

ST4241: Design and Analysis of Clinical Trials

2009/2010: Semester I

Tutorial 9

1. The effect of five different ingredients (A,B, C, D, E) on the reaction time of a chemical process is being studied . Each batch of new material is only large enough to permit five runs to be made. Furthermore, each run requires approximately $1\frac{1}{2}$ hours, so only five runs can be made in one day. The experimenter decides to run the experiment as a Latin square so that day and batch effects may be systematically controlled. The data of the experiment is as follows.

Batch	Day				
	1	2	3	4	5
1	8 (A)	7 (B)	1 (D)	7 (C)	3 (E)
2	11 (C)	2 (E)	7 (A)	3 (D)	8 (B)
3	4 (B)	9 (A)	10 (C)	1 (E)	5 (D)
4	6 (D)	8 (C)	6 (E)	6 (B)	10 (A)
5	4 (E)	2 (D)	3 (B)	8 (A)	8 (C)

(i) Derive the ANOVA table for the data above.

(ii) Test whether the five ingredients have significant difference in their effect on reaction time at level 0.05. Draw your conclusion.

2. The following table provides the data of the study comparing four infant formulas with a single Latin square design, where the observation X_{213} is missing.

Infant	Week			
	1	2	3	4
1	0.40(2)	1.11(3)	1.16(4)	0.88(1)
2	(3)	1.04(4)	0.57(1)	0.80(2)
3	1.14(1)	1.11(2)	1.32(3)	1.38(4)
4	1.08(4)	1.34(1)	1.73(2)	1.55(3)

(i) Define a linear model for the data above.

(ii) Using the linear model approach, test the significance of the treatment (Formula) effect at level $\alpha = 0.05$. Give the value of the F statistic and draw your conclusion .

(iii) Using the linear model approach, test the significance of the time (Week) effect at level $\alpha = 0.05$. Give the value of the F statistic and draw your conclusion .

Hint: the F statistics can be obtained from the Wald statistics corresponding to the two tests.

3. The yield of a chemical process was measured using five batches of raw material, five acid concentrations, five standing times (A,B,C,D,E) and five catalyst concentrations ($\alpha, \beta, \gamma, \delta, \epsilon$). The Graeco-Latin square that follows was used. The observations of yield are imposed on the square.

Batch	Acid concentration				
	1	2	3	4	5
1	$A\alpha = 26$	$B\beta = 16$	$C\gamma = 19$	$D\delta = 16$	$E\epsilon = 13$
2	$B\gamma = 18$	$C\delta = 21$	$D\epsilon = 18$	$E\alpha = 11$	$A\beta = 21$
3	$C\epsilon = 20$	$D\alpha = 12$	$E\beta = 16$	$A\gamma = 25$	$B\delta = 13$
4	$D\beta = 15$	$E\gamma = 15$	$A\delta = 22$	$B\epsilon = 14$	$C\alpha = 17$
5	$E\delta = 10$	$A\epsilon = 24$	$B\alpha = 17$	$C\beta = 17$	$D\gamma = 14$

(i) Derive the ANOVA table of the data above.

(ii) Analyze the data and draw conclusions on various effects.

Submit your solutions to Question 1 and 2 by October 29, 2009.