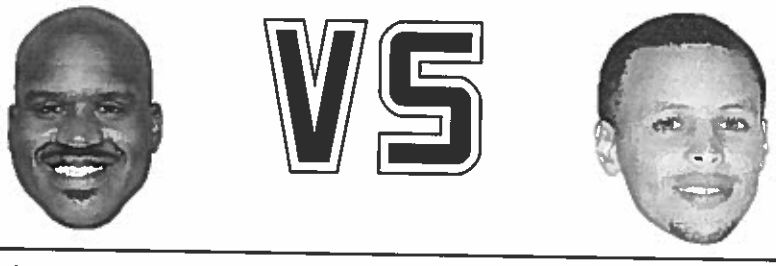
Name: _____ Hour: _____ Date: _____

Chapter 9 Intro: Is Mrs. Gallas a good free throw shooter?



Mrs. Gallas claims she is an 80% free throw shooter. To prove her skills she shoots 50 free throws and makes 32 shots. Is Mrs. Gallas exaggerating about her free throw skills?

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

Population: _____ Parameter: _____

Sample: _____ Statistic: _____

2. There are two possible explanations for why Mrs. Gallas only made 32/50 shots.

1.)

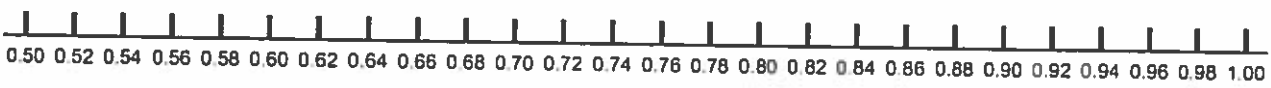
2.)

To test Mrs. Gallas' claim, we will **assume #1, she is an 80% free throw shooter**, and examine the likelihood that she makes 32/50 shots through simulation.

3. Use the spinner provided to simulate 50 free throws **shot by an 80% free throw shooter** by spinning 50 times. What is your sample proportion of shots made?

4. Repeat for another sample of 50 spins. Calculate the sample proportion.

5. Add your sample proportions to the dotplot on the board. Each person in your group should add two dots to the board. Sketch the dotplot below.



Name: _____ Hour: _____ Date: _____

6. What does each dot represent?

7. One student says, "Each dot represents the proportion of free throws made out of 50 free throws shot by Mrs. Gallas." Is this correct? Explain.

8. What percentage of the dots represent a percentage of 64% or less?

Interpret this percentage in context.

9. Based on your answer to Question 8, does the observed $\hat{p} = 0.64$ result give convincing evidence that Mrs. Gallas is exaggerating? Or is it plausible that an 80% shooter can have a performance this poor by chance alone?

Name: _____ Hour: _____ Date: _____

Lesson 9.1: Day 1: Is this gender discrimination?

A local engineering firm had to conduct a series of lay offs recently. They will lay off 10 people. The company has 180 employees that could be laid off. All are equally qualified so the company decides to use a lottery system to be carried out by the manager to decide who will be laid off. The manager posts a list of the employees to be laid off. Five employees are women and 5 are men. One of the women claims this is gender discrimination and starts a lawsuit against the company.

1. The manager responds, "How could there be gender discrimination when half of the employees laid off were female and half were male?" What additional information do you need to evaluate this statement?

2. How can you investigate the gender discrimination claim? Detail a process that could be used.

3. Complete your investigation below.

4. What percentage of the dots represent half or more females being laid off?

5. Interpret this percentage in context.

6. Do you have convincing evidence of gender discrimination? Explain.

Name: _____ Hour: _____ Date: _____

Lesson 9.1 Day 1– Significance Tests: The Basics

Important ideas:

Check Your Understanding

Calcium is a vital nutrient for healthy bones and teeth. The National Institutes of Health (NIH) recommends a calcium intake of 1300 milligrams (mg) per day for teenagers. The NIH is concerned that teenagers are not getting enough calcium, on average. Is this true?

