On-line course materials

MATH48001 - Statistical Inference

Year: 4 - **Semester:** 1 - **Credit Rating:** 15

Requisites

Prerequisites
MATH20701 Probability 2

Aims

This course unit aims to introduce students to the principles of efficient estimation and hypothesis testing and acquaint them with the more successful methods of estimation and of constructing test procedures.

Brief Description

Statistical Inference is the body of principles and methods underlying the statistical analysis of data. In this course we introduce desirable properties that good estimators and hypothesis tests should enjoy and use them as criteria in the development of optimal estimators and test procedures. This is done both from the Classical/Frequentist as well as from the Bayesian point of view.

Learning Outcomes

On successful completion of this module students will be able

- to determine how good an estimator or test procedure is on a number of criteria;
- to construct estimators and test procedures based both on the maximum likelihood principle and on Bayesian principles.

Syllabus

- Estimation: point estimation, unbiasedness, mean square error, consistency, sufficiency, factorization theorem, Cramer-Rao inequality, the score function, Fisher information; efficiency: most efficient estimators, minimal sufficiency, Rao Blackwell theorem and its use in improving an estimator. [8]
- Methods of estimation: maximum likelihood estimators (m.l.e) and their asymptotic properties, asymptotic distribution of the score function. Confidence intervals based on the m.l.e and on the score function (multivariate case included). Restricted m.l.e and their asymptotic properties. [7]

- Hypothesis testing: Neyman-Pearson criteria, size and power function. Simple null vs simple alternative hypothesis and the Neyman-Pearson lemma. Hypothesis tests based on (i) m.l.e's; (ii) score function; (iii) the generalised likelihood ratio, profile log-likelihood and its use in interval estimation. The Deviance function and graphical methods in obtaining confidence regions for parameters. [9]
- Bayesian inference: introduction, priors, posteriors, conjugate prior, non-informative priors, Jeffrey's non informative prior, Bayesian estimation, predictive distributions, accuracy of an estimate, loss functions and expected posterior loss, optimal decisions with respect to a loss function, credibility intervals, highest posterior density credible intervals, hypothesis tests, large sample Bayesian approximation. [12]

Teaching & Learning Process (Hours Allocated To)

Lectures	Tutorials/ Example Classes	Practical Work/ Laboratory	Private Study	Total
33	11	0	106	150

Assessment and Feedback

- Coursework: weighting 20%
- End of semester examination: three hours, weighting 80%

Further Reading

- Beaumont, G. P., Intermediate Mathematical Statistics. Chapman & Hall 1980.
- Cox, D. R. and Hinkley, D. V., Theoretical Statistics. , Chapman & Hall 1974.
- Lindgren, B. W. Statistical Theory, 4th edition, Chapman & Hall 1993.
- Mood, A. M., Graybill, F. A. and Boes, D. C., Introduction to the Theory of Statistics, 3rd edition, McGraw-Hill 1974.
- Silvey, S. D., Statistical Inference, Chapman & Hall 1075.

Staff Involved

Dr Eos Kyprianou - Lecturer

Data source is EPS system

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