STAT7121

Multivariate Analysis

Session 2, In person-scheduled-weekday, North Ryde 2022

School of Mathematical and Physical Sciences

Contents

General Information

Unit convenor and teaching staff
Lecturer and Convenor
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Credit points
10

Prerequisites
Admission to MRes

Corequisites
STAT7310 or STAT710

Co-badged status

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

LATE SUBMISSION OF ASSIGNMENT:

From 1 July 2022, Students enrolled in Session based units with written assessments will have the following university standard late penalty applied. Please see https://students.mq.edu.au/study/assessment-exams/assessments for more information. Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark) will be applied each day a written assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of '0' will be awarded even if the assessment is submitted. Submission time for all written assessments is set at 11:55 pm. A 1-hour grace period is provided to students who experience a technical concern. For any late submission of time-sensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, students need to submit an application for Special Consideration.

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.

• Assignment submission is via iLearn. You must upload your work as a single scanned PDF file.

Please note 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.

Assessments where Late Submissions will be accepted

In this unit, late submissions will accepted as follows: ·

Assignment 1 – YES, Standard Late Penalty applies

Assignment 2 – YES, Standard Late Penalty applies

Assignment 3– YES, Standard Late Penalty applies

FINAL EXAMINATION: 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. In case of unavoidable disruption, the students may be eligible for Special Consideration. The application

for Special Consideration can be lodged 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. 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.

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%**

Formal invigilated examination testing the learning outcomes of the unit.

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.

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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 R software. R can be downloaded from http://www.r-project.org/ free of charge. From Week 2, students will be given exercises each week covering materials from the lectures, and most exercises require using R.

Recommended references are

"Applied Multivariate Statistical Analysis" by R. A. Johnson, Dean W. Wichern (6th edition);

"*The R software*." Lafaye de Micheaux, Pierre Lafaye, Rémy Drouilhet, and Benoit Liquet. Springer. New York, 2013.

 "Multivariate Statistical Methods: A Primer, 4th Edition" by Manly, Bryan FJ, and Jorge A.

Navarro Alberto. Chapman and Hall/CRC, 2016.

"*Introduction to multivariate analysis*." by Chatfield C. and Collins AJ, Chapman and Hall/CRC.

"Multivariate statistics: A practical approach" by Morrison, D..

Unit Schedule

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

12	A brief introduction to canonical correlation analysis
13	A brief introduction to cluster analysis

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). 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
- Assessment Procedure
- Complaints Resolution Procedure for Students and Members of the Public
- Special Consideration Policy

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

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/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

Academic Integrity

At Macquarie, we believe academic integrity – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free online writing an

d maths support, academic skills development and wellbeing consultations.

Student Support

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

The Writing Centre

The Writing Centre provides resources to develop your English language proficiency, academic writing, and communication skills.

- Workshops
- Chat with a WriteWISE peer writing leader
- Access StudyWISE
- Upload an assignment to Studiosity
- Complete the 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

Macquarie University offers a range of Student Support Services including:

- IT Support
- Accessibility and disability support with study
- Mental health support
- Safety support to respond to bullying, harassment, sexual harassment and sexual assault
- Social support including information about finances, tenancy and legal issues

Student Enquiries

Got a question? Ask us via AskMQ, or contact Service Connect.

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.