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# Mathematics 10

## Quarter 3 Week 6 – Module 5
## Illustrating the Probability of a Union and Intersection of Events

**AIRs - LM**

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# Target

This module was designed and written to help you understand the probability of union and intersection of events. As you go through this lesson, you will learn the importance of probability in making decisions in real life.

In going over this module, you are expected to:

**Learning Competency:**

Illustrates the probability of union and intersection of events (**M10SP-IIIg-1)**

**Objectives:**

1. recalls the probability of simple events
2. defines the probability of union and intersection of events
3. illustrates the probability of union and intersection of events

Before we start the lesson, find out how much you already know about this module by answering the pre – assessment test.

**PRE - ASSESSMENT**

*Directions:* Read and answer each statement below. After taking and checking this short test, take note of the items that you were not able to answer correctly and look for the right answer as you go through this module. Write your answers on a separate sheet of paper.

1. Which of the following refers to the branch of mathematics that deals with uncertainty?
   A. Algebra B. Geometry C. Trigonometry D.Probability

2. Which of the following does NOT belong to the group?
   A. Chance B. Interpretation
   C. Possibilities D.Uncertainty

3. Which of the following terms is defined as the set of all possible outcomes of an experiment?
   A.event B. outcome C. sample space D. sample point

4. Which of the following refers to the set that contains all of the elements that are in both events?

A. Union of Events
B. Intersection of Events
C. Mutually Exclusive Events
D. Non-mutually exclusive Events

5. Which of the following refers to the set that contains all of the elements that are in at least one of the two events?

A. Union of Events
B. Intersection of Events
C. Mutually Exclusive Events
D. Non-mutually exclusive Events

6.Which of the following refers to the set of all outcomes that are NOT in the event?

A. Union of Events
B. Intersection of Events
C. Complement of an Event
D. Supplement of an Event

7. All the possible outcomes that can occur when a coin is tossed twice are listed in the box. What is the probability of having a head?

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

HH, HT,TH,TT

8. The local weather forecaster said that the is a 30% chance of rain tomorrow. What is the probability that it will not rain tomorrow?

A.0.3 B.0.7 C.30 D.70

9. Suppose you toss two fair coins once. How many possible outcomes are there?

A.1 B.2 C.4 D.8

10. A balanced die is rolled. What is the probability of rolling a number that is not 3?

A. 0 B. $\frac{1}{6}$ C. $\frac{5}{6}$ D.1

11. A die is rolled once. What is the probability of obtaining an odd number?

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

12. A box contains 4 red balls, 6 yellow balls, 5 green balls and 5 blue balls. If a ball is picked at random from the box, what is the probability that a ball picked is a red ball?

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

13. A fair die is rolled once. Let A be the event that an "odd number turns up" and B the event that a "number turns up is divisible by 3". Find the probability of the event E = "the number that turns up is odd or is divisible by 3".

A. $\frac{1}{6}$ B. $\frac{1}{5}$ C. $\frac{1}{2}$ D. $\frac{2}{3}$

14. A fair die is rolled once. Let A be the event that an "odd number turns up" and B the event that a "number turns up is divisible by 3". Find the probability of the event E = "the number that turns up is odd and is divisible by 3".

A. $\frac{1}{6}$ B. $\frac{1}{5}$ C. $\frac{1}{2}$ D. $\frac{2}{3}$

15. The probability of an event E is P(E)= 0.63. what is the probability of the complement of E?

A. 0.36 B.0.37 C.0.63 D. 1

## Jumpstart

Before we proceed to our lesson, we first recall the concepts previously learned like the union and intersection of events and basic concepts on probability of simple events by answering the given activity.

Activity 1. **United As One!**

Study the situation then answer the following questions.

Let A, B and C be three sets such that:

Set A = {2, 4, 6, 8, 10, 12}, set B = {3, 6, 9, 12, 15} and set C = {1, 4, 7, 10, 13, 16}. What is:

1. $A \cup B$

2. $A \cap B$

3. $B \cap A$

4. $B \cup A$

5. $B \cup C$

Activity 2. **Game of Chance!**

Find the probability of the following simple events.

