Chapter 8 Statistical Inference: Significance Tests About Hypotheses

A student observed people getting milk at the Phelps cafeteria. Of the 154 she observed, 94 chose skim. We will assume this proportion came from a simple random sample.

Conducting a test of significance for a proportion on a TI-83

With the above scenario, can we determine that a majority of milk drinkers at Phelps get skim milk?

- **Step 1: Going to the Proportion Test on the stat tests menu and entering the data.** To go to the proportion test window press [STAT] 1 7. Toggle down and press [ENTER] on 5:1-PropZTest…. Set up the window as shown on the right. Once the data are entered toggle down to Calculate and press [ENTER].

- **Step 2: Reading the results.** Our test statistic of \( z \approx -2.74 \), our \( P \)-value of approximately 0.00307, and the sample proportion, \( \hat{p} \), of about 0.6104 are shown to the right.

Significance Tests about Proportions

1. Complete the test of significance by writing out the hypotheses, test statistic, \( P \)-value, and conclusion for the skim milk example given above.

2. What does the \( P \)-value you obtained in question 1 mean?
3. In an October 2003 Gallup poll, 1108 out of 1305 American adults said they plan to vote in the next presidential election. It is estimated that 55% of the voting age population in the United States voted in the 2004 presidential election. Can we conclude that a greater proportion of people say they plan to vote than do? Complete the test of significance, at the 5% level, by writing out the hypotheses, test statistic, \( P \)-value, and conclusion.

4. Using the sample proportion from question 3, find the \( P \)-value if the alternative hypothesis would have been that the population proportion is different than 0.55. How is this \( P \)-value related to your \( P \)-value from question 3?

**Conducting a test of significance for a mean on a TI-83**

We want an interval estimate for the mean life of a light bulb. A random sample of 100 of these bulbs is taken and the mean of our sample is found to be \( \bar{x} = 960 \) hours and the sample standard deviation is found to be \( s = 240 \) hours. Can we determine that the mean life of all bulbs is less than 1000 hours?

- **Step 1: Going to the T-Test on the stat tests menu.**
  To go to the T-Test window press [STAT] \( \boxed{} \) \( \boxed{} \). Toggle down and press \( \boxed{} \) on 2:T-Test....

- **Step 2: Input the statistics.** Set up the T-Test window as shown on the right. Once the statistics are entered toggle down to Calculate and press \( \boxed{} \).

- **Step 3: Reading the results.** Our test statistic, \( t \approx -1.67 \), and our \( P \)-value of approximately 0.04937 are shown to the right.
Significance Tests about Means

5. A simple random sample of the 17 Payday candy bars is taken and each bar is weighed. The sample mean is 21.871 grams and the sample standard deviation is 0.969 grams. The label weight for these bars is 20 grams. Can we conclude that the mean weight of all Payday candy bars of this size is more than 20 grams? Complete a test of significance, at the 5% level, by writing out the hypotheses, test statistic, $P$-value, and conclusion.

6. A random sample of 10 body temperatures (in degrees Fahrenheit) was taken with the following results.

   97.3, 97.8, 98.8, 99.0, 97.9, 98.8, 98.2, 97.4, 97.2, 98.2

   a) You speculate that the mean body temperature is less than 98.6°F. You collect the data shown above. Complete a test of significance at the $\alpha = 0.05$ level to determine if the mean body temperature for everyone is less than 98.6°F. Make sure you give your hypotheses, test statistic, $P$-value, and conclusion.

   b) What does the $P$-value you obtained in part (a) mean?

   c) Suppose you did another study where you obtained the same sample mean as in part (a), but this time had a sample size of 100. What is your $P$-value this time?
Type I and Type II Errors

A type I error is to reject a true null hypothesis.
A type II error is to not reject a false null hypothesis.

<table>
<thead>
<tr>
<th></th>
<th>$H_0$ is true</th>
<th>$H_0$ is not true</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reject $H_0$</td>
<td>Type I Error</td>
<td>Correct Decision</td>
</tr>
<tr>
<td>Not reject $H_0$</td>
<td>Correct Decision</td>
<td>Type II Error</td>
</tr>
</tbody>
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- The probability of making a type I error is the same as the significance level.
- The probability of making a type II error depends on what the population mean really is. This can be quite high.

Suppose $H_0: p = 0.5$, $H_a: p < 0.5$, $n = 100$, $\alpha = 0.01$.

7. Suppose in fact the null hypothesis is correct.
   
   a) You will reject the null hypothesis for a $P$-value less than what number?

   b) You will reject the null hypothesis for a $\hat{p}$ less than what number?

   c) What is the probability that you would make an incorrect conclusion?

8. Suppose that $p$ was really 0.40. What is the probability that you would make an incorrect conclusion?

9. Suppose that $p$ was really 0.45. What is the probability that you would make an incorrect conclusion?