## ANOVA tests with the Analysis ToolPak

## Excel 2013, PC

As with any statistical analysis in Excel, the first step is to enter your data into the spreadsheet in a logical fashion. For this guide, the data is separated by treatment, and each treatment is entered into a different column.

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	Α	В	С	D	E
1			Treat	ment	
2		A	В	С	D
3		6.5	8.9	11.5	7.6
4		7.8	9.6	7.3	14.5
5	Data	5.3	6.7	10.7	13.7
6	Data	5.7	8.5	9.2	13.8
7		6.7	7.3	10.3	10.2
8		7.1	7.4	9.9	12.6
9					

It would be just as correct to lay out your data as seen below, too, by row as long as each treatment's data is collected together in a single series of cells.

G	Н	Ι	J	K	L	м	N
				Data			
	Α	6.5	7.8	5.3	5.7	6.7	7.1
ont	В	8.9	9.6	6.7	8.5	7.3	7.4
atme	С	11.5	7.3	10.7	9.2	10.3	9.9
1 te	D	7.6	14.5	13.7	13.8	10.2	12.6

To perform an ANOVA test (which stands for ANalysis Of VAriance), you need to click on the "Data" ribbon. Then select the option all the way to the right that says "Data Analysis." If the Data Analysis button does not appear on your ribbon, you need to activate the Analysis ToolPak in Excel's Options menu. To make sure the Analysis ToolPak add-in is activated, click FILE.

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	A	L		•	2	× 🗸	f <sub>x</sub>			
		Α		В		С	D		E	
	1			Samp	le 1	Sample 2			T test	
	2				5	15	5			
	3				8	17	7			
	4				9	19	)			Τ
	5				7	17	7			Ť
	6				6	18	3			Ť
	7				5	13	3			t
							-			-

At the bottom of the File menu, select Options.



When the Excel Options box pops up, click Add-Ins on the left side menu.

Excel Options		? <mark>X</mark>
General Formulas	General options for working with Excel.	
Proofing	User Interface options	
Save Language Advanced Customize Ribbon Quick Access Toolbar Add-Ins Trust Center	<ul> <li>Show Mini Toolbar on selection </li> <li>Show Quick Analysis options on selection</li> <li>Enable Live Preview </li> <li>Screen Tip style: Show feature descriptions in Screen Tips </li> <li>When creating new workbooks</li> <li>Use this as the default font: Body Font </li> <li>Font size: 11 </li> <li>Default yiew for new sheets: Normal View </li> </ul>	
	Personalize your copy of Microsoft Office User name: Always use these values regardless of sign in to Office. Office Ineme: White Start up options	
	Choose the extensions you want Excel to open by default: <u>I</u> ell me if Microsoft Excel isn't the default progam for viewing and editing spreadsheets. <u>Sh</u> ow the Start screen when this application starts	
	ОК	Cancel

Within the Add-Ins section of the Excel Options menu, click Go at the bottom next to where it says "Manage Excel Add-ins"



In the next menu that pops up, make sure that the box next to Analysis ToolPak is checked, then click OK



Activating the add-in means that now when you go to the Data ribbon, you'll see an option "Data Analysis" available on the right hand side.

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Prope R	ections erties inks	2↓ Z Z↓ S	ort	Filter	Clear Reapply Advanced	Text to Columns	Flash Fill	Remove Duplicates	Data Validation	Consolidat	e What-It Analysis	f Relationships	Group	Ungrou	p Subtota	*3 -3	L Dat	a Analysis
Connection	15		Sor	rt & Filter					Data	Tools				Outlin	e	5	Ar	nalysis
E	F		G	н	I	J		K	L	М	N	0 P		Q	Data Ar Tools fo analysis	n <b>alysis</b> or finar	<b>Tools</b> ncial and	l scientific da
D 7.6															FUI Tell	NCRES mem	ore	

When the Data Analysis menu pops up, you need to choose which test you would like to use on the data. Since these treatments are only testing a single variable's effect on the subjects, select the first option, "Anova: Single Factor," and click OK.

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

This will prompt another menu to appear where you select which cells in the spreadsheet make up your dataset and enter other test parameters.

Anova: Single Factor		? ×
Input Input Range: Grouped By: Labels in First Row Alpha: 0.05	<ul> <li> <u>C</u>olumns</li></ul>	Cancel Help
Output options           Output options           Output Range:           New Worksheet Ply:           New Workbook	1	

First, after placing your cursor in the empty box next to "Input Range:" highlight all of the data for all of the treatments.

