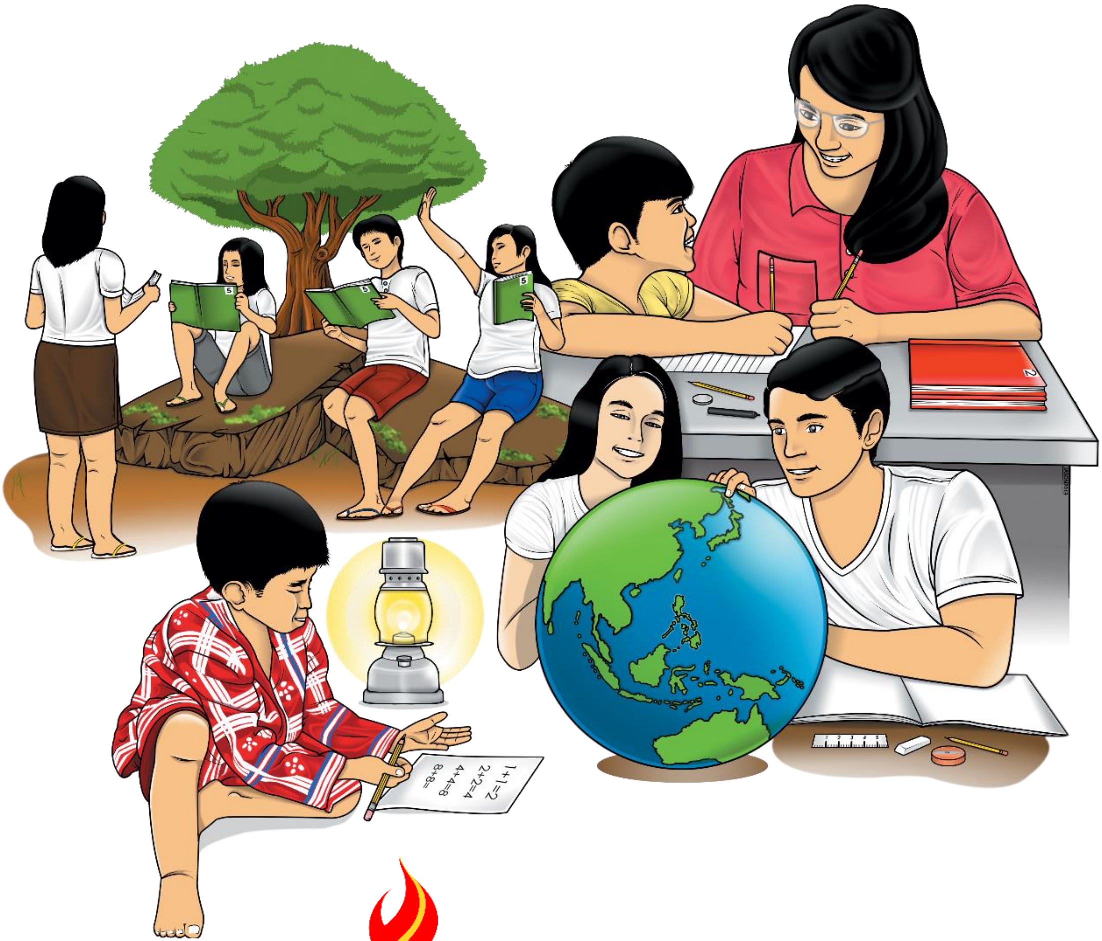
8

DEPARTMENT OF EDUCATION

Mathematics

Quarter 4 – Module 10:

Solving Problems Involving Probabilities of Simple Events



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Mathematics

Quarter 4 – Module 10:

Solving Problems Involving Probabilities of Simple Events

DEPARTMENT OF EDUCATION

Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.

What I Need to Know

This module was designed and written with you in mind to help you master the skills of solving problems involving probabilities of simple events. You are provided with varied activities to process the knowledge and skills learned and to deepen and transfer your understanding of the lesson. The scope of this module enables you to use it in many different learning situations. The lesson is arranged to follow the standard sequence of the course. But the order in which you read them can be changed to correspond with the textbook you are now using.

