

**Unit 7**  
**Probability**

**M2 13.1,2,4, 5,6**

# 7.1 Probability



- **Obj.:** I will be able to determine the experimental and theoretical probabilities of an event, or its complement, occurring.

## ■ Vocabulary

○ Outcome	○ Event	○ Sample Space	○ Probability
○ Experimental Probability		○ Theoretical Probability	
○ Complement of an Event		○	

# 7.1 Probability



## ■ Outcomes

- An outcome is the possible result of a situation or experiment.
- An event may be a single outcome or a group of outcomes
- The set of all possible outcomes is the sample space

# 7.1 Probability



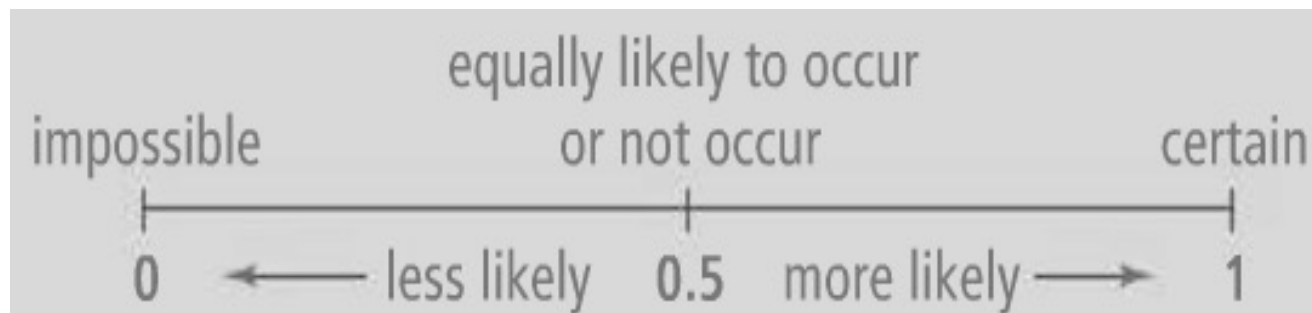
## ■ Probabilities

### ■ Probability

■ A numerical value from 0 to 1 that measures the likelihood of an event

■ Notation:  $P(\text{event})$

■ 
$$P(\text{event}) = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}}$$



# 7.1 Probability



## ■ Experimental Probability

- The likelihood that an event occurs based on the actual results of an experiment

- $$P(\text{event}) = \frac{\text{number of times the event occurs}}{\text{number of times the experiment is done}}$$

## ■ Theoretical Probability

- The likelihood of an event based on mathematical reasoning

# 7.1 Probability



- Complement of an event
  - Consists of all the possible outcomes in the sample space that are not part of the event.
  - Probability of a Complement
    - The sum of the probability of an event and its complement is 1
    - Notation:  $P(\text{not event})$
    - $P(\text{event}) + P(\text{not event}) = 1$

$$P(\text{not event}) = 1 - P(\text{event})$$

# 7.1 Probability - Practice



You roll a standard number cube 10 times. The results are shown below.

6, 4, 6, 1, 5, 2, 4, 2, 4, 3

Find the experimental probability of each outcome.

1.  $P(\text{rolling an even number})$                       2.  $P(\text{rolling a 1})$

Find the theoretical probability of each outcome.

3.  $P(\text{rolling a 5})$     4

5.  $P(\text{rolling an odd number})$     6

A bag contains 2 red ping-pong balls, 3 green ping-pong balls, 3 blue ping-pong balls, and 1 yellow ping-pong ball. Find the probability of randomly selecting each outcome.

7.  $P(\text{not red})$     8.  $P(\text{not green})$

Two standard number cubes are rolled. Find each probability.

9.  $P(\text{a sum equal to 2})$     10.  $P(\text{sum not equal to 2})$

11.  $P(\text{a product equal to 15})$     12.  $P(\text{a sum greater than 6})$

# 7.2 Tables



- *Obj.:* I will be able to read frequency tables and two-way frequency tables. I will be able to determine relative frequencies, probability distributions, and conditional probabilities of events.

## ■ Vocabulary

◦ Frequency Table	◦ Relative Frequency	◦ Probability Distribution
◦ Two-Way Frequency Table	◦ Conditional Probability	



## 7.2 Tables



- **Frequency Tables**
  - **Displays data that shows how often an item appears in a category**
  - **Relative Frequency**
    - **Relative frequency is the ratio of the frequency of the category to the total frequency**
    - **Can be used to approximate probabilities of events**

## 7.2 Tables



- **Probability Distribution**
  - Shows the probability of each possible outcome.
  - Can be shown in a frequency table
- **Two-Way Frequency Tables**
  - A.k.a. contingency table
  - Frequencies of data in two different categories

## 7.2 Tables



- **Conditional Probability**
  - The probability that an event will occur given that another event has already occurred
  - Probability of event B given that event A has occurred:  $P(B | A)$

# 7.2 Tables - Practice



1. Waterskiing
2. Hiking
3. Canoeing

**Camp Activities**

Activity	Number of People
Waterskiing	12
Hiking	18
Canoeing	13

Colors	RR	RB	RG	BB	BR	BG	GG	GR	GB
Frequency	3	5	2	1	4	2	3	2	1

4. What is the probability of spinning red *exactly* once on the next two spins?
5. What is the probability of spinning blue twice on the next two spins?
7. What is the probability that a randomly chosen patient exercised and did not catch a cold?
8. What is  $P(\text{did not exercise} \mid \text{did not catch a cold})$ ?

