Chapter 16 ANOVA Tables

Treatment effects are most often analyzed using ANOVA, which is short for “Analysis of Variance”. This is somewhat of an odd name for a method to test for treatments effects - what do differences in means have to do with an analyis of variance? The name makes sense in light of the decomposition of the total variance into a model variance and the residual variance (chapter xxx). If there are differences among the means, then the total variance is increased because of variation among groups.

The engine underneath modern ANOVA is a linear model. If the model has a single categorical factor, the ANOVA is **one-way**. If the model has two categorical factors it is a two-way ANOVA. If the model has a single categorical factor and one continuous factor it is an ANCOVA, short for **analysis of covariance** (next chapter). More complex experimental designs classically analyzed with ANOVA are nested, split-plot, latin-square, and many others.

16.1 Summary of usage

If you choose to report an ANOVA, also report the effects and their uncertainty in some way, either the model coefficients or contrasts.

1. ANOVA generates a table with one row for each term in the linear model. A term is a factor or a covariate or an interaction. For a two-way factorial ANOVA, these terms are the two main effects and the interaction effect.
2. The ANOVA generates an F and p-value for the whole model and for each term in the ANOVA table.
3. The p-value of an interaction term is often used as a decision rule to interpret the main effects. If $p \leq 0.05$ then do not interpret the main effects but instead examine the condition (“simple”) effects. If $p > 0.05$, then interpret the main effects. Regardless, this sort of decision rule is itself controversial, and for good reason.
4. If the main effects are to be interpreted, some statisticians advocate re-fitting the model without the interaction effect, others advocate interpreting the main effects with the interaction term in the model. This only matters if the design is unbalanced (see below).
5. Regardles of any decision, always plot the data using a Harrell plot or interaction plot to understand