

UNIT

INTRODUCTION TO PROBABILITY

8

Learning Out comes: At the end of this unit, learners will be able to:

- Understand the concept of probability.
- Find event, sample space and probability of simple events.
- Apply problems of real-life situations in solving the probabilities.

Main Content

- 8.1. The concept of probability
- 8.2. Probability of simple events
- 8.3. Application on business, climate, road transport, accidents and drug effects

Summary

Review Exercise

INTRODUCTION

Group work 8.1

- 1) Discuss what result is expected for the following experiments.
 - a) A ball is dropped from a certain height.
 - b) A spoon full of sugar is added to a cup of milk.
 - c) Petrol is poured over fire.
 - d) Tossing a coin.
 - e) Throwing a die.
 - f) Drawing a card from a pack of cards.
- 2) The weather forecaster announces that the probability of heavy rain with thunder in the afternoon is $\frac{1}{4}$. What does it mean? Explain.

In each of the first three experiments, the result or outcome is certain, and known in advance. That is, in experiment (a), the ball is certain to touch the earth and in (b) the sugar will certainly dissolve in milk and in (c) the petrol is sure to burn. But in the experiments d – e the results are uncertain. For example, when a coin is tossed everyone knows that there are two possible outcomes namely head and tail but no one could say with certainty which of the two possible outcomes will be obtained. In all, such experiments, that there is an element of chance, called probability which express the element of chance numerically. The occurrence or non-occurrence of things is studied in mathematics by the theory of probability. The theory of probability was introduced to give quantification to the possibility of certain outcome of the experiment in the face of uncertainty. Probability is used by governments, scientists, insurance company, etc. to predict what is likely to happen in the future by studying what has already happened. In this unit you will learn the introductory concept of probability.

8.1. The concept of probability

Competency: At the end of this sub-unit, students should:

- Describe the concepts of probability.

Definition 8.1: An activity involving chance in which results are observed is called an **experiment**.

Definition 8.2: Each observation of an experiment is called a **trial** and each result of the experiment is an outcome.

Note: The experiment in probability has the following properties.

- ✓ All the outcomes are known in advance.
- ✓ What specific outcome will result is not known in advance.
- ✓ The experiment can be repeated under same conditions.

Example 8.1:

Toss a coin once.

Experiment: Tossing a coin

Trial: one time

Outcome: Head (H), Tail (T)



Figure 8.1

Definition 8.3: The set of all possible outcomes of an experiment is called a sample space or possibility set of the experiment and is denoted by S .

Definition 8.4: Any set of outcomes of the experiment is called an event. That is, event is a subset of the sample space. Events will be denoted by the capital letters A, B, C, D, E , and so on.

Example 8.2:

Consider the experiment “throwing a die once”.

(A die is a cube with each of its six faces marked with a different number of dots from one to six)



Figure 8.2

What are the possible outcomes?

- a) Write the sample space.
- b) Write the event of a number 5 appearing on the upper face.
- c) Write the event of getting “the number shown on the upper face is even”.
- d) Write the event of getting “a number different from three”.
- e) Write the event of getting “a prime number and an even number”.

Solution:

- a) The possible outcomes: 1, 2, 3, 4, 5, 6
- b) $S = \{1, 2, 3, 4, 5, 6\}$
- c) $E = \{5\}$
- d) $E = \{2, 4, 6\}$
- e) $E = \{1, 2, 4, 5, 6\}$
- f) $E = \{2\}$

Exercise 8.1:

- 1) Discuss the following terms
 - a) Experiment
 - b) Possibility set
 - c) Event
- 2) Write a number 1 through 10 on a ten identical cards. Then select one card randomly from the cards.
 - a) What is the experiment?
 - b) Write the sample space.
 - c) Write the event of getting an odd number.

Definition 8.5: Events (two or more) of an experiment are said to be equally likely, if any one of them cannot be expected to occur in preference to the others.

Example 8.3:

- a) Getting a 1, 2, 3 on the toss of a die and getting a 4, 5, 6 on the toss of a die are equally likely because the chance of occurrence of each event are equal.
- b) A bag has 10 balls of different colors and sizes. If you pick up a ball randomly from the bag, the chance of occurrence of all the balls are not necessarily the same. Such outcomes are not equally likely outcomes.

Activity 8.1:

1) Consider the experiment “throwing a fair die once”.

What can you say about the events

- a) The number on the upper face is a whole number.
- b) The number on the upper face is the number 7.

2) Identify the following events are certain or impossible events.

- a) A newly born baby will be a boy or a girl.
- b) Rolling a die and getting a number less than 7.
- c) A glass jar contains 15 red marbles and selecting a single white marble randomly from the jar.

Definition 8.6: An event which is sure to occur at every performance of an experiment is called a certain event to the experiment.

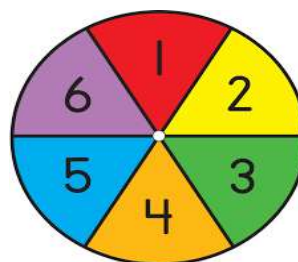
Definition 8.7: An event which cannot occur at any performance of the experiment is called an impossible event to the experiment.

