

Sampling Variability

Student Objectives

- I can use data from a random sample to estimate a population mean.
- I can understand the term *sampling variability* in the context of estimating a population mean.

Classwork

Example 1: Estimating a Population Mean

The owners of a gym have been keeping track of how long each person spends at the gym. Two hundred of these times (in minutes) are shown in the population tables located at the end of the lesson. These 200 times will form the population that you will investigate in this lesson.

Look at the values in the population. Can you find the longest time spent in the gym in the population? Can you find the shortest?

On average, roughly how long do you think people spend at the gym? In other words, by just looking at the numbers in the table, make an estimate of the population mean. _____

Instead of doing a calculation using every value in the population, we will use a random sample to find the mean of the sample. The sample mean will then be used as an estimate of the population mean.

Example 2: Selecting a Sample

To select items from a population randomly, you could use a die or you could select slips of paper from a bag. Imagine that each of the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9 is written on a slip of paper and placed in a bag. After thoroughly mixing the bag, one slip is drawn. You use this slip to determine the row that you will select a piece of data from. The slip is then returned to the bag and another slip is selected. You use the second digit to determine the column that you will select. The slip is returned to the bag. The process is repeated over and over until you have selected enough data for your sample.

Exercises 1–4

Initially, you will select just five values from the population to form your sample. This is a very small sample size, but it is a good place to start to understand the ideas of this lesson.

Select a random sample of five.

1. Use the die to select five values from the population of times. What are the five observations in your sample?
2. For the sample that you selected, calculate the sample mean.

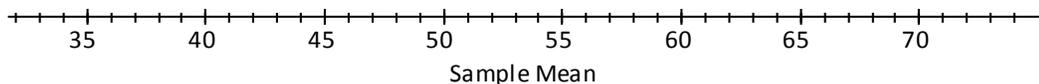
3. You selected a random sample and calculated the sample mean in order to estimate the population mean. Do you think that the mean of these five observations is exactly correct for the population mean? Explain.
4. In practice, you only take one sample in order to estimate a population characteristic. But, for the purposes of this lesson, suppose you were to take another random sample from the same population of times at the gym. Could the new sample mean be closer to the population mean than the mean of these five observations? Could it be further from the population mean?

As a class, you will now investigate sampling variability by taking several samples from the same population. Each sample will have a different sample mean. This variation provides an example of sampling variability.

Exercises 5–8

You will now use the sample means from Exercise 2 from the entire class to make a dot plot.

5. Write the sample means for everyone in the class in the space below.
6. Use all the sample means to make a dot plot using the axis given below. (Remember, if you have repeated or close values, stack the dots one above the other.)



7. What do you see in the dot plot that demonstrates sampling variability?

8. Remember that in practice you only take one sample. (In this lesson, many samples were taken in order to demonstrate the concept of sampling variability.) Suppose that a statistician plans to take a random sample of size 5 from the population of times spent at the gym and that he or she will use the sample mean as an estimate of the population mean. Approximately how far can the statistician expect the sample mean to be from the population mean?

Population

	0	1	2	3	4	5	6	7	8	9
01	50	45	45	66	71	55	65	33	60	51
02	53	83	40	51	83	57	75	38	43	77
03	49	49	81	57	42	36	22	66	68	52
04	60	67	43	60	55	63	56	44	50	58
05	64	41	67	73	55	69	63	46	50	65
06	54	58	53	55	51	74	53	55	64	16
07	28	48	62	24	82	51	64	45	41	47
08	70	50	38	16	39	83	62	50	37	58
09	79	62	45	48	42	51	67	68	56	78
10	61	56	71	55	57	77	48	65	61	62
11	65	40	56	47	44	51	38	68	64	40
12	53	22	73	62	82	78	84	50	43	43
13	81	42	72	49	55	65	41	92	50	60
14	56	44	40	70	52	47	30	9	58	53
15	84	64	64	34	37	69	57	75	62	67
16	45	58	49	78	59	36	52	39	70	51
17	50	45	45	66	71	55	65	33	60	51
18	53	83	40	51	83	57	75	38	43	77
19	49	49	81	57	42	36	22	66	68	52
20	60	67	43	60	55	63	56	44	50	58

Lesson Summary

A population characteristic is estimated by taking a random sample from the population and calculating the value of a statistic for the sample. For example, a population mean is estimated by selecting a random sample from the population and calculating the sample mean.

The value of the sample statistic (e.g., the sample mean) will vary based on the random sample that is selected. This variation from sample to sample in the values of the sample statistic is called **sampling variability**.

Homework Homework Homework Homework Homework

1. Yousef intends to buy a car. He wishes to estimate the mean fuel efficiency (in miles per gallon) of all cars available at this time. Yousef selects a random sample of 10 cars and looks up their fuel efficiencies on the Internet. The results are shown below.

22 25 29 23 31 29 28 22 23 27

- a. Yousef will estimate the mean fuel efficiency of all cars by calculating the mean for his sample. Calculate the sample mean. (Be sure to show your work.)
- b. In practice, you only take one sample to estimate a population characteristic. However, if Yousef were to take another random sample of 10 cars from the same population, would he likely get the same value for the sample mean? Explain.
- c. What if Yousef were to take *many* random samples of 10 cars? Would the entire sample means be the same? Explain.
- d. Using the example of fuel efficiencies, explain what sampling variability is.

