The University of Southern Queensland

Course specification

This version produced 20 Dec 2007.
The current and official versions of the course specifications are available on the web at <http://www.usq.edu.au/coursespecification/current>.
Please consult the web for updates that may occur during the year.

Description: Statistical Models

Subject	Cat-nbr	Class	Term	Mode	Units	Campus
STA	3301	66250	2, 2007	EXT	1.00	Toowoomba

Academic group: FOSCI
Academic org: FOS003
Student contribution band: 2
ASCED code: 010103

STAFFING

Examiner: Peter Dunn
Moderator: Ashley Plank

REQUISITES

Pre-requisite: STA2302

RATIONALE

Linear Models and generalised linear models are very widely used statistical tools. Linear models allow us to model data with normally distributed errors and generalised linear models extend these methods to a wider family of distributions. Students seeking to specialise in statistics will need to understand and be competent in these techniques. While students are expected to have obtained some understanding of linear regression techniques in previous courses, this course offers a more mathematically complete introduction to linear models and then, building on this, extends into generalised linear models. The key functions of linear models are for describing the relationships between variables and predicting outcomes and so inference methods will be addressed in some detail. Finally, as models only give useful information when they provide an accurate reflection of the 'real world', various diagnostic tests on the appropriateness and goodness of fit of various models will be introduced.

SYNOPSIS

This course introduces the student to linear models. Both the mathematical development and practical applications of these models will be considered. Appropriate mathematical and statistical computer programs will be used. The topics include developing multiple regression models, testing hypotheses for these models, selecting the 'best' model, diagnosing problems in model fit, developing generalised linear models, and a range of applications of generalised linear models including logistic, Poisson and log-linear models.

OBJECTIVES

On successful completion of this course students will be able to:

1. specify a linear model, including the assumptions; (Assignment 1, Exam)
2. describe how least square and maximum likelihood estimators are calculated and specify the least squares and maximum likelihood estimators for the parameters of the linear model; (Assignment 1, Exam)
3. describe the characteristics (such as mean and variance) of the least square and maximum likelihood estimators of the parameters of the linear model; (Assignment 1, Exam)
4. describe an appropriate estimator of the error variance; (Assignment 1, Exam)
5. fit linear models using an appropriate software package; (Assignment 1-3, Exam)
6. use the resulting model for prediction; (Assignment 1-3, Exam)
7. calculate and interpret the coefficient of determination and multiple and partial correlations for the model; (Assignment 1 & 2, Exam)
8. test hypotheses about the significance of individual regression coefficients and combinations of regression coefficients; (Assignment 1-3, Exam)
9. test the goodness of fit of the model; (Assignment 1-3, Exam)
10. describe and apply a range of criteria for selecting the 'best' model; (Assignment 1-3, Exam)
11. conduct appropriate diagnostic checks on the model, such as analysis of residuals, checks for outliers and influential points and checks for multicollinearity and suggest possible solutions to any problems identified; (Assignment 1-3, Exam)
12. describe the exponential family of distributions and check whether specific distributions are members of this family; (Assignment 2 & 3, Exam)
13. find the mean and variance of a member of the exponential family of distributions; (Assignment 2 & 3, Exam)
14. specify the generalised linear model; (Assignment 2 & 3, Exam)
15. describe the role of the link function and how it is derived; (Assignment 2 & 3, Exam)
16. fit generalised linear models using appropriate software; (Assignment 2 & 3, Exam)
17. calculate the deviance and find the 'best' model using analysis of deviance; (Assignment 2 & 3, Exam)
18. fit logistic regression models to binary variables using appropriate software; and correctly interpret the results; (Assignment 3, Exam)
19. fit Poisson regression models using appropriate software and correctly interpret the results; (Assignment 3, Exam)
20. fit appropriate models to contingency table counts and test the significance of potential regressors. (Assignment 3, Exam)

TOPICS

	Description	Weighting (%)
1.	Review of multiple regression: specifying the model, least squares estimators of regression parameters and variance, maximum likelihood estimators of the regression parameters and variance, multiple and partial correlation, regression through the origin.	15.00
2.	Inference on the normal model: interval estimation of the regression parameters and variance, prediction of future responses, analysis of variance, coefficient of determination,tests on single regression coefficients, confidence regions, tests on a subset of the regression coefficients, procedures for model selection, tests on the general linear model, test of goodness fit.	15.00

3.	Model selection and checking: criteria for selecting regressors, residual analysis, data transformations, weighted least squares, detecting outliers and influential observations, multicollinearity, detecting multicollinearity.	15.00
4.	Generalised linear models: the exponential family of distributions, the mean and variance of the exponential family, specifying the generalised linear model, the link function, estimation of the regression parameters, adequacy of the model, the deviance, analysis of deviance and model selection.	25.00
5.	Binary variables and logistic regression: probability distributions, generalised linear models, logistic regression model, deviance, Pearson's Chi-Square test, residuals and other diagnostics.	15.00
6.	Count data, Poisson regression and log-linear models: Poisson regression, probability models for contingency tables, log-linear models, inference for log-linear models.	15.00

TEXT and MATERIALS required to be PURCHASED or ACCESSED

ALL textbooks and materials are available for purchase from USQ BOOKSHOP (unless otherwise stated). Orders may be placed via secure internet, free fax 1800642453, phone 07 46312742 (within Australia), or mail. Overseas students should fax +61 7 46311743, or phone +61 7 46312742. For costs, further details, and internet ordering, use the 'Textbook Search' facility at http://bookshop.usq.edu.au click 'Semester', then enter your 'Course Code' (no spaces).

