

UNIVARIATE STATISTICAL ANALYSIS

TUTORIAL SESSION 7

HYPOTHESIS TESTING (TWO TAILED)

Extra Question 1.

Given that $\bar{x} = 70$, $\sigma = 12$ and $n = 50$, test the following hypotheses with $\alpha = 0.01$

$$H_o: \mu = 66$$

$$H_a: \mu \neq 66$$

Extra Question 2.

From a normal population whose standard deviation is 6. Test with $\alpha = 0.1$ sample of 30 and sample mean of 40. Can we conclude that the population mean differs from 35?

Extra Question 3.

Given that $\bar{x} = 46$, $s = 5$ and $n = 9$, test the following hypotheses with $\alpha = 0.05$

$$H_o: \mu = 50$$

$$H_a: \mu \neq 50$$

Chapter 10

Question 10.49 (page.538) – Heart Rate

Part a. only

- 10.45 Give as much information as you can about the P -value of a t test in each of the following situations:
- Two-tailed test, $df = 9$, $t = 0.73$
 - Upper-tailed test, $df = 10$, $t = -0.5$
 - Lower-tailed test, $n = 20$, $t = -2.1$
 - Lower-tailed test, $n = 20$, $t = -5.1$
 - Two-tailed test, $n = 40$, $t = 1.7$
- 10.46 Paint used to paint lines on roads must reflect enough light to be clearly visible at night. Let μ denote the mean reflectometer reading for a new type of paint. A test of $H_0: \mu = 20$ versus $H_a: \mu > 20$ based on a sample of 15 observations resulted in $t = 3.2$. What conclusion is appropriate at each of the following significance levels?
- $\alpha = 0.05$
 - $\alpha = 0.01$
 - $\alpha = 0.001$
- 10.47 A certain pen has been designed so that actual mean writing lifetime under controlled conditions (involving the use of a writing machine) is at least 10 hours. A random sample of 18 pens is selected, the writing lifetime of each is determined, and a normal probability plot of the resulting data supports the use of a one-sample t test. The relevant hypotheses are $H_0: \mu = 10$ versus $H_a: \mu < 10$.
- If $t = -2.3$ and $\alpha = 0.05$, what conclusion is appropriate?
 - If $t = -1.83$ and $\alpha = 0.01$, what conclusion is appropriate?
 - If $t = 0.47$, what conclusion is appropriate?
- 10.48 The average diameter of ball bearings of a certain type is supposed to be 0.5 inch. What conclusion is appropriate when testing $H_0: \mu = 0.5$ versus $H_a: \mu \neq 0.5$ inch each of the following situations:
- $n = 13$, $t = 1.6$, $\alpha = 0.05$
 - $n = 13$, $t = -1.6$, $\alpha = 0.05$
 - $n = 25$, $t = -2.6$, $\alpha = 0.01$
 - $n = 25$, $t = -3.6$
- 10.49 The paper "Playing Active Video Games Increases Energy Expenditure in Children" (*Pediatrics* [2009]: 534–539) describes an interesting investigation of the possible cardiovascular benefits of active video games. Mean heart rate for healthy boys age 10 to 13 after walking on a treadmill at 2.6 km/hour for 6 minutes is 98 beats per minute (bpm). For each of 14 boys, heart rate was measured after 15 minutes of playing Wii Bowling. The resulting sample mean and standard deviation were 101 bpm and 15 bpm, respectively. For purposes of this exercise, assume that it is reasonable to regard the sample of boys as representative of boys age 10 to 13 and that the distribution of heart rates after 15 minutes of Wii Bowling is approximately normal.
- Does the sample provide convincing evidence that the mean heart rate after 15 minutes of Wii Bowling is different from the known mean heart rate after 6 minutes walking on the treadmill? Carry out a hypothesis test using $\alpha = 0.01$.
 - The known resting mean heart rate for boys in this age group is 66 bpm. Is there convincing evidence that the mean heart rate after Wii Bowling for 15 minutes is higher than the known mean resting heart rate for boys of this age? Use $\alpha = 0.01$. (Hint: See Example 10.15.)
 - Based on the outcomes of the tests in Parts (a) and (b), write a paragraph comparing the benefits of treadmill walking and Wii Bowling in terms of raising heart rate over the resting heart rate.
- 10.50 A study of fast-food intake is described in the paper "What People Buy from Fast-Food Restaurants" (*Obesity* [2009]: 1369–1374). Adult customers at three hamburger chains (McDonald's, Burger King, and Wendy's) at lunchtime in New York City were approached as they entered the restaurant and asked to provide their receipt when exiting. The receipts were then used to determine what was purchased and the number of calories consumed was determined. In all, 3857 people participated in the study. The sample mean number of calories consumed was 857 and the sample standard deviation was 677.
- The sample standard deviation is quite large. What does this tell you about number of calories consumed in a hamburger-chain lunchtime fast-food purchase in New York City?
 - Given the values of the sample mean and standard deviation and the fact that the number of calories consumed can't be negative, explain why it is *not* reasonable to assume that the distribution of calories consumed is normal.
 - Based on a recommended daily intake of 2000 calories, the online Healthy Dining Finder (healthydiningfinder.com) recommends a target of 750 calories for lunch. Assuming that it is reasonable to regard the sample of 3857 fast-food purchases as representative of all hamburger-chain lunchtime purchases in New York City, carry out a hypothesis test to determine if the sample provides convincing evidence that the mean number of calories in a New York City hamburger-chain lunchtime purchase is greater than the lunch recommendation of 750 calories. Use $\alpha = 0.01$. (Hint: See Example 10.15.)
- 10.51 Refer to the study and hypothesis test of the previous exercise.
- Would it be reasonable to generalize the conclusion of the test in Part (c) of the previous exercise to the lunchtime fast-food purchases of all adult Americans? Explain why or why not.
 - Explain why it is better to use the customer receipt to determine what was ordered rather than just asking a customer leaving the restaurant what he or she purchased.