

1. (4 pts) Determine which of the following variables is continuous and which is discrete (circle the answer):

X = the number of pets owned by a person.

DISCRETE

CONTINUOUS

X = the time a person takes to run a marathon

DISCRETE

CONTINUOUS

2. (6 pts) (a) If you wanted to obtain a Simple Random Sample of 20 statistics (Cuesta) students, what would you have to do? Describe the process you would have to go through. Assume there are about 300 statistics students at Cuesta.

*Assign a number to all 300 students, 1 to 300.  
Use a random number generator to select  
20 numbers, from 1 to 300. The 20 students  
with those numbers would be a SRS.*

(b) If you used our class as a sample of, that would be called

a Sample of Convenience.

3. (4 pts) Suppose you wanted to find out the proportion of Cuesta students who think there should be more funding for tutoring. If you used a sample of the students in the Math Lab would the results be biased? (Circle your answers)

Bias? YES NO

If biased, would the bias be POSITIVE or NEGATIVE?

4. (4 pts) What is the mean and standard deviation of the distribution  $N(30, 6)$ ?

Standard deviation = 6 Mean = 30

5. (4 pts) Hypothesis testing is used to do which of the following?

(a) Use data in a sample to make an inference about the sample.

(b) Use census data to make an inference about a sample.

(c) Use census data to make an inference about a population.

(d) Use data in a sample to make an inference about a population.

6. (6 pts) Suppose a hypothesis test was done correctly, with perfect random, independent sampling and all conditions for the test satisfied. If the P-value for the test was .002, which of the following would be correct (circle all correct statements):

(a) We would reject the alternative hypothesis

(b) We would reject the null hypothesis

(c) There is a .2% chance we would get these data values and test statistic due to sampling variability.

(d) The result of the test is statistically significant.

(e) We would know with 100% certainty that the null hypothesis is false.

7. (6 pts) Suppose in conducting a study, you've done everything correctly in gathering data, in doing the analysis via hypothesis testing, then in forming a conclusion based on the P-value.

There is still the possibility, due to Sampling variability, that the evidence led you to a conclusion that is incorrect.

A Type I Error (error of the first kind) happens if the evidence leads you to reject  $H_0$  the null hypothesis when in reality the null is true.

A Type II Error (error of the second kind) happens if the evidence leads you to not reject the null hypothesis when in reality the null hypothesis is false.

8. (14 pts) SAT scores are approximately normally distributed with a mean of 500 points and a standard deviation of 100 points.

$$\mu = 500 \quad \sigma = 100$$

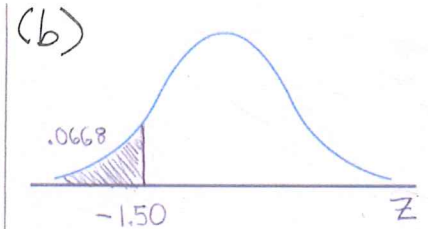
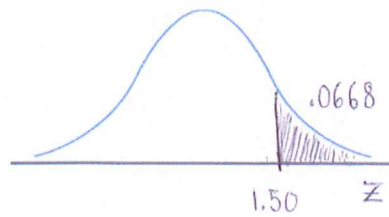
- (a) Calculate z for an SAT score of 350 points.  $X = 350$

$$Z = \frac{350 - 500}{100} = \frac{-150}{100} = -1.5$$

Use the appropriate graphs to answer (b) and (c)

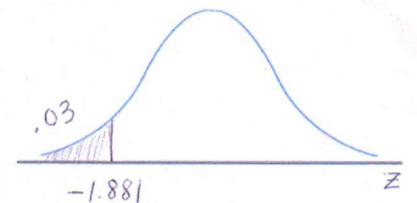
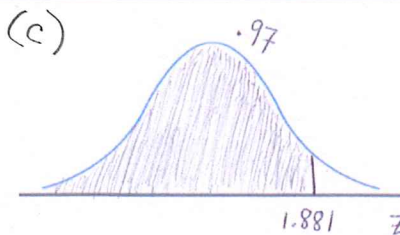
- (b) What percentage of people taking the exam scored at 350 points or below?

$$P(X \leq 350) = P(Z \leq -1.50) = .0668 = \boxed{6.68\%}$$



- (c) What is the z-score for the 97<sup>th</sup> percentile?

$$\boxed{Z = 1.881}$$



- (d) Calculate the SAT score that would be at or close to the 97<sup>th</sup> percentile.