1. State appropriate hypotheses for performing a significance test. Be sure to define the parameter of interest.

Researchers decide to perform a test using the hypotheses stated in #1. They ask a random sample of 20 teens to record their food and drink consumption for 1 day. The researchers then compute the calcium intake for each student. Data analysis reveals that $\bar{x}$ = 1198 mg and s_x = 411 mg. Researchers performed a significance test and obtained a P-value of 0.1404.

2. Explain what it would mean for the null hypothesis to be true in this setting.

3. Interpret the P-value.

4. What conclusion would you make at the $\alpha = 0.05$ level?

Name: _____ Hour: _____ Date: _____

Lesson 9.1: Day 2: Should Rockford switch to bottled water?

WOLVERINE

The Wolverine Worldwide (a shoe company in Rockford) improperly disposed of chemicals (PFAS), which have leaked into the ground water. The state's drinking water limit of 70 parts per trillion (ppt) is considered safe, while anything above 70 ppt is considered dangerous. Officials believes the water in Rockford may be unsafe. They take a random sample of 200 households in Rockford. They find the average lead level of the sample is 70.5 ppt.

1. State appropriate hypotheses for performing a significance test using words and symbols.

2. After conducting a significance test, a *P*-value of 0.045 is found. Interpret this value.

3. Based on the P-value, should Rockford keep the current water or switch to bottled water? Explain.

4. Let's suppose this decision is wrong. What would be a consequence of this error?

5. Given the water is safe, how often will this error occur?

6. Now suppose the P-value was 0.14. Should the town keep the current water or switch to bottled water?

7. Let's suppose this decision is wrong. What would be a consequence of this error?

8. Are the consequences in question #4 or question #7 more serious? Explain.

Name: _____ Hour: _____ Date: _____

Lesson 9.1 Day 2 – Type 1 and Type 2 Errors

Important ideas:

Check Your Understanding

The manager of a fast-food restaurant wants to reduce the proportion of drivethru customers who have to wait longer than 2 minutes to receive their food after placing an order. Based on store records, the proportion of customers who had to wait longer than 2 minutes was $p = 0.63$. To reduce this proportion, the manager assigns an additional employee to drive-thru orders. During the next month, the manager collects a random sample of 250 drive-thru times and finds that $\hat{p} = \frac{144}{250} = 0.576$. The manager then performs a test of the following hypotheses at the $\alpha = 0.10$ significance level:

$$H_0: p = 0.63$$
$$H_a: p < 0.63$$

where p = the true proportion of drive-thru customers who have to wait longer than 2 minutes to receive their food.

1. Describe a Type I error and a Type II error in this setting.

2. Which type of error is more serious in this case? Justify your answer.

3. Based on your answer to Question 2, do you agree with the company's choice of $\alpha = 0.10$? Why or why not?

4. The *P*-value of the manager's test is 0.0385. Interpret the *P*-value.

Name: _____ Hour: _____ Date: _____

Lesson 9.2: Day 1: Are you sure Mrs. Gallas isn't a good free throw shooter?

VS

In Lesson 9.1 we used simulation to estimate a P-value to decide whether or not Mrs. Gallas was exaggerating about her free throw percentage. Today, we will use a formula to find a P-value.

1. We're going to carry out the significance test from lesson 9.1 again. Begin by writing the hypotheses.

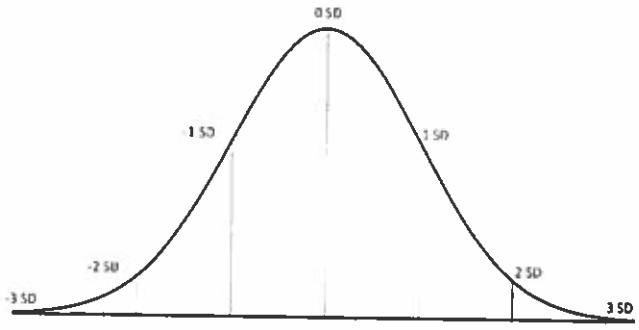
2. a. Each class found a different P-value because each dotplot was different. Would it be appropriate to use a Normal distribution to model the sampling distribution of $\hat{p}$? Justify your answer.

   b. Are there any other conditions we should check?

