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DEPARTMENT OF EDUCATION

Mathematics

Quarter 3 – Module 29

Introduction to Probability of Compound Events

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Mathematics

Quarter 3 – Module 29

Introduction to Probability of Compound Events

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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.

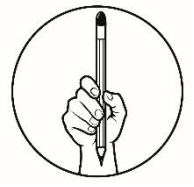
What I Need to Know

This module was designed and written with you in mind. It is here to help you understand the concept of combination.

The scope of this module permits it to be used in many different learning situations. The lessons are arranged to follow the standard sequence of the course but the pacing in which you read and comprehend the contents and answer the exercises in this module will depend on your ability.

After going through this module, you are expected to demonstrate understanding of key concepts on combination. Specifically, you should be able to:

1) recall the concepts related to sets and probability of simple events,
2) differentiate probability of simple events from compound events,
3) find the probability of the union and the intersection of events,
4) solve problems involving probability of compound events.



What I Know

Let us determine how much you already know about probability of compound events.

DIRECTION: Read and answer each item carefully. Write only the letter of the correct answer on your answer sheet.

1) If $A = \{2, 4, 6, 8, 10, 12, 14, 16\}$ and $B = \{3, 6, 9, 12, 15\}$, find $n(A \cap B)$.

   A) 0 B) 2 C) 8 D) 11

2) Which of the following is NOT a true statement?

   A) If the probability of an event is closer to 0, then the event is more likely to happen.
   B) The probability that an event will happen is from 0 to 1.
   C) The probability of an impossible event is 0.
   D) The probability of a certain event is 1.

3) Which of the following is a compound event?

   A) Getting at least two heads when tossing a coin thrice.
   B) Choosing a female student from a class.
   C) Three turning up in rolling die once.
   D) Picking a dress in the closet.

4) How many possible outcomes are there in tossing three coins once?

A) 3 B) 6 C) 8 D) 12

5) There are 12 apples and 14 oranges in a basket. If a fruit is picked at random from the basket, what is the probability of picking an orange?

A) $\frac{7}{13}$ B) $\frac{6}{13}$ C) $\frac{7}{12}$ D) $\frac{6}{12}$

6) What is the probability that the two children of a couple are both females?

A) $\frac{1}{2}$ B) $\frac{2}{3}$ C) $\frac{1}{5}$ D) $\frac{1}{4}$

For items #7 & 8. In an experiment of tossing a six – sided die once, let *A* be the event of getting a factor of 6 and *B* be the event of getting an odd number.

7) What is $A \cup B$?

A) {1, 2, 3, 6} B) {1, 2, 3, 5, 6} C) {1, 3, 5} D) {1, 3}

8) What is the cardinality of $A \cap B$?

A) 0 B) 1 C) 2 D) 3

9) A box contains 7 black marbles, 8 white marbles, and 5 yellow marbles. If a marble is drawn at random, what is the probability of getting a black or a yellow marble?

A) $\frac{3}{5}$ B) $\frac{1}{4}$ C) $\frac{2}{5}$ D) $\frac{13}{20}$

10) A letter is randomly chosen from the word "MATHEMATICS". Find the probability that a letter A or T is selected.

A) $\frac{2}{11}$ B) $\frac{4}{11}$ C) $\frac{6}{11}$ D) $\frac{7}{11}$

11) A die is rolled once. What is the probability that the result is an even number and a factor of 2?

A) $\frac{1}{4}$ B) $\frac{2}{3}$ C) $\frac{1}{2}$ D) $\frac{1}{6}$

12) Two fair dice, each with faces numbered 1 to 6 are rolled once. What is the probability of getting a sum that is greater than 5 and less than 10?

A) $\frac{13}{18}$ B) $\frac{5}{6}$ C) $\frac{5}{9}$ D)1

For items #13 & 14. From a survey of habits, 48% of students interviewed said that they surf the internet, 36% read pocketbooks, and 28% surf the internet and read pocketbooks. If a student is chosen from those interviewed, find the probability that this student

13) surf the internet or read pocketbooks.

A) 72% B) 56% C) 44% D) 16%

14) does NOT surf the internet nor read pocketbooks.

A) 72% B) 56% C) 44% D) 16%

15) In a graduating class of 100 students, 54 will study mathematics, 60 will study physics, and 35 will study both mathematics and physics. If one of these students is selected at random, find the probability that the student will study physics but NOT mathematics.

A) $\frac{7}{20}$ B) $\frac{3}{5}$ C) $\frac{21}{100}$ D) $\frac{1}{4}$

Lesson 1

Introduction to Probability of Compound Events

What's In

When you were in grade 7 and grade 8, you learned the different mathematics concepts related to sets, Venn diagram and probability of simple events. These knowledge and skills are very important in understanding the probability of compound events. Hence, let us review the following concepts and do the activity that follows.