	Caught a cold	Did not catch a cold	Totals
Exercised	8	30	38
Did not exercise	10	2	12
Totals	18	32	50

# 7.2 Tables - Practice



9. What is  $P(\text{girl})$ ?

10. What is  $P(\text{has not played tennis})$ ?

	Has played tennis	Has not played tennis	Totals
Boys	10	6	16
Girls	10	4	14
Totals	20	10	30

11. What is the probability that a randomly selected student has a yard given that they have pets?

12. What is  $P(\text{does not have a yard} \mid \text{have no pets})$ ?

	Pets	No pets	Totals
Yard	0.60	0.05	0.65
No yard	0.25	0.10	0.35
Totals	0.85	0.15	1

13. What is  $P(\text{has red berries} \mid \text{has lobed leaves})$ ?

14. What is  $P(\text{has lobed leaves} \mid \text{has red berries})$ ?

	Lobed Leaves	Non-lobed Leaves	Totals
Red Berries	12	48	60
No Red Berries	40	0	40
Totals	52	48	100

## 7.3 Compound Probabilities



- **Compound Events**
  - Events that are made up of two or more events
  - If the occurrence of an event does not affect how another event occurs, the events are called independent events.
  - If the occurrence of an event does affect how another event occurs, the events are called dependent events.
  - Two events are independent if and only if
$$P(A \text{ and } B) = P(A) * P(B)$$

## 7.3 Compound Probabilities



### ■ Mutually Exclusive Events

- Events that cannot happen at the same time
- The probability of both A and B occurring is 0.
- If A and B are mutually exclusive events, then  $P(A \text{ and } B) = 0$ , and  $P(A \text{ or } B) = P(A) + P(B)$

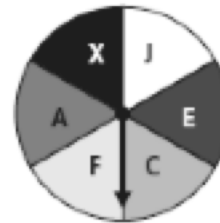
### ■ Overlapping Events

- Events with outcomes in common.
- If A and B are overlapping events, then  $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

# 7.3 Compound Probabilities - Practice



1. You roll a 2 on a number cube and spin a 3 on a spinner.
3. What is  $P(A \text{ and } B)$  if  $P(A) = \frac{1}{2}$  and  $P(B) = \frac{2}{7}$ , where  $A$  and  $B$  are independent events?
5. What is  $P(A \text{ or } B)$  if  $P(A) = 32\%$  and  $P(B) = 17\%$ , where  $A$  and  $B$  are mutually exclusive events?
7. What is  $P(A \text{ or } B)$  if  $P(A) = \frac{1}{4}$  and  $P(B) = \frac{1}{2}$ , where  $A$  and  $B$  are overlapping events?
9. In a local town, 55% of the residents drive to work, 23% of the residents own a dog, and 6% of the residents walk to work. Find the probability that a randomly chosen resident owns a dog or walks to work.
11. What is the probability of the arrow stopping on a consonant or one of the first 4 letters of the alphabet?
12. What is the probability of the arrow stopping on "X" on the first spin and "F" on the second spin?





## 7.4 Conditional Probabilities



- *Obj.:* I will be able to calculate the conditional probability of events without a table. I will be able to determine if two events are independent using conditional probabilities.

## 7.4 Conditional Probabilities



### ■ Conditional Probabilities

- For any two events  $A$  and  $B$ , the probability of  $B$  occurring, given that  $A$  has occurred, is

$$P(B|A) = \frac{P(A \text{ and } B)}{P(A)}, \text{ where } P(A) \neq 0$$

- Not reversible  $\rightarrow P(B|A) \neq P(A|B)$
- The formula for conditional probabilities can be rearranged to solve for the probability of two events occurring when you know the conditional probability:  
 $P(A \text{ and } B) = P(A) * P(B|A)$

## 7.4 Conditional Probabilities



### ■ Independent Events

- Two events  $A$  and  $B$  are independent events if and only if  $P(A | B) = P(A)$  and  $P(B | A) = P(B)$

# 7.4 Conditional Probabilities - Practice



At a recent swim meet, half of the swim club members experienced an improvement in their race times over a previous swim meet. The probability of a swim club member experiencing an improvement in their race time and training the week before the meet was 30%.

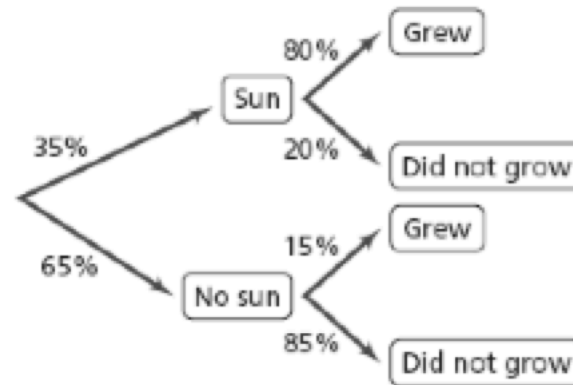
1. What is the probability that a swimmer trained the week before the meet given that his or her race time improved?
3. Half of a class took Form A of a test, and half took Form B. Of the students who took Form B, 39% passed. What is the conditional probability that a randomly chosen student took Form B and passed?
5. In the senior class, 24% of the students play softball, 32% of the students play field hockey, and 14% play both. What are the probabilities that a softball player also plays field hockey, and a field hockey player also plays softball?

# 7.4 Conditional Probabilities - Practice



Use the diagram at the right for Exercises 6 and 7. The tree diagram shows the percentages of plants that received sunlight and whether or not they grew.

6. What is the combined probability that a plant grew?
7. What is the combined probability that a plant did not grow?



9. Of a group of friends, 28% take dance lessons, 32% take singing lessons, and 8% take both. What is the probability that a dancer takes singing lessons? What is the probability that a singer takes dance lessons?