

11-1 Permutations and Combinations

State Standards

A2. S.IC.A.1 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

Objective

Count permutations and combinations

Key Concepts

_____ describes the method of using multiplication to count.

nPr —the number of _____ of n items in a set arranged r items at a time. (order matters)

nCr —the number of _____ of n items in a set chosen r items at a time. (order does NOT matter)

_____ $n! = n(n - 1) \cdot \dots \cdot 3 \cdot 2 \cdot 1$

Take note

Key Concept Fundamental Counting Principle

If event M can occur in m ways and is followed by event N that can occur in n ways, then event M followed by event N can occur in $m \cdot n$ ways.

Example 3 pants and 2 shirts give $3 \cdot 2 = 6$ possible outfits.

Examples

1. (I do) Many motor vehicle license plates are arranged with a series of 3 letters followed by a series of 3 numbers. How many possible license plates can there be of this style?

2. (I do) In how many ways can you file 12 folders one after another in a drawer?

3. (We do) Ten students are in a race. First, second and third place will earn medals. In how many ways can 10 runners finish first, second, third (no ties allowed)?

4. (We do) Permutation or Combination? A teacher divides the class into 8 groups for a project. She decides to display 4 of the projects. In how many different ways can the teacher select the projects for display?

5. (They do) Permutation or Combination? In a raffle, three winners are chosen. The first ticket drawn wins \$100, the second wins \$50, the third wins \$10. In how many different ways can you draw 3 winning tickets out of a total of 25 raffle tickets?

You do Practice 11-1: Complete your assignment on a separate sheet of paper. Show all work.

1. You have five shirts and four pairs of pants. How many different ways can you arrange your shirts and pants into outfits?
2. To create a passcode, you need to first choose a letter and then, three single-digit numbers. How many different passcodes can you create?
3. Evaluate
 - a. $10!$
 - b. ${}_6P_3$
 - c. ${}_7C_5$
4. How many different nine-player batting orders can be chosen from a baseball team of 16?
5. Explain the difference between permutations and combinations.

11-2 Probability

CCRS Objectives

- **A2. S.IC.A.2** Use data from a sample survey to estimate a population mean or proportion; use a given margin of error to solve a problem in context.

Objective

To find the probability of an event using theoretical, experimental, and simulation methods.

Key Concepts

_____ - a model of an event used to estimate the experimental probability of an event.

_____ - the set of all possible outcomes in an experiment.

_____ - when each outcome in a sample space has the same chance of occurring.

Take note


Key Concept Experimental Probability

experimental probability of event: $P(\text{event}) = \frac{\text{number of times the event occurs}}{\text{number of trials}}$

Take note

Key Concept Theoretical Probability

If a sample space has n equally likely outcomes and an event A occurs in m of these outcomes, then the theoretical probability of event A is $P(A) = \frac{m}{n}$.



Examples

1. (I do) What is the theoretical probability?
 - a. getting a 5 on one roll of a standard number cube?
 - b. getting a sum of 5 in one roll of two standard number cubes?

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

2. (I do) Of the 60 vehicles in the parking lot, 15 are pickup trucks. What is the experimental probability that a vehicle is a pickup truck? What is the probability a vehicle is NOT a pickup truck?

3. (We do) A bag contains 36 red blocks, 48 green blocks, 22 yellow blocks and 19 blue blocks. You pick one block from the bag at random. What is the theoretical probability of the following?
 - a. $P(\text{green})$

 - b. $P(\text{yellow or green})$

 - c. $P(\text{blue or not red})$

4. (We do) What is the theoretical probability of being dealt exactly two 7's in a 5-card hand from a standard 52 card deck?

5. (They do) A lottery has 53 numbers from which five are drawn at random. Each number can only be drawn once. What is the probability your lottery ticket matches all five numbers drawn in any order?

You do Practice 11-2: Complete your assignment on a separate sheet of paper. Show all work.

1. What is the probability a quarterback will complete his next pass if he has completed 30 of his last 40 passes?

2. A group of five cards are numbered 1 through 5. You choose one card at random. Find each theoretical probability.
 - a. $P(\text{card is } 2)$
 - b. $P(\text{even number})$
 - c. $P(\text{less than } 5)$

3. Explain the difference between experimental probability and theoretical probability.

11-3 Probability of Multiple Events

State Standards

A2. S.CP.A.1 Describe events as subsets of a sample space using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).

A2. S.CP.A.2 Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.