A) **Set** is any well-defined collection of objects. The objects comprising the set are called **elements**. The notation $a \in A$ is used to denote that a is an element of set A.

1) The number of distinct elements in a set is called the **cardinality** of the set. The symbol *n(A)* represents the number of elements of set *A*. It is read as the "number of *A*" or the "cardinality of set A".

2) If A and B are any two sets, the **intersection** of A and B, denoted by $A \cap B$, is the set consisting of all elements that belong to both A and B. In symbol,

$$A \cap B = \{ x \mid x \in A \text{ and } x \in B \}$$

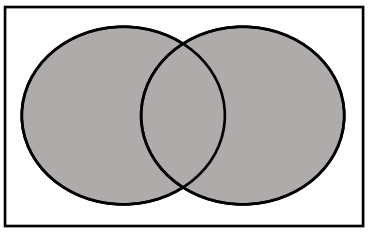
This notation is read as "*A* intersection *B* is the set of *x* such that *x* is an element of *A* and *x* is an element of *B*".

3) The **union** of two sets A and B, denoted by $A \cup B$, is the set of all elements that belong to A or to B. Symbolically,

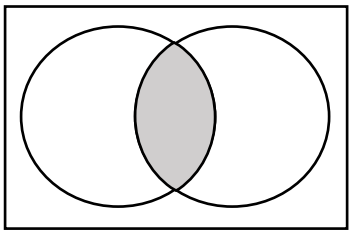
$$A \cup B = \{ x \mid x \in A \text{ or } x \in B \}$$

This notation is read as "*A* union *B* is the set of *x* such that *x* is an element of *A* or *x* is an element of *B*".

4) The relationship among sets can be represented using a **Venn diagram**.
Examples:



$A \cup B$



$A \cap B$

Illustrative Example 1. If R is the set of colors in a rainbow and F is the set of colors in the Philippine flag, a) name the elements of each set and b) their cardinality. Find the c) union and d) intersection of these two sets.

a) Elements
R = {red, orange, yellow, green, blue, indigo, violet}
F = {blue, red, white, yellow}
b) Cardinality
$n(R) = 7$
$n(F) = 4$
c) Union
$R \cup F$ = { red, orange, yellow, green, blue, indigo, violet, white}
d) Intersection
$R \cap F$ = { red, yellow, blue}

B) **Probability** is a measure or estimation of how likely that an event will occur or happen.

1) The probability of simple event is finding the probability of a single event occurring.

2) In an experiment with outcomes that are equally likely to happen, the probability of an event, E, is a ratio that compares the number of favorable outcomes to the number of possible outcomes. In symbols,

$$P(E) = \frac{number\ of\ favorable\ outcomes}{number\ of\ possible\ outcomes}$$

3) The notation $P(E)$ is read as "the probability of an event E" or simply the probability of E".

Illustrative Example 2: A bag has 3 red, 4 yellow, 6 blue and 7 white marbles. If a marble is picked at random, what is the probability that the picked marble is blue?

Solution:
Total number of marbles in the bag = 20 → possible outcomes

Number of blue marbles in the bag = 6 → favorable outcomes

$$P(E) = \frac{number\ of\ favorable\ outcomes}{number\ of\ possible\ outcomes}$$

$$P(\text{blue}) = \frac{6}{20} = \frac{3}{10}$$

C) **Other terms associated with probability:**

1) **Experiments** are activities which have well – defined results.

2) **Outcomes** are possible results of an experiment.

3) **Sample Space** is the set of all possible outcomes of an experiment.

4) **Event** is a subset of the sample space.

***Illustrative Example 3*:**

Experiment: Tossing a coin twice.
Outcomes: Getting two heads (HH), getting a head on the first toss and tail on the second toss (HT), getting tail on the first toss and head on the second toss (TH) and getting two tails (TT).
Sample Space: {HT, HH, TH, TT}
Event: Getting at least one head, getting at most one tail, etc

Now, your turn!

Activity 1. Answer what is asked.

1) Name the elements of the following sets:

a) *A* is the set of Southeast Asia nations.
_____

b) *B* is the set of months of the year with exactly 30 days.
_____

c) *C* is the set of positive odd integers less than 10.
_____

2) Find the cardinality of the following sets:

d) *D* = {positive multiples of 3 less than 30} _____

e) *E* = {positive even prime number} _____

f) *F* = {distinct letters in the word PHILIPPINES} _____

3) If $G = \{x/x\ is\ a$ multiple of 3 between 10 and 28$\}$ and
$H = \{y/y\ is\ a$ multiple of 6 between 5 and 40$\}$

g) $G \cup H$ _____

h) $G \cap H$ _____

4) Linda has 6 roses, 5 anthuriums, 9 daisies, and 10 dahlias in her flower vase. If she picks one flower at random, what is the probability that she will pick a

i) rose? _____

j) daisy? _____

5) Grade 10 - Prestige has 18 male and 24 female students. Suppose that the officers are chosen at random, what is the probability of choosing a

k) female as the president of this class? _____

l) male as the vice-president of this class? _____

Let's have more!

