

# How can Scheffe's test be performed in SAS?

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## RECOMMENDED CITATION

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Scheffe's test is a statistical method used to compare multiple groups and determine if there are significant differences between them. In SAS, this test can be performed by using the PROC GLM procedure, which allows for the analysis of variance (ANOVA) and post-hoc tests.

To perform Scheffe's test in SAS, the first step is to input the data into the software and specify the variables to be analyzed. Next, the PROC GLM statement is used to run the ANOVA and obtain the overall F-test for the groups. If the F-test is significant, indicating that there are differences between the groups, the Scheffe option can be added to the PROC GLM statement to perform the post-hoc test.

The results of Scheffe's test in SAS will include the group means, confidence intervals, and the significance level for each comparison. This information can help determine which specific groups are significantly different from each other. Additionally, graphical representations, such as box plots or means plots, can be created to visually display the results.

In summary, Scheffe's test can be easily performed in SAS by using the PROC GLM procedure and specifying the Scheffe option to conduct post-hoc analyses. This allows for a comprehensive and reliable way to compare multiple groups and identify significant differences.

## Perform Scheffe's Test in SAS

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

**If the overall p-value from the ANOVA table is less than some significance level, then 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.**

**One of the most commonly used post hoc tests is Scheffe's test, which allows us to make pairwise comparisons between the means of each group while controlling for the family-wise error rate.**

**The following example shows how to perform Scheffe's test in R.**

**Example: Scheffe's Test in SAS**

**Suppose a researcher recruits 30 students to participate in a study. The students are to use one of three studying methods to prepare for an exam.**

**We can use the following code to create this dataset in SAS:**

```
/*create dataset*/  
data my_data;  
input Method $ Score;  
datalines;
```

**A 76**

**A 77**

**A 77**

**A 81**

**A 82**

**A 82**

**A 83**

**A 84**

**A 85**

**A 89**

**B 81**

**B 82**

**B 83**

**B 83**

**B 83**

**B 84**

**B 87**

**B 90**

**B 92**

**B 93**

**C 77**

**C 78**

**C 79**

**C 88**

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```
C 89
```

```
C 90
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C 91
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C 95
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C 98
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C 98
```

```
;
```

```
run;
```

Next, we'll use `proc ANOVA` to perform the one-way ANOVA:

```
/*perform one-way ANOVA with Scheffe's post-hoc test*/
```

```
proc ANOVA data=my_data;class Method;model Score = Method;means Method /scheffe cldiff;
```

```
run;
```

**Note:** We used the `means` statement along with the `scheffe` and `cldiff` options to specify that Scheffe's post-hoc test should be performed (with confidence intervals) if the overall p-value of the one-way ANOVA is statistically significant.

## First, we'll analyze the ANOVA table in the output:

**The ANOVA Procedure**

**Dependent Variable: Score**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	229.266667	114.633333	3.49	0.0448
Error	27	886.100000	32.818519		
Corrected Total	29	1115.366667			

  

R-Square	Coeff Var	Root MSE	Score Mean
0.205553	6.721249	5.728745	85.23333

  

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Method	2	229.2666667	114.6333333	3.49	0.0448

From this table we can see:

The overall F Value: 3.49  
 The corresponding p-value: 0.0448  
 H<sub>0</sub>: All group means are equal.  
 H<sub>A</sub>: At least one group mean is different from the rest.

Since the p-value from the ANOVA table (0.0448) is less than  $\alpha = .05$ , we reject the null hypothesis.

This tells us that the mean exam score is not equal between the three studying methods.

To determine exactly which group means are different, we must refer to the final table in the output that shows the results of Scheffe's post-hoc tests:

**The ANOVA Procedure**

**Scheffe's Test for Score**

**Note:** This test controls the Type I experimentwise error rate, but it generally has a higher Type II error rate than Tukey's for all pairwise comparisons.

Alpha	0.05
Error Degrees of Freedom	27
Error Mean Square	32.81852
Critical Value of F	3.35413
Minimum Significant Difference	6.6356

  

Comparisons significant at the 0.05 level are indicated by ***.			
Method Comparison	Difference Between Means	Simultaneous 95% Confidence Limits	
C - B	2.500	-4.136	9.136
C - A	6.700	0.064	13.336 ***
B - C	-2.500	-9.136	4.136
B - A	4.200	-2.436	10.836
A - C	-6.700	-13.336	-0.064 ***
A - B	-4.200	-10.836	2.436

To tell which group means are different, we must look at which pairwise comparisons have stars (\*\*\*) next to them.

From the table we can see there is a statistically significant difference in mean exam scores between group A and group C.

There are no statistically significant differences

**between any other group means.**

**Specifically, we can see that the mean difference in exam scores between group C and group A is 6.7.**

**The 95% confidence interval for the difference in means between these groups is .**

**The following tutorials provide additional information about ANOVA models:**

**[A Guide to Using Post Hoc Tests with ANOVA](#)**