Topic #11: Design of experiments

Experimental design is a research design in which the researcher has control over the selection of participants in the study, and these participants are randomly assigned to treatment and control groups. The first statistician to consider a methodology for the design of experiments was Sir Ronald A. Fisher. He described how to test the hypothesis that a certain lady could distinguish by flavor alone whether the milk or the tea was first placed in the cup. While this sounds like a frivolous application, it allowed him to illustrate the most important means of experimental design:

- Randomization - The process of making something random
- Replication - repeating the creation of a phenomenon, so that the variability associated with the phenomenon can be estimated
- Blocking - the arranging of experimental units in groups (blocks) which are similar to one another
- Orthogonality - Means perpendicular, at right angles or statistically normal
- use of factorial experiments instead of the one-factor-at-a-time method Analysis of the design of experiments was built on the foundation of the analysis of variance, a collection of models in which the observed variance is partitioned into components due to different factors which are estimated and/or tested

Some efficient designs for estimating several main effects simultaneously were found by Raj Chandra Bose and K. Kishen in 1940 at the Indian Statistical Institute, but remained little known until the Plackett-Burman designs were published in Biometrika in 1946.

In 1950, Gertrude Mary Cox and William Cochran published the book Experimental Design which became the major reference work on the design of experiments for statisticians for years afterwards.

Developments of the theory of linear models have encompassed and surpassed the cases that concerned early writers. Today, the theory rests on advanced topics in abstract algebra and combinatorics.

As with all other branches of statistics, there is both classical and Bayesian experimental design.