STAT7121

Multivariate Analysis

Session 2, Special circumstance 2020

Department of Mathematics and Statistics

Contents

Disclaimer

Notice

As part of Phase 3 of our return to campus plan, most units will now run tutorials, seminars and other small group learning activities on campus for the second half-year, while keeping an online version available for those students unable to return or those who choose to continue their studies online.

To check the availability of face-to-face and online activities for your unit, please go to timetable viewer. To check detailed information on unit assessments visit your unit's iLearn space or consult your unit convenor.

General Information

Unit convenor and teaching staff
Unit Convenor/Lecturer
Jun Ma
jun.ma@mq.edu.au
Contact via by email
Please refer to iLearn

Lecturer
Nino Kordzakhia
nino.kordzakhia@mq.edu.au
Contact via by email
Please refer to iLearn

Credit points
10

Prerequisites
Admission to MRes

Corequisites
STAT7310 or STAT710

Co-badged status
STAT8121

Unit description
This unit studies basic methods of multivariate statistical analysis. Multivariate data arise when each unit of observation in the sample has more than one variable measured. Multivariate statistical analysis provides ways to analyse dependence structures within multivariate data, as well as to meaningfully simplify, classify and group such data. The unit introduces methodologies and techniques for the exploration and analysis of multivariate data. Topics include graphical displays, discriminant analysis, principal components analysis, multivariate normal distribution, multivariate linear models, cluster analysis.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

ULO1: Understand the fundamental difference between univariate and multivariate analysis.

ULO2: Know how to perform hypothesis testing (mainly the Hotelling T2 test and chi-square test) using multivariate data.

ULO3: Understand and be able to apply MANOVA and understand multivariate regression.

ULO4: Know the theories of PCA and factor analysis (FA), and be able to apply these methods to real data.

ULO5: Understand likelihood based, as well as minimum expected cost based, discriminant analysis. Be able to apply these discriminant analysis methods to real data.

ULO6: Know how to display multivariate data graphically using R and be able to use the R package for multivariate data analysis.

General Assessment Information

ASSIGNMENT SUBMISSION: Assignment submission will be online through the iLearn page. Submit assignments online via the appropriate assignment link on the iLearn page. A personalised cover sheet is not required with online submissions. Read the submission statement carefully before accepting it as there are substantial penalties for making a false declaration.

• Assignment submission is via iLearn. You should upload this as a **single scanned PDF file**.

• Please note the quick guide on how to upload your assignments provided on the iLearn page.

• It is your responsibility to make sure your assignment submission is legible.

• If there are technical obstructions to your submitting online, please email us to let us know.

You may submit as often as required prior to the due date/time. Please note that each submission will completely replace any previous submissions. It is in your interests to make frequent submissions of your partially completed work as insurance against technical or other problems near the submission deadline.

LATE SUBMISSION OF WORK: All assignments or assessments must be submitted by the official due date and time. No marks will be given to late work unless an extension has been granted following a successful application for Special Consideration. Please contact the unit convenor for advice as soon as you become aware that you may have difficulty meeting any of the assignment deadlines. It is in your interests to make frequent submissions of your partially completed work. Note that later submissions completely replace any earlier submission, and so only the final submission made before the due date will be marked.

FINAL EXAM POLICY: examinations for individuals or groups of students. All students are expected to ensure that they are available until the end of the teaching semester, that is, the final day of the official examination period. The only excuse for not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In these special

circumstances, you may apply for special consideration via ask.mq.edu.au.

SUPPLEMENTARY EXAMINATIONS: IMPORTANT: If you receive special consideration for the final exam, a supplementary exam will be scheduled in the interval between the regular exam period and the start of the next session. If you apply for special consideration, you must give the supplementary examination priority over any other pre-existing commitments, as such commitments will not usually be considered an acceptable basis for a second application for special consideration. Please ensure you are familiar with the policy prior to submitting an application. You can check the supplementary exam information page on FSE101 in iLearn (https://bit.ly/FSESupp) for dates, and approved applicants will receive an individual notification sometime in the week prior to the exam with the exact date and time of their supplementary examination.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 1	15%	No	Week 4
Assignment 2	15%	No	Week 8
Assignment 3	15%	No	Week 12
Final Exam	55%	No	University Formal Examination Period

Assignment 1

Assessment Type [1]: Quantitative analysis task
Indicative Time on Task [2]: 10 hours
Due: **Week 4**
Weighting: **15%**

Students should prepare this assignment using a word-processing software such as Microsoft Word or Latex and then students should convert the assignment to a pdf document.

Students are required to submit their assignments (pdf documents) before the due time. Students will submit their assignments via a link on iLearn.

