

Statistics 514: Design of Experiments

Topic 4 Summary

Experimental Design

Use statistical ideas (randomization, factor inclusion) to improve accuracy, reduce bias.

Sometimes works well.

Themes

- What's measured vs. what's analyzed
 - *Experimental Units (EU)* – independent, source of replication and repeating measures
 - *Replication* occurs between EU's.
 - Use *blinding* and *controls* to guard against effect of act of experimentation.
- *Variability*
 - Want to estimate types (planned and chance-like)
 - Want to avoid confounding source
 - May result from selection procedure (with unseen factors)

Randomization

- Guards against unforeseen patterns . . . probably
- Usually all possible allocations with equal probability, not haphazardly
- Allows randomization analysis (same as *t*-test for large sample size)

Principles

- *Removing bias*
 - intervention
 - randomization
- *Improving precision*
 - replication
 - blocking
 - balance

- *Possibilities for interpretation*
 - completeness
 - interaction
 - random/fixed effects – inference vs. prediction

Mechanics of Randomization Test

- List all possible permutations of levels within pairs (equally likely under null hypothesis).
- Calculate test statistic value for each permutation.
- Find proportion of value that are larger (in absolute value) than data-based value.
- Does not require normality assumption, but constant variance is implied.

Ultimately, simple randomization is not necessarily the most efficient sampling scheme, but it is the most straightforward setup which leads to valid assertions.

Randomization

Being unlucky is inevitable; best strategy is to understand chances of being unlucky.

Blocking

Turn known “nuisance factors” (with homogeneous levels) into quantifiable variation.

- Increases precision (as opposed to reducing bias with randomization)