

How do you perform a Bonferroni Correction in Excel?

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PSYCHOLOGICAL SCALES. Retrieved from <https://scales.arabpsychology.com/?p=106515>

A **Bonferroni Correction** refers to the process of adjusting the alpha (α) level for a family of statistical tests so that we control for the probability of committing a type I error.

The formula for a Bonferroni Correction is as follows:

$$\alpha_{\text{new}} = \alpha_{\text{original}} / n$$

where:

α_{original} : The original α level

n: The total number of comparisons or tests being performed

For example, if we perform three statistical tests at once and wish to use $\alpha = .05$ for each test, the Bonferroni Correction tell us that we should use $\alpha_{\text{new}} = .01667$.

$$\alpha_{\text{new}} = \alpha_{\text{original}} / n = .05 / 3 = .01667$$

Thus, we should only reject the null hypothesis of each individual test if the p-value of the test is less than .01667.

This type of correction is often made in following an ANOVA when we want to compare several group means at once.

The following step-by-step example shows how to perform a Bonferroni Correction following a one-way ANOVA in Excel.

Step 1: Create the Data

First, let's create a fake dataset that shows the exam scores of students who used one of three different studying techniques to prepare for the exam:

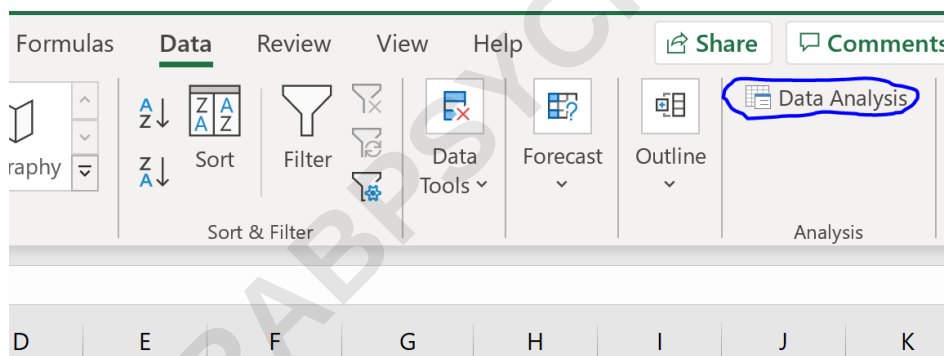
	A	B	C	D	E	F
1	Technique 1	Technique 2	Technique 3			
2	72	75	84			
3	72	83	84			
4	73	83	86			
5	75	83	86			
6	77	84	87			
7	80	86	89			
8	83	88	92			
9	85	89	94			
10	88	92	95			
11	89	93	97			
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Step 2: Perform the One-Way ANOVA

Next, let's perform a one-way ANOVA to determine if the mean exam scores are equal across all three groups.

First, highlight all of the data including the column headers:

	A	B	C	D	E
1	Technique 1	Technique 2	Technique 3		
2	72	75	84		
3	72	83	84		
4	73	83	86		
5	75	83	86		
6	77	84	87		
7	80	86	89		
8	83	88	92		
9	85	89	94		
10	88	92	95		
11	89	93	97		
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					



If you don't see this option available, you need to first .

In the window that appears, click **Anova: Single Factor** and then click **OK**.

Fill in the following information, then click **OK**:

	A	B	C	D	E	F	G	H	I
1	Technique 1	Technique 2	Technique 3						
2	72	75	84						
3	72	83	84						
4	73	83	86						
5	75	83	86						
6	77	84	87						
7	80	86	89						
8	83	88	92						
9	85	89	94						
10	88	92	95						
11	89	93	97						
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									

Anova: Single Factor

Input
Input Range: 

Grouped By: ☒ Columns ☐ Rows

☒ Labels in first row
Alpha:

Output options
☒ Output Range: 
☐ New Worksheet Ply:
☐ New Workbook

OK Cancel Help

The results of the one-way ANOVA will automatically appear:

Variation	SS	df	MS	F	P-value	F crit
Groups	509.6	2	254.8	8.197807	0.001652	3.354131
Residuals	839.2	27	31.08148			
Total	1348.8	29				

A one-way ANOVA has the following null and alternative hypotheses:

Null hypothesis): All group means are equal.

Alternative hypothesis): At least one group mean is different from the rest.

The *p*-value in the ANOVA table (0.001652) is less than .05, we have sufficient evidence to reject the null hypothesis. In other words, the mean exam scores between the three groups are different.

Now we can perform multiple comparisons using a Bonferroni correction between the groups to see exactly which group means are different.

H0 (null hypothesis): All group means are equal.

HA (alternative hypothesis): At least one group mean is different from the rest.

Next, we can perform multiple comparisons using a Bonferroni correction between the three groups to see exactly which group means are different.

Using a Bonferroni correction, we can calculate the adjusted alpha level as follows:

In our example, we'll be performing the following three comparisons:

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Technique 1 vs. Technique 3

Technique 2 vs. Technique 3

Since we want to use $\alpha = .05$ for each test, the Bonferroni Correction tell us that we should use $\alpha_{\text{new}} = .0167$.

E	F	G	H	I	J	K
Anova: Single Factor						
SUMMARY						
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
Technique 1	10	794	79.4	42.93333		
Technique 2	10	856	85.6	27.6		
Technique 3	10	894	89.4	22.71111		
ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	509.6	2	254.8	8.197807	0.001652	3.354131
Within Groups	839.2	27	31.08148			
Total	1348.8	29				
Bonferroni-Adjusted Alpha						
0.0167	=0.05/3					

Next, we'll use a t-test to compare the means between each group. In Excel, we can use the following syntax:

=TTEST(Array1, Array2, tails=2, type=2)

where:

Array1: The first array of data

Array2: The second array of data

tails: The number of tails of the test. We'll use "2" to indicate a two-tailed test.

type: The type of t-test to perform. We'll use "2" to indicate a t-test with equal variances.

The following screenshot shows how to perform each t-test:

	A	B	C	D	E	F	G	H	I
1	Technique 1	Technique 2	Technique 3		Anova: Single Factor				
2	72	75	84						
3	72	83	84		SUMMARY				
4	73	83	86		<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Varian</i>
5	75	83	86		Technique 1	10	794	79.4	42.933
6	77	84	87		Technique 2	10	856	85.6	2
7	80	86	89		Technique 3	10	894	89.4	22.711
8	83	88	92						
9	85	89	94						
10	88	92	95		ANOVA				
11	89	93	97		<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>
12					Between Groups	509.6	2	254.8	8.1978
13					Within Groups	839.2	27	31.08148	
14									
15					Total	1348.8	29		
16									
17					Bonferroni-Adjusted Alpha				
18					0.0167				
19									
20					Comparison	P-value			
21					Technique 1 vs. 2	0.031354	=TTEST(A2:A11, B2:B11, 2, 2)		
22					Technique 1 vs. 3	0.001042	=TTEST(A2:A11, C2:C11, 2, 2)		
23					Technique 2 vs. 3	0.107469	=TTEST(B2:B11, C2:C11, 2, 2)		
24									
25									
26									
27									

The only p-value that is less than the Bonferroni-adjusted alpha level is from the comparison between technique 1 vs. technique 2, which had a p-value of **0.001042**.

Thus, we would conclude that only statistically significant difference in mean exam scores was between technique 1 and technique 2.