Example 8.4:

- a) A teacher chooses a girl from a class of 30 girls is a certain event. Because all the students in the class are girls, the teacher is certain to choose a girl.
- b) A spinner has 4 equal sectors colored yellow, red, green and blue. It is impossible to land on purple after spinning the spinner.

Exercise 8.2:

- 1) A glass jar contains 3 red, 6 blue and 4 green chocolates. If a chocolate is chosen at random from the jar, then which of the following is an impossible event?
 - a) Choosing a red chocolate.
 - b) Choosing a yellow chocolate.
 - c) Choosing a green chocolate.
- 2) A spinner has 6 equal sectors numbered 1 to 6. If you spin the spinner, then which of the following is a certain event?
 - a) Landing on a number greater than 1.
 - b) Landing on a number less than 7.
 - c) Landing on a number between 6 and 9.
- 3) Identify certain and impossible events
 - a) You will live to be 300 years.
 - b) Two lines intersect at one point.
 - c) The earth revolves around the sun.

*Figure 8.3*

Definition 8.8: The probability of an event is the measure of the chance that the event will occur as a result of the experiment.

The probability of an event E , denoted by $P(E)$, is a number between 0 and 1, inclusive, that measures the likelihood of an event in the following way:

- ✓ If $P(E_1) > P(E_2)$, then event E_1 is more likely to occur than an event E_2 . That is, E_1 has a big chance to occur and E_2 has little chance (unlikely) to occur.
- ✓ If $P(E_1) = P(E_2)$, then the events E_1 and E_2 are equally likely to occur. That is, E_1 and E_2 have the same chance to occur.
- ✓ If event E_1 is impossible, then $P(E_1) = 0$.
- ✓ If event E_1 is certain, then $P(E_1) = 1$.

This can be shown on a probability scale, starting at 0(impossible) and ending at 1(certain)

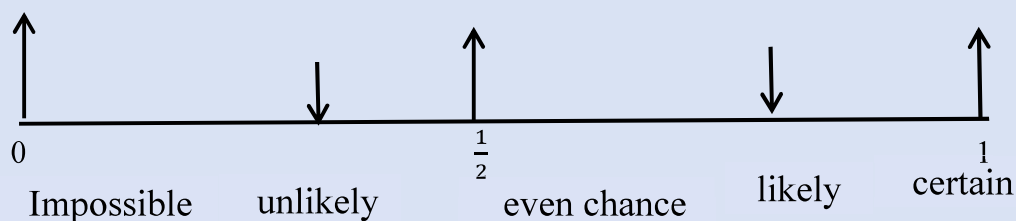


Figure 8.4

Example 8.5:

Decide whether or not each of the statements below is reasonable.

- a) The probability that you will go to bed before midnight is 0.99.
- b) The probability that your pocket money is doubled tomorrow is 0.01.

Solution:

- a) This is a reasonable statement as it is very likely that you will go to bed before midnight, but not certain that you will.
- b) This is a reasonable statement, as it is very unlikely that your pocket money will be doubled tomorrow, but not totally impossible.

Example 8.6:

On a probability scale, mark and estimate the probability that

- It will rain on today in Addis Ababa.
- Ethiopia will win the next world cup.
- Some one in your class has a birthday tomorrow.

Solution:

- This will depend on the time of year and prevailing weather conditions.

During a dry season:

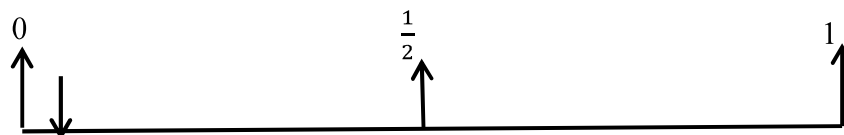


Figure 8.5

During a summer season

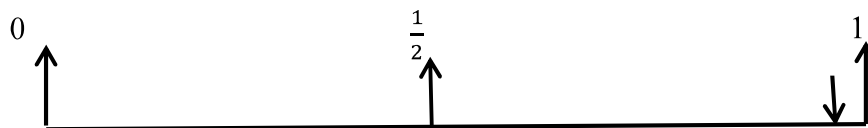


Figure 8.6

- Based on their recent performance, it is reasonable to say that Ethiopia are slightly more unlikely to win the world cup.

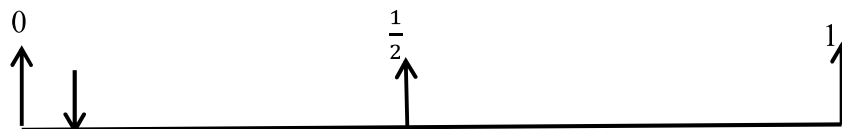


Figure 8.7

- The probability of this will be fairly small, as you can expect there to be about 2 or 3 birth days per month for students in a class of about 45 students.

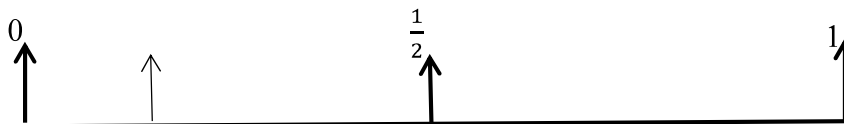


Figure 8.8

Note: probabilities are given on a scale of 0 to 1, as decimals or fractions; sometimes probabilities are expressed as percentages using a scale of 0% to 100% particularly on weather forecasts.

