

STAT302: Secs 102 and 103  
Summer I 1999  
Exam #3 **Form A**

Instructor: Julie Hagen Carroll

1. **Don't EVEN open this until you are told to do so.**
2. Be sure to mark your section number and your test form (A, B, C or D) on the scantron!
3. Sign your name where indicated on your scantron and write your section number, seat number and computer number beside it. You will get your scantrons back tomorrow in class. You may keep this exam.
4. There are 20 multiple-choice questions on this exam, each worth 5 points. There is partial credit. Please mark your answers **clearly** on the scantron. Multiple marks will be counted wrong.
5. You will have 60 minutes to finish this exam.
6. If you are caught cheating or helping someone to cheat on this exam, you both will receive a grade of **zero** on the exam. You must work alone.
7. This exam is worth 100 points, and will constitute 20% of your final grade.
8. Good luck!

1. Ok, let's say you just got a job as a lab tech, and you're going to be doing different tests on possible new drugs that your company is creating. Of course, the reason you got the job is because they know you have an excellent knowledge of how statistics works, and they're sure you will do the job right! You need to find statistical evidence that your company's new wonder drug actually works better than Brand X, which is the best selling product on the market today. Now Brand X claims their 'effectiveness' rating is 8, out of a possible 10. You, however, are skeptical that this is true and decide to test their product along with yours. Let's call yours Brand A, and let  $\mu_A$  be your product's true mean effectiveness rating.  $\mu_X$  be the true mean effectiveness rating for Brand X. First of all, what hypotheses should you test?

- A.  $H_0 : \mu_A = \mu_X$  vs.  $H_A : \mu_A \neq \mu_X$   
 B.  $H_0 : \pi_A = \pi_X$  vs.  $H_A : \pi_A \neq \pi_X$   
 C.  $H_0 : \mu_A = \mu_X$  vs.  $H_A : \mu_A > \mu_X$   
 D.  $H_0 : \mu_A = 10$  vs.  $H_A : \mu_A > 8$   
 E.  $H_0 : \mu_A = 8$  vs.  $H_A : \mu_A > 8$

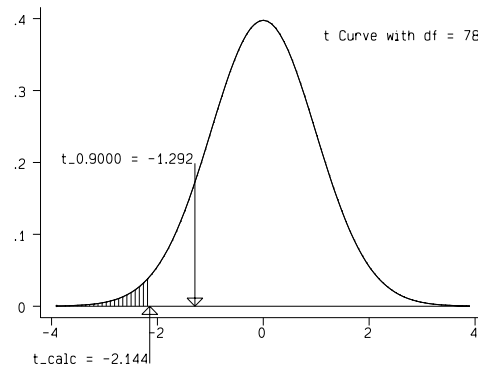
2. Same scenario: How are you going to go about getting the data to test your hypotheses?

- A. Take random samples of both drugs and give them to the first 50 people who have a headache.  
 B. Take two random samples of people with headaches and give one group Brand A and the other Brand X.  
 C. Take one random samples of people with headaches and give every other one Brand A and the rest Brand X.  
 D. Take two random samples of people with headaches and give each person one tablet of each Brand.  
 E. Take a couple of aspirin yourself because all of these people are giving you a headache!

3. Same scenario still: Let's say you decide to test  $H_0 : \mu_A = \mu_X$  vs.  $H_A : \mu_A < \mu_X$  since you've decided to use time until the headache is gone, *i.e.*, you're testing which drug works faster. Knowing what you do about Type I and Type II errors, what  $\alpha$ -level should you use in your test? Pick the answer that is most correct!

