

Answer the following questions NEATLY. Show all necessary work directly on the exam. Scratch paper will be discarded unread. *1 point each part unless otherwise marked. Total points: 38.*

- 1) The military stockpiles different types of drugs for soldiers to use in case of an emergency. However, replacing these drugs when they reach their expiration date is extremely expensive. The Pentagon wants to test the potency of one stockpiled antibiotic to see if the drug is safe to use. They take a random sample of 81 pills and find that they have a mean potency of 33 micrograms of the active ingredient. If the standard deviation of the sample is 5 micrograms find the 95% confidence interval for the mean potency of all the pills for this drug.

- a) Provide the 95% confidence interval.

(31.894, 34.106)

- b) Interpret the interval you provided in the context of the problem.

We are 95% confident that the mean potency of the antibiotic is between 32 and 34 micrograms.

- ~~c) If the safe potency for the antibiotic is 34.79 micrograms, can we conclude that the stockpiled antibiotics are safe? (Choose one.)~~

- A. Yes, because 33 is below 34.79
 B. Yes, because the interval is below 34.79
C. No, because we only took one sample of size 81
D. No, there is not enough information to make a conclusion

- 2) A particular psychological test is used to measure academic motivation. The average test score for all university students nationwide is 115. A university in the south of the country estimates the mean test score for students in its economic faculty by testing a random sample of n students and constructing a confidence interval based on their scores. Which of the following statements about the confidence interval are true? Circle **all** TRUE statements. (3 points)

- A. The resulting interval will definitely contain 115.
B. The 95 percent confidence interval for $n = 100$ will generally be wider than the 95 percent confidence interval for $n = 50$.
 C. For $n = 100$, the 95 percent confidence interval will be wider than the 90 percent confidence interval.

3) Bill, a psychologist, has developed a new aptitude test. He was able to show (through a somewhat dubious study) that 80% of the public passed the test. A second psychologist, Tamera, wants to recreate this study. She believes the actual percentage is less than 80%. A random sample of 200 people took the test, and 146 passed. Does Tamera have enough evidence to say that Bill's test is invalid? Conduct an appropriate hypothesis test.

a) Hypotheses (2 points)

$$H_0: p = .8$$

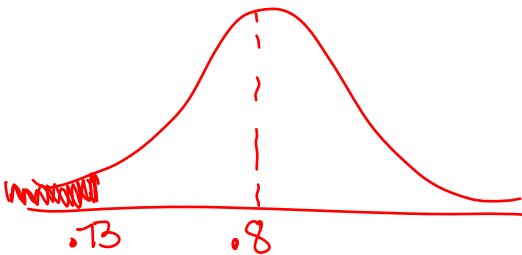
$$H_A: p < .8$$

b) Check Conditions

① Indep / Rand / Rep. ✓

② S/F ✓

c) Draw, label, and shade the model.



d) Test statistic and p-value. (2 points)

↓
-2.47 ↘ 0.007

}} or .010
and NO T.S.

e) State conclusions (both statistical and experimental). (2 points)

Reject H_0 .

There is statistically significant evidence to support Tamera.

f) If your conclusion is wrong, what kind of error have you made?

Type I

- 4) To determine whether students tend to do better on the SAT Mathematics (SAT-M) test if they chew gum while taking the test, researchers recorded the score with gum and the score without gum for a random sample of 40 students, who take the test 2 times, randomly determining whether they chewed gum first or second. Assume that the change in SAT-M score (score with gum - score without gum) for the population of all students taking the test twice is normally distributed. For this sample, they found \bar{x} , the mean difference in scores, was 25.1 and that the researcher rejects the hypothesis that the population mean difference in scores $\mu = 0$ (at the .05 level).
- a) Based on the reported results, would you be willing to conclude that the researchers have shown that the mean SAT-M score is higher for the students chewing gum than for the students not chewing gum in this population? (Choose one.)
- A. Yes, because the researcher rejected the hypothesis that there is no difference
 - B. No, because the confidence interval is not provided
 - C. Yes, because the mean difference in scores is 25.1, which is larger than 0.
 - D. No, because we haven't seen a histogram of the original data
- b) Suppose the sample mean difference in scores had been $\bar{x} = 20$ instead of 25. Would the p -value have been larger, smaller, or the same? (Choose one.)
- A. Larger because 25 is further from zero
 - B. Smaller because 20 is closer to zero
 - C. The same because both numbers are above 0
 - D. The same because of sampling variability
- c) ^{have} Suppose instead that the sample standard deviation of the differences had been smaller, would the p -value ~~had been~~ larger, smaller, or the same? (Choose one.)
- A. Larger because the sample value becomes closer to zero
 - B. Smaller because the sampling distribution is more concentrated at the center
 - C. The same because the p -value measures the mean, not the standard deviation
 - D. The same because of sampling variability
- d) Another researcher proposes a study that will randomly assign 40 students to chew gum and 40 students to not chew gum and then compare the results of the two groups. Which design is best? (Choose one.)
- A. Matched pairs
 - B. Independent
 - C. Both designs work equally well
 - D. Neither design will work

- 5) A group of randomly selected men and women between the ages of 25 and 35 were asked "How many hours did you work last week?" The summary statistics from the study are provided in the table. Determine whether there is a significant difference between men and women in the mean number of hours they work each week. Provide statistical evidence to support your conclusion. (2 points)

Hours Worked Last Week	Gender	n	Mean	Std. Deviation
	Male	142	47.79	11.80
	Female	119	39.13	13.99

$$H_0: \mu_m = \mu_f \quad P\text{-val.} = 0 \quad CI: (5.47, 11.85)$$

$$H_A: \mu_m \neq \mu_f$$

There is a difference between men and women in the mean number of hours they work each week.

