The game of golf is one that is enjoyed by men and women all around the world, regardless of skill level. One of the critical facets in the game of golf is the ability to drive the ball a long distance. How much of a drive’s distance can be attributed to the equipment a golfer uses? Specifically, does the type of driver, the type of golf ball and/or the interaction between the two have significant effects on a drive’s distance? You are asked to help design an experiment to investigate the effects of golf equipment on a drive’s distance. There will be three brands of golf ball: Titleist, Bridgestone and Nike. There will be two brands of driver: Taylor Made and Callaway. Amateur golfers will be the experimental material. The response will be the average driving distance for five drives with a combination of brand of golf ball and brand of driver.

1. [12 pts] Consider designing an experiment involving the three brands of golf ball and two brands of driver using a completely randomized design.
   a) [2] With Alpha = 0.05 and Beta = 0.10, how many golfers would you need in order to detect a 2 standard deviation difference in treatment combination means?
   b) [2] Using Alpha = 0.05 and Beta = 0.10 and the number of golfers found in part a) how big a difference in driver level means can be detected?
   c) [2] Using Alpha = 0.05 and Beta = 0.10 and the number of golfers you found in part a) how big a difference in golf ball level means can be detected?
   d) [3] Give a partial analysis of variance table showing all sources of variation and associated degrees of freedom.
   e) [3] What contributes to error variation in this completely randomized design?

2. [12 pts] Consider designing an experiment involving the three brands of golf ball and two brands of driver using a randomized complete block design.
   a) [2] Why would a randomized complete block design be better than a completely randomized design?
   b) [2] Explain how you would form blocks by sorting experimental material.
   c) [2] Explain how you would form blocks by reusing experimental material.
   d) [3] Give two reasons why reusing would be better than sorting.
   e) [3] What contributes to error variation in this randomized complete block design where blocks are made by reusing experimental material?

3. [16 pts] Another factor that may affect a drive’s distance is the height of the tee (short or long) the golf ball is placed on. Consider designing an experiment with the three factors; brand of golf ball (3 levels), brand of driver (2 levels) and height of tee (2 levels).
a) [1] If treatments are made by factorial crossing of the three factors, how many treatment combinations will there be?

b) [6] Changing the height of the tee for an individual golfer can throw off the golfer’s swing mechanics so it is better if an individual golfer uses only one tee height for all drives. Explain how to design a split plot/repeated measures experiment involving brand of golf ball, brand of driver and height of tee. In the explanation be sure to identify

- The whole plot.
- The whole plot, between subjects, factor.
- The sub plot.
- The sub plot, with subjects, factor(s).

c) [5] Give a partial analysis of variance table showing all sources of variation and associated degrees of freedom. Assume you have the number of golfers you found in 1 a). Also include formulas for calculating the F statistics for evaluating the effects of each of the factors and interactions.

d) [4] What contributes to error variation in this split plot/repeated measures design?