Objectives

Find the probability of the event A and B and the probability of event A or B

Vocabulary

_____ - when the occurrence of one event affects how a second event can occur.

_____ - when the occurrence of one event does not affect how a second event can occur.

_____ - two events that cannot happen at the same time.

Key Concepts

take note **Key Concept Probability of A and B**

If A and B are independent events, then $P(A \text{ and } B) = P(A) \cdot P(B)$.

take note **Key Concept Probability of A or B**

$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

If A and B are mutually exclusive events, then $P(A \text{ or } B) = P(A) + P(B)$.

Examples

1. (I do) Identify the pair as independent or dependent. Explain.
 - a. Roll a number cube, then spin a spinner.
 - b. Pick one flashcard and then another from the same stack of 30 flashcards.
 - c. Select a coin at random from your pocket. You replace the coin and select again.

2. (We do) At a picnic there are 10 diet drinks and 5 regular drinks. There are also 8 bags of fat-free chips and 12 bags of regular chips. What is the probability that you pick a diet drink and fat-free chips?
3. (We do) About 37% of students take Spanish in high school and 15% take French. What is the probability that a student is taking Spanish or French?
4. (They do) A standard number cube is tossed. Find each probability.
- a. $P(2 \text{ or even})$ b. $P(\text{odd or prime})$ c. $P(\text{even or less than 5})$
5. (They do) Suppose you have 5 books in your backpack. Three are novels, one is a biography and one is a poetry book. Today you grab one book out of your bag and return it later. Tomorrow you do the same thing. What is the probability you grab a novel both days?

You do Practice 11-3: Complete your assignment on a separate sheet of paper. Show all work.

1. A and B are independent events. Find $P(A \text{ and } B)$.

a. $P(A) = \frac{1}{6}, P(B) = \frac{2}{5}$

b. $P(A) = \frac{9}{20}, P(B) = \frac{3}{4}$

2. C and D are mutually exclusive events. Find $P(C \text{ or } D)$.

a. $P(C) = \frac{2}{5}, P(D) = \frac{3}{5}$

b. $P(C) = \frac{1}{2}, P(D) = \frac{3}{8}$

3. Events A and B are not mutually exclusive. If $P(A) = \frac{1}{2}, P(B) = \frac{1}{4}$ and $P(A \text{ and } B) = \frac{1}{8}$, Find $P(A \text{ or } B)$.

4. Explain the difference between mutually exclusive events and independent events.

5. The weather forecast for the weekend is a 30% chance of rain on Saturday and a 70% chance of rain on Sunday. Your friend says that means there is a 100% chance of rain this weekend. What error did your friend make?

11-4 Conditional Probability

State Standards

A2. S.CP.A.1 Describe events as subsets of a sample space using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).

A2. S.CP.A.2 Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.

Objective

The students will use tables and charts to find conditional probabilities.

Key Concepts

_____ - the probability that an event will occur given another event has already occurred.

_____ - formula for probability of B given A

Examples

1. (I do) A card is drawn from a standard deck of cards. Find each probability, given that the card drawn is red.

a. $P(\text{diamond})$

b. $P(\text{club})$

c. $P(\text{face card})$

2. (I do) The table shows students by gender at two and four year colleges and graduate schools in 2005. You pick a student at random, calculate the following.

a. $P(\text{female} \mid \text{graduate school})$

b. $P(\text{male} \mid \text{4-year college})$

c. $P(\text{female})$

	Males	Females
2-year colleges	1866	2462
4-year colleges	4324	5517
graduate schools	1349	1954

3. (We do) A utility company asked 50 customers whether they pay bills online or by mail. What is the probability that the customer pays the bill online given they are male?

	<i>Online</i>	<i>By Mail</i>
<i>Male</i>	12	8
<i>Female</i>	24	6

4. (They do) A school system compiled the following information from a survey it sent to people who were juniors ten years earlier.

-85% graduated from high school

-Of the ones who graduated from high school, 90% were happy with their current jobs.

-Of the students who did not graduate, 60% are not happy with their current jobs.

- What is the probability that a person graduated from high school and is happy with his or her job?
- What is the probability that a student did not graduate and is happy with his or her job?

You do Practice 11-4: Complete your assignment on a separate sheet of paper. Show all work.

1. A card is drawn from a standard deck of cards. Find each probability, given that the card drawn is black.

- $P(\text{club})$
- $P(4)$
- $P(\text{diamond})$

2. The probability that a car has two doors, given that it is red is 0.6. The probability that a car has two doors and is red is 0.2. What is the probability that a car is red?

