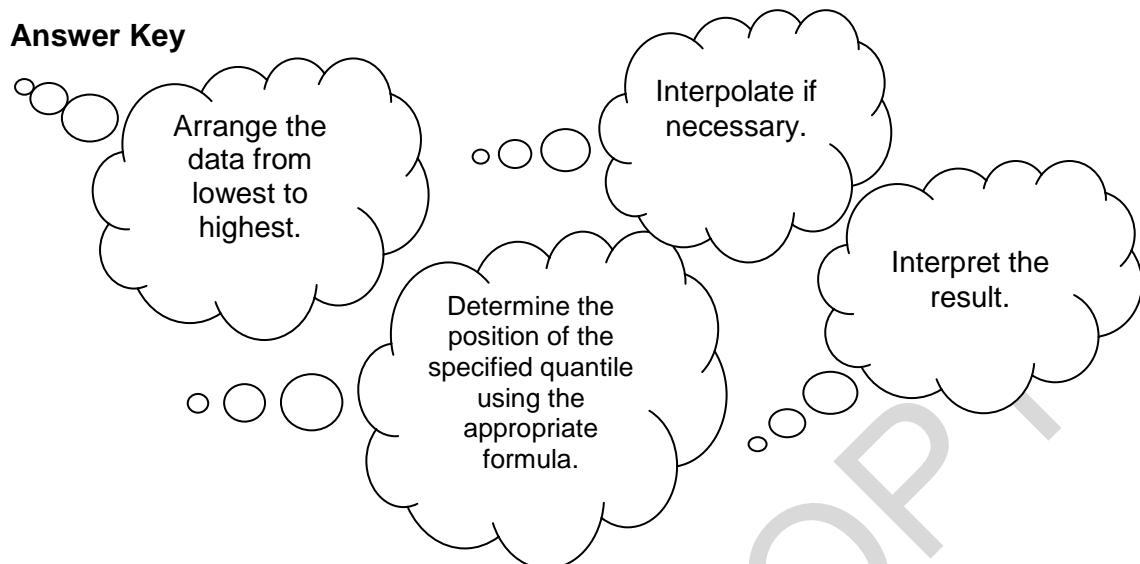
What to TRANSFER

This section of the module will test the students' understanding of the different measures of position by applying them to real-life situation. To demonstrate and apply their knowledge, give them practical tasks specifically in business and the social sciences.

On the next activity, lead the students in recalling the steps in finding the position / location in a given set of data using the clouds on the next page

Activity 15: Cloud Process

Answer Key



Activity 16: Shopping Time!

Tell a story or experience relating the picture to the personal experiences of the students for them to appreciate the practical applications of quantiles.

Answer Key

The third quartile is 7712.50.

The 40th percentile is 1660.

Activity 17: The Cleanest Classroom Is

Explain clearly to the students the expected outcome/output and inform them how they will be assessed.

Create a scenario of the task in paragraph form incorporating **GRASPS**:

Goal: Make your own criteria in choosing the Cleanest Classroom

Role: Students by Section

Audience: School Administration and Supreme Student Government (SSG) Officers

Situation: The SSG Officers will grant cash prizes and additional assistance to environmental program of the school for those who will qualify based on the given standards.

Product /performance: Criteria

Standards: Understanding of task, completion of task, communication of findings, group process

Performance task of the students may be assessed using the suggested rubric.

Rubric in Assessing Students' Performance (Group Task)

Standards	4	3	2	1
Understanding of Task	Demonstrated a substantial understanding of the content, processes, and demands of the task	Demonstrated understanding of the content and task, even though some supporting ideas or details may have been overlooked or misunderstood	Demonstrated gaps in understanding of the content and task	Demonstrated minimal understanding of the content
Completion of Task	Fully achieved the purpose of the task, including thoughtful, insightful, interpretations, and conjectures	Accomplished the task	Completed most of the task	Attempted to accomplish the task, but with little or no success
Communication of Findings	Communicated their ideas and findings effectively, raised interesting and provocative questions, and went beyond what was expected	Communicated their findings effectively	Communicated their ideas and findings	Did not finish the investigation and/or were not able to communicate ideas very well
Group Process	Used all their time productively Everyone was involved and contributed to the group process and product.	Worked well together most of the time They usually listened to each other and used each other's ideas.	Worked together some of the time Not everyone contributed equal efforts to the task.	Did not work very productively as a group Not everyone contributed to the group effort.

