# Activity 3.6 Statistical Analysis with Excel (PREVIEW)

## Introduction

Engineers use various tools to make their jobs easier. Spreadsheets can greatly improve the accuracy and efficiency of repetitive and common calculations; therefore, engineers often employ spreadsheet applications in their work.

In this activity you will collect data and use Microsoft Excel to perform statistical analyses and create statistical charts your data.

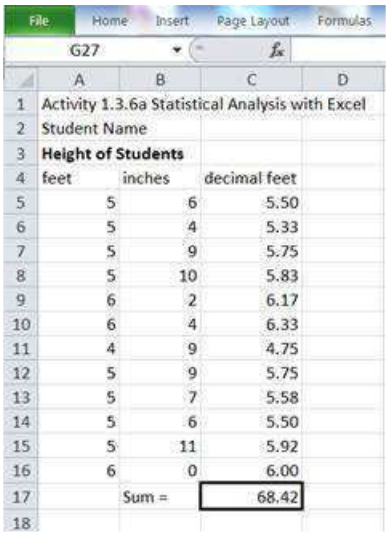
## Equipment

- Engineering notebook
- Pencil
- Completed activity 1.3.6 Applied Statistics

## Procedure

**Part 1.** Perform a statistical analysis in Excel of height measurements of students in your class.

**1.** Open an Excel workbook. On worksheet 1 type "Activity 1.3.6 Statistical Analysis with Excel" in cell A1 and your name in cell A2.
**2.** In your notebook, record the height of each student in your class in feet and decimal inches to the nearest quarter of an inch.
**3.** Input the raw data into an Excel worksheet using a separate column (A) for feet and a separate column (B) for inches. Include appropriate data (column) headers.
**4.** Using a formula, convert each height to decimal feet and place the results in column C using an appropriate column heading.
**5.** Format the height measurements in decimal feet to show two decimal places.
**6.** In the cell just below the column of heights in decimal feet, calculate the sum of the height measurements using the SUM function. Format the cell containing the sum to display a box around the number and add the text "Sum =" in the cell to the left of the sum cell. Note that the sum should display two decimal places.
**OPTIONAL:** Use formulas to calculate the standard deviation of your height data.



| | A | B | C | D |
|---|---|---|---|---|
| 1 | Activity 1.3.6a Statistical Analysis with Excel | | | |
| 2 | Student Name | | | |
| 3 | **Height of Students** | | | |
| 4 | feet | inches | decimal feet | |
| 5 | 5 | 6 | 5.50 | |
| 6 | 5 | 4 | 5.33 | |
| 7 | 5 | 9 | 5.75 | |
| 8 | 5 | 10 | 5.83 | |
| 9 | 6 | 2 | 6.17 | |
| 10 | 6 | 4 | 6.33 | |
| 11 | 4 | 9 | 4.75 | |
| 12 | 5 | 9 | 5.75 | |
| 13 | 5 | 7 | 5.58 | |
| 14 | 5 | 6 | 5.50 | |
| 15 | 5 | 11 | 5.92 | |
| 16 | 6 | 0 | 6.00 | |
| 17 | | Sum = | 68.42 | |
| 18 | | | | |

**7.** Calculate the statistics indicated in the image to the right. Create the text labels in the appropriate cells. Be sure to calculate the population standard deviation (STDEV.P) and the sample standard deviation (STDEV.S) as well as the appropriate Mode function (single or multimodal).

| | |
|---|---|
| Mean | 5.701 |
| Mode | 5.500 |
| | 5.750 |
| Standard Deviation (P) | 0.399 |
| Standard Deviation (S) | 0.417 |
| Mimum | 4.750 |
| Median | 5.750 |
| Maximum | 6.333 |
| Range | 1.583 |

If your data has more than one mode, use the MODE.MULT function. This function will create an answer in the form of an array. Therefore before typing the function into a cell, highlight multiple cells (vertically), type in the function text and select the range of values. Then depress **Cntl**/**Shift**/**Enter** keys simultaneously to indicate an array will be returned.

You can create a simple formula to calculate the range.

