Lectures in Statistics

An Indo-French Workshop
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Indian Statistical Institute)
[In honour of Professor C.R. Rao who turned 100 on September 10, 2020]
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Linear Models

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Outline of lectures

We intend to cover the following topics -- in the order mentioned, as much as we can in the stipulated time.

1. Introduction to linear models through examples
2. Formulation using matrix algebra and questions we may like to answer
3. Background from linear (matrix) algebra
4. General theory of linear models: estimating and testing
5. One-way ANOVA (analysis of variance) model
6. Balanced two-way ANOVA model, without interaction
7. Balanced two-way ANOVA model, with interaction

A short discussion on testing statistical hypotheses

Mohan Delampady
Indian Statistical Institute, Bengaluru

A brief introduction to hypothesis testing will be presented.

Topics to be covered:

- Elements of statistical hypothesis tests
- Optimality of tests
- Hypothesis testing versus model selection
- Likelihood ratio tests

Probal Chaudhuri
Indian Statistical Institute
Kolkata

Regression techniques

I shall discuss linear regression and least squares. I shall briefly talk about the history of least squares and regression in addition to standard statistical issues and problems.

Tapas Samanta
Indian Statistical Institute
Kolkata

A short discussion on point estimation

The following topics will be briefly discussed.

Sufficient statistics
Methods of estimation
Methods of evaluating estimators
Consistency and efficiency of estimators

From linear regression to mixed effects models. Applications in bio pharmacy.

Marc Lavielle (Ecole Polytechnique-Paris)

Population models describe biological and physical phenomena observed in each of a set of individuals, and also the variability between individuals. This approach finds its place in domains like pharmacometrics when we need to quantitatively describe interactions between diseases, drugs and patients. This means developing models that take into account that different patients react differently to the same disease and the same drug. The population approach can be formulated in statistical terms using mixed effects models.

In this course, we will define what is a (linear and non-linear) mixed effects model. We will briefly present some estimation methods for these models and consider an example in pharmacokinetics.

Some references

Davidian, M and Giltinan, D. M. *Nonlinear models for repeated measurement data.* CRC press, 1995.

Lavielle M. *Mixed Effects Models for the Population Approach. Models, Tasks, Methods & Tools*, Chapman & Hall/CRC Biostatistics Series, 2014.

Website *Statistics in Action* http://sia.webpopix.org/nlme

Introduction to concentration inequalities with statistical applications

Bernard Bercu, University of Bordeaux, France

The purpose of these two courses is to provide an introduction to concentration inequalities for sums of independents random variables with statistical applications. The course program is as follows.

1) Introduction
2) Hoeffding's inequality
3) Improvement of Hoeffding's inequality
4) The Chernoff calculation
   4a) Bernoulli random variables
   4b) Geometric random variables
   4c) Exponential random variables
   4d) Gaussian random variables
5) Statistical applications
   5a) Exact confidence intervals
   5b) Random walks
   5c) Random permutations

Reference

B. Bercu, B. Delyon, E. Rio, Concentration inequalities for sums and martingales, Springer Briefs in Mathematics, 2015.