BIA 654 Homework
Due on Apr. 12
Spring 2016

BIA 654 Homework 8

Karen Donegan, a staffer at the business school, is thinking about buying some new golf equipment to improve her game in preparation for the annual golf tournament. One day she comes across some notes on experimental design that she finds on top of a file cabinet near her office. “Hmm,” she thinks to herself as she begins to read them, “this looks interesting. Maybe this will help me decide what equipment to purchase.”

Karen has been thinking about replacing her current steel shaft, small head driver. The company that makes her clubs has three other drivers that she is considering. The first has the same steel shaft but a newly designed very large head. The second has a graphite shaft with the same small head that is on her current driver, while the third has the graphite shaft with the newly designed very large head. She is also wondering whether a new pair of golf shoes might help, as well as switching to an expensive golf ball (at $3.00 per ball) rather than sticking with her discount store special (at $0.75 per ball). She also has her eye on a rather expensive new golf sweater, which should put her in the right frame of mind to hit some really long drives. Finally, she does not wear a golf glove when she plays, and her husband pointed out to her that she is no Fred Couples, one of the few golf professionals who does not wear a glove. After spending an evening reading the notes, Karen concludes that “this is pretty clear” and decides to perform the experiment whose design matrix is shown below. She includes six factors and decides to do 16 runs, all to be performed at the local driving range. Each run is performed in random order.

Karen buys the necessary golf balls, and the glove but is able to borrow the shoes and golf clubs from a local store. She has her own steel shaft, small-head driver, and she has ten days to return the sweater for a full refund.

The design matrix and the results of the experiment are shown below. Each run is a single drive (shot) and the response variable is the distance the shot carries in yards. Karen's goal is to find the equipment that will maximize her distance, but she doesn't want to spend money on anything that will not help in that regard.

(a) Obtain the estimated effects and determine the confounding patterns (you can use stat packages or hand calculations). Assume interactions of order 3 or higher are negligible.

(b) Find all the effects including higher-order interactions that are confounded with C, with CD, with AB.

(c) Suppose that based on prior extensive experience at the driving range measuring the length of her drives, Karen has determined that the standard deviation of a single drive is 13 yards. What is the 95% confidence interval for an effect? Which effects are significant?

(d) Based on your analysis of the results, what are the most reasonable and likely conclusions you can draw without doing any additional runs? What should Karen do? Make plots for effects of A and B and their interaction. What is the regression prediction equation?

(e) How much additional yardage can Karen expect to get if she follows your advice?

(f) Suppose instead of doing all 16 runs on one day, Karen decides to do 8 of the runs on one day and the other 8 runs the next day. Karen's husband Harold suggests she do the even numbered runs on one day and the odd numbered runs on the other. Is this a good idea? Explain. A professor at the business school suggests she do runs 1, 3, 6, 8, 10, 12, 13, and 15 on one day and the others on the next day. Karen asks why? The professor says, "Look at the column of signs for the ACD interaction. The runs with - signs should be run on one day and the runs with + signs should be run on the other day. That's how I picked the runs for each day." Explain why the professor's suggestion is better than Harold's. Think of the day as the "seventh factor" (and see its confounding).

Factors	Levels	
	-	+
A	small club head	large club head
B	steel shaft	graphite shaft
C	cheap ball	expensive ball
D	no glove	glove
E	old shoes	new shoes
F	old sweater	expensive new sweater

Design with generators: E = ABC, F = BCD							
Run	A	B	C	D	E	F	Response
1	-	-	-	-	-	-	182
2	+	-	-	-	+	-	157
3	-	+	-	-	+	+	155
4	+	+	-	-	-	+	226
5	-	-	+	-	+	+	184
6	+	-	+	-	-	+	166
7	-	+	+	-	-	-	177
8	+	+	+	-	+	-	218
9	-	-	-	+	-	+	178
10	+	-	-	+	+	+	152
11	-	+	-	+	+	-	135
12	+	+	-	+	-	-	232
13	-	-	+	+	+	-	173
14	+	-	+	+	-	-	156
15	-	+	+	+	-	+	154
16	+	+	+	+	+	+	223