

## Final

**Instructions:** Whenever a significance level is needed and not specified, use  $\alpha = 0.05$ . Only provide outputs that are directly related to your answer.

---

1. le Riche and Csima (1964) evaluated four hypnotic drugs and a placebo to determine their effect on quality of sleep in elderly patients. The treatment levels were labeled (A=Placebo, B=Ethchlorvynol, C=Glutethimide, D=Chloral hydrate and E=Secobarbital sodium). Elderly patients were given one of the capsules for five nights in succession and their quality of sleep was rated by a trained nurse on a four point scale (0=poor to 3=excellent) each night. An average score was calculated for each patient over the five nights in a week. Each patient received all five treatments in successive weeks. A Latin-square design was used to account for patient to patient differences and week to week effects. The design and the response (mean quality of sleep rating) are shown in the table below

Patient	Week 1	Week 2	Week 3	Week 4	Week 5
1	B(2.92)	E (2.43)	A(2.19)	C(2.71)	D(2.71)
2	D(2.86)	A (1.64)	E(3.02)	B(3.03)	C(3.03)
3	E(1.97)	B (2.50)	C(2.47)	D(2.65)	A(1.89)
4	A(1.99)	C (2.39)	D(2.37)	E(2.33)	B(2.71)
5	C(2.64)	D (2.31)	B(2.44)	A(1.89)	E(2.78)

- (a) What is the appropriate model for this data?
  - (b) Complete the ANOVA and determine if there are any significant differences among the treatments.
  - (c) Use an appropriate method to determine if there is a significant difference between the Placebo and the average of the other drugs, and if there are significant differences among the four drugs.
  - (d) Use residual plots to check the assumptions for the model you fit.
2. Melo et al. (2007) used a  $2^{4-1}$  fractional factorial design with generator  $D = ABC$  to study the factors that influence the production of levan by aerobic fermentation using the yeast *Zymomonas mobilis*. Levan is a sugar polymer of the fructan group which has been shown to have anti-tumor activity against sarcoma and Ehrlich carcinoma in Swiss albino mice. The factors varied in the fermentation medium and their levels are shown in the table below.

- (a) What is the defining relation and complete alias structure for this design?

Label	Factor	Level(-)	Level(+)
A	Sucrose initial concentration(g/L)	150	250
B	Temperature( $^{\circ}C$ )	20	30
C	Yeast extract initial concentration(g/L)	2.0	5.0
D	Agitation(rpm)	50	100

- (b) What is the resolution of this design?
- (c) The fermentations were carried out batchwise in Pyrex flasks. After 72 hours of fermentation, the levan produced was extracted from the fermented medium and its dry weight was determined. The results (in g/L) for the 8 experiments (in standard order) were: 4.70, 14.67, 1.71, 3.73, 9.47, 7.61, 0.15, 4.78. From this data, calculate the 7 effects and make a normal probability plot to determine what is significant.
- (d) Delete the smallest three effects and fit the model again. Are the four effects left in the model significant?
- (e) Based on the effect heredity principle, what do you think the significant string of aliased two factor interactions could represent?
- (f) Can the design be collapsed to a full factorial by ignoring insignificant factors?
- (g) Based on what you said in e) write an interpretation of the significant effects and interaction. Based on your model determine the factor levels that will produce the maximum dry weight of levan.