LESSON MAKER PRO

How Means Vary

Predict the spread of sample means.

HIGH SCHOOL · MT.PLUS.DATA.DES.3.b

MT.PLUS.DATA.DES.3.b "Evaluate the effect of sample size on the expected variability in the sampling distribution of a sample statistic by: Demonstrating that the standard deviation of each simulated sampling distribution is the known standard deviation of the..."

NAME _____ **DATE** _____

THE BIG IDEA

When you take independent random samples of size n, their means form a sampling distribution. Its standard deviation is the population SD divided by sqrt(n). A simulation should give a value close to this prediction, but not necessarily an exact match.

WORKED EXAMPLE

A population has an SD of 21. What is the expected SD of the means of samples of size 49?

1. Use expected SD = population SD / sqrt(n).
2. Substitute: expected SD = 21 / sqrt(49).
3. Since sqrt(49) = 7, divide 21 / 7.

Answer: 3

PRACTICE 6 problems

1 A population has an SD of 12. Find the expected SD of the means of samples of size 4.

ANSWER _____

2 A population has an SD of 24. Find the expected SD of the means of samples of size 36.

ANSWER _____

3 A population has an SD of 28. Find the expected SD of the means of samples of size 16.

ANSWER _____

4 A population has an SD of 32. What sample size gives an expected SD of 8 for the sample means?

ANSWER _____

5 A population has an SD of 40. Find the expected SD of the sample means. Is the simulated SD close to it?

SIMULATION SUMMARY

Sample size	Simulated SD of sample means
100	4.2

ANSWER _____

_____

6 A population has an SD of 42. Find the expected SD of the sample means, then choose the simulation run that is closer to it.

TWO SIMULATION RUNS

Sample size	Run A: simulated SD	Run B: simulated SD
36	7.2	8.6

ANSWER _____

_____

APPLY IT Show your work

1 At a school café, the population SD of wait times is 18 seconds. Students simulate many independent samples of 81 wait times and record each sample's mean. What SD should they expect for those sample means?

WORK SPACE

ANSWER _____

2 A streaming app studies song lengths, which have a population SD of 48 seconds. It simulates independent samples of 64 songs and of 256 songs. Find the expected SD of the sample means for each size. Which size gives less variable means?

WORK SPACE

ANSWER _____

CHALLENGE One step up

A simulation draws independent samples from a population with an SD of 50. Find the expected SD for each sample size in the table. Then explain in two sentences whether the simulated results support the rule.

SPREAD OF SIMULATED SAMPLE MEANS

Sample size	Simulated SD of sample means
25	10.4
100	5.1

WORK SPACE AND ANSWER

ANSWER KEY # How Means Vary

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A population has an SD of 12. Find the expected SD of the means of samples of size 4.	**6**
2	A population has an SD of 24. Find the expected SD of the means of samples of size 36.	**4**
3	A population has an SD of 28. Find the expected SD of the means of samples of size 16.	**7**
4	A population has an SD of 32. What sample size gives an expected SD of 8 for the sample means?	**16**
5	A population has an SD of 40. Find the expected SD of the sample means. Is the simulated SD close to it?	**Expected SD: 4. Yes, 4.2 is close to 4.**
6	A population has an SD of 42. Find the expected SD of the sample means, then choose the simulation run that is closer to it.	**Expected SD: 7. Run A is closer.**

PART 2 · APPLY IT

1. **2 seconds** Divide the population SD by sqrt(81): 18 / 9 = 2 seconds.
2. **64 songs: 6 seconds. 256 songs: 3 seconds. Samples of 256 give less variable means.** Compute 48 / sqrt(64) = 6 and 48 / sqrt(256) = 3. The larger sample size has the smaller expected SD.

CHALLENGE

The expected SDs are 10 for samples of size 25 and 5 for samples of size 100. The simulated SDs, 10.4 and 5.1, are close to those values, and the spread roughly halves when the sample size quadruples.

Accept equivalent calculations and wording. Simulated SDs need to be close to the predicted values, not exactly equal.