Activity 2. Identify the outcomes, sample space and event of each experiment.

1) Experiment: Rolling a six sided – die once.

Outcomes: _____

Sample Space: _____

Event: _____

2) Experiment: Two leaders are selected from five students *A, B, C D* and *E* to lead a tree planting activity.

Outcomes: _____

Sample Space: _____

Event: _____

What's New

The probability of simple event involves a single event occurring and the **probability of compound events** involves more than one event happening together. Compound events are usually connected by the word "and" or "or".

Illustrative Example 4.

a) *Simple probability*: The probability of getting a head when tossing a coin once.
b) *Compound probability*: The probability of getting a head and an even number when tossing a coin once and rolling a die once.

Let us see if you understand simple event and compound events. Do the activity below.

Activity 3.

Directions: Write **S** if the required probability is simple and write **C** if compound in each of the following items.

_____1) The probability of getting a 4 in rolling a standard die once.

_____2) The probability of choosing a male student for SSG president.

_____3) The probability of getting an even number or a multiple of 3 on a die in rolling a standard die once.

_____4) The probability of drawing a spade from a standard deck of cards.

_____5) The probability of choosing a male and a Grade10 student for SSG President.

_____6) The probability of drawing a heart and a red card from a standard deck of cards.

Always remember the following concept of probability.

If an event E has $n(E)$ equally likely outcomes and S has $n(S)$ equally likely outcomes, the **probability of event *E*,** is

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

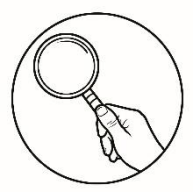
$n(E)$ → cardinality of event E (favorable outcomes)

$n(S)$ → cardinality of the sample space (all possible outcomes)

Because the number of favorable outcomes in an event must be less than or equal to the number of outcomes in the sample space, the probability of any event *E*, must be a number from 0 to 1. That is,

$$0 \leq P(E) \leq 1.$$

Hence, the probability of an impossible event is 0 and the probability of a certain event is 1.



What is It

Solving the probability of compound events can be illustrated using the concepts of union and intersection of events and the Venn diagram.

- The **union** of events *A* and *B,* denoted by $\boldsymbol{A \cup B}$, is the set of all outcomes in either *A* **or** *B*.
- The **intersection** of events *A* and *B,* denoted by $\boldsymbol{A \cap B}$, is the set of all outcomes shared by *A* **and** *B.*

Let's have examples:

Illustrative Example 5. In an experiment of rolling a standard die once and tossing a coin once, let *E* denote the event that an even number turns up and let *T* denote the event that a tail turns up, respectively. Find the a) union and b) intersection of these events.

sample space, $S = \{1H, 2H, 3H, 4H, 5H, 6H, 1T, 2T, 3T, 4T, 5T, 6T\}$

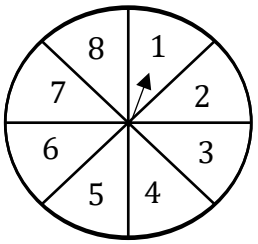
$E = \{2H, 4H, 6H, 2T, 4T, 6T\}$
$T = \{1T, 2T, 3T, 4T, 5T, 6T\}$

$E \cup T = \{2H, 4H, 6H, 1T, 2T, 3T, 4T, 5T, 6T\}$
$E \cap T = \{2T, 4T, 6T\}$

Activity 4. Identify the sample space *S*, the elements of *M*, *N*, *M* ∪ *N* and *M* ∩ *N*.

1) A family of three children is selected at random from a set of families with three children each. Let *M* denote the family that exactly one child is a boy and *N* denote the family that exactly two children have the same gender.
   a) *S* = _____
   b) *M* = _____
   c) *N* = _____
   d) *M* ∪ *N* = _____
   e) *M* ∩ *N* = _____

2) In an experiment of turning a spinner as shown at the right, let *M* denote the event that the arrow will stop on an odd number and *N* denote the event that the arrow will stop on numbers less than 6.



   a) *S* = _____
   b) *M* = _____
   c) *N* = _____
   d) *M* ∪ *N* = _____
   e) *M* ∩ *N* = _____

This time, let's have examples on solving probability of compound events.

Example 1. A six-face die which contains numbers of dots from 1 to 6 is rolled once. Find the probability of getting an:
   a) even number or a multiple of 3.
   b) even number and a multiple of 3.

Solution:

The experiment is rolling a die once, whose sample space, *S*, is

S = {1, 2, 3, 4, 5, 6}

n(*S*) = 6 → cardi*nality of the sample space*

The elements of the two events are:

A = {2, 4, 6} *Let A be the event of getting an even number.*

B = {3, 6} *Let B be the event of getting a multiple of 3.*

a) Solve for *P(A* ∪ *B)* since problem *a* illustrates union of two events.

