

# 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.

F	ile Hon	ne Insert	Page Layout	Formulas
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1	A	В	C	D
1	Activity 1.	3.6a Statist	ical Analysis w	ith Excel
2	Student N	ame		
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			1	

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).

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.

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

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.

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

	Bins	
	4.75	
	5	
	5.25	
	5.5	
	5.75	
	6	
	6.25	
	6.5	
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4	Bin	Frequency
	Bin 4.75	Frequency 1
	Bin 4.75 5	Frequency 1
	Bin 4.75 5 5.25	Frequency 1 0
	Bin 4.75 5.25 5.5	Frequency 1 0 0
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	<i>Bin</i> 4.75 5.25 5.25 5.5 5.75 6	Frequency 1 0 3 3 3
	Bin 4.75 5.25 5.25 5.5 5.75 6.25	Frequency 1 0 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
	Bin 4.75 5.25 5.5 5.75 6 6.25 6.5	Frequency 1 0 3 3 3 1 1

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





Mean Mode	5.701 5.500	Column	1				
Mean Mode	5.701 5.500	Column	Ť				
Mode	5.500						
	5.750	Mean	5.70138889				
		Standard Error	0.12026308				
Standard Deviation (P)	0.399	Median	5.75				
Standard Deviation (S)	0.417	Mode	5.5				
Minimum	4.750	Standard Deviation	0.41660353				
		Sample Variance	0.1735585				
Median	5,750	Kurtosis	1.50058203				
		Skewness	-0.8098347				
Maximum	6.333	Range	1.58333333				
		Minimum	4.75				
Range	1.583	Maximum	6.33333333				
		Sum	68.4166667				
		Count	12				
		4	1	Heights			
Sin F	requency						
4.75	1	3					
5	0	5					
5.25	0	\$ 2					
5.5	3	ŝ					
-5.75	-3						
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6.5	1	0	100 000 0	e l'en l'	-	1	AL AND A
More	0	4.75	5 5.25 5	5 5.75	0 6.25	6.5	More
	6.5 More	6.5 1 More 0	6:5 1 0 4.75	6.5 1 0 4.75 S 5.25 S	6.5 1 0 More 0 4.75 5 5.25 5.5 5.75 Height (in.)	6:5 1 0 More 0 4.75 5 5.25 5.5 5.75 6 6.25 Height (in.)	6.5 1 0 More 0 4.75 5 5.25 5.5 5.75 6 6.25 6.5 Height (in.)

**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.

	х	x-mean	(x-mean)^2	Mean =	
	3.8			Standard Deviation (P) =	
	3.9			Standard Deviation (S) =	
	3.9			Mean + SD =	
	4.0			Mean - SD =	
	4.0			Mean + 2SD =	
	4.0			Mean - 2SD =	
	4.1				
	4.1			Median =	
	4.1			Mode =	
	4.2				
	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.



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

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52	1 2		0.751	0.000255	0.00000	÷			Minu!	6.7458		0.750		0.755	4							1000	

- 4. Use Excel to calculate μ ± σ and μ ± 2σ using the sample standard deviation and complete the following:
  - Record the following values.

+σ

Choose Descriptive Statistics from the list in the Data Analysis dialqg  $\mu - \sigma$ Sum box. Depress the OK button.

Analysis Tools		OK
Anova: Single Factor Anova: Two-Factor With Replication Anova: Two-Factor Without Replication Correlation Covariance		Cancel Help
Descriptive Statistics Exponential Smoothing F-Test Two-Sample for Variances Fourier Analysis Histogram	-	

iii. μ + 2σ	
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iv. μ - 2σ

- b. Can the values above be useful in the selection of wooden cubes for assembly into puzzles? How?
- Sume Choose the Input Range, activate the radio button for Output Range, and input a cell address for the Output Range. Depress the OK button. c. What range of cube lengths 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.

Input	-		10000	OK
Input Range:	\$C\$5	5:\$C\$31	252	
Grouped By:	00	olumns		Cancel
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Output options				
Qutput Range:	\$0\$5	5		
New Worksheet Ply:				
New Workbook				
Summary statistics				
Confidence Level for Mean:		95	%	
Kth Largest:	1			
Kth Smallect:	1			

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

Why do you think this is the case?

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

Activity 3.6	5 Statistics with E	xcel									
Student Nar	me										
Cube No. N	Measurement (in.)	x-mu	(ximu)*2					and the second			
1	0.747	-0.003741	0.000014		Mean =	0.7507	Bin Limits	Bin	Frequency		
2	0.753	0.002259	0.000005		Mode =	0.7500	0.745	0.745	1		
3	0.751	0.000259	0.000000	Standard D	eviation (P) =	0.00371	0.746	0.746	- 2		
4	0,746	-0.004741	0.000022	Standard D	eviation (5) =	0.00378	0.747	0.747	2		
5	0.745	-0.005741	0.000033		Range =	0.0150	0.748	0.748	3		
6	0.750	-0.000741	0.000001				0.749	0.749	3		
7	0.751	0.000259	0.000000		Min =	0.7450	0.750	0.750	4		
8	0.760	0.009259	0.000086			0.00002255	0.751	0.751	3		
9	0.756	0.005259	0.000028		Median =	0.7500	0.752	0.752	2		
10	0.749	-0.001741	0.000003				0.753	0.753	2		
11	0.749	-0.001741	0.000003		Max =	0.7600	0.754	0.754	0		
12	0.748	-0.002741	0.000008		11000311	240350702	0,755	0,755	20		
13	0.752	0.001259	0.000002				0.756	0.756	1		
14	0.750	-0.000741	0.000001		mean + SD	0.7545	0.757	0.757	0		
15	0,750	-0.000741	0.000001		mean - SD	0.7470	0.758	0.758	0		
16	0,759	0.008259	0.000068		mean + 250	0.7583	0,759	0,759	8 1		
17	0.755	0.004259	0.000018		mean - 250	0.7432	0.760	0.760	1		
18	0.748	-0.002741	0.000008					More	0		
19	0.747	-0.003741	0.000014					10	i p		
20	0.750	-0.000741	0.000001		-	2223 62	15 6882 IV	6217		Descriptive Stat	listics
21	0.748	-0.002741	800000.0			Wooder	Cube Side Le	ngths			
22	0.752	0.001259	0.000002							Mean	0.75074
23	0.755	0.004259	0.000018		5					Standard Error	0.00073
24	0.751	0.000259	0.000000		192					Median	0.75
25	0.746	0.004741	0.000022		1165					Mode	0.75
26	0.749	-0.001741	0.000003		ž I					Standard Deviation	0.00378
27	0,753	0.002259	0.000005		20		and the second			Sample Variance	1.4E-05
SUM =	20.270		0.000371		£	1.1		í		Kurtosis	0.4648
10.12001					1			-		Skewness	0.84566
										Range	0.015
	Standard	Deviation =	0.003708 [table	e]					0	Minimum	0.745
			and a second second	1928	72 120	30 30 30 30 A	5.8855	9 8 8 8	30 Sec.	Maximum	0,76
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							Rendering the Part of the			a second and a second sec	CONTRACTOR 1.

#### 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?