3. Now that conditions have been met, find the mean and standard deviation of the sampling distribution of $\hat{p}$.

4. Use the mean and standard deviation you found to label the Normal curve.

5. How many standard deviations below the mean (z-score) is $\hat{p} = 0.64$? Label it on the normal curve.



6. Find the probability of an 80% shooter making 32/50 ($\hat{p} = 0.64$) or less.

7. What conclusion can we make?

Name: _____ Hour: _____ Date: _____

Lesson 9.2 Day 1– Significance Test for *p*

Important ideas:

Check Your Understanding

According to the U.S. Census Bureau, the proportion of students in high school who have a part-time job is 0.25. An administrator at a local high school suspects that the proportion of students at her school who have a part-time job is less than the national figure. She would like to carry out a test at the $\alpha = 0.05$ significance level. The administrator selects a random sample of 200 students from the school and finds that 39 of them have a part-time job.

(a) State appropriate hypotheses for performing a significance test. Be sure to define the parameter of interest.

(b) Explain why the sample result gives some evidence for the alternative hypothesis.

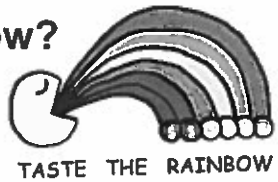
(c) Check if the conditions for performing the significance test are met.

(d) Calculate the standardized test statistic and P-value.

(e) What conclusion would you make?

Name: _____ Hour: _____ Date: _____

Lesson 9.2: Day 2: Can you taste the rainbow?



Many students claim that they can taste the different colors of Skittles. Today we will conduct an experiment and perform a significance test to see if students really can "taste the rainbow".

Collect data: **How many correct?** _____ **How many total?** _____

STATE: Parameter:

Statistic:

Hypotheses:

Significance level: 5% ($\alpha = 0.05$)

PLAN: Name of procedure:

Check conditions:

DO: General Formula:

Specific Formula:

Picture (of the Normal curve):

Work:

Test statistic:

P-value:

CONCLUDE: Based on the P-value, what conclusion do you make?

Name: _____ Hour: _____ Date: _____

Lesson 9.2 Day 2– Significance Tests: The 4 Steps

Important ideas:

Check Your Understanding

According to the National Institute for Occupational Safety and Health, job stress poses a major threat to the health of workers. A news report claims that 75% of restaurant employees feel that work stress has a negative impact on their personal lives. Managers of a large restaurant chain wonder whether this claim is valid for their employees. A random sample of 100 employees finds that 68 answer "Yes" when asked, "Does work stress have a negative impact on your personal life?"

1. Do these data provide convincing evidence at the $\alpha = 0.10$ significance level that the proportion of all employees in this chain who would say "Yes" differs from 0.75?

STATE: Parameter:

Statistic:

Hypotheses:

Significance level:

PLAN: Name of procedure:

Check conditions:

DO: General Formula:

Specific Formula:

Work:

Picture:

Test statistic:

P-value:

CONCLUDE:

2. A 90% confidence interval for the restaurant worker data was also created and found to be (0.603272, 0.756728). Explain how the confidence interval is consistent with, but gives more information than, the test.

Name: _____ Hour: _____ Date: _____

Lesson 9.3: Day 1: Are you getting enough sleep?


It's recommended that teenagers get 8 hours of sleep a night. Mrs. Gallas believes her AP Stats students are getting less than the recommended 8 hours of sleep per night. To test her belief, take a random sample of 10 students in class and record the number of hours of sleep for each. Do these data provide convincing evidence that the AP stats students get less than 8 hours of sleep per night using $\alpha = 0.05$?

1. Calculate the sample mean and standard deviation.

2. State the appropriate hypotheses for a significance test. Be sure to define the parameter of interest.

3. What conditions must be met? Check them.

4. Give the formulas for the mean and standard deviation of the sampling distribution of $\bar{x}$ and calculate the values.

