

### 13.1: Two-Factor ANOVAs

A single factor ANOVA is the statistical analysis appropriate when we are analyzing the results of an experiment in which we have one factor and are looking for differences in the response variable among three or more groups, each of which is receiving different levels or amounts of the factor. In chapter 12, we learned about the single factor ANOVA, also known as the one-way. We will now conceptually review a multi-factor ANOVA. We will keep it on the simpler side and use 2-factors (two independent/predictor variables) using a between-subjects design.

#### Logic of a 2 Factor ANOVA

A two factor ANOVA is used when we believe that more than one factor may affect a particular response (dependent) variable. For example, believe that the age of an adolescent will have an impact on number of phone calls made to the opposite sex and I also suspect that gender of the adolescent will have an impact on the number of phone calls made to the opposite sex.

To test my hypothesis that Age and Gender of adolescent will impact the number of phone calls made to the opposite sex in the past week. In this case, we have a between-subjects design for both age and gender. I have 2 conditions/levels/groups for each factor/variable. I will have to collect data for these for 4 samples of subjects:

Age	Gender	
	Teen Males	Teen Females
	Older Males	Older Females

Table 1. Example of 2×2 ANOVA

A 2×2 ANOVA gives you 4 conditions. *Note:* one way to identify the total conditions in a factorial study is to multiply the conditions for each factor. Thus, a 2×2 design is 2 times 2 giving us 4 total conditions for the study. We will discuss this more in a moment.

Remember that there are different types of ANOVAs based on design. In this case, we have a between-subjects design. An individual can only be in 1 condition for gender and 1 condition for age. So among the 4 total conditions/levels/groups between the 2 factors, an individual is

only in 1 of the samples. For a between-subjects design, there are 4 different samples. Two Factor ANOVA data is commonly organized like the table above and is referred to a **matrix**. When the data is organized in a matrix it is very easy to see the factors, as well as the separate levels of the factors.

- **Factorial designs** like the 2-Factor ANOVA allow a researcher to examine more than one independent variable on the dependent variable
  - Individually for each factor, reporting out a F for each
  - Collectively where the collective influence of the factors is referred to as an **interaction**. An interaction is the result of the two independent variables combining to produce a result that is different from a result that is produced by either variable alone.
- A 2-Factor ANOVA allows a researcher to assess the main effects (the independent variables) and the interaction yielding three outcomes (3 Fs), a F for factor 1, a F for factor 2 and an interaction between factor 1 and 2.

Let's go back to our example:

- Main Effect of Factor A
  - Is there a significant effect of age of teen (Factor A) on number of phone calls made to the opposite sex (response variable).
- Main Effect of Factor B
  - Is there a significant effect of sex of the teen (Factor B) on number of phone calls made to the opposite sex (response variable).
- Interaction of AxB
  - Does the effect of age of teen (Factor A) on the number of phone calls made to the opposite sex (response variable) depend on the sex of the teen (Factor B)?