This module contains lesson on solving problems involving probabilities of simple events (M8GE-IVi-j-1).

After going through this module, you are expected to:

1. find solutions to problems involving probabilities of simple events; and
2. cite the importance of the process in finding solutions to problems involving probabilities of simple events to real-life setting.

What I Know

Pre-Assessment

Directions: Answer each of the following items. Write the letter of the correct answer on a separate sheet of paper.

1. If there are 16 possible outcomes in tossing a coin, then how many times is the coin tossed?
   A. 1 B. 2 C. 3 D. 4

2. You got coins from your pocket which accidentally fell on the floor. If there were 8 possible outcomes, how many coins fell on the floor?
   A. 3 B. 4 C. 8 D. 16

3. A student is selected at random to join the Provincial Scout Jamboree from a class of 40 students. How many girls are there in the class if the probability of a boy being selected is 52.5%?
   A. 19 B. 20 C. 21 D. 29

4. A bag contains 70 colored candies (orange, green, red, and white). There are 10 green candies and the probability of getting white candy from the bag is 3/14. How many white candies are there in the bag?
   A. 10 B. 15 C. 20 D. 25

5. Which of the following is TRUE?
   A. Flipping a coin thrice has 3 possible outcomes.
   B. The probability of an event that is sure to happen is 0.
   C. Answering a true/false-type question has one possible outcome.
   D. The probability of getting a head when a coin is tossed once can be expressed as 1/2, 0.5, or 50%.

For items 6 – 9, consider the situation "A container has green, yellow, and red caps of empty bottles of juice drinks and a cap is to be picked. There are 3 red caps and the probability of picking a red cap is 0.15".

6. How many percent of the caps in the container are red?
   A. 10 B. 15 C. 30 D. 150

7. How many caps are there in a container?
   A. 10 B. 15 C. 20 D. 25

8. If the probability of picking a yellow cap is 35%, how many yellow caps are there?
   A. 3 B. 4 C. 7 D. 10

9. If the probability of picking a green cap is 1/2, how many green caps are there?
   A. 3 B. 5 C. 10 D. 15

10. A jar contains 30 marbles (red, green, blue, and yellow marbles). The probability of drawing a green marble at random is 1/5. What does this mean?
   A. There are 6 green marbles in the jar.
   B. There are 15 green marbles in the jar.
   C. There is only one green marble in the jar.
   D. There are more green marbles than the others.

11. During your PE class, your teacher formed four teams to compete in a basketball game as a performance task. Team A has 25% chance of winning. Team B has the same chance as Team D which has 5% more than team A. Team C has half the chance of winning as team B. Which of the following has the correct table of probabilities for winning the tournament?

A.

TEAM	A	B	C	D
Probability of winning	25%	30%	30%	15%

B.

TEAM	A	B	C	D
Probability of winning	25%	20%	20%	25%

C.

TEAM	A	B	C	D
Probability of winning	25%	30%	15%	30%

D.

TEAM	A	B	C	D
Probability of winning	25%	15%	10%	50%

For items 12 and 13, consider the situation "There will be a random selection for Grade 8 representative, and you are one of the candidates. The probability that you will be selected is 20%".

12. How many candidates are in the selection?
   A. 5 B. 6 C. 7 D. 8

13. If the probability that a male will be selected is 60%, how many male candidates are in the selection for Grade 8 representative?
   A. 1 B. 2 C. 3 D. 4

14. Your class adviser will choose three (3) contestants to represent your section for "*dobleclara*" talent showcase for the upcoming Celebration of Valentine's Day. Each of you were asked to write your name on a sheet of paper and placed it in a container. There are 18 male students in the class and the probability that a male student chosen at random is 2/5. How many female students are there in your class?
   A. 18 B. 27 C. 36 D. 45

15. You have different colors of rubber bands in your pocket; blue, green, yellow and red. The probability of picking a green rubber band is 1/2. The probability of picking a blue one is 1/6. The probability that you will pick a yellow one is 1/5. There are 4 red rubber bands, how many rubber bands are there in your pocket?
   A. 120 B. 90 C. 60 D. 30

Lesson 1	Solving Problems Involving Probabilities of Simple Events

This lesson is designed for you to solve problems involving probabilities of simple events. The activities are provided for your better understanding.

