10

Mathematics

Quarter 3 – Week 7 Module 6
Illustrating the Probability of Mutually Exclusive Events

AIRs - LM

Mathematics 10
Quarter 3 - Week 7 Module 6:
Illustrating the Probability of Mutually Exclusive Events

First Edition, 2021

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Target

Have a great day! In this module you will be learning about key concepts of mutually exclusive and non – mutually exclusive events. You are also given the opportunity to illustrate and find the probability of mutually exclusive and non – mutually exclusive events and solve problems involving these concepts through appropriate and accurate representations.

After going through this module, you are expected to attain the following objectives:

Learning Competency:

Illustrates mutually exclusive events. (**M10SP-IIIi – 1**)

Subtasks:

1. define mutually exclusive and non – mutually exclusive events;

2. find the probability of mutually exclusive and non – mutually exclusive events and

3. solve problems involving mutually exclusive and non – mutually exclusive events.

Before going on, find out how much you already know about the topic in this module. Answer the pre- assessment below.

Pre – Assessment

Directions: Choose the letter of the correct answer. Write your answer on a separate sheet of paper.

1. What do you call the events that have no outcomes in common and they cannot happen at the same time?

A. dependent B. independent
C. mutually exclusive D. non – mutually exclusive

2. The following situations are examples of mutually exclusive events, EXCEPT

A. If we toss a coin, either head or tail might turn up.
B. In a single throw of a die, we only have one number shown at the top face.
C. The children of two different families.
D. Drawing a heart or a black card in a standard deck of cards.

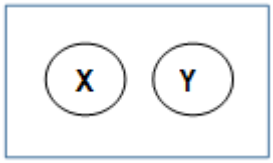
3. Which of the following events is a mutually exclusive?

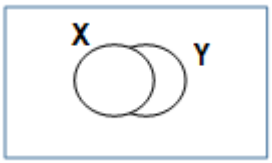
A. card selected from a deck will be either a queen or a red.
B. card selected from a deck will be either a black or a king.
C. card selected from a deck will be either an ace or a king.
D. card selected from a deck will be either a spade or 2.

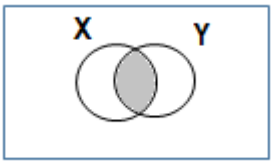
4. If two events, A and B, are mutually exclusive, then what is the probability that either A or B occurs?

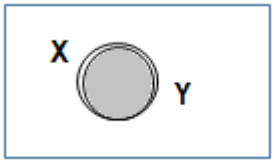
A. P(A or B) = P(A) + P(B)
B. P(A or B) = P(A) + P(B) + P(A and B)
C. P(A or B) = P(A) - P(B)
D. P(A or B) = P(A) + P(B) – P(A and B)

5. Which of the following illustrations illustrates mutually exclusive events X and Y?

A. 

B. 

C. 

D. 

6. A bowl contains 15 balls numbered 1 to 15. If a ball is drawn randomly from a bowl, what is the probability that it is a number 3 or a number 4?

A. $\frac{1}{15}$ B. $\frac{2}{15}$ C. $\frac{4}{15}$ D. $\frac{7}{15}$

7. What is the probability of drawing a heart or a black card in a standard deck of cards?

A. $\frac{1}{26}$ B. $\frac{1}{13}$ C. $\frac{1}{2}$ D. $\frac{19}{26}$

8. A basket contains 6 chicos, 5 bananas, 4 mangoes and 5 guavas. A fruit is randomly selected from the basket. What is the probability that it is a banana or a mango?

A. $\frac{9}{20}$ B. $\frac{5}{20}$ C. $\frac{4}{20}$ D. $\frac{1}{10}$

9. A card is randomly selected from a well – shuffled standard deck of 52 cards. Find the probability that it is a black card or a king?

