

MATH 110: Sampling Design — Worksheet

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Learning Objectives

- Distinguish a population from a sample
- Compute the standard error of the sample mean
- Connect sample size to the Central Limit Theorem

Simplify each expression completely. Show all steps and circle your final answer.

Central Limit Theorem

1. A population has mean $\mu=131$ and standard deviation $\sigma=8$. Samples of size $n=25$ are drawn. Find the mean and standard error of the sampling distribution of \bar{x} .

Answer: _____

2. A population has mean $\mu=84$ and standard deviation $\sigma=6$. Samples of size $n=100$ are drawn. Find the mean and standard error of the sampling distribution of \bar{x} .

Answer: _____

3. A population has mean $\mu=123$ and standard deviation $\sigma=10$. Samples of size $n=25$ are drawn. Find the mean and standard error of the sampling distribution of \bar{x} .

Answer: _____

Lurking and Confounding Variables

4. A study finds that students who eat breakfast score higher on tests. However, students from higher-income families are more likely to eat breakfast AND more likely to have tutoring resources. Identify the confounding variable.

Answer: _____

5. Researchers notice that cities with more ice cream sales have higher drowning rates. They suspect a hidden variable is responsible. Identify the lurking variable.

Answer: _____

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Answer: _____

Population vs. Sample

10. A city has 80,000 registered voters. A polling company surveys 500 of them about a ballot measure. Identify the population and the sample.

Answer: _____

11. A college wants to know the average GPA of all its 12,000 students. A dean randomly selects 200 student records to review. Identify the population and the sample.

Answer: _____

12. A nutritionist studies the eating habits of all patients at a clinic by interviewing every patient who visited last Tuesday (38 patients total). Identify the population and the sample.

Answer: _____

13. A city has 80,000 registered voters. A polling company surveys 500 of them about a ballot measure. Identify the population and the sample.

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18. A nutritionist studies the eating habits of all patients at a clinic by interviewing every patient who visited last Tuesday (38 patients total). Identify the population and the sample.

Answer: _____

Sampling Techniques

19. A researcher assigns each of 1,000 employees a number from 1 to 1,000, then uses a random number generator to select 50 employees to survey. Identify the sampling technique.

Answer: _____

20. A school divides its 800 students into four grade levels and randomly selects 25 students from each grade level. Identify the sampling technique.

Answer: _____

21. A pollster divides a city into 50 neighborhoods and randomly selects 5 neighborhoods, then surveys every household in those 5 neighborhoods. Identify the sampling technique.

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22. A researcher assigns each of 1,000 employees a number from 1 to 1,000, then uses a random number generator to select 50 employees to survey. Identify the sampling technique.

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Answer: _____

27. A pollster divides a city into 50 neighborhoods and randomly selects 5 neighborhoods, then surveys every household in those 5 neighborhoods. Identify the sampling technique.

Answer: _____

Standard error of the sample mean

28. A population has standard deviation $\sigma = 12$. For random samples of size $n = 25$, find the standard error of the sample mean (the standard deviation of the sampling distribution).

Answer: _____

29. A population has standard deviation $\sigma = 20$. For random samples of size $n = 25$, find the standard error of the sample mean (the standard deviation of the sampling distribution).

Answer: _____

30. A population has standard deviation $\sigma = 15$. For random samples of size $n = 16$, find the standard error of the sample mean (the standard deviation of the sampling distribution).

Answer: _____

Answer Key & Solutions

Topics: Sampling Techniques, Population vs. Sample, Standard error of the sample mean, Lurking and Confounding Variables, Central Limit Theorem. All answers verified by independent computation.

Solutions

Central Limit Theorem

1. A population has mean $\mu=131$ and standard deviation $\sigma=8$. Samples of size $n=25$ are drawn. Find the mean and standard error of the sampling distribution of \bar{x} .
 - By the Central Limit Theorem, the sampling distribution of \bar{x} has mean equal to the population mean.
 - Mean of $\bar{x} = \mu = 131$.
 - Standard error: $SE = \sigma / \sqrt{n} = 8 / \sqrt{25} = 8 / 5 = 1.6$.

Answer: _____

2. A population has mean $\mu=84$ and standard deviation $\sigma=6$. Samples of size $n=100$ are drawn. Find the mean and standard error of the sampling distribution of \bar{x} .
 - By the Central Limit Theorem, the sampling distribution of \bar{x} has mean equal to the population mean.
 - Mean of $\bar{x} = \mu = 84$.
 - Standard error: $SE = \sigma / \sqrt{n} = 6 / \sqrt{100} = 6 / 10 = 0.6$.

Answer: _____

3. A population has mean $\mu=123$ and standard deviation $\sigma=10$. Samples of size $n=25$ are drawn. Find the mean and standard error of the sampling distribution of \bar{x} .
 - By the Central Limit Theorem, the sampling distribution of \bar{x} has mean equal to the population mean.
 - Mean of $\bar{x} = \mu = 123$.
 - Standard error: $SE = \sigma / \sqrt{n} = 10 / \sqrt{25} = 10 / 5 = 2.0$.

