

Two-Way ANOVA Model

Now let's take a look at the mathematical equation of two-way ANOVA with interaction. The response variable Y_{ijk} is the observed reading test score for school i , gender j , and student k . μ is the overall population mean of the response, **Reading3**. This value essentially represents the average reading test score of all the students, regardless of the type of school or gender. α_i represents the effect of school type. It is the difference between the population mean of the i th type of school and the overall mean, μ . β_j represents the effect of gender. It is the difference between the population mean of the j th level of gender and the overall mean, μ . $(\alpha\beta)_{ij}$ represents the effect of interaction between the i th school type and the j th gender. ϵ_{ijk} is the error term or unaccounted-for variation in the model.

What should you do if you determine that the interaction is not significant? When the interaction is not statistically significant you can analyze the main effects with the model in its current form. This is generally the method that you use when you analyze designed experiments. However, even when you analyze designed experiments, some statisticians might suggest that if the interaction is not significant, you can delete the interaction effect from your model, rerun the model, and then analyze the main effects only. This increases the power of the main effects test. The approach that you choose might depend on your subject-matter knowledge of the data and whether you think you should include the nonsignificant interaction term.

In some situations, experimenters like to retain the nonsignificant interactions in the model. These situations typically include when the data is from designed experiments, when the degrees of freedom for the residuals are not too small (for example, > 5), and when the F statistic for the nonsignificant interaction term is not too small (for example, > 2) (Nelder, Kutner, Wasserman, and Nachtsheim 1996). If the interaction term is significant, it is good practice to keep the main effect terms that make up the interaction in the model, whether they are significant or not. This preserves model hierarchy. Also notice that, in the case of a significant interaction between the factors, the tests for the individual factor effects might be misleading due to the masking of these effects by the interaction.