Basic Probability

Objective 1: Simple Probability

To find the probability of event E,

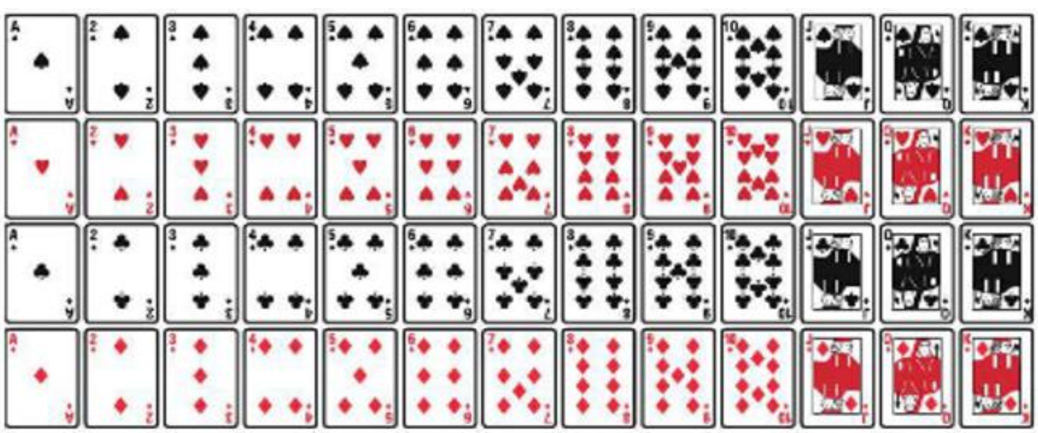
$$P(E) = \frac{\text{number of ways event } E \text{ can occur}}{\text{total number of outcomes in sample space}}$$

Example 1: In a pet store, there are 15 puppies, 22 kittens, and 18 rabbits. What is the probability of randomly selecting a rabbit?

Example 2: The following data represent the number of classes a student is taking and their gender. What is the probability that a randomly selected student is taking 1 class?

	1 class	2 classes	3 classes	4+ classes	TOTAL
Female	13	35	56	28	**132**
Male	35	29	38	13	**115**
TOTAL	**48**	**64**	**94**	**41**	**247**

Example 3: What is the probability of drawing a heart from a standard 52-card deck?



1. In the game of Roulette, a wheel is spun and a ball will randomly come to rest in a slot on the wheel. If there are 18 red slots, 18 black slots, and 2 green slots, what is the probability that the ball will come to rest in a red slot? Round your answer to 4 decimal places, if necessary.

2. What is the probability of drawing a "9" from a standard 52- deck of cards? Write your answer as a fraction in lowest terms.

3. The following data represent the number of classes a student is taking and their gender. What is the probability that a randomly selected student is male? Round your answer to four decimal places.

	1 class	2 classes	3 classes	4+ classes	TOTAL
Female	13	35	56	28	**132**
Male	35	29	38	13	**115**
TOTAL	**48**	**64**	**94**	**41**	**247**

Objective 2: Addition Rule for Disjoint Events

Definition: *Two events, E and F, are* ***disjoint (****or* ***mutually exclusive)*** *if they have no outcomes in common.*

Addition Rule for Disjoint (Mutually Exclusive) Events

If two events E and F are disjoint, then the probability of event E ***OR*** *the probability of event F occurring is*

$$P(E\ OR\ F) = P(E) + P(F)$$

<u>Example 4</u>: What is the probability of drawing a king or a queen from a standard deck of 52 playing cards?

<u>Example 5</u>: The following data represent the number of classes a student is taking and their gender. What is the probability that a randomly selected student is taking 2 classes or 3 classes?

	1 class	**2 classes**	**3 classes**	**4+ classes**	**TOTAL**
Female	13	35	56	28	**132**
Male	35	29	38	13	**115**
TOTAL	**48**	**64**	**94**	**41**	**247**

1. What is the probability of drawing a "Red Card" or a "Club" from a standard deck of 52 playing cards? The red cards include the hearts and the diamonds. Write your answer as a fraction in lowest terms.

2. The following data represent the number of classes a student is taking and their gender. What is the probability that a randomly selected student is taking 1 class or 2 classes or 3 classes? Round your answer to 4 decimal places.

	1 class	**2 classes**	**3 classes**	**4+ classes**	**TOTAL**
Female	13	35	56	28	**132**
Male	35	29	38	13	**115**
TOTAL	**48**	**64**	**94**	**41**	**247**

Objective 3: General Addition Rule

If two events are not disjoint, which means they do have outcomes in common, then you should use the General Addition Rule.

General Addition Rule

For ANY two events E and F, then the probability of event E ***OR*** *the probability of event F occurring is*

$$P(E\ OR\ F) = P(E) + P(F) - P(E\ AND\ F)$$

Example 6: What is the probability of drawing a diamond or a king from a standard deck of 52 playing cards?

Example 7: The following data represent the number of classes a student is taking and their gender. What is the probability that a randomly selected student is a female or taking 3 classes?

	1 class	**2 classes**	**3 classes**	**4+ classes**	**TOTAL**
Female	13	35	56	28	**132**
Male	35	29	38	13	**115**
TOTAL	**48**	**64**	**94**	**41**	**247**

1. What is the probability of drawing a red card or a "Face card" from a standard deck of 52 playing cards? A face card is a jack, queen, or king. Round your answer as a fraction in lowest terms.

2. The following data represent the number of classes a student is taking and their gender. What is the probability that a randomly selected student is a male or taking 2 classes? Round your answer to 4 decimal places.

