

Thursday, May 13

Note: Show your work in detail to receive a full credit.

1. (40pt) A large manufacturing company operates three region training schools for mechanics, one in each of its operating districts. The schools have two instructors each, who teach classes of about 15 mechanics in three-week sessions. The company was concerned about the effect of school (factor A) and instructor (factor B) on the learning achieved. To investigate these effects, classes in each district were formed in the usual way and then randomly assigned to one of the two instructors in the school. This was done for two sessions, and at the end of each session a suitable summary measure of learning for the class was obtained. The results are presented in the following table.

School	Instructor		Average
	1	2	
Atlanta	25, 29	14, 11	$\bar{Y}_{1..} = 19.75$
Chicago	11, 6	22, 18	$\bar{Y}_{2..} = 14.24$
San Francisco	17, 20	5, 2	$\bar{Y}_{3..} = 11.00$
Average			$\bar{Y}_{...} = 15$

- (a) Write an appropriate statistical model for this experimental situation. State the model assumptions.
- (b) Draw an ANOVA table and perform hypothesis tests for the school and instructor effect.
- (c) Now, consider that the schools indeed have more than two instructors and for this study two instructors were randomly selected. Restate the model assumption and estimate all the variances in the model. Perform hypothesis tests for this case.
2. (40pt) Consider an experimental data below

Run	Factors			Replication	
	A	B	C	1	2
1	-	-	-	1	
2	+	+	-	5	
3	-	+	+	0	
4	+	-	+	4	
5	+	-	-		3
6	-	+	-		5
7	-	-	+		2
8	+	+	+		6

- (a) Assuming you can only afford the first replication, identify the experimental design. Find the resolution and aliases.
- (b) Estimate all the effects and provide an ANOVA table and draw conclusions
- (c) Now, your boss allowed you to do the second replication (you now have both replications). Identify the design and redo (b).
3. (20pt) Consider a confounding  $2^4$  factorial design with 16 runs without replication.
- (a) Design the experiment with 4 blocks with factors BCD and ABC confounded. Find other confounded factor(s), if any.
- (b) Design the experiment with 8 blocks with factors BC, AD, CD confounded. Find other confounded factor(s), if any.