A ∪ *B* = {2, 3, 4, 6} *union of A and B*

n (A ∪ *B)* = 4 *number of favorable outcomes n(E)*

$P(A \cup B) = \frac{n(A \cup B)}{n(S)}$ *In* $P(E) = \frac{n(E)}{n(S)}$, *let n(E) = n(A*∪*B)*

$P(A \cup B) = \frac{4}{6} = \frac{2}{3}$ *Substitute n(A*∪*B) by 4 and n(S) by* 6

∴The probability of getting an even number or a multiple of 3 is $\frac{2}{3}$.

b) Solve for $P(A \cap B)$ since problem *b* illustrates intersection of two events.

$A \cap B = \{6\}$ *intersection of A and B*

$n(A \cap B) = 1$ *number of favorable outcomes n(E)*

$P(A \cap B) = \frac{n(A \cap B)}{n(S)}$ *In* $P(E) = \frac{n(E)}{n(S)}$, *let* $n(E) = n(A \cap B)$

$P(A \cap B) = \frac{1}{6}$ *Substitute* $n(A \cap B)$ *by 1 and* $n(S)$ *by* 6

∴The probability of getting a result that is both an even number and a multiple of 3 is $\frac{1}{6}$.

Example 2.

Two fair dice are rolled once. Find the probability that both dice turn up

a) the same number or that the sum of the numbers is less than 7.
b) the same number and that the sum of the numbers is less than 7.

Solution:

The experiment is rolling two dice once, whose sample space, *S*, is

$S = \{(1,1), (1,2),..., (3,1), (3,2),..., (6,4), (6,5), (6,6)\}$

$n(S) = 36$

Let the two events that are involved be:

C = the event that both dice turn up the same number.
D = the event that the sum of the numbers is less than 7.

The elements of the two events are

$C = \{(1,1), (2,2), (3,3), (4,4), (5,5), (6,6)\}$

$D = \{(1,1), (1,2), (1,3), (1,4), (1,5), (2,1), (2,2), (2,3), (2,4), (3,1), (3,2), (3,3), (4,1), (4,2), (5,1)\}$

a) Solve for $P(C \cup D)$ since problem *a* illustrates union of two events.

$C \cup D = \{(1,1), (1,2), (1,3), (1,4), (1,5), (2,1), (2,2), (2,3), (2,4), (3,1), (3,2), (3,3), (4,1), (4,2), (4,4), (5,1), (5,5), (6,6)\}$

$n(C \cup D) = 18$

$P(C \cup D) = \frac{n(C \cup D)}{n(S)} = \frac{18}{36} = \frac{1}{2}$

∴The probability of both dice turn up the same number or that the sum of the numbers is less than 7 is $\frac{1}{2}$.

b) Solve for $P(C \cap D)$ since problem *b* illustrates intersection of two events.

$C \cap D = \{(1,1), (2,2), (3,3)\}$

$n\ (C \cap D) = 3$

$$P(C \cap D) = \frac{n(C \cap D)}{n(S)} = \frac{3}{36} = \frac{1}{12}$$

∴The probability of both dice turn up the same number and that the sum of the numbers is less than 7 is $\frac{1}{12}$.

Example 3. Three coins are tossed. Find the probability of getting at least one head.

Solution:

The experiment is tossing three coins, whose sample space, *S*, is

$S = \{HHH,HHT, HTH, HTT, TTT, TTH, THT, THH\}$

$n(S) = 8$

The event is to get at least one head, which has three possible cases- either the favorable outcomes should have 1 head or 2 heads or 3 heads.

$A = \{HTT, TTH, THT\}$ *Let A be the event that one head turns up*
$B = \{HHT, HTH, THH\}$ *Let B be the event that two heads turn up*
$C = \{HHH\}$ *Let* C be the event that three heads turn up

$A \cup B \cup C = \{HTT, TTH, THT, HHT, HTH, THH, HHH\}$

$n(A \cup B \cup C) = 7$

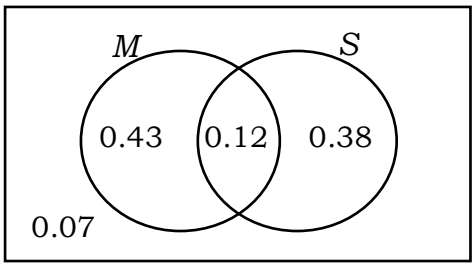
Hence,

$P(\text{at least one head}) = P(A \cup B \cup C)$

$$P(A \cup B \cup C) = \frac{n(A \cup B \cup C)}{n(S)} = \frac{7}{8}$$

∴ The probability of getting at least one head in tossing 3 coins is $\frac{7}{8}$.