Students will require access to the Semester 2, Department of Mathematics and Computing DVDROM SET, 2007 (available from the USQ Bookshop). This DVD set contains Semester 2 course material, and Windows software relevant to this course. For more information about the DVD sets and their use, please refer to http://www.sci.usq.edu.au/dvdrom and the course web site.

Dobson, AJ 2002, *An Introduction to Generalized Linear Models*, 2nd edn, Chapman and Hall, London.

REFERENCE MATERIALS

Reference materials are materials that, if accessed by students, may improve their knowledge and understanding of the material in the course and enrich their learning experience.

Christensen, R 1997, *Log-linear models and logistics regression*, 2nd edn, Springer, New York.

(Also available electronically through ebrary)

Cox, DR & Snell, EJ 1989, *Analysis of binary data*, 2nd edn, Chapman and Hall, London.

Draper, N & Smith, H 1998, *Applied regression analysis*, 3rd edn, Wiley, New York.

Everitt, BS 1992, *The analysis of contingency tables*, 2nd edn, Chapman and Hall, London.

Krzanowski, WJ 1998, *An introduction to statistical modelling*, Arnold, London.

McCullagh, P & Nelder, JA 1989, *Generalised linear models*, 2nd edn, Chapman and Hall, London: New York.

Montgomery, DC, Peck, EA & Vining, GG 2001, *Introduction to linear regression analysis*, 3rd edn, Wiley, New York.

Myers, RH 1990, *Classical and modern regression with applications*, 2nd edn, Duxbury Press, Belmont.

Myers, RH, Montgomery, DC & Vining, GC 2001, *Generalised linear models with applications in engineering and the sciences*, Wiley, New York.

Weisberg, S 2005, *Applied linear regression*, 3rd edn, Wiley, New York.

STUDENT WORKLOAD REQUIREMENTS

ACTIVITY	HOURS
Assessment	30.00
Examinations	2.00
Private Study	127.00

ASSESSMENT DETAILS

Description	Marks out of	Wtg(%)	Due date
ASSIGNMENT 1	15.00	15.00	20 Aug 2007
ASSIGNMENT 2	15.00	15.00	14 Sep 2007
ASSIGNMENT 3	15.00	15.00	22 Oct 2007
2 HR RESTRICTED EXAMINATION	55.00	55.00	END S2 (see note 1)

NOTES

1. Examination dates will be available during the Semester. Please refer to Examination timetable when published.

IMPORTANT ASSESSMENT INFORMATION

1 Attendance requirements:
There are no attendance requirements for this course. However, it is the students' responsibility to study all material provided to them or required to be accessed by them to maximise their chance of meeting the objectives of the course and to be informed of course-related activities and administration.

2 Requirements for students to complete each assessment item satisfactorily:
To satisfactorily complete an assessment item a student must achieve at least 50% of the marks or a grade of at least C-. Students do not have to satisfactorily complete each assessment item to be awarded a passing grade in this course. Refer to Statement 4 below for the requirements to receive a passing grade in this course.

3 Penalties for late submission of required work:
If students submit assignments after the due date without prior approval then a penalty of 10% of the total marks gained by the student for the assignment will apply for each working day late.

4 Requirements for student to be awarded a passing grade in the course:
To be assured of receiving a passing grade a student must achieve at least 50% of the total weighted marks available for the course.

5 Method used to combine assessment results to attain final grade:

The final grades for students will be assigned on the basis of the aggregate of the weighted marks obtained for each of the summative assessment items in the course.

6 Examination information:
Candidates are allowed access only to specific materials during a Restricted Examination. The only materials that candidates may use in the restricted examination for this course are: writing materials (non-electronic and free from material which could give the student an unfair advantage in the examination); calculators which cannot hold textual information (students must indicate on their examination paper the make and model of any calculator(s) they use during the examination); Students whose first language is not English, may, with the Examiner's approval, take an appropriate non-electronic translation dictionary (but not technical dictionary) into the examination. Students who wish to use a translation dictionary MUST request and receive written approval from the Examiner at least one week before the examination date. Translation dictionaries will be subject to perusal and may be removed from the candidate's possession until appropriate disciplinary action is completed if found to contain material that could give the candidate an unfair advantage.

7 Examination period when Deferred/Supplementary examinations will be held:
Any Deferred or Supplementary examinations for this course will be held during the examination period at the end of the semester of the next offering of this course.

8 University Regulations:
Students should read USQ Regulations 5.1 Definitions, 5.6. Assessment, and 5.10 Academic Misconduct for further information and to avoid actions which might contravene University Regulations. These regulations can be found at the URL http://www.usq.edu.au/corporateservices/calendar/part5.htm or in the current USQ Handbook.

ASSESSMENT NOTES

9 Students must retain a copy of each item submitted for assessment. If requested, students will be required to provide a copy of assignments submitted for assessment purposes. Such copies should be despatched to USQ within 24 hours of receipt of a request being made.

10 The due date for an assignment is the date by which a student must despatch the assignment to the USQ. The onus is on the student to provide proof of the despatch date, if requested by the Examiner. In accordance with University Policy, the Examiner may grant an extension of the due date of an assignment in extenuating circumstances.

11 The Faculty will normally only accept assessments that have been written, typed or printed on paper-based media. The Faculty will NOT accept submission of assignments by facsimile.