A. $\frac{1}{13}$ B. $\frac{1}{2}$ C. $\frac{7}{13}$ D. $\frac{15}{26}$

10. Out of 345 students surveyed, 82 students participated in drama, 159 students participated in athletics and 4 students participated in both drama and athletics. If a student is randomly chosen, what is the probability that the student participates in athletics or drama?

A. $\frac{82}{345}$ B. $\frac{159}{345}$ C. $\frac{237}{345}$ D. $\frac{241}{345}$

11. A box contains 5 tickets numbered 1 through 5. A ticket is selected at random from the box. What is the probability that the ticket selected is a 1 or 5?

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

12. In a certain city, 55% of the families own only one car and 20% own exactly two cars. One family is selected at random. Find the probability that the family selected has one or two cars.

A. 20% B. 35% C. 55% D. 75%

13. Thirty tickets numbered 1 to 30 are in a box. What is the probability that the randomly selected ticket is an odd or even?

A. 1 B. $\frac{1}{2}$ C. $\frac{1}{20}$ D. 0

14. A bowl contains five red, two white and 3 green balls. If a ball is selected at random, find the probability that it is a red or a white ball.

A. $\frac{7}{10}$ B. $\frac{5}{10}$ C. $\frac{3}{10}$ D. $\frac{2}{10}$

15. What is the probability of selecting a number from 1 to 10 that is less than 5 or an even number?

A. $\frac{9}{10}$ B. $\frac{7}{10}$ C. $\frac{5}{10}$ D. $\frac{3}{10}$

Lesson

Mutually Exclusive and Non – Mutually Exclusive Events

Start the lesson of this module by assessing your knowledge of the different mathematical concepts previously studied and other mathematical skills learned. These knowledge and skills will help you understand the concepts of events which are mutually exclusive and which are not mutually exclusive. If you find any difficulty in answering the different exercises, seek the assistance of your teacher or peers or refer to the modules you have studied earlier.

Review

Activity 1: Probability of Simple Events

Consider the situation below and answer the questions that follow.

A box contains five red, two white, and three green balls. If a ball is selected at random find the probability that it is

A. red.

B. green.

C. not red.

D. black.

E. white.

Reflect:

a. How did you answer each question?

b. In finding the probability of each event above, what concepts are needed?

Were you able to answer the problem? Do you remember your previous lesson on probability of simple events? How useful your knowledge and skills on simple events in solving problems on probability?

Jumpstart

The next activity will help you understand the concepts of events which are mutually exclusive and which are non - mutually exclusive. Try to figure out events which are mutually exclusive and which are not. Good luck!!

Activity 2: Taking Chances with Events A and B

Consider the situations below and answer the questions that follow.

1. A bowl contains 15 chips numbered 1 to 15. If a chip is drawn randomly from the bowl, what is the probability that it is

   a. 7 or 15?

   b. 5 or a number divisible by 3?

   c. even or divisible by 3?

   d. a number divisible by 3 or divisible by 4?

2. Dario puts 44 marbles in a box in which 14 are red, 12 are blue, and 18 are yellow. If Dario picks one marble at random, what is the probability that he selects a red marble or a yellow marble?

3. Out of 5200 households surveyed, 2107 had a dog, 807 had a cat, and 303 had both a dog and a cat. What is the probability that a randomly selected household has a dog or a cat?

Questions:
1. How did you answer each question?
2. What do you notice about the events in each question? (question 1c as compared to 1d, question 2 as compared to question 3)
3. Draw a Venn diagram showing the sample space for numbers 3 and 4. What do you notice about the Venn diagram?

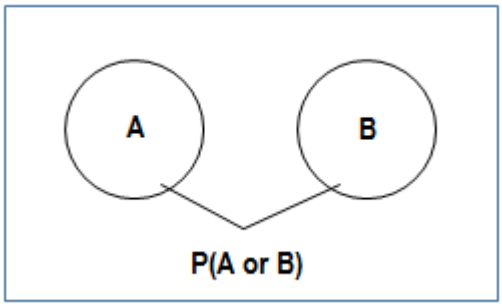
Were you able to recognize problems on probability which involve mutually exclusive and non – mutually exclusive events in the situations above? I am sure it was! This time, to help you understand the concepts of mutually exclusive events, read the discussion below.

