

Name: ANSWER KEY Period: _____ Date: _____

7.1 Homework #1: What is a Sampling Distribution?

1. Is the fast-food promotion fair?

A fast-food restaurant promotes certain food items by giving a game piece with each item. Advertisements proclaim that "25% of the game pieces are Instant Winners!" To test this claim, a frequent diner collects 20 game pieces and gets only 3 instant winners.

a. Identify the population, the parameter, the sample, and the statistic in this context.

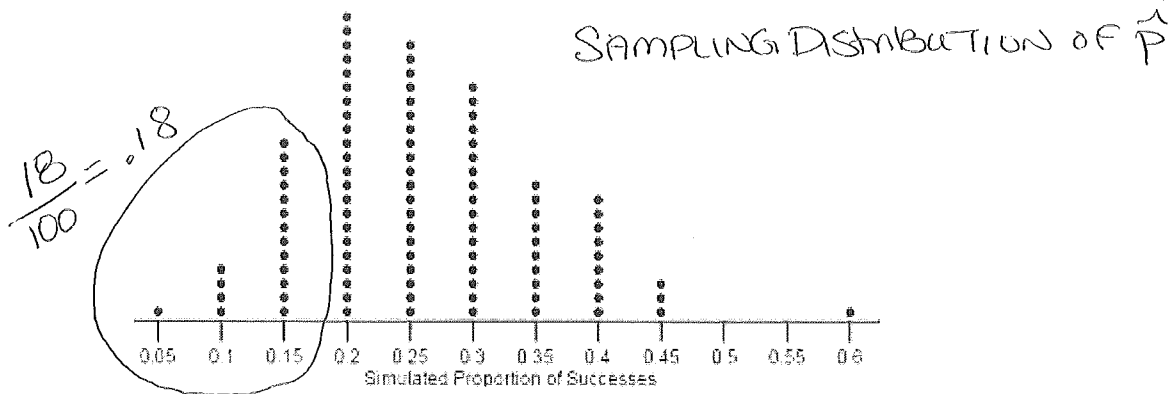
Population: All the game pieces

Sample: the 20 game pieces collected

Parameter: $p \rightarrow$ true proportion of all game pieces that are winners.

Statistic: $\hat{p} \rightarrow$ the proportion of the sample that are winners. $\hat{p} = 3/20$

Suppose the advertisements are correct and $p = 0.25$. The dotplot below shows the distribution of the sample proportion of instant winners in 100 simulated SRSs of size $n = 20$.



b. Would it be unusual to get a sample proportion of $\hat{p} = 3/20 = 0.15$ or less in a sample of size $n = 20$ when $p = 0.25$? Explain.

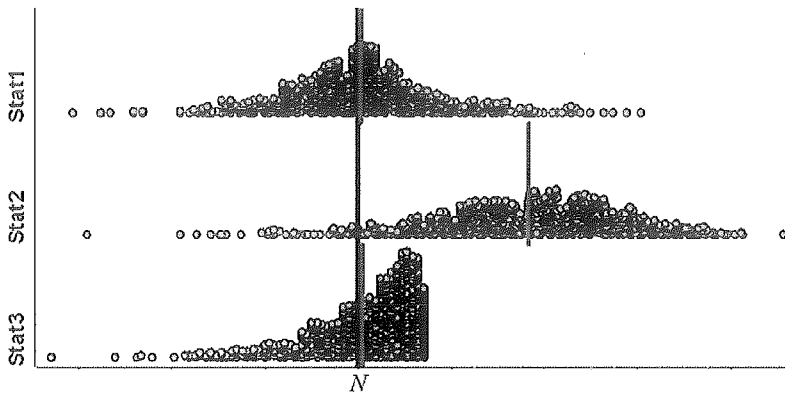
Not unusual. Would happen purely by chance $\frac{18}{100} = 18\%$ of the time

c. Based on your answer to part 2, is there convincing evidence that fewer than 25% of all game pieces are instant winners? Explain.

No. Not statistically significant. Could have happened purely by chance.

2. How many tanks does the enemy have?

During World War II, the Allies captured many German tanks. Each tank had a serial number on it. Allied commanders wanted to know how many tanks the Germans had so that they could allocate their forces appropriately. They sent the serial numbers of the captured tanks to a group of mathematicians in Washington, D.C., and asked for an estimate of the total number of German tanks N . Here are simulated sampling distributions for three statistics that the mathematicians considered, using samples of size $n = 7$. The blue line is at N , the total number of German tanks. The shorter green line segments mark the mean of each simulated sampling distribution.



a) Do any of these statistics appear to be unbiased? Justify.

Stats 1 & 3. N is close to the mean of those distributions.

b) Which of these statistics do you think is best? Explain your reasoning. Stat 3

It is the less variable

It is UNBIASED

c) Explain how the Allies could get a more precise estimate of the number of German tanks using the statistic you chose in part b).

Capture more tanks to increase the sample size.

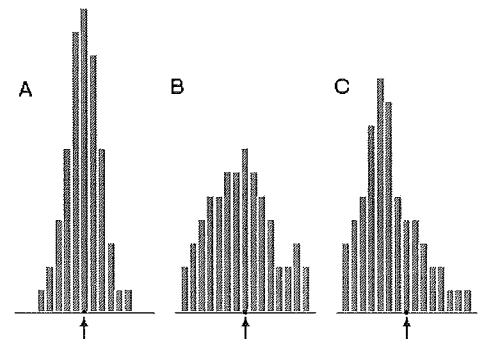
3. Below are histograms of the values taken by three sample statistics in several hundred samples from the same population. The true value of the population parameter is marked on each histogram

a. Which statistic has the largest bias among these three? Justify your answer.

C, the middle is not centered at the arrow.

b. Which statistic has the lowest variability among these three?

A, smallest spread



c. Based on the performance of the three statistics in many samples, which is preferred as an estimate of the parameter? Why?

A. It has the lowest variability & lowest bias