# CHAPTER OVERVIEW

## 11: Introduction to Repeated Measures

**Objectives**

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

- Recognize repeated measures designs in time.
- Understand the different covariance structures that can be imposed on model error.
- Use software such as SAS, Minitab, and R for fitting repeated measures ANOVA.

The focus of many studies can be expanded by introducing time also as a potential covariate. In the greenhouse example, the growth of plants can be measured weekly over a period of time, allowing time also to be included as a predictor in the statistical model. Another example is to compare the effect of two anti-cancer drugs on disease status at different intervals of time. In both these examples, the response has to be measured multiple times from the same experimental unit, hence the term "repeated measures." The repeated measurements made on the same experimental unit cannot be assumed independent which means that the model errors may not be uncorrelated anymore and the statistical model should be modified accordingly.

Two fundamental types of repeated measures are common. Repeated measures in time are the type in which experimental units receive treatment, and they are simply followed with repeated measures on the response variable over several times. In contrast, experiments can involve administering all treatment levels (in a sequence) to each experimental unit. This type of repeated measures study is called a crossover design, the topic of our next lesson.

Repeated measures are frequently encountered in clinical trials including longitudinal studies, growth models, and situations in which experimental units are difficult to acquire.