TOPIC 11

Topic Review

TOPIC ESSENTIAL QUESTION

1. What questions can you answer by using statistics and normal distributions?

Vocabulary Review

Choose the correct term to complete each sentence.

2. _____ is used to find a range of reasonable values used to estimate the population parameter based on a sample statistic.
3. A(n) _____ involves applying a treatment to some group or groups and measuring the effects of the treatment.
4. The _____ is a statement that expresses that there is no difference between the parameter and the benchmark.
5. A(n) _____ can be answered by collecting many pieces of information, or data, and summarizing the data.
6. The _____ counts how many standard deviations a data value is from the mean.

- experiment
- margin of error
- null hypothesis
- statistical question
- *z*-score

Concepts & Skills Review

LESSON 11-1 Statistical Questions and Variables

Quick Review

A **statistical variable** is a quantity or quality for which data are expected to differ. A **categorical variable** has values that belong to a limited set of possible qualitative responses. A **quantitative variable** has values that are numbers that you could meaningfully compare, add, subtract, and so on.

A **population** represents all the members of a group studied by a statistical question. A **sample** is a subset of the population—one that is being studied to answer a statistical question about the population.

Example

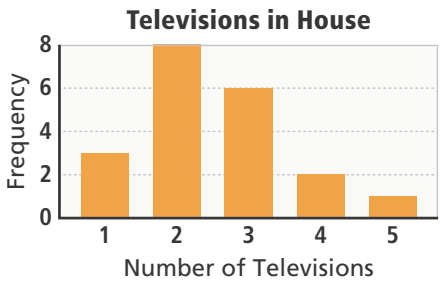
A political volunteer asked passersby about who they would vote for in an upcoming election for city council to try to determine who would win. What are the sample and the population in this scenario?

The population is all the voters in the city who plan to vote in the election. The sample is all of the passersby who responded.

Practice & Problem Solving

Is the given question a statistical question?

7. How many days are in September?
8. Do football coaches generally get paid more than swimming coaches?
9. **Communicate Precisely** Explain how to determine if a quantity is a statistic or a parameter.
10. **Make Sense and Persevere** What type of statistical variable is represented by the graph?



LESSON 11-2 Statistical Studies and Sampling Methods

Quick Review

An **experiment** is a statistical study where a researcher applies treatment(s) to the sample. In an **observational study** researchers observe the sample without intentionally affecting it. Researchers use **sample surveys** to ask sample members the same set of questions.

Example

What sampling method is used in the following example? Is the method biased?

The first ten students who enter the school are sampled.

This is convenience sampling because only the first ten students were sampled. The method is biased.

Practice & Problem Solving

In Exercises 11–12, describe what king of study you would conduct to answer each statistical question.

11. Is the lifespan of giraffes affected by the number of offspring they produce?

12. Do employees at a company want vending machines with healthy snacks?

13. **Communicate Precisely** Explain the difference between an experimental group and a control group.

14. **Look for Relationships** What sampling method is used below? Is the method biased?

Every 10th person in line was chosen to fill out a survey.

LESSON 11-3 Data Distributions

Quick Review

The **standard deviation** is a measure of how much the values in a data set vary, or deviate, from the mean.

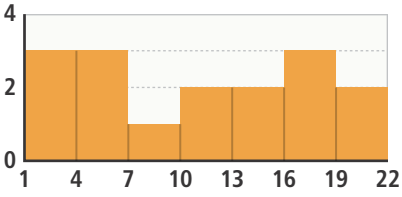
For **skewed distributions**, use the median and interquartile range to describe the data. For distributions that are symmetric, use the mean and standard deviation to describe the data.

Example

Which measures of center and spread are best for describing this set of data?

9 2 17 12 3 20 5 22 7 11 6 14 3 15 10 19

Draw a histogram of the data.



Since the data are not skewed, the best measures of center and spread and the mean and standard deviation.

Practice & Problem Solving

Find the mean, standard deviation, and five-number summary of the data set. Round to the nearest tenth, if necessary.

15. 23 35 19 27 33 24 18 26 38 29

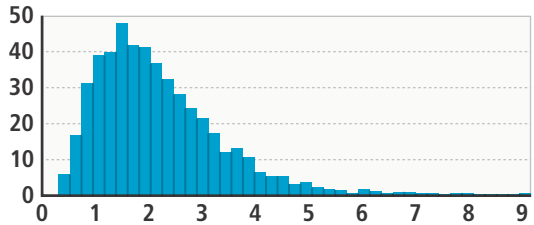
16. 82 77 88 65 68 73 81 74 68 83 80

Which measures of center and spread describe each data set best?

17. 13 28 14 30 18 22 29 24 26 12 20 16

18. 45 56 38 48 41 35 59 46 52 79 62

19. **Communicate Precisely** Describe a situation that could produce a data distribution similar to this one.

