Subject Information Guide

Advanced Data Analysis

Semester 1, 2017

Administration and contact details

Host Department	School of Mathematics and Applied Statistics
Host Institution	University of Wollongong
Name of lecturer	Dr Thomas Suesse
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Subject details

Handbook entry URL	
Subject homepage URL	
Honours student hand-out URL	
Start date:	28 February 2017
End date:	**30 May.**
Contact hours per week:	2
Lecture day and time:	Tuesday 15:30-17:30
Description of electronic access arrangements for students (for example, WebCT)	You will be given access to the eLearning site of UOW and will be able to download all material.

Subject content

1. Subject content description

STAT902 introduces a variety of techniques for advanced data analysis, particularly regression, for handling categorical data, dependent data, nonlinear data, and situations where parts of the model are unknown or misspecified. Generalised linear models are considered in detail, as well as other ways of modelling nonlinearity, such as nonlinear models and nonparametric analysis. A variety of

ways to model dependent (e.g., repeated measures) data is considered, particularly, linear mixed models, generalised linear mixed models, generalised estimating equations, and latent variable models. Frequentist and Bayesian approaches to inference are considered, including likelihood, quasilikelihood, bootstrap, and sandwich estimation, conjugate priors, Monte-Carlo methods and Markov chain Monte-Carlo, as well as some graphical models, numerical integration, and prior elicitation.

2. Week-by-week topic overview

Tentative schedule:

Weeks 1: Subject overview; revision of matrix algebra and vector calculus, distributions, and maximum likelihood.

Weeks 2–3: Estimating functions, quasi-likelihood, sandwich estimation, mean-variance misspecification, and bootstrap techniques.

Weeks 4–5: Bayesian inference and computation, prior elicitation.

Week 6–8: Generalised linear models and nonlinear least-squares, overview of model selection.

Weeks 9–10: Linear models for dependent data: linear mixed models and generalised estimating equations.

Weeks 11–12: Nonlinear models for dependent data: generalised linear mixed models and nonlinear mixed models.

Week 13: Overview of nonparametric methods.

3. Assumed prerequisite knowledge and capabilities

Statistical distribution theory, maximum likelihood estimation, fundamentals of statistical inference, multiple regression (linear), logistic and/or Poisson regressions, basic matrix algebra.

4. Learning outcomes and objectives

After successful completion of this subject, students should be able to perform the following tasks which develop the listed Graduate Qualities (GQ):

1. Analyse complex data, particularly data with dependence, repeated measures, categorical response variables, overdispersion, and nonlinearity; and interpret the analyses
2. Select and apply sophisticated statistical techniques (mostly regression-related) to answer

substantive questions. Techniques include generalised linear models, Bayesian inference, mixed models, quasilikelihood, sandwich estimation, bootstrap, generalised estimating equations, model selection, and nonlinear and nonparametric models.

3. Recognise assumptions and limitations of statistical techniques considered, and diagnose their suitability for the data and the research question.
4. Derive expressions for point estimates, variances, and other quantities of interest for the techniques considered
5. Implement and perform data analyses and diagnostics using R and BUGS/JAGS, including writing independent code in R language.

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
Insert Program Learning Outcome here	Choose from list below
Insert Program Learning Outcome here	Choose from list below
Insert Program Learning Outcome here	Choose from list below
Insert Program Learning Outcome here	Choose from list below
Insert Program Learning Outcome here	Choose from list below
Insert Program Learning Outcome here	Choose from list below
Insert Program Learning Outcome here	Choose from list below

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

Available from eLearning Site (Moodle).

6. Assessment

Exam/assignment/classwork breakdown					
Exam	60 %	**Assignment**	40 %	**Class work**	
Assignment due dates		TBA	.		
Approximate exam date				10 June	

Institution Honours program details

Weight of subject in total honours assessment at host department	1/8
Thesis/subject split at host department	BMath (Hons): Thesis worth 25% BMathAdv (Hons): Thesis worth 37.5%
Honours grade ranges at host department:	
H1	85-100
H2a	75-84
H2b	65-74
H3	50-64