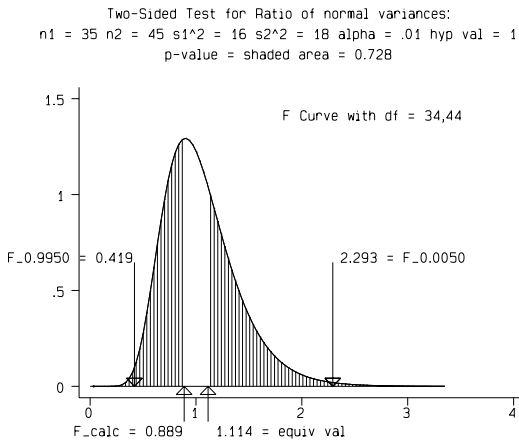
- A. Use  $\alpha = 0.10$  because you want to reject as much as possible.  
 B. Use  $\alpha = 0.01$  because you want to reject as much as possible.  
 C. Use  $\alpha = 0.10$  because you don't want to claim there is insufficient evidence when your brand is really faster.  
 D. Use  $\alpha = 0.01$  because you don't want to claim there is insufficient evidence when your brand is really faster.  
 E. Use  $\alpha = 0.10$  because you don't want to claim your brand is better if it really isn't any faster.

Left-Sided Test for Difference of normal means, ind samples, vars equal:  
 n's: 35,45 xbars: 26,28 var's: 16,18 alpha = .1 hyp val = 0  
 p-value = shaded area = 0.018



4. Ok, this is the output from your test of hypotheses. What can you conclude? (Don't forget to use the  $p$ -value!)

- A. At the 5 and 10% levels, you conclude your brand gets rid of headaches faster.  
 B. At the 1% level, you conclude your brand gets rid of headaches faster.  
 C. At the 1% level, you conclude your brand takes longer to get rid of headaches.  
 D. Both A. and C. are correct conclusions.  
 E. None of the above are correct conclusions.



5. In the previous output, you had to assume the variances of both samples were the same (Case 8). The above output tests if that assumption is valid. What do you think? (I know you haven't looked at one like this before, but read the title, determine the hypotheses, and then your conclusion.)

- A. Since we reject the null hypothesis, we conclude the assumption is valid.
- B. Since we reject the null hypothesis, we conclude the assumption is invalid.
- C. Since we fail to reject the null hypothesis, we conclude the assumption is valid.
- D. Since we fail to reject the null hypothesis, we conclude the assumption is invalid.
- E. Since we reject the null hypothesis, we conclude the test is invalid.

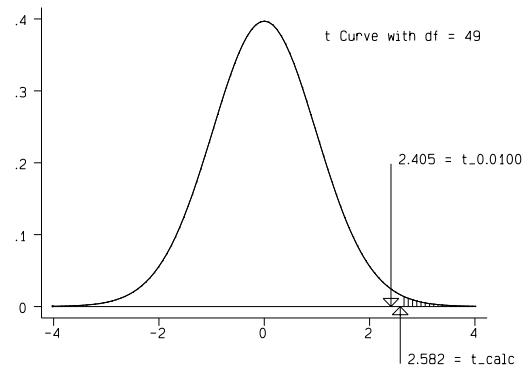
6. Now the guy in the office next door is jealous of all the attention you've been getting, so he decides to run his own little experiment. He takes 10 samples and calculates 90% confidence intervals for the true mean time it takes for Brand A to stop a headache. From these 10 confidence intervals, he finds 3 of them don't contain the mean of Brand X = 15, their supposed true mean time. He thinks this is substantial proof that Brand A is better. What's really going on?

- A. He's correct. Brand A is obviously better.
- B. He's obviously miscalculated since all 10 intervals should contain 15.
- C. He's obviously miscalculated since all 10 intervals should NOT contain 15.
- D. He didn't take random samples so his results are skewed.
- E. He merely had approximately 10% of the intervals not contain the true mean = 15.

7. So we're still worried about this jealous guy. Now he's doing a hypothesis test. You KNOW that there's is no evidence that Brand A is better than Brand X. You've tested it a zillion times. Obviously, to you, your company's product is only just as good. But, the boss really wants to say it's better, and the guy next door wants to make him happy. Which of following would lead them, the boss and your neighbor, to the wrong conclusion, but the one they want? Remember, the null is that the brands are the same; the alternative is that Brand A is better.

