Work Problems Chapter 10

Because the details of how to calculate the statistics for a factorial ANOVA are not presented in this chapter, I cannot ask you to calculate your own statistics using raw data, as I have in previous chapters. Instead, I present the output tables from a factorial ANOVA that I have conducted using the SPSS statistical software and will ask you to interpret the results of this analysis.

Table 10.5: Descriptive statistics for Grade Point Average by Gender and Generation.

Dependent Variable: Cumulative GPA

Generation	Gender	Mean	Std. Deviation	N
3+ gen	Girl	2.80	1.21	143
	Boy	2.63	1.52	106
	Total	2.73	1.35	249
2nd gen	Girl	3.06	1.00	206
	Boy	2.76	.92	189
	Total	2.92	.98	395
1st gen	Girl	3.18	.75	116
	Boy	2.99	.80	77
	Total	3.10	.77	193
Total	Girl	3.01	1.03	465
	Boy	2.77	1.11	372
	Total	2.90	1.07	837

Table 10.6: Summary Statistics for the Factorial ANOVA with Gender, Generation, and the Gender by Generation interaction effects on Grade Point Average (GPA).

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	27865418.736[a]	5	5573083.747	4.929	.000	.029
Intercept	6318381546.677	1	6318381546.677	5588.057	.000	.871
Generation	14751468.548	2	7375734.274	6.523	.002	.015
Gender	8953089.504	1	8953089.504	7.918	.005	.009
Generation * gender	781668.532	2	390834.266	.346	.708	.001
Error	939606563.822	831	1130693.819			
Total	8047918449.299	837				
Corrected Total	967471982.557	836				

a. R Squared = .029 (Adjusted R Squared = .023)

The data presented in Tables 10.5 and 10.6 come from a study I conducted several years ago with a sample of high school students. In this study, I asked students to report their gender and I also asked them to tell me in which country they were born and in which country their mothers were born. From this second question I created a variable called "Generation." Students who were born in the United States to mothers who were also born in the U.S. are "3+" generation because their families have been in the U.S. for at least three generations (i.e., the student, the student's mother, and the mother's mother all lived in the U.S.). Students who were born in the U.S. to mothers who were born outside of the U.S. are 2nd generation, and students born outside of the U.S. are 1st generation. I also collected students' cumulative grade point average (GPA) from school records. Using this information, the information presented in Tables 10.5 and 10.6, and information presented earlier in this chapter, try to answer the following questions.

1. Just looking at the means presented in Table 10.5, predict whether there will be statistically significant main effects for Gender and Generation and a significant interaction between the two.

   It is difficult to know whether the main effects for Gender and Generation will be statistically significant. But we can see that, across the three generation groups, girls have higher average GPAs than boys (i.e., 3.01 > 2.77). Similarly, the GPAs of 1st generation students (*M* = 3.10) is slightly higher than the mean for 2nd generation students (*M* = 2.92), which is higher than the 3rd+ generation students (*M* = 2.73).

Further analyses are needed to determine whether the differences between these means are statistically significant.

2. Based on the summary statistics in Table 10.6, is the difference between the GPAs of boys and girls statistically significant?

   Yes, the main effect for gender is statistically significant ($F_{(1, 831)} = 7.918$, $p = .005$). On average, in the populations of male and female high school students that these samples represent, girls have a higher GPA than boys.

3. Based on the summary statistics in Table 10.6, what is the effect size for the main effect of Generation? What does this effect size tell you?

   The effect size for Generation, as measured by the partial eta squared, is .015. This tells us that, when controlling for the other effects in the model, Generation explains about 1.5% of the unique variance in the dependent variable, GPA.

4. Is there a statistically significant interaction between Gender and Generation on GPA?

   There is NOT a statistically significant interaction between Gender and Generation on GPA. In Table 10.6, we can see that the *F* value for this interaction effect was not significant ($F_{(2, 831)} = .346$, $p = -708$).

5. Using the degrees of freedom for Generation and for Error and the values in Appendix C, what is the critical value for *F* if the alpha level is .05? **(For a brief video explaining how to read and interpret Appendix C, please refer to the website that accompanies this book.)**

   The critical *F* value, using 2 and 831 degrees of freedom, is *F* = 8.00. NOTE: I used 1,000 *df* for the error because that was closest to 831 in Appendix C.

6. Combining the information for the three main tests of effects (i.e., main effects for Gender and Generation, interaction effect for Gender x Generation), write a sentence that summarizes these tests of statistical significance.

   This factorial ANOVA revealed statistically significant main effects for Gender ($F_{(1, 831)} = 7.918$, $p = .005$) and Generation ($F_{(2, 831)} = 6.523$, $p = .002$), but no significant interaction between the two ($F_{(2, 831)} = .346$, $p = -708$).

7. How much of the variance in GPA is explained by Gender, Generation, and their interaction combined?

   If we looked at the partial eta squared for the "Corrected Model" in Table 10.6, we find a value of .029. This tells us that all of the predictors in the model (two independent variables and the interaction between them), combined, explain about

2.9% of the total variance in GPA. This information is also presented just beneath Table 10.6.