LESSON MAKER PRO

Means in Motion

See how sample size changes the spread of sample means.

HIGH SCHOOL · MT.PLUS.DATA.DES.3

MT.PLUS.DATA.DES.3 "Evaluate the effect of sample size on the expected variability in the sampling distribution of a sample statistic by: Simulating a sampling distribution of sample means from a population with a known distribution..."

NAME _____ DATE _____

PREDICT THE SPREAD

The predicted standard deviation (SD) of sample means is population SD / sqrt(sample size). In a simulation, the SD may not match that prediction exactly, but larger samples tend to produce less spread.

WORKED EXAMPLE

A population has a mean of 70 and an SD of 30. Find the SD of each set of simulated sample means. Does each match the prediction?

SIMULATED SAMPLE MEANS

Sample size 9	Sample size 25
60	64
60	64
80	76
80	76

1. Both columns have a mean of 70.
2. Size 9: simulated SD = sqrt((4 × 10^2)/4) = 10; predicted SD = 30/sqrt(9) = 10.
3. Size 25: simulated SD = sqrt((4 × 6^2)/4) = 6; predicted SD = 30/sqrt(25) = 6.

Answer: Both simulated SDs match the predictions. The larger sample size has less spread.

PRACTICE 4 problems

1 A population has an SD of 40. Find the predicted SD of sample means when the sample size is 4.

ANSWER _____

2 A population has an SD of 48. Find the predicted SD of sample means when the sample size is 36.

ANSWER _____

3 A population has an SD of 18. What sample size gives sample means a predicted SD of 2?

ANSWER _____

4 A population has an SD of 72. Find the predicted SD of sample means for sample sizes 16 and 64.

ANSWER _____

APPLY IT Show your work

1 A school measures students' commute times. The population SD is 32 minutes. What is the predicted SD of mean commute time for random samples of 64 students?

WORK SPACE

ANSWER _____

2 A music app tracks daily listening time. The population SD is 28 minutes. The table shows simulated sample means, in minutes. Find each simulated SD and check it against the predicted SD.

SIMULATED SAMPLE MEANS

Sample size 4	Sample size 49
86	96
86	96
114	104
114	104

ANSWER _____

CHALLENGE One step up

A population has an SD of 16. A simulation gives an SD of 7 for sample size 4 and an SD of 4 for sample size 16. Find both predicted SDs. Does the simulation disprove the rule? Explain.

WORK SPACE AND ANSWER

Means in Motion

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A population has an SD of 40. Find the predicted SD of sample means when the sample size is 4.	**20**
2	A population has an SD of 48. Find the predicted SD of sample means when the sample size is 36.	**8**
3	A population has an SD of 18. What sample size gives sample means a predicted SD of 2?	**81**
4	A population has an SD of 72. Find the predicted SD of sample means for sample sizes 16 and 64.	**Size 16: 18; size 64: 9.**

PART 2 · APPLY IT

1. **4 minutes** Divide the population SD by the square root of the sample size: 32/sqrt(64) = 32/8 = 4 minutes.
2. **Size 4: simulated and predicted SD are both 14 minutes. Size 49: simulated and predicted SD are both 4 minutes.** Both columns have a mean of 100. Their values are 14 and 4 minutes from that mean, so their simulated SDs are 14 and 4; the predictions are 28/sqrt(4) = 14 and 28/sqrt(49) = 4.

CHALLENGE

The predicted SDs are 16/sqrt(4) = 8 and 16/sqrt(16) = 4. No. A simulated SD can differ from its prediction, and the simulation still shows less spread with the larger sample.

Use the population SD divided by sqrt(sample size) for predictions. For simulated SDs, divide the sum of squared differences from the mean by the number of simulated means before taking the square root.