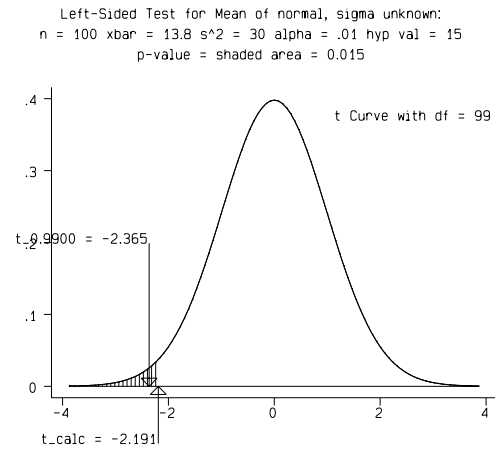
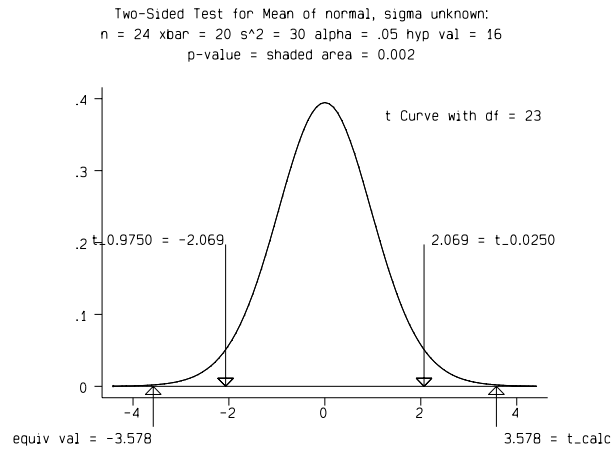
- A. a Type I error
- B. a Type II error
- C. a test with a very small  $\alpha$ -level.
- D. switching the null and alternative hypotheses
- E. It is impossible to claim Brand A is better because it really is only just as good.

Right-Sided Test for Mean of nonnormal, sigma unknown but n large:  
 $n = 50$   $\bar{x} = 62$   $s^2 = 30$   $\alpha = .01$   $\text{hyp val} = 60$   
 p-value = shaded area = 0.006

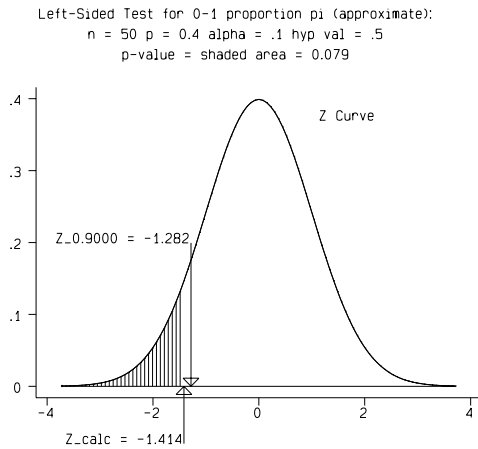


8. What would be the result above if we used a larger  $\alpha$  level, as 5 or 10%?

- A. We would have the same conclusion, just at the different  $\alpha$  level.
- B. We would fail to reject  $H_0$ .
- C. We would increase our chance of making a Type II error.
- D. We would have weaker evidence against  $H_0$  (less strong).
- E. Exactly two of the above are correct.



