

Econometrics - Problem Set #1

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Concepts and Critical Thinking

Please answer the following questions briefly (1-2 sentences).

1. (5 points) Explain, in your own words, what the Central Limit Theorem says, and why it is important in econometrics. Describe the the sampling distribution of the sample mean (e.g. its mean and standard deviation).

2. (5 points) Explain, in your own words, what a p -value is, and how it is used to establish statistical significance.

3. (5 points) When do we use a t -distribution for hypothesis testing, and when do we use a standard normal distribution (Z -score)? What are the main differences?

4. (10 points) Suppose a number of patients suffer from acutemadeupdisease. One symptom of this disease is higher blood pressure. Pharmabeuterolicin, a new drug, claims to treat acutemadeupdisease and reduce blood pressure. A hospital runs clinical trials to examine how patients' blood pressure changes with or without pharmabeuterolicin. One group is treated with pharmabeuterolicin and another group is given a placebo (sugar pill). The pills are randomly assigned and each patient does not know which pill they received. Suppose the hospital wants to test whether pharmabeuterolicin reduces blood pressure.
- (a) What is the null hypothesis? Be precise.
 - (b) What is a relevant two-sided alternative hypothesis?
 - (c) What is a relevant one-sided alternative hypothesis?
 - (d) What would constitute a Type I error?
 - (e) What would constitute a Type II error?
 - (f) Which type of error is likely to be more significant for this problem?

5. (5 points) Explain how conducting a randomized controlled experiment helps to identify the causal connection between two variables.

Quantitative Applications

Please perform the requested calculations and provide interpretations where asked. Unless otherwise specified, round to 3 decimal places.

- (5 points) A college senior has applied for admission to two medical schools, A and B. She estimates the probability of acceptance at A at 0.7 and the probability of acceptance at B at 0.4 and the probability that she will be admitted to both at 0.2. What is the chance she will not be accepted at either school?

- (5 points) Suppose the probabilities of a visitor to Amazons website and buying 0, 1, or 2 books are 0.2, 0.4, and 0.4 respectively. What is the expected number of books a visitor will purchase? What is the standard deviation of book purchases?

8. (10 points) In the last quarter of 2015, a group of 64 mutual funds had a mean return of 2.4% with a standard deviation of 5.6%. These returns can be approximated by a normal distribution.
- (a) What percent of the funds would you expect to be earning between -3.2% and 8.0%?
 - (b) What percent of the funds would you expect to be earning 2.4% or less?
 - (c) What percent of the funds would you expect to be earning between -8.8% and 13.6%?
 - (d) What percent of the funds would you expect to be earning returns greater than 13.6%?

9. (10 points) A particular elevator will collapse if a group of people weighing in total more than 2,080 lbs. Suppose we know the population average weight is 150 lbs, with a standard deviation of 25 lbs. The elevator manufacturer wants to limit the number of people allowed in an elevator to minimize accidents. Suppose they set a maximum limit of 11 people. What is the probability that if 11 random people enter the elevator, their weight will exceed 2,080 lbs? (Hint: treat the 11 people as a random sample and use the sampling distribution of the sample mean).

10. (20 points) A marketing firm knows that customers usually spend on average 300 seconds reading a given webpage with a standard deviation of 75 seconds. Its client wants to release a webpage that entices visitors to stay for *more than* 300 seconds. The marketing firm runs a sample of 100 random visitors and finds that the average time spent among the participants was 310 seconds.
- (a) State the hypotheses.
 - (b) What test would we run and why?
 - (c) Calculate the test statistic. Using the test statistic, is the finding significant at the 5% level?
 - (d) Calculate the p -value.
 - (e) Construct a 95% confidence interval for the true population mean.
 - (f) Make a conclusion and interpret it in the context of the problem. Is this finding significant at the 5% level? The 10%?

11. (20 points) A new manager of a small convenience store randomly samples 20 purchases from yesterday's sales. The mean was \$45.26 and the standard deviation was \$20.67. The manager wants to see if the average sales per day is at least \$40.
- (a) State the hypotheses.
 - (b) What test would we run and why?
 - (c) Calculate the test statistic.
 - (d) Calculate the p -value.
 - (e) Construct a 95% confidence interval for the true population mean. A hint: the critical value you're looking for is 2.093
 - (f) Make a conclusion and interpret it in the context of the problem.