LESSON MAKER PRO

Means in Motion

Simulate samples and compare how their means vary.

HIGH SCHOOL · A2S.DSP.H.31.a

A2S.DSP.H.31.a "Simulate a sampling distribution of sample means from a population with a known distribution, observing the effect of the sample size on the variability."

NAME _____ DATE _____

THE BIG IDEA

To simulate a sampling distribution, draw many samples of the same size from a population and find each sample's mean. The range of those means is the largest mean minus the smallest. Larger samples generally produce means that vary less, though a small simulation may not show that pattern.

WORKED EXAMPLE

A population has equally likely values 10 and 16. Three simulated samples of size 3 are (10, 10, 10), (10, 16, 16), and (16, 16, 16). Find the sample means and their range.

1. First mean: (10 + 10 + 10) / 3 = 10.
2. Second mean: (10 + 16 + 16) / 3 = 14.
3. Third mean: (16 + 16 + 16) / 3 = 16.
4. Range: 16 - 10 = 6.

Answer: The sample means are 10, 14, and 16. Their range is 6.

PRACTICE 6 problems

1 A population has equally likely values 0 and 4. One simulated sample of size 2 is (0, 4). What is its mean?

ANSWER _____

2 A population has equally likely values 0 and 4. One simulated sample of size 4 is (4, 4, 4, 0). What is its mean?

ANSWER _____

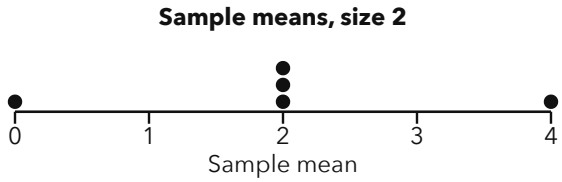
3 Each row shows a sample drawn from a population with equally likely values 0 and 4. How many of the sample means equal 2?

SIMULATED SAMPLES OF SIZE 2

Draw 1	Draw 2
0	0
0	4
4	0
4	4

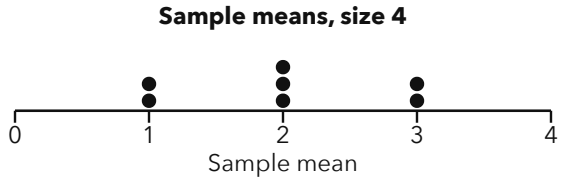
ANSWER _____

4 The dot plot shows means from repeated samples of size 2. What is the range of the sample means?



ANSWER _____

5 The dot plot shows means from repeated samples of size 4. What is the range of the sample means?



ANSWER _____

6 Both groups of samples were drawn from a population with equally likely values 0 and 4. Which sample size has the smaller observed range, and what is that range?

MEANS FROM TWO SIMULATIONS

Sample size	Observed sample means
2	0, 2, 2, 4
4	1, 2, 2, 3

ANSWER _____

APPLY IT Show your work

1 An arcade game awards either 0 or 8 bonus points per round, equally likely. A player simulates three samples of 2 rounds: (0, 0), (0, 8), (8, 8). They also simulate three samples of 4 rounds: (0, 0, 0, 8), (0, 0, 8, 8), (0, 8, 8, 8). Which sample size has the smaller range of sample means? How much smaller is it?

WORK SPACE

ANSWER _____

2 A streaming app takes either 0 or 12 seconds to start a video, equally likely. A student simulates four samples of 4 starts: (0, 0, 0, 12), (0, 0, 12, 12), (0, 12, 0, 12), and (0, 12, 12, 12). What is the mean of these four sample means? What is their range?

WORK SPACE

ANSWER _____

CHALLENGE One step up

A population has equally likely values 0 and 4. The table counts the sample means from every possible ordered sample, with each draw made independently. How much greater is the fraction of means within 1 of 2 for samples of size 4 than for samples of size 2? Explain using the counts.

COUNTS OF ALL POSSIBLE SAMPLE MEANS

Sample mean	Size 2 count	Size 4 count
0	1	1
1	0	4
2	2	6
3	0	4
4	1	1

WORK SPACE AND ANSWER

ANSWER KEY

Means in Motion

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A population has equally likely values 0 and 4. One simulated sample of size 2 is (0, 4). What is its mean?	**2**
2	A population has equally likely values 0 and 4. One simulated sample of size 4 is (4, 4, 4, 0). What is its mean?	**3**
3	Each row shows a sample drawn from a population with equally likely values 0 and 4. How many of the sample means equal 2?	**2 sample means**
4	The dot plot shows means from repeated samples of size 2. What is the range of the sample means?	**4**
5	The dot plot shows means from repeated samples of size 4. What is the range of the sample means?	**2**
6	Both groups of samples were drawn from a population with equally likely values 0 and 4. Which sample size has the smaller observed range, and what is that range?	**Sample size 4; range 2.**

PART 2 · APPLY IT

1. **Size 4 has the smaller range. Its range is 4 points, which is 4 points smaller than the size 2 range.** The size 2 means are 0, 4, and 8, giving a range of 8. The size 4 means are 2, 4, and 6, giving a range of 4.
2. **The mean of the sample means is 6 seconds, and their range is 6 seconds.** The sample means are 3, 6, 6, and 9 seconds. Their mean is (3 + 6 + 6 + 9) / 4 = 6 seconds, and their range is 9 - 3 = 6 seconds.

CHALLENGE

The fraction is 3/8 greater for size 4. For size 2, 2 of 4 means are within 1 of 2, giving 1/2. For size 4, 14 of 16 means are within 1 of 2, giving 7/8. The difference is 7/8 - 1/2 = 3/8.

Accept equivalent fractions. The ranges in these simulations illustrate the usual pattern, but a larger sample size does not guarantee a smaller range in every small simulation.