

AP Statistics – Chapter 19 - 22 Review (Inference with Proportions)

Please show all work (and answers) on separate paper!

Part 0 – Recommended Reading

On page 512, read the “Review of Part V” (Quick Review). You should read through all of the bullets, but pay special attention to the bullets on the right-hand side (for hypothesis tests).

Part I – Work out completely

- In a survey of 12,000 adults aged 19 – 74, National Cancer Institute researchers found that 9% in the survey ate at least the recommended two servings of fruit or juice and three servings of vegetables per day. Based on these findings, calculate the probability that in a random sample of 6 adults, that at most 1 of them ate the recommended amount of fruit/juice and vegetables per day. (*hint: this is from late first semester*)
- In a study of air-bag effectiveness, a recent survey found that in 821 crashes of midsize cars equipped with air bags, 46 of the crashes resulted in hospitalization of the drivers.
 - Create and interpret a 90% confidence interval to estimate the true air-bag hospitalization rate.
 - Interpret the 90% confidence **level** in context.
- 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.
 - Describe both a type I and type II error in context, along with a possible consequence of each.
 - In an experimental study, a random sample of 43 patients with the disease was 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.
 - The p-value that you **should** have obtained in part (b) is 0.0829. Interpret the meaning of this p-value in context.
 - 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)?
 - 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? Interpret this value in context.
 - What are two ways to increase the power of this hypothesis test?
- 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.
 - Is there evidence of a difference in the defect rate between the two procedures at the 5% significance level?
 - Explain the meaning of the p-value that was calculated in part (a).
- 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.
 - Estimate the difference between the proportions at which businesses headed by men and women fail using a 90% confidence interval.
 - 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.
- 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?

Part II – Identify problem types and write formulas

For these problem, (a) state the type of problem, (b) state the hypotheses *if appropriate*, and (c) state the formula(s) needed and substitute the appropriate values (IF THE PROBLEM TYPE IS A 2-PROPORTION PROCEDURE, YOU MAY SKIP THE FORMULA).

You may assume that the data has met the necessary conditions.

Do not answer the question asked in the problem (unless you really want the extra practice!)

Types of problems: 1 proportion z-interval or z-test
 2 proportion z-interval or z-test

- The Reserve Mining Company of Minnesota commissioned a team of physicians to study the breathing patterns of its miners who were exposed to taconite dust. The physicians compared the breathing of 307 miners who had been employed in Reserve's Babbit, Minnesota, mine for more than 20 years with eighty-five Duluth area men with no history of exposure to taconite dust. Suppose the physicians determined that sixty-one of the 307 miners had breathing irregularities, and that 12 of the Duluth men had breathing irregularities. Give a 96% confidence interval for the difference between the proportion of miners with breathing irregularities and the proportion of Duluth residence with breathing irregularities.
- USA Today* (1992) reported that 39% of all elementary school children claimed that when they grow up they want to do something to help other people. However, in 1995, 128 of a random sample of 317 of these same children claimed that when they grow they want to do something to help other people. Does this information indicate that there has been an attitude change either way?
- 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?
- 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