13.5 Template and APA-Style Write-Up

Finally we come to an example paragraph of the results for the two-factor statistics lab example. Recall that our graduate research assistant, Marie, was working on a research project for an independent study class to determine if there was a mean difference in the number of statistics labs attended based on the attractiveness of the lab instructor (four categories) and time of day the lab was attended (afternoon or evening). Her research question was the following: Is there a mean difference in the number of statistics labs students attended based on the attractiveness of the lab instructor and time of day the lab was attended? Marie then generated a factorial ANOVA as the test of inference. A template for writing a research question for a factorial ANOVA is presented as follows;
Is there a mean difference in [dependent variable] based on [independent variable 1] and [independent variable 2]?

This is illustrated assuming a two-factor model, but it can easily be extended to more than two factors. As we noted in Chapter 11, it is important to ensure the reader understands the levels or groups of the independent variables. This may be done parenthetically in the actual research question, as an operational definition, or specified within the methods section. In this example, parenthetically we could have stated the following: Is there a mean difference in the number of statistics labs students attend based on the attractiveness of the lab instructor (unattractive, slightly attractive, moderately attractive, very attractive) and time of day the lab was attended (afternoon or evening)?

It may be helpful to preface the results of the factorial ANOVA with information on an examination of the extent to which the assumptions were met (recall there are three assumptions: normality, homogeneity of variance, and independence). This assists the reader in understanding that you were thorough in data screening prior to conducting the test of inference:

A factorial ANOVA was conducted to determine if the mean number of statistics labs attended by students differed based on the level of attractiveness of the statistics lab instructor (unattractive, slightly attractive, moderately attractive, very attractive) and the time of day the lab was attended (afternoon or evening). The assumption of normality was tested and met via examination of the residuals. Review of the S-W test for normality (SW = .977, df = 32, p = .701) and skewness (.400) and kurtosis (-.162) statistics suggested that normality was a reasonable assumption. The boxplot suggested a relatively normal distributional shape (with no outliers) of the residuals. The Q-Q plot and histogram suggested normality was reasonable. According to Levene's test, the homogeneity of variance assumption was satisfied [F(7, 24) = .579, p = .766]. Random assignment of individuals to groups helped ensure that the assumption of independence was met. Additionally, scatterplots of residuals against the levels of the independent variables were reviewed. A random display of points around 0 provided further evidence that the assumption of independence was met.

Here is an APA-style example paragraph of results for the factorial ANOVA (remember that this will be prefaced by the previous paragraph reporting the extent to which the assumptions of the test were met):

From Table 13.8, we see that the interaction of attractiveness by time of day is not statistically significant, but there are statistically significant main effects for both attractiveness and time of day (F_attract = 21.350, df = 3, 24, p = .001; F_time = 61.791, df = 1, 24, p = .001). Effect sizes are large for both attractiveness and time (partial η²_attract = .727; partial η²_time = .720), and observed power for attractiveness and time is maximal (i.e., 1.000).

Post hoc analyses were conducted given the statistically significant omnibus ANOVA F tests. The profile plot (Figure 13.2) summarizes these differences. Tukey HSD tests were conducted on all possible
pairwise contrasts. For the main effect of attractiveness, Tukey HSD post hoc comparisons revealed that the unattractive level had statistically significantly lower attendance than all the other levels of attractiveness and that the slightly attractive level had statistically significantly lower attendance than the very attractive level. More specifically, the following pairs of groups were found to be significantly different ($p < .05$):

- Groups 1 (unattractive; $M = 11.125, SD = 5.4886$) and 2 (slightly attractive; $M = 17.875, SD = 5.9387$)
- Groups 1 (unattractive) and 3 (moderately attractive; $M = 20.2500, SD = 7.2850$)
- Groups 1 (unattractive) and 4 (very attractive; $M = 24.3750, SD = 5.0973$)
- Groups 2 (slightly attractive) and 4 (very attractive)

In other words, students enrolled in the least attractive instructor group attended statistically significantly fewer statistics labs than students enrolled in any of the three more attractive instructor groups.

For the main effect of time of day, Tukey HSD post hoc comparisons revealed that the students enrolled in the afternoon ($M = 23.125, SD = 5.655$) had statistically significantly higher statistics lab attendance than students in the evening ($M = 13.688, SD = 6.096$).

### 13.6 Summary

This chapter considered methods involving the comparison of means for multiple independent variables. The chapter began with a look at the characteristics of the factorial ANOVA, including (a) two or more independent variables each with two or more fixed levels; (b) subjects are randomly assigned to cells and then exposed to only one combination of the independent variables; (c) the factors are fully crossed such that all possible combinations of the factors’ levels are included in the design; and (d) the dependent variable measured at the interval level or better. The ANOVA model was examined and followed by a discussion of main effects and, in particular, the interaction effect. Some discussion was also devoted to the ANOVA assumptions. The ANOVA summary table was shown along with partitioning the sums of squares. MCPs were then extended to factorial models. Then effect size measures, CIs, power, and expected mean squares were considered. Finally, several approaches were given for the unequal $n$'s case with factorial models. At this point, you should have met the following objectives: (a) be able to understand the characteristics and concepts underlying factorial ANOVA, (b) be able to determine and interpret the results of factorial ANOVA, and (c) be able to understand and evaluate the assumptions of factorial ANOVA. In Chapter 14, we introduce the analysis of covariance.