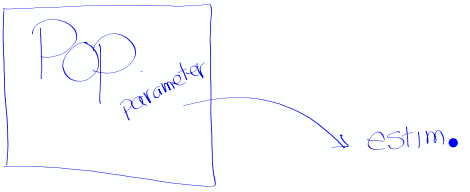
Use a sampling Distribution of a statistic to evaluate a claim about a parameter. ← continued

Determine if a statistic is an unbiased estimator of a population parameter.

Describe the relationship between sample size and the variability of a statistic



Use a sampling Distribution of a statistic to evaluate a claim about a parameter. → of a real popul. from Sheldon

Determine if a statistic is an unbiased estimator of a population parameter.

Describe the relationship between sample size and the variability of a statistic

Lesson 7.1 (Day 2): What was the real Final Exam average?

Today, we will be taking a **sample** from a **population**. We will use the average from the **sample** to estimate the average for a real **population**. Yesterday we looked at a very small class of 4 students as the population. Today we will look at larger population, the combined final exam scores from three Algebra 2 classes at Sheldon High School. (actual scores)

Take a random sample of 5 students and record their scores. Then find the mean. Repeat this for a total of 4 times.

Scores:_____ Mean:_____ Scores:_____ Mean:_____

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1. Write each mean on a different sticker and put the stickers in the appropriate location on the poster at the front of the room. Copy down the dotplot that is created on the poster.

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2. What does each dot on the poster represent?

3. What do you think the true final exam average is?

4. A **sampling distribution** shows the means calculated from all of the possible samples of size 5 from the population. Is the above dotplot a sampling distribution? Explain.

5. Suppose we took a random sample of 5 final exam scores from Churchill High School and got a mean of 68. Is this convincing evidence that Churchill students did worse than students at our school?

2. What does each dot on the poster represent?
   One mean from a random sample of 5
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2. What does each dot on the poster represent?
   One mean from a random sample of 5
3. What do you think the true final exam average is? $\mu =$
4. A **sampling distribution** shows the means calculated from all of the possible samples of size 5 from the population. Is the above dotplot a sampling distribution? Explain.
   No. We didn't take all possible samples.
   (That would be $_{74}C_5 = 16,108,764$ samples)
5. Suppose we took a random sample of 5 final exam scores from Churchill High School and got a mean of 35. Is this convincing evidence that Churchill students did worse than students at our school?
   how many of our samples of 5 are 35 or lower?
   $\frac{3}{68}$ ← total samples $= 0.044$ μ
   Yes, we have convincing evidence because 4.4% < 5%

Pick 3 Grading

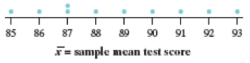
Pick Three Grading- Mrs. Perry Ameter, the teacher, has an interesting approach to assigning grades in her statistics class. Of the 5 tests students take throughout the semester, Mrs. Ameter selects a random sample of 3, finds the average score of these tests, and records this average as the student's final grade. Joe's test scores are as follows: **93, 87, 96, 78, 90.**

(a) List all 10 possible samples of size 3. (this is actually done for you on the right!)

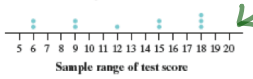
93, 87, 96
93, 87, 78
93, 87, 90
93, 96, 78
93, 96, 90
93, 78, 90
87, 96, 78
87, 96, 90
87, 78, 90
96, 78, 90

(b) Calculate the mean of each sample and display the **sampling distribution of the sample mean** using a dotplot. (already done on the right).

And while you are at it, calculate the range of each sample and display the **sampling distribution of the sample range** using dot plot. (Has Mr. Cedarlund gone mad?.... All of this has also done for you below as well).



$\bar{x}$ = sample mean test score



Sample range of test score

Sample	Sample mean	Sample range
93, 87, 96	92	9
93, 87, 78	86	15
93, 87, 90	90	6
93, 96, 78	89	18
93, 96, 90	93	6
93, 78, 90	87	15
87, 96, 78	87	18
87, 96, 90	91	9
87, 78, 90	85	12
96, 78, 90	88	18

c) Is the sample mean an **unbiased estimator** of the population mean? Explain your answer.