Given Set R = {1,2,3,4,5,6,7,8,9,10}

1. a 2
2. a 12
3. odd number
4. even number
5. an odd number divisible by 3

Can you still remember the basic concepts on probability? The following are some important concepts that must be recalled in order to understand the lesson at hand.

The branch of mathematics that deals with uncertainty is **probability. Probability** is a measure or estimation of how likely it is that an event will occur. Some of the important concepts that you will learn are:

a. **Experiments** – activities such as tossing or flipping a coin or picking a card from a standard deck of cards
b. **Outcomes** – the result of an experiment
c. **Event** – set of possible outcomes resulting from a particular experiment
d. **Sample Space** -the set of all outcomes in an experiment
e. **Sample Point** – each individual outcome

When you roll a balanced die once, there are 6 possible outcomes which are 1,2,3,4,5,6. Getting an even number includes 3 outcomes; these are 2,4,6. "Getting an even number" is called an event.

Illustration of the terms:

| **Experiment** | **Sample Space** | **Sample Point** |
|---|---|---|
| Flipping two coins | HH,HT,TH,TT | HH |
| Rolling a die | 1,2,3,4,5,6 | 3 |
| Rolling a coin and a die | H1,H2,H3,H4,H5,H6<br>T1,T2,T3,T4,T5,T6 | H5 |
| Drawing a card from a deck of 52 cards | 13 Diamonds, 13 Hearts<br>13 Spades, 13 Clubs<br>( Ace,2,3,4,5,6,7,8,9,10,Jack Queen, King) | King of Hearts |

**Probability of Events**

The probability of an event, P(event) is a number from 0 to 1 which tells how likely the event is to happen.

**Probability Rules**

1. The probability of any event is a number (either a fraction , a decimal or a percent) from 0 to 1.
   Example: The weather forecast shows a 70% rain.

   P(rain) =70%

2. If an event will never happen, then its probability is 0.
   Example: When a single die is rolled, find the probability of getting an 8.
   Solution: Since the sample space consists 1,2,3,4,5 and 6, it is impossible to get an 8. Therefore, $P(8) = \frac{0}{6} = 0$
3. If an event is sure to happen, then the probability is 1.
   Example: When a s ingle die is rolled, what is the probability of getting a number less than 7?
   Solution: Since all the outcomes 1,2 3,4,5,6 are less than 7,
   $P(\text{number less than } 7) = \frac{6}{6} = 1$

4. The sum of the probabilities of all the outcomes in the sample space is 1.
   Example: In rolling a fair die, each outcome in the sample space has a probability of 1/6. Therefore, the sum of the probabilities of the outcomes is 1.
   If a fair coin is flipped, P(T) =1/2 and P(H) = ½

**Probability of Simple Events:** If each of the outcomes in a sample space is equally likely to occur, then the probability of an event E, denoted as P(E) is given by

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

**or**

$$\mathbf{P(E) = \frac{\text{number of outcomes in the event}}{\text{number of outcomes in the sample space}}}$$

Examples:

1. What is the probability of getting a diamond from a standard deck of cards?
   Solution: P(diamond) = 13/52 = ¼
2. What is the probability of getting an Ace from a standard deck of cards?
   Solution: P(Ace) = 4/52 = 1/13
3. A die is rolled once. Find the probability of obtaining a 5.
   Solution: P(5) =1/6

# Discover

For you to understand the lesson better, consider the following situation.

**Activity 3: Understanding Compound Events!**

Sebastien has a 5-peso coin in his pocket. He tosses the coin thrice.

1. How many possible outcomes are there?
2. What are those possible outcomes?
3. What is the probability of getting at least two heads?

Reflect:

a. How did you determine the sample space?

b. How can you find the total number of possible outcomes?

c. Describe the outcome in this situation as compared to the events that you studied in grade8.

From this activity, you were able to recognize that the events in the given situation are not simple events. This is because in finding the sample space, you need to find first the sample space using the fundamental counting principle. The events mentioned here are called compound events.

**Compound Events:** Events which consist of more than one outcome. A compound event consists of two or more simple events.

Examples:

- In rolling a pair of dice, the sample space is 6x6 or 36.
- In tossing two coins, the sample space is 2x2 or 4.