What's In

Directions: Determine whether the probability used in each item is experimental or theoretical. Write your answer on a separate sheet of paper.

________ 1. You and your friend played a computer game 40 times and you won 20 times, then probability that you won in the game is $\frac{20}{40} = \frac{1}{2} = 0.5$.

________ 2. The probability of drawing a heart from a deck of 52 playing cards is $\frac{13}{52} = 0.25$.

________ 3. The probability of getting a sum of 8 when rolling a pair of dice is $\frac{5}{36}$.

________ 4. You toss a coin 500 times and gets 306 heads and 194 tails. The probability of obtaining a tail is $\frac{194}{500} = 0.388$.

________ 5. Your group surveyed 500 people in your barangay about their civil status. The results are 180 single and 320 married. The probability that a person chosen at random is single is $\frac{180}{500} = 0.36$.

________ 6. The probability of getting a tail when tossing a coin once is $\frac{1}{2}$.

________ 7. The probability of getting no tail when tossing two coins once is $\frac{1}{4}$.

________ 8. A die is rolled 300 times and the number "4" appeared 158 times. The probability of getting "4" is $\frac{158}{300} = \frac{79}{150}$.

________ 9. A card is drawn from a deck of 52 playing cards. The probability of getting a club is $\frac{1}{4}$.

________ 10. On November 23, AstraZeneca and the University of Oxford announced high-level results from an interim analysis of their COVID-19 vaccine, AZD1222. The analysis was from the trials in the UK and Brazil and demonstrated efficacy of up to 90%.

Questions:

1. Were you able to identify the items that illustrated experimental and the items that illustrated theoretical probability?
2. What were your bases in identifying situations that use experimental, and situations that use theoretical probability?

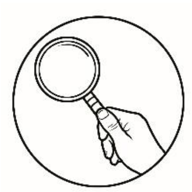
What's New

Directions: Read the problem below and answer the questions that follow.

A deck of standard playing cards has 52 cards: 4 suits (heart♥, club♣, diamond♦, and spade♠). Each suit has 9 numbers (2 to 10), an ace, a king, a queen, and a jack. Hearts and diamonds are red cards, clubs and spades are black cards.

a. How many are red cards?
b. What is the probability of drawing a red card?
c. How many cards are hearts?
d. What is the probability of drawing a heart card?

Questions:
1. Were you able to identify the possible outcomes for items a and c? How?
2. Were you able to solve the probabilities of the events in items b and d? How?
3. In items b and d, how many event/s is/are mentioned in each item?
4. If you were asked to identify the number of favorable outcomes and/or the number of total possible outcomes given the probability of simple event, how would you do it?



What is It

In real life, several circumstances may happen. Fortunately, we have a mathematical concept that deals with the possibility of the occurrence of a particular happening or event, and this is known as **probability**. In the study of probability, activities such as tossing of coins, rolling of dice, drawing a card, or doing any activity that has several possible results like predicting the weather are all called **experiments**. The individual results of these experiments are called **outcomes**, like 6 turning up in a single roll of a die. The collection of all the possible outcomes is called the **sample space**, denoted by S. Any subset of the sample space is called **event,** including the empty set. An example of event in rolling of a die is rolling an even number. The event for even numbers on a single roll of a die refers to {2, 4, 6}. An event that has one possible outcome is called **simple event.**

In the previous module, it was shown that the probability of simple event can be computed using the formula.

$$P(E) = \frac{n(E)}{n(S)}$$

where;

$P(E)$ is the probability of the simple event.

