Randomized Complete Block Designs
Solutions

1. Describe how you would assign diets to pens.

We could randomly assign each of the four diets to the four pens, separately, on each farm (i.e., each farm would require a separate randomization). This gives a RCBD; see 3 below. The advantage of this randomization scheme is that we take steps to ensure that the treatments are applied under similar experimental conditions (by appearing on each farm). This allows us to make better comparisons between the performances of the diets (treatments).

This design differs from a completely randomized design (CRD). In a CRD, we would say that there are 24 pens total (4 pens on each of 6 farms) and then ignoring potential differences in the farms, we would randomly pick 6 pens out of the 24 to assign diet A; then we would randomly pick 6 pens out of the remaining 6 to assign diet B; then we would randomly pick 6 pens out of the remaining 6 to assign diet C; the remaining 6 pens would go to diet D. By this randomization, we don't control how often treatments appear on any single farm.

2. What are the experimental units in this experiment? An experimental unit is a pen.

3. The researchers used a **randomized complete block design** (RCBD) in this experiment. Describe the blocks in this experiment.

A group of pens on any farm form a block (similar experimental units).

4. The back of this handout contains data, SAS code, and SAS output for the analysis of this experiment. Why is the first *glm* statement inappropriate for the analysis of this data?

The first SAS analysis ignores the farms and treats the experiment like a CRD.

5. There is a big difference between the results of the two analyses. What features of the data cause the results to differ?

The RCBD analysis (2nd SAS analysis) treats the blocks (the "farms") as a source of variation in weight gain measurements due to differences in the farms; we know that there should be natural differences in the farms (management, location, etc.) and we can explain this source of variation by incorporating a "farm effect" into the model. After we account for sources of variation due to differences in farms and differences in diets (the treatments), the remaining variation goes into the "SSE" which is small compared to the SS due to "farms" and "diets". (Note that we use this error to test for differences in diets and because this error is small, this allows us to make sharper comparisons of the treatments/diets.)

6. Pretend that the experiment had not included diets C and D so that only 12 pens had been used to study diets A & B (not 24) with 2 pens per farm on each of the 6 farms. Try to fill in the missing entries in the following ANOVA table for the experiment comparing diets A & B.

Source	DF	SS	MS	F	P-VALUE
Farm	5	2.69174167	0.53834833	60.16	less than 0.001 (by SAS, exact 0.0002)
Diet	1	0.29140833	0.29140833	32.57	between 0.001 & 0.01 (exact is 0.0023)
Error	5	0.04474167	0.00894833		
C. Total	11	3.02789167			