**Probability of Union of Events**

Examples:

1. In the experiment of rolling a single die, find the union of the events A: "the number rolled is even" and B: "the number rolled is greater than two".

   Solution:

   Sample Space= {1,2,3,4,5,6}

   A= {2,4,6}

B= {3,4,5,6}

AUB= {2,3,4,5,6}

$P(E) = \frac{n(AUB)}{n(S)} = \frac{5}{6}$

2. A two-child family is selected at random. Let B denote that the event that at least one child is a boy, let D, denote the event that the genders of the two children differ and let M denote the event that the genders of the two children match. Find: a.B*U*D b. B*U*M.

   Solution:

   Sample Space= {bb,bg,gb,gg}

   B= {bb,bg,gb}

   D= {bg,gb}

   M= {bb,gg}

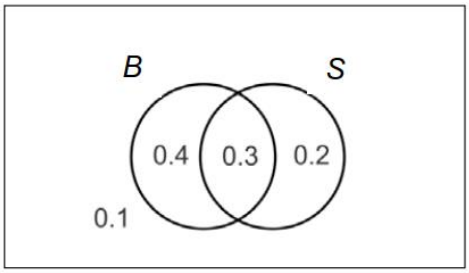
   a. Therefore, B*U*D={ bb,bg,gb}

   $P(E) = \frac{n(BUD)}{n(S)} = \frac{3}{4}$

   b. B*U*M={ bb,bg,gb,gg}

   $P(E) = \frac{n(BUM)}{n(S)} = \frac{4}{4}$ or 1

3. The Venn Diagram shows the probabilities of grade 10 students joining either soccer (S) or basketball (B).




   Use the Venn Diagram to find the probabilities.

   a. P(B)

   b. P(S)

   c. P(BUS)

Solutions:

a.P(B)= 0.4+0.3= 0.7

b.P(S)= 0.3+0.2= 0.5

c.P(B$\cup$S)= 0.4+0.3+0.2=0.9

**Probability of Intersection of Events**

Examples:

1. In the experiment of rolling a single die, find the intersection of the events A: “the number rolled is even” and B: “the number rolled is greater than two”.

   Solution:

   Sample Space = { 1,2,3,4,5,6}

   A= { 2,4,6}

   B= { 3,4,5,6}

   A $\cap$ B={ 4,6}

   $P(E) = \frac{n(A \cap B)}{n(S)} = \frac{2}{6}$ or $\frac{1}{3}$

2. In the experiment of rolling a single die, find the intersection of the events A: “the number rolled is odd” and B: “the number rolled is less than three”.

   Solution:

   Sample Space = { 1,2,3,4,5,6}

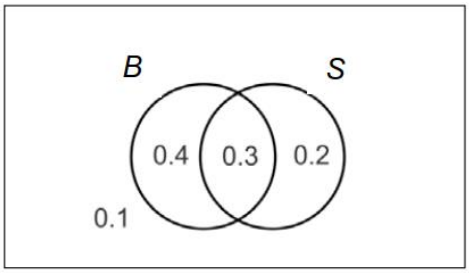
   A= { 1,3,5}

   B= { 1,2}

   A$\cap$B= { 1}

   $P(E) = \frac{n(A \cap B)}{n(S)} = \frac{1}{6}$

3. The Venn Diagram shows the probabilities of grade 10 students joining either soccer (S) or basketball (B). What is P B?




Solution:

$P \cap B = 0.3$

**Complement of an Event**

The complement of an event is the set of all outcomes that are NOT in the event. This means that if the probability of an event , A is P(A), then the probability that the event would not occur ( also known as complementary event) is 1-P(A), denoted by P(A').

**P (A') = 1 - P ( A )**

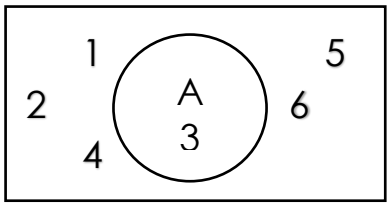
Example:

1. Consider the Venn Diagram below.

   Sample Space: 1,2,3,4,5,6}

   a. What is the probability of getting a 3?

   b. What is the complement of A?