$n(E)$ is the number of favorable outcomes for the event E.

$n(S)$ is the number of total possible outcomes of the experiment.

The $P(E)$ or probability of an event can be expressed in *fraction, in decimal, or in percent.* Example, in tossing a coin once, the probability of getting a head can be expressed in fraction as 1/2, in decimal as 0.5 or in percent as 50%.

We can solve the probabilities of simple events by identifying the number of favorable outcomes divided by the total number of possible outcomes. However, if the problem is asking for the favorable outcomes or number of total possible outcomes given a certain probability of simple event, we need to manipulate the formula so that the unknown will become the dependent variable.

Consider the process done below. If the unknown is the ***number of favorable outcomes n(E)*** of the event, then from the probability formula for the simple event;

$$P(E) = \frac{n(E)}{n(S)}$$

Multiply both sides with the number of total possible outcomes $n(S)$.

$$\boldsymbol{n(S)} \cdot P(E) = \frac{n(E)}{\cancel{n(S)}} \cdot \cancelto{1}{\boldsymbol{n(S)}}$$

Therefore,

$$n(S) \cdot P(E) = n(E)$$

or

$$n(E) = P(E) \cdot n(S)$$

Finding the number of favorable outcomes is just the product of the probability of simple event and the number of total possible outcomes.

However, there are cases wherein the unknown is the ***total number of possible outcomes n(S).*** To find it, just simply derive it from the formula for finding the probability of simple event:

$$P(E) = \frac{n(E)}{n(S)}$$

Multiply both sides with the total number of possible outcomes $n(S)$.

$$\boldsymbol{n(S)} \cdot P(E) = \frac{n(E)}{n(S)} \cdot \boldsymbol{n(S)}$$

$$n(S) \cdot P(E) = n(E)$$

Multiply both sides by the reciprocal of $P(E)$, probability of simple event

$$\frac{1}{\cancel{P(E)}} \cdot n(S) \cdot \cancel{P(E)} = n(E) \cdot \frac{1}{P(E)}$$

Therefore,

$$n(S) = \frac{n(E)}{P(E)}$$

Finding the total number of possible outcomes of a experiment is just the quotient of the number of favorable outcomes and the probability of simple event.

Let us now solve problems involving probabilities of simple events.

Illustrative Examples

1. A student will be randomly chosen from 35 students in class to join the "Fire Prevention-Jingle Writing Contest" to represent his/her grade level. The probability that a boy will be chosen from the class is 0.4. How many girls are in a class?

Given: **a)** $\boldsymbol{P(E_1) = P(boy) = 0.4}$

where $P(\boldsymbol{E_1})$ is the probability the a boy will be chosen from the class. It can be expressed as $P(boy)$.

b) $\boldsymbol{n(S) = 35\ students}$

$\boldsymbol{n(S)}$ is the total number of possible outcomes and in this problem, it is the number of students in the class.

Let $\boldsymbol{E_1}$ be the event for the boys and $\boldsymbol{E_2}$ be the event for the girls.

Find: $\boldsymbol{n(E_2) = n(girls)} =$ _____
It is the number of girls in a class.

Solution:

To solve the problem, use the formula, $n(\boldsymbol{E_2}) = P(\boldsymbol{E_2}) \cdot n(S)$
Since the given probability is for a boy to be chosen, let us find the first how many boys are there in a class using the formula $n(\boldsymbol{E_1}) = P(\boldsymbol{E_1}) \cdot n(S)$.

By substitution,

$$n(boys) = P(boys) \cdot n(S)$$
$$n(boys) = (0.4)(35)$$
$$n(boys) = 14$$

There are 14 boys in a group of 35 students. To find the number of girls, subtract the number of boys from the total number of students.

$$\boldsymbol{n(E_2)} = n(girls) = n(S) - n(boys)$$
$$\boldsymbol{n(E_2)} = n(girls) = 35 - 14$$
$$\boldsymbol{n(E_2)} = n(girls) = 21$$

Therefore, there are 21 girls in the class.