Discover

The events in the above activity may be either **mutually exclusive or non – mutually** exclusive. Events that cannot occur at the same time are called **mutually exclusive events.** An example is obtaining a head in tossing a coin and obtaining a tail in the same toss.

In problem 1a of the preceding activity, the event of getting a 7 and the event of getting a 15 from the set {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15} are mutually exclusive events likewise in problem 1b, the event of getting a 5 and the event of getting a number divisible by 3 from the set are also mutually exclusive events.

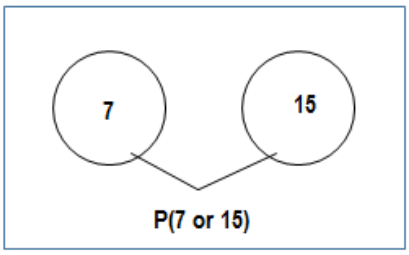
Consider the Venn diagram below. What do you notice about the events A and B? These two events are **mutually exclusive.**



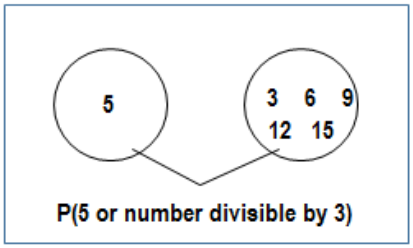
If two events, A and B, are mutually exclusive, then the probability that either A or B occurs is the sum of their probabilities. In symbols

P(A or B) = P(A) + P(B)

In problem 1a, 1b and 2 in the preceding activity



1a. P(7 or 15) = P(7) + P(15) $= \frac{1}{15} + \frac{1}{15} = \frac{2}{15}$



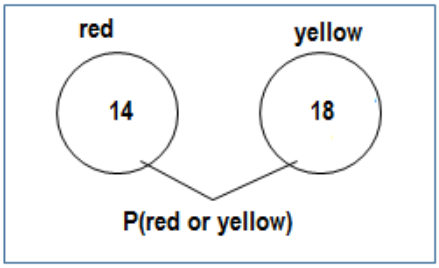
1b. P(5 or a number divisible by 3)

= P(5) + P(div. by 3)

$$= \frac{1}{15} + \frac{5}{15} = \frac{6}{15}\ or\ \frac{2}{5}$$

2. P(red or yellow) = P(red) + P(yellow)

$$= \frac{14}{44} + \frac{18}{44} = \frac{32}{44} or\ \frac{8}{11}$$



On the other hand, in problem 1c, the event of getting an even number or an event of getting a number divisible by 3 in the set {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15} are **not mutually exclusive or non – mutually exclusive events**. Observe that a subset of numbers that are even also contains elements which are a subset of the numbers divisible by 3. Likewise in problem 1d, the event of getting a number divisible by 3 or the event of getting a number divisible by 4 in the set are also **non – mutually exclusive events**. Observe that a subset of numbers divisible by 3 also contains an element which is a subset of the numbers divisible by 4. A non – mutually exclusive event is an event that can happen no matter what happens to another event.

