

## JMP INTRO® Lab Activities

### Lab Activity – Hypothesis Testing – the $z$ -test

The Stanford-Binet IQ test is nationally normed with a mean of 100 and a standard deviation of 15. A principal in an elementary school believes that her students have above average intelligence and wants verification of her belief. She randomly selects 20 students and checks the student files. She finds the following IQ scores for these 20 students. You need to determine whether or not the students in this school have above average intelligence.

Student Name	IQ
Kathy	110
Mike	132
Adam	98
Celia	97
Christina	115
Aaron	145
Elaine	77
Jesse	130
Sam	114
Nikki	128
Amanda	89
Steve	101
Jason	92
Tabitha	85
Mindy	112
Drew	79
Shailja	139
Samir	102
Robert	103
Tiffany	89

Start your computer and open JMP INTRO. From the **JMP Starter** menu, select **New Data Table**. Double-click on the **Column 1** header, and for the **Column Name**, enter **Student Name**. Click **OK**. Enter the student names into the data table, starting with the cell below the column heading. JMP INTRO will warn you that you have entered non numeric data and ask if you wish to enter a character variable column. Click **Change**, and continue entering the student names. Next, create a new column for the IQ's. To do this, double-click in the column heading space for the column to the right of the **Student Name** column. Enter the title for this column, **IQ**. Enter the IQ's for the students. Make sure you enter the correct IQ for each individual.

To conduct a hypothesis test using JMP INTRO, choose **Analyze** ® **Distribution** from the menu bar, and select **IQ** for the **Y,Columns** variable. Then click **OK**. Click on the red triangle next to **IQ**, and choose **Test Mean**. Enter the normed values for the mean and standard deviation, and click **OK**.

Using your results from JMP INTRO, write a complete hypothesis test, using the  $\alpha = .05$  significance level. 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.

Aaron has the highest IQ in this sample of students. We are going to exclude Aaron from the analysis to see if your results would have been different had Aaron not been chosen. To do this, select Aaron from the data table, and then choose **Rows** ® **Exclude/Unexclude** from the menu bar. Repeat the hypothesis test with Aaron excluded. Discuss how your results differ from the sample with Aaron included. Include a copy of the hypothesis test results from JMP INTRO in your document.

## JMP INTRO® Lab Activities

### Teacher Notes

#### Lab Activity – Hypothesis Testing – the $z$ -test

##### 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 known.
- Create a word processing document, incorporating displays from JMP INTRO.

Time Required: 45 minutes

Materials: Hypothesis Testing – the  $z$ -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 known.
- Students should have experience writing conclusions in the context of the problem for hypothesis tests.

##### 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.
- The  $z$ -test is rarely used in reality. Most often, the standard deviation of the population is unknown.
- As students enter data into the table, they need to be careful to enter the correct IQ for the student in each row. The number of IQ entries should match the number of name entries.
- 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.
- Excluding the row with Aaron allows Aaron to remain in the data table, but the Aaron's value will not be used in the analysis. If you wish to delete Aaron, select Aaron from the data table, and then choosing **Rows** ® **Delete Rows** from the menu bar.

## JMP INTRO® Lab Activities

### Answer Key

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

**Assumptions:** We were told the data came from a random sample of students. Although, based on the histogram or box plot, the data appears slightly skewed to the right, with a sample of size 20 and no outliers, we should be safe in using the z procedures.

**Hypotheses:**  $H_0: \mu = 100$  The average IQ of the students in this school is 100.  
 $H_a: \mu > 100$  The average IQ of the students in this school is above 100.

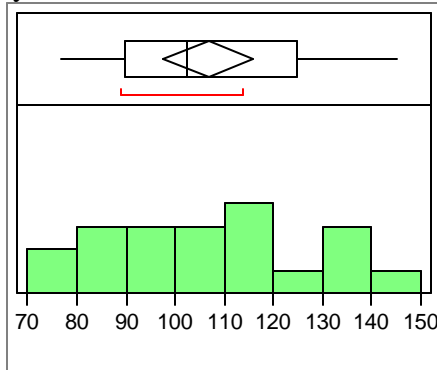
**Test Mechanics:** 
$$z = \frac{\bar{x} - m}{\frac{s}{\sqrt{n}}} = \frac{106.85 - 100}{\frac{15}{\sqrt{20}}} = 2.0423$$
  
 $p = 0.0206$

**Conclusions:** At the  $\alpha = .05$  level, because  $p = 0.0206 < 0.05$ , we should reject the null hypothesis and accept the alternative hypothesis. We have evidence to show that students at this school have an average IQ above 100.

**Data:**

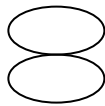
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Mindy	112
Drew	79
Shailja	139
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Tiffany	89

Graphical Display:



JMP INTRO Hypothesis Test Results:

<b>Test Mean=value</b>	
Hypothesized Value	100
Actual Estimate	106.85
df	19
Std Dev	19.8793
Sigma given	15



	<b>z Test</b>
Test Statistic	2.0423
Prob >  z	0.0411
Prob > z	0.0206
Prob < z	0.9794

The p-value of 0.0206 was chosen because this was a one-sided greater than test.

JMP INTRO Hypothesis Test Results with Aaron Removed:

<b>Test Mean=value</b>	
Hypothesized Value	100
Actual Estimate	104.842
df	18
Std Dev	18.2217
Sigma given	15

	<b>z Test</b>
Test Statistic	1.4071
Prob >  z	0.1594
Prob > z	0.0797
Prob < z	0.9203

With Aaron removed, at the  $\alpha = .05$  level, because  $p = 0.0797 > 0.05$ , we fail to reject the null hypothesis. We would not have enough evidence to show that students at this school have an average IQ above 100.