

# “What are the steps to interpret ANOVA results in Excel?”

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## RECOMMENDED CITATION

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ANOVA (Analysis of Variance) is a statistical analysis tool used to compare the means of three or more groups. Excel offers a straightforward and efficient way to perform ANOVA analysis. The following are the necessary steps to interpret ANOVA results in Excel:

1. Organize the data into columns and rows in an Excel spreadsheet, with each column representing a different group or treatment.
2. Calculate the mean for each group using the AVERAGE function.
3. Calculate the overall mean by taking the average of all the means calculated in step 2.
4. Calculate the sum of squares (SS) for each group using the SUMSQ function.
5. Calculate the total sum of squares (SST) by summing up all the SS values.
6. Calculate the between-group sum of squares (SSG) by subtracting SST from the sum of squares for each group.
7. Calculate the degrees of freedom for each group and the total using the COUNT function.
8. Calculate the mean square (MS) for each group by dividing the SS values by their respective degrees of freedom.
9. Calculate the F-value by dividing the MS for between-groups by the MS for within-groups (calculated by subtracting the MS of each group from the overall MS).
10. Use a significance level (typically 0.05) to determine if the F-value is significant. If it is, then there is a significant difference between the means of the groups.
11. Finally, interpret the results by looking at the F-value and p-value. A low p-value indicates a significant result, and the F-value indicates the strength of the relationship between the groups.

In conclusion, interpreting ANOVA results in Excel involves organizing the data, calculating the necessary values, and determining the significance of the results to draw conclusions about the differences between the means of the groups.

## Complete Guide: Interpret ANOVA Results in Excel

**An is used to determine whether or not there is a statistically significant difference between the means of**

**three or more independent groups.**

**The following example provides a complete guide on how to interpret the results of a one-way ANOVA in Excel.**

**Example: How to Interpret ANOVA Results in Excel**

**Suppose a teacher 30 students in her class to use one of three studying methods to prepare for an exam.**

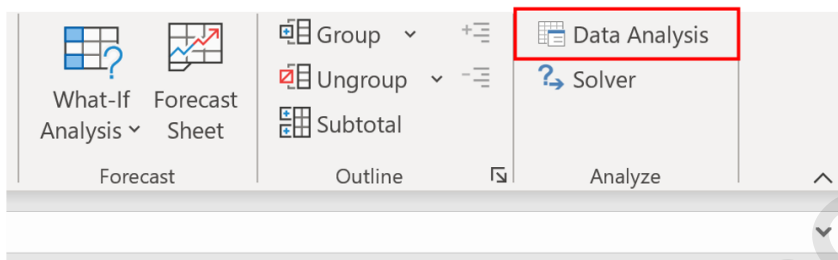
**The following screenshot shows the scores of the students based on the method they used:**

	A	B	C	D	E	F
1	<b>Method 1</b>	<b>Method 2</b>	<b>Method 3</b>			
2	75	78	82			
3	77	78	82			
4	78	79	84			
5	78	81	86			
6	79	81	86			
7	81	82	87			
8	81	83	87			
9	83	85	89			
10	86	86	90			
11	87	88	94			
12						
13						
14						
15						

**Suppose the teacher wants to perform a one-way ANOVA to determine if the mean scores are the same**

**across all three groups.**

**To perform a one-way ANOVA in Excel, click the Data tab along the top ribbon, then click Data Analysis within the Analyze group.**



**If you don't see the Data Analysis option, then you need to first load the free Analysis ToolPak.**

**Once you click this, a new window will appear. Select Anova: Single Factor, then click OK.**

**In the new window that appears, enter the following information:**

	A	B	C	D	E	F	G	H
1	<b>Method 1</b>	<b>Method 2</b>	<b>Method 3</b>					
2	75	78	82					
3	77	78	82					
4	78	79	84					
5	78	81	86					
6	79	81	86					
7	81	82	87					
8	81	83	87					
9	83	85	89					
10	86	86	90					
11	87	88	94					

Anova: Single Factor

Input  
 Input Range:

Grouped By:  
 Columns  
 Rows

Labels in first row  
 Alpha:

Output options  
 Output Range:    
 New Worksheet Ply:  
 New Workbook

**Once you click OK, the results of the one-way ANOVA will appear:**

E	F	G	H	I	J	K
Anova: Single Factor						
SUMMARY						
Groups	Count	Sum	Average	Variance		
Method 1	10	805	80.5	15.16667		
Method 2	10	821	82.1	11.65556		
Method 3	10	867	86.7	13.56667		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	207.2	2	103.6	7.695186	0.002266	3.354131
Within Groups	363.5	27	13.46296			
Total	570.7	29				

There are two tables that are shown in the output: **SUMMARY** and **ANOVA**.

Here's how to interpret the values in each table:

- Groups:** The names of the groups
- Count:** The number of in each group
- Sum:** The sum of the values in each group
- Average:** The average value in each group
- Variance:** The variance of the values in each group

This table provides us with several useful summary statistics for each group used in the ANOVA.

From this table we can see that the students who used Method 3 had the highest average exam score (86.7) but they also had the highest in exam scores (13.56667).

To determine if the differences in the group means are statistically significant we must refer to the ANOVA table.

### ANOVA Table:

**Source of Variation:** The variation being measured (either between groups or within groups)  
**SS:** The sum of squares for each source of variation  
**df:** The degrees of freedom, calculated as #groups-1 for df Between and #observations - #groups for df Within  
**MS:** The mean sum of squares, calculated as SS / df  
**F:** The overall F-value, calculated as MS Between / MS Within  
**P-value:** The p-value corresponding to the overall F-value  
**F crit:** The F critical value that corresponds to  $\alpha = .05$

The most important value in this table is the , which turns out to be 0.002266.

Recall that a one-way ANOVA uses the following null and alternative hypotheses:

**H0: All group means are equal. HA: All group means are not equal.**

**Since the p-value is less than  $\alpha = .05$ , we reject the null hypothesis of the one-way ANOVA and conclude that we have sufficient evidence to say that not all of the group means are equal.**

**This means that the three studying methods do not all lead to the same average exam scores.**

**Note: You could also compare the overall F value to the F critical value to determine whether you should reject or fail to reject the null hypothesis. In this case, since the overall F value is greater than the F critical value we would reject the null hypothesis. Note that the p-value approach and the F critical value approach will always lead to the same conclusion.**

#### **Additional Resources**

**The following tutorials explain how to perform different ANOVA's in Excel:**