Example 4. The Venn Diagram at the right shows the probabilities of Grade 10 students who joined either Mathematics Club (M) or Science Club (S).



a) Find the probability of selecting a student who joined Mathematics Club or Science Club.
b) Find the probability of selecting a student who joined Mathematics and Science Club.

Solution: The diagram represents the total sample space of the two events M and S because the sum of all the values in the diagram is

$$0.43 + 0.12 + 0.38 + 0.07 = 1.$$

a) One way to solve the probability of $M \cup S$ is to add all the probabilities found within the two circles in the diagram. Thus,

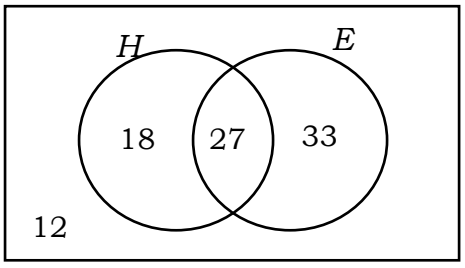
$$P(M \cup S) = 0.43 + 0.12 + 0.38 = 0.93$$

b) The probability of $M \cap S$ is the value in the overlapping region 0.12.

Example 5.A poll conducted by the school canteen showed that 45 students liked hamburger (H), 60 students liked egg sandwich (E), 27 liked both hamburger and egg sandwich and, 12 liked neither snacks. What is the probability of selecting a student who likes hamburger or egg sandwich?

Solution:

Illustrate the problem using Venn diagram so that we can visualize the probabilities easier.



- Because 27 is the number of students who liked both hamburger and egg sandwich, we place 27 in the intersection of the two sets.
- There are 45 students who liked hamburger but 27 were already placed inside circle H. Hence, there are 45 – 27 = 18 students who liked hamburger only.
- There are 60 students who liked egg sandwich but 27 were already placed inside circle E. Hence, there are 60 – 27 = 33 students who liked egg sandwich only.

- 12 students neither liked hamburger nor egg sandwich so it will be placed outside the two circles.
- Thus the number of elements in the sample space, S, is

$$18 + 27 + 33 + 12 = 90.$$

- To solve for the probability of selecting a student who liked hamburger or egg sandwich is to solve for $P(H \cup E)$.

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

$$P(H \cup E) = \frac{18 + 27 + 33}{90}$$

$$P(H \cup E) = \frac{78}{90} = \frac{13}{15}$$

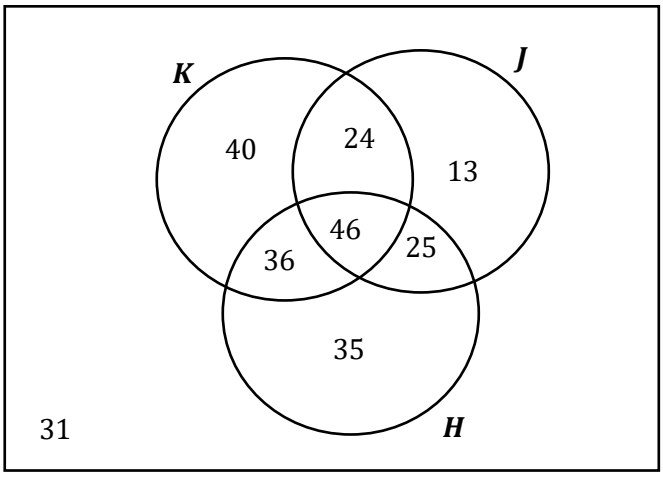
∴The probability of selecting a student who like hamburger or egg sandwich is $\frac{13}{15}$.

Example 6.

Out of 250 tourists, 146 visited Korea (K), 108 visited Japan (J), 142 visited Hong Kong (H), 70 visited Korea and Japan, 71 visited Japan and Hong Kong, 82 visited Korea and Hong Kong and 46 visited Korea, Japan and Hong Kong.

The Venn diagram at the right illustrates the relationship of these sets of data. If a tourist is randomly chosen from this group, what is the probability of choosing a tourist who visited

a) Korea?
b) Korea only?
c) Japan or Hong Kong?
d) Korea and Hong Kong?
e) Hong Kong but not Japan?