$$Z = 1.881 \quad X = ?$$

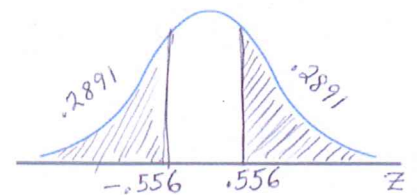
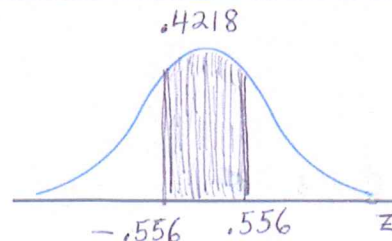
$$Z = \frac{X - \mu}{\sigma}$$

$$1.881 = \frac{X - 500}{100}$$

$$188.1 = X - 500$$

$$X = 688.1$$

The score is 688.1



9. (20 pts) Sampling Distribution of  $\hat{p}$ . According to studies done in the 1940's, 29% of all people dream in color. Assume this is still true. Suppose you drew a random sample of 200 independent people, asked whether they dream in color, and found that 32% of the people in your sample said they do.

(a) Use the information above to determine each of the following values

$$p = \underline{.29} \quad \hat{p} = \underline{.32} \quad n = \underline{200}$$

(b) List the conditions for the Central Limit Theorem and determine whether this situation satisfies those conditions. Briefly explain how the conditions are or are not satisfied. Show your calculations.

1. Random sample, independent observations?  
Yes, stated in problem

2. Large sample?  $E_{\text{success}} = np = 200(.29) = 58 \geq 10 \checkmark$   
 $E_{\text{failure}} = n(1-p) = 200(.71) = 142 \geq 10 \checkmark$

3. Large population?  $Pop \geq 10(200) = 2,000$   
More than 2000 people who dream? Yes

(c) Find the Standard Error for the sampling distribution of  $\hat{p}$ . (Use 3 decimal places in your answer.)

$$SE = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{.29(.71)}{200}} = .032$$

$$\boxed{SE = .032}$$

(d) Find the z-score for the sample proportion.

$$Z = \frac{\hat{p} - p}{SE} = \frac{.32 - .29}{.032} = \frac{.03}{.032} = .938$$

$$\boxed{Z = .938} \text{ (or } Z = .9375)$$

(e) Based just on the z-score, is the sample proportion an unusual observation? (Circle your answer)

Yes, unusual

No, not unusual

$z < 1$  is not an unusual value!

(f) Without conducting a hypothesis test, do you think this sample would show there has been a significant increase in the proportion of people dreaming in color? (Circle your answer)

Yes, a significant increase

No, not a significant increase

Can't tell from this information

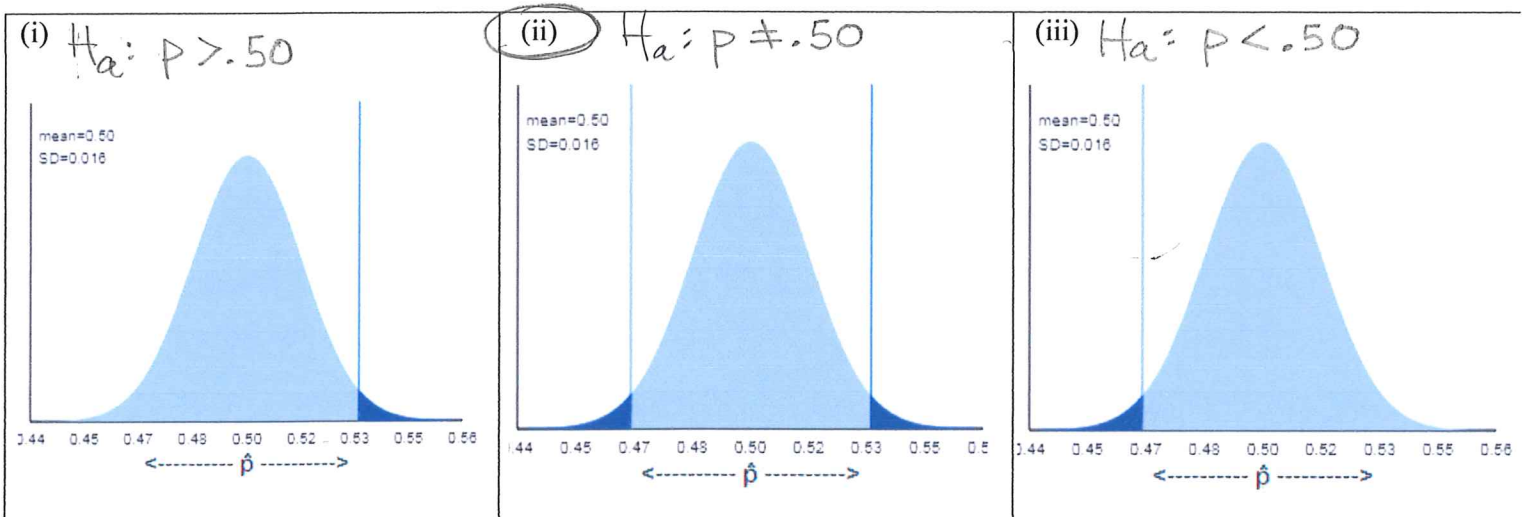
10. (12 pts) In the past, an average of 50% of employed people said they were completely or very satisfied with their jobs. Recently, the General Social Survey sampled 1016 employed people and asked them how satisfied they were with their jobs. Of the 1016 people sampled, 475 said they were completely satisfied or very satisfied with their jobs.