2. A box contains two dozens of ball pen. Some are colored red, and the other pens are black. The probability of getting a black pen is $\frac{3}{4}$.
    a. How many black ball pens are there in the box?
    b. If a pen is randomly chosen from the box, what is the probability of getting a red pen?

Given:

$$\boldsymbol{P(black\ pen)} = \frac{3}{4}$$
$$\boldsymbol{n(S)} = (\boldsymbol{two\ dozen\ ball\ pens})\mathbf{=24}$$

Find:

a. $\boldsymbol{n(black\ pen)} =$ _____

b. $\boldsymbol{n(red\ pen)} =$ _____

$\boldsymbol{P(E)} = \boldsymbol{P(red\ pen)} =$ _____

The number of the (a) black pens and (b) red pens; probability of getting a red pen.

Solution:

a. Let us first find the number of black pens. By substitution,

$$n(E) = P(E).n(S)$$
$$n(black\ pens) = P(black\ pen).n(S)$$
$$n(black\ pens) = \left(\frac{3}{4}\right)(24)$$
$$n(black\ pens) = 18$$

Therefore, there are 18 black pens.

b. To complete the data, if $n(black\ pens) = 18$, then the number of red pens must be;

$$n(black\ pens) + n(red\ pens) = n(S)$$
$$18 + n(red\ pens) = 24$$
$$n(red\ pens) = 24 - 18$$
$$n(red\ pens) = 6$$

Therefore, there are 6 red pens, hence the probability of getting a red pen is,

$$P(red\ pen) = \frac{6}{24} = \frac{1}{4}\ or\ 0.25\ or\ 25\%$$

Another way of solving $P(red\ pen)$ is,

$$P(black\ pen) + P(red\ pen) = 1$$
$$\frac{3}{4} + P(red\ pen) = 1$$

$$P(red\ pen) = 1 - \frac{3}{4}$$
$$P(red\ pen) = \frac{4-3}{4}$$
$$P(red\ pen) = \frac{1}{4}$$

3. A Math teacher divided a spinner into congruent sectors according to the number of students in the class. Each sector is labeled with the name of a student. The sectors are painted with red, yellow, blue, and white. If there are 10 red sectors, the probability that it will spin at red is 40%. How many congruent sectors does the spinner have?

Given:

$$\boldsymbol{P(E) = P(red) = 40\%\ or\ 0.4}$$
$$\boldsymbol{n(E) = n(red) = 10}$$

Find:

$$n(S) = \underline{\quad\quad}$$

It is the total number of possible outcomes or the total number of congruent sectors of the spinner.

Solution:

The formula in finding the number of total possible outcomes is,

$$n(S) = \frac{n(E)}{P(E)}$$

$$n(S) = \frac{n(red\ sectors)}{P(red\ sector)}$$

By substitution,

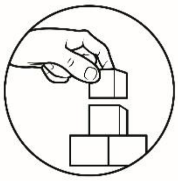
$$n(S) = \frac{10}{0.4}$$
$$n(S) = 25$$

Therefore, the spinner has 25 congruent sectors.

Things to remember:

In probability, we have to remember the following:

- ✓ The probability of an event is a number from 0 to 1.
- ✓ The sum of the probabilities of all the outcomes of an experiment is 1.
- ✓ The probability of a certain event is 1.
- ✓ The probability of an impossible event is 0.



What's More

Directions: Read each situation carefully and answer the questions that follow. Write your answer and the solution on a separate sheet of paper.

Problem 1:

There are red, blue, and black ball pens in a jar. There are 6 red ball pens. The probability of getting a red ball pen is 22.22% while the probability of getting a black ball pen is 40.74%.

a. How many ball pens are there in the jar?
b. How many are black pens in the jar?
c. How many are blue pens in the jar?

