STAT810
Statistical Theory
S1 Evening 2014

Statistics

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General Information

Unit convenor and teaching staff
Other Staff
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E4A 530
Monday 2 - 4 pm

Unit Convenor
Ian Marschner
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E4A 540
11am Wednesday

Credit points
4

Prerequisites
Admission to MAappStat or PGDipAppStat or PGCertAppStat or (ACST601 and ACST602 and ACST604)

Corequisites

Co-badged status

Unit description
This unit introduces the fundamental principles of statistical inference and estimation theory. The unit begins with a discussion of probability concepts, including relative frequency, random variables, distributions and large sample theory. A discussion of estimation concepts is provided, particularly unbiasedness, consistency and efficiency. Likelihood theory is then developed, including the concept of sufficiency and the maximum likelihood approach to estimation. Hypothesis testing concepts and methods are discussed with a particular focus on likelihood ratio, score and Wald tests. An introduction to Bayesian inference principles is also provided.

Important Academic Dates
Information about important academic dates including deadlines for withdrawing from units are available at https://students.mq.edu.au/important-dates
Learning Outcomes

1. be familiar with techniques to calculate probabilities, expected values and probability, moment and cumulant generating functions for discrete, continuous and multivariate random variables and know how to apply these concepts in practical problems
2. understand fundamental limit theorems of Probability and Statistics and be able to apply them in practical problems
3. understand three modes of convergence of random variables and be able to apply them to get practical large sample approximations
4. understand and know how to use the Delta Method in practical problems
5. understand the principles and theory of estimation
6. understand the principles and theory of statistical hypothesis testing

Assessment Tasks

<table>
<thead>
<tr>
<th>Name</th>
<th>Weighting</th>
<th>Due</th>
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<tbody>
<tr>
<td>Assignment 1</td>
<td>15%</td>
<td>25 March 2014</td>
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<tr>
<td>Assignment 2</td>
<td>15%</td>
<td>29 April 2014</td>
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<tr>
<td>Assignment 3</td>
<td>15%</td>
<td>20 May 2014</td>
</tr>
<tr>
<td>Mid-year examination</td>
<td>55%</td>
<td>To be determined</td>
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Assignment 1

Due: **25 March 2014**
Weighting: **15%**

Assignment 1

This Assessment Task relates to the following Learning Outcomes:

- be familiar with techniques to calculate probabilities, expected values and probability, moment and cumulant generating functions for discrete, continuous and multivariate random variables and know how to apply these concepts in practical problems
- understand fundamental limit theorems of Probability and Statistics and be able to apply them in practical problems

Assignment 2

Due: **29 April 2014**
Weighting: **15%**
Assignment 2

This Assessment Task relates to the following Learning Outcomes:
• understand three modes of convergence of random variables and be able to apply them to get practical large sample approximations
• understand and know how to use the Delta Method in practical problems

Assignment 3
Due: 20 May 2014
Weighting: 15%

Assignment 3

This Assessment Task relates to the following Learning Outcomes:
• understand the principles and theory of estimation
• understand the principles and theory of statistical hypothesis testing

Mid-year examination
Due: To be determined
Weighting: 55%

Mid-year examination

This Assessment Task relates to the following Learning Outcomes:
• be familiar with techniques to calculate probabilities, expected values and probability, moment and cumulant generating functions for discrete, continuous and multivariate random variables and know how to apply these concepts in practical problems
• understand fundamental limit theorems of Probability and Statistics and be able to apply them in practical problems
• understand three modes of convergence of random variables and be able to apply them to get practical large sample approximations
• understand and know how to use the Delta Method in practical problems
• understand the principles and theory of estimation
• understand the principles and theory of statistical hypothesis testing

Delivery and Resources

LECTURES
Tuesday 6-9 p.m. in W5C-320.
TUTORIALS (Weeks 2-13)
E5A-150 on Wednesday 6-7 p.m.
E5A-130 on Wednesday 7-8 p.m.
E5A-230 on Wednesday 8-9 p.m.
(note: the number of tutorials will depend on enrollment and may change)

SOFTWARE
The R software package will be used for simulation and graphics. This software is freely available to be downloaded at www.r-project.org

TEXTBOOK
This textbook will provide additional readings and problems, to supplement the lecture and tutorial material.

INTERNET RESOURCES / TECHNOLOGIES USED
This unit has an iLearn website available at https://ilearn.mq.edu.au/login/MQ/
Lecture notes: these will be available on the iLearn site prior to the lecture.
Audio recordings: all lectures will be recorded and will be available after the lecture.
Consult the iLearn website frequently. Other resources available include a discussion board, assignments, administrative updates etc.

CONSULTATION HOURS
Members of the Statistics Department have consultation hours each week when they are available to help students. These consultation hours are listed on the doors of the Statistics staff located on E4A level 5.

ASSIGNMENT SUBMISSION
Students may submit assignments during the lecture or via the iLearn website.

CHANGES SINCE LAST DELIVERY
Unit Schedule

Week 1: Introduction to Probability and Statistics. Discrete random variables and their probability distributions.

Week 2: Continuous random variables and their probability distributions. Probability, Moment and Cumulant Generating Functions.

Week 3: Multivariate probability distributions. Functions of random variables.

Weeks 4 – 7: Laws of Large Numbers, Central Limit Theorem, Asymptotic Theory.

Weeks 8 – 10: Estimation, properties of estimators, likelihood theory.

Week 11 – 13: Hypotheses testing, properties of tests, likelihood-based inference methods, Bayesian inference.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:


In addition, a number of other policies can be found in the Learning and Teaching Category of 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/support/student_conduct/](https://students.mq.edu.au/support/student_conduct/)

Policy on Late submission of Assignments
Graduate Capabilities

PG - