

Question 1. [*Hypothesis testing for μ when σ is known*]

Imagine choosing $n = 16$ women at random from a large population and measuring their heights. Assume that the heights of the women in this population are normal with $\mu = 64$ inches and $\sigma = 3$ inches. Suppose you then test the null hypothesis $H_0 : \mu = 64$ versus the alternative that $H_a : \mu \neq 64$, using $\alpha = 0.10$. Assume σ is known. Simulate the results of doing this test 20 times as follows:

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random 16 c1-c20;
normal 64 3.
ztest 64 3 c1-c20
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- (a) [1 mark.] In how many tests did you reject H_0 . Any answer less than 6 is Okay. Are these rejections “correct decisions” or “incorrect decisions”? Incorrect.
- (b) [0.5 mark.] Are the p -values all the same for the 20 tests? No.
- (c) [1 mark.] Suppose you used $\alpha = .05$ instead of $\alpha = 0.10$. Does this change any of your decisions to reject or not? Yes/No. Should it in some cases? Yes, number of rejections can decrease.
- (d) [1 mark.] Now assume that the population really has a mean of $\mu = 63$, instead of 64., and carry out the above 20 times, (thus, use the above minitab commands with 'normal 64 3' changed to 'normal 63 3'). Once again, using $\alpha = 0.10$ and assuming σ is known, in how many tests did you reject H_0 ? Any number greater than 2 and less than 15 is Okay. Are these rejections “correct decisions” or “incorrect decisions”? Correct.

Question 2. [*Confidence intervals for μ when σ is NOT known.*]

Suppose that $n = 9$ men are selected at random from a large population. Assume the heights of the men in this population are normal, with mean $\mu = 69$ inches and $\sigma = 3$ inches. Simulate the results of this selection 20 times and in each case find a 90% confidence interval for μ using the 'interval' command. The following commands may be used:

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random 9 c1-c20;
normal 69 3.
tinterval 0.90 c1-c20
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- (a) [0.5 mark.] How many of your intervals contain μ ? Any number greater than 14 is Okay.
- (b) [1 mark.] Would you expect all 20 of the intervals to contain μ ? No. Why? 18=20(0.9).
- (c) [1 mark.] Do all the intervals have the same width? No. Why (what is the theoretical width)? $2t_{0.05}(8)(5/\sqrt{9})$.
- (d) [1 mark.] Suppose you took 95% intervals instead of 90%. Would they be narrower or wider? Wider.
- (e) [0.5 mark.] How many of your intervals contain the value 71? Any number in [5,16] is Okay.
- (f) [1 mark.] Suppose you took samples of size $n = 100$ instead of $n = 9$. Would you expect more or fewer intervals to contain 71? Fewer. What about 69? Same. What about the width of the intervals for $n = 100$: Would they be narrower or wider than for $n = 9$? Narrower.

Question 3. [*Hypothesis testing for μ when σ is NOT known*]

Repeat Question 3, using ttest instead of ztest, and answer parts (a), (b), and (c) again. (Thus 'ztest 64 3 c1-c20' changes to 'ttest 64 c1-c20')

- (a) [1 mark.] In how many tests did you reject H_0 Any number less than or equal 6 is Okay. Are these rejections “correct decisions” or “incorrect decision”? Incorrect.
- (b) [0.5 mark.] Are the p -values all the same for the 20 tests? No.
- (c) [1 mark.] Suppose you used $\alpha = .05$ instead of $\alpha = 0.10$. Does this change any of your decisions to reject or not? Yes/No. Should it in some cases? Yes, number of rejections should decrease.

ALSO do the following questions:

1. [1.8 marks.] The manager of a university bookstore wants to estimate the mean amount spent on books in the Fall term, for all students, to within \$1.5 of the true mean with 90% probability. What is the smallest sample size n needed to achieve this. You may assume that the amounts spent on books in the Fall term vary from \$370 to \$450.

- (a) 193 (b) 383 (c) 482 (**) (d) 192.

2. [1.8 marks.] In a test of hypothesis to determine whether the proportion of heads obtained when flipping a coin differs from 0.5, the coin was flipped 100 times, and the appropriate test statistic was found to be 1.80. What is the P-value of this test?

- (a) 0.9216 (b) 0.0718 (**) (c) 0.0344 (d) Cannot be determined.

3. [1.8 marks.] The hear beats (per minute) of 6 individuals were recorded before and immediately after drinking 2 cups of coffee each. They were:

Before: 71 68 73 65 72 69

After: 78 74 72 70 78 70.

Suppose that you want to test if caffeine can increase heart beat counts. What is the value of the appropriate test statistic? (You may assume normality, where needed.)

- (a) 2.033 (b) -1.367 (c) 3.038 (**) (d) 4.021.

4. [1.8 marks.] A parent believes the average height for 14 year old girls differs from that of 14 year old boys. What is the 95% confidence interval for the difference in the height between girls and boys based on the following summary data? You may assume the two populations are normal with equal variances. (Height is measured in feet.)

$$n_1 = 12, \bar{x}_1 = 5.1, s_1 = 0.2, n_2 = 15, \bar{x}_2 = 4.92, s_2 = 0.3$$

- (a) $-0.028 < \mu_1 - \mu_2 < 0.388$ (**) (b) $0.028 < \mu_1 - \mu_2 < 0.388$
 (c) $-0.388 < \mu_1 - \mu_2 < -0.028$ (d) $-0.388 < \mu_1 - \mu_2 < 0.028$

5. [1.8 marks.] Data from the Bureau of Labor Statistics indicate that in one recent year the unemployment rate in Cleveland was 7.5% and unemployment rate in Chicago was 7.2%. Suppose that both figures are based on random samples of 1,000 people in each city. Test the null hypothesis that the unemployment rates in both cities are equal versus the alternative hypothesis that they are not equal. What is the p -value?

- (a) 0.3974 (b) 0.257 (c) 0.7948 (**) (d) 0.625