Problem 2:

There are blue, red, and green marbles in a jar. There are 7 blue marbles in the jar. The probability of getting a blue marble is $\frac{1}{6}$ and the probability of green is $\frac{5}{21}$.

a. How many marbles are there in the jar?
b. How many green marbles are there in the jar?
c. How many red marbles are there in the jar?

Problem 3:

There are cards in a box. Fifteen of these cards are red, the others are blue, and the rests are white cards. If the probability of drawing a blue card is 0.125 and the probability of drawing a white card is twice the probability of getting a blue card, how many cards are there in the box?

a. What is the probability of the red cards?
b. How many cards are there in the box?
c. How many white cards are in the box?
d. How many blue cards are in the box?

What I Have Learned

Directions: Fill in the blank with the correct value or word/s which you can choose from the box below.

I learned that probability of a simple event can be expressed in ________, ________, or ________. For example, in rolling a die once, the probability of getting an even number is ________ (fraction), ________ (decimal), or ________ (percent).

I learned that Probability of a simple event is the ratio of the ________of event E and the________.

In finding the number of favorable outcomes $n(E)$, you just have to find the ________ of the probability of the event and the ________. In finding the total number of possible outcomes $n(S)$, you just have to find the ________ of number of favorable outcomes of event E and the probability of the event $P(E)$.

Decimal	quotient	percentage	Product
number of favorable outcomes	probability of an event	total number of possible outcomes	50%
0.5	fraction	½	sum

What I Can Do

Directions: Read and answer the problem carefully. Explain your answer.

In your town fiesta celebration, the LGU initiates an inter-barangay basketball league. During the championship game between Barangay 1 and 2, the scores are 65 and 67 respectively with a remaining time of 5 seconds in the 4^{th} quarter and both teams are in penalty situation. The last ball position is for Barangay 1 and the coach calls for a time out to plan for their last offensive position. If you were the team coach of Barangay 1, who will you let to shoot the ball if you only have two shooters, James having 93% 3-point field goal percentage, and has only 40% free throw percentage or Mike having 89% 3-point field goal percentage and has an 80% free throw percentage? Why?

Rubric for Scoring:

10	8	6	4	2
Able to choose the player and justify the choice based on the given data.	Able to choose the player but the justification of the choice using the data is not so clear.	Able to choose the player but the justification is not clear or irrelevant.	Able to choose the player but no justification of the choice.	No choice was made.

Assessment

Post-Assessment

Directions: Answer each of the following items accurately. Write the letter of the correct answer on a separate sheet of paper.

1. In a container, there are 20 colored marbles (blue, red, green, and black). If the probability of drawing a red marble is 45%, then which of the following is false?
   A. The $P(red\ marble) = 9/20$.
   B. There are 9 red marbles.
   C. There is 0.45 probability of drawing a red marble.
   D. There is a higher probability for red than the other marbles.

For items 2 and 3, consider the situation "A glass jar contains white, blue, brown, red, and yellow coated candies. There are 15 white coated candies and the $P(white) = 3/10$, $P(blue) = 6/25$, $P(brown) = 9/50$, $P(red) = 3/25$ and $P(yellow) = 4/25$."

2. How many yellow candies are in the bottle?
   A. 6 B. 8 C. 9 D. 12

3. How many blue coated candies are in the bottle?
   A. 8 B. 9 C. 12 D. 15

For items 4 and 5, consider the situation "Rolling two dice once has 36 possible outcomes. The probability that the sum of the two results is a composite number is 7/12."

4. How many outcomes have the sum of a composite number?
   A. 7 B. 14 C. 21 D. 28

5. How many outcomes have the sum of a prime number?
   A. 5 B. 10 C. 15 D. 20

For items 6 to 11, consider the situation "There are 216 total number of possible outcomes in rolling a certain number of dice once."