8. Use the Data Analysis tool to calculate the Descriptive Statistics (Summary Statistics) and place the output data next to the your calculated statistics.

| *Column1* | |
|---|---|
| Mean | 5.701389 |
| Standard Error | 0.120263 |
| Median | 5.75 |
| Mode | 5.5 |
| Standard Deviation | 0.416604 |
| Sample Variance | 0.173559 |
| Kurtosis | 1.500582 |
| Skewness | -0.80983 |
| Range | 1.583333 |
| Minimum | 4.75 |
| Maximum | 6.333333 |
| Sum | 68.41667 |
| Count | 12 |

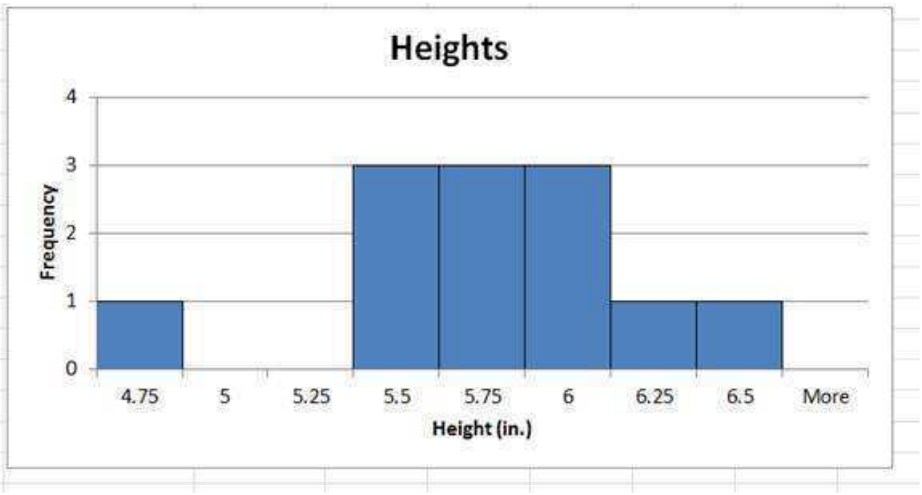
10. Create class intervals (value ranges) for a histogram at 0.25 feet intervals that will include **your** minimum and maximum recorded height.

| Bins |
|---|
| 4.75 |
| 5 |
| 5.25 |
| 5.5 |
| 5.75 |
| 6 |
| 6.25 |
| 6.5 |

11. Create a frequency table using the Histogram tool choice in the Data Analysis Tool (Data tab, Analysis panel).

| *Bin* | *Frequency* |
|---|---|
| 4.75 | 1 |
| 5 | 0 |
| 5.25 | 0 |
| 5.5 | 3 |
| 5.75 | 3 |
| 6 | 3 |
| 6.25 | 1 |
| 6.5 | 1 |
| More | 0 |

12. Create a histogram using the 2D chart tool. Format the chart as shown below.




13. Print out your worksheet. Include all of the elements shown on the worksheet below.

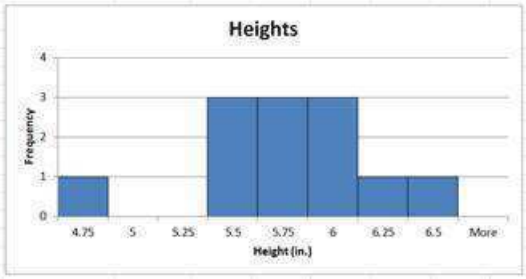
Activity 3.6 Statistical Analysis with Excel
Student Name

| Height of Students | | | | |
|---|---|---|---|---|
| feet | inches | decimal feet | | |
| 5 | 6 | 5.50 | | |
| 5 | 4 | 5.33 | | |
| 5 | 9 | 5.75 | Standard Deviation (P) | 0.399 |
| 5 | 10 | 5.83 | Standard Deviation (S) | 0.417 |
| 6 | 2 | 6.17 | Minimum | 4.750 |
| 6 | 4 | 6.33 | | |
| 4 | 9 | 4.75 | Median | 5.750 |
| 5 | 9 | 5.75 | | |
| 5 | 7 | 5.58 | Maximum | 6.333 |
| 5 | 6 | 5.50 | | |
| 5 | 11 | 5.92 | Range | 1.583 |
| 6 | 0 | 6.00 | | |
| | Sum = | 68.42 | | |

