Ch. 6.2 - HOMEWORK

6.50 What’s wrong? Here are several situations where there is an incorrect application of the ideas presented in this section. Write a short paragraph explaining what is wrong in each situation and why it is wrong.

(a) A researcher tests the following null hypothesis: $H_0: \mu = 23$.
(b) A random sample of size 30 is taken from a population that is assumed to have a standard deviation of 5. The standard deviation of the sample mean is $5/30$.
(c) A study with $\bar{x} = 45$ reports statistical significance for $H_a : \mu > 50$.
(d) A researcher tests the hypothesis $H_0: \mu = 350$ and concludes that the population mean is equal to 350.

6.51 What’s wrong? Here are several situations where there is an incorrect application of the ideas presented in this section. Write a short paragraph explaining what is wrong in each situation and why it is wrong.

(a) A significance test rejected the null hypothesis that the sample mean is equal to 500.
(b) A test preparation company wants to test that the average score of their students on the ACT is better than the national average score of 21.2. They state their null hypothesis to be $H_0 : \mu > 21.2$.
(c) A study summary says that the results are statistically significant and the $P$-value is 0.98.
(d) The $z$ statistic is equal to 0.018. Because this is less than $\alpha = 0.05$, the null hypothesis was rejected.

6.52 Determining hypotheses. State the appropriate null hypothesis $H_0$ and alternative hypothesis $H_a$ in each of the following cases.

(a) A 2008 study reported that 88% of students owned a cell phone. You plan to take an SRS of students to see if the percentage has increased.
(b) The examinations in a large freshman chemistry class are scaled after grading so that the mean score is 75. The professor thinks that students who attend early morning recitation sections will have a higher mean score than the class as a whole. Her students this semester can be considered a sample from the population of all students she might teach, so she compares their mean score with 75.
(c) The student newspaper at your college recently changed the format of their opinion page. You take a random sample of students and select those who regularly read the newspaper. They are asked to indicate their opinions on the changes using a five-point scale: −2 if the new format is much worse than the old, −1 if the new format is somewhat worse than the old, 0 if the new format is the same as the old, +1 if the new format is somewhat better than the old, and +2 if the new format is much better than the old.

6.53 More on determining hypotheses. State the null hypothesis $H_0$ and the alternative hypothesis $H_a$ in each case. Be sure to identify the parameters that you use to state the hypotheses.
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(a) A university gives credit in first-year calculus to students who pass a placement test. The mathematics department wants to know if students who get credit in this way differ in their success with second-year calculus. Scores in second-year calculus are scaled so the average each year is equivalent to a 77. This year 21 students who took second-year calculus passed the placement test.

(b) Experiments on learning in animals sometimes measure how long it takes a mouse to find its way through a maze. The mean time is 20 seconds for one particular maze. A researcher thinks that playing rap music will cause the mice to complete the maze slower. She measures how long each of 12 mice takes with the rap music as a stimulus.

(c) The average square footage of one-bedroom apartments in a new student-housing development is advertised to be 880 square feet. A student group thinks that the apartments are smaller than advertised. They hire an engineer to measure a sample of apartments to test their suspicion.

6.55 Translating research questions into hypotheses.
Translate each of the following research questions into appropriate \( H_0 \) and \( H_a \).

(a) Census Bureau data show that the mean household income in the area served by a shopping mall is $42,800 per year. A market research firm questions shoppers at the mall to find out whether the mean household income of mall shoppers is higher than that of the general population.

(b) Last year, your online registration technicians took an average of 0.4 hours to respond to trouble calls from students trying to register. Do this year’s data show a different average response time?

6.56 Computing the \( P \)-value.
A test of the null hypothesis \( H_0: \mu = \mu_0 \) gives test statistic \( z = 1.63 \).

(a) What is the \( P \)-value if the alternative is \( H_a: \mu > \mu_0 \)?
(b) What is the \( P \)-value if the alternative is \( H_a: \mu < \mu_0 \)?
(c) What is the \( P \)-value if the alternative is \( H_a: \mu \neq \mu_0 \)?

6.57 More on computing the \( P \)-value.
A test of the null hypothesis \( H_0: \mu = \mu_0 \) gives test statistic \( z = -1.82 \).

(a) What is the \( P \)-value if the alternative is \( H_a: \mu > \mu_0 \)?
(b) What is the \( P \)-value if the alternative is \( H_a: \mu < \mu_0 \)?
(c) What is the \( P \)-value if the alternative is \( H_a: \mu \neq \mu_0 \)?

6.58 A two-sided test and the confidence interval.
The \( P \)-value for a two-sided test of the null hypothesis \( H_0: \mu = 30 \) is 0.032.

(a) Does the 95% confidence interval include the value 30? Why?
(b) Does the 90% confidence interval include the value 30? Why?
6.59 More on a two-sided test and the confidence interval. A 90% confidence interval for a population mean is (25, 32).