Lesson 2: Measures of Position for Grouped Data

What to KNOW

To assess students' readiness for the next topic, test them on the previous knowledge that they acquired – determining measures of position for ungrouped data. These concepts will help them in the study of Measures of Position for Grouped Data. The teacher may say: As you study the module, you may answer the question: "How the measures of position for grouped data are used in real-life situations?"

This activity will check if the students can still recall and really understand the process in determining the specified measures of position for the ungrouped data. The teacher will present the given set of data and let the students answer the questions through drill.

Activity 1: Do You Have a Sharp Memory?

The following are scores of ten students in their 40-item quiz.

34 23 15 27 36 21 20 13 33 25

Answer Key

- a. 13 and 15 b. 13, 15, 20, 21, 23, and 25 c. None

To perform this activity, inform the students to bring a calculator to make sure that everyone will participate.

Activity 2: 2.2 Calculate or Drill?

The teacher will post the set of data and the specified measure of position to be computed. Let the students answer each question as fast as they could.

- | | |
|----------------------------------|----------------------------------|
| 1. The 75th percentile is 8875. | 3. a. The 3rd quartile is 66. |
| 2. The 15th percentile is 57.40. | b. The 9th decile is 76.40. |
| | c. The 33rd percentile is 53.53. |

What to PROCESS

Did you find the previous activities easy? Were you able to answer them? Are you now ready to get the measure of position in a grouped data? For you to be familiar with the next topic, study the notes with illustrative examples provided.

Discuss the QUARTILES for grouped data.

The Quartiles for Grouped Data

Recall that quartiles divide the distribution into four equal parts.

The steps in computing the median are similar to that of Q_1 and Q_3 . In finding the median, we first need to determine the median class. In the same manner, the Q_1 and the Q_3 class must be determined first before computing for the value of Q_1 and Q_3 . The Q_1 class is the class interval where the $\left(\frac{N}{4}\right)$ th score is contained, while the class interval that contains the $\left(\frac{3N}{4}\right)$ th score is the Q_3 class.

In computing the quartiles of grouped data, the following formula is used:

$$Q_k = LB + \left(\frac{\frac{kN}{4} - cf_b}{f_{Qk}} \right) i$$

where:

LB = lower boundary of the Q_k class

N = total frequency

cf_b = cumulative frequency of the class before the Q_k class

f_{Q_k} = frequency of the Q_k class

i = size of class interval

k = nth quartile

Example 1:

Calculate Q_1 , Q_2 , and Q_3 of the Mathematics test scores of 50 students.

Scores	Frequency
46-50	4
41-45	8
36-40	11
31-35	9
26-30	12
21-25	6

Solution:

Class Interval Scores	Frequency (f)	Lower Boundaries (LB)	Less than Cumulative Frequency (<cf)
46-50	4	45.5	50
41-45	8	40.5	46
36-40	11	35.5	38
31-35	9	30.5	27
26-30	12	25.5	18
21-25	6	20.5	6

$N = 50$

(28th-38th score) Q_3 class
(19th-27th score) Q_2 class
(7th-18th score) Q_1 class

$$Q_1 : \frac{N}{4} = \frac{50}{4}$$

$$LB = 25.5$$

$$N = 50$$

$$cf_b = 6$$

$$f_{Q_2} = 12 \\ = 5$$

$$Q_1 = LB + \left(\frac{\frac{N}{4} - cf_b}{f_{Q_1}} \right) i$$

$$Q_1 = 25.5 + \left(\frac{12.5 - 6}{12} \right) 5$$

$$Q_1 = 28.21$$

This means we need to find the class interval where the 12.5th score is contained.

Note that the 7th-18th scores belong to the class interval: 26 – 30. So, the 12.5th score is also within the class interval.

The Q_1 class is class interval 26 – 30.

Therefore, 25% of the students have a score less than or equal to 28.21. The first quartile 28.21 falls within the class boundaries of 26-30 which is 25.5 – 30.5.

$$Q_2 \text{ class: } \frac{2N}{4} = \frac{2(50)}{4} \\ = \frac{100}{4} \\ = 25$$

This means we need to find the class interval where the 25th score is contained.

Note that the 19th – 27th scores belong to the class interval: 31 – 35. So, the 25th score is 33 which is also within the class interval.

The Q_2 class is class interval 31–35.

Therefore, 50% of the students got a score less than or equal to 34.39. The second quartile 34.39 falls within the class boundaries of 31-35 which is 30.5 – 35.5.

$$Q_3 \text{ class: } \frac{3N}{4} = \frac{3(50)}{4} \\ = \frac{150}{4} \\ = 37.5$$

This means we need to find the class interval where the 37.5th score is contained.

