

Statistics 514: Design of Experiments

Topic 1 Summary

- *Statistics* is about summarizing information with models when variability present.
- Use (possibly different) assumptions to report evidence.
- *Statisticians* seek to generalize data methodology across disciplines.
- *Experiments* involve manipulation of sample X values to find information on distribution of Y .
 - Several possible outcomes
 - Want accurate, efficient, and generalizable results.

Context of Experimentation

What an experiment does:

- Gives information about a system
 - Comparison of treatment/levels
 - Screening of possible effects
 - Function exploration/optimization
 - Robustness to noise
- Does so directly, accurately – leading to strong inference
- Part of iterative process/Scientific Method

Alternatives to Experiments

- Experiments never replace insight/experience but can leverage.
- Advantages in making conclusions beyond observations

Examples

- No statistics: other sources of information besides data
 - Judgment from Experience
 - Rule books
 - Mathematical Manipulation
 - Hunches

- Non-comparative experiments
- Investigating Accidents
- Observational Studies

Not Experiments

- no manipulation
- commonly subject to unaccounted bias
- compare populations

Experiments

- Problems to solve: fill out (aspects of) relationship between (controlled) input and output
 - Several aims (usually based on context of prediction)
 - Dependence?
 - Looking for best (category, value, variance)
- Approach to planning
 - Steps obvious but overlooked
 - Bring order to ingredients (problem statement then response then treatment then ...)

Themes

- Good science vs. good statistics
- Statistical vs. non-statistical concepts
- Analysis vs. design
- Practical vs. statistical significance
- Consistency vs. generalizability
- Importance of prior knowledge: experiments iterate.
- Testing assumptions
- Simple/straightforward/concise: how much do you *need* to know?
- Importance of interaction