

Two-Factor ANOVA Example

Suppose the USGA tests four different brands (A,B,C,D) of golf ball and two different clubs (driver, five-iron) in a completely randomized design. Each of the eight Brand-Club combinations (treatments) is randomly and independently assigned to four experimental units, each experimental unit consisting of a specific position in the sequence of hits by Iron Byron. The distance response is recorded for each of the 32 hits, and the results are shown in the table below.

TABLE of Distance Data for 4 X 2 Factorial Golf Experiment

CLUB	BRAND			
	A	B	C	D
Driver	226.4	238.3	240.5	219.8
	232.6	231.7	246.9	228.7
	234.0	227.7	240.3	232.0
	220.7	237.2	244.7	237.6
Five-iron	163.8	184.4	179.0	157.8
	179.4	180.6	168.0	161.8
	168.6	179.5	165.2	162.1
	173.4	186.2	156.5	160.3

1. Produce an ANOVA table similar to the table in the textbook.
2. Evaluate the aptness of the ANOVA model by examining residuals for normality and constancy of error variance. (Checking for independence of error terms is not necessary here.)
3. Test the null hypothesis that all treatment means are equal.
4. Create a plot of estimated treatment means ($\bar{Y}_{ij.}$) vs. CLUB levels (driver, five-iron). Create a plot of estimated treatment means ($\bar{Y}_{.ij}$) vs. GOLF BALLS (A,B,C,D). (See figure in text). Comment on your plots regarding possible interaction and main effects. Does either of the plots reveal anything glaring? Do you think there is a CLUB main effect? a Ball main effect?, etc.
5. If the null hypothesis above (in 3) is rejected, test the null hypothesis that factors CLUB and BRAND do not interact to affect the response.
6. If the null hypothesis of no interaction is rejected, that is, if Brand and Club interact to affect mean distance, investigate the nature of the interaction effects. Are the interactions transformable? Do they have a simple structure? (Read text.)
7. Use the Bonferroni multiple comparisons procedure to compare mean distances for different balls when CLUB type is "driver". (Read appropriate section and examples in text).
8. Summarize your results from above. (Use no more than 3 paragraphs).