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Lab Assignment 6

(40 points)

DIRECTIONS

- ***An uploaded copy is due by next Thursday.***

A. A group of paleontologists hypothesize that insect wings evolved from modification of ancestral arthropod limbs (α=0.05). Insect wings are small, so this hypothesis requires that ancestral arthropod limbs be less than 4 cm. The scientists sampled 25 arthropods and determined that the mean limb length is 4.5cm, with a standard deviation of 1.4cm. Assume the arthropod limb length follows a normal distribution (12 pts total).

1. Using the 6 steps in hypothesis testing (practice but don't attach drawing), determine whether or not the null hypothesis of the paleontologists is true (5 pts). Be sure to find the critical value from R and compare this to the test statistic (2 pts). Make a conclusion in the context of the situation given (1 pt).

H0: u >= 4cm

Ha: u < 4cm

a = .05

sketch a t

t = (x - u) / (s/sqrt(n))

t = (4.5 - 4) / (1.4/sqrt(25)) = 1.79

crit <- qt(.5,24) = -1.71

Do not have enough evidence to reject the null hypothesis

2. Construct a “error table” specific for this data. If we assume that your statistical decision is correct, put a check mark where your decision falls on the truth table (1 pt). Write the specific Type I and Type II errors possible for your hypothesis test in a sentence format (1 pt).

	H0 is true	Ha is true
Fail to reject H0	Correct	Type II error
Reject H0	Type 1 error	correct

Type I: Concluding limbs were less than 4cm when they were actually longer.

Type II: Concluding limbs were longer than 4cm but were actually shorter.

3. How can Type I error be reduced (1 pt)? How can Type II error be reduced (1 pt)?

Type I error can be reduced by choosing a smaller significance level.

Type II error can be reduced by increasing the sample size.

B. Based upon beer sales in UNCC, it is expected that UNCC students consume 7.5 beers a week. In a questionnaire of 60 random UNCC students, the sample mean of beers consumed per week is 6.5, with a standard deviation of 3.4 beers consumed per week. Assume the number of beers consumed follows a normal distribution (7 pts total).

State the null and alternative hypothesis. Find the test statistic and compare it with the critical value at alpha = 0.10. Determine the confidence interval at 95% (5 pts). Draw a conclusion from the confidence interval (1 pts).

H0: u=7.5

Ha: u =/= 7.5

Z = X - u0/ (sd/sqrt(n))

Z = 6.5 - 7.5 / (3.4/sqrt(60)) = -2.28

|-2.28| > 1.645

X +- (Z(.05) * 3.4/sqrt(60))

95% confidence interval is (5.64, 7.36)

The H0 is not included in this confidence interval and therefore we must reject the null hypothesis.

2. What is the relationship between conclusions of the hypothesis test and the confidence interval you found (1 pt)?

Both methods led to the same answer of rejecting the null hypothesis.

C. Based on recent biodiversity study, a microbiologist at UNH thinks there are 3000 bacterial species in your gut lining (α=0.10). The microbiologist sampled the gut lining of 27 humans, and determined that there was a mean number of 2700 bacterial species, with a standard deviation of 300. Assume that gut bacterial species follows a normal distribution. We want to test if the mean number of bacterial species in a human's gut lining is different from 3000 (9 pts total).

1. Using hypothesis testing (six steps – practice drawing, but don't attach figure) and using the p-value method, determine whether or not the null hypothesis of the microbiologists is true (6 pts). Be sure to compare the p-value to alpha to make your conclusion (2 pts). Make a conclusion in the context of the situation given (1 pt).

H0: u = 3000

Ha: u =/= 3000

t = (x - u) / (s/sqrt(n))

t = (2700 - 3000) / (300 / sqrt(27)) = -5.2

P(t <= -5.2 | t>= 5.2) = .00002 < .1

Because the P value is less than a, we reject the null hypothesis

D. The measured heights of 9 randomly sampled *Arabidopsis thaliana* are 1.42, 1.22, 1.36, 1.55, 1.18, 1.47, 1.22, 1.12, 1.62. Is there evidence that the mean level of these samples is greater than that of a species with a mean of 1.28 at α=0.01?

1. Using hypothesis testing (six steps – practice drawing but don't attach drawn figure), determine whether or not the null hypothesis t (6 pts). Find the test statistic and be sure to compare the p-value to alpha to make your conclusion (2 pts). Make a conclusion in the context of the situation given (1 pt).

2. State the hypothesis, show R commands, and use the t.test function in R to make a conclusion (3 pts).

H0: u <= 1.28

Ha: u > 1.28

X = 1.3511

sd = .1779

t = 1.3511 - 1.28 / (.1779/sqrt(9)) = 1.1997

P(t >= 1.1997) = .1321 > .01

Because the P value is greater than the a, we fail to reject the null hypothesis.

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output <- t.test(heights, mu = 1.28, alternative = "greater")
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