| | |
|---|---|
| Mean | 5.701 |
| Mode | 5.500 |
| | 5.750 |

| Column1 | |
|---|---|
| Mean | 5.70138889 |
| Standard Error | 0.12026308 |
| Median | 5.75 |
| Mode | 5.5 |
| Standard Deviation | 0.41660353 |
| Sample Variance | 0.1735585 |
| Kurtosis | 1.50058203 |
| Skewness | -0.8098347 |
| Range | 1.58333333 |
| Minimum | 4.75 |
| Maximum | 6.33333333 |
| Sum | 68.4166667 |
| Count | 12 |

| Bins | Bin | Frequency |
|---|---|---|
| 4.75 | 4.75 | 1 |
| 5 | 5 | 0 |
| 5.25 | 5.25 | 0 |
| 5.5 | 5.5 | 3 |
| 5.75 | 5.75 | 3 |
| 6 | 6 | 3 |
| 6.25 | 6.25 | 1 |
| 6.5 | 6.5 | 1 |
| | More | 0 |




**Part 2**. Perform a statistical analysis using Excel to check the toy connector depth statistics that you calculated in number 1 of activity 3.5 Applied Statistics.

1. Use formulas to verify your answers to number 1 of Activity 3.5 Applied Statistics. Your worksheet should contain entries similar to those shown below. Print a copy of your worksheet.

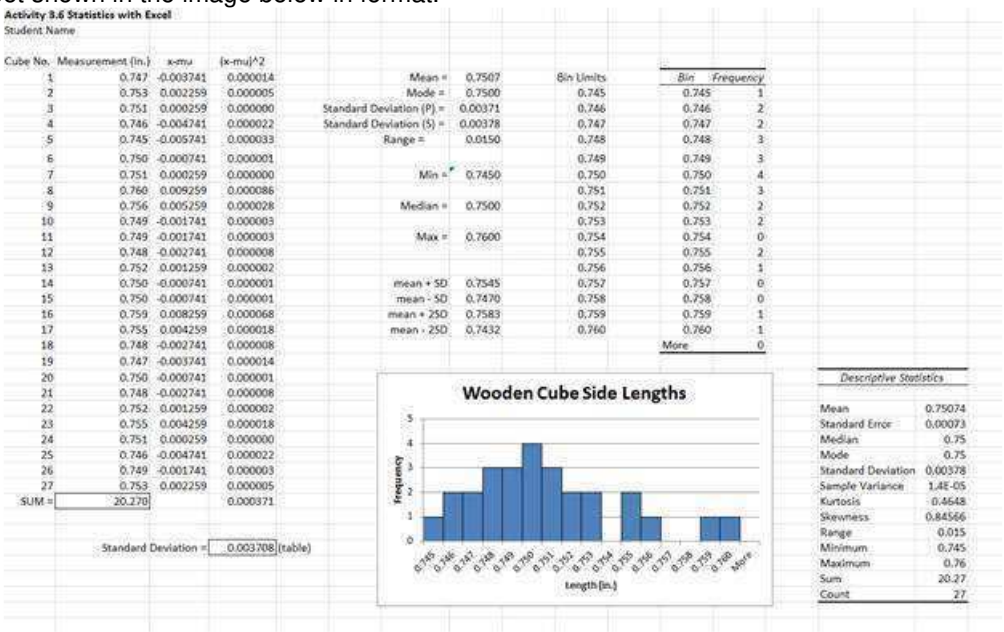
   Note that the data is multimodal, therefore you must use the MODE.MULT function in Excel. The MODE.MULT function will create an answer in the form of a vertical array (list of numbers). Therefore before typing the function (MODE.MULT) into a cell, highlight multiple cells (vertically), type in the function and select the range of data values. Then depress **Cntl**/**Shift**/**Enter** keys simultaneously to enter the formula and to indicate that an array will be returned.