Answer: _____

Lurking and Confounding Variables

4. A study finds that students who eat breakfast score higher on tests. However, students from higher-income families are more likely to eat breakfast AND more likely to have tutoring resources. Identify the confounding variable.
 - The explanatory variable is breakfast eating; the response variable is test scores.
 - Family income is related to both breakfast eating and test scores.
 - Because it is associated with both variables and was not controlled, it is a confounding variable.
 - Answer: Family income is a confounding variable..

Answer: _____

5. Researchers notice that cities with more ice cream sales have higher drowning rates. They suspect a hidden variable is responsible. Identify the lurking variable.

- Ice cream sales and drowning rates are both higher in hot weather.
- Hot weather drives both variables independently.
- This is a classic lurking variable — not a causal relationship.
- Answer: Hot weather (temperature) is a lurking variable causing both increased ice cream sales and more swimming, which leads to more drownings..

Answer: _____

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Answer: _____

Population vs. Sample

10. A city has 80,000 registered voters. A polling company surveys 500 of them about a ballot measure. Identify the population and the sample.

- The group of interest (all registered voters in the city) is the population.
- The 500 surveyed voters are a subset chosen for study -> this is the sample.
- Answer: Sample: the 500 surveyed voters. Population: all 80,000 registered voters..

Answer: _____

11. A college wants to know the average GPA of all its 12,000 students. A dean randomly selects 200 student records to review. Identify the population and the sample.

- The group of interest (all 12,000 students) is the population.
- The 200 randomly selected students are the sample.
- Answer: Sample: the 200 selected students. Population: all 12,000 students at the college..

Answer: _____

12. A nutritionist studies the eating habits of all patients at a clinic by interviewing every patient who visited last Tuesday (38 patients total). Identify the population and the sample.

- The population is all patients at the clinic.
- Only those who visited last Tuesday were studied -> this is the sample.
- Answer: Sample: the 38 patients seen last Tuesday. Population: all patients at the clinic..

Answer: _____

13. A city has 80,000 registered voters. A polling company surveys 500 of them about a ballot measure. Identify the population and the sample.

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Answer: _____

Sampling Techniques

19. A researcher assigns each of 1,000 employees a number from 1 to 1,000, then uses a random number generator to select 50 employees to survey. Identify the sampling technique.

- Every individual is numbered and selected by a random process.
- Each possible sample of size 50 has an equal chance of being chosen.
- This is a Simple Random Sample (SRS).

Answer: _____

20. A school divides its 800 students into four grade levels and randomly selects 25 students from each grade level. Identify the sampling technique.

- The population is divided into subgroups (strata) by grade level.
- A random sample is drawn from each stratum.
- This is a Stratified Random Sample.

Answer: _____

21. A pollster divides a city into 50 neighborhoods and randomly selects 5 neighborhoods, then surveys every household in those 5 neighborhoods. Identify the sampling technique.

- The population is divided into groups (clusters) — here, neighborhoods.
- Entire clusters are randomly selected and all members within are surveyed.
- This is a Cluster Sample.

Answer: _____

22. A researcher assigns each of 1,000 employees a number from 1 to 1,000, then uses a random number generator to select 50 employees to survey. Identify the sampling technique.

- Every individual is numbered and selected by a random process.
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25. A researcher assigns each of 1,000 employees a number from 1 to 1,000, then uses a random number generator to select 50 employees to survey. Identify the sampling technique.

- Every individual is numbered and selected by a random process.
- Each possible sample of size 50 has an equal chance of being chosen.
- This is a Simple Random Sample (SRS).

Answer: _____

26. A school divides its 800 students into four grade levels and randomly selects 25 students from each grade level. Identify the sampling technique.

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Answer: _____

Standard error of the sample mean

28. A population has standard deviation $\sigma = 12$. For random samples of size $n = 25$, find the standard error of the sample mean (the standard deviation of the sampling distribution).

- Standard error of the mean = σ / \sqrt{n} .
- = $12/\sqrt{25} = 12/5 = 2.4$.

Answer: _____

29. A population has standard deviation $\sigma = 20$. For random samples of size $n = 25$, find the standard error of the sample mean (the standard deviation of the sampling distribution).

- Standard error of the mean = σ / \sqrt{n} .
- = $20/\sqrt{25} = 20/5 = 4.0$.

Answer: _____

30. A population has standard deviation $\sigma = 15$. For random samples of size $n = 16$, find the standard error of the sample mean (the standard deviation of the sampling distribution).

- Standard error of the mean = σ / \sqrt{n} .
- = $15/\sqrt{16} = 15/4 = 3.75$.

Answer: _____