	1 class	**2 classes**	**3 classes**	**4+ classes**	**TOTAL**
Female	13	35	56	28	**132**
Male	35	29	38	13	**115**
TOTAL	**48**	**64**	**94**	**41**	**247**

Objective 4: Complement Rule

Definition: *Let E be any event. Then, the* ***complement of E****, denoted as* $\boldsymbol{E^c}$*, is all the outcomes in the sample space that are* ***NOT*** *outcomes in the event E.*

Complement Rule

If E represents any event and E^c *represents the complement of* E*, then*

$$P(E^c) = 1 - P(E) \quad \text{and} \quad P(E) = 1 - P(E^c)$$

Example 8: What is the probability of not drawing a spade card from a standard deck of 52 playing cards?

Example 9: According to the Pew Research Group, 81% of teens use social media networks. What is the probability that a randomly selected teen does not use social media networks?

1. A class of 36 students has 3 students who are Math majors. If one student from the class is selected at random, find the probability that he/she is not a Math major. Write your answer as a fraction in lowest terms.

2. According to the Statistical Abstract of the United States, about 17% of all 18- to 25-year-olds are current marijuana users. What is the probability that an 18- to 25-year-old does not use marijuana?

Objective 5: Multiplication Rule for Independent Events

Definition: *Two events E and F are* ***independent*** *if the occurrence of event E does not affect the probability of event F. Two events are* ***dependent*** *if the occurrence of event E does affect the probability of event F.*

Multiplication Rule for Independent Events

*If E and F are independent events, then the probability of event E **AND** event F occurring would be*

$$P(E\ AND\ F) = P(E) \cdot P(F)$$

<u>Example 10</u>: A die is rolled and a coin is flipped. What is the probability that the result of the die is a 5 and the coin comes up heads?

<u>Example 11</u>: According to the Pew Research group, 95% of teens use the internet. Suppose four teens are randomly selected. What is the probability that all four use the internet?

1. 98% of men have a height less than 76 inches (6 ft. 4 in). Suppose 10 men are chosen at random. What is the probability that all 10 of them have a height less than 76 inches? Write your answer rounded to 4 decimal places.

2. Two coins are flipped and a die is rolled. What is the probability that both the coins land "heads", and the die is <u>not</u> a "6"? Write your answer as a fraction in lowest terms.

Objective 6: Conditional Probability

Definition: *The* ***conditional probability,*** *denoted as* $\boldsymbol{P(E|F)}$***,*** *is the probability that event E occurs GIVEN that event F has already occurred.*

Conditional Probability

If E and F are any events, then the conditional probability, $P(E|F)$*, can be found by*

$$P(E|F) = \frac{P(E\ AND\ F)}{P(F)} \quad \text{or} \quad P(E|F) = \frac{\text{number of outcomes in E AND F}}{\text{number of outcomes in F}}$$

Example 12: According to the U.S. National Center for Health Statistics, in 1997, 0.2% of deaths in the U.S. were of 25–34 year olds whose cause of death was cancer. In addition, 1.97% of all people who died were 25–34 years old. What is the probability that a randomly selected death is the result of cancer, if the individual is known to have been 25–34 years old?

Example 13: The following data represent the number of classes a student is taking and their gender. What is the probability that a randomly selected student is taking 3 classes, given that the student is male?

	1 class	**2 classes**	**3 classes**	**4+ classes**	**TOTAL**
Female	13	35	56	28	**132**
Male	35	29	38	13	**115**
TOTAL	**48**	**64**	**94**	**41**	**247**

1. 17.8% of U.S. adults are cigarette smokers. 13.96% of U.S. adults are cigarette smokers and smoke every day. What is the probability that a randomly selected U.S. adult smokes cigarettes every day given that he/she is a smoker? Round your answer to 4 decimal places.

2. The following data represent the number of classes a student is taking and their gender. What is the probability that a randomly selected student is female, given that the student is taking 4+ classes? Round your answer to 4 decimal places.

	1 class	**2 classes**	**3 classes**	**4+ classes**	**TOTAL**
Female	13	35	56	28	**132**
Male	35	29	38	13	**115**
TOTAL	**48**	**64**	**94**	**41**	**247**

Objective 7: General Multiplication Rule (Dependent Events)

If we have two events E and F and event F **does** affect event E (E and F are dependent events), then the probability that E ***and*** F both occur is

$$P(\text{E AND F}) = P(\text{E}) \cdot P(\text{F} \mid \text{E})$$

Example 14: Suppose two cards are randomly selected from a standard deck of 52 playing cards. What is the probability that the first card is a club and the second card is also a club if the draw is done without replacement?

1. A card is chosen at random from a standard deck of 52 playing cards. Without replacing that card, a second card is chosen. What is the probability that the first card chosen is a "Jack" and the second card chosen is a "Face card"? A face card is a jack, queen, or king. Round your answer to 4 decimal places.

2. A committee consists of four women and three men. The committee will randomly select two people to attend a conference in Hawaii. Compute the probability that both are women. Round your answer to 4 decimal places.

Challenge Questions – These problems relate to more than one of the objectives covered in this video.

3. Four dice are rolled. Find the probability that at least one is a “1” or a “2”. (Hint: First consider that the complement of this event is that all four dice are NOT a “1” or a “2”.)

4. A playlist consists of 3 rock songs and 5 pop songs. Two songs are played at random without repetition. Find the probability that one of the songs is a rock song and one is a pop song. (Hint: The first song played could be either a rock song or a pop song.)