In problem 1c

Even numbers	{2, 4, **6**, 8, 10, **12**, 14}
Numbers divisible by 3	{3, **6**, 9, **12**, 15}
Common elements	{**6, 12**}

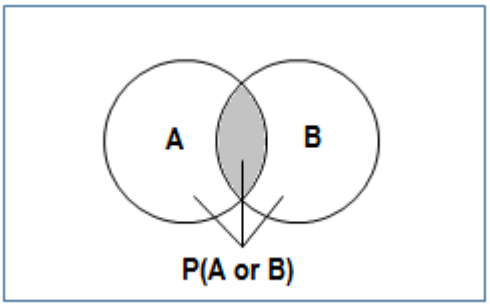
In problem 1d

Numbers divisible by 3	{3, 6, 9, **12**, 15}
Numbers divisible by 4	{4, 8, **12**}
Common element	{**12**}

In problem 3

2107 had a dog
807 had a cat
303 had **both** a dog and a cat

The Venn diagram below shows **events A and B which are not mutually exclusive or non – mutually exclusive events** because A and B intersect. Note that **there are outcomes that are common to A and B which is the intersection of A and B**

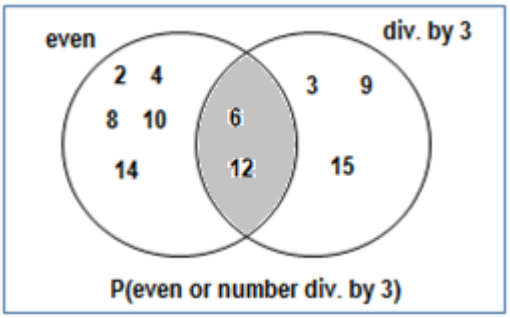


If two events, A and B, are not mutually exclusive or non – mutually exclusive, then the probability that either A or B occurs is the sum of their probabilities decreased by the probabilities of both occurring. In symbols

P(A or B) = P(A) + P(B) – P(A and B)

In problem 1c, 1d and 3 in the preceding activity

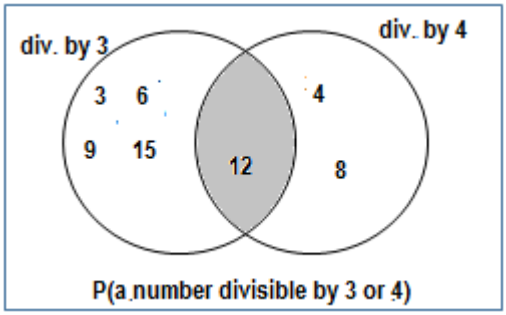
1c.



P(even or a number divisible by 3) = P(even) + P(number divisible by 3) – P(even and div. 3)

$$= \frac{7}{15} + \frac{5}{15} - \frac{2}{15} = \frac{10}{15} \; or \; \frac{2}{3}$$

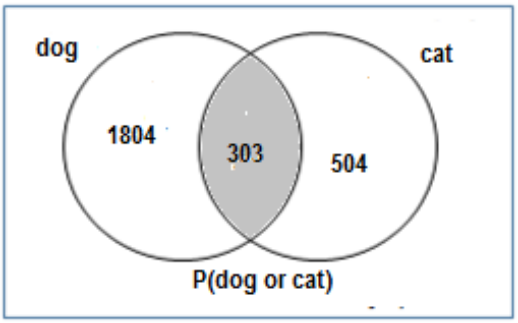
1d.



P(a number divisible by 3 or 4) = P(div. by 3) + P(div. by 4) - P(div. by 3 and div. by 4)

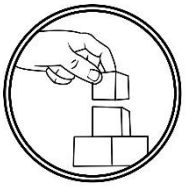
$$= \frac{5}{15} + \frac{3}{15} - \frac{1}{15} = \frac{7}{15}$$

3.



P(dog or cat) = P(dog) + P(cat) – P(dog and cat) = $\frac{2107}{5200} + \frac{807}{5200} - \frac{303}{5200} = \frac{2611}{5200}$

Now that you know the important ideas about the topic, use the mathematical ideas you learned from the activity and from the discussion. Answer the problems in the following activities in different ways when possible.