Solution:

a. P(3) = 1/6

b. P(A') = 1 – 1/6

= 5/6

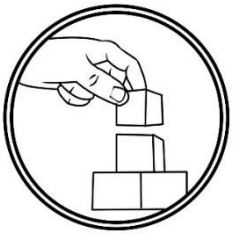
2. If there is a 60% chance of rain tomorrow, what is the probability of having a fair weather?

   Solution:

   P(fair weather) = 100% - 60%

   = 40%

Were you able to follow and understand the discussion on the probability of union and intersection of events? Let's continue exploring!



# Explore

Here are some enrichment activities for you to work on to master and strengthen the basic concepts you have learned in this lesson.

**Activity 1: See My Prob-ability!**

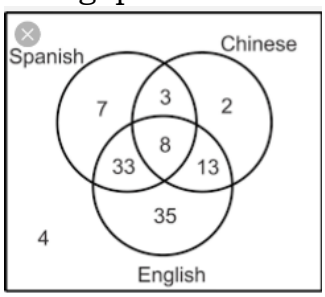
Solve the following carefully.

1. Conie is asked to choose a day from a week. What is the probability of choosing a day which starts with S?
2. Choosing a month from a year, what is the probability of selecting a month with 31 days?
3. The sides of a cube are numbered 1 to 6. What is the probability of rolling a prime number?
4. A box contains 3 red balls, 5 yellow balls, 4 blue balls and 2 green balls. What is the probability of drawing a red ball?
5. What is the probability of getting a heart from a standard deck of cards?

**Activity 2: Finding Probabilities!**

Study the Venn Diagram and answer the following questions.

The International Club of a school has 105 members, many of whom speak multiple languages. The most commonly spoken in the club are English, Spanish and Chinese. Use The Venn diagram to determine the Probability of selecting a student who speaks:




1.Chinese

2.English

3.Spanish

4.Spanish or Chinese

5.Chinese or English

6.English or Spanish

7.English and Chinese

8.Chinese and Spanish

9.English and Spanish

10.does not speak the three language

**Activity 3: Rock and Roll!**

Determine the elements of the following operations. After which , find the probabilities of each number.

Sample Space: {0,1,2,3,4,5,6,7,8,9}

A= {0,1,2,3,4} B ={ 0,2,4,6,8 } C= {1,3,5,7,9}

1..P(AUB)

2. P(AUC)

3.P(AUBUC)

4.P(A ∩ B)

5.P(B ∩ C)

6.P(A ∩ B ∩ C)

7.P(A ∩ B)UC

8. P(A')

9.P(B')

10.P(C')

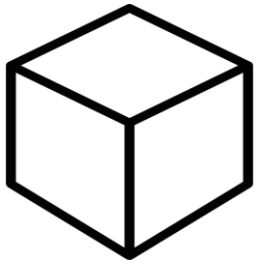
How was the activity? Did you enjoy answering the given activities? Now let's go deeper!

# Deepen

At this point, you are going to apply the mathematical concepts learned from this module.

Invite any member of the family to toss a cube numbered 11 to 16 then read and answer together the following questions.

1. How many possible outcomes are there?
2. What are the possible outcomes?



3. What is the probability that the face which lands up is 20?
4. What is the probability that the face which lands up is an odd number or prime number?
5. What is the probability that the face which lands up is an even number and a composite number?

# Gauge

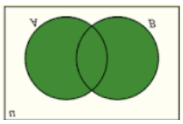
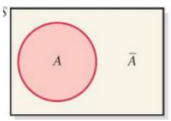
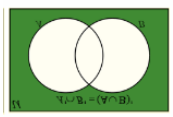
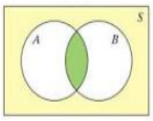
*Directions*: Choose the letter of the best answer from the given choices. Write your answers in a separate sheet of paper. *(1 point each)*

1. Which of the following refers to the measure or estimation of how likely it is an event will occur?
   A. Algebra B. Geometry C. Trigonometry D. Probability

2. Which statement is TRUE?
   A. The probability of any event is a number from 1 to 10.
   B. If an event will never happen, then its probability is 1.
   C. If an event is sure to happen, then the probability is 1.
   D. The sum of the probabilities of all the outcomes in the sample space is 10.