Exercise 8.3:

1. Give at least two examples of events that you think
 - a) are impossible events.
 - b) are certain events.
 - c) are likely.
 - d) are unlikely.
 - e) have an even chance.
2. Draw a probability scale and mark on where you find the following events
 - a) If you toss a coin, you will get a tail.
 - b) It will rain at least one day on July in Addis Ababa.
 - c) You will win a lottery.
 - d) If you roll a die, you will get 6.
 - e) You have already had a birthday this year.

8.2. Probability of Simple events

Competency: At the end of this sub-unit, students should:

- Find the probability of simple events.

In this sub-unit we consider the probabilities of equally likely outcomes, experiment and associated sample space and event, and the different methods of finding the probability of an event.

What does a simple event mean? A simple event is an event containing exactly one outcome. For instance, in a toss of one coin, the occurrence of head is a simple event.

Historical Note

Mathematics was only one area of interest for Gerolamo Cardano. Gambling led Cardano in the 16th century to the study of probability, and he was the first writer of Games of Chance on the subject probability. It is the major starting point of the study of mathematical probability.

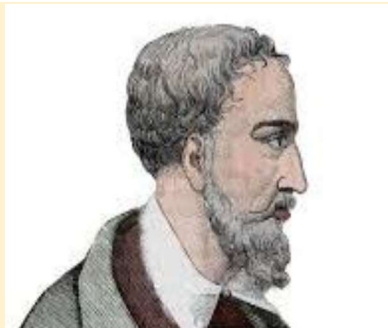


Figure 8.9

The following definition of probability is a theoretical approach of probability.

Definition 8.9

Let S be the possibility set of an experiment and each element of S be equally likely to occur. Then the probability of the event E occurring is given by

$$P(E) = \frac{\text{number of favourable outcomes}}{\text{number of all possible outcomes}} = \frac{n(E)}{n(S)}$$

Example 8.7:

A box contains 5 green balls and 3 black balls. If one ball is drawn at random, what is the probability of getting a

- a) Black ball b) Green ball

Solution:

Let event B = a black ball appears and event G = a green ball appears. There are 8 possible outcomes. Then

$$\text{a) } P(B) = \frac{n(E)}{n(S)} = \frac{3}{8}$$

$$\text{b) } P(G) = \frac{n(E)}{n(S)} = \frac{5}{8}$$

Example 8.8:

A die is thrown once. What is the probability that the number appearing on the upper face will be

- a) 6? b) 7?
c) a number greater than 3 d) a number smaller than 9

Solution:

There are 6 possible outcomes. Hence, $n(S) = 6$

- a) Only one of these outcomes is 6. Hence, $n(E) = 1$

$$\text{Therefore, } P(E) = \frac{n(E)}{n(S)} = \frac{1}{6}$$

- b) 7 do not appear on the experiment. Hence, $n(E) = 0$

$$\text{Therefore, } P(E) = \frac{n(E)}{n(S)} = 0$$

- c) 4, 5, 6 are the required elements. Hence, $n(E) = 3$

$$\text{Therefore, } P(E) = \frac{n(E)}{n(S)} = \frac{3}{6} = \frac{1}{2}$$

- d) All possible outcomes are smaller than 9. Hence $n(E) = 6$

$$\text{Therefore, } P(E) = \frac{n(E)}{n(S)} = \frac{6}{6} = 1$$

Example 8.9:

An integer is chosen at random out of the integers 1 to 50. What is the probability that it is

- a) a multiple 6
- b) divisible by 11
- c) greater than 38

Solution:

The total number of possible outcomes = 50

- a) The favorable outcomes for the event “a multiple of 6” are 6, 12, 18, 24, 30, 36, 42, 48.

Hence, $n(\text{favorable outcomes } E) = 8$.

$$\text{Therefore, } P(E) = \frac{n(E)}{n(S)} = \frac{8}{50} = \frac{4}{25}$$

- b) The favorable outcomes for the event “divisible by 11” are 11, 22, 33, and 44. Hence, $n(\text{favorable outcomes } E) = 4$

$$\text{Therefore, } P(E) = \frac{n(E)}{n(S)} = \frac{4}{50} = \frac{2}{25}$$

c) 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50 are the required events.

Hence, $n(E) = 12$

$$\text{Therefore, } P(E) = \frac{n(E)}{n(S)} = \frac{12}{50} = \frac{6}{25}$$

Example 8.10:

A card is selected at random from a pack of 52 playing cards. What is the probability that it is:

- | | |
|----------------|--------------------|
| a) A red card | d) an even number |
| b) A queen | e) the 7 of hearts |
| c) A red “Ace” | |

Solution:

A standard deck of playing cards consists of 52 cards in each of the four suits of Spades, Hearts, Diamonds, and clubs. Each suit contains 13 cards: Ace, 2, 3, ..., 10, Jack, Queen, and King.