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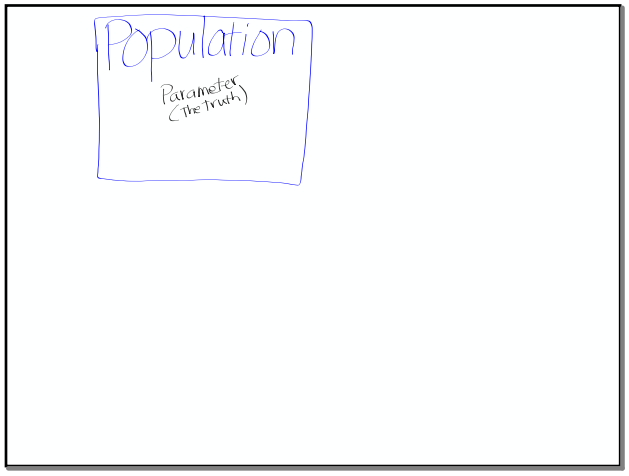

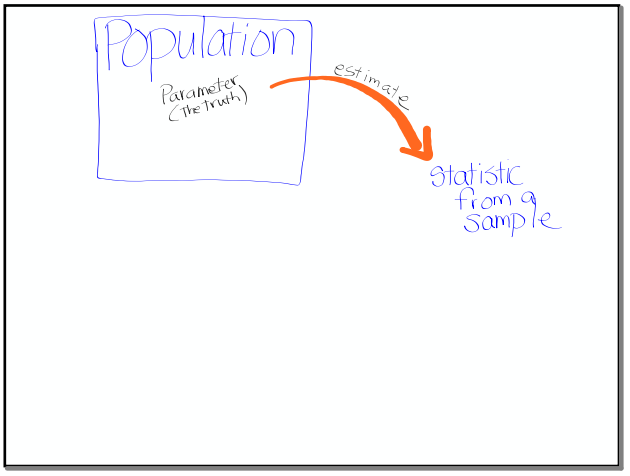

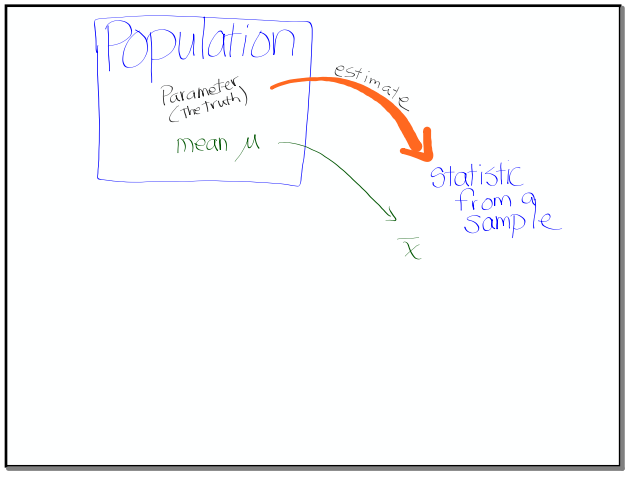

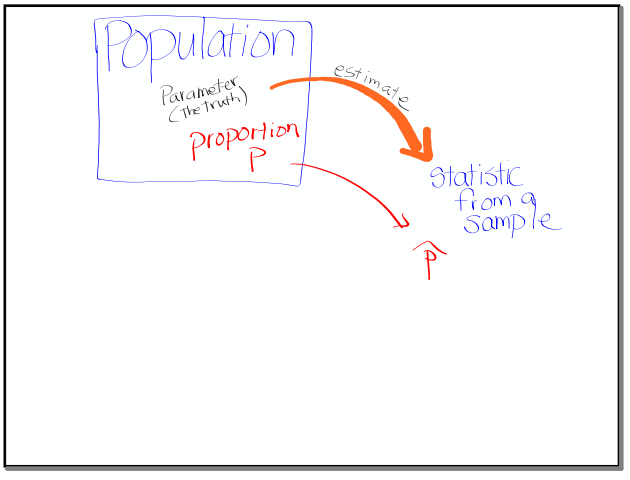

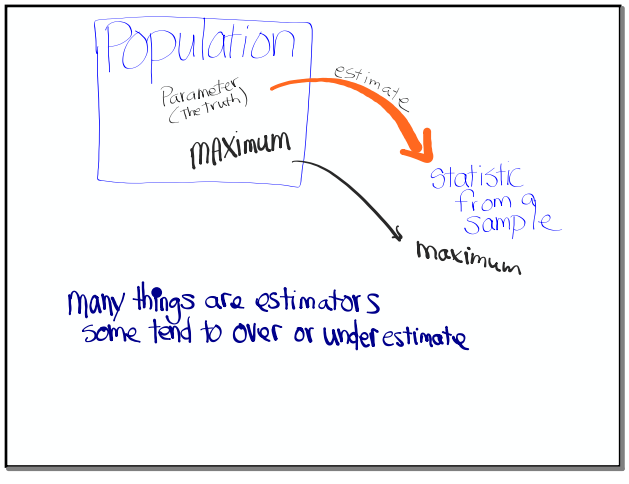

Describing Sampling Distributions

A statistic used to estimate a parameter is an **unbiased estimator** if the mean of its sampling distribution is equal to the value of the parameter being estimated.