Note that the 28th – 38th scores belong to the class interval: 36 – 40. So, the 37.5th score is also within the class interval.

The Q_3 class is class interval 36 – 40.

Therefore, 75% of the students got a score less than or equal to 40.27. The third quartile 40.27 falls within the class boundaries of 36-40 which is 35.5 – 40.5.

$$LB = 30.5$$

$$N = 50$$

$$cf_b = 18$$

$$f_{Q_2} = 9$$

$$i = 5$$

$$Q_2 = LB + \left(\frac{\frac{2N}{4} - cf_b}{f_{Q_2}} \right) i$$

$$Q_2 = 30.5 + \left(\frac{25 - 18}{9} \right) 5$$

$$Q_2 = 34.39$$

$$LB = 35.5$$

$$N = 50$$

$$cf_b = 27$$

$$f_{Q_3} = 11$$

$$i = 5$$

$$Q_3 = LB + \left(\frac{\frac{3N}{4} - cf_b}{f_{Q_3}} \right) i$$

$$Q_3 = 35.5 + \left(\frac{37.5 - 27}{11} \right) 5$$

$$Q_3 = 40.27$$

Discuss the Deciles of grouped data.

The Deciles of Grouped Data

Deciles are those values of the distribution that divide the total frequency into 10 groups. The k th decile denoted by D_k is computed as follows:

$$D_k = LB + \left(\frac{\frac{kN}{10} - cf_b}{f_{D_k}} \right) i$$

where:
 LB = lower boundary of the D_k class
 N = total frequency
 cf_b = cumulative frequency before the D_k class
 f_{D_k} = frequency of the D_k class
 i = size of class interval
 k = n th decile where $n = 1, 2, 3, 4, 5, 6, 7, 8$, and 9

Example 2:

Calculate the 7th decile of the Mathematics test scores of 50 students.

Scores	Frequency
46-50	4
41-45	8
36-40	11
31-35	9
26-30	12
21-25	6

Solution:

Class Interval Scores	Frequency (f)	Lower Boundaries (LB)	Less than Cumulative frequency (<cf)
46-50	4	45.5	50
41-45	8	40.5	46
36-40	11	35.5	38 (28 th -38 th score) D ₇ class
31-35	9	30.5	27
26-30	12	25.5	18
21-25	6	20.5	6

$N = 50$

$$D_7 \text{ class} : \frac{7N}{10} = \frac{7(50)}{10} \\ = \frac{350}{10} \\ = 35$$

This means we need to find the class interval where the 35th score is contained.

$$D_7 = LB + \left(\frac{\frac{7N}{10} - cf_b}{f_{D_7}} \right) i \\ D_7 = 35.5 + \left(\frac{35 - 27}{11} \right) 5$$

$$D_7 = 39.14$$

Note that the 28th – 38th scores belong to the class interval: 36 – 40. So, the 35th score is also within the class interval.

The D_7 class is class interval 36 – 40.

The 7th decile is equivalent to the 70th percentile. Therefore, 70% of the students got a score less than or equal to 39.14. The 7th decile 39.14 falls within the class boundaries of 36-40 which is 35.5 – 40.5.

Discuss the Percentiles of grouped data.

The Percentiles of Grouped Data

The percentile of grouped data is used to characterize values according to the percentage below them.

Early on, you have already learned that k th quartile denoted by Q_k and the k th deciles denoted by D_k are computed respectively as follows:

$$Q_k = LB + \left(\frac{\frac{kN}{4} - cf_b}{f_{Q_k}} \right) i \quad \text{and} \quad D_k = LB + \left(\frac{\frac{kN}{10} - cf_b}{f_{D_k}} \right) i$$

Finding percentiles of a grouped data is similar to that of finding quartiles and deciles of a grouped data.

The k th percentile, denoted by P_k , is computed as follows:

$$P_k = LB + \left(\frac{\frac{kN}{100} - cf_b}{f_{P_k}} \right) i$$

where:

LB = lower boundary of the k^{th} percentile class.

N = total frequency

cf_b = cumulative frequency before the percentile class

f_{P_k} = frequency of the percentile class

i = size of class interval

k = n th percentile where $n = 1, 2, 3, \dots, 97, 98$ and 99

Example 3:

Calculate the 65th percentile and 32nd percentile of the Mathematics test scores of 50 students.

