CHAPTER OVERVIEW

5: Multi-Factor ANOVA

Learning Objectives

Upon completion of this lesson, you should be able to:

1. Identify factorial, nested, and cross-nested treatment designs.
2. Use main effects and interaction effects in factorial designs.
3. Create nested designs and identify the nesting effects.
4. Use statistical software to analyze data from different treatment designs via ANOVA and mean comparison procedures.

Researchers often identify more than one experimental factor of interest. One alternative is to set up separate, independent experiments in which a single treatment (or factor) is used in each experiment, and data from each experiment to be analyzed as we have done using a one-way ANOVA. This approach might have the advantage of a concentrated focus on the single treatment of interest and the simplicity of computations. However, there are several disadvantages as well.

- First, environmental factors or experimental material conditions may change during the process. This could distort the assessment of the relative importance of different treatments on the response variable.
- Second, it is inefficient. Setting up and running multiple separate experiments usually will involve more work and resources.
- Last, and probably the most important, this one-at-a-time approach does not allow the examination of how several treatments jointly impact the response.

ANOVA methodology can be extended to accommodate this multi-factor setting. Here are Dr. Rosenberger and Dr. Shumway talking about some of the things to look out for as you work your way through this lesson.

Video 5.1: Experimental design drives analysis.

To put it into perspective, let’s take a look at the phrase "Experimental Design" a term that you often hear. We are going to take this colloquial phrase and divide it into two formal components:

A. The Treatment Design
B. The Randomization Design

We will use the treatment design component to address the nature of the experimental factors under study and the randomization design component to address how treatments are assigned to experimental units. An experimental unit is defined to be that which

receives a specific treatment level and in a multi-factor setting, a specific treatment or factor combination. In the single-factor greenhouse example, which is an experiment, the experimental unit is a single plant receiving one specific fertilizer level. Note that the ANOVA model pertaining to a given study depends on both the treatment design and the randomization process.

The following figure illustrates the conceptual division between the treatment design and the randomization design. The terms that are in boldface type will be addressed in detail in this or future lessons.

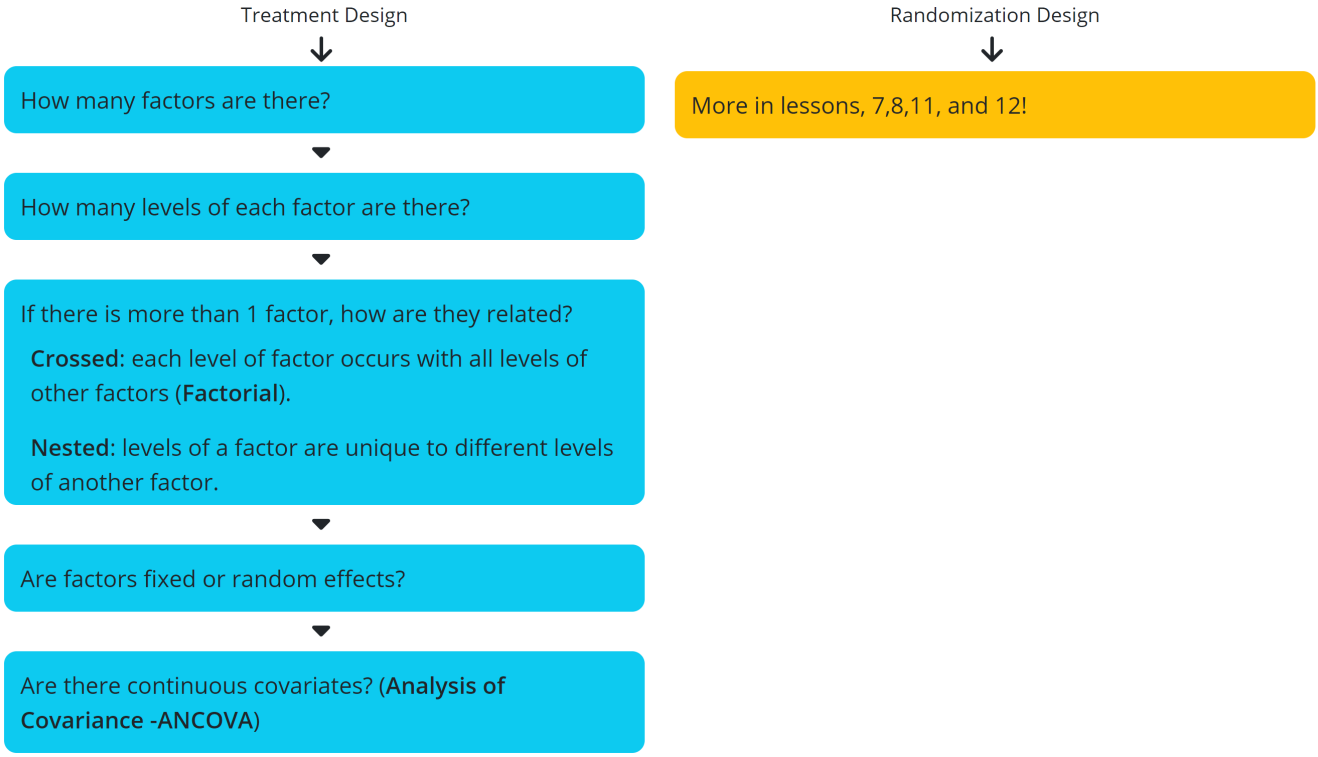

Figure 5.1: Concepts to consider in experimental design, for treatment design and randomization design.