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Design and Analysis of Experiments

07 - Paired Design

Version 2.11

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“*I am driven by two main philosophies: know more today about the world than I knew yesterday and lessen the suffering of others. You’d be surprised how far that gets you.*”

Neil deGrasse Tyson
1958 -
American astrophysicist and author.

Image: `http://goo.gl/hzzFUJ`

Comparison of two means

Dependent samples

Comparison of two means

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Comparison of two means

Paired design

Suppose the following situation: a young researcher develops an optimization algorithm (A) for a given family of problems, and wants to compare its converegence speed against a method that represents the state-of-the-art (B).

The researcher implements both methods and, after adjusting their parameters in a balanced way, performs a battery of tests on 11 representative instances of the family of problems she is interested in.

The measurements are made under homogeneous conditions (same computer, same operational conditions, etc.) and in randomized order, trying to avoid the contamination of the results by spurious influences. 20 repeated runs are performed for each algorithm on each problem.

Comparison of two means

Paired design

Some important questions worth considering:

- What is the actual question of interest?
- What is the *population* for which that question is relevant?
- What are the independent observations for that population?
- What is the relevant sample size for the experiment?

Comparison of two means

Paired design

The *variation among the test problems* is a source of a large spurious variation that can and must be controlled;

An elegant solution to eliminate the influence of this nuisance parameter is the *pairing* of the measurements by problem:

- Observations are considered in pairs (A, B) for each problem;
- Hypothesis testing is done on the sample of *differences*;

Let y_{1j} and y_{2j}, $(j = 1, \ldots, n)$ denote paired observations of average time for the proposed method (1) and the standard one (2), for each problem j;

The *paired differences* of the observations are calculated as $d_j = y_{1j} - y_{2j}$.

Bibliography

Required reading

1

Recommended reading

1

About this material

Conditions of use and referencing

Please reference this work as:

Felipe Campelo (2015), *Lecture Notes on Design and Analysis of Experiments*.
Online: https://github.com/fcampelo/Design-and-Analysis-of-Experiments
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