The Islamic University of Gaza
Faculty of Commerce
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An Introduction to Statistics Course (ECOE 1302)
Spring Semester 2011

Chapter 9 - FUNDAMENTALS OF HYPOTHESIS TESTING: ONE-SAMPLE TESTS

Practice Problems - Solution

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SECTION I: MULTIPLE-CHOICE

1. Which of the following would be an appropriate null hypothesis?
   a. The mean of a population is equal to 55.
   b. The mean of a sample is equal to 55.
   c. The mean of a population is greater than 55.
   d. Only (a) and (c) are true.

2. Which of the following would be an appropriate alternative hypothesis?
   a. The mean of a population is equal to 55.
   b. The mean of a sample is equal to 55.
   c. The mean of a population is greater than 55.
   d. The mean of a sample is greater than 55.

3. A Type II error is committed when
   a. we reject a null hypothesis that is true.
   b. we don't reject a null hypothesis that is true.
   c. we reject a null hypothesis that is false.
   d. we don't reject a null hypothesis that is false.

4. The power of a test is measured by its capability of
   a. rejecting a null hypothesis that is true.
   b. not rejecting a null hypothesis that is true.
   c. rejecting a null hypothesis that is false.
   d. not rejecting a null hypothesis that is false.

5. If an economist wishes to determine whether there is evidence that average family income in a community exceeds $25,000
   a. either a one-tailed or two-tailed test could be used with equivalent results.
   b. a one-tailed test should be utilized.
   c. a two-tailed test should be utilized.
   d. None of the above.

6. If the *p*-value is less than α in a two-tailed test,
   a. the null hypothesis should not be rejected.
   b. the null hypothesis should be rejected.
   c. a one-tailed test should be used.
   d. no conclusion should be reached.

7. It is possible to directly compare the results of a confidence interval estimate to the results obtained by testing a null hypothesis if
   a. a two-tailed test for μ is used.
   b. a one-tailed test for μ is used.
   c. Both of the previous statements are true.
   d. None of the previous statements is true.

8. The symbol for the power of a statistical test is
   a. α.
   b. $1 - \alpha$.
   c. β.
   d. $1 - \beta$.

9. How many Kleenex should the Kimberly Clark Corporation package of tissues contain? Researchers determined that 60 tissues is the average number of tissues used during a cold. Suppose a random sample of 100 Kleenex users yielded the following data on the number of tissues used during a cold: $\overline{X} = 52$, $s = 22$. Give the null and alternative hypotheses to determine if the number of tissues used during a cold is less than 60.
   a. $H_0 : \mu \leq 60$ and $H_1 : \mu > 60$.
   b. $H_0 : \mu \geq 60$ and $H_1 : \mu < 60$.
   c. $H_0 : \overline{X} \geq 60$ and $H_1 : \overline{X} < 60$.
   d. $H_0 : \overline{X} = 52$ and $H_1 : \overline{X} \neq 52$.

10. How many Kleenex should the Kimberly Clark Corporation package of tissues contain? Researchers determined that 60 tissues is the average number of tissues used during a cold. Suppose a random sample of 100 Kleenex users yielded the following data on the number of tissues used during a cold: $\overline{X} = 52$, $s = 22$. Suppose the alternative we wanted to test was $H_1 : \mu < 60$. State the correct rejection region for $\alpha = 0.05$.
    a. Reject H_0 if $t > 1.6604$.
    b. Reject H_0 if $t < -1.6604$.
    c. Reject H_0 if $t > 1.9842$ or $Z < -1.9842$.
    d. Reject H_0 if $t < -1.9842$.

11. How many Kleenex should the Kimberly Clark Corporation package of tissues contain? Researchers determined that 60 tissues is the average number of tissues used during a cold. Suppose a random sample of 100 Kleenex users yielded the following data on the number of tissues used during a cold: $\overline{X} = 52$, $s = 22$. Suppose the test statistic does fall in the rejection region at $\alpha = 0.05$. Which of the following conclusion is correct?
    a. At $\alpha = 0.05$, there is not sufficient evidence to conclude that the average number of tissues used during a cold is 60 tissues.
    b. At $\alpha = 0.05$, there is sufficient evidence to conclude that the average number of tissues used during a cold is 60 tissues.
    c. At $\alpha = 0.05$, there is not sufficient evidence to conclude that the average number of tissues used during a cold is not 60 tissues.

d. At $\alpha = 0.10$, there is sufficient evidence to conclude that the average number of tissues used during a cold is not 60 tissues.

12. We have created a 95% confidence interval for μ with the result (10, 15). What decision will we make if we test $H_0 : \mu = 16$ versus $H_1 : \mu \neq 16$ at $\alpha = 0.10$?
    a. **Reject H_0 in favor of H_1.**
    b. Accept H_0 in favor of H_1.
    c. Fail to reject H_0 in favor of H_1.
    d. We cannot tell what our decision will be from the information given.

13. A _____ is a numerical quantity computed from the data of a sample and is used in reaching a decision on whether or not to reject the null hypothesis.
    a. significance level
    b. critical value
    c. **test statistic**
    d. parameter

14. The owner of a local nightclub has recently surveyed a random sample of $n = 250$ customers of the club. She would now like to determine whether or not the mean age of her customers is over 30. If so, she plans to alter the entertainment to appeal to an older crowd. If not, no entertainment changes will be made. The appropriate hypotheses to test are:
    a. $H_0 : \mu \geq 30$ versus $H_1 : \mu < 30$.
    b. **$H_0 : \mu \leq 30$ versus $H_1 : \mu > 30$.**
    c. $H_0 : \overline{X} \geq 30$ versus $H_1 : \overline{X} < 30$.
    d. $H_0 : \overline{X} \leq 30$ versus $H_1 : \overline{X} > 30$.

15. The owner of a local nightclub has recently surveyed a random sample of $n = 250$ customers of the club. She would now like to determine whether or not the mean age of her customers is over 30. If so, she plans to alter the entertainment to appeal to an older crowd. If not, no entertainment changes will be made. If she wants to be 99% confident in her decision, what rejection region should she use?
    a. Reject H_0 if $t < -2.34$.
    b. Reject H_0 if $t < -2.55$.
    c. **Reject H_0 if $t > 2.34$.**
    d. Reject H_0 if $t > 2.58$.

16. The owner of a local nightclub has recently surveyed a random sample of $n = 250$ customers of the club. She would now like to determine whether or not the mean age of her customers is over 30. If so, she plans to alter the entertainment to appeal to an older crowd. If not, no entertainment changes will be made. Suppose she found that the sample mean was 30.45 years and the sample standard deviation was 5 years. If she wants to be 99% confident in her decision, what decision should she make?
    a. Reject H_0.
    b. Accept H_0.
    c. **Fail to reject H_0.**
    d. We cannot tell what her decision should be from the information given.

17. The owner of a local nightclub has recently surveyed a random sample of $n = 250$ customers of the club. She would now like to determine whether or not the mean age of her customers is over 30. If so, she plans to alter the entertainment to appeal to an older crowd. If not, no entertainment changes will be

made. Suppose she found that the sample mean was 30.45 years and the sample standard deviation was 5 years. If she wants to be 99% confident in her decision, what conclusion can she make?
   a. **There is not sufficient evidence that the mean age of her customers is over 30.**
   b. There is sufficient evidence that the mean age of her customers is over 30.
   c. There is not sufficient evidence that the mean age of her customers is not over 30.
   d. There is sufficient evidence that the mean age of her customers is not over 30.

18. The owner of a local nightclub has recently surveyed a random sample of $n = 250$ customers of the club. She would now like to determine whether or not the mean age of her customers is over 30. If so, she plans to alter the entertainment to appeal to an older crowd. If not, no entertainment changes will be made. Suppose she found that the sample mean was 30.45 years and the sample standard deviation was 5 years. What is the p-value associated with the test statistic?
   a. 0.3577
   b. 0.1423
   c. **0.0780**
   d. 0.02

19. The marketing manager for an automobile manufacturer is interested in determining the proportion of new compact-car owners who would have purchased a passenger-side inflatable air bag if it had been available for an additional cost of $300. The manager believes from previous information that the proportion is 0.30. Suppose that a survey of 200 new compact-car owners is selected and 79 indicate that they would have purchased the inflatable air bags. If you were to conduct a test to determine whether there is evidence that the proportion is different from 0.30, which test would you use?
   a. Z-test of a population mean
   b. **Z-test of a population proportion**
   c. t-test of population mean
   d. t-test of a population proportion

