

How do you perform a One-Way ANOVA in SAS?

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One-Way ANOVA (Analysis of Variance) is a statistical method used to analyze the differences between the means of three or more groups. SAS (Statistical Analysis System) is a software that allows for efficient analysis of data. To perform a One-Way ANOVA in SAS, first the data should be organized and imported into the software. Then, the ANOVA procedure should be called and the necessary variables should be specified. The output will provide information on the significance of the differences between the groups. Additionally, post-hoc tests can be performed to determine which specific groups differ significantly from each other. Overall, SAS offers a straightforward and comprehensive approach to conducting One-Way ANOVA analysis.

Perform a One-Way ANOVA 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.

This tutorial provides a step-by-step example of how to perform a one-way ANOVA in SAS.

Step 1: Create the Data

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.

The exam results for each student are shown below:

Method A	Method B	Method C
78	81	84
81	83	88
82	83	88
82	85	89
85	86	90
88	88	93
88	90	95
90	91	98

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

```
/*create dataset*/  
data my_data;  
input Method $ Score;  
datalines;  
A 78  
A 81  
A 82  
A 82  
A 85  
A 88  
A 88  
A 90  
B 81
```

B 83

B 83

B 85

B 86

B 88

B 90

B 91

C 84

C 88

C 88

C 89

C 90

C 93

C 95

C 98

;

run;

Step 2: Perform the One-Way ANOVA

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

```
/*perform one-way ANOVA*/
```

```
proc ANOVAdata=my_data;
```

```

class Method;
model Score = Method;
means Method / tukeycliff;
run;

```

Note: We used the means function to specify that a should be performed if the overall p-value of the one-way ANOVA is statistically significant.

Step 3: Interpret the Results

The first table we want to analyze in the results is the ANOVA table:

The ANOVA Procedure
Dependent Variable: Score

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	175.5833333	87.7916667	5.26	0.0140
Error	21	350.2500000	16.6785714		
Corrected Total	23	525.8333333			

R-Square	Coeff Var	Root MSE	Score Mean
0.333914	4.698685	4.083941	86.91667

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Method	2	175.5833333	87.7916667	5.26	0.0140

From this table we can see:

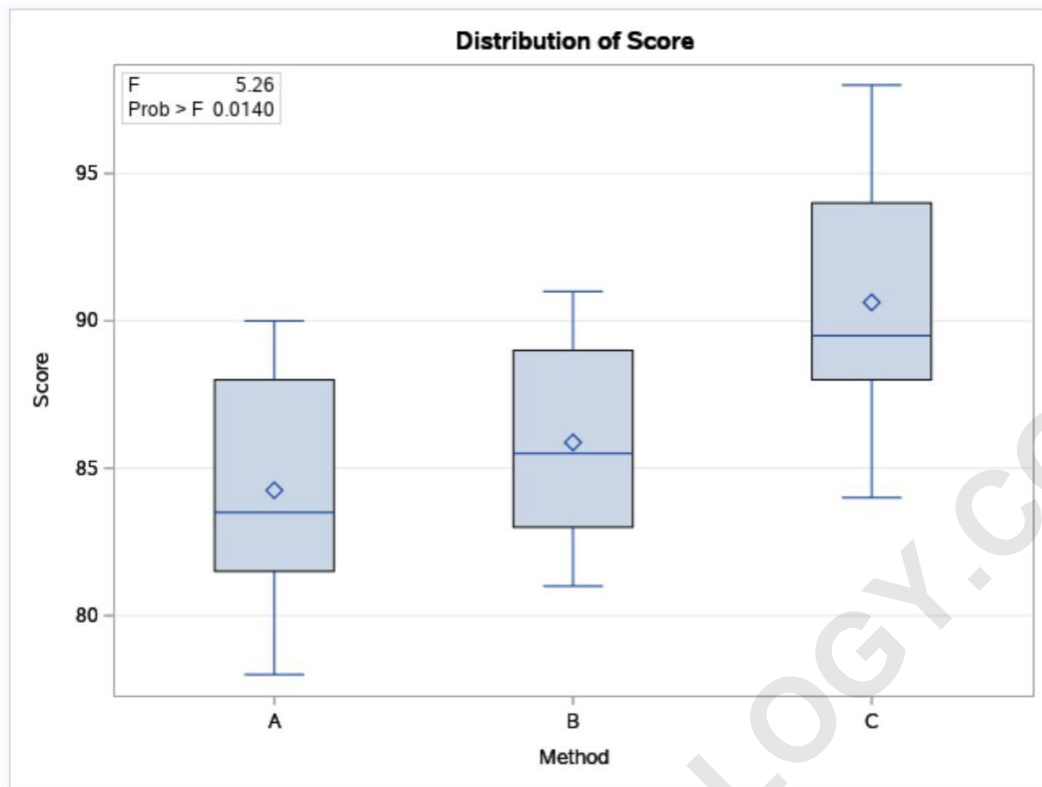
The overall F Value: 5.26
The corresponding p-value: 0.0140
H₀: All group means are equal.
H_A: At least one group mean is different from the rest.

Since the p-value from the ANOVA table (0.0140) 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.

Related:

SAS also provides to visualize the distribution of exam scores for each of the three studying methods:



From the boxplots we can see that the exam scores tend to be higher among students who used studying method C compared to methods B and A.

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

The ANOVA Procedure

Tukey's Studentized Range (HSD) Test for Score

Note: This test controls the Type I experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	21
Error Mean Square	16.67857
Critical Value of Studentized Range	3.56462
Minimum Significant Difference	5.1469

Comparisons significant at the 0.05 level are indicated by ***.

Method Comparison	Difference Between Means	Simultaneous 95% Confidence Limits		
C - B	4.750	-0.397	9.897	
C - A	6.375	1.228	11.522	***
B - C	-4.750	-9.897	0.397	
B - A	1.625	-3.522	6.772	
A - C	-6.375	-11.522	-1.228	***
A - B	-1.625	-6.772	3.522	

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 that the mean values for groups A and C are statistically significantly different.

We can also see the 95% confidence interval for the difference in mean exam scores between group A and C:

95% Confidence Interval for Difference in Means:

Step 4: Report the Results

Lastly, we can of the one-way ANOVA:

A one-way ANOVA was performed to compare the effect of three different studying methods on exam scores.

A one-way ANOVA revealed that there was a statistically significant difference in mean exam score between at least two groups ($F(2, 21) = , p = 0.014$).

Tukey's HSD Test for multiple comparisons found that the mean value of exam score was significantly different between method C and method A (95% C.I. =).

There was no statistically significant difference in mean exam scores between method A and method B or between method B and method C.

Additional Resources

The following tutorials provide additional information about one-way ANOVAs: