ANOVA

The One-Way ANOVA compares the mean of one or more groups based on one independent variable (or factor). We assume that the dependent variable is normally distributed and that groups have approximately equal variance on the dependent variable.

Null Hypothesis: There are no significant differences between groups' mean scores.
Alternate Hypothesis: There is a significant difference between groups' mean scores.

In this example, we compare "frequency of sex" by church attendance, which was recoded from 9 groups to 3 groups (0=not often, 1=sometimes, 2=often).

```
PROC ANOVA;
CLASS church;
MODEL sexfreq=church;
MEANS church/TUKEY;
MEANS church/BON;
RUN;
```

The ANOVA Procedure
Dependent Variable: SEXFREQ FREQUENCY OF SEX DURING LAST YEAR

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	114.423493	57.211746	14.26	<.0001
Error	2139	8581.451391	4.011899		
Corrected Total	2141	8695.874883			

R-Square	Coeff Var	Root MSE	SEXFREQ Mean
0.013158	70.98556	2.002972	2.821662

Source	DF	Anova SS	Mean Square	F Value	Pr > F
CHURCH	2	114.4234927	57.2117464	14.26	<.0001

F =   variance between groups (model)   = 57.212 = 14.26
         variance expected due to chance (error)   4.012

If the sample means are clustered closely together (i.e., small differences), the variance will be small; if the means are spread out (i.e., large differences), the variances will be larger.

Our F value is 14.26. Our significance level is .000. We can conclude that there is a significant difference between the three groups. To determine which groups are different from one another, we use the "comparisons" results below.

General Rule: If there are equal number of cases in each group, choose Tukey. If there are not equal numbers of cases of each group, choose Bonferroni. For this example, we will use Bonferroni.

The ANOVA Procedure
Tukey's Studentized Range (HSD) Test for SEXFREQ

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

Alpha	0.05
Error Degrees of Freedom	2139
Error Mean Square	4.011899
Critical Value of Studentized Range	3.31681

Comparisons significant at the 0.05 level are indicated by ***.			
CHURCH Comparison	**Difference Between Means**	**Simultaneous 95% Confidence Limits**	
1 - 0	0.10709	-0.13871	0.35288	
1 - 2	0.55865	0.29426	0.82303	***
0 - 1	-0.10709	-0.35288	0.13871	
0 - 2	0.45156	0.20724	0.69589	***
2 - 1	-0.55865	-0.82303	-0.29426	***
2 - 0	-0.45156	-0.69589	-0.20724	***

SAS notes a significant difference with an asterisk (*). In this example, we can see that those attending church "often" are significantly different from both of the other groups. However, there is not a significant difference between "not often" and "sometimes."

The ANOVA Procedure
Bonferroni (Dunn) t Tests for SEXFREQ

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	2139
Error Mean Square	4.011899
Critical Value of t	2.39586

Comparisons significant at the 0.05 level are indicated by ***.			
CHURCH Comparison	Difference Between Means	Simultaneous 95% Confidence Limits	
1 - 0	0.10709	-0.14400	0.35817	
1 - 2	0.55865	0.28857	0.82872	***
0 - 1	-0.10709	-0.35817	0.14400	
0 - 2	0.45156	0.20197	0.70115	***
2 - 1	-0.55865	-0.82872	-0.28857	***
2 - 0	-0.45156	-0.70115	-0.20197	***

SAS notes a significant difference with an asterisk (*). In this example, we can see that those attending church "often" are significantly different from both of the other groups. However, there is not a significant difference between "not often" and "sometimes."