20. The marketing manager for an automobile manufacturer is interested in determining the proportion of new compact-car owners who would have purchased a passenger-side inflatable air bag if it had been available for an additional cost of $300. The manager believes from previous information that the proportion is 0.30. Suppose that a survey of 200 new compact-car owners is selected and 79 indicate that they would have purchased the inflatable air bags. If you were to conduct a test to determine whether there is evidence that the proportion is different from 0.30 and decided not to reject the null hypothesis, what conclusion could you draw?
   a. There is sufficient evidence that the proportion is 0.30.
   b. There is not sufficient evidence that the proportion is 0.30.
   c. There is sufficient evidence that the proportion is 0.30.
   d. **There is not sufficient evidence that the proportion is not 0.30**.

SECTION II: TRUE OR FALSE

1. For a given level of significance, if the sample size is increased, the power of the test will increase.
True

2. Suppose, in testing a hypothesis about a proportion, the *p*-value is computed to be 0.043. The null hypothesis should be rejected if the chosen level of significance is 0.05.
True

3. Suppose, in testing a hypothesis about a proportion, the *Z* test statistic is computed to be 2.04. The null hypothesis should be rejected if the chosen level of significance is 0.01 and a two-tailed test is used.
False

4. The smaller is the *p*-value, the stronger is the evidence against the null hypothesis.
True

5. A sample is used to obtain a 95% confidence interval for the mean of a population. The confidence interval goes from 15 to 19. If the same sample had been used to test the null hypothesis that the mean of the population is equal to 20 versus the alternative hypothesis that the mean of the population differs from 20, the null hypothesis could be rejected at a level of significance of 0.05.
True

6. A sample is used to obtain a 95% confidence interval for the mean of a population. The confidence interval goes from 15 to 19. If the same sample had been used to test the null hypothesis that the mean of the population is equal to 18 versus the alternative hypothesis that the mean of the population differs from 18, the null hypothesis could be rejected at a level of significance of 0.05.
False

7. A sample is used to obtain a 95% confidence interval for the mean of a population. The confidence interval goes from 15 to 19. If the same sample had been used to test the null hypothesis that the mean of the population is equal to 20 versus the alternative hypothesis that the mean of the population differs from 20, the null hypothesis could be rejected at a level of significance of 0.10.
True

8. A sample is used to obtain a 95% confidence interval for the mean of a population. The confidence interval goes from 15 to 19. If the same sample had been used to test the null hypothesis that the mean of the population is equal to 20 versus the alternative hypothesis that the mean of the population differs from 20, the null hypothesis could be rejected at a level of significance of 0.02.
False

9. A sample is used to obtain a 95% confidence interval for the mean of a population. The confidence interval goes from 15 to 19. If the same sample had been used to test the null hypothesis that the mean of the population is equal to 20 versus the alternative hypothesis that the mean of the population differs from 20, the null hypothesis could be accepted at a level of significance of 0.02.
False

TABLE (A)

Microsoft Excel was used on a set of data involving the number of parasites found on 46 Monarch butterflies captured in Pismo Beach State Park. A biologist wants to know if the mean number of parasites per butterfly is over 20. She will make her decision using a test with a level of significance of 0.10. The following information was extracted from the Microsoft Excel output for the sample of 46 Monarch butterflies:

$n = 46$; Arithmetic Mean = 28.00; Standard Deviation = 25.92; Standard Error = 3.82; Null Hypothesis: $H_0 : \mu \leq 20.000$; $\alpha = 0.10$; df = 45; T Test Statistic = 2.09; One-Tailed Test Upper Critical Value = 1.3006; p-value = 0.021; Decision = Reject.

1. the parameter the biologist is interested in is:
    a. the mean number of butterflies in Pismo Beach State Park.
    b. the mean number of parasites on these 46 butterflies.
    c. the mean number of parasites on Monarch butterflies in Pismo Beach State Park.
    d. the proportion of butterflies with parasites.