	Α	В	С	D	E
1			Treatn	nent	
2		Α	В	С	D
3		6.5	8.9	11.5	7.6
4		7.8	9.6	7.3	14.5
5	Data	5.3	6.7	10.7	13.7
6	Data	5.7	8.5	9.2	13.8
7		6.7	7.3	10.3	10.2
8		7.1	7.4	9.9	12.6
9					
10					
11					
12					
13					
14					

If your data is arranged in columns the way this guide is organized, leave the "Columns" option checked for the "Grouped By:" selection. If you arranged your data by rows (as shown in the second figure of this guide), check "Rows" instead.

In this guide the labels for each treatment (A,B,C, and D) were highlighted along with the numbers when selecting the Input Range. Since this is the case, "Labels in First Row" needs to be selected because the first row is not actually data. It is usually easier to select only the numbers and leave this box unchecked, but if you are interested in the summary statistics of each group, this method will label each group's results for you when the ANOVA results appear.

Α	В	С	D	E	Anova: Single Factor	
		Treatn	nent		Innut	
	Α	В	С	D	Input Range:	\$B\$2:\$E\$8
	6.5	8.9	11.5	7.6		
	7.8	9.6	7.3	14.5	Grouped By:	Olumns
Data	5.3	6.7	10.7	13.7	Citabala in Sint David	<u> </u>
Data	5.7	8.5	9.2	13.8	Labels in First Row	
	6.7	7.3	ONLY	' IF the la	bels were selected for	r Input Range
	7.1	7.4				mpartiange
					Output Demon	
					Output Range:	
					New Worksheet Ply:	
					New Workbook	

"Alpha:" can be left at the default of 0.05 (so we only judge p-values *lower than 0.05* significant), and "Output options:" can be changed as desired. The default option places your results in a new sheet, and in this example a cell next to the data is chosen as the place the results will appear.

G1		r ± ×	√ _ f:	e l						
	Α	В	С	D	Е	F	G	н	Anova: Single Factor	? × 0
1			Treatr	nent					Input	
2		Α	В	С	D				Input Range: SB\$2:SES8	
3		6.5	8.9	11.5	7.6				Grouped By:   O Columns	Cancel
4		7.8	9.6	7.3	14.5				© <u>R</u> ows	Help
5	Data	5.3	6.7	10.7	13.7				Labels in first row	
6	Data	5.7	8.5	9.2	13.8				Alpha: 0.05	
7		6.7	7.3	10.3	10.2			_		
8		7.1	7.4	9.9	12.6				Output options	
9									🖲 Output Range: \$G\$1 🔣	
10									New Worksheet Ply:	
11									New Workbook	
12								_		
13										
14										

When you click OK, your ANOVA results appear wherever you specified!

G1		• ± ×	√ f;	* Anov	a: Single F	actor							
	А	В	С	D	Е	F	G	Н	I	J	K	L	М
1			Treatr	nent			Anova: Single Factor						
2		Α	В	С	D								
3		6.5	8.9	11.5	7.6		SUMMARY						
4		7.8	9.6	7.3	14.5		Groups	Count	Sum	Average	Variance		
5	Data	5.3	6.7	10.7	13.7		A	6	39.1	6.516667	0.833667		
6	Data	5.7	8.5	9.2	13.8		В	6	48.4	8.066667	1.226667		
7		6.7	7.3	10.3	10.2		с	6	58.9	9.816667	2.113667		
8		7.1	7.4	9.9	12.6		D	6	72.4	12.06667	7.062667		
9													
LO													
1							ANOVA						
12							Source of Variation	SS	df	MS	F	P-value	F crit
L3							Between Groups	102.33	3	34.11	12.14239	9.53E-05	3.098391
L4							Within Groups	56.18333	20	2.809167			
L5													
L6							Total	158.5133	23				
١7													

Because the labels were highlighted in the Input Range, the labels appear under "Groups" in the ANOVA summary. If you do not select labels, they will simply be called 1, 2, 3, 4, etc. The most important numbers to take away from these results are the **F** statistic and the **P-value**. These values tell you whether there is a significant difference between any of the treatment groups, but not which group is different.

Anova: Single Factor						
SUMMARY						
Groups	Count	Sum	Average	Variance		
Α	6	39.1	6.516667	0.833667		
В	6	48.4	8.066667	1.226667		
С	6	58.9	9.816667	2.113667		
D	6	72.4	12.06667	7.062667		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	102.33	3	34.11	12.14239	9.53E-05	3.09839
Within Groups	56.18333	20	2.809167			烜

Go forth and test your data! And email me if you have any lingering questions!