**FORMULAS:**

 

 

**STAT ESSENTIALS:** Know: 1) how to write hypotheses in statistical format and in written format; 2) what statistical significance means; 3) what terms associated with hypothesis testing mean – e.g. critical value(s), test statistic, p value, etc.; 4) how to conduct a hypothesis test and interpret the results. **[NOTE: see Orange sheets for additional problems and resources.]**

**General Steps in testing a hypothesis:**

1. List the given information
2. State in statistical and word format the null hypothesis and the alternative hypothesis
	1. Identify the “claim”
3. Determine if the test is one-tailed (left or right) or two-tailed
4. Identify the critical value for the test (or the stated p-value level at which the test is being conducted)
5. Draw a picture containing the critical value(s) and, after testing, the test statistic
6. Identify the statistical test
7. Conduct the test and obtain the test statistic (place it on your drawing)
8. Analyze your results (relationship between critical value and test statistic (or p-values comparison)
9. State a conclusion. Include a statement of the null hypothesis, the level at which it was tested, and whether it was retained or rejected.

**PROBLEMS:**

**Small Samples**

1. A manufacturer of light bulbs makes a 60-watt bulb having a mean life of 1000 hours. The research and development (R&D) department has developed a new bulb that it claims will, on average, outlast the present bulb. To justify its claim, R&D tests 10 new bulbs. The results show that the 10 bulbs tested have a mean life of 1050.2 hours and a standard deviation of 65.8 hours. At the 1% significance level, do the data obtained by R&D support its claim? Assume bulb life is normally distributed.

[Weiss; page 520]

H0: µ=1000

Ha: µ>1000

 (test statistic)

Critical value: 2.821

Fail to reject the null hypothesis. The data obtained does not support the claim.

1. Brown Swiss Dairy sells “half-gallon” cartons of milk. The contents of the cartons are known to be normally distributed with a standard deviation of 1.1 fluid oz. Suppose 15 randomly selected cartons have a mean content of 64.48 fluid oz. Do the data provide sufficient evidence to infer that the cartons actually contain more milk, on average, than 64 fluid oz? Perform the appropriate hypothesis test at the 0.05 level of significance.

[Weiss; page 520]

H0: µ=64

Ha: µ>64

(test statistic)

Critical value: 1.761

Fail to reject the null hypothesis. The data concludes that the mean is approximately equal to 64.

1. College tuition: The mean annual tuition and fees in the 2009-2010 academic year for a sample of 14 private colleges in California was $30,500 with a standard deviation of $4,500. A dotplot shows that it is reasonable to assume the population is approximately normal. Can you conclude that the mean tuition and fees for private institutions in California differs from $30,000?
2. State the null and alternative hypotheses.
3. Compute the value for the test statistic. How many degrees of freedom are there?
4. State your conclusion. Use the α=.01 level of significance.

a) H0: µ=30,000

 Ha: µ≠30,000

1. (test statistic)

There are 13 degrees of freedom.

1. Critical values= -3.012, 3.012

Fail to reject the null hypothesis. At the α=.01 significance level, we can conclude that the mean tuition and fees for private institutions in California does not differ from $30,000.

 **Large Samples**

1. Is there a doctor in the house? The Bureau of Labor Statistics reported that in May 2009, the mean annual earnings of all family practitioners in the United States was $168,550. A random sample of 55 family practitioners in Missouri that month had mean earnings of $154,590 with a standard deviation of $42,750. Do the data provide sufficient evidence to conclude that the mean salary for family practitioners in Missouri is less than the national average?
2. State the null and alternative hypotheses.
3. Compute the value of the test statistic.
4. State your conclusion. Use the α=0.05 level of significance.

