Course information 2023-24
ST2134 Advanced statistics: statistical inference (half course)

General information

COURSE LEVEL: 5

CREDIT: 15

NOTIONAL STUDY TIME: 150 hours

Summary

To infer means to make general statements on the basis of specific observations. From an early age, human beings are experts at inference. It is such a fundamental part of our intelligence that we do it without even thinking about it. We learn to classify objects on the basis of a very limited set of examples. In statistical inference, we go from specific to general via a mathematical model. Our specific observations come from a data set; that is, a collection of numbers, or at least, information that can be represented numerically. The mathematical models that we use draw on distributions of probability that are described in the companion half course *ST2133 Advanced statistics: distribution theory*. Methods for using probabilistic models to make general statements on the basis of an observed set of data is the central topic of this half course.

Conditions

Co-requisite: Students can only take ST2134 Advanced statistics: statistical inference at the same time as, or after, the following courses, not before:

- ST2133 Advanced statistics: distribution theory

Prerequisites: If taken as part of a BSc degree, the following courses must be attempted before you can register on this course:

- **EITHER** MT1174 Calculus **OR** MT1186 Mathematical methods **OR** (**BOTH** MT105a Mathematics 1 **AND** MT105b Mathematics 2)

AND

- ST1215 Introduction to Mathematical Statistics **OR** (**BOTH** ST104a Statistics 1 AND ST104b Statistics 2)†

† You are advised to take a full unit mathematics course (MT1174 Calculus **OR** MT1186 Mathematical methods) **and** the full unit statistics course (ST1215 Introduction to mathematical statistics) as they provide a stronger foundation in concepts used in ST2134 Advanced statistics: statistical inference than are provided by the half-unit combinations MT105A Mathematics 1 + MT105B Mathematics 2 and ST104A Statistics 1 + ST104B Statistics 2.

Please consult the current EMFSS Programme Regulations for further information on the availability of a course, where it can be placed on your programme's structure, and other important details.

Aims and objectives

The aim of this course is to provide a thorough theoretical grounding in statistical inference. The course teaches fundamental material which is required for specialised courses in statistics, actuarial science and econometrics.

Learning outcomes

At the end of this half course and having completed the essential reading and activities students should be able to:

- explain the principles of data reduction
- judge the quality of estimators
- choose appropriate methods of statistical inference to tackle real problems.

Recommended reading

For full details, please refer to the reading list.

Casella, G. and R.L. Berger Statistical Inference. (Duxbury, 2008) second edition [ISBN 978-8131503942]

Assessment

This course is assessed by a two-hour and fifteen-minute closed-book written examination.

Syllabus

Data reduction; Sufficiency, minimal sufficiency. Likelihood.

Point estimation; Bias, mean squared error, consistency. Rao–Blackwell theorem. Central limit theorem. Method of moments estimators. Order statistics. Minimum variance unbiased estimators, Cramér–Rao lower bound. Properties of maximum likelihood estimators.

Interval estimation; Coverage probability and length. Pivotal functions.

Hypothesis testing; Most powerful tests. Neyman–Pearson lemma. Likelihood ratio test.

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