Activity 3.6 Statistical Analysis with Excel

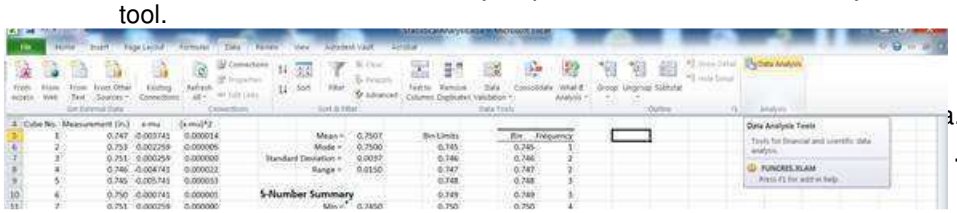
| | X | x-mean | (x-mean)^2 | |
|---|---|---|---|---|
| | 3.8 | | | Mean = |
| | 3.9 | | | Standard Deviation (P) = |
| | 3.9 | | | Standard Deviation (S) = |
| | 4.0 | | | Mean + SD = |
| | 4.0 | | | Mean - SD = |
| | 4.0 | | | Mean + 2SD = |
| | 4.1 | | | Mean - 2SD = |
| | 4.1 | | | |
| | 4.1 | | | Median = |
| | 4.2 | | | Mode = |
| | 4.3 | | | |
| | 4.4 | | | |
| Sum | 48.8 | | 0.0000 | |

**Part 3.** Perform a statistical analysis using Excel on the wooden cube side length data that you collected in Activity 3.5 Applied Statistics.

1. Use formulas to calculate the (population) standard deviation of the data (not the STDEV.P or the STDEV.S function). Hint, set up a table in Excel similar to that shown in number 1b of Activity 1.3.6 and use formulas to calculate $(x - \mu)$ and $(x - \mu)^2$. The screen shot below shows columns in which $(x - \mu)$ and $(x - \mu)^2$ are calculated. Create single cell formulas to calculate the mean and then the standard deviation.
2. Using Excel, create a worksheet that displays each of the following statistics. Be sure to label each number. Note that both the population and sample standard deviation are shown. Your worksheet should resemble the worksheet shown in the image below in format.




3. Use the Data Analysis Tool to calculate summary statistics
   - In the Data tab within the Analysis panel, choose the Data Analysis tool.



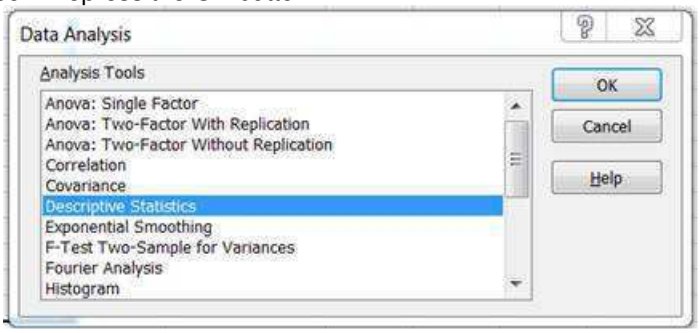
4. Use Excel to calculate $\mu \pm \sigma$ and $\mu \pm 2\sigma$ using the sample standard deviation and complete the following:

a. Record the following values.