2. state the alternative hypothesis for this study.
$$H_1 : \mu > 20.000$$

3. what critical value should the biologist use to determine the rejection region?
a. 1.6794
b. 1.3011
c. 1.3006
d. 0.6800

4. True or False: the null hypothesis would be rejected.
True

5. True or False: the null hypothesis would be rejected if a 4% probability of committing a Type I error is allowed.
True

6. True or False: the null hypothesis would be rejected if a 1% probability of committing a Type I error is allowed.
False

7. the lowest level of significance at which the null hypothesis can be rejected is _____.
0.021

8. True or False: the evidence proves beyond a doubt that the mean number of parasites on butterflies in Pismo Beach State Park is over 20.
False

9. True of False: the biologist can conclude that there is sufficient evidence to show that the average number of parasites per Monarch butterfly in Pismo Beach State Park is over 20 using a level of significance of 0.10.
True

10. True or False: the biologist can conclude that there is sufficient evidence to show that the average number of parasites per Monarch butterfly in Pismo Beach State Park is over 20 with no more than a 5% probability of incorrectly rejecting the true null hypothesis.
True

11. True or False: the biologist can conclude that there is sufficient evidence to show that the average number of parasites per Monarch butterfly in Pismo Beach State Park is over 20 with no more than a 1% probability of incorrectly rejecting the true null hypothesis.
False

12. True or False: the value of β is 0.90.
False

13. True or False: if these data were used to perform a two-tailed test, the p-value would be 0.042.
True

TABLE (B)

A bank tests the null hypothesis that the mean age of the bank's mortgage holders is less than or equal to 45, versus an alternative that the mean age is greater than 45. They take a sample and calculate a p-value of 0.0202.

1. True or False: the null hypothesis would be rejected at a significance level of $\alpha = 0.05$.
True

2. True or False: the null hypothesis would be rejected at a significance level of $\alpha = 0.01$.
False

3. True or False: the bank can conclude that the average age is greater than 45 at a significance level of $\alpha = 0.01$.
False

4. if the same sample was used to test the opposite one-tailed test, what would be that test's p-value?
   a. 0.0202
   b. 0.0404
   c. 0.9596
   d. **0.9798**

TABLE (C)

A major home improvement store conducted its biggest brand recognition campaign in the company's history. A series of new television advertisements featuring well-known entertainers and sports figures were launched. A key metric for the success of television advertisements is the proportion of viewers who "like the ads a lot". A study of 1,189 adults who viewed the ads reported that 230 indicated that they "like the ads a lot." The percentage of a typical television advertisement receiving the "like the ads a lot" score is believed to be 22%. Company officials wanted to know if there is evidence that the series of television advertisements are less successful than the typical ad (i.e. if there is evidence that the population proportion of "like the ads a lot" for the company's ads is less than 0.22) at a 0.01 level of significance.

1. the parameter the company officials is interested in is:
    a. the mean number of viewers who "like the ads a lot".
    b. the total number of viewers who "like the ads a lot".
    c. the mean number of company officials who "like the ads a lot".
    d. the proportion of viewers who "like the ads a lot".

2. state the null hypothesis for this study.
$$H_0 : \pi \geq 0.22$$

3. state the alternative hypothesis for this study.
$$H_1 : \pi < 0.22$$

4. what critical value should the company officials use to determine the rejection region?
−2.3263

5. the null hypothesis will be rejected if the test statistics is
    a. greater than 2.3263
    b. less than 2.3263
    c. greater than −2.3263
    d. less than −2.3263

6. True or False: the null hypothesis would be rejected.
False

7. the lowest level of significance at which the null hypothesis can be rejected is _____.
0.0135

8. the largest level of significance at which the null hypothesis will not be rejected is _____.
0.0135

9. True of False: the company officials can conclude that there is sufficient evidence to show that the series of television advertisements are less successful than the typical ad using a level of significance of 0.01.
False

10. True or False: the company officials can conclude that there is sufficient evidence to show that the series of television advertisements are less successful than the typical ad using a level of significance of 0.05.
True

11. True or False: the value of β is 0.90.
False

12. what will be the p-value if these data were used to perform a two-tailed test?
0.027