Scores	Frequency
46-50	4
41-45	8
36-40	11
31-35	9
26-30	12
21-25	6

Solution:

Class Interval Scores	Frequency (f)	Lower Boundaries (LB)	Less than Cumulative Frequency (<cf)
46-50	4	45.5	50
41-45	8	40.5	46
36-40	11	35.5	38 (28th-38th score)
31-35	9	30.5	27 P_{65} class
26-30	12	25.5	18 (7th-18th score)
21-25	6	20.5	6 Q_1 class

$N = 50$

$$\begin{aligned}
 P_{65} \text{ class} : \frac{65N}{100} &= \frac{65(50)}{100} \\
 &= \frac{3250}{100} \\
 &= 32.5
 \end{aligned}$$

This means we need to find the class interval where the 32.5th score is contained.

Note that the 28th – 38th scores belong to the class interval: 36 – 40. So, the 32.5th score is also within the class interval.

The D_{65} class is class interval 36 – 40

Therefore, 65% of the students got a score less than or equal to 38.

The 65th percentile, 38, falls within the class boundaries of 36-40 which is 35.5 – 40.5.

$$\begin{aligned}
 P_{32} \text{ class} : \frac{32N}{100} &= \frac{32(50)}{100} \\
 &= \frac{1600}{100} \\
 &= 16
 \end{aligned}$$

This means we need to find the class interval where the 16th score is contained.

Note that the 7th – 18th scores belong to the class interval: 26 – 30. So, the 16th score is also within the class interval.

The P_{32} class is class interval 26 – 30.

Therefore, 32% of the students got a score less than or equal to 29.67. The 32nd percentile, 29.67 falls within the class boundaries of 26-30 which is 25.5 – 30.5.

Discuss Percentile Rank.

$$LB = 35.5$$

$$N = 50$$

$$Cf_b = 27$$

$$f_{P_{65}} = 11$$

$$i = 5$$

$$\begin{aligned}
 P_{65} &= LB + \left(\frac{\frac{65N}{100} - cf_b}{f_{P_{65}}} \right) i \\
 P_{65} &= 35.5 + \left(\frac{32.5 - 27}{11} \right) 5
 \end{aligned}$$

$$P_{65} = 38$$

$$\begin{aligned}
 P_{32} &= LB + \left(\frac{\frac{32N}{100} - cf_b}{f_{P_{32}}} \right) i \\
 P_{32} &= 25.5 + \left(\frac{16 - 6}{12} \right) 5
 \end{aligned}$$

$$P_{32} = 29.67$$

Percentile Rank

Percentile ranks are particularly useful in relating individual scores to their positions in the entire group. A percentile rank is typically defined as the proportion of scores in a distribution that a specific score is greater than **or equal to**. For instance, if you received a score of 95 in a mathematics test and this score was greater than or equal to the scores of 88% of the students taking the test, then your percentile rank would be 88.

An example is the National Career Assessment Examination (NCAE) given to Grade 9 students. The scores of students are represented by their percentile ranks.

$$P_{PR} = \frac{100}{N} + \left[\frac{(P - LB)f_P}{i} + cf_P \right]$$

where: PR = percentile rank, the answer will be a percentage

cf_P = cumulative frequency of all the values below the critical value

P = raw score or value for which one wants to find a percentile rank

LB = lower boundary of the k th percentile class

N = total frequency

i = size of the class interval

Example 4:

Find how many percent of the scores are greater than the cumulative frequency of 38 in the previous table.

Solution:

Scores	Frequency	cf
46-50	4	50
41-45	8	46
36-40	11	38
31-35	9	27
26-30	12	18
21-25	6	6

$N = 50$

(28th– 38th score)

38 is within 36 – 40

$$LB = 35.5$$

$$P = 38$$

$$N = 50$$

$$f_P = 11$$

$$cf_P = 27$$

$$i = 5$$

$$P_{PR} = \frac{100}{N} + \left[\frac{(P - LB)f_P}{i} + cf_P \right]$$

$$P_{PR} = \frac{100}{50} + \left[\frac{(38 - 35.5)27}{5} + 27 \right]$$

$$P_{PR} = 65$$

Therefore, 65% of the scores are less than the cumulative frequency of 38 while, 35% of the scores are greater than the cumulative frequency of 38.

Example 5:

Assume the role of a researcher who wanted to know the percentage of consultants who earn Php 5,400.00 or more per day.

