LESSON MAKER PRO

Means in Motion

See how sample size changes variation.

HIGH SCHOOL · MT.PLUS.DATA.DES.3.a

MT.PLUS.DATA.DES.3.a "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 _____

THE BIG IDEA

Variance is the average squared distance from a mean. For independent draws with replacement, the expected variance of sample means is the population variance divided by sample size n.

WORKED EXAMPLE

A draw gives 10 or 14 with equal chance. The table lists all possible sample means when each draw is replaced. Compare the variances.

POSSIBLE SAMPLE MEANS

Sample size	Sample means
1	10, 14
2	10, 12, 12, 14

1. Both lists have a mean of 12.
2. Size 1 variance: $[(10 - 12)^2 + (14 - 12)^2]/2 = 4$.
3. Size 2 variance: $[(10 - 12)^2 + 0 + 0 + (14 - 12)^2]/4 = 2$.

Answer: The variance falls from 4 to 2.

PRACTICE 4 problems

1 A population gives 0 or 2 with equal chance. With replacement, list all size-2 sample means and find their variance.

ANSWER _____

2 A population gives 1 or 7 with equal chance. Find the expected variance of sample means when n = 3.

ANSWER _____

3 A population gives 0 or 8 with equal chance. Find the expected variance of sample means when n = 4.

ANSWER _____

4 A population gives -3 or 5 with equal chance. Find the expected variance of sample means for n = 2 and n = 8.

ANSWER _____

APPLY IT Show your work

1 A game awards 2 or 6 points per play, each with equal chance. The table shows simulated averages from independent plays. Find each row's variance. Which row varies less?

SIMULATED AVERAGES

Plays per average	Averages
1	2, 6, 2, 6
2	2, 4, 4, 6

ANSWER _____

2 A concert entry wait is 15 or 25 minutes with equal chance. If waits are independent, compare the expected variance of average waits for 5 visits and 10 visits.

WORK SPACE

ANSWER _____

CHALLENGE One step up

Daily views of a student's video are 30 or 50 with equal chance. The expected variance of a sample mean is 5. What is the sample size? Explain what happens to the variance if the size doubles.

WORK SPACE AND ANSWER

Means in Motion

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A population gives 0 or 2 with equal chance. With replacement, list all size-2 sample means and find their variance.	**Means: 0, 1, 1, 2. Variance: 1/2.**
2	A population gives 1 or 7 with equal chance. Find the expected variance of sample means when n = 3.	**3**
3	A population gives 0 or 8 with equal chance. Find the expected variance of sample means when n = 4.	**4**
4	A population gives -3 or 5 with equal chance. Find the expected variance of sample means for n = 2 and n = 8.	**n = 2: 8; n = 8: 2**

PART 2 · APPLY IT

1. **One play: 4. Two plays: 2. The two-play averages vary less.** Both rows have a mean of 4. Average the squared distances from 4 in each row.
2. **5 visits: 5 minutes squared. 10 visits: 5/2 minutes squared.** The population mean is 20 minutes and its variance is 25 minutes squared. Divide 25 by each sample size.

CHALLENGE

The population variance is 100, so 100/n = 5 and n = 20. Doubling the size to 40 halves the expected variance to 5/2.

Accept equivalent fractions or decimals. Variances have squared units when the population values have units.