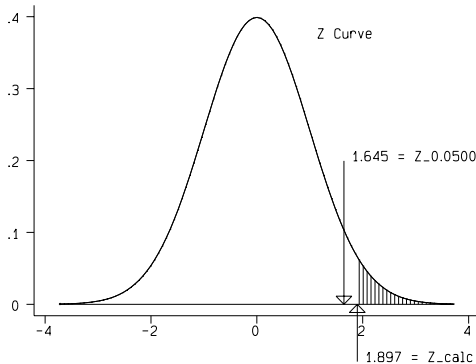
9. Given the data in the output above, which of the following is/are correct?
- The true mean, 16, would be in a 90 and 95% confidence interval for the mean, but it would not be in a 99%.
  - The true mean, 16, would be in a 99% confidence interval for the mean, but it would not be in a 95 or 99%.
  - The true mean, 16, would be in a 90, 95 and 99% confidence interval for the mean.
  - The true mean, 16, would NOT be in a 90, 95 or 99% confidence interval for the mean.
  - The true mean, 16, would be in a 90% confidence interval for the mean only.
10. If confidence intervals can tell us the same thing that a hypothesis test can, why would we ever need to run hypothesis tests anyway?
- There's no reason; it's just a different way to do analyze data.
  - Hypothesis tests are more accurate because you are testing an exact value for  $\mu$  or  $\pi$ .
  - Hypothesis tests can test two samples, but confidence intervals are only for one sample.
  - Hypothesis tests can have smaller  $p$ -values since you can run one sided tests ( $>$  or  $<$ ), but confidence intervals are only equivalent to two sided tests.
  - Exactly two of the above are true.
11. What would be the result of a making a Type II error in the hypothesis test above?
- You conclude that the true mean is less than 15 when it really is 15.
  - You fail to conclude that the true mean is not 15 when it really is not 15.
  - You conclude that the true mean is greater than 15 when it really is not.
  - You fail to conclude that the true mean is greater than 15 when it really is greater than 15.
  - You fail to conclude that the true mean is less than 15 when it really is less than 15.
12. Which of the following BEST describes what 95% confidence means in a 95% confidence interval for  $\mu$  of (7.8,9.4)?
- There is a 95% probability that  $\mu$  is between 7.8 and 9.4.
  - In repeated sampling,  $\mu$  will fall between 7.8 and 9.4 about 95% of the time.
  - In repeated sampling, about 95% of the observations will fall between 7.8 and 9.4.
  - In repeated sampling, about 95% of the observations will fall within the confidence interval.
  - In repeated sampling, the confidence intervals will contain  $\mu$  about 95% of the time.



13. Looking at the graph above, what would have happened if we had gotten a sample proportion,  $p = 0.30$ , instead?
- The conclusion would have been exactly the same.
  - The value of the test statistic would have increased.
  - The value of the  $p$ -value would have decreased.
  - The value of the  $p$ -value would have increased.
  - The probability of making a Type I error would have decreased.
14. Which of the following is FALSE?
- If I reject at the 5% level, I will always reject at the 10% level.
  - A test of hypotheses can never prove the null to be true.
  - Assuming the data is normal and we are given the population standard deviation, we use a  $t$ -test if the sample size is small.
  - The simple random sample assumption is always necessary.
  - All of the above statements are true; none are false.

15. We believe that more Aggies graduate with 4.0's than those people who go to that little school in Austin. We gather random samples from both schools' graduating classes, but we notice that A&M has many more students graduating (not surprising since who would want to go to that school!). What type hypothesis test should we run? Use your flow chart to help you decide. Assume that we take large enough samples for all of the necessary rules to hold.
- Case 11: a two-sample test of proportions using the number of graduates with 4.0 out of the total graduating within each school
  - Case 8: a two-sample test for the mean number of 4.0 graduates since it make sense that the variances would be the same
  - Case 9: a two-sample test for the mean number of 4.0 graduates since we don't know that the variances are the same
  - Case 3: two separate tests for the mean using the average GPR for each school
  - Case 6: two separate tests for the proportion of graduates with 4.0's.
16. Ok, remember all those pennies we've been playing with? Why is it better to use 50 tosses and do this 10 times than only 5 tosses even if we do it 100 times?
- The sample proportion,  $p_{50}$ , calculated for 50 tosses will be closer to  $\pi$  than the sample proportion,  $p_5$ , for 5 tosses.
  - The standard deviation for 50 tosses will be smaller than the standard deviation for 5 tosses.
  - The distribution for 50 tosses will be approximately normal, whereas the distribution for 5 will not.
  - All of the above are true.
  - Exactly 2 of the above are true (excluding D.).

