

STAT 3470 Exam 2 Autumn 2019

Multiple Choice Questions (3 points each, please circle the letter for the best option)

1. Which of the following statements about the t-distribution is FALSE?
 - a. It has heavier tails than the standard normal distribution to account for the added variability that comes from estimating σ with s .
 - b. It is slightly skewed because we don't know the population standard deviation.
 - c. It is approximately equal to the standard normal distribution when n is very large
 - d. It has a parameter called "degrees of freedom" which get larger as n gets larger
2. Suppose you want to estimate the true proportion of OSU students who plan on buying student football tickets next year. If you want the margin of error to be at most .05 with 98% confidence, how many students do you need to sample? Use the conservative approach.
 - a. 33
 - b. 43
 - c. 421
 - d. 543

True/False Questions (2 points each, please circle T or F for each statement)

3. T F The margin of error for a prediction interval is larger than for a confidence interval for the same data.
4. T F The p-value is the probability that we would get a sample result at least as unusual as the one we got, if the alternative hypothesis is really true.
5. T F If the p-value is very high, we should conclude that we are very confident the null hypothesis is true.

For problems 6-8, determine whether the width of the confidence interval would increase, decrease, or stay the same based on the given change. Assume all other things are held constant. Circle your answer. (2 points each)

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| 6. Increasing the significance level | Increase | Decrease | Stay the Same |
| 7. Increasing the sample size | Increase | Decrease | Stay the Same |
| 8. Increasing the point estimate | Increase | Decrease | Stay the Same |

9. (12 points) A company that makes cement bricks claims that the thermal conductivity of their bricks is 0.340. A sample of 35 bricks is taken, resulting in a mean thermal conductivity of 0.343 and a standard deviation of 0.010. You would like to test whether or not the company's claim is correct.

i. Circle the correct hypotheses for this test

- a. $H_0: \mu = 0.34, H_a: \mu > 0.34$ d. $H_0: \mu = 0.34, H_a: \mu \neq 0.34$
b. $H_0: \mu = 0.34, H_a: \mu < 0.34$ e. $H_0: \mu < 0.34, H_a: \mu = 0.34$
c. $H_0: \mu > 0.34, H_a: \mu = 0.34$ f. $H_0: \mu \neq 0.34, H_a: \mu = 0.34$

ii. What type of test is this? Why?

- a. This is a z-test, because we are given the value of the standard deviation.
b. This is a z-test, because our sample size isn't large enough for a t test.
c. This is a t-test, because we don't know the value of the population standard deviation.
d. This is a t-test, because $35 > 30$.

iii. Conduct the hypothesis test you chose above. Use $\alpha = .05$. You do not have to check assumptions.

iv. Which of the following would be a Type I error for this test?

- a. You conclude that the true thermal conductivity is 0.340, when in reality it is different than 0.340
- b. You forget to check one of the conditions and it causes the results of your test to be invalid.
- c. You use the sample standard deviation instead of the population standard deviation.
- d. You conclude that the true thermal conductivity isn't 0.340, when in reality it is 0.340.

10. (6 points) The Gamma(α, β) distribution has pdf: $f(x) = \frac{1}{\Gamma(\alpha)\beta^\alpha} x^{\alpha-1} e^{-x/\beta}, \quad \text{if } x > 0$
 $0, \quad \text{otherwise}$.

Recall that $E(X) = \alpha\beta$ and $Var(X) = \alpha\beta^2$. Suppose that we have a random sample of size n from a Gamma($\alpha, 3$) distribution.

- i. What is the method of moments estimator of α ?

11. (6 points) Suppose X_1, X_2, \dots, X_n are i.i.d. from a distribution with pdf:

$$f(x) = \theta e^{\theta} x^{-\theta-1} \quad \text{for } x > e$$

$$f(x) = 0 \quad \text{otherwise}$$

- i. What is the maximum likelihood estimator of θ ? [You do not have to check the second derivative to verify that it is a maximum.]

12. (8 points) In a recent Pew Research poll, 54% out of a random sample of 3487 American adults approve of the House of Representatives' decision to conduct an impeachment inquiry.
- Calculate a 99% confidence interval for the true proportion of American adults who approve of the inquiry. Make sure to check the assumptions for the interval.
 - Which of the following is a correct interpretation of your interval? (Circle the letter of the best answer)
 - There is a 99% chance the true proportion of American adults who approve of the inquiry is in my interval.
 - If I took repeated samples of the same size and calculated confidence intervals each time, about 99% of the intervals would contain the sample proportion of American adults who approve of the inquiry.
 - I am 99% confident the true proportion of American adults who approve of the inquiry is in my interval
 - The probability of capturing the true proportion of American adults who approve of the inquiry in my interval is .95
 - Does this interval provide significant evidence that a majority of American adults approve of the inquiry? Explain.