Lecture 31 Wednesday April 19

~~PLAN~~ What we actually did:

•) 15 min Sample ALC Talk & Pointers (← About 10 min.) for Statistics Majors, illustrating:

under Homework on class web site

1) Speak with sufficient volume & clarity to be understood at the back of the room
2) Make eye contact w/ the audience occasionally (it's ok to refer to some notes)
3) Prepare slides that contain the essential content and which are easily visible in back of room
   - tables & graphs all visible

(pp. 163-168 of lecture notes) •) Introduce randomized complete block design - for HW07 Q#2

•) Project 2 last-minute questions

CHAPTER 21 Randomized Block Design

This is a very commonly-used design. Call the response variable Y; let r be the number of treatments. Suppose there is a nuisance variable which is known to affect the variance of Y. In this design we group experimental units into several blocks; each block contains r units that have equal or similar values of the nuisance variable. Then apply each treatment to one unit in each block. Thus each block is a *replicate* of the base experiment.

- For this to be a randomized block design, there must be random assignment of treatments within the blocks.
- If blocking is done well, the experimental error variance can be greatly reduced in comparison to what would be obtained from a completely randomized one-way design.

Example 1: Crop yield Suppose the field for the experiment has a fertility gradient, and suppose you have $r = 4$ treatments as in the corn yield (fertility, manure) example. Divide the field up into five blocks of four plots each from High (Block 1) to Low fertility (Block 5). Randomly assign the four treatments within each of the five blocks. This makes sense, to be sure each treatment gets a fair representation in the range of available fertility levels.

Recall the educational experiment, Ch. 15. Three different math methods were assigned at random to three seventh-grade sections within several schools. School is the blocking factor.

Example 2: Risk premium (text, p. 895/901). In an experiment on decision making, executives were exposed to one of three methods of quantifying the maximum risk premium they would be willing to pay to avoid uncertainty in a business decision.

Treatment factor: Method (utility, worry, comparison)

Response variable: $Y =$ degree of confidence in the method, on a scale from 0 (no confidence) to 20 (highest confidence).

Experimental units: Fifteen executives served as subjects to whom the levels of the trt factor would be assigned at random within blocks.

Blocking factor: Age, five levels from oldest to youngest; three executives per block.

In an experiment on decision making, executives were exposed to one of three methods of quantifying the maximum risk premium they would be willing to pay to avoid uncertainty in a business decision. The three methods (treatments) are the utility method, the worry method, and the comparison method. After using the assigned method, the subjects were asked to state their degree of confidence in the method of quantifying the risk premium on a scale from 0 (no confidence) to 20 (highest confidence).

Fifteen subjects were grouped into five blocks of three executives each, according to age. Block 1 contained the three oldest executives, and so on. Five independent random permutations of three were used to assign treatments separately in each block (layout not shown here).

Main reasons for blocking:

- Reduction of confounding: In small experiments especially, in the completely randomized design, the randomization may not "work" to perfectly balance all confounding variables among the treatment groups. With the RB design, you are guaranteed to get fair comparisons of all treatments with respect to the blocking variable.
- By controlling for block factor in this way, you reduce the experimental error variance, compared to the one-way completely randomized design, sometimes by a lot.

Randomized blocks, randomization in R

```
> set.seed(16)
> for (i in 1:5)
>  {
>    print(sample(1:3,replace=FALSE))
>  }
#
[1] 1 2 3
[1] 1 3 2
[1] 3 2 1
[1] 2 3 1
[1] 3 1 2
```

Randomization chart

Give ID's 1, 2, 3 to the three exec's within a block. Our randomization:

```
[1] 1 2 3
[1] 1 3 2
[1] 3 2 1
[1] 2 3 1
[1] 3 1 2
```

Blocks	Treatments 1	2	3
1	Exec. 1	Exec. 2	Exec. 3
2	Exec. 1	Exec. 3	Exec. 2
3	3	2	1
4	2	3	1
5	3	1	2