5. Draw a picture and then calculate the test statistic.

6. Remember, since we are working with means, the test statistic is a *t* value. Use table B to find the P-value.

7. What conclusion can we make?

Name: _____ Hour: _____ Date: _____

Lesson 9.3 Day 1– Significance Test for μ

Important ideas:

Check Your Understanding

The level of dissolved oxygen (DO) in a stream or river is an important indicator of the water's ability to support aquatic life. A researcher measures the DO level at 30 randomly chosen locations along a stream. Here are the results in milligrams per liter (mg/l): $\bar{x} = 4.77$ and $s_x = 0.939$. An average dissolved oxygen level below 5 mg/l puts aquatic life at risk. Do the data provide convincing evidence at the α = 0.05 significance level that aquatic life in this stream is at risk?

State: Parameter:

Statistic:

Hypotheses:

α Level:

Plan: Name of procedure:

Check conditions:

Do: General:

Picture:

Specific:

Work:

Test Statistic:

P-value:

Conclude:

Name: _____ Hour: _____ Date: _____

Lesson 9.3: Day 2: How powerful is EKHS math?

The national mean score on the math portion of the SAT is 511 with a standard deviation of 120. We believe the students at EKHS have a higher mean than the national average. To find out, we take a random sample of 8 students and find their average. We will then use the data to conduct a significance test with $\alpha = 0.05$.

1. Write the appropriate hypotheses for the significance test. Be sure to define the parameter of interest.

Suppose the mean math SAT score at EKHS is 535 (alt. μ). Go to stapplet.com and launch the "Statistical Power" applet. Enter all of this information into the fields on the left of the applet. You'll notice a value called "Power". This is the probability that the significance test will find convincing evidence against the null with the information you've entered.

2. What is the probability that the test will find convincing evidence against the null hypothesis?

Interpret this value in context.

3. We want to **increase** the power of our test. How could we adjust each of the following factors to increase our power? Use the applet to explore each.

a. Sample size:

b. Alpha level:

c. Alternative μ:

Name: _____ Hour: _____ Date: _____

Lesson 9.3 Day 2– Power of a Test

Important ideas:

Check Your Understanding

Can a six-month exercise program increase the total body bone mineral content (TBBMC) of young women? A team of researchers is planning a study to examine this question. The researchers would like to perform a test of H_0: $\mu = 0$ H_a: $\mu > 0$ where μ is the true mean percent change in TBBMC during the exercise program.

1. The power of the test to detect a mean increase in TBBMC of 1% using $\alpha = 0.05$ and $n = 25$ subjects is 0.80. Interpret this value.

2. Find the probability of a Type I error and the probability of a Type II error for the test in Question 1.

3. Determine whether each of the following changes would increase or decrease the power of the test. Explain your answers.

(a) Use $\alpha = 0.01$ instead of $\alpha = 0.05$.

(b) Use $n = 100$ instead of $n = 25$.

AP Stats Chapter 9 Formula Study Sheet

Lesson	9.2 – Significance Test for a Proportion	9.3 – Significance Test for a Mean
Symbol for statistic (sample)		
Symbol for parameter (population)		
Name the procedure		
RANDOM condition		
10% condition		
NORMAL condition		
Formula for mean of the sampling distribution		
Formula for standard deviation of the sampling distribution		
General formula for test statistic		
Specific formula for test statistic		
Picture		
How to find P-value		

4 STEP PROCESS

STATE: Parameter, statistic, hypotheses, and significance level.

PLAN: Name the appropriate inference method and check conditions.

DO: If the conditions are met, perform the calculations.

Picture, general formula, specific formula, work, test statistic, P-value.

CONCLUDE: Make a conclusion about the hypotheses in the context of the problem.

AP Statistics Activity Wrap-up

Name_____

Activity Name:

Describe the activity or context:	
What important statistical concepts did we learn?	

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