

CHAPTER OVERVIEW

3: ANOVA Models Part I

In Chapter 2 we learned that ANOVA is based on testing the effect of the treatment relative to the amount of random error. In statistics, we call this the partitioning of variability (due to treatment and due to random variability in the measurements). This partitioning of the deviations can be written mathematically as:

$$\underbrace{Y_{ij} - \bar{Y}_{..}}_{(1)} = \underbrace{\bar{Y}_{i.} - \bar{Y}_{..}}_{(2)} + \underbrace{Y_{ij} - \bar{Y}_{i.}}_{(3)} \quad (3.1)$$

Thus, the total deviation $Y_{ij} - \bar{Y}_{..}$ in (1) can be viewed as the sum of two components:

(2) Deviation of estimated factor level mean around overall mean, and

(3) Deviation of the j^{th} response of the i^{th} factor around the estimated factor level mean.

These two deviations are also called variability between groups, a reflection of differences between treatment levels and the variability within groups that serves as a proxy for the error variability among individual observations. A practitioner would however be more interested in the variability between groups as it is the indicator of treatment level differences and may have little interest in the within-group variability, expecting it to be in fact small. However, it will be seen that both these variability measures will play an important role in statistical procedures.

There are several mathematically equivalent forms of ANOVA models describing the relationship between the response and the treatment. In this chapter we will focus on the **effects model**, and in the next chapter three other alternative models will be introduced.

This lesson will also cover the topic of model assumptions needed to employ the ANOVA. Model diagnostics, which deal with verifying the validity of model assumptions, are also discussed, along with power analysis techniques to assess the power associated with a statistical study. How software can be used to analyze data using the statistical techniques discussed will also be presented.

[3.1: The Model](#)

[3.2: Assumptions and Diagnostics](#)

[3.3: Anatomy of SAS Programming for ANOVA](#)

[3.4: Greenhouse Example in SAS](#)

[3.5: SAS Output for ANOVA](#)

[3.6: One-Way ANOVA Greenhouse Example in Minitab](#)

[3.7: One-Way ANOVA Greenhouse Example in R](#)

[3.8: Power Analysis](#)

[3.9: Try It!](#)

[3.10: Chapter 3 Summary](#)

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