Advanced Placement Statistics Name: Mr. Morton
Chapter 9 Review Sheet Date: ________ Period ________

A. Multiple Choice

1. Which of the following best describes a sampling distribution of a statistic?
   (A) It is the probability that a sample statistic equals the parameter of interest.
   (B) It is the probability distribution of all the values that are contained in all possible samples of the same size.
   (C) It is the distribution of all the statistics calculated from all possible samples of the same size.
   (D) It is the histogram of sample statistics from all possible samples of the same size.
   (E) It is none of these.

2. The conditions that $np \geq 10$ and $n(1-p) \geq 10$ are imposed on a sampling distribution to protect against
   (A) a sample that is not representative of the population.
   (B) bias in the responses of the sample participants.
   (C) skewness in the distribution.
   (D) a very small population size.
   (E) The conditions are not designed to protect against any of these conditions

3. An investigator anticipates that the proportion of red blossoms in his hybrid plants is 0.15. A random sample of 50 of his plans indicated that 22% of the blossoms were red. The standard deviation of the sampling distribution of the sample proportion is approximately:
   (A) 0.051 → 0.0504975
   (B) 0.059
   (C) 0.07
   (D) 0.116
   (E) Cannot be determined

4. A sample of size 25 is drawn from a normal population with a mean of 62. If the standard deviation of the distribution of sample means is 3.5, what is the standard deviation of the original population?
   (A) 0.056
   (B) 0.408
   (C) 2.48
   (D) 17.5
   (E) 87.5

$$3.5 = \frac{\sigma}{\sqrt{25}}$$

5. The distribution of SAT Math scores of students taking Calculus I at a large university is skewed left with a mean of 625 and a standard deviation of 44.5. If random samples of 100 students are repeatedly taken, which statement best describes the sampling distribution of sample means?
   (A) Normal with a mean of 625 and standard deviation of 44.5.
   (B) Normal with a mean of 625 and standard deviation of 4.45.
   (C) Shape unknown with a mean of 625 and standard deviation of 44.5.
   (D) Shape unknown with a mean of 625 and standard deviation of 4.45.
   (E) No conclusion can be drawn since the population is not normally distributed.

$$\sigma_{\bar{x}} = \frac{44.5}{\sqrt{100}}$$

6. Suppose that 35% of all business executives are willing to switch companies if offered a higher salary. If a headhunter randomly contacts an SRS of 100 executives, what is the probability that over 40% will be willing to switch companies if offered a higher salary?
   (A) 0.1469
   (B) 0.1977
   (C) 0.4207
   (D) 0.8023
   (E) 0.8531

$$P(\hat{p} > .40)$$

B. Free Response

1. The cable TV company monitors 20% of the calls to their customer support line, in order to provide quality assuranc In one shift they received 250 calls. Consider these an SRS from the population of class received in a month.

a. What is the mean and standard deviation of the proportion of calls that are monitored?

$\mu_{\hat{p}} = 0.2$, $\sigma_{\hat{p}} = 0.0253$ | $N > 10n$

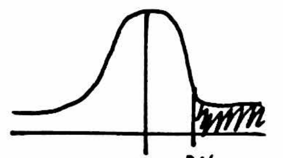
b. What is the probability that at least 60 calls (24% of the sample) are monitored? (Remember to show that you have checked the two "Rules of Thumb")

$n = 60 \geq 30$ CLT

$np \geq 10$ ✓

$n(1-p) \geq 10$ ✓

Approx. Normal



$P(\hat{p} \geq .24) = 0.0569$

2. According to government data, 22% of American children under the age of 6 were born to single mothers. A study of nutrition in early childhood chooses an SRS of 300 children.

$p = .22$, $n = 300$

a. What is the mean of the sampling distribution? What is the standard deviation?

$n = 300 \geq 30$ CLT

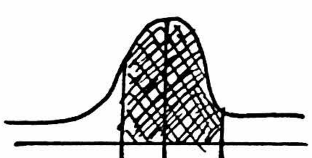
$\mu_{\hat{p}} = 0.22$, $\sigma_{\hat{p}} = 0.0239$ | $N > 10n$

Approx. Normal

b. Find the probability that between 20% and 30% of the children from the sample were born to single mothers.