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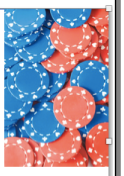
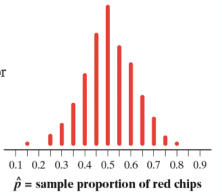
Problem: To determine how much homework time students will get in class, Mrs. Lin has a student select an SRS of 20 chips from a large bag. The number of red chips in the SRS determines the number of minutes in class students get to work on homework. Mrs. Lin claims that there are 200 chips in the bag 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.



Describing Sampling Distributions

A statistic used to estimate a parameter is an **unbiased estimator** if the mean of its sampling distribution is equal to the value of the parameter being estimated.

If we took **ALL** possible samples of 20 chips from the population, calculated $\hat{p}$ for each sample, and then found the mean of all those $\hat{p}$ values, we'd get *exactly* 0.5.



c) Is the sample mean an **unbiased estimator** of the population mean? Explain your answer.

Mean of pop. $\mu = \frac{93+87+96+78+90}{5} = 88.8$

Mean of sample distribut $\bar{x} = \frac{92+86+90+89+93+87+87+91+85+88}{10}$

$= 88.8$

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$= 88.8$

Because they are the same, the sample mean is an unbiased estimator of the population mean.

Example

If we say $\hat{p}$ is an unbiased estimator of p,

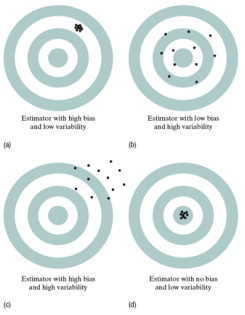
We assume that the value of $\hat{p}$ came from an SRS, not a convenience sample or voluntary response sample.

[likewise, No problems w/ Response bias, or NON-response]

To decide which estimator to use when there are several reasonable choices, consider both bias and variability.

Bias means that our sample statistics do not center on the population parameter. In other words, our estimates are not *accurate*.

High variability means that repeated samples do not give very similar results. In other words, our estimates are not very *precise*.



AP® Exam Tip

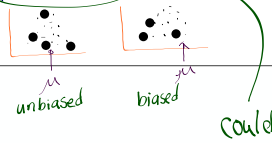
Make sure to understand the difference between **accuracy** and **precision** when writing responses on the AP® Statistics Exam. Many students use "**accurate**" when they really mean "**precise**."

For example, a response that says "increasing the sample size will make an estimate more **accurate**" is incorrect. It should say that increasing the sample size will make an estimate more **precise**. If you can't remember which term to use, don't use either of them. Instead, explain what you mean without using statistical vocabulary.

Biased and Unbiased Estimators

Important ideas:

A statistic is an unbiased estimator if the mean of the sampling distribution is equal to the true parameter.



Could be estimating proportions, medians, Q3, maximums, means

Biased and Unbiased Estimators

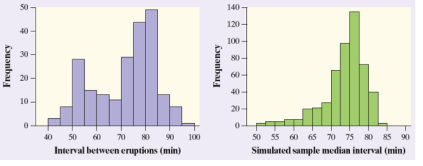
Important ideas:

A statistic is an unbiased estimator if the mean of the sampling distribution is equal to the true parameter.

Increasing sample size decreases variability of the statistic.

Old Faithful

The histogram on the left below shows the interval (in minutes) between eruptions of the Old Faithful geyser for all 222 recorded eruptions during a particular month. For this population, the median is 75 minutes. We used technology to take 500 SRSs of size 10 from the population. The 500 values of the sample median are displayed in the histogram on the right. The mean of these 500 values is 73.5.



1. Is the sample median an unbiased estimator of the population median? Justify your answer.

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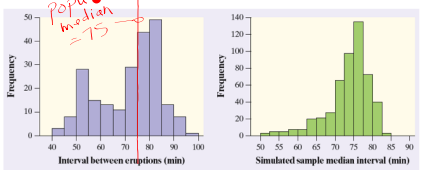

1. Is the sample median an unbiased estimator of the population median? Justify your answer.

No, the mean of the sample medians (73.5) is not the same as the true pop. median (75).

2. Suppose we had taken samples of size 20 instead of size 10. Would the variability of the sampling distribution of the sample median be larger, smaller, or about the same? Justify your answer.

3. Describe the shape of the sampling distribution of the sample median.

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2. Suppose we had taken samples of size 20 instead of size 10. Would the variability of the sampling distribution of the sample median be larger, smaller, or about the same? Justify your answer.

The variability would decrease because sample size was decreased.

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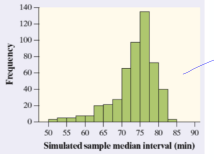

skewed left with a single peak between 75 and 77.5

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B.B.

7.1 .....11, 13, 15, 19, 21, 25, 26-30

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