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9.3 - The ANOVA Table

In this section, we present the Analysis of Variance Table. Recall that we want to examine the between group variation and the within group variation by using an F Test

$$F = \frac{\text{between group variance}}{\text{within group variance}}$$

However, to understand what an F test is doing we need to understand what we mean by "between group variance" and "within group variance".

These terms should remind you of the early course material on variability. We introduced variability relative to each observation's deviance from the mean. This idea is true when looking at ANOVA. Between group variability is the deviance of each GROUP MEAN from the overall mean. Within group variability is the observation's deviance from that observation's group mean. As with calculating variance and standard deviation, we work with these deviance scores as squared terms.

In ANOVA the between and within group variability is presented as "sums of squares" in the ANOVA table:

Sum of Squares for Treatment or the Between Group Sum of Squares

$$\text{SST} = \sum_{i=1}^{t} n_i(\bar{y}_{i.} - \bar{y}_{..})^2$$

Sum of Squares for Error or the Within Group Sum of Squares

$$\text{SSE} = \sum_{i,j}(y_{ij} - \bar{y}_{i.})^2$$

Total Sum of Squares

$$\text{TSS} = \sum_{i,j}(y_{ij} - \bar{y}_{..})^2$$

It can be derived that $\text{TSS} = \text{SST} + \text{SSE}$.

We can set up the ANOVA table to help us find the F-statistic. Hover over the light bulb to get more information on that item.

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Treatment	$t-1$	SST	$\text{MST} = \frac{\text{SST}}{t-1}$	$\frac{\text{MST}}{\text{MSE}}$	
Error	$n_T - t$	SSE	$\text{MSE} = \frac{\text{SSE}}{n_T - t}$		
Total	$n_T - 1$	TSS			

The ANOVA Table

Moriah's data yields the following ANOVA table.

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	2	6197.85	3098.93	3549.44	0.000
Error	87	75.96	0.87		
Total	89	6273.81			

Note for Moriah's data that the F is very very large. This large F is the ratio of the Adj MS for the "factor" (which is the food insecurity or BETWEEN GROUP variance) and the "error" which is the WITHIN GROUP variance, or 3098.93/0.87.

The p-value is found using the F-statistic and the F-distribution. We will not ask you to find the p-value for this test. You will only need to know how to interpret it. If the p-value is less than our predetermined significance level, we will reject the null hypothesis that all the means are equal. However, in a case like Moriah's the p value is less than our significance level of .05, therefore Moriah can reject the null and conclude at least one of the means is different.

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