Course Aims

The aim of this course is to introduce graduate students to advanced statistical principles and practice. The course builds on the statistical inference and mathematical statistics you have already met in your undergraduate studies and in Theory of Statistics III in particular. Students who complete ASI IV can expect to gain

- a substantial knowledge of the mathematical statistics underpinning advanced statistical methodology such as pattern recognition;
- an understanding of modern model selection methods and the expertise to use them appropriately;
- the ability to use and develop modern computer-intensive methods including the bootstrap and cross-validation (especially in R); and
- a firm understanding and working knowledge of Bayesian statistics.

Lecturer

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Lectures

Tuesdays at 3.10pm and and Fridays at 3.10pm in Room EMG07.

I will mostly use the black-board to present the lecture material, so please come along prepared to take your own notes. Additional handouts and notes will be provided from time to time.

There are no formal tutorials or practicals for this course so you should seek help from me when you need it. Handouts, assignments, etc will be available from my web page http://www.maths.adelaide.edu.au/people/psolomon/teaching/html

Assignments and Assessment:

There will be four assignments during the course and a final three-hour exam. The best three assignments will count 30% towards your final mark if your combined assignments plus exam (30% + 70%) give the higher final mark. Otherwise, your final mark will be based on the exam result alone.
Course outline

Frequentist inference: Exponential family models; group transformation models. Sufficient statistics and minimal sufficiency. Conditional and marginal inference; ancillary statistics.

Model selection and prediction: Stepwise selection procedures; Likelihood selection methods: Mallow’s $C_p$, Akaike’s Information Criterion (AIC), Bayesian Information Criterion (BIC). Cross-validation. Model averaging.


Bayesian statistics: Introduction to Bayesian inference: point estimation and interval estimation. Choosing a prior; conjugate distributions.

Statistical decision theory: (if we have time) Mathematical formulation; criteria for decision rules: admissibility, unbiased rules, minimax and Bayes rules. Pattern recognition.

Recommended reading

There is no set textbook for this course but there are a number of books you will find helpful background reading. The key references by topic are as follows:

- Inference:

  
  *I like this book for its more detailed treatment of mathematical statistical inference without being too technical. It's not a very exciting read though.*

  
  *This book includes sections on many of the topics we will be covering in this course, in particular the sections on frequentist inference and Bayesian statistics. The treatment is a little more formal than mine, but you will find it useful and the examples are interesting.*

  
  *Bits and pieces from this book will be useful. For example, it contains nice treatments of distributions and generalised linear models.*

- Model selection and prediction

  There isn't a good book on model selection yet, so I will primarily source the original papers and subsequent publications for material on this topic. Two books that are relevant and provide useful background reading are


• **Bootstrapping**

*The best monograph on this topic is still*


*The following book provides more advanced and technical reading:*


• **Bayesian statistics:**


Further library details of some of these books are given in the attached bibliography, where additional useful sources and reading are also given. The key course references are available on Reserve as well as via normal loan from the Barr Smith Library. You can borrow Reserve collection books overnight if you call by the desk at around 5pm. Other references are dispersed through the research journal literature, and will be referred to in the lectures as appropriate.

Patty Solomon  
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