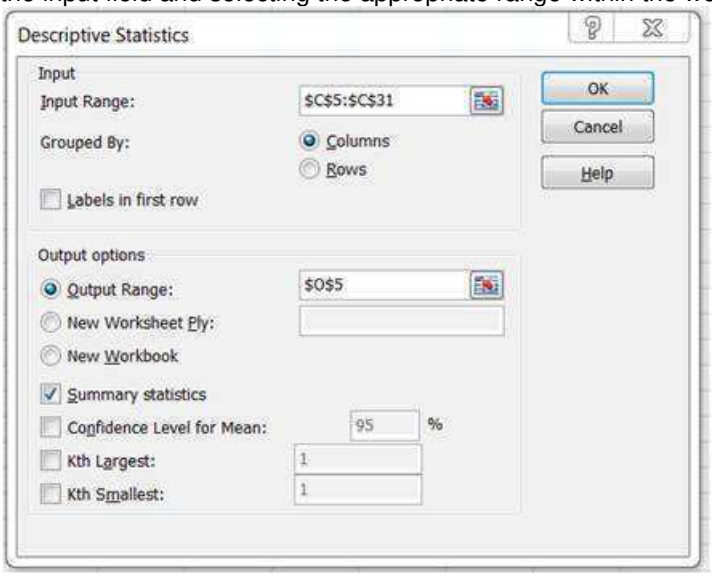
**+ σ**

_____

- Choose Descriptive Statistics from the list in the Data Analysis dialog box. Depress the OK button.




- Choose the Input Range, activate the radio button for Output Range, and input a cell address for the Output Range. Depress the OK button. Note that you may input a range by clicking on the button to the right of the input field and selecting the appropriate range within the worksheet.




- Replace the table title "Column 1" with "Descriptive Statistics". Compare the Descriptive Statistics with your calculated statistics.

  Why do you think this is the case?

iii. $\mu - \sigma$ _____

iii. $\mu + 2\sigma$ _____

iv. $\mu - 2\sigma$ _____

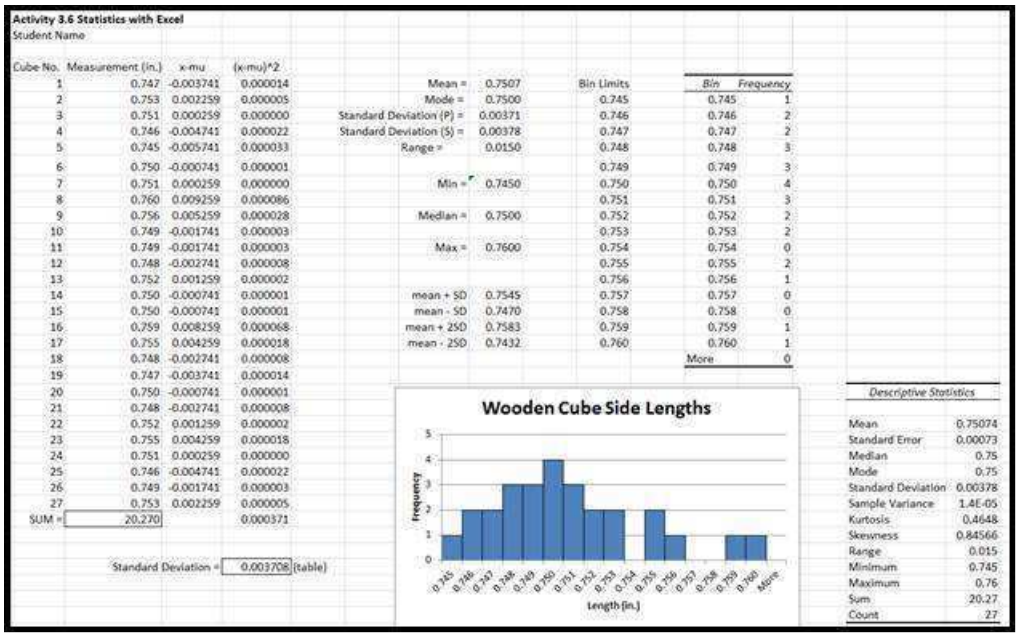
b. Can the values above be useful in the selection of wooden cubes for assembly into puzzles? How?

c. What range of cube lengths would you recommend for puzzle cube construction? Write your answer in the form of a compound inequality.

d. Using your recommended length range from above, what percentage of your puzzle cubes would **not** be acceptable for puzzle cube construction. SHOW YOUR WORK.

e. Which standard deviation formula (population or sample) does Excel use when you use the Data Analysis Descriptive Statistics tool?