(a) Can you reject the null hypothesis that \( \mu = 24 \) against the two-sided alternative at the 10% significance level? Why?
(b) Can you reject the null hypothesis that \( \mu = 30 \) against the two-sided alternative at the 10% significance level? Why?

6.61 Peer pressure and choice of major. A recent study followed a cohort of students entering a business/economics program. All students followed a common track during the first three semesters and then chose to specialize in either business or economics. Through a series of surveys, the researchers were able to classify roughly 50% of the students as either peer driven (ignored abilities and chose major to follow peers) or ability driven (ignored peers and chose major based on ability). When looking at entry wages after graduation, the researchers conclude that a peer-driven student can expect an average wage that is 13% less than that of an ability-driven student. The report states that the significance level is \( P = 0.09 \). Can you be confident of this statement regarding the wage decrease? Discuss.

6.62 Symbol of wealth in ancient China? Every society has its own symbols of wealth and prestige. In ancient China, it appears that owning pigs was such a symbol. Evidence comes from examining burial sites. If the skulls of sacrificed pigs tend to appear along with expensive ornaments, that suggests that the pigs, like the ornaments, signal the wealth and prestige of the person buried. A study of burials from around 3500 B.C. concluded that, “there are striking differences in grave goods between burials with pig skulls and burials without them…. A test indicates that the two samples of total artifacts are significantly different at the 0.01 level.” Explain clearly why “significantly different at the 0.01 level” gives good reason to think that there really is a systematic difference between burials that contain pig skulls and those that lack them.

6.65 Sleep quality and elevated blood pressure. A recent study looked at \( n = 238 \) adolescents, all free of severe illness. Subjects wore a wrist actigraph, which allowed the researchers to estimate sleep patterns. For those subjects classified as having low sleep efficiency, they are reported as having an average systolic blood pressure that is 4 mm Hg higher than other children with a standard deviation of the mean equal to 1.2 mm Hg. Based on these results, test whether this difference is significant at the 0.01 level.

6.68 Who is the author? Statistics can help decide the authorship of literary works. Sonnets by a certain Elizabethan poet are known to contain an average of \( \mu = 8.9 \) new words (words not used in the poet’s other works). The standard deviation of the number of new words is \( \sigma = 2.5 \). Now a manuscript with six new sonnets has come to light, and scholars are debating whether it is the poet’s work. The new sonnets contain an average of \( \bar{x} = 10.2 \) words not used in the poet’s
known works. We expect poems by another author to contain more new words, so to see if we have evidence that the new sonnets are not by our poet we test

\[ H_0: \mu = 8.9 \]
\[ H_a: \mu > 8.9 \]

Give the \( z \) test statistic and its \( P \)-value. What do you conclude about the authorship of the new poems?

6.69 **Attitudes toward school.** The Survey of Study Habits and Attitudes (SSHA) is a psychological test that measures the motivation, attitude toward school, and study habits of students. Scores range from 0 to 200. The mean score for U.S. college students is about 115, and the standard deviation is about 30. A teacher who suspects that older students have better attitudes toward school gives the SSHA to 25 students who are at least 30 years of age. Their mean score is \( \bar{x} = 127.8 \).

(a) Assuming that \( \sigma = 30 \) for the population of older students, carry out a test of

\[ H_0: \mu = 115 \]
\[ H_a: \mu > 115 \]

Report the \( P \)-value of your test, and state your conclusion clearly.

(b) Your test in part (a) required two important assumptions in addition to the assumption that the value of \( \sigma \) is known. What are they? Which of these assumptions is most important to the validity of your conclusion in part (a)?

6.70 **Nutritional intake in Canadian high performance athletes.** Since previous studies have reported that elite athletes are often deficient in their nutritional intake (e.g., total calories, carbohydrates, protein), a group of researchers decided to evaluate Canadian high performance athletes. A total of \( n = 324 \) athletes from eight Canadian sports centers participated in the study. One reported finding was that the average caloric intake among the \( n = 201 \) women was 2403.7 kcal/day. The recommended amount is 2811.5 kcal/day. Is there evidence that female Canadian athletes are deficient in the caloric intake?

(a) State the appropriate \( H_0 \) and \( H_a \) to test this.

(b) Assuming a standard deviation of 880 kcal/day, carry out the test. Give the \( P \)-value, and then interpret the result in plain language.
6.73 Level of nicotine in cigarettes. According to data from the Tobacco Institute Testing Laboratory, Camel Lights king size cigarettes contain an average of 0.9 milligrams of nicotine. An advocacy group commissions an independent test to see if the mean nicotine content is higher than the industry laboratory claims.

(a) What are $H_0$ and $H_a$?
(b) Suppose that the test statistic is $z = 1.83$. Is this result significant at the 5% level?
(c) Is the result significant at the 1% level?

6.77 Understanding levels of significance. Explain in plain language why a significance test that is significant at the 5% level must always be significant at the 10% level.

6.78 More on understanding levels of significance. You are told that a significance test is significant at the 5% level. From this information can you determine whether or not it is significant at the 1% level? Explain your answer.