JMP INTRO® Lab Activities

Lab Activity – Hypothesis Testing – the *t*-test

In 1738 the Paris observatory determined that the angle of the earth's spin (obliquity) was 23.4722°. This was accomplished through the use of a new measurement technique. One of the astronomers believed that this angle was different from those measured in the past. Historical accounts were examined and five measurements were randomly selected, dating from 1460 to 1570. These results differed somewhat from the Paris measurements. You are going to examine the question of whether these differences reveal a real change in the measurement of the Earth's rotation angle or whether they can be attributed to chance variability. The following are the data from the historical accounts.

Source	Date	Obliquity
Regiomontanus	1460	23.5
Copernicus	1500	23.47333
Waltherus	1500	23.48778
Danti	1570	23.50778
Tycho	1570	23.525

Start your computer and open JMP INTRO. From the **JMP Starter** menu, select **New Data Table** and enter these data. Also name the variables To conduct a hypothesis test using JMP INTRO, choose **Analyze** ® **Distribution** from the menu bar, and select **Obliquity** for the **Y,Columns** variable. Then click **OK**. Click on the red triangle next to **Obliquity**, and choose **Test Mean**. Enter the Paris measurement for the mean, and leave the standard deviation blank. As JMP INTRO indicates, because you don't know the population standard deviation, you will need to perform a *t* test rather than a *z* test.

Using your results from JMP INTRO, write a complete hypothesis test, using one of the commonly used alpha levels. Include assumptions, hypotheses, sample statistic values, test statistic and p-value, and conclusions in the context of the problem. In addition, copy the data table, a graphical display of the data, and hypothesis test results from JMP INTRO into your word processing document. Circle the test statistic and p-value results from the computer output, and explain how you chose the proper p-value for this test. In your solution, remember to answer the original question posed.

JMP INTRO® Lab Activities
Teacher Notes

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Objectives:
- Gain familiarity with some of the basic operational tools of JMP INTRO.
- Use JMP INTRO to conduct a hypothesis test for a mean when the standard deviation is unknown.
- Create a word processing document, incorporating displays from JMP INTRO.

Time Required: 30 minutes

Materials: Hypothesis Testing - the *t*-test student activity directions

Prerequisites:
- Students should have basic knowledge of how to use JMP INTRO.
- Students should have experience conducting tests of hypothesis by hand and/or with graphing calculators for a mean when the standard deviation is unknown.
- Students should have experience writing conclusions in the context of the problem for hypothesis tests.
- Students should have had experience creating a data table in JMP INTRO.

JMP INTRO Notes:
- JMP INTRO includes an extensive online help system. It contains a table of contents and/or can be used to search for a specific topic. In addition, JMP INTRO has context sensitive help. You can access it by selecting the help tool (?) from the tools toolbar and clicking inside a data table or report. JMP INTRO opens help specific to the clicked-on item.
- Students need to choose the correct p-value based on their alternate hypothesis. A brief discussion of the three p-values reported by JMP INTRO may be necessary.
- The **Normal Quantile Plot** option adds a graph to the report that is useful for visualizing the extent to which the variable is normally distributed. If a variable is normal, the normal quantile plot approximates a diagonal straight line. This kind of plot is also called a quantile-quantile plot, or Q-Q plot.

JMP INTRO® Lab Activities
Answer Key

The following are suggested answers for Hypothesis Testing – the *t*-test.

Assumptions: We were told the data came from a random sample of historical accounts. Although there were only five data values, examining the plots of the data, along with the normal quantile plot, we have no reason to believe the data are not normally distributed.

Hypotheses: H_o: $\mu = 23.4722$ The average Earth obliquity angle was 23.4722 degrees in the 15th and 16th century.

H_a: $\mu \neq 23.4722$ The average Earth obliquity angle was not 23.4722 degrees.

Test Mechanics: $$t = \frac{\bar{x} - m}{\frac{s}{\sqrt{n}}} = \frac{23.498778 - 23.4722}{\frac{0.019613}{\sqrt{5}}} = 3.0301$$

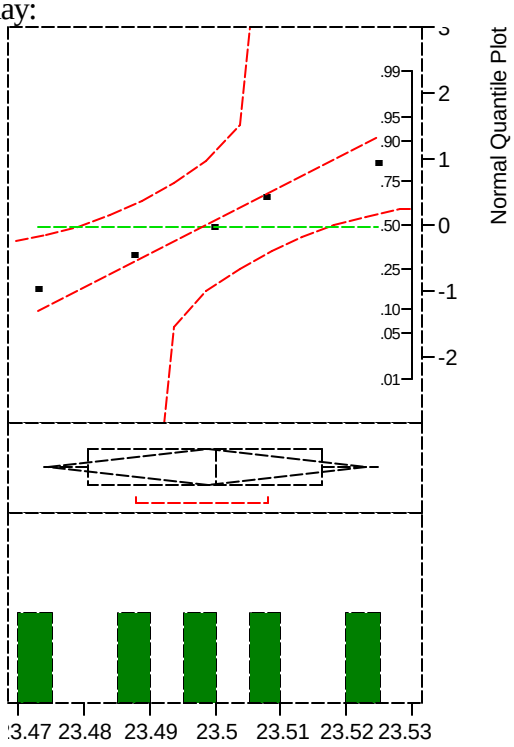
p = 0.0388

Conclusions: At the $\alpha = .05$ level, because $p = 0.0388 < 0.05$, we should reject the null hypothesis and accept the alternative hypothesis. We have evidence to show the average obliquity was not 23.4722 degrees and have evidence to show that these differences reveal a change in the Earth's rotation angle.

Data:

Source	Date	Obliquity
Regiomontanus	1460	23.5
Copernicus	1500	23.47333
Waltherus	1500	23.48778
Danti	1570	23.50778
Tycho	1570	23.525

Graphical Display:



JMP INTRO Hypothesis Test Results:

Test Mean=value

Hypothesized Value	23.4722
Actual Estimate	23.4988
df	4
Std Dev	0.01961

	t Test
Test Statistic	3.0301
Prob > |t|	0.0388
Prob > t	0.0194
Prob < t	0.9806

The p-value of 0.0388 was chosen because this was a two-sided test.