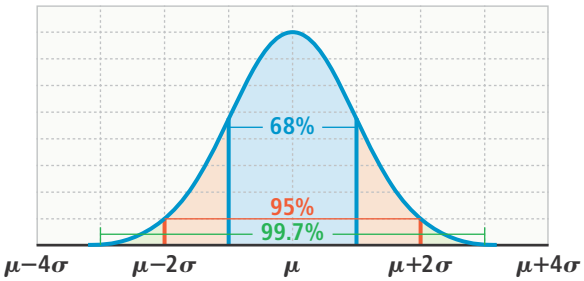


20. **Use Structure** A data set has a mean that is equal to the median. What is the likely shape of the distribution of the data? Explain.

LESSON 11-4 Normal Distributions

Quick Review

The Empirical Rule gives the percentage of data values falling near the mean.



Example

Suppose test scores are normally distributed with mean score 78 and standard deviation 3. What portion of the students scored between 72 and 84?

The interval between 72 and 84 includes all the scores within two standard deviations of the mean.

According to the Empirical Rule, 95% of students scored between 72 and 84.

Practice & Problem Solving

Find the percentage of all values in a normal distribution for each *z*-score.

21. $z \leq 0.29$

22. $z \leq 1.45$

23. $z \leq 0.89$

24. $z \geq 2.11$

25. $z \geq -0.67$

26. $z \leq -1.55$

27. The heart rate of a random sample of people is approximately normally distributed. The mean heart rate is 73 beats per minutes and the standard deviation is 6 beats per minute. What range of heart rates contains the 95% closest to the mean?

28. **Error Analysis** Hana said the percentage of all values in a normal distribution with $z \geq 1.05$ is 85.31%. Describe and correct Hana's error.

29. **Reason** Suppose travel times of employees at a company are normally distributed with mean travel time of 18 min and standard deviation of 3.25 min. What portion of the employees have a travel time between 14.75 and 22.5 min?

LESSON 11-5 Margin of Error

Quick Review

Margin of Error (ME)	
Quantitative Data	Categorical Data
$ME \approx \frac{2\sigma}{\sqrt{n}}$	$ME \approx \frac{1}{\sqrt{n}}$
σ = standard deviation n = sample size	n = sample size

Example

A random sample of 100 Jefferson High seniors reveals that 80% plan to go to college next year. Use the margin of error to predict the actual proportion of seniors planning to go to college.

The data is categorical, so the margin of error is $\frac{1}{\sqrt{100}} = 0.1 = 10\%$.

Range: $80\% - 10\% = 70\%$ and $80\% + 10\% = 90\%$

The proportion of seniors planning to go to college next year is between 70% and 90%.

Practice & Problem Solving

30. Find the sample proportion and margin of error to the nearest percent for an event that occurs 67 times in a sample size of 400.

31. Suppose a population has standard deviation 32.5 and the sample size is 350. Find the margin of error to the nearest tenth.

32. **Communicate Precisely** What happens to the margin of error when the sample size increases? Explain.

33. **Reason** Kimberly makes 20% of the goals she attempts in lacrosse. Use technology to simulate 50 trials with 100 goals each. Identify the range that contains the middle 95% of results.

LESSON 11-6 Introduction to Hypothesis Testing

Quick Review

The **null hypothesis** H_0 is a statement that expresses that there is no difference between the quantities of interest. The **alternative hypothesis** H_a is the statement that expresses that there is a difference between the quantities.

Example

Keen Beenz reports that the average price for a can of their beans is \$0.85. A sample of 100 retail prices of their beans has a mean price of \$1.15. The standard deviation of prices nationally is \$0.25. Does this study provide strong evidence that Keen Beenz' claim is true or false?

Write the hypotheses: H_0: $\mu = 0.85$; H_a: $\mu \neq 0.85$

Calculate the margin of error: $\frac{2\sigma}{\sqrt{n}} = \frac{2(0.25)}{\sqrt{100}} = 0.05$

Predict a range of reasonable values:
sample mean $\pm$ margin of error $= 1.15 \pm 0.05$

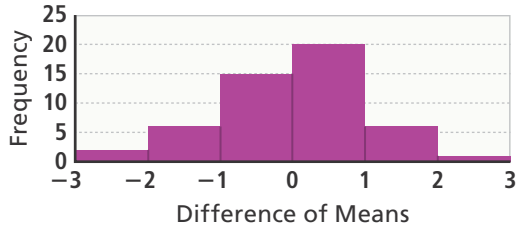
The range of values is 1.10 to 1.20.

The claim falls outside the range of reasonable values predicted by the statistical study. This evidence suggests that the claim is false.

Practice & Problem Solving

34. A baseball player got a hit in 30.5% of his attempts. After his coach attempted to improve his swing, he got a hit in 32.8% of the attempts. Write the null hypothesis and alternative hypothesis for a statistical study to evaluate the effect of the change on the player's percentage of getting a hit.

35. Scores from students chosen randomly for a study group had a sample mean 2.8 points higher than that for students who studied alone. The data were randomized 50 times, producing this histogram. Can you conclude that the study group improved scores? Explain.



36. **Make Sense and Persevere** SportORiffic reports that they sell a daily average of 25 athletic tops per day. A national sample of 100 SportORiffic stores is selected, and mean number of athletic tops sold was 23 per day. The standard deviation is 12 per day. Does this study provide strong evidence that SportORiffic's claim is true or false? Explain.