



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: Statistics for Climate Research

Subject	Cat-nbr	Class	Term	Mode	Units	Campus
STA	3303	66727	2, 2007	ONC	1.00	Toowoomba

<b>Academic group:</b>	FOSCI
<b>Academic org:</b>	FOS003
<b>Student contribution band:</b>	2
<b>ASCED code:</b>	010103

### STAFFING

Examiner: Peter Dunn

Moderator: Ashley Plank

### REQUISITES

Pre-requisite: STA2301

### RATIONALE

A significant amount of climate research is statistically based. A climatologist should therefore have a breadth of statistical training, particularly in those methods prominent in climatological research.

### SYNOPSIS

This course extends the statistical methods learnt in previous statistics courses to include higher level methods applicable to climatology. The course introduces students to time series and forecasting and multivariate analysis, with an emphasis on the application of the methods.

### OBJECTIVES

On completion of this course students will be able to:

1. demonstrate understanding of various times series and forecasting techniques, including: fitting AR models; fitting MA models; fitting ARMA models; the ACF; the PACF; diagnostic testing; the backshift operator; Markov chains (Assignment 1 and 2, Exam);
2. correctly apply time series and forecasting techniques to data, especially climatological data (Assignment 1 and 2, Exam);
3. recognize which time series and forecasting techniques may be applicable in given situations (Assignment 1 and 2, Exam);
4. demonstrate an understanding of the following multivariate analysis techniques: principal components analysis; factor analysis; cluster analysis; discriminant analysis (Assignment 3, Exam);

5. correctly apply multivariate analysis techniques to data, especially climatological data (Assignment 3, Exam);
6. demonstrate skill and knowledge using the R statistical software package to perform appropriate statistical analysis (Assignment 3, Exam).

## TOPICS

	Description	Weighting (%)
1.	Introduction to Time Series: - definitions, purpose, notation, signal and noise, simple methods, the R software.	5.00
2.	Autoregressive (AR) models: - definition, forecasting, the backshift operator, statistics of AR models	5.00
3.	Moving Average (MA) models: - definition, the backshift operator, forecasting, statistics of MA models; why have two different types of models?	10.00
4.	ARMA models: - definition, the backshift operator, statistics of ARMA models, forecasting, conversion of models	10.00
5.	Finding a model: - identifying a model, the ACF, the PACF, the AIC, parameter estimation, forecasting using R	10.00
6.	Diagnostic tests: - the residual ACF, the residual PACF, identification of ARMA models, the Box-Pierce (Q)-test, the cumulative periodogram, significance of parameters, alternative models, evaluating the performance of a model	10.00
7.	Non-stationary models: - non-stationarity in the mean, non-stationarity in the variance, ARIMA models, seasonal models, forecasting, diagnostics	10.00
8.	Markov chains: - terminology, the transition matrix, forecasting the future, classification of finite Markov chains, limiting probabilities	10.00
9.	Other Models: - using other models, brief descriptions of some other models	5.00
10.	Introduction to multivariate analysis: - multivariate data, preview of methods, review of mathematical concepts, software, displaying multivariate data, some hypothesis tests.	5.00
11.	Principal components analysis: - the procedure, when should the correlation matrix be used?, selecting the number of PCs, interpretation, uses of PCA, using R, spatial PCA, rotation of PCs	10.00
12.	Factor Analysis: - the procedure, interpretation, the differences between PCA and factor analysis., rotation, using R	5.00
13.	Cluster Analysis: - types of cluster analysis, problems with cluster analysis, measures of distance, using PCA and cluster analysis, using R.	5.00

## **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.

Introductory Book 2007, *Course STA3303 Statistics for Climate Research*, USQ Distance and e-Learning Centre, Toowoomba.

Manly, BFJ 2004, *Multivariate statistical methods: a primer*, 3rd edn, Chapman & Hall, New York.

(ISBN: 1584884142)

Selected Readings 2007, *Course STA3303 Statistics for Climate Research*, USQ Distance and e-Learning Centre, Toowoomba.

Study Book 2007, *Course STA3303 Statistics for Climate Research*, USQ Distance and e-Learning Centre, Toowoomba.

## **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.

Box, GE, Jenkins, GM & Reinsel, GC 1994, *Time series analysis forecasting and control*, 3rd edn, Prentice Hall, Englewood Cliffs, NJ.

Cureton, EE & D'Agostino, RB 1983, *Factor analysis: an applied approach*, L Erlbaum Associates, Hillsdale, NJ.

Dalgaard, P 2002, *Introductory statistics with R*, Springer, New York.

Dunteman, GH 1989, *Principal components analysis*, Sage Publications, Newbury Park.

Everitt, B 1993, *Cluster analysis*, 3rd edn, Edward Arnold, London.

Flury, B 1988, *Multivariate statistics: a practical approach*, Chapman & Hall, London/New York.

Karson, MJ 1982, *Multivariate statistical methods: an introduction*, Iowa State University Press, Ames, Iowa.

Krause, A 1997, *The basics of S and S-Plus*, Springer, New York.

(2002 edition available through ebrary (through library catalogue))

Krzanowski, WJ 2000, *Principles of multivariate analysis: a user's perspective*, Clarendon Press, Oxford.

Makridakis, S, Wheelwright, S & Hyndman, RJ 1998, *Forecasting: methods and applications*, 3rd edn, Wiley, New York.

Mehdi, J 1994, *Stochastic processes*, John Wiley & Sons, New York.

Papoulis, A 2002, *Probability, random variables and stochastic processes*, 4th edn, McGraw Hill, New York.

Polyak, I 1996, *Computational statistics in climatology*, Oxford University Press, New York.

Solomon, F 1987, *Probability & stochastic processes*, Prentice Hall, Englewood Cliffs, NJ.

Storch, HV 1999, *Statistical analysis in climate research*, Cambridge University Press, Cambridge.  
(Also available through ebrary (electronic book through library catalogue))

Venables, WN 1999, *Modern applied statistics with S-PLUS*, 3rd edn, Springer, New York.

Wilks, DS 1995, *Statistical methods in the atmospheric sciences: an introduction*, Academic Press, New York.

## STUDENT WORKLOAD REQUIREMENTS

ACTIVITY	HOURS
Assessment	40.00
Laboratory or Practical Classes	26.00
Lectures	26.00
Private Study	73.00

## ASSESSMENT DETAILS

Description	Marks out of	Wtg(%)	Due date
ASSIGNMENT 1	30.00	30.00	17 Aug 2007
ASSIGNMENT 2	30.00	30.00	01 Oct 2007
ASSIGNMENT 3	20.00	20.00	26 Oct 2007
1 HR RESTRICTED EXAMINATION	20.00	20.00	END S2 (see note 1)

### NOTES

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

## IMPORTANT ASSESSMENT INFORMATION

- 1 Attendance requirements:  
It is the students' responsibility to attend and participate appropriately in all activities (such as lectures, tutorials, laboratories and practical work) scheduled for them, and 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 available for that assessment item.
- 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:  
In a Restricted Examination, candidates are allowed access to specific materials during the 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).
  - 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.