Right-Sided Test for Mean of normal, sigma known:  
 $n = 10$   $\bar{x} = 15$   $\sigma^2 = 25$   $\alpha = .05$   $\text{hyp val} = 12$   
 $p\text{-value} = \text{shaded area} = 0.029$



17. Which of the following is the best definition of the  $p$ -value in terms of the test represented above?

- A. The  $p$ -value = 0.029 says that 97.1% of the time we will get sample means of 15 or more when the true mean is only 12.
- B. The  $p$ -value = 0.029 says that 97.1% of the time we will get sample means of 12 or more when the true mean is only 15.
- C. The  $p$ -value = 0.029 says that there is a 2.9% chance that the true mean is only 15.
- D. The  $p$ -value = 0.029 says that there is a 2.9% chance that the true mean is greater than 12.
- E. The  $p$ -value = 0.029 says that 2.9% of the time we will get sample means of 15 or more when the true mean is only 12.

18. Which of the following defines the significance level of a hypothesis test,  $\alpha$ ?

- A. how often we make a Type I error.
- B. how often we reject  $H_0$ .
- C. how often  $H_0$  is false.
- D. how often  $H_0$  is true.
- E. Exactly two of the above (excluding D.)

90% | Lower Limit = 10.177573  
 | Upper Limit = 11.822427

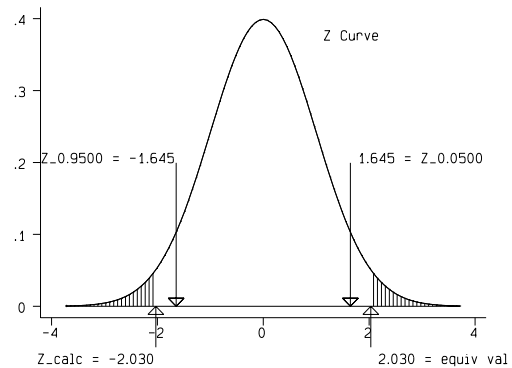
95% | Lower Limit = 10.020018  
 | Upper Limit = 11.979982

99% | Lower Limit = 9.7120853  
 | Upper Limit = 12.287915

19. We haven't done this exactly in class, but using the chart at the bottom of the review sheet, what is the correct range of the  $p$ -value for testing  $H_0 : \mu = 10$  vs.  $H_A : \mu \neq 10$ ?

- A.  $p\text{-value} > 0.10$
- B.  $0.10 > p\text{-value} > 0.05$
- C.  $0.05 > p\text{-value} > 0.01$
- D.  $p\text{-value} < 0.01$
- E. You need a test statistic value to determine the  $p$ -value

Two-Sided Test for Difference of proportions  $\pi_1 - \pi_2$ :  
 $n_1 = 63$   $n_2 = 82$   $p_1 = .42$   $p_2 = .59$   $\alpha = .1$   $\text{hyp val} = 0$   
 $p\text{-value} = \text{shaded area} = 0.042$



20. What are the hypotheses being tested in the graph above? Read the title carefully!

- A.  $H_0 : \mu_1 = \mu_2$  vs.  $H_A : \mu_1 = \mu_2$
- B.  $H_0 : \pi_1 - \pi_2 = 0$  vs.  $H_A : \pi_1 - \pi_2 \neq 0$
- C.  $H_0 : \mu_1 = 0.42$  vs.  $H_A : \mu_2 = 0.59$
- D.  $H_0 : \pi_1 = 0.42$  vs.  $H_A : \pi_2 = 0.59$
- E.  $H_0 : \mu_1 - \mu_2 = 0$  vs.  $H_A : \mu_1 - \mu_2 \neq 0$

1C,2B,3C,4A,5C,6E,7A,8A,9D,10D,11E,  
 12E,13C,14C,15A,16E,17E,18A,19C,20B