Consultant Fees (in Php)	Number of Consultants	Cumulative Frequency
6400 – 7599	24	120
5200 – 6399	36	96
4000 – 5199	19	60
2800 – 3999	26	41
1600 – 2799	15	15

Php 5,400.00 is within 5200 -6399

$$LB = 5199.5$$

$$N = 120$$

$$P = 5,400.00$$

$$cf_P = 60$$

$$f_P = 36$$

$$i = 1200$$

$$P_{PR} = \frac{100}{N} + \left[\frac{(P - LB)f_P}{i} + cf_P \right]$$

$$P_{PR} = \frac{100}{120} \left[\frac{(5400 - 5199.5)36}{1200} + 60 \right]$$

$$P_{PR} = 55.01$$

Round off the resulting value to the nearest whole number.

Therefore, 55% of the consultants earn Php 5,400.00 or less per day and 45% of the consultants earn Php 5,400.00 or more per day.

After discussing the ways on how to compute for the quartiles, deciles, and percentiles of grouped data, here is the activity for the students to work on.

Activity 3: That's My Place

Post the frequency distribution of the daily allowance of 60 students on the board together with the specified measures of position to be computed and the letter codes of the answers. The class will be divided into five, and the students will answer Activity 2.3 by group.

D_6	P_{15}	P_{35}	D_8	D_4	P_{70}	Q_1	Q_2	D_8	Q_3
M	Y	L	O	C	A	T	I	O	N

Activity 4: Guess Where I Am!

The teacher will present the frequency distribution for the number of employees in 45 companies belonging to certain industry. Ask the students to answer it individually.

Answer Key

The 3rd quartile is 40.29.

The 4th decile is 29.79.

The 85th percentile is 42.43.

Activity 5: Look at Me!

Present the frequency distribution. Divide the class into five. The students will work as a group. Each group will be given a specified measure of position to compute or an indicated percentile rank. Let the students present their work and explain the process on how they arrived at the answer.

The 1st quartile is 95.88.

The percentile rank of 115 is 41.4th.

The 7th decile is 133.83.

The percentile rank of 155 is 76.85th.

The 35th percentile is 102.32.

What to REFLECT on and UNDERSTAND:

After having several discussions, illustrative examples, and activities, check if there are still aspects which the students find hard and confusing. After accomplishing the activities, they are now ready to answer questions like: *How can the position of data be described and used in solving real-life problems?*

Activity 6: Am I a Scholar?

Prepare copies of the Worksheet entitled “**Am I a scholar?**” Make this activity “as an individual output.” Give each student a copy of the worksheet. Present and explain the given situation.

Dennis and Christine scored 32 and 23, respectively, on the National Career Assessment Examination (NCAE). The determining factor for a college scholarship is that a student’s score should be in the top 10% of the scores of his/her graduating class. The students in the graduating class obtained the following scores in NCAE.

NCAE Scores	F	LB	<cf
39 – 41	6	38.5	99
36 – 38	7	35.5	93
33 – 35	9	32.5	86
30 – 32	13	29.5	77
27 – 29	22	26.5	64
24 – 26	10	23.5	42
21 – 23	9	20.5	32
18 – 20	7	17.5	23
15 – 17	8	14.5	16
12 – 14	4	11.5	8
9 – 11	2	8.5	4
6 – 8	1	5.5	2
3 – 5	1	2.5	1

Answer Key

The lower boundary is obtained by subtracting 0.50 from the lower limit of each given interval. It is called the true boundary.

The lower cumulative frequency can be obtained by adding the frequencies starting from the frequency of the lowest interval.

The 3rd quartile is 31.87.

The 72nd percentile is 31.18.

The 8th deciles is 33.23.

The percentile rank of Dennis is 24th.

The percentile rank of Christine is 17th.

Dennis and Christine are not qualified for a college scholarship.

Activity 7: 1 – 4 – 3 List

Prepare copies of the Worksheet entitled “1-4-3 List.” Make this activity “as an individual output.” Give each student a copy of the worksheet and let them be guided by the given directions.

In this activity, you will be asked to complete the 1 – 4 – 3 chart. Write down what is being asked for regarding the different measures of position.

1 – 4 – 3 List	
One thing I really love about this topic:	
1.	
Four important reasons why I love this topic:	
1.	
2.	
3.	
4.	
Three things I still need to understand about this topic:	
1.	
2.	
3.	

Students may give varied responses.

What to TRANSFER

Now, that the students have already learned and identified the measures of position and the process on how to compute and interpret them, provide exercises/activities to check if they still have misconceptions about measures of position.

