STAT 216 - Worksheet #9 Name: _____ **Lab:** ____ **Table:** ____

Chapter 13 introduces one of the most fundamental concepts we work with in statistics: the notion of a sampling distribution. The concept can be difficult to grasp, but this worksheet will allow us to investigate a sampling distribution through a simple simulation. Each table has been given a bin of beads. Let these beads represent the fish population in Ross' Fork, a tributary of Rock Creek, which is a 54 mile stream feeding into the Clark Fork River.

The table to the right lists the fish species represented by each bead color. Your plastic bin has been filled with beads according to fish population surveys conducted by Montana Fish Wildlife & Parks.

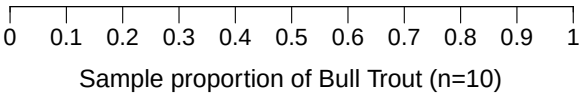
Bead Color	Species
Red	Westslope Cutthroat Trout
White	Brown Trout
Yellow	Bull Trout
Gold	Brook Trout
Silver	Rainbow Trout

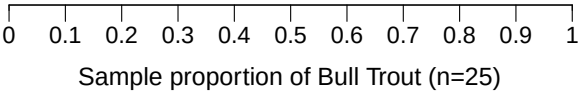
1. Shake up the bin of beads and randomly select n = 10 beads. Don't look at the beads while selecting your sample so the process is random. Record the proportion of "fish" that are Bull Trout in the table. Repeat this process four more times. Also do this for n = 25. Please make sure to report these proportions in decimal form and round to the nearest two decimal places. Each group should produce one table.

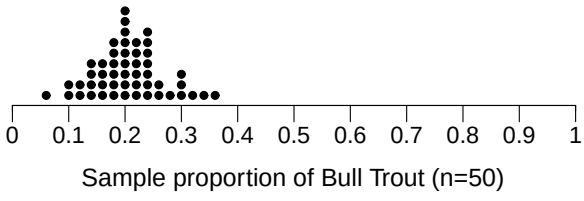
$\hat{p}$ for $n = 10$					
$\hat{p}$ for $n = 25$					

2. Each time we took a sample of size n, we were attempting to estimate a parameter. Define the parameter of interest in words and also give its symbol.

3. Once all of the proportions from the entire class are provided for you, create dotplots of these proportions to the right and below for $n = 10$ and $n = 25$. We also performed the same simulation for $n = 50$ and provided the corresponding dotplot below to the right.







4. Compute the mean of the proportions of Bull Trout for all of the sample proportions your class found (for n = 10). Also compute the standard deviation. Your lab instructor will provide you with the mean and standard deviation for the simulation with n = 25. Fill in the table to the right.

Sample Size	Mean	Standard Deviation
$n = 10$		
$n = 25$		
$n = 50$	.2060	.0624

5. Which sampling distribution (for $n = 10$, $n = 25$, or $n = 50$) has the least amount of variability?

6. What is your best guess for the true proportion of Bull Trout in Ross' Fork?

7. The Central Limit Theorem is one of the most important theorems used in statistics and we have studied it at length in lecture (see page 166 of your course notes for a summary). Suppose that in a section of the Blackfoot river, 30% of the fish are Bull Trout. If we can somehow "randomly" select 100 fish from this population, what does the Central Limit Theorem say about the sampling distribution of $\hat{p}$, the sample proportion of fish that are bull trout in a sample of size $n = 100$? Make sure to specifically address the three main features we have discussed in class.

Take a moment to look at your simulated distributions from the front page and associate them with the Central Limit Theorem. There is nothing to report here.

8. Every time you shake up the bin of beads and randomly select a handful of n beads, what type of sampling plan are you using?

9. It would of course be difficult in practice to conduct a simple random sample of n fish from a population (such as all fish in Ross' Fork). A common sampling technique is called Electrofishing. A site in a river is randomly selected, two electrodes are inserted into the water, and all fish within a given radius are temporarily stunned and collected in a net. Fish are then often weighed & measured and their species is recorded prior to being returned to the water. This usually results in no permanent harm to fish. What sampling method discussed in class does this most closely resemble?

Aside: Bull trout require cold & pristine waters to live and are used as an indicator species for aquatic ecosystem health within the Rocky Mountain region. They are considered to be a threatened species and it is usually illegal to keep them if you catch one while fishing. The Westslope Cutthroat trout is the Montana state fish and the population of this species has also been in decline.