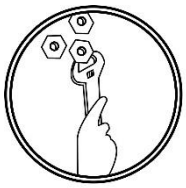
Explore

Activity 3: More Exercises on Mutually Exclusive and Not Mutually Exclusive Events

Consider the situations in column A below and answer the questions that follow. Select your answers in column B

A	B
1. A restaurant serves a bowl of candies to their customers. The bowl of candies Gabriel receives has 10 chocolate candies, 8 coffee candies, and 12 caramel candies. After Gabriel chooses a candy, he eats it. Find the probability of getting candies with the indicated flavors. a. P(chocolate or coffee) b. P(caramel or not coffee) c. P(coffee or caramel) d. P(chocolate or not caramel)	A. $\frac{2}{3}$ B. $\frac{3}{5}$ C. $\frac{1}{15}$ D. $\frac{11}{15}$ E. $\frac{7}{10}$ F. $\frac{1}{52}$
2. Rhian likes to wear colored shirts. She has 15 shirts in her closet. Five of these are blue, four are in different shades of red, and the rest are of different colors. What is the probability that she will wear a blue or a red shirt?	
3. Mark has pairs of pants in three different colors, blue, black and brown. He has 5 colored shirts: a white, a red, a yellow, a blue, and a mixed – colored shirt. What is the probability that Mark wears a black pair of pants and a red shirt on a given day?	
4. A motorcycle license plate has 2 letters and 3 numbers. What is the probability that a motorcycle has a license plate containing a double letter and an even number?	
5. In a set of numbers from 1 to 10. What is the probability of selecting a number that is less than 5 or an odd?	

Did you answer all the questions correctly? To help you understand more about mutually exclusive events, you may proceed to activity 4.



Deepen

Activity 4: Mutually Exclusive or Not!
Consider each problem below. Determine whether the events are mutually exclusive or non – mutually exclusive. Then, find the probability.

1. Mario has 45 red chips, 12 blue chips, and 24 white chips. What is the probability that Mario randomly selects a red chip or a white chip?

2. Of 240 students, 176 are on the honor roll, 48 are members of the varsity team, and 36 are in the honor roll and are also members of the varsity team. What is the probability that a randomly selected student is on the honor roll or is a member of the varsity team?

3. Ruby's dog has 8 puppies. The puppies include 2 white females, 3 mixed – color females, 1 white male, and 2 mixed – color males. Ruby wants to keep one puppy. What is the probability that she randomly chooses a puppy that is female and white?

4. Carl's basketball shooting records indicate that for any frame, the probability that he will score in a two – point shoot is 30%, a three – point shoot is 45%, and neither, 25%. What is the probability that Carl will score either a two - point or in a three – point shoot?

Reflect on the activities you have done in this module by completing the following sentences. Write your answers on your notebook.

I learned that I _____
I was surprised that I _____
I noticed that I _____
I discovered that I _____
I was pleased that I _____

Your goal in this section is to take a closer look at some aspects of the topic. You are going to think deeper and test further your understanding of mutually exclusive and non – mutually exclusive events. Work on the last activity.

Gauge

A. Directions: Select the letter of the correct answer. Write your answer on a separate sheet of paper.

1. What do you call the events that have no outcomes in common and they cannot happen at the same time?

A. dependent B. independent
C. mutually exclusive D. non – mutually exclusive

2. The following situations are examples of mutually exclusive events, EXCEPT

A. The children of two different families.
B. If we toss a coin, either head or tail might turn up.
C. Card selected is a heart or a black card in a standard deck.
D. In a single throw of a die, we only have one number shown at the top face.

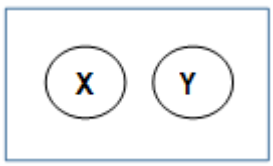
3. A card is drawn from a well – shuffled deck of 52 cards. Which of the following events is a mutually exclusive?

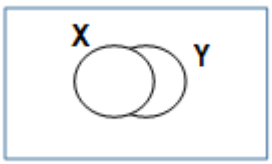
A. card selected is a queen or a red.
B. card selected is a black or a king.
C. card selected is an ace or a king.
D. card selected is a spade or 2.

