How do I perform a Tukey-Kramer post hoc test in Excel?

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The Tukey-Kramer post hoc test is a statistical analysis tool used to compare multiple groups and determine the significant differences between them. This test is commonly used in research studies and experiments to identify specific group differences, after an overall statistical test has shown a significant result. To perform a Tukey-Kramer post hoc test in Excel, first arrange the data in a table format, then use the "Data Analysis" tool to run the test. This will generate a table of results, including the group means, differences, and significance levels. The results can then be interpreted to determine the significant differences between the groups. This test is a useful tool for researchers and analysts looking to gain a deeper understanding of their data and identify important group differences.

Perform a Tukey-Kramer Post Hoc Test in Excel

A is used to determine whether or not there is a statistically significant difference between the means of three or more independent groups.

The used in an ANOVA are as follows:

The null hypothesis (H0): μ1 = μ2 = μ3 = … = μk (the means are equal for each group)

The alternative hypothesis: (Ha): at least one of the means is different from the others

If the from the ANOVA is less than the significance level, we can reject the null hypothesis and conclude that we have sufficient evidence to say that at least one of the means of the groups is different from the others.

However, this doesn't tell us *which* groups are different from each other. It simply tells us that not all of the group means are equal. In order to find out exactly which groups are different from each other, we must conduct a post hoc test.

The most commonly used post hoc test is the Tukey-Kramer test, which compares the mean between each pairwise combination of groups.

The following example shows how to perform the Tukey-Kramer test in Excel.

Example: Tukey-Kramer Test in Excel

Suppose we perform a one-way ANOVA on three groups: A, B, and C. The results of the one-way ANOVA are shown below:

A	B	C
10	15	19
13	17	20
14	20	22
16	22	24
16	25	24
17	26	26
19	27	27
20	27	28
22	30	29
22	31	29

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
A	10	169	16.9	15.43333
B	10	240	24	28.66667
C	10	248	24.8	13.06667

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	378.2	2	189.1	9.923615	0.000588	3.354131
Within Groups	514.5	27	19.05556			
Total	892.7	29				

The p-value from the ANOVA table is 0.000588. Since this p-value is less than .05, we can reject the null hypothesis and conclude that the means between the three groups are *not* equal.

To determine exactly *which* group means are different, we can perform a Tukey-Kramer post hoc test using the following steps:

Step 1: Find the absolute mean difference between each group.

First, we'll find the absolute mean difference between

each group using the averages listed in the first table of the ANOVA output:

E	F	G	H	I	J	K
Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
A	10	169	16.9	15.43333		
B	10	240	24	28.66667		
C	10	248	24.8	13.06667		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	378.2	2	189.1	9.923615	0.000588	3.354131
Within Groups	514.5	27	19.05556			
Total	892.7	29				
Comparison	**Abs. Mean Diff**					
A vs. B	7.1	=ABS(H5-H6)				
B vs. C	0.8					
A vs. C	7.9					

Next, we need to find the Q critical value using the following formula:

Q critical value = Q*√(s2pooled / n.)

where:

Q = Value from Studentized Range Q Tables2pooled = Pooled variance across all groupsn. = Sample size for a given group

To find the Q value, you can refer to the Studentized Range Q Table which looks like this:

df	k= Number of Treatments			
0	2	3	4	5
5	3.64	4.6	5.22	5.67
6	3.46	4.34	4.90	5.30
7	3.34	4.16	4.68	5.06
8	3.26	4.04	4.53	4.89
9	3.2	3.95	4.41	4.76
10	3.15	3.88	4.33	4.65
11	3.11	3.82	4.26	4.57
12	3.08	3.77	4.20	4.51
13	3.06	3.73	4.15	4.45
14	3.03	3.70	4.11	4.41
15	3.01	3.67	4.08	4.37
16	3	3.65	4.05	4.33
17	2.98	3.63	4.02	4.30
18	2.97	3.61	4.00	4.28
19	2.96	3.59	3.98	4.25
20	2.95	3.58	3.96	4.23
24	2.92	3.53	3.90	4.17
30	2.89	3.49	3.85	4.10

In our example, k = the number of groups, which is k = 3. The degrees of freedom is calculated as n-k = 30 - 3 = 27. Since 27 is not shown in the table above, we can use a conservative estimate of 24. Based on k = 3 and df = 24, we find that Q = 3.53.

The pooled variance can be calculated as the average of the variances for the groups, which turns out to be 19.056.

E	F	G	H	I	J	K	L
Anova: Single Factor							
SUMMARY							
Groups	*Count*	*Sum*	*Average*	*Variance*			
A	10	169	16.9	15.43333	19.056	=AVERAGE(I5:I7)	
B	10	240	24	28.66667			
C	10	248	24.8	13.06667			
ANOVA							
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*	
Between Groups	378.2	2	189.1	9.923615	0.000588	3.354131	
Within Groups	514.5	27	19.05556				
Total	892.7	29					
Comparison	**Abs. Mean Diff**	**Q Critical Value**	**Significant?**				
A vs. B	7.1						
B vs. C	0.8						
A vs. C	7.9						

Lastly, the sample size of each group is 10.

Thus, our Q critical value can be calculated as:

Q critical value = Q*√(s2pooled / n.) = 3.53*√(19.056/10) = 4.87.

E	F	G	H	I	J	K
Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
A	10	169	16.9	15.43333		
B	10	240	24	28.66667		
C	10	248	24.8	13.06667		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	378.2	2	189.1	9.923615	0.000588	3.354131
Within Groups	514.5	27	19.05556			
Total	892.7	29				
Comparison	**Abs. Mean Diff**	**Q Critical Value**	**Significant?**			
A vs. B	7.1	4.87				
B vs. C	0.8	4.87				
A vs. C	7.9	4.87				

Step 3: Determine which group means are different.

Lastly, we can compare the absolute mean difference between each group to the Q critical value. If the absolute mean difference is larger than the Q critical value, then the difference between the group means is statistically significant:

E	F	G	H	I	J	K
Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
A	10	169	16.9	15.43333		
B	10	240	24	28.66667		
C	10	248	24.8	13.06667		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	378.2	2	189.1	9.923615	0.000588	3.354131
Within Groups	514.5	27	19.05556			
Total	892.7	29				
Comparison	**Abs. Mean Diff**	**Q Critical Value**	**Significant?**			
A vs. B	7.1	4.87	Yes	=IF(F18>G18, "Yes", "No")		
B vs. C	0.8	4.87	No			
A vs. C	7.9	4.87	Yes			

Based on the Tukey-Kramer post hoc test, we found the following:

The difference in means between group A and group B is statistically significant.The difference in means between group B and group C is *not* statistically significant.The difference in means between group A and group C is statistically significant.