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F Statistic and Critical Values

After calculating the model and error sum of squares, you're able to evaluate your hypothesis by creating your analysis of variance table.

The ANOVA Procedure					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	66835556221	22278518740	18.50	<.0001
Error	296	356387963289	1204013389.5		
Corrected Total	299	423223519511			

In general, the degrees of freedom (DF) represent the number of independent pieces of information that go into each calculation. The model degrees of freedom are the number of levels for the predictor minus one, or in this case, 4 - 1 = 3. The error degrees of freedom are the number of observations used in the analysis minus the number of groups. Here, it's 300 - 4 = 296. Finally, the total degrees of freedom are the number of observations minus 1.

The mean squares in the table are calculated by simply dividing the sum of squares by their respective number of degrees of freedom. That is, the model sum of squares is divided by 3 to get the mean square model, and the error sum of squares is divided by 296 to get the mean squared error. Notice that the mean squared error is an estimate of the model variance, that is, the variance of the sale price for each level of heating quality.

Our test statistic for the analysis of variance hypothesis, the F value, is calculated as the mean squared model divided by the mean squared error. Intuitively, as the F value increases, the more evidence we have that not all group means are equal, because it indicates that more variability is explained by the model and not attributed to error.

Finally, the p-value is calculated based on the F value test statistic and the model and error degrees of freedom. In this case, the p-value is highly significant, and we can conclude that the group means are significantly different.

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