As each card is equally likely to be drawn from the pack,

- a) There are 26 red cards in the pack, so:

$$P(\text{red}) = \frac{26}{52} = \frac{1}{2}$$

- b) There are 4 Queens in the pack, so:

$$P(\text{queens}) = \frac{4}{52} = \frac{1}{13}$$

- c) There are 2 red Aces in the pack, so: $P(\text{red Ace}) = \frac{2}{52} = \frac{1}{26}$

- d) There are 20 cards that have even numbers in the pack, so:

$$P(\text{even number}) = \frac{20}{52} = \frac{5}{13}$$

- e) There is only one 7 of hearts in the pack, so:

$$P(7 \text{ of hearts}) = \frac{1}{52}$$



Figure 8.10

Example 8.11:

Toss a coin twice (or toss two coins once at a time).

- a) Find the possible out comes
- b) Find the probability of getting exactly two heads.
- c) Find the probability of getting at least one tail.

Solution:

- a) The possible outcomes are: HH, HT, TH, TT.

Therefore, the total number of possible outcomes, $n(S) = 4$

- b) The favorable outcome for the event “exactly two heads” is HH.

Hence, the total number favorable outcomes = 1

Therefore, $P(\text{exactly two heads}) = \frac{1}{4}$

- c) The favorable outcomes for the event “at least one tail” are HT, TH, TT.

Hence, the total number favorable outcomes = 3

Therefore, $P(\text{at least one tail}) = \frac{3}{4}$

Example 8.12:

Determine the probability that the sum 7 appear in a single toss of a pair of fair dice?

Solution:

Each of the six faces of one die can be associated with each of the six faces of the other die, so that the total number of cases that can arise are all equally likely is $6 \times 6 = 36$. These can be denoted by (1,1), (2,1), ..., (6,6)

There are six ways of obtaining the sum 7, denoted by (1,6), (2,5), (3,4), (5,2), (4,3), and (6,1).

$$\begin{aligned}\text{Thus } p(\text{sum } 7) &= \frac{6}{36} \\ &= \frac{1}{6}\end{aligned}$$

Example 8.13:

If a family has three children, find the probability that two of the three children are girls.

Solution:

The sample space for the gender of the children for a family that has three children has eight outcomes, that is, BBB, BBG, BGB, GBB, GGG, GGB, GBG and BGG. Since there are three ways to have two girls, namely: GGB, GBG, and BGG.

Therefore, $P(\text{two girls}) = \frac{3}{8}$.

Exercise 8.4

1) A spinner is numbered as shown below in the diagram. Each score is equally likely to occur. What is the probability of scoring

- a) 1
- b) 2
- c) 3
- d) 4
- e) a number less than 5?

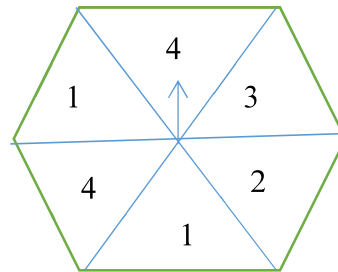


Figure 8.11

2) A letter is chosen at random from the word "ETHIOPIA". Find the probability that it will be:

- a) the letter I?
- b) a vowel?
- c) the letter B?

3) Describe something that has a probability of zero? One?

4) The probability that a train is late is 0.25. Which of the following is the most reasonable?

- a) The train is unlikely to be late.
- b) The train is likely to be late.
- c) The train is impossible to come.

In the above discussion, you saw how to determine probabilities of events of equally likely outcomes using theoretical approach. The following group work introduces you the other approach of probability.

Group Work 8.2:

Perform the following experiment repeatedly and observe your result.

- Toss a coin 10 times, 20 times, and 30 times
- Record your results on landing of coin on Tails.

Number of tosses	Number of Tails
10	
20	
30	

For each row in the table, what proportion of the number of tosses landed as tails?

How do your answers compare with $P(\text{Tail}) = \frac{1}{2}$?

If you toss a coin 480 times, how many times would you expect to obtain a head?

From the above experiment, that is, based on the frequency of an outcome when an experiment is repeated a large number of times under the same conditions, the proportion of times that the outcome is contained in event E approaches some value as the number of repetitions increase and we derive the formula of the probability of a simple event as:

Definition 8.10:

The probability of an event is the ratio of the number of successful outcomes in the event to the total number of possible outcomes in the experiment.

$$\text{Thus, } P(\text{Event}) = \frac{\text{Number of times the event occur}}{\text{Total number of observations}}$$

[experimental approach of probability]

Example 8.14:

If a certain experiment record shows 120 tails get out of 10,000 trial of throwing a coin, then what is the probability of getting another tail?

Solution:

$$\begin{aligned} P(\text{Event}) &= \frac{\text{Number of times the event occur}}{\text{Total number of observations}} \\ &= \frac{120}{10000} \\ &= 0.012 \end{aligned}$$

Therefore, the probability of getting tail for the next throw is 0.012.

Example 8.15:

Suppose you roll a fair die 240 times. How many times would you expect to obtain?