$np \geq 10$ ✓

$n(1-p) \geq 10$ ✓



$P(.20 < \hat{p} < .30) = 0.7982$

3. I roll a fair six-sided die ten times and record the proportion of fives I obtain. I then repeat this process of rolling the die ten times and recording the proportion of fives obtained. I repeat this procedure many times. When done, I make a histogram of my results.

a. About where will the center of my histogram be? Use appropriate notation to describe this fact.

$\mu_{\hat{p}} = p = 1/6 = 0.1667$

b. What is the standard deviation of the sampling distribution of the proportion of fives obtained?

$\sigma_{\hat{p}} = 0.1179$

c. Describe the shape of the sampling distribution of $\hat{p}$. Justify your answer.

$np \not\geq 10 \rightarrow$ Not Normal

The shape will be skewed right!

4. The Brevard College Application Study finds that 67% of college freshmen completed their application online. The study took a sample of almost 15,000 freshmen, so the population proportion who applied online is very close to $p = 0.67$. Given: 62 completed the app. online of 100!

a. What is the sample proportion $\hat{p}$ who applied online?

$\hat{p} = 0.62$

b. If in fact the proportion of all students on your campus who applied online is the same as the national 67%, what is the probability that the proportion in the SRS of 100 students is no larger than the result of the administration's sample? Be sure to check that any necessary rules of thumb are met.

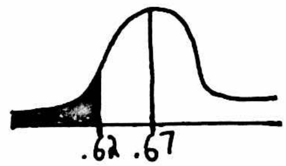
$np \geq 10$ ✓

$n(1-p) \geq 10$ ✓

$N > 10n$ ✓

$\mu_{\hat{p}} = 0.67$

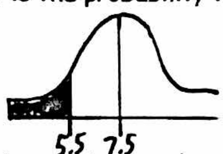
$\sigma_{\hat{p}} = 0.04702$



$P(\hat{p} \leq .62) = 0.1438$

5. The weights of ripe watermelons grown in North Carolina vary according to the normal distribution with mean 7.5 pounds and standard deviation 1.25 pounds. The NC Dept. of Agriculture classifies a watermelon as being small if the weight is less than 5.5 pounds.

a. What is the probability that a watermelon chosen at random weighs less than 5.5 pounds?



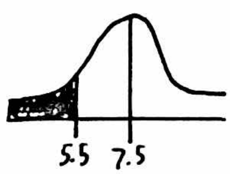
$z = \frac{5.5-7.5}{1.25}$

0.0548

b. You choose three melons at random and compute their mean weight, $\bar{x}$. What are the mean and standard deviation of the mean weight $\bar{x}$ of the three melons?

$\mu_{\bar{x}} = 7.5$, $\sigma_{\bar{x}} = \frac{1.25}{\sqrt{3}} = 0.7217$

c. What is the probability that the average weight of your three melons is less than 5.5 pounds?

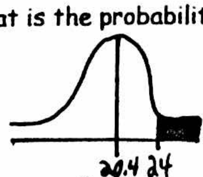


$z = \frac{5.5-7.5}{0.7217}$

0.0028

6. The price of dinner at Angus Barn has the normal distribution with mean $\mu = 20.4$ and standard deviation $\sigma = 5.8$.

a. What is the probability that a randomly chosen dinner costs \$24 or more?



$z = \frac{24-20.4}{5.8}$

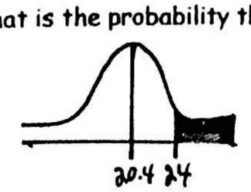
Table: 0.2676

Calc: 0.2674

b. What are the mean and standard deviation of the average mean price $\bar{x}$ for an SRS of 30 customers?

$\mu_{\bar{x}} = 20.4$, $\sigma_{\bar{x}} = \frac{5.8}{\sqrt{30}} = 1.0589$

c. What is the probability that the average meal price of an SRS of 30 customers is \$24 or higher?