$$\hat{p} = 475/1016 = .468 = 46.8\%$$

- (a) If you were to test to see whether the proportion of completely or very satisfied workers has changed from the previous proportion of 50%, what would the hypotheses be? Write in math symbols and in words.

Math symbols	Words
$H_0: p = .50$	The proportion of all (population!) workers who are completely or very satisfied is still 50%.
$H_a: p \neq .50$	The proportion (population!) has changed.

- (b) Choose the graph below that correctly represents the P-value for the test. (No calculations necessary!)



- (c) The P-value is .0384. What is the conclusion to the hypothesis test?

Assuming a significance level of .05 (default) and noting that  $p\text{-value} = .0384 < .05$  we would reject  $H_0$  and accept  $H_a$ .

There is sufficient evidence (from the data) that there has been a significant change in the proportion of all workers who are satisfied with their jobs.

- (d) What error could we make with this conclusion? (Circle your answer)

Type I/error of the first kind

Type II/error of the second kind

No error, we know that the sample proportion tells us exactly what the population proportion is.

11. (20 pts) A manufacturer is testing out a new shampoo. Before going into full production, the company wants to be sure that more than 80% of all potential customers will like the shampoo. They select a random sample of 120 potential customers to try the shampoo then ask them for their opinion. 99 individuals like the shampoo. Perform a hypothesis test to determine whether the company has significant evidence that more than 80% of all potential customers will like the shampoo. Use  $\alpha = .05$

(a) Step 1: Hypothesize (fill in word) Write the hypotheses in symbols and also in words.

Math symbols	Words
$H_0: p = .80$	The proportion of <u>ALL</u> potential customers who would like the shampoo is 80%
$H_a: p > .80$	The proportion is more than 80%

(b) Step 2: Prepare (fill in word)

Significance level: .05

Name the test you will use: 1 proportion z-test  
 (Assume conditions are met...you do NOT have to check.)

(c) Step 3: Compute (fill in word)

Show all computation up to finding the P-value. For full credit, include a sketch and shade in the area that represents the P-value.

Parking Lot  
 $n = 120$   
 $X = 99$   
 $\hat{p} = \frac{99}{120} = .825$

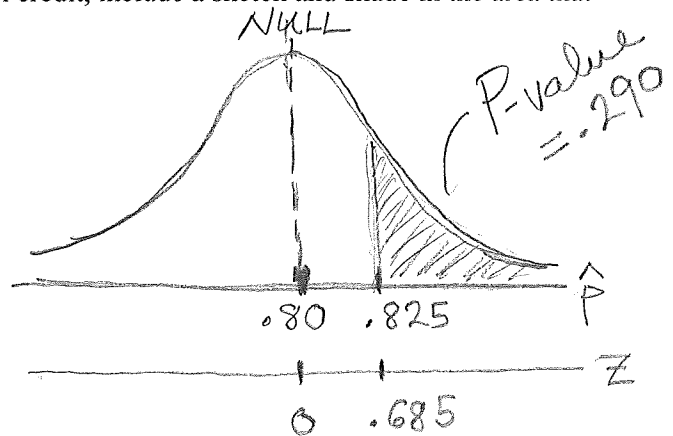
$$Z = \frac{\hat{p} - p_0}{SE}$$

$$Z = \frac{.825 - .80}{.0365}$$

$Z = .685$

$p_0 = p_{null} = .80$

$$SE = \sqrt{\frac{.8(.2)}{120}} = .0365$$



(d) Step 4: Interpret (fill in word)

The P-value is .290. Finish the Hypothesis Test using this information. Choose the correct conclusion

- (i) There is sufficient evidence to reject the null so we conclude the proportion of people who like the shampoo is significantly more than 80%..
- (ii) There is insufficient evidence to reject the null so we conclude that the proportion of people who like the shampoo is not significantly more than 80%.