Calculating the ANOVA Test Statistic and Summary Table

We calculate the F test statistic from the sample data. In ANOVA, this is no easy task. It involves a series

of new equations and careful attention to detail.

NOTE: A *balanced design* is one in which all the groups are the same size (all have the same ). An *unbalanced design* is one in which at least one group is a different size than the others. The book and MindTap use two different sets of equations for calculating the in ANOVA, and one set **only** works if you have a balanced design. **The formulas in this handout will work properly no matter which design is being used, so I recommend you just stick with these.**

For the following equations:

There are treatment groups. Each group has a sample size, called for the jth treatment group (e.g. the second treatment group has a sample size of ). Keep this notation in mind.

The **test statistic** has a **numerator** and a **denominator** that must be calculated separately.

1. **The numerator of the F test statistic is the MSTR:**
   * Recall: the MSTR is the Mean Square due to Treatments, also called the between-treatments estimate of the variance. This is the estimate of the true variance under the assumption that is true, which would mean that all the group population means were equal.

Here are the **four** steps to calculate the :

NOTE: The total sample size, is just the sum of the sample sizes of each group

NOTE:

3)

|  |  |
| --- | --- |
|  |  |

4)

1. **The denominator of the test statistic is the :**

* The MSE is the Mean Square due to Error, also called the within-treatments estimate of the variance. This is the estimate of the true variance under the assumption that is false, which would mean that at least one group population mean was different than the others.

Here are the **two** steps to calculate the :

1. First, calculate the Sum of Squares due to Error, :

2) Second, use the to calculate the :

1. **Now calculate the test statistic, :**

**with**

In the process of calculating the ANOVA test statistic, we organize all of the results of our calculations into an ANOVA table. ANOVA tables may be labeled with different terminology (e.g. the book uses different labels than Excel) but the numbers always represent the same calculations.

**ANOVA Summary Table: Equations**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Source of Variation** | **Sum of Squares** | **Degrees of Freedom** | **Mean Square** | **F** | **p-value** | **Critical value of F** |
| **Treatments** |  |  |  |  | Upper tail  p-value for |  |
| **Error** |  |  |  |  |  |  |
| **Total** |  |  |  |  |  |  |

**ANOVA Summary Table: Simplified**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Source of Variation** | **Sum of Squares** | **Degrees of Freedom** | **Mean Square** | **F** | **p-value** | **Critical value of F** |
| **Treatments** |  | numerator |  |  | Upper tail  p-value for |  |
| **Error** |  | denominator |  |  |  |  |
| **Total** |  |  |  |  |  |  |