

Math 121 - Midterm 2 Review

Here are problems that are similar to the ones you might see on the exam. Be sure to also review old homework and lab questions too.

1. Suppose you have a biased coin that lands on heads 60% of the time. If you flip the coin two times, make a weighted tree diagram showing the possible outcomes.
2. Which of the following best describes the null hypothesis?
 - A. It is the theory that the researcher wants to prove.
 - B. It is the theory that the researcher wants to disprove.
 - C. It is a way to remove bias from the sample.
 - D. It is a starting point for a mathematical analysis.
3. If the significance level α in a hypothesis test is 5%, then
 - A. there is a 5% chance that the results will be statistically significant.
 - B. there is a 5% chance of making a Type I error if H_0 is true.
 - C. there is a 5% chance of making a Type II error if H_0 is true.
 - D. there is a 5% that the results will not appear statistically significant, even though they are.
 - E. we can be 95% sure that the results are statistically significant.
4. Explain in words what it means to “reject the null hypothesis.”
5. The heights of men in the United States have an approximately normal distribution with mean $\mu = 70$ inches and standard deviation $\sigma = 3$ inches.
 - (a) What is the distribution $\bar{x}$ in a randomly selected sample of 9 men?
 - (b) What is the probability that $\bar{x}$ is greater than 5’11” (i.e., 71 inches)?
6. Which is more likely, to flip a fair coin 10 times and get 6 or more heads, or to flip a fair coin 100 times and get 60 or more heads?
7. A study of college students found an average credit card balance of \$2100 with a standard deviation of about \$2000. If the sample size was 400, then was compute a 90% confidence interval for the average credit card balance for all college students.
8. A market researcher chooses at random from women entering a large suburban shopping mall. One outcome of the study is a 95% confidence interval for the mean of “the highest price you would pay for a pair of jeans.”
 - (a) Explain why this confidence interval does not give useful information about the population of all women.
 - (b) Explain why it may give useful information about the population of women who shop at large suburban malls.

The National Assessment of Educational Progress (NAEP) includes a “long-term trend” study that tracks reading and mathematics skills over time in a way that allows comparisons between results from different years. The following questions are based on information on 17-year-old students from the report on the long-term trends study carried out in 2004.

For the following questions, describe the inference procedure you would use, then write down the formula for that procedure with the correct numbers in the correct places. You do not need to compute anything, however.

9. The 2004 NAEP sample contained 1122 female students and 1036 male students. The women had a mean mathematics score (on a scale of 0 to 500) of 305 with standard error $s/\sqrt{N} = 0.9$. The male mean was 308 with standard error $s/\sqrt{N} = 1.0$. Is there evidence that the mean mathematics scores of men and women differ in the population of all 17-year-old students?
10. In the 1978 sample of 17,554 students, 32% had at least one parent who was a college graduate. In the 2004 sample of 2158 students, 47% had at least one college graduate parent. Estimate how much the proportion of students with a college graduate parent has increased between 1978 and 2004.
11. When you play craps, you roll two six-sided dice, and you win on the first roll if the two dice show a total of 7 or 11.
 - (a) What is your probability of winning on the first roll in craps?
 - (b) If you play craps 36 times, what is the expected number of times that you will win on the first roll?
 - (c) What is the name of the probability distribution for the number of times that you win on the first roll when you play 36 times? What are the two parameters that describe this distribution. What is the short-hand for this distribution?
12. What is a p-value? Give a precise definition.
13. The birth control shot is one of the most effective methods of birth control available, and it works best when you get the shot regularly, every 12 weeks. Under ideal conditions, only 1% of women getting the shot become pregnant within one year. In typical use, however, 3% become pregnant. Choose at random 600 women using the shot as their method of birth control. We count the number who become pregnant in the next year.
 - (a) The number of women who get pregnant in our sample has the $B(600, 0.03)$ distribution. What is the mean of this distribution?
 - (b) Is this distribution approximately normal? Why or why not?
 - (c) The standard deviation of the number of women who might become pregnant in our sample is $\sqrt{p(1-p)N} = \sqrt{0.03(0.97)600} \approx 4$. Use this information to estimate the probability that over 22 women get pregnant in our sample.