3. The population of a high school is 51% male. 45% of the males and 49% of the females attend concerts. Use a tree diagram to find the probabilities.

- $P(\text{male and attends concerts})$
- $P(\text{female and does not attend concerts})$

4. Use the table to find each probability.

- $P(\text{male graduate})$
- $P(\text{the degree is a BS})$
- $P(\text{The graduate is female, given the degree is an AAS})$

	<i>Male</i>	<i>Female</i>
<i>AAS degree</i>	245	433
<i>BS degree</i>	598	858

11-5 thru 11-9 Analyzing Data, Standard Deviation & Sample Surveys

State Standards

A2. S.ID.A.1 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages using the Empirical Rule.

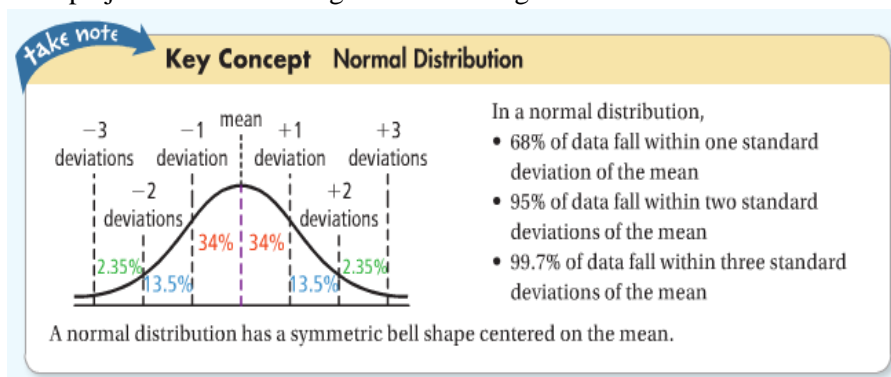
A2. S.CP.A.4 (formerly S-CP.A.5) Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.

Objectives

Students will analyze data using measures of central tendency, identify sampling methods and bias, and use normal distributions.

Key Concepts

- **population:** all members of a set
- **sample:** part of a population
- **convenience sample:** any members of the population that are readily available
- **self-selected sample:** only members of the population that volunteer
- **systematic sample:** order the population and select from it at regular intervals
- **random sample:** all members of the population are equally likely to be chosen
- **observational study:** you measure or observe people in a way that does not affect them
- **controlled experiment:** there are 2 groups in which one group receive treatment and one does not (control group), then you compare the effects.
- **survey:** you ask every member of a sample certain questions.
- **leading survey question:** suggesting that you want a certain answer.
- **loaded survey question:** using words that cause strong reactions
- **confusing survey question:** asking about more than one issue or using double negatives
- **ambiguous survey question:** a question that offers answers that overlap
- **bias:** prejudice in favor or against something.



Examples

1. (I do) Find the mean, median, mode, range, minimum, maximum, interquartile range, variance and standard deviation of the data. Then create a box & whisker plot. Are there any outliers?
62, 64, 68, 74, 80, 84, 86, 86, 84, 78, 70, 64

2. (We do) A newspaper wants to find what percent of the city's population favors a property tax increase to raise money for local parks. Identify the sampling method and any bias.
 - a. A newspaper article invites readers to call and express their opinions.
 - b. A reporter interviews people leaving the park.
 - c. A survey service calls every 50th person in a local phone book.

3. (I do) The mean body length of a male eel is 15.7 inches and the standard deviation is 2.8 inches.
 - a. Sketch a normal distribution curve showing 1, 2 and 3 standard deviations away from the mean.
 - b. What is the probability that a male eel is between 10.1 and 21.3 inches?
 - c. What is the probability that a male eel is greater than 18.5 inches?

You do Practice 11-5 thru 11-9: Complete your assignment on a separate sheet of paper. Show all work.

1. Find the mean, median, mode, range, minimum, maximum, interquartile range, variance and standard deviation of the data. Then create a box & whisker plot. Are there any outliers?
Data: 90, 100, 110, 40, 98, 102, 112, 90, 92
2. To investigate a community's reading habits, a newspaper conducts a poll from a table near the exit of a history museum. What is the sampling method used and does the method have any bias? Explain.
3. A survey asks, "Aren't handmade gifts always better than tacky purchased gifts?" Does this survey question have any bias? Explain and give the question type.
4. A set of data has a normal distribution with a mean of 50 and a standard deviation of 8. Sketch a normal distribution curve and determine the percent of data within each interval.
 - a. from 42 to 58
 - b. greater than 34
 - c. less than 50