

Midterm

1. Consider the following Completely Randomized Design in which percentage yield of a product is studied as the percent of one of its constituents is changed. Use $\alpha = .01$ for all tests.
 - (a) Test whether the linear model is better than the intercept model, and whether the linear model is as good as the quadratic model (the quadratic model is equivalent to the cell means model in a 3-level design).
 - (b) Construct separate power curves for each of the above hypotheses, using a reasonable estimate of σ^2 in your power analysis, and assuming the researcher wanted to be able to detect a linear contrast of 1 and a quadratic contrast of 2. What conclusions can you reach about the sample sizes needed to detect effects for the two hypotheses? Do the sample sizes seem unreasonable in comparison to the size of the pilot experiment?

	15	20	25
23.72	31.48	33.44	
24.83	33.12	35.22	
21.96	30.96	34.23	
24.54	29.98	32.97	
23.69	31.99	35.20	

2. Consider the following SAS output from analysis of a BIBD.
 - (a) If the grand mean is 17.36, compute $\hat{\tau}_1, \dots, \hat{\tau}_a$.
 - (b) Compute estimates of $V(\hat{\tau})$, $V(\tilde{\tau})$, and an appropriate estimate of α_1 .

Source	DF	Sum of Squares	Mean Square	F Value	Pr>F
Model	6	35.3643213	5.894054	1.68	.2927
Error	5	17.5361432	3.507229		
Total	11	52.9004645	4.809133		

Source	DF	Type III SS	Mean Square	F Value	Pr>F
Trt	3	28.1711298	9.390377	1.98	.2395
Block	3	8.1365558	2.712185	0.77	.5568

Trt	y LSMEAN	LSMEAN Number
A	25.36113298	1
B	26.53332198	2
C	9.87876314	3
D	13.58998693	4

3. The defect rate (in parts per thousand–ppt) for three different products (1, 2, and 3) is measured on each of three assembly lines. In the study, three operators from three different shifts are monitored for their defect rate.

	Shift 1			Shift 2			Shift 3		
	Operator								
Line	1	2	3	4	5	6	7	8	9
1	3=9	1=1	2=8	2=4	3=7	1=2	1=5	2=7	3=11
2	1=4	2=12	3=18	3=17	1=5	2=14	2=8	3=19	1=10
3	2=19	3=22	1=10	1=6	2=14	3=19	3=20	1=4	2=18

- (a) Develop tests for Product effect, Shift effect, Operator effect, Line effect, Operator(Shift), and the Product X Shift interaction. Multiple GLM, MODEL or CONTRAST statements are permissible.