Solution:

The total number of elements in the sample space, S, is
$n(S) = 40 + 24 + 13 + 36 + 46 + 25 + 35 + 31 = 250$

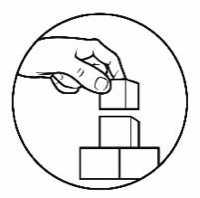
a) $P(K) = \frac{n(K)}{n(S)} = \frac{40 + 24 + 36 + 46}{250} = \frac{146}{250} = \mathbf{\frac{73}{125}}$

b) $P(\text{only } K) = \frac{n(\text{only } K)}{n(S)} = \frac{40}{250} = \mathbf{\frac{4}{25}}$

c) $P(J \cup H) = \dfrac{n(J \cup H)}{n(S)} = \dfrac{24 + 13 + 46 + 25 + 36 + 35}{250} = \mathbf{\dfrac{179}{250}}$

d) $P(K \cap H) = \dfrac{n(K \cap H)}{n(S)} = \dfrac{46 + 36}{250} = \dfrac{82}{250} = \mathbf{\dfrac{41}{125}}$

f) $P(H \text{ but not } J) = \dfrac{n(H \text{ but not } J)}{n(S)} = \dfrac{36+35}{250} = \mathbf{\dfrac{71}{250}}$



What's More

Now, your turn.

Activity 5.

What is the mathematical term for the division sign (÷)**?**

1	$\frac{2}{15}$	$\frac{1}{2}$	$\frac{1}{15}$	0	$\frac{8}{15}$

Directions: To answer the question above, solve the following problem by answering the items that follow. Then, match your answer to the decoder.

Problem: Number cards 1 through 30 are shuffled and placed on the table face down. One card is chosen at random. What is the probability that the number chosen is:

E) a multiple of 3 or a multiple of 4?
L) a multiple of 3 and a multiple of 4?
O) an even number or an odd number?
U) an even number and an odd number?
S) a multiple of 5 or contains the digit 2?
B) a multiple of 3 and contains the digit 2?

Activity 6. Out of the 250 Grade 10 students, 120 liked mathematics *(M)*, 160 liked science *(S)* and 75 liked both mathematics and science.

a) Draw a Venn diagram illustrating this problem.

If a student is selected from this group, what is the probability that

b) he/she liked mathematics or science?
c) he/she did NOT like any of the two subjects?

Activity 7.

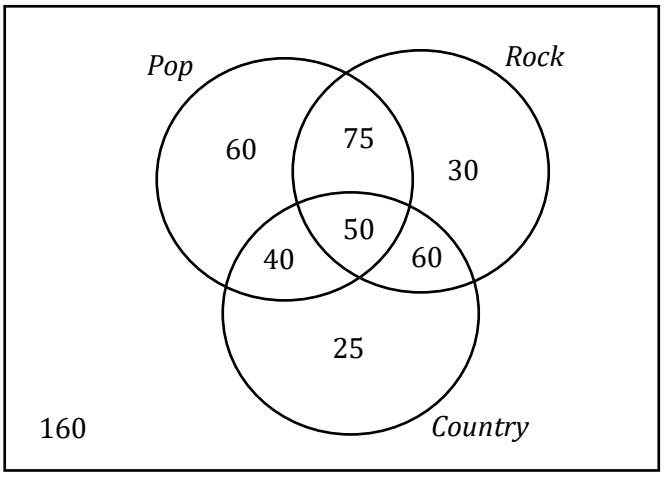
What do you call the division slash (/)?

$\frac{9}{50}$	$\frac{7}{20}$	$\frac{21}{100}$	$\frac{17}{25}$	$\frac{63}{100}$	$\frac{1}{10}$	$\frac{3}{50}$

Directions: To answer the question above, solve the following problem by answering the items that follow. Then, match your answer to the decoder.

Problem. Out of 500 surveyed students, 225 liked pop music, 215 liked rock music, 175 liked country music, 90 liked pop and country music, 125 liked pop and rock music, 110 liked rock and country music and 50 liked pop, rock, and country music.

The Venn diagram below shows the relationship of these sets of data.



If a student is selected at random from this group, what is the probability of choosing a student who liked

I) country music?

E) rock music only?

V) pop and country music?

U) pop or rock music?

R) rock but not country?

G) pop or rock or country music?

L) pop and rock and country music?

What I Have Learned

Let us summarize what we have learned in our discussion.

Activity 8. Fill in the blanks with words that will best complete the statements given below. Choose your answer from the answer box below

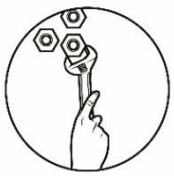
- ____1____ are set of repeated activities which have well-defined results and ____2____ are the possible results of these activities.
- ____3____is the set of all possible outcomes of an experiment and any of its subset is called a/an ____4____.
- In an experiment with equally probable outcome, to determine the probability of an event *E*, you can use the formula $P(E)=\frac{n(E)}{n(S)}$, where *n(E)* is the number of ____5____ outcomes and *n(S)* is the number of ____6____ outcomes.
- If *P(E)* = 0, then *E* is a/an ____7____ event, and if *P(E)* = 1, then *E* is a/an ____8____ event.
- The ____9____ of two events is the set of all outcomes that are in at least one of the event while the ____10____of two events is the set of all outcomes that are in both events.

Answer Box

Probability	Intersection	Impossible	Outcome
Certain	Experiment	Cardinality	Possible
Event	Favorable	Union	Sample Space

Reflect!