3. Which of the following refers to the activities such as rolling a die, tossing a coin or choosing a ball from a box which could be repeated over and over again and which have well defined results?
   A. event B. outcome C. experiment D. sample space

4. Which of the following terms is associated to union of events?
   A. or B. is C. and D. for

5. Which of the following Venn Diagrams illustrates the intersection of A and B?
   A. 
   B. 
   C. 
   D. 

6. Suppose you flip a coin, how many possible outcomes are there?
   A.1 B.2 C.3 D.4

7.A glass jar contains 40 red, green, blue and yellow marbles. The probability of drawing a single green marble at random is $\frac{1}{5}$. What does this mean?

A. There are 5 green marbles in the glass jar.
B. There are 8 green marbles in the glass jar.
C. There are more green marbles than the others.
D. There is only one green marble in the glass jar.

8. The probability of heads landing up when you flip a coin is $\frac{1}{2}$. What is the probability of getting tails if you flip it again?

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

9. A fair die is rolled once. Let A be the event that an "even number turns up" and B the event that a "number turns up is divisible by 2". What is the probability of the event E = "the number that turns up is even or is divisible by 2"?

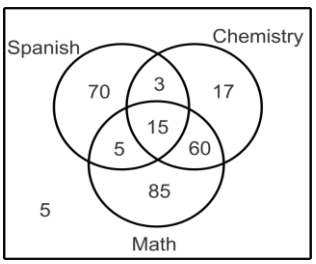
A. $\frac{1}{6}$ B. $\frac{1}{5}$ C. $\frac{1}{2}$ D. $\frac{2}{3}$

10. A fair die is rolled once. Let A be the event that an "even number turns up" and B the event that a "number turns up is divisible by 2". Find the probability of the event E = "the number that turns up is even and is divisible by 2".

A. $\frac{1}{6}$ B. $\frac{1}{5}$ C. $\frac{1}{2}$ D.1

II. Study the Venn Diagram and answer the following questions.

The subjects in which the students of Francisco High School enrolled are shown in the Venn Diagram below.




1.How many students are in the class?

2.How many students like Math?

3. If a student is randomly chosen, what is the probability that the student likes Math or Chemistry?

4. If a student is randomly chosen, what is the probability that the student likes Spanish or Chemistry?

5.If a student is randomly chosen, what is the probability that the student likes Spanish and Math?

# References:


**BOOKS**

- Learners Module, K to 12 Grade 10 Mathematics (Third Quarter, Mathematics)
- Teachers Guide, K to 12 Grade 10 Mathematics (Third Quarter, Mathematics)
- Learners Module, K to 12 Grade 8 Mathematics (Fourth Quarter, Mathematics)

**LINKS**

- https://www.google.com/search?q=image+of+union+and+intersection+in+probability+band%2C+drama%2C+athletics&tbm=isch&ved=2ahUKEwjhlPv2pfLtAhVqEqYKHfbEB5QQ2-cCegQIABAA&oq=image+of+union+and+intersection+in+probability+band%2C+drama%2C+athletics&gs_lcp=CgNpbWcQA1Dt7Q5Y-cIPYJfJD2gAcAB4AoABjQmIAfNRkgEPMC42LjUuMS4xLjMuMy4zmAEAoAEBqgELZ3dzLXdpei1pbWfAAQE&sclient=img&ei=2KjqX-HIE-qkmAX2iZ-gCQ&bih=625&biw=1366#imgrc=wchcW4POq7C07M

- https://stats.libretexts.org/Bookshelves/Introductory_Statistics/Book%3A_Introductory_Statistics_(Shafer_and_Zhang)/03%3A_Basic_Concepts_of_Probability/3.02%3A_Complements_Intersections_and_Unions

- https://www.google.com/search?q=image+of+union+and+intersection+in+probability&rlz=1C1GCEA_enPH923PH923&sxsrf=ALeKk009fKCRlTWBoSpnSf_aWaWmA07Yqw:1609073701161&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjW1f_Smu7tAhXZc3AKHZhZBbIQ_AUoAXoECBIQAw&biw=1366&bih=625#imgrc=T-5YCeRfHQPvuM&imgdii=BCwRx5H79-Ny8M

- https://www.math-only-math.com/worksheet-on-union-and-intersection-of-sets.html