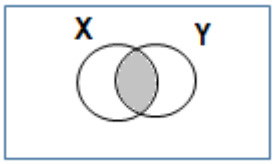
4. If two events, X and Y, are mutually exclusive, then what is the probability that either A or B occurs?

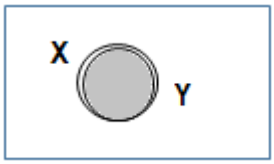
A. P(X or Y) = P(X) + P(Y) B. P(X or Y) = P(X) + P(Y) + P(X and Y)
C. P(X or Y) = P(X) - P(Y) D. P(X or Y) = P(X) + P(Y) – P(X and Y)

5. Which of the following illustrations illustrates mutually exclusive events X and Y?

A. 

B. 

C. 

D. 

6. A bowl contains 15 balls numbered 1 to 15. If a ball is drawn randomly from a bowl, what is the probability that it is a number 5 or a number 7?

A. $\frac{1}{15}$ B. $\frac{2}{15}$ C. $\frac{4}{15}$ D. $\frac{7}{15}$

7. What is the probability of drawing a heart or a red card in a standard deck of 52 cards?

A. $\frac{1}{26}$ B. $\frac{1}{13}$ C. $\frac{1}{2}$ D. $\frac{19}{26}$

8. A basket contains 6 chicos, 5 bananas, 4 mangoes and 5 guavas. A fruit is randomly selected from the basket. What is the probability that it is a guava or a mango?

A. $\frac{9}{20}$ B. $\frac{5}{20}$ C. $\frac{4}{20}$ D. $\frac{1}{10}$

9. A card is randomly selected from a well – shuffled standard deck of 52 cards. Find the probability that it is a black card or a queen?

A. $\frac{1}{13}$ B. $\frac{1}{2}$ C. $\frac{7}{13}$ D. $\frac{15}{26}$

10. Out of 345 students surveyed, 82 students participated in drama, 159 students participated in athletics and 4 students participated in both drama and athletics. If a student is randomly chosen, what is the probability that the student participates in athletics or drama?

A. $\frac{32}{345}$ B. $\frac{159}{345}$ C. $\frac{237}{345}$ D. $\frac{241}{345}$

11. A box contains 5 tickets numbered 1 through 5. A ticket is selected at random from the box. What is the probability that the ticket selected is a 2 or 4?

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

12. In a certain city, 55% of the families own only one car and 20% own exactly two cars. One family is selected at random. Find the probability that the family selected has one or two cars.

A. 20% B. 35% C. 55% D. 75%

13. Thirty tickets numbered 1 to 30 are in a box. What is the probability that the randomly selected ticket is an even or odd?

A. 1 B. $\frac{1}{2}$ C. $\frac{1}{20}$ D. 0

14. A bowl contains 5 red, 2 white and 3 green balls. If a ball is selected at random, find the probability that it is a green or a white ball.

A. $\frac{7}{10}$ B. $\frac{5}{10}$ C. $\frac{3}{10}$ D. $\frac{2}{10}$

15. What is the probability of selecting a number from 1 to 10 that is less than 5 or an even number?

A. $\frac{9}{10}$ B. $\frac{7}{10}$ C. $\frac{5}{10}$ D. $\frac{3}{10}$

References

Books:

Mathematics Grade 9 Learner's Module, First Edition 2014, Reprint 2017
Mathematics Grade 10 Learner's Module, First Edition 2015,
Mathematics Grade 10 Teacher's Guide, First Edition
MSA Statistics and Probability, 2010 Revised Edition

Websites:
https://study.com/academy/lesson/mutually-exclusive-events-non-mutually-exclusive-events.html#:~:text=We're%20talking%20about%20a,what%20happens%20to%20another%20event.

https://www.onlinemathlearning.com/mutually-exclusive-events.html#:~:text=Two%20events%20are%20said%20to,shown%20at%20the%20top%20face.