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Sampling Distributions: What was the average for the Final exams?

How did the Final exam go? Today, we will be taking a **sample** from a **population**. We will use the average from the **sample** to estimate the average for the **population**.

Let's start with a very simple example. My 5th hour is very small. There were only 5 people who took the Final exam. Their scores were: 60 70 75 80 90.

1. Make a dotplot of the population distribution.

2. Take a sample of any 2 of the scores. Find the mean of your sample.

3. Figure out all of the possible samples of size 2. Calculate a sample mean for each sample of 2.

4. Make a dotplot using each of the means you found in #3.

5. What is the mean of the population? Label this on the dotplot above.

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Chapter 8: Day 1– What is a Sampling Distribution?

Important ideas: Parameter vs. Statistic	Define a sampling distribution:	Unbiased estimator

Check Your Understanding

To determine how much homework time students will get in class, Mrs. Lin has a student select an SRS of 20 chips from a large bag. The number of red chips in the SRS determines the number of minutes in class students get to work on homework. Mrs. Lin claims that there are 200 chips in the bag and that 100 of them are red. When Jenna selected a random sample of 20 chips from the bag (without looking), she got 7 red chips. Does this provide convincing evidence that less than half of the chips in the bag are red?

1. Identify the population, parameter, sample and statistic.

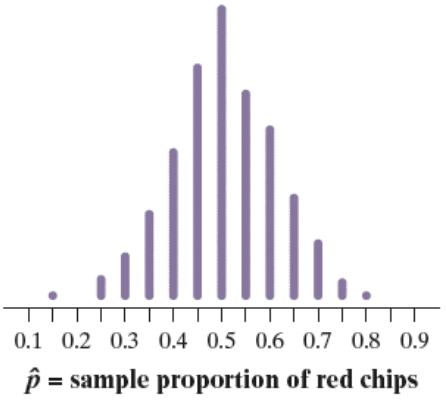
   Population: _____ Parameter: _____

   Sample: _____ Statistic: _____

2. What is the evidence that less than half of the chips in the bag are red?

3. Provide two explanations for the evidence described in part (Q2).

We used technology to simulate choosing 500 SRSs of size n = 20 from a population of 200 chips, 100 red and 100 blue. The dotplot shows $\hat{p}$ = the sample proportion of red chips for each of the 500 samples.



4. There is one dot on the graph at 0.80. Explain what this value represents.

5. Would it be surprising to get a sample proportion of $\hat{p}$ = 7/20 = 0.35 or smaller in an SRS of size 20 when p = 0.5? Justify your answer.

6. Based on your previous answers, is there convincing evidence that less than half of the chips in the large bag are red? Explain your reasoning.

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ANSWERS

Sampling Distributions: What was the average for the Final exams?

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Let's start with a very simple example. My 5th hour is very small. There were only 5 people who took the Final exam. Their scores were: 60 70 75 80 90.

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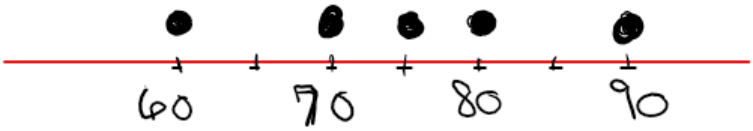


Student's test scores

2. Take a sample of any 2 of the scores. Find the mean of your sample.

$\bar{x}$ = (any 2)

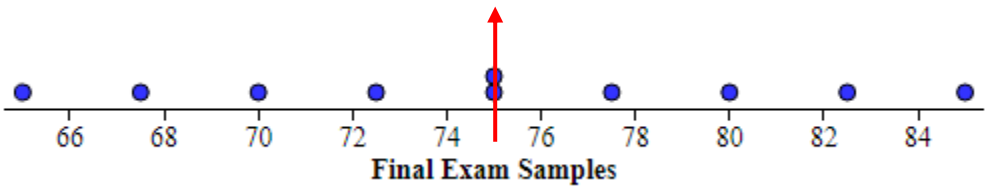
3. Figure out all of the possible samples of size 2. Calculate a sample mean for each sample of 2.