- a) a 4? b) an even score c) a score greater than 4

Solution:

a) $P(4) = \frac{1}{6}$ (Theoretical probability)

$$\text{Expected number of 4's} = \frac{1}{6} \times 240 = 40$$

b) $P(\text{Even score}) = \frac{1}{2}$

$$\text{Expected number of even scores} = \frac{1}{2} \times 240 = 120$$

c) $P(\text{score greater than 4}) = \frac{2}{6} = \frac{1}{3}$

$$\text{Expected number of scores greater than 4} = \frac{1}{3} \times 240 = 80$$

8.3. Applications on Business, Climate, Road Transport,

Accidents and Drug Effects

Competency: At the end of this sub-unit, students should:

- Solve the probability of real-life problems.

The preceding sections contained a discussion of the meaning and different ways of viewing probability. This section focuses on some real-life applications of probability.

Example 8.16:

At a car park there are 52 vehicles, 26 of which are cars, 8 are vans and the remaining Lorries. If every vehicle is equally likely to leave, find the probability of

- a) A van leaving first.
- b) A lorry leaving first.

Solution:

- a) Let E be the event of van leaving first. Then $n(E) = 8$

$$P(\text{van leaving first}) = P(E) = \frac{n(E)}{n(S)} = \frac{8}{52} = \frac{2}{13}$$

- b) Let A be the event of a lorry leaving first. Then

$$n(A) = 52 - 26 - 8 = 18$$

$$P(\text{lorry leaving first}) = P(A) = \frac{n(E)}{n(S)} = \frac{18}{52} = \frac{9}{26}$$

Example 8.17:

A factory has 2 machines A and B producing 300 and 720 bulbs per day respectively. A produces 1% defective and B produces 1.5% defective. A bulb is chosen at random at the end of a day and found defective. What is the probability that

- a) Machine A produces a defective bulb
- b) Machine B produces a defective bulb.

Solution:

- a) Number of defective bulbs produced by machine

$$A = 1\% \times 300 = 3$$

Therefore, the probability of the chosen bulb defective is

$$P(\text{defective bulb}) = \frac{3}{300} = 0.01$$

- b) Number of defective bulbs produced by machine

$$B = 1.5\% \times 720 = 108$$

Therefore, the probability of the chosen bulb defective is

$$P(\text{defective bulb}) = \frac{108}{720} = 0.15$$

Example 8.18:

Suppose that a researcher for the road transport office asked 350 people who plan to travel over the Epiphany holiday how they will get to Gondar from Addis Ababa. The result can be categorized as: drive-85, fly-115 and bus-150. In the travel survey, just described find the probability that a person will travel by bus over the Epiphany holiday?

Solution:

Total number of travellers = 350

Number of travellers by using bus = 150 = n(E)

$$P(\text{Event}) = \frac{\text{Number of times the event occur}}{\text{Total number of observations}}$$

$$P(E) = \frac{150}{350} = \frac{3}{7} = 0.43$$

Example 8.19:

The record of a weather station shows that out of the past 250 consecutive days, its weather forecasts were correct 205 times. What is the probability that

- On a given day it was correct?
- It was not correct on a given day?

Solution:

$$\begin{aligned} \text{a) } P(\text{correct}) &= \frac{\text{number of days when the forecast was correct}}{\text{total number of days for which the records is available}} \\ &= \frac{205}{250} \\ &= 0.82 = 82\% \end{aligned}$$

Therefore, 82% of the next forecast will be correct.

$$\begin{aligned} \text{b) } P(\text{incorrect}) &= \frac{\text{number of days when the forecast was not correct}}{\text{total number of days for which the records is available}} \\ &= \frac{250 - 205}{250} \\ &= \frac{45}{250} \\ &= 0.18 = 18\% \end{aligned}$$

Therefore, 18% of the next forecast will be incorrect.

Example 8.21:

A company receives regular deliveries of raw materials from a supplier. The supplies do not always arrive on time. Over the last 120 delivery days, supplies have been late on 15 occasions. What is the probability that the supplies will be on time on the next delivery?

Solution:

Number of days arrive on time = $120 - 15 = 105$.

$$P(\text{arrive on time}) = \frac{105}{120} = 0.875 = 87.5\%$$

Therefore, the on time delivery the supply will be 87.5%.

Example 8.22:

According to Addis Ababa Annual Road Safety Report; The following table presents summary findings on fatally injured victims from road traffic crashes in 2011 E.C in Addis Ababa.

Deaths	Fatal crashes	Injury crashes	Property damage	Total
458	1875	1115	26000	29448

Find the probability of

- Being killed in a road traffic crash.
- Being injured in a road traffic crash.

Solution:

$$\text{a) } P(\text{deaths}) = \frac{458}{29448} = 0.016 = 1.6\%$$

$$\text{b) } P(\text{injured}) = \frac{1875 + 1115}{29448} = \frac{2990}{29448} = 0.102 = 1.02\%$$

Therefore, according to road traffic crashes in 2011 E.C in Addis Ababa was 1.6% of victims died and 1.02% of victims injured.

Example 8.23:

Are we likely to die in an accident? For instance,

Per 100,000 populations in Addis Ababa the death rate in 2011 was 13.3. Find the probability of being to die in a car accident?

