One mean t-test
One-Tailed and Two Tailed Tests for means

• Ho always has a symbol with an equal in it. Ha never has a symbol with an equal in it.

• Left-tailed and Right-tailed are referred to as one-tailed test.

<table>
<thead>
<tr>
<th>Left-tailed test</th>
<th>Right-tailed test</th>
<th>Two-tailed test</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_0: \mu \geq \text{population mean}$</td>
<td>$H_0: \mu \leq \text{population mean}$</td>
<td>$H_0: \mu = \text{population mean}$</td>
</tr>
<tr>
<td>$H_a: \mu &lt; \text{population mean}$</td>
<td>$H_a: \mu &gt; \text{population mean}$</td>
<td>$H_a: \mu \neq \text{population mean}$</td>
</tr>
</tbody>
</table>
One mean t-test requirements

• We are going to compare a sample mean to a population mean. If we don’t know the population standard deviation, you can use a one mean t-test.

• A simple random sample is used

• Population standard deviation (σ) is unknown so use the sample standard deviation

• Sample size (n) is 30 or greater or normally distributed

• Note that if the sample size is sufficiently large, a t-test will work even if the population is not approximately normally distributed.
One mean t-test explained

- We are comparing the sample to the mean to see how it compares and if it is different.
What matters?

The most important thing that the calculator and website gives us is:

The t-test statistics

The p-value
T-Test Example

Statistics students believe that the mean score on the first statistics test is 65. A statistics instructor thinks the mean score is 65.

He samples ten statistics students and obtains the scores 65; 65; 70; 67; 66; 63; 63; 68; 72; 71.

He performs a hypothesis test using a 5% level of significance. The data are assumed to be from a normal distribution.
Example of Hypothesis testing

a. Which test should be used? T-test because the population standard deviation was known.

b. State the null and alternative hypotheses.
   - $H_0: \mu = 65$
   - $H_a: \mu \neq 65$

c. Is this a right-tailed, left-tailed, or two-tailed test? Two-tailed

d. Is the population standard deviation known and, if so, what is it? The population standard deviation is unknown so I have to run a T-test.
**TI 83 and 84 CALCULATOR INSTRUCTIONS**

*(If sample data is given)*

**Z-test If entering a set of data:**

1. Enter the data under STATS, EDIT, L1
2. Enter STAT, Arrow over to TESTS, chose T-Test
3. The next screen will show the following for entering information:
   - Inpt: Data (choose if you have to enter data)
   - \( \mu_0 \): Population mean (the mean in the hypotheses)
   - List: L1 (where the data is)
   - Freq: 1
4. \( \mu \): choose the alternative hypothesis
5. Scroll to Calculate and it will go to a new screen

**The output screen is:**

- The first line is the alternative hypothesis
- \( t \): t-test statistic
- \( p \): p-value
- \( \bar{x} \): sample mean
- Sx: sample standard deviation
- n: sample size
Example of Hypothesis testing (Calculator input)

Input in calculator
Example of Hypothesis testing (Calculator output)

Output in calculator
Website Instructions

Go to [WWW.SOCSCIStatistics.com](http://WWW.SOCSCIStatistics.com)

Go to Calculators, t-test calculator for a single sample

**Entering a set of data:**
Enter the sample data in the empty box on the right. Make a list going down (not across).

Enter the following:

- **Population mean (μ)**
- Choose your level of significance
- Choice one-tailed or two-tailed hypothesis?
  - If you have an alternative hypothesis of less than (<) or greater than (>), pick one-tailed.
  - If you have an alternative hypothesis of not equals (≠), pick the two-tailed.
Example of Hypothesis testing (Website with data (input))

Single Sample T-Test Calculator

A single sample t-test compares the mean ($m$) of a single sample of scores to a known or hypothesized population mean ($m$). This means you need to input the value of your known (or hypothetical) population mean and your sample scores (likely you’ve already worked that out!). So, for example, if you want to test the students from a particular fraternity study the same number of hours as the control group, you’ll enter “4” as your population mean ($m$) and your fraternity sample scores in the text box.

Note: sample scores have to be entered either one score per line or as a comma delimited list (the calculator runs a type check on the data, and it won’t work otherwise).

Population mean ($m$)

<table>
<thead>
<tr>
<th>Sample X</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td></td>
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<td>68</td>
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<tr>
<td>72</td>
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<tr>
<td>71</td>
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</tr>
</tbody>
</table>

Significance Level:
- 0.01
- 0.05
- 0.10

One-tailed or two-tailed hypothesis?
- One-tailed
- Two-tailed

Remember to select significance level and whether your hypothesis is one or two-tailed.

Calculate  Reset

Input in Website
Example of Hypothesis testing (Website with data (output))

Single Sample T-Test Calculator

The value of t is 1.978141.

Population mean (μ) 65

Sample X
65 65 67 66 63 63 68 72

Significance Level:
○ 0.01
○ 0.05
○ 0.10

One-tailed or two-tailed hypothesis?:
○ One-tailed
○ Two-tailed

The t-value is 1.978141. The p-value is 0.079296. The result is not significant at p < 0.05.
Example of Hypothesis testing (3)

g. What is the t-test statistics? \( t = 1.97 \)

h. Find the p-value. \( 0.079 \)

i. At a pre-conceived \( \alpha = 0.05 \), what is your: \( p \) versus \( \alpha \) \( 0.079 > 0.05 \)

i. Decision: **fail to reject the null hypothesis**

ii. Reason for the decision: \( p \) was larger than \( \alpha \)

iii. Conclusion (write out in a complete sentence):

At the 5% level of significance, there is sufficient evidence to show that the mean test score is 65.

Think about it: I said the null hypothesis was true so the mean test score is 65.