[Navidi; page 378]

a) H0: µ=168,550

 Ha: µ<168,550

b) 

c) Critical value=-1.645

Reject the null hypothesis. At the α=.05 significance level, we can conclude that the mean salary for family practitioners in Missouri is less than the national average

1. Heavy children: Are children heavier now than they were in the past? The National Health and Nutrition Examination Survey (NHANES) taken between 1999 and 2002 reported that the mean weight of six-year-old girls in the United States was 49.3 pounds. Another NHANES, published in 2008, reported that a sample of 193 six-year-old girls weighed between 2003 and 2006 had an average weight of 51.5 pounds. The standard deviation of this sample is 15 pounds. Can you conclude that the mean weight of six-year-old girls is higher in 2006 than in 2002? Use the α=0.01 level of significance.

[Navidi; page 364]

H0: µ=49.3

H1: µ>49.3

(test statistic)

Critical value=2.33

Fail to reject the null hypothesis. At the α=0.01 significance level, we can conclude that the mean weight of six-year-old girls in 2006 is approximately equal to the mean weight of six-year-old girls in 2002.

1. According to *Crime in the United States,* a publication of the FBI, the mean value lost due to purse snatching was $279 in 1994. For this year, 41 randomly selected purse-snatching offenses have a mean value lost of $260 with a standard deviation of $84. Do the data provide sufficient evidence to conclude that the mean value lost due to purse snatching has decreased from the 1994 mean? Use α=0.05.

[Weiss; page 524]

H0: µ=279

Ha: µ<279

(test statistic)

Critical value: -1.645

Fail to reject the null hypothesis. The mean has not decreased.

**Proportions**

1. Environment: In 2008, the General Social Survey asked 1493 U.S. adults to rate their level of interest in environmental issues. Of these, 751 said that they were “very interested.” Does the survey provide convincing evidence that more than half of U.S. adults are very interested in environmental issues? Use the α=.05 level of significance.

[Navidi; page 389]

H0: p=.5

Ha: p>.5



(test statistic)

Critical value=1.645

Fail to reject the null hypothesis. The survey does not provide convincing evidence that more than half of U.S. adults are very interested in environmental issues at the α=.05 significance level.

1. Quit smoking: In a survey of 444 HIV-positive smokers, 170 reported that they had used a nicotine patch to try to quit smoking. Can you conclude that less than half of HIV-positive smokers have used a nicotine patch. Use the α=.05 level of significance.

[Navidi; page 389]

H0: p=.5

Ha: P<.5

(test statistic)

Critical value=-1.645

Reject the null hypothesis. We can conclude that less than half of the HIV-positive smokers have used a nicotine patch at the α=.05 levels.

1. Good credit: The Fair Isaac Corporation (FICO) credit score is used by banks and other lenders to determine whether someone is a good credit risk. Scores range from 300 to 850, with a score of 720 or more indicating that a person is a very good credit risk. An economist wants to determine whether the mean FICO credit score is lower than the cutoff of 720. She finds that a random sample of 100 people had a mean FICO score of 703 with a standard deviation of 92. Can the economist conclude that the mean FICO score is less than 720? Use α=.05 level of significance.

[Navidi; page 378]

H0: µ=720

Ha: µ<720

(test statistic)

Critical value=-1.645

Reject the null hypothesis. At the α=.05 significance level, we can conclude that the mean FICO score is less than 720.

1. High salaries for executives: A Washington Post-ABC News poll conducted in October 2009 surveyed a random sample of 1004 adults in the United States. Of these people, 713 said they would support federal legislation putting limits on the amounts that top executives are paid at companies that receive emergency government loans. One highly paid executive claims that less than 75% of U.S. adults support limits on the amounts that executives are paid.
2. State the appropriate null and alternate hypotheses.
3. Compute the test statistic.
4. Using α=.05, can you conclude that the executive’s claim is true?
5. Using α=.01, can you conclude that the executive’s claim is true?

[Navidi; page 389]

1. H0: p=.75

Ha: p<.75

1.  (test statistic)
2. Critical values= -1.645

Reject null hypothesis. There is sufficient evidence to support the claim at the α=.05 level.

1. Critical values= -2.575

Reject the null hypothesis. There is sufficient evidence to support the claim at the α=.01 level.