Solution:

The chance of being killed in a crash = $\frac{13.3}{100000} = 0.000133 = 0.0133\%$

Thus, a person has a 0.0133% chance to die in a car accident.

Example 8.24:

The blood type of 400 people is grouped as follows.

Blood types	A	B	AB	O
Number of people	108	96	88	108

If a person is selected at random from the group, what is the probability that the person has a blood type A?

Solution:

$$n(S) = 400$$

$$n(E) = 108, \text{ where } E \text{ is an event with blood type A.}$$

$$\text{Then, } p(E) = \frac{n(E)}{n(S)} = \frac{108}{400} = 0.27 = 27\%$$

Therefore, the probability of selecting a person with blood type A is 27%.

SUMMARY FOR UNIT 8

1. A process of an observation is often called an **experiment**.
2. The possibility set for an experiment is the set of all possible outcomes of the experiment. It also known as **the sample space**.
3. An event is a favorable outcome from the possibility set.
4. If S is the possibility set of an experiment and each element of S is equally likely, then the probability of an event E occurring, denoted by P(E), is defined as

$$P(E) = \frac{\text{number of favourable outcomes}}{\text{number of all possible outcomes}} = \frac{n(E)}{n(S)}$$

5. Probabilities can be expressed as fractions, decimals, or where appropriate percentages.
6. An event which is certain to happen has a probability of 1.
7. An event which cannot happen is impossible event and has a probability of 0.
8. The probability of an event is the ratio of the number of successful outcomes in the event to the total number of possible outcomes in the experiment.

Thus, $P(Event) = \frac{\text{Number of times the event occur}}{\text{Total number of observations}}$ [experimental approach of probability]

9. The probability of any event E is a number between and including 0 and 1. This is denoted by $0 \leq P(E) \leq 1$. Therefore, probabilities cannot be negative or greater than 1.

REVIEW EXERCISE FOR UNIT 8

- 1) Write true if the statement is correct and false if it is not.
 - a) The probability of an event that is sure to occur is $\frac{1}{2}$.
 - b) If three coins are thrown at a time, then $n(S) = 8$
 - c) If the set of all possible outcomes is an event, the probability of an event is 1.
 - d) The range of the values of the probability of an event is between 0 and 1.
- 2) Answer the following questions.
 - a) What is a probability experiment?
 - b) Define sample space.
 - c) What is the difference between an outcome and an event?
 - d) What are equally likely events?
 - e) If an event cannot happen, what value is assigned to its probability?
- 3) Which of the following statements describe a certain event?
 - a) Roll a die once and the event of getting a number less than 7.
 - b) Toss a coin twice and the event of getting two tails.
 - c) Out of a family of 4 girls the event of selecting two boys.
- 4) Suppose you write the days of the week on identical pieces of paper. Mix them and select one at a time. What is the probability that the day you select will have
 - a) The letter r in it.
 - b) The letter d in it.
 - c) The letter b in it.
- 5) A number is chosen out of the numbers 1 through 30. What is the probability that it is:
 - a) A multiple of 6?
 - b) A perfect square?

- 6) A coin has two sides, heads and tails
- Surafel is going to toss a coin. What is the probability that Surafel will get heads? Write your answer as a fraction and decimal.
 - Meseret is going to toss 2 coins. Copy and complete the following table to show the different results she could get.

First toss	Second toss
Heads	Heads

- What is the probability that she will get tails with both her coins?
- 7) If a die is rolled one time, find these probabilities
- Of getting a 4
 - Of getting an even number
 - Of getting a number greater than 4
 - Of getting a number less than 7
- 8) Suppose a pair of dice is thrown.
- Set up a sample space.
 - What is the probability that
 - The sum of the scores is 7?
 - Both numbers are the same?
 - The first number is odd and the second number is even.
 - A sum is greater than 9

- 9) There are 18 tickets marked with numbers 1 to 18. What is the probability of selecting a ticket having the following property?
- a) Even number
 - b) Number divisible by 3
 - c) Prime number
 - d) Number divisible by 4
- 10) There are 20 pens in a box, 13 of the pens are blue. 7 of the pens are black.
- If one pen is chosen random, what is the probability of getting
- a) Blue pen?
 - b) Red pen?
 - c) Both color?
- 11) A spinner is marked with the letters A, B, C, and D, so that each letter is equally likely to be obtained. The spinner is spun twice.
- a) List the 16 possible outcomes.
 - b) What is the probability that
 - i) A is obtained twice
 - ii) A is obtained at least once.
 - iii) both letters are the same.
 - iv) the letter B is not obtained at all
- 12) In a class there are 12 boys and 14 girls. The teacher calls on a student at random to read a theorem stated on a text book. What is the probability that the first person called a girl?
- 13) There are seven cups of coffee on a table. Three of them contain sugar. What is your chance of choosing a cup with sugar in it?