On successful completion you will be able to:
- Understand the fundamental difference between univariate and multivariate analysis.
- Know how to perform hypothesis testing (mainly the Hotelling T2 test and chi-square test) using multivariate data.
- Know how to display multivariate data graphically using R and be able to use the R

package for multivariate data analysis.

Assignment 2

Assessment Type [1]: Quantitative analysis task
Indicative Time on Task [2]: 10 hours
Due: **Week 8**
Weighting: **15%**

Students should prepare this assignment using a word-processing software such as Microsoft Word or Latex and then students should convert the assignment to a pdf document.

Students are required to submit their assignments (pdf documents) before the due time. Students will submit their assignments via a link on iLearn.

On successful completion you will be able to:

- Understand and be able to apply MANOVA and understand multivariate regression.
- Know how to display multivariate data graphically using R and be able to use the R package for multivariate data analysis.

Assignment 3

Assessment Type [1]: Quantitative analysis task
Indicative Time on Task [2]: 10 hours
Due: **Week 12**
Weighting: **15%**

Students should prepare this assignment using a word-processing software such as Microsoft Word or Latex and then students should convert the assignment to a pdf document.

Students are required to submit their assignments (pdf documents) before the due time. Students will submit their assignments via a link on iLearn.

On successful completion you will be able to:

- Know the theories of PCA and factor analysis (FA), and be able to apply these methods to real data.
- Understand likelihood based, as well as minimum expected cost based, discriminant analysis. Be able to apply these discriminant analysis methods to real data.
- Know how to display multivariate data graphically using R and be able to use the R

package for multivariate data analysis.

Final Exam

Assessment Type [1]: Examination
Indicative Time on Task [2]: 40 hours
Due: **University Formal Examination Period**
Weighting: **55%**

The final exam will be an open book online exam.

On successful completion you will be able to:

- Understand the fundamental difference between univariate and multivariate analysis.
- Know how to perform hypothesis testing (mainly the Hotelling T2 test and chi-square test) using multivariate data.
- Understand and be able to apply MANOVA and understand multivariate regression.
- Know the theories of PCA and factor analysis (FA), and be able to apply these methods to real data.
- Understand likelihood based, as well as minimum expected cost based, discriminant analysis. Be able to apply these discriminant analysis methods to real data.
- Know how to display multivariate data graphically using R and be able to use the R package for multivariate data analysis.

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[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Writing Centre for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

We use the software package R in this Unit. R is becoming increasingly important for statisticians and other scientists. More information about R can be found at the web site http://www.r-projec t.org/ and the package can be downloaded free of charge from there. R is very similar to the package S-PLUS and most of its codes will also work in S-Plus. From week 2, students will be given exercises each week covering materials from the lectures, and most exercises require using R. Recommended texts Prescribed textbook: "Applied Multivariate Statistical Analysis" by

Richard A. Johnson, Dean W. Wichern (6th edition)

Students are expected to possess a copy of this textbook and are required to read certain book chapters each week. The following books may be used as other references for this unit: DILLON & GOLDSTEIN Multivariate Analysis – Methods and applications(QA 278 .d55) FAHRMEIR & TUTZ Multivariate statistical modelling based on generalized linear models (QA 278 .F34) FLURY, B A first course in multivariate statistics FLURY, B Multivariate statistics: A practical approach MORRISON, D Multivariate statistical methods

Unit Schedule

Week	Topic
1	1. Introduction to multivariate analysis; 2. Overview of matrix algebra
2	1. Basic concepts of multivariate distribution; 2. Sample statistics
3	1. Multivariate sample statistics (cont.); 2. Some useful multivariate distributions
4	1. Inferences: estimation and hypothesis testing
5	1. Inferences (cont.)
6	1. MANOVA
7	1. MANOVA (cont.); 2. Multivariate regression
8	1. Regression (cont.); 2. Principal component analysis (PCA)
9	1. Factor analysis (FA)
10	1. Factor analysis (FA) (cont.)
11	1. Discriminant analysis and classification
12	1. A brief introduction to canonical correlation analysis
13	1. A brief introduction to cluster analysis

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy

- Fitness to Practice Procedure

- Grade Appeal Policy

- Complaint Management Procedure for Students and Members of the Public

- Special Consideration Policy *(**Note:** The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

Students seeking more policy resources can visit the Student Policy Gateway (https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/study/getting-started/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to help you improve your marks and take control of your study.

- Getting help with your assignment

- Workshops

- StudyWise

- Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides

- Ask a Librarian

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

If you are a Global MBA student contact globalmba.support@mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.