Activity 8: Reflection Journal

Write a reflection journal entitled “Measure of Position” using the format:

- I. Things Learned and Insights
- II. Concept Map
- III. Difficulties
- IV. Unforgettable Experiences / Activities

An output/reflection journal about “Measures of Position”

Activity 9: Based on Research

Conduct a mini-research study on students' performance in their final examination in Mathematics. Apply the knowledge and skills you have learned in this particular lesson to evaluate and interpret test results and to make/formulate meaningful decisions based on the results to resolve the students' difficulties.

Performance task of the students may be assessed using the suggested rubric.

It is important that the rubric considers also the accuracy of the mathematical computations and concepts that the students used.

Rubric in Assessing Students' Performance (Group Task)

CRITERIA	PROFICIENT	APPROACHING PROFICIENT	DEVELOPING	BEGINNING
INTEGRATION OF KNOWLEDGE	The paper demonstrates that the group fully understands and has applied concepts learned in the course. Concepts are integrated into the writer's own insights. The writer provides concluding remarks that show analysis and synthesis of ideas.	The paper demonstrates that the group, for the most part, understands and has applied concepts learned in the course. Some of the conclusions, however, are not supported in the body of the paper.	The paper demonstrates that the group, to a certain extent, understands and has applied concepts learned in the course.	The paper does not demonstrate that the group has fully understood and applied concepts learned in the course.

CRITERIA	PROFICIENT	APPROACHING PROFICIENT	DEVELOPING	BEGINNING
TOPIC FOCUS	The topic is focused narrowly enough for the scope of this assignment. The research study provides direction for the paper, either by statement of a position or hypothesis.	The topic is focused but lacks direction. The paper is about a specific topic but the group has not established a position.	The topic is too broad for the scope of this assignment.	The topic is not clearly defined.
DEPTH OF DISCUSSION	In-depth discussion and elaboration in all sections of the paper	In-depth discussion and elaboration in most sections of the paper	The group has omitted pertinent content or content run-ons excessively.	Cursory discussion in all the sections of the paper or brief discussion in only a few sections
COHESIVENESS	Ties together information from all sources. Paper flows from one issue to the next without the need for headings. Group's writing demonstrates an understanding of the relationship among materials obtained from all sources.	For the most part, ties together information from all sources. Paper flows with only some disjointedness. Group's writing demonstrates an understanding of the relationship among materials obtained from all sources.	Sometimes ties together information from all sources. Paper does not flow, disjointedness is apparent. Group's writing does not demonstrate an understanding of the relationship among materials obtained from all sources.	Does not tie together information. Paper does not flow and appears to be created from disparate issues. Headings are necessary to link concepts. Writing does not demonstrate understanding of any relationships.
SPELLING & GRAMMAR	No spelling and/or grammar mistakes	Minimal spelling and/or grammar mistakes	Noticeable spelling and grammar mistakes	Unacceptable number of spelling and/or grammar mistakes

Activity 10: Show Me the Proof!

This activity will show the proof that the students really understand the lessons presented and tackled in this module. Explain clearly the instructions needed to perform this activity well. The students' output will be the proof or evidence of what they learned in this module.

Let the students ask their classmates about their Science, English, and Mathematics grades and gather all the data from their classmates by listing. Then, let them construct a frequency distribution of a grouped data. (use $i = 5$). Calculate the following:

- a. 1st quartile
- b. 2nd quartile
- c. 3rd quartile
- d. 7th decile
- e. 4th decile
- g. 60th percentile
- h. 85th percentile
- i. percentile rank of 75
- j. percentile rank of 82

Interpret each result.

Activity 11: What's the Meaning of This?

After the discussion of the measures of position for grouped and ungrouped data, let the students do the activity about **“What's the meaning of this?”** again. This time, instruct the students to write their final definition of the quartile, decile, and percentile based on what they have learned in this module.

Ask them to write their definition of the different Measures of Position.

Summary/Synthesis/Generalization:

This module is about measures of position (quantiles) such as quartiles, deciles, and percentiles. In this module, you were able to illustrate measures of position: quartiles, deciles and percentiles, calculate a specified measure of position (e.g, 90th percentile) of a set of data, interpret measures of position, and solve problems involving measures of position. More importantly, you were given the chance to formulate and solve real-life problems, and demonstrate your understanding of the lesson by doing some practical tasks.