The Function $y = x^2$
5.69

$$1.00 \leq x \leq$$

X	0	1	2	3	4	5	6	7	8	9
1.0	1.000	1.020	1.040	1.061	1.082	1.102	1.124	1.145	1.166	1.188
1.1	1.210	1.232	1.254	1.277	1.277	1.322	1.346	1.369	1.392	1.416
1.2	1.440	1.464	1.488	1.513	1.513	1.562	1.588	1.613	1.638	1.644
1.3	1.690	1.716	1.742	1.769	1.769	1.822	1.850	1.877	1.904	1.932
1.4	1.960	1.988	2.016	2.045	2.045	2.102	2.132	2.161	2.190	2.220
1.5	2.250	2.280	2.316	2.341	2.341	2.402	2.434	2.465	2.496	2.528
1.6	2.560	2.592	2.610	2.657	2.657	2.722	2.756	2.789	2.822	2.856
1.7	2.890	2.924	2.964	2.993	2.993	3.062	3.098	3.133	3.168	3.204
1.8	3.240	3.276	2.958	3.349	3.349	3.422	3.460	3.497	3.534	3.572
1.9	3.610	3.648	3.686	3.725	3.764	3.802	3.842	3.881	3.920	3.960
2.0	4.000	4.040	4.080	4.121	4.162	4.202	4.244	4.285	4.326	4.368
2.1	4.410	4.452	4.494	4.537	4.580	4.622	4.666	4.709	4.752	4.796
2.2	4.840	4.884	4.928	4.973	5.018	5.062	5.108	5.153	5.198	5.244
2.3	5.290	5.336	5.382	5.429	5.476	5.522	5.570	5.617	5.664	5.712
2.4	5.760	5.808	5.856	5.905	5.954	6.002	6.052	6.101	6.150	6.200
2.5	6.250	6.300	6.350	6.401	6.452	6.502	6.554	6.605	6.656	6.708
2.6	6.760	6.812	6.864	6.917	6.970	7.022	7.076	7.129	7.182	7.236
2.7	7.290	7.344	7.398	7.453	7.508	7.562	7.618	7.673	7.728	7.784
2.8	7.840	7.896	7.952	8.009	8.066	8.122	8.180	8.237	8.294	8.352
2.9	8.410	8.468	8.526	8.585	8.644	8.702	8.762	8.821	8.880	8.940
3.0	9.000	9.060	9.120	9.181	9.242	9.302	9.364	9.425	9.486	9.548
3.1	9.610	9.672	9.734	9.797	9.860	9.922	9.986	10.05	10.11	10.18
3.2	10.24	10.30	10.37	10.43	10.50	10.56	10.63	10.69	10.76	11.82
3.3	10.89	10.96	11.02	11.09	11.16	11.22	11.29	11.36	11.42	11.49
3.4	11.56	11.63	11.70	11.76	11.83	11.90	11.97	12.04	12.11	12.18
3.5	14.25	12.32	12.39	12.46	12.53	12.60	12.67	12.74	12.82	12.89
3.6	12.96	13.03	13.10	13.18	13.25	13.32	13.40	13.47	13.54	13.62
3.7	13.69	13.76	13.84	13.91	13.99	14.06	14.14	14.21	14.29	14.36
3.8	14.44	14.52	14.59	14.67	14.75	14.82	14.90	14.98	15.08	15.13
3.9	15.21	15.29	15.37	15.44	15.52	15.60	15.68	15.76	15.84	15.92
4.0	16.00	16.08	16.16	16.24	16.32	16.40	16.48	16.56	16.65	16.73
4.1	16.81	16.89	16.97	17.06	17.14	17.22	17.31	17.39	17.47	17.56
4.2	17.64	17.72	17.81	17.89	17.98	18.06	18.15	18.23	18.32	18.40
4.3	18.49	18.58	18.66	18.75	18.84	18.92	19.01	19.10	19.18	19.27
4.4	19.96	19.45	19.54	19.62	19.71	19.80	19.89	19.98	20.98	20.16
4.5	20.25	20.34	20.43	20.52	20.61	20.70	20.79	20.88	21.90	21.07

