A split-plot design with whole plots arranged in blocks (RCBSPD)

(Steel, Torrie and Dickey, 1997) Consider an experiment to compare the yields on oats using three chemical seed treatments and an untreated check:

- Treatments
  - check, CeresanM, Pannogen, Agrox

Four lots of oats will be used:

- Lots
  - Vicland 1 (infected w/ *H. Victoriae*)
  - Vicland 2 (not infected)
  - Clinton
  - Branch

The experiment involves 16 whole plots. Blocks of size four, with homogeneous fertility within blocks, are formed from these plots. Seed lots are randomized to the blocks in such a way that each lot is observed on exactly one plot within each block. In turn, the seed treatments were assigned at random to four subplots within each whole plot. Appropriate SAS code appears in "oats.sas".

		Seed Treatment			
Seed lot	Block	Check	Ceresan M	Panogen	Agrox
Vicland 1	1	42.9	53.8	49.5	44.4
	2	41.6	58.5	53.8	41.8
	3	28.9	43.9	40.7	28.3
	4	30.8	46.3	39.4	34.7
Vicland 2	1	53.3	57.6	59.8	64.1
	2	69.6	69.6	65.8	57.4
	3	45.4	42.4	41.4	44.1
	4	35.1	51.9	45.4	51.6
Clinton	1	62.3	63.4	64.5	63.6
	2	58.5	50.4	46.1	56.1
	3	44.6	45.0	62.6	52.7
	4	50.3	46.7	50.3	51.8
Branch	1	75.4	70.3	68.8	71.6
	2	65.6	67.3	65.3	69.4
	3	54.0	57.6	45.6	56.6
	4	52.7	58.5	51.0	47.4
	Mean				

1. Use PROC MEANS to obtain mean yield for all 16 treatment combinations. Obtain an interaction plot of these treatment means.

2. Characterize the interaction. What's going on with these treatments?

3. Fit this model using PROC MIXED:

$$Y_{ijk} = \mu + \alpha_i + B_k + (\alpha B)_{ik} + \beta_j + (\alpha\beta)_{ij} + E_{ijk}$$

   where B_k denote random block effects, $(\alpha B)_{ik}$ denote random block-variety interactions and E_{ijk} are random errors.

```
proc mixed method=type3;
   class variety block treatment;
   model yield=treatment|seedlot;
   random block block*seedlot;
run;
```

4. Use LSMEANS with the SLICE option to obtain F-ratios and p-values for appropriate contrasts or hypotheses suggested by the interaction plot.