1. I'm doing well with _____.
2. I still need help with_____.
3. I commonly made mistake in _____.



What I Can Do

Let us solve more problems on compound probability!

Activity 9. Solve the following problems:

1) Out of the 45 books in the bookshelves, 18 are mathematics books, 10 are science books, 9 are history books and 8 are story books. If you pick one book at random, what is the probability that it is a science or mathematics book?

2) In a particular class, 78% of the students have a smartphone, 38% have a smartphone and a tablet, and 3 % have neither a smartphone nor a tablet. Find the probability that a randomly selected student has a
   a) tablet?
   b) tablet or a smartphone?
   c) smartphone but does not have a tablet?

3) In a junior high school completing class of 510 students, 110 are on the Science, Technology and Engineering (STE) Program. Of these, 78 of the STE Program students and 112 of the non-STE program students will take STEM as their senior high school track. A student is selected from the class, what is the probability that the student chosen will:
   a) take STEM as their senior high school track?
   b) not take STEM and on the Science, Technology and Engineering Program?
   c) take STEM or on the Science, Technology and Engineering Program?

4) A sample survey results of the talents of some grade 10 students are given in the following table.

	Dancing	Singing	Total
Male	28	24	
Female	32	26	
Total			

If a student is selected at random from this group, what is the probability that the student selected is a
   a) male?
   b) female whose talent is singing?
   c) student whose talent is dancing?
   d) male whose talent is singing?

Assessment

Let us determine how much you have learned from this module.

DIRECTIONS: Read and answer each item carefully. Write only the letter of the correct answer on your answer sheet.

1) If $A = \{2, 4, 6, 8, 10, 12, 14, 16\}$ and $B = \{3, 6, 9, 12, 15\}$, find $n(A \cup B)$.

A) 0 B) 2 C) 8 D) 11

2) Which of the following is a true statement?

A) The probability of a certain event is 0.
B) The probability that an event will happen is from 0 to 1.
C) The closer is the probability of an event to 0, the more likely it is to happen.
D) In an experiment with outcome that are equally likely to happen, the probability of an event is the ratio that compares the number of favorable outcomes to the number of not favorable outcomes.

3) Which of the following does NOT illustrate compound events?

A) Getting a 4 or an even number in rolling a standard die.
B) Choosing a female and a grade 10 student.
C) Picking a blue or a pink dress in the closet.
D) Head turning up in tossing a coin once.

4) How many possible outcomes are there in tossing a coin once and rolling a die once?

A) 3 B) 6 C) 8 D) 12

5) There are 22 apples and 24 oranges in a basket. If a fruit is picked at random, what is the probability of picking an apple?

A) $\frac{12}{23}$ B) $\frac{11}{23}$ C) $\frac{11}{22}$ D) $\frac{6}{11}$

6) Find the probability of getting at least 2 heads in tossing a coin thrice?

A) $\frac{1}{2}$ B) $\frac{2}{3}$ C) $\frac{1}{5}$ D) $\frac{1}{4}$

For items 7 & 8. In tossing a six – sided die, let A be the event of getting a factor of 4 and B be the event of getting an even number.

7) What is $A \cap B$?

A) {1, 2, 4} B) {2, 4, 6} C) {2,4} D) {1, 2, 4, 6}

8) What is the cardinality of $A \cup B$?

A) 4 B) 3 C) 2 D) 1

9) A box contains 8 black marbles, 12 white marbles, and 5 yellow marbles. If a marble is drawn at random, what is the probability of getting a black or a white marble?

A) $\frac{17}{25}$ B) $\frac{12}{25}$ C) $\frac{13}{25}$ D) $\frac{4}{5}$

10) Find the probability of choosing the letter M or the letter E from the word "MATHEMATICS".

A) $\frac{3}{11}$ B) $\frac{4}{11}$ C) $\frac{5}{11}$ D) $\frac{6}{11}$

11) A die is rolled once. What is the probability of getting a result which is an odd number and a factor of 6?

A) $\frac{1}{2}$ B) $\frac{1}{3}$ C) $\frac{2}{3}$ D) $\frac{1}{6}$

12) Two fair dice are rolled once. What is the probability of getting a sum that is greater than 6 but less than 9?

A) $\frac{5}{18}$ B) $\frac{2}{3}$ C) $\frac{7}{18}$ D) $\frac{11}{36}$

For items 13 & 14. From a survey of habits, 52% of students interviewed said that they surf the internet, 28% read pocketbooks, and 15% surf the internet and read pocketbooks. If a student is chosen from those who were interviewed, find the probability that this student

13) surf the internet or read pocketbooks.

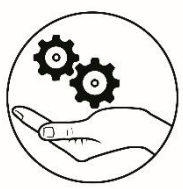
A) 80% B) 67% C) 65% D) 15%

14) does NOT surf the internet nor read pocketbooks.

