Subject Information Guide

Theory of Statistics, STA4TS

Semester 2, 2016

Administration and contact details

Host Department	Department of Mathematics and Statistics
Host Institution	La Trobe University
Name of lecturer	Assoc Prof Paul Kabaila
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Subject details

Handbook entry URL	http://www.latrobe.edu.au/students/subjects/2016/STA4TS
Subject homepage URL	http://www.latrobe.edu.au/students/subjects/2016/STA4TS
Honours student hand-out URL	http://www.latrobe.edu.au/students/subjects/2016/STA4TS
Start date:	25 July 2016
End date:	17 October 2016
Contact hours per week:	2
Lecture day and time:	Monday, 10am to 12noon, with extra time for questions (if needed)
Description of electronic access arrangements for students (for example, WebCT)	Students are sent PDF files of the lecture slides a few days before the lectures, by email attachment. They are also sent PDF files of assignments, by email attachment.

Subject content

1. Subject content description

This subject covers a selection of topics in classical statistical inference at the fourth year level. It consists of a selection of material from the following chapters of Casella and Berger (2002): Chapter 6 (Principles of Data Reduction), Chapter 7 (Point Estimation), Chapter 8 (Hypothesis

Testing), Chapter 9 (Interval Estimation) and Chapter 10 (Asymptotic Evaluations). A knowledge of this material is helpful in almost any statistical endeavour.

Reference: Casella, G. and Berger, R.L. (2002) Statistical Inference, 2nd edition. Duxbury.

2. Week-by-week topic overview

Week 1: Overview of sufficiency (including the factorization theorem) and minimal sufficiency.

Week 2: Ancillary statistic defined as a statistic whose distribution does not depend on theta. Alternative definition of ancillary statistic via preliminary reduction by minimal sufficiency. The role of ancillary statistics in inference -- Cox's mixture of normal distributions example. The practical importance of inference conditional on an ancillary statistic.

Week 3: Further comments on inference conditional on an ancillary statistic. Introduction to data reduction by equivariance. Review of confidence intervals, including the coverage probability and the confidence coefficient. Properties of the coverage probability function for confidence intervals obtained from count data. Risk functions for confidence intervals.

Week 4: The effect of preliminary model selection on confidence intervals. Review of the following paper: Freeman, P.R. (1989). The performance of the two-stage analysis of two-treatment, two-period crossover trials. Statistics in Medicine, 8, 1421 -- 1432.

Week 5: Revision of the method of moments and maximum likelihood estimation from third year statistical inference. Introduction to two methods of evaluating estimators - (a) comparison after first restricting the class of estimators (e.g. to be unbiased) and (b) comparing the risk functions.

Week 6: Review of the Cramer-Rao inequality. Proof of this inequality.

Week 7: The likelihood ratio test. Neyman-Pearson Lemma and its proof.

Week 8: Definitions of level and size of a hypothesis test. An introduction to Intersection-Union tests. Level and size of these tests.

Week 9: p-values from an advanced standpoint (Probability Integral Transformation result assumed), including in the presence of nuisance parameters. Confidence sets obtained by inverting a family of hypothesis tests.

Week 10: Convergence in probability and convergence in distribution.

Week 11: Slutsky's theorem and the rigorous justification of the Delta Method.

Week 12: The definition of a consistent estimator and the difference between limiting and asymptotic variances. Review.

3. Assumed prerequisite knowledge and capabilities

A third year statistical inference subject or equivalent.

4. Learning outcomes and objectives

AQF specific Program Learning Outcomes and Learning Outcome Descriptors (if available):

AQF Program Learning Outcomes addressed in this subject	Associated AQF Learning Outcome Descriptors for this subject
Present clear proofs of fundamental results in the advanced theory of statistical inference given in the lectures.	K1, S2
Derive mathematical calculations to investigate properties of data reduction by sufficiency, data reduction by ancillarity, data reduction by invariance, the assessment of confidence intervals and the effect of model selection on confidence intervals.	K1, S2
Write clear, well structured and rigorous proofs of results in the theory of statistical inference that the students have not seen in lectures. This includes appropriate use of statistical and mathematical vocabulary and notation.	K2, S1, S3, S4, A2, A3, A4
Describe some important implications for statistical practice of the advanced theory of statistical inference.	A3

Learning Outcome Descriptors at AQF Level 8

Knowledge

K1: coherent and advanced knowledge of the underlying principles and concepts in one or more disciplines

K2: knowledge of research principles and methods

Skills

S1: cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problem with intellectual independence

S2: cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas

S3: cognitive skills to exercise critical thinking and judgement in developing new understanding

S4: technical skills to design and use in a research project

S5: communication skills to present clear and coherent exposition of knowledge and ideas to a variety of audiences

Application of Knowledge and Skills

A1: with initiative and judgement in professional practice and/or scholarship

A2: to adapt knowledge and skills in diverse contexts

A3: with responsibility and accountability for own learning and practice and in collaboration with others within broad parameters

A4: to plan and execute project work and/or a piece of research and scholarship with some independence

5. Learning resources

Copies of lecture slides are sent to the students by email attachment before the lectures each week. Copies of the assignments are sent to the students by email attachment. Extensive reference is made to the reference text:
Casella, G. and Berger, R.L. (2002) Statistical Inference, 2nd edition. Duxbury.

6. Assessment

Exam/assignment/classwork breakdown					
Exam	60 %	**Assignment**	40 %	**Class work**	0 %
Assignment due dates		Assignments are due 2 weeks after the assignment is given out, with the possibility of extension, if needed.			
Approximate exam date				Mid- November	

Institution Honours program details

Weight of subject in total honours assessment at host department	15/120
Thesis/subject split at host department	45/75
Honours grade ranges at host department:	
H1	80-100 %
H2a	70-79 %
H2b	60-69 %
H3	50-59 %