6. How many dice are rolled?
   A. 1 B. 2 C. 3 D. 4

7. If the number outcomes have a sum of 5 with a probability of 1/36, how many outcomes have the sum of 5?
   A. 1 B. 3 C. 6 D. 10

8. If the number outcomes have a sum of at most 5 with a probability of 5/108, how many outcomes have the sum of at most 5?
   A. 1 B. 3 C. 6 D. 10

9. If the number outcomes have a sum of less than 17 with a probability of 53/54, how many outcomes have the sum of less than 17?
   A. 53 B. 106 C. 159 D. 212

10. The number results on the dice are used to form a number. If the probability of the numbers formed whose two last digits are prime numbers is 25%, how many numbers have two last digits that are prime?
   A. 54 B. 108 C. 162 D. 216

11. If the probability of the number outcomes whose sum is greater than 18 is 0, what does this mean?

   I. There is no outcome whose sum of the number outcomes is greater than 0.
   II. The event of obtaining a sum of the number outcomes greater than 18 is impossible.
   III. The event of obtaining a sum of the number outcomes greater than 18 is certain.

   A. I only B. II only C. III only D. I and II

For items 12 to 14, consider the situation "According to World Health Organization, the total number of cases of coronavirus disease (COVID-19) from January 18 to July 7, 2020 is 47,873. The probability that a chosen patient in this pool is a female is 44% *(the result in percentage is an estimation).*"

12. How many are female covid patients during the said period?
   A. 21,064 B. 21,406 C. 21,604 D. 21,640

13. How many are male covid patients during the said period?
   A. 26,089 B. 26,809 C. 26,890 D. 26,908

14. What is the probability that the chosen patient from the pool is a male?
   A. 46% B. 54% C. 56% D. 64%

15. You choose a number at random from 2 to 7. What can you conclude on the probability of each event?
   I. The event even and odd are not equally likely to occur because there are three odd numbers and only two even numbers from 2 to 7.
   II. The probability of choosing an even number is equal to the probability of choosing an odd number.
   III. The even and odd numbers are equally likely to occur because their numbers are equal.
   IV. The even and odd numbers are equally likely to occur because the probability of choosing even numbers is always equal to the probability of choosing odd numbers in any case.

   A. I and II B. III and IV C. I, II and III D. II and III

Additional Activities

Activity

I. Name five situations at home, in school or in your community that involve solving problems on probability of simple events. Explain each situation clearly.

Rubric:

10	8	6	4	2
Able to identify 5 situations and explain clearly and correctly the application of probabilities of simple event.	Able to identify at least 4 situations and explain clearly and correctly at least 3 of those application on probabilities of simple event.	Able to identify at least 3 situations and explain clearly and correctly at least 2 of those application on probabilities of simple event.	Able to identify at least 2 situations and explain clearly and correctly at least 1 of those application on probabilities of simple event.	Able to identify at least 1 situation and explain clearly and correctly at least 1 of those application on probabilities of simple event.

Answer Key

What I Know

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

What's In

1. Experimental
2. Theoretical
3. Theoretical
4. Experimental
5. Experimental
6. Theoretical
7. Theoretical
8. Experimental
9. Theoretical
10. Experimental

What's New

a. 26
b. $\frac{26}{52} = \frac{1}{2}$
c. 13
d. $\frac{13}{52} = 1/4$

What's More: Problem 1

a. 27
b. 11
c. 10

What's More: Problem 2

a. 42
b. 10
c. 25

What's More: Problem 3

a. 0.625
b. 24
c. 6
d. 3

What I Have Learned

I learned that probability of a simple event can be expressed in fraction, decimal, or percentage. For example, rolling a die and the probability of getting an even number is 1/2 (fraction), 0.5(decimal) or 50% (percentage).

I learned that Probability of a simple event is the ratio of the number of favorable outcomes and the number of total possible outcomes.

In finding the number of favorable outcomes $n(E)$, you just have to find the product of the probability of the event and the total number of possible outcomes. In finding the total number of possible outcomes, you just have to find the quotient of number of favorable outcomes of event E and the probability of the event.

What I Can Do

(*Student's answer varies.)*

Assessment

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

Additional Activities

I.

(*Student's answer varies.)*

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Website links

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