4.6	21.16	21.25	21.34	21.44	21.53	21.62	21.72	21.81	22.85	22.00
4.7	22.09	22.18	22.28	22.37	22.47	22.56	22.66	22.75	23.81	22.94
4.8	23.04	23.14	23.33	23.33	23.43	23.52	23.62	23.72	24.80	23.91
4.9	24.01	24.11	24.24	24.30	24.40	24.50	24.60	24.70	25.81	24.90
5.0	25.00	25.10	25.20	25.30	25.40	25.50	25.60	25.70	26.83	25.91
5.1	26.01	26.11	26.21	26.32	26.42	26.52	26.63	26.73	27.88	26.94
5.2	27.04	27.14	27.25	27.35	27.46	27.56	27.67	27.77	28.94	27.98
5.3	28.09	28.20	28.30	28.41	28.52	28.62	28.73	28.84	28.94	29.05
5.4	29.16	29.27	29.38	29.48	29.59	29.70	29.81	29.92	30.03	30.14
5.5	30.25	30.36	30.47	30.58	30.69	30.80	30.91	31.02	31.14	31.25
5.6	31.36	31.47	31.58	31.70	31.81	31.92	32.04	32.15	32.26	32.38
The Function $y = x^2$					$5.70 \leq x \leq 9.99$					
5.7	32.46	32.60	32.72	32.83	32.95	33.06	33.18	33.29	33.41	33.52
5.8	33.64	33.76	33.87	33.99	34.11	34.22	34.34	34.46	34.57	34.69
5.9	34.81	34.93	35.05	35.16	35.28	35.40	35.52	35.64	35.76	35.88
6.0	36.00	36.12	36.24	36.36	36.48	36.60	36.72	36.84	36.97	37.09
6.1	37.21	37.33	37.45	37.58	37.70	37.82	37.95	38.07	38.19	38.32
6.2	38.44	38.56	38.69	38.81	38.94	39.06	39.19	39.31	39.44	39.56
6.3	39.69	39.82	39.94	40.07	40.20	40.32	40.45	40.58	40.70	40.83
6.4	40.96	41.09	41.22	41.34	41.47	41.60	41.73	41.86	41.99	42.12
6.5	42.25	42.38	42.51	42.64	42.77	42.90	43.03	43.16	43.30	43.43
6.6	43.56	43.69	43.82	43.96	44.09	44.22	44.36	44.49	44.62	44.77
6.7	44.89	45.02	45.16	45.29	45.43	45.56	45.70	45.83	45.97	46.10
6.8	46.24	46.38	46.51	46.65	46.79	46.92	47.06	47.20	47.34	47.47
6.9	47.61	47.75	47.89	48.02	48.16	48.30	48.44	48.58	48.72	48.86
7.0	49.00	49.14	49.28	49.42	49.56	49.70	49.84	49.98	50.12	50.27
7.1	50.41	50.55	50.69	50.84	50.98	51.12	51.27	51.41	51.56	51.70
7.2	51.84	51.98	52.13	52.27	52.42	52.56	52.71	52.85	53.00	53.14
7.3	53.29	53.44	53.58	53.73	53.88	54.02	54.17	54.32	54.47	54.61
7.4	54.76	54.91	55.06	55.20	55.35	55.50	55.65	55.80	55.95	56.10
7.5	56.25	56.40	56.55	56.70	56.85	57.00	57.15	57.30	57.45	57.61
7.6	57.76	57.91	58.06	58.22	58.37	58.52	58.68	58.83	58.99	59.14
7.7	59.29	59.44	59.60	59.75	59.91	60.06	60.22	60.37	60.53	60.68
7.8	60.84	61.00	61.15	61.31	61.47	61.62	61.78	61.94	62.10	62.25
7.9	62.41	62.57	62.73	62.88	63.04	63.20	63.36	63.52	63.68	63.84
8.0	64.00	64.16	64.32	64.48	64.64	64.80	64.96	65.12	65.29	65.45
8.1	65.61	65.77	65.93	66.10	66.26	66.42	66.59	66.75	66.91	67.08
8.2	67.24	67.40	67.57	67.73	67.90	68.06	68.23	68.39	68.56	68.72

8.3	68.29	69.06	69.22	69.39	69.56	69.72	69.89	70.06	70.22	70.39
8.4	70.56	70.73	70.90	71.06	71.23	71.40	71.57	71.74	71.91	72.01
8.5	72.25	72.42	72.59	72.76	72.93	73.10	73.27	73.44	73.62	73.79
8.6	73.96	74.13	74.30	74.48	74.65	74.82	75.00	75.17	75.34	75.52
8.7	75.69	75.86	76.04	76.21	76.39	76.56	76.74	76.91	76.09	77.26
8.8	77.44	77.62	77.79	77.97	78.15	78.32	78.50	78.68	78.85	79.03
8.9	79.21	79.39	79.57	79.74	79.92	80.10	80.28	80.46	80.46	80.82
9.0	81.00	81.18	84.36	81.54	81.72	81.90	82.08	82.26	82.45	82.63
9.1	82.81	82.99	83.17	83.36	83.54	83.72	83.91	84.09	86.12	84.46
9.2	84.64	84.82	85.01	85.19	85.38	85.56	85.75	84.93	87.96	86.30
9.3	86.49	86.68	86.86	87.05	87.24	87.42	87.61	87.80	87.96	88.17
9.4	88.36	88.55	88.74	88.92	89.11	89.30	89.49	89.68	89.87	90.06
9.5	90.25	90.44	90.63	90.82	91.01	91.20	91.39	91.58	91.78	91.97
9.6	92.16	92.35	92.54	92.74	92.93	93.12	93.32	93.51	93.70	93.90
9.7	94.09	94.28	94.67	94.67	94.87	95.06	95.26	95.45	95.65	95.84
9.8	96.04	96.24	96.43	96.63	96.83	97.02	97.22	97.42	97.61	97.81
9.9	98.01	98.21	98.41	98.60	98.80	99.00	99.20	99.40	99.60	99.80

$(7.95)^2 = 63.20$, $(0.795)^2 = 0.6320$, $(79.5)^2 = 6320$, $\sqrt{23.33} = 4.83$, $\sqrt{2333} = 48.3$, $\sqrt{0.2333} = 0.483$

If you move the comma in x one digit to the right (left), then the comma in x^2 must be two digits to the right (left)