A) 15% B) 35% C) 65% D) 85%

15) In a graduating class of 100 students, 65 will study mathematics, 70 will study physics, and 40 will study both mathematics and physics. If one of these students is selected at random, find the probability that the student will study physics but NOT mathematics.

A) $\frac{3}{10}$ B) $\frac{9}{20}$ C) $\frac{1}{20}$ D) $\frac{1}{4}$



Additional Activities

This time, let's have more challenging problems to solve!

Activity 10. Answer the following problems:

1) An experiment involves rolling a die and flipping a coin once if even number turns up and flipping a coin twice if odd number turns up on the die. Let A be the event that the result of the die is a number less than 3; let B be the event that 2 tails occur.

    a) List the elements of the sample space, S.

    b) List the elements of event A.

    c) List the elements of event B.

    d) What is the probability of $A \cup B$?

    e) What is the probability of $A \cap B$?

2) Of the 300 grade 10 students of a certain high school, 120 joined Mathematics club, 115 joined Science club and 100 joined English club. Furthermore, 55 joined Mathematics and Science club, 50 joined Mathematics and English club and 40 joined Science and English club. Finally, 80 students did not join any of these clubs. If a student is selected from this group, find the probability that the chosen student joined

    a) all the three clubs.

    b) Mathematics or the English club.

    c) any of the three clubs.

    d) Science club only.

    e) Mathematics and Science club but not English club.

Answer Key

What I Know

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

Activity 1

a) A = {Philippines, Thailand, Singapore, Malaysia, Cambodia, Vietnam, Laos Timor Leste, Myanmar, Brunei, Indonesia}

b) B = {April, June, September, November }

c) C = {1, 3, 5, 7, 9}

d) n(D) = 9

e) n(E) = 1

f) n(F) = 7

g) $G \cup H$ = {6, 12, 15, 18, 21, 24, 27, 30, 36}

h) $G \cap H$ = {12, 18, 24}

i) P(rose) = $\frac{1}{5}$

j) P(daisy) = $\frac{3}{10}$

k) P(female) = $\frac{4}{7}$

l) P(male) = $\frac{3}{7}$

Activity 2

1) *Outcomes:* Rolling a one, a two, a three, a four, a five and a six.
Sample Space: {1, 2, 3, 4, 5, 6}
Event: Rolling an even number, rolling an odd number, etc.

2) *Outcomes:* Selecting A & B, B & C, C & D, D & E, E &A, B & D, B & E, C & E, A & C, D & A
Sample Space: {AB, BC, CD, DE, AE, BD, BE, CE, AC, DA}
Event: A must be one of the two. C must not be selected, etc.

Activity 3

1) S	2) S	3) C	4) S	5) C	6) C

Activity 4

1) S = {BBB, BBG, BGB, BGG, GGG, GGB, GBG, GBB}
M = {BGG, GGB, GBG}
N = {BBG, BGB, BGG, GGB, GBG, GBB}
$M \cup N$ = {BBG, BGB, BGG, GGB, GBG, GBB}

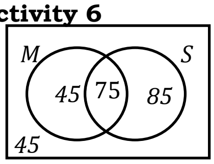
2) S = {1, 2, 3, 4, 5, 6, 7, 8}
M = {1, 3, 5, 7}
N = {1, 2, 3, 4, 5}
$M \cup N$ = {1, 2, 3, 4, 5, 7}

Activity 5

OBELUS

Activity 6

a)



b) $P(M \cup S) = \frac{41}{50}$

c) $P(not\ M \cup S) = \frac{9}{50}$

Activity 7

VIRGULE

Activity 8

1) Experiment
2) outcomes
3) Sample space
4) event
5) favorable
6) possible
7) impossible
8) certain
9) union
10) intersection

Activity 9

1) $\frac{28}{45}$

2) a) 57% b) 97% c) 40%

3) a) $\frac{19}{51}$ b) $\frac{16}{255}$ c) $\frac{37}{85}$

4) a) $\frac{26}{55}$ b) $\frac{13}{55}$ c) $\frac{6}{11}$ d) $\frac{12}{55}$

Activity 10

1) a) $S = \{2H, 2T, 4H, 4T, 6H, 6T, 1HH, 1HT, 1TH, 1TT, 3HH, 3HT, 3TH, 3TT, 5HH, 5HT, 5TH, 5TT\}$
b) $A = \{1HH, 1HT, 1TH, 1TT, 2H, 2T\}$
c) $B = \{1TT, 3TT, 5TT\}$
d) $P(A \cup B) = \frac{4}{9}$ e) $P(A \cap B) = \frac{1}{18}$

2) a) $\frac{1}{10}$ b) $\frac{17}{30}$ c) $\frac{11}{15}$ d) $\frac{1}{6}$ e) $\frac{1}{12}$

Assessment

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

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