5. Print a copy of your worksheet. The final worksheet should contain all of the elements shown below.



**Activity 3.6 Statistics with Excel**
Student Name

| Cube No. | Measurement (in.) | x-mu | (x-mu)^2 |
|---|---|---|---|
| 1 | 0.747 | -0.003741 | 0.000014 |
| 2 | 0.753 | 0.002259 | 0.000005 |
| 3 | 0.751 | 0.000259 | 0.000000 |
| 4 | 0.746 | -0.004741 | 0.000022 |
| 5 | 0.745 | -0.005741 | 0.000033 |
| 6 | 0.750 | -0.000741 | 0.000001 |
| 7 | 0.751 | 0.000259 | 0.000000 |
| 8 | 0.760 | 0.009259 | 0.000086 |
| 9 | 0.756 | 0.005259 | 0.000028 |
| 10 | 0.749 | -0.001741 | 0.000003 |
| 11 | 0.749 | -0.001741 | 0.000003 |
| 12 | 0.748 | -0.002741 | 0.000008 |
| 13 | 0.752 | 0.001259 | 0.000002 |
| 14 | 0.750 | -0.000741 | 0.000001 |
| 15 | 0.750 | -0.000741 | 0.000001 |
| 16 | 0.759 | 0.008259 | 0.000068 |
| 17 | 0.755 | 0.004259 | 0.000018 |
| 18 | 0.748 | -0.002741 | 0.000008 |
| 19 | 0.747 | -0.003741 | 0.000014 |
| 20 | 0.750 | -0.000741 | 0.000001 |
| 21 | 0.748 | -0.002741 | 0.000008 |
| 22 | 0.752 | 0.001259 | 0.000002 |
| 23 | 0.755 | 0.004259 | 0.000018 |
| 24 | 0.751 | 0.000259 | 0.000000 |
| 25 | 0.746 | -0.004741 | 0.000022 |
| 26 | 0.749 | -0.001741 | 0.000003 |
| 27 | 0.753 | 0.002259 | 0.000005 |
| SUM = | 20.270 | | 0.000371 |

Standard Deviation = 0.003708 (table)

| | |
|---|---|
| Mean = | 0.7507 |
| Mode = | 0.7500 |
| Standard Deviation (P) = | 0.00371 |
| Standard Deviation (S) = | 0.00378 |
| Range = | 0.0150 |
| Min = | 0.7450 |
| Median = | 0.7500 |
| Max = | 0.7600 |
| mean + SD | 0.7545 |
| mean - SD | 0.7470 |
| mean + 2SD | 0.7583 |
| mean - 2SD | 0.7432 |

| Bin Limits | Bin | Frequency |
|---|---|---|
| 0.745 | 0.745 | 1 |
| 0.746 | 0.746 | 2 |
| 0.747 | 0.747 | 2 |
| 0.748 | 0.748 | 3 |
| 0.749 | 0.749 | 3 |
| 0.750 | 0.750 | 4 |
| 0.751 | 0.751 | 3 |
| 0.752 | 0.752 | 2 |
| 0.753 | 0.753 | 2 |
| 0.754 | 0.754 | 0 |
| 0.755 | 0.755 | 2 |
| 0.756 | 0.756 | 1 |
| 0.757 | 0.757 | 0 |
| 0.758 | 0.758 | 0 |
| 0.759 | 0.759 | 1 |
| 0.760 | 0.760 | 1 |
| | More | 0 |



| Descriptive Statistics | |
|---|---|
| Mean | 0.75074 |
| Standard Error | 0.00073 |
| Median | 0.75 |
| Mode | 0.75 |
| Standard Deviation | 0.00378 |
| Sample Variance | 1.4E-05 |
| Kurtosis | 0.4648 |
| Skewness | 0.84566 |
| Range | 0.015 |
| Minimum | 0.745 |
| Maximum | 0.76 |
| Sum | 20.27 |
| Count | 27 |

## Conclusion

1. How do the statistics that you calculated using Excel compare to the statistics you calculated by hand in Activity 3.5 Applied Statistics for the wooden cube side lengths?

2. Other than the calculation of statistics, how could an engineer use a spreadsheet application to increase their efficiency?