A Two-Phase Corn Seed Germination Experiment

(Prof. T.B. Bailey Jr., Iowa State University, kindly provided a more complicated version of this experiment.) A study to investigate corn seed germination involved a field and a laboratory phase. In the field phase, an experiment to produce corn seed was conducted at three sites; at each site a randomized complete block design of two blocks was run to investigate the differences between three mechanical harvesters. Four samples of seed were harvested from each plot, combined and then divided into 36 lots. In the laboratory phase of the experiment, there were nine containers each with four plates that were to be used for germinating seed in each of 18 intervals. In each of these intervals, the 36 lots of the seed from a plot were placed on the four plates in the nine containers, the interval in which the seed from a plot was germinated being assigned at random. In each interval, nine temperature-moisture conditions, referred to as nine treatments, were randomly assigned to the nine containers. Thus the inherent crossing of containers with intervals was ignored. The percentage germination of the seeds was recorded for each plate.

This two-phase experiment differs from others in that treatments are introduced in both the first and second phases. The sets for this experiment are plates, lots, harvesters and treatments and the tiers are $\mathcal{F}_{\text{plates}} = \{\text{Intervals}, \text{Containers}, \text{Plates}\}$, $\mathcal{F}_{\text{lots}} = \{\text{Sites}, \text{Plots}, \text{Blocks}, \text{Lots}\}$, $\mathcal{F}_{\text{harvesters}} = \{\text{Harvesters}\}$ and $\mathcal{F}_{\text{treatments}} = \{\text{Temperatures}, \text{Moistures}\}$. There are three randomizations: harvesters to plots, lots to plates and treatments to plates. The first two randomizations are composed and the third is partly coincident with and partly independent of the second. Figure 1 gives the randomization diagram. New in this diagram is the black circle preceded by an arrow and with lines leading from it to both Containers and Plates — it indicates that Lots are randomized to Containers $\wedge$ Plates. This randomization and that of Plots $\wedge$ Sites $\wedge$ Blocks are independent, but can be reduced to single randomization. The randomization of Lots is coincident with that of treatments. On the other hand the randomization of Plots $\wedge$ Sites $\wedge$ Blocks and treatments are independent, but cannot be reduced to a single randomization.

The permutation group used for the first randomization is $S_3 \wr S_2 \wr S_3$ (since Lots are only implicit at this stage) while that for the coincident second and third randomizations is $S_4 \wr S_9 \wr S_{18}$.

The factor Lots could be omitted from the above description, but it is included to emphasize that the 36 lots from a given plot must not be allocated systematically to the 36 plates.

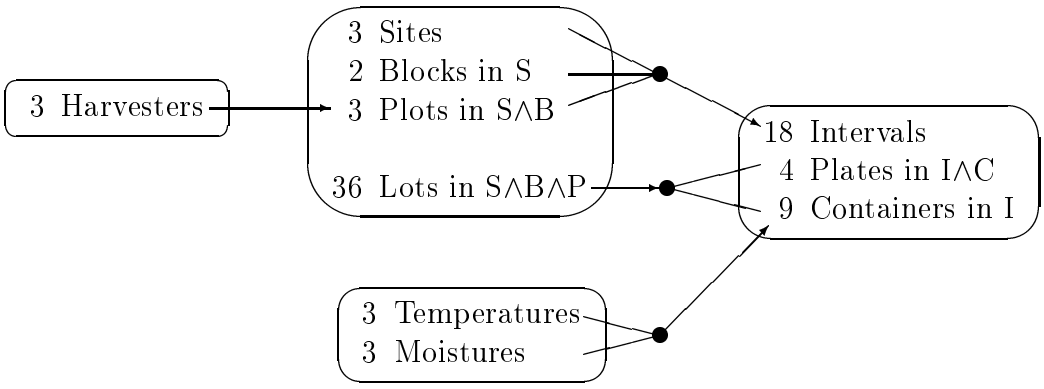

Figure 1: Composed and coincident randomizations in the two-phase corn experiment