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MAS 314 Design of Experiments

Assignment 6 For discussion on 20 February 2007

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1 A factorial experiment has two treatment factors: C, which has three levels, and D, which has two levels. The design has four complete blocks. The systematic design is shown below.

Block	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	4
Plot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
C	1	1	2	2	3	3	1	1	2	2	3	3	1	1	2	2	3	3	1	1	2	2	3	3
D	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2

Which of the following methods of randomizing is correct? What is wrong with the other methods?

(a) Choose a random permutation of 24 objects and apply it to levels of both C and D at the same time.

(b) Choose a random permutation of 24 objects and apply it to levels of C; then choose another random permutation of 24 objects and apply it to levels of D.

(c) Within each block independently, choose a random permutation of 6 objects and apply it to levels of both C and D at the same time.

(d) Within each block independently, choose one random permutation of 6 objects and apply it to levels of C; then choose another random permutation of 6 objects and apply it to levels of D.

(e) Within each block and each level of C independently, toss a coin to decide the order of the two levels of D.

(f) Within each block and each level of D independently, choose a random permutation of three objects and apply it to the levels of C.

(g) Choose a random permutation of three objects and use it to relabel the levels of C; then do a similar thing for D.

2 A food company was interested in the precision of measuring the amount of the vitamin called niacin in bran products. Thirty-six samples of bran flakes were used. Twelve were left alone; twelve were enriched with 4 milligrams of niacin; and twelve were enriched with 8 milligrams of niacin.

Four laboratories were asked to take part in the study. The company was interested in differences between the laboratories, and also wanted to know if the laboratories were consistent in their estimation of differences in the amounts of niacin.

Three samples of each type were sent to each laboratory. Each laboratory put its nine samples into a random order, and then measured the amount of niacin in each sample according to instructions sent by the company. The measurements are shown below. The data have been reordered for ease of manual calculation.

	Niacin enrichment		
	+0 mg	+4 mg	+8 mg
Laboratory 1	8.03	11.50	15.10
	7.35	10.10	14.80
	7.66	11.70	15.70
Laboratory 2	8.50	11.75	16.20
	8.46	12.88	16.16
	8.53	12.64	16.48
Laboratory 3	7.31	11.11	15.00
	7.85	11.00	17.00
	7.92	11.67	15.50
Laboratory 4	8.82	12.90	17.30
	8.76	12.00	17.60
	8.52	13.50	18.40

(a) Calculate the analysis-of-variance table for these data.

(b) Are the laboratories consistent in their measurement of the differences in the amounts of niacin?

(c) Calculate the two tables of means for main effects.

(d) Give the standard error of the difference between two laboratories and the standard error of the difference between two enrichment amounts.

(e) Test the hypothesis that the method of measurement correctly gives the difference between the amount of niacin in the "+0 mg" samples and the "+4 mg" samples.

3 A group of people researching ways to reduce the amount of cholesterol in the blood are planning their next experiments. One says:

> We know that aspirin reduces cholesterol. Let's experiment with the quantity of aspirin. We could enrol about 150 healthy men into the trial, give 50 of them one aspirin tablet per day for a year, another 50 one and a half aspirin tablets a day, and the final 50 will get two aspirin tablets per day.
>
> When we have decided which quantity is best, we can run another trial to find out if there is any difference between taking the aspirin after breakfast or after dinner.

How do you reply?