The University of Southern Queensland

# Course specification

**Description: Statistics for Climate Research**

| Subject | Cat-nbr | Class | Term | Mode | Units | Campus |
|---|---|---|---|---|---|---|
| STA | 3303 | 44960 | 2, 2005 | ONC | 1.00 | Toowoomba |

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

## STAFFING

Examiner: Karla Ziri-Castro
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;
2. correctly apply time series and forecasting techniques to data, especially climatological data;
3. recognize which time series and forecasting techniques may be applicable in given situations;
4. demonstrate an understanding of the following multivariate analysis techniques: principal components analysis; factor analysis; cluster analysis; discriminant analysis;
5. correctly apply multivariate analysis techniques to data, especially climatological data;
6. demonstrate skill and knowledge using the R statistical software package to perform appropriate statistical analysis.

## 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).

Department of Mathematics and Computing CDROM SET 1, 2005 (available from the USQ Bookshop). This CD set contains course material Windows and Linux software relevant to this course offering. For more information about the CD sets and their use, please refer to http://www.sci.usq.edu.au/cdrom and the course web site.

Introductory Book 2005, *Course STA3303 Statistics for Climate Research*, USQ Distance and e-Learning Centre, Toowoomba.

Manly, Bryan F.J. 2004, *Multivariate Statistical Methods: A Primer*, 3rd edn, Chapman & Hall, New York. ISBN: 1584884142.

Selected Readings 2005, *Course STA3303 Statistics for Climate Research*, USQ Distance and e-Learning Centre, Toowoomba.

Study Book 2005, *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, G E & Jenkins, G M & Reinsel, G C 1994, *Time Series Analysis Forecasting and Control*, 3rd edn, Prentice Hall, Englewood Cliffs, NJ.

Cureton, Edward E & D'Agostinao, Ralph B 1983, *Factor analysis: an applied approach*, L Erlbaum Associates, Hillsdale, NJ.

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

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

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

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

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

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

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

Makridakis, S, Wheelwright, Steven & Hyndman, Rob J 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, Ilya 1996, *Computational statistics in climatology*, Oxford University Press, New York.

Solomon, F 1987, *Probability & Stochastic Processes*, Prentice Hall, Englewood Cliffs, NJ.

Storch, H V 1999, *Statistical analysis in climate research*, Cambridge University Press, Cambridge.

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

Wilks, Daniel S 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 | 40.00 | 40.00 | 23 Sep 2005 |
| ASSIGNMENT 2 | 40.00 | 40.00 | 19 Oct 2005 |
| 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 complete each of the assessment items satisfactorily, students must obtain at least 50% of the marks available for each 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 submit all of the summative assessment items and achieve at least 50% of the available marks for those items.

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.