- 6) We are interested in studying the heights of American adult men. The mean height of adult American men is 69 inches with a standard deviation of 2.5 inches. Imagine that all possible random samples of size 75 ($n = 75$) are taken from the population of American adult men's heights. The means from each sample form the sampling distribution of sample means.

- a) What is the mean value for this sampling distribution?

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- b) What is the standard deviation of this sampling distribution?

$$\frac{2.5}{\sqrt{75}} = 0.289$$

- c) Describe the shape of this sampling distribution. (Choose one.)

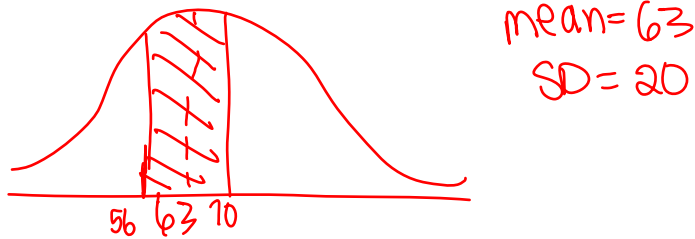
- A. Skew toward the low end because no one can have a height lower than 0 inches
- B. The distribution will be unimodal and symmetric because 75 is a large sample
- C. The distribution will have outliers for really short and really tall people
- D. The distribution will be flat (uniform) because sampling evens things out

- 7) Food inspectors inspect samples of food products to see if they are safe. This can be thought of as a hypothesis test where H_0 : the food is safe, and H_A : the food is not safe. If you are a consumer, which type of error would be the worst one for the inspector to make? (Choose one.)

- A. Type I because the food is really safe
- B. Type II because the food is really safe
- C. Type I because the food is really not safe
- D. Type II because the food is really not safe

- 8) A large college class has 900 students, broken down into section meetings with 30 students each. On the final exam, scores followed a normal distribution with an average of 63 and a standard deviation of 20.
- a) If you randomly select one of these students, what is the probability that the selected student scored between 56 and 70 on the final exam?

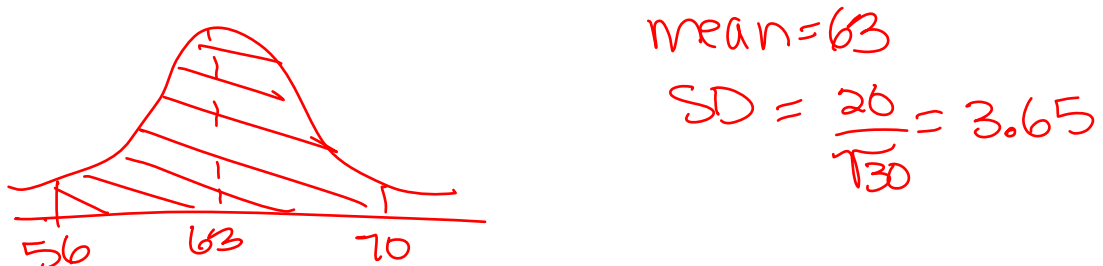
i) Clearly label a graph and shade in the area that corresponds to the probability.



ii) Find the probability: 27.4%

- b) If we consider a section of 30 students as a random sample from this population, will the probability that the average for the section is between 56 and 70 be higher or lower or the same as what you calculated in the previous question? Explain. (You do not need to perform any additional calculations.)

i) Clearly label a graph and shade in the area that corresponds to the probability.



ii) Find the probability: 94.5% ← so much higher

- 9) In a survey of randomly selected licensed drivers in Wisconsin, 264 of 1140 women and 211 of 845 men said that they did not drink alcohol. Can we conclude that Wisconsin women abstain from drinking alcohol at a higher rate than Wisconsin men? Provide statistical evidence to support your conclusion. (2 points)

$$\hat{P}_w = 23\%$$

$$\hat{P}_m = 25\%$$

NO $\hat{P}_w < \hat{P}_m!$

So there is NO evidence.

10) National data show that, on the average, college freshmen spend 7.5 hours a week going to parties. A local college president does not believe that these figures apply at his school. He takes a simple random sample of 50 freshmen, and interviews them. He finds that the 95% confidence interval for the number of hours spent a week going to parties is (5.72, 7.42).

- a) Now he wants to test the hypothesis that the mean for his college is different from the national mean at a 5% significance level. Specify the null and alternative hypotheses for this test. (2 points)

$$H_0: \mu = 7.5$$
$$H_A: \mu \neq 7.5$$

- b) Specify the statistical and experimental conclusions for the hypothesis test. (2 points)

Reject H_0 .

Evidence supports the president's belief.

11) The average number of fruit candies in a large bag is estimated. The 95% confidence interval is (40, 48).

- a) Based on this information, you know that the best estimate of the population mean is (Choose one.)

A. 40

B. 48

C. 44

D. 8

E. We cannot determine the best estimate from the information given.

- b) Based on this information, you know that you can reject $H_0: \mu = 38$ at $\alpha = \underline{\hspace{1cm}}$. (Choose one.)

A. .85

B. .15

C. .10

D. .05

E. .01

- c) After calculating this confidence interval, you discover an additional 10 bags of these candies. You add that data to the original set of counts and recalculate the confidence interval. Which of the following confidence intervals is most likely to result? (Choose one.)

A. 38 to 50

B. 40 to 50

C. 42 to 46

D. 41 to 46

E. The confidence interval will not change