$_5C_2 = 10$ possible combinations

All samples:

$\{60, 70\} \rightarrow \bar{x}_1 = 65$	$\{60, 75\} \rightarrow \bar{x}_2 = 67.5$
$\{60, 80\} \rightarrow \bar{x}_3 = 70$	$\{60, 90\} \rightarrow \bar{x}_4 = 75$
$\{70, 75\} \rightarrow \bar{x}_5 = 72.5$	$\{70, 80\} \rightarrow \bar{x}_6 = 75$
$\{70, 90\} \rightarrow \bar{x}_7 = 80$	$\{75, 80\} \rightarrow \bar{x}_8 = 77.5$
$\{75, 90\} \rightarrow \bar{x}_9 = 82.5$	$\{80, 90\} \rightarrow \bar{x}_{10} = 85$

4. Make a dot plot using each of the means you found in #3.



5. What is the mean of the population (of samples)? (mean = 75)

Summary Statistics

n	mean	SD	min	Q_1	med	Q_3	max
10	75	6.455	65	70	75	80	85

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Chapter 8: Day 1– What is a Sampling Distribution?

Important ideas: Parameter vs. Statistic You Must identify the Pop. & parameter You must identify the Sample & statistic	Define a sampling distribution:	Unbiased estimator
	The **sampling distribution** of a statistic is the distribution of values taken by the statistic in all possible samples of the same size from the same population.	An estimator of a given parameter is said to be *unbiased* if its expected value is equal to the true value of the parameter.

Check Your Understanding

Warm up

WUP: Figure out all of the possible samples of size 20 from a population of 200.

$$_{200}C_{\ 20} = 1.6135877 \cdot 10^{27}$$

1. Identify the population, parameter, sample and statistic.

   Population: population of 200 chips Parameter: population proportion ($p = 0.5$)

   Sample: SRS of 20 chips Statistic: *sample proportion* $\hat{p} = \frac{7}{20} = 0.35$

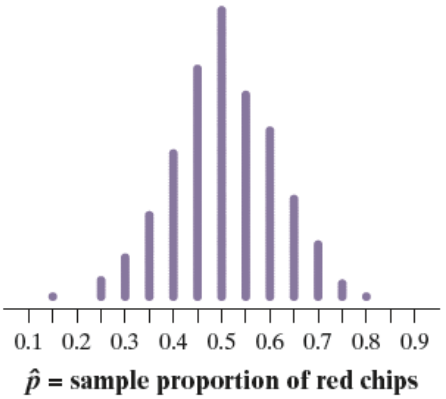
2. What is the evidence that less than half of the chips in the bag are red?

   Since Jenna selected a random sample of 20 chips from the bag (without looking), and she got only 7 red chips, or 35%, the statistic suggests evidence that less than half of the chips are red.

3. Provide two explanations for the evidence described in the previous answer.

   Option 1: The Random sample Jenna obtained was not representative of bag of chips, and was less than half *merely by chance*.
   Option 2: The claim by Ms. Lin that half of the chips are red is not true, and therefore most random samples would have less than 50% of the chips that are red.

   We used technology to simulate choosing 500 SRSs of size n = 20 from a population of 200 chips, 100 red and 100 blue. The dotplot shows $\hat{p}$ = the sample proportion of red chips for each of the 500 samples.



4. There is one dot on the graph at 0.80. Explain what this value represents.

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This dot at 0.8 represents a statistic, namely one random sample of 20 chips, where 80% of those chips selected were red.

5. Would it be surprising to get a sample proportion of $\hat{p}$ = 7/20 = 0.35 or smaller in an SRS of size 20 when p = 0.5? Justify your answer.

By the term “surprising”, We are trying to consider how unusual it is to get a sample proportion of 0.35 or less. So we are trying to determine how likely it would be to get a sample proportion where the value is $\hat{p} \leq 0.35$ Based on the simulation, we can see that we obtained many random samples that were less than this proportion (more than 5% of the time).
Therefore, it is not really very surprising to get a sample proportion of red chips that is 0.35 , meaning that we do not have strong evidence to reject the claim that Ms. Lin made stating that half of the chips in the bag are red.