

3. A pharmaceutical company is testing a new drug to treat a potentially fatal disease. The current treatment is effective on 32% of patients. The cost of the research is quite expensive for the company, and research on the newer version will only be allowed to continue if tests show that the effectiveness for the newer version is significantly higher than the current 32%. A clinical study is planned to test the newer treatment.

a) Describe both a type I and type II error in context, along with a possible consequence of each.

b) In a randomized experiment, 43 patients with the disease were given the newer version of the drug, and the treatment was effective on 18 of them (this is almost 42%). Perform a test of significance to see if the newer version of the drug is more effective than the current treatment.

- c) The p-value that you **should** have obtained in part (b) is 0.0829. Interpret the meaning of this p-value in context.
- d) Biomedical research suggests that this new treatment should be effective on 45% of patients. Assuming this is true, what type of error was probably committed based on the results of the test conducted in part (b)?
- e) Against this alternative, the probability of a type II error for the hypothesis test in part (a) is 0.432. What is the power of this hypothesis test?
- f) What are two ways to increase the power of this hypothesis test?
4. An automobile manufacturer tries two distinct assembly procedures. In a random sample of 850 cars coming off the line, 350 were randomly assigned to the first procedure with 28 major defects, while 500 autos were randomly assigned to the second line with 32 major defects.
- a) Is there a difference in the defect rate between the two procedures at the 5% significance level.

- b) Explain the meaning of the p-value that was calculated in part (a).
5. A study of small-business failures looked at a random selection of 148 food-and-drink businesses in Texas. Of these, men headed 106 and 42 were headed by women. During a three-year period, 15 of the men's businesses and 11 of the women's businesses failed.
- a) Estimate the difference between the proportions at which businesses headed by men and women fail using a 90% confidence interval.
- b) Does this interval provide evidence that food-and-drink businesses in Texas that are headed by women are more likely to fail than those headed by men? Explain.

6. Hannah performs the calculations for a hypothesis test and obtains a z-statistic of -2.04. Unfortunately, Hannah's lab partner, Jeanette, lost their lab papers, and Hannah cannot remember what their hypotheses were.
- If Hannah was performing a two-sided test, what would their p-value be?
 - If Hannah was performing a one-sided test, what are the possible p-values for their test? (THERE IS MORE THAN ONE!)
7. **ALPHA REVISITED** A biomedical engineer named Masha is testing a new treatment to fight a horrible seasonal disease called "senioritis". After conducting a 6-week long clinical trial, her team of researchers finds that the new treatment is NOT significantly better than the currently available treatment when testing at the 5% level of significance. Thus, she decides to stop development on the new anti-senioritis treatment.
- Was the p-value of the hypothesis test greater than or less than 5%? Explain.
 - Would the researchers have come to the same conclusion (that the new treatment is NOT better than the current treatment) if testing at a 1% (one percent) level of significance? Explain.
 - Would they have come to the same conclusion if testing against a 10% (ten percent) level of significance? Explain.

Now suppose that after another 8 months of research and development, Masha and her team conduct another study using a new formula for their anti-senioritis treatment. This time, the researchers find that the new formula IS significantly more effective than the current treatment at fighting senioritis when testing at the 5% level of significance.

- Would the researchers have come to the same conclusion (that the new treatment is now more effective than the current treatment) if testing at the 1% level of significance? What if they were testing at the 10% level of significance?

10. The book *Secrets of Sleep* describes research on dreams. During normal sleep, there is a phase known as REM (rapid eye movement). For most people, REM sleep occurs about every 90 minutes or so, and it is thought that dreams occur just before or during the REM phase. If a person is wakened immediately after the REM phase, he or she usually can describe a dream that has just taken place. Suppose that two groups of subjects are randomly chosen for a sleep study. In group I, before going to sleep, the subjects spend 1 hour watching a comedy movie. In this group, there were a total of 175 dreams recorded of which 49 were dreams with feelings of anxiety, fear or aggression. In group II, the subjects went directly to sleep. In this group, there were a total of 180 dreams of which 63 were dreams with feelings of anxiety, fear or aggression. Does the data indicate that a comedy reduces the proportion of "bad" dreams at a 1% significance level?
11. You wish to estimate, with 80% confidence the true proportion of adults age 18 to 29 who have high blood pressure. Four and a half percent of a random sample of 155 adults in the specified age group was found to have high blood pressure. Compute the interval.

Part III – Multiple Choice

- _____ 12. We test the hypothesis that $p = 0.77$ versus $p > 0.77$. We are not aware that actually $p = 0.83$. The power of the test is largest when
- A) $\alpha = 0.10, n = 330$ B) $\alpha = 0.10, n = 480$ C) $\alpha = 0.05, n = 330$ D) $\alpha = 0.05, n = 480$
- _____ 13. We test the hypothesis $H_0: p = 0.73$ versus $H_a: p < 0.73$. Assume that the alternative hypothesis is true, and that we keep both the sample size and significance level fixed. The power of the test is largest if the actual population proportion is which of the following?
- A) 0.70 B) 0.72 C) 0.75 D) 0.78 E) 0.80