For Problems 1 to 6, use the scenario and data for Exercise 6.19 on page 314.
- Define Factor A to be type of machine, and Factor B to be sex.
- Do problems 1 to 6 by hand, not using R.

1. First, let’s make sure you understand what was done in this study. Answer the following.
   a. What is the response variable that was recorded for each of the individuals who participated in this study?
   b. Could the levels of Factor A have been randomly assigned to the participants? Explain.
   c. Could the levels of Factor B have been randomly assigned to the participants? Explain.

2. Draw an interaction plot, putting the Factor A categories on the horizontal axis and drawing separate lines for the Factor B categories.

3. Based on the plot you drew in Problem 2:
   a. Does there appear to be an interaction between the two factors? If not, explain how you know. If so, explain the nature of the interaction.
   b. Which appears to be stronger – the Factor A effect, or the Factor B effect? Explain how you decided.

4. Continuing to use the data in Exercise 6.19, give numerical values to estimate all of the parameters in the two-factor ANOVA model $Y_{ikj} = \mu + \alpha_k + \beta_j + \gamma_{kj} + \varepsilon_{ikj}$ in the order listed below:
   a. The estimate for $\mu$.
   b. The estimates for $\alpha_k$ with $k = 1, 2$ where $k = 1$ for Treadmill and $k = 2$ for Rowing machine.
   c. The estimates for $\beta_j$ with $j = 1, 2$ where $j = 1$ for Men and $j = 2$ for Women.
   d. The estimates for $\gamma_{kj}$ for all $j, k$ pairs.

5. Consider your answers to Problem 3, and the estimates you found in Problem 4.
   a. Do the values you found in Problem 4(d) confirm your answer to Problem 3(a), or do they seem to contradict it? Explain.
   b. Do the values you found in Problem 4 parts (b) and (c) confirm your answer to Problem 3(b), or do they seem to contradict it? Explain.

6. One of the questions the researchers wanted to answer was whether you can burn 200 calories faster using a treadmill or a rowing machine. Based on the data provided, how would you answer that question? (Assume all relevant sample data showed statistically significant results.)

For Problems 7 to 10, use the Swahili data accompanying the book. It is described in Exercise 6.28 on page 318. You will need to read the introduction to that exercise as well as Part (c) to get the full explanation of the variables. The response variable in this data set is attitude about the Swahili language, called Attitude.Score, and there are 3 categorical variables, which we will label as follows:
- Factor A: Province
- Factor B: Sex
- Factor C: School
7. Read the explanations of the categorical variables (factors) and answer the following:
   a. For each factor, specify whether it is fixed or random. Explain your answer.
   b. Are any of the factors nested under any other factor? Explain your answer.

8. For each of the following interactions, state whether there is appropriate data to include it in a model:
   a. Province by Sex
   b. Province by School
   c. Sex by School

9. Use R to create an interaction plot for Province by Sex, putting the categories of Sex on the horizontal axis. (Note that you will need to include the name of the dataset when you name the variables in the R command, such as Swahili$Sex instead of just Sex. The appropriate R command was given in Lecture 17 on Nov 27.) Describe what the plot tells you about interaction and main effects.

10. Carry out the analysis requested and answer the questions in Exercise 6.28 (a). You do not need to do Parts (b) and (c).

11. Do Exercise 8.2 (page 435). Note: This last homework exercise brings us full circle, because it involves the basic concepts we discussed on the first day of class!