You have learned the following:

Quartile for Ungrouped Data

$$\text{Position of } Q_k = \frac{k}{4}(n+1)$$

Decile for Grouped Data

$$D_k = LB + \left(\frac{\frac{kN}{10} - cf_b}{f_{D_k}} \right) i$$

Decile for Ungrouped Data

$$\text{Position of } D_k = \frac{k}{10}(n+1)$$

Percentile for Grouped Data

$$P_k = LB + \left(\frac{\frac{kN}{100} - cf_b}{f_{P_k}} \right) i$$

Percentile for Ungrouped Data

$$\text{Position of } P_k = \frac{k}{100}(n+1)$$

Percentile Rank

$$P_{PR} = \frac{100}{N} + \left[\frac{(P - LB)f_P}{i} + cf_P \right]$$

Quartile for Grouped Data

$$Q_k = LB + \left(\frac{\frac{kN}{4} - cf_b}{f_{Qk}} \right) i$$

Glossary of Terms

Deciles - the nine score-points which divide a distribution into ten groups. These deciles are denoted as $D_1, D_2, D_3, \dots, D_9$.

Percentiles - the ninety-nine score points which divide a distribution into one hundred groups so that each group represents $\frac{1}{100}$ of the data set. They are used to characterize values according to the percentage of values below them.

Quantiles - measures of positions that divide a distribution into four, ten, and hundred equal parts. Such measures of positions are quartiles, deciles, and percentiles.

Quartiles - the score-points which divide a distribution into four groups. Twenty-five percent (25%) of the distribution fall below the first quartile, fifty percent (50%) fall below the second quartile, and seventy-five percent (75%) fall below the third quartile.

At the end of this module, check how well the students learn and understand the knowledge, skills, and concepts of measures of position. The results of this assessment will be the evidences of students' learning.

SUMMATIVE TEST

Choose the letter of your answer to each item.

1. The median score is also the
 - A. 75th percentile
 - B. 5th decile
 - C. 3rd decile
 - D. 1st quartile
2. Rochelle got a score of 55, which is equivalent to a 70th percentile rank in a mathematics test. Which of the following is NOT true?
 - A. She scored above 70% of her classmates.
 - B. Thirty percent of the class got scores of 55 and above.
 - C. If the passing mark is the first quartile, she passed the test.
 - D. Her score is below the 5th decile.
3. The lower quartile is equal to
 - A. 50th percentile
 - B. 25th percentile
 - C. 2nd decile
 - D. 3rd quartile
4. In the set of scores 14, 17, 10, 22, 19, 24, 8, 12, and 19, the median score is _____.
 - A. 17
 - B. 15
 - C. 16
 - D. 13
5. In a 70-item test, Melody got a score of 50 which is the third quartile. This means that
 - A. She got the highest score.
 - B. Her score is higher than 25 of his classmates.
 - C. She surpassed 75% of his classmates.
 - D. Seventy-five percent of the class did not pass the test.
6. Angie ranks 10th in a class of 40. Her percentile rank is _____.
 - A. 75
 - B. 90
 - C. 10
 - D. 25
7. The 1st quartile of the ages of 250 fourth year students is 16 years. Which of the following statements is true?
 - A. Most of the students are below 16 years old.
 - B. Seventy-five percent of the students are 16 years old and above.
 - C. Twenty-five percent of the students are 16 years old.
 - D. One hundred fifty students are younger than 16 years.

For items 11 to 14, consider the score distribution of 15 students given below:

83	72	87	79	82	77	80	73
86	81	79	82	79	74	74	

11. The median score is _____.
A. 80 C. 73
B. 82 D. 79

12. The lower quartile is _____.
A. 74 C. 86
B. 72 D. 79

13. The value of the 2nd deciles is _____.
A. 74 C. 72
B. 85 D. 83

14. The median in the score distribution for items 11 to 14 can also be interpreted as _____.
A. seven students scored above 79.
B. seven students scored below 79.
C. seven students scored below and seven students scored above 79.
D. fourteen students scored below 79.

15. In a group of 55 examinees taking the 50-item test, Rachel obtained a score of 38 and 38 scores were above her. This implies that her score is _____.

- A. the 38th percentile C. the 55th percentile
B. at the upper quartile D. below the 4th decile

For items 16 to 19, please refer to the Table A below.

Table A

Score	Frequency	Cumulative Frequency	Cumulative Percentage (%)
40-45	6	18	100.00
35-39	5	12	66.67
30-34	3	7	38.89
25-29	4	4	22.22

16. In solving for the 60th percentile, the lower boundary to use is ____.

- A. 34 C. 39
B. 34.5 D. 39.5

17. What cumulative frequency should be used in solving for the 35th percentile?

- A. 4 C. 12
B. 7 D. 18

18. The 45th percentile is _____.

- A. 33.4 C. 30.8
B. 32.7 D. 35.6

19. The 50th percentile is ____.

- A. 36.0 C. 36.5
B. 37.0 D. 37.5

20. The 50th percentile is equivalent to _____.

- A. 5th decile C. mean score
B. 2nd quartile D. all of the above

Part II.