$z = \frac{24-20.4}{1.0589}$

Table: 0.0003

Calc: 0.0003373

7. A snack-sized bag of M&M's contains 26 candies. On average 18% of them are blue. If an SRS of 6 of them is chosen, Matt thinks the standard deviation can be found by the formula $\sigma = \sqrt{\frac{(p)(1-p)}{n}}$. Michelle insists he is wrong. Who is correct, and why? Michelle!

$np \not\geq 10$.

Can't use $\sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}$.

8. Explain in your own words the difference between bias and variability.

Variability is the spread of data, and bias is the sample mean NOT equaling the true proportion.

9. When an SRS is chosen, what can the experimenter do that will decrease variability?

Pick a larger sampe size (increase SRS).

10. What must be done to cut the standard deviation in half?

$5 = \frac{10}{\sqrt{n}} \Rightarrow n=4$ (Multiply the SRS by 4).

11. Explain the difference between a statistic and a parameter, and give an example of each.

Parameter: Numerical characteristic of a population.
Statistic: Numerical characteristic of a sample.

12. What does the Central Limit Theorem mean?

As n increases, the shape of the distribution approaches a Normal Distribution with mean $= \mu$, and the standard deviation $= \frac{\sigma}{\sqrt{n}}$.

13. What does the Law of Large Numbers mean?

As n increase $\bar{x} \to \mu$.

AP Statistics
Chapter 9 Test Review

Name: Mr. Morton
Date: ______ Period: ______

1. Methohexital (MXT) is a barbiturate, used as a sedative in certain situations. Studies suggest that the amount of time required for MXT to cause full sedation has a mean of 8 minutes, with standard deviation 3.5 minutes. A random sample of 100 patients is given MXT, and the mean time to sedation is found to be 8.5 minutes. Use this information to answer the questions below.

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

(a) Let $\bar{x}$ be the mean time to sedation for a random sample of 100 patients receiving MXT. What are the values of $\mu_{\bar{x}}$ and $\sigma_{\bar{x}}$?

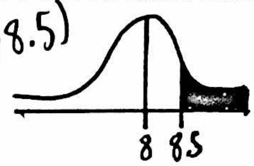
$\mu_{\bar{x}} = 8$ minutes, $\sigma_{\bar{x}} = 0.35$ minutes

(b) What is the shape of the sampling distribution of $\bar{x}$? Justify your answer.

CLT $n = 100 \geq 30 \rightarrow$ Approximately Normal.

(c) Regardless of your answer to (b), assume that the distribution of $\bar{x}$ is approximately normal, with mean and standard deviation as given in (a). What is the probability that a sample of 100 patients will have a mean time to sedation greater than 8.5 minutes?

$P(\bar{x} > 8.5)$



$$z = \frac{8.5 - 8}{0.35}$$

Table: 0.0764
Calc: 0.0766

2. Studies have suggested that about 45% of people who die from sudden circulatory arrest (SCA) have a prior history of cardiac disease. A random sample of 114 victims of SCA found that 55 had a prior history of cardiac disease. Use this information to answer the questions below.

(a) Let $\hat{p}$ be the proportion of SCA victims, in a sample of 114 cases, where the victim had a history of cardiac disease. What are the values of $\mu_{\hat{p}}$ and $\sigma_{\hat{p}}$?

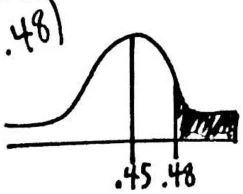
$\mu_{\hat{p}} = 0.45$, $\sigma_{\hat{p}} = 0.04659$ $\quad N > 10n$

(b) What is the shape of the sampling distribution of $\hat{p}$? Justify your answer.

$np \geq 10$ $\quad n(1-p) \geq 10$
$114(.45) \geq 10$ ✓ $\quad 114(.55) \geq 10$ ✓ $\quad$ Approximately Normal.

(c) Regardless of your answer to (b), assume that the sampling distribution of $\hat{p}$ is approximately normal, with mean and standard deviation as given in (a). What is the probability that more than 55 out of 114 SCA victims will have a history of cardiac disease?

$P(\hat{p} > .48)$



$$z = \frac{\left(\frac{55}{114}\right) - .45}{.04659}$$

Table: 0.242
Calc: 0.243