Read and understand the situation below, then answer or perform what are asked.

Jefferson, your classmate, who is also an SK Chairman in Barangay Cut-Cot, organized a Run-for-a-Cause activity, entitled FUN RUN. He informed your school principal to motivate students to join the said FUN RUN.

Conduct a mini-research or a simple research study on the students' performance based on the number of minutes it took them to reach the finish line.

Rubric in Assessing Students' Performance (Group Task)

Standards	4	3	2	1
Understanding of Task	Demonstrated substantial understanding of the content, processes, and demands of the task	Demonstrated understanding of the content and task, even though some supporting ideas or details may have been overlooked or misunderstood	Demonstrated gaps in their understanding of the content and task	Demonstrated little understanding of the content
Completion of Task	Fully achieved the purpose of the task, including thoughtful, insightful, interpretations, and conjectures	Accomplished the task	Completed most of the task	Attempted to accomplish the task, but with little or no success
Communication of findings	Communicated their ideas and findings effectively, raised interesting and provocative questions, and went beyond what was expected	Communicated their findings effectively	Communicated their ideas and findings	Did not finish the research study and/or were not able to communicate ideas very well
Group Process	Used all their time productively Everyone was involved and contributed to the group process and product.	Worked well together most of the time They usually listened to each other and used each other's ideas.	Worked together some of the time Not everyone contributed equal efforts to the task.	Did not work very productively as a group Not everyone contributed to the group effort.

SUMMATIVE TEST

Answer Key

Part I

- | | | | |
|------|-------|-------|-------|
| 1. B | 6. A | 11. D | 16. B |
| 2. D | 7. B | 12. A | 17. A |
| 3. B | 8. B | 13. A | 18. D |
| 4. A | 9. A | 14. C | 19. C |
| 5. C | 10. A | 15. C | 20. D |

Part II

Performance task of the students may be assessed using the suggested rubrics.

Rubric in Assessing Students' Performance (Group Task)

Standards	4	3	2	1
Understanding of Task	Demonstrated substantial understanding of the content, processes, and demands of the task	Demonstrated understanding of the content and task, even though some supporting ideas or details may have been overlooked or misunderstood	Demonstrated gaps in their understanding of the content and task	Demonstrated little understanding of the content
Completion of Task	Fully achieved the purpose of the task, including thoughtful, insightful, interpretations and conjectures	Accomplished the task	Completed most of the task	Attempted to accomplish the task, but with little or no success
Communication of findings	Communicated their ideas and findings effectively, raised interesting and provocative questions, and went beyond what was expected.	Communicated their findings effectively	Communicated their ideas and findings	Did not finish the research study and/or were not able to communicate ideas very well

Standards	4	3	2	1
Group Process	Used all their time productively Everyone was involved and contributed to the group process and product.	Worked well together most of the time They usually listened to each other and used each other's ideas.	Worked together some of the time Not everyone contributed equal efforts to the task.	Did not work very productively as a group Not everyone contributed to the group effort.

References and Website Links Used in the Lesson

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Websites:

<http://www.slideshare.net/maggiev/the-interpretation-of-quartiles-and-percentiles-july-2009>

This site provides formula, examples, and exercises of Quartile, Percentile, and Decile.

<http://www.mathsisfun.com/data/quartiles.html>

This site provides examples of Quartile.

www.mathsisfun.com/data/percentiles.html

This site provides examples and exercises of Percentile.

www.harding.edu/sbreeze1/460%20files/statbook/chapter5.pdf

This site provides formula, examples, and exercises of Percentile and Percentile Ranks.

<http://www.onlinemathlearning.com/quartile.html>

This site provides problem for the crossquantile problem.

<https://www.google.com.ph>

The following sites provide pictures that made the module more attractive and interesting especially to students.

<http://books.google.com.ph/>

International Business Research By Neelankavil

This provides exercise for business in calculator drill.

<http://alstatr.blogspot.com/2013/06/quartiles-deciles-and-percentiles.html>

This provides exercise for business in calculator drill.

<http://answers.yahoo.com/question/index?qid=20100630123126AA7IZZa>

This provides exercise for business in calculator drill.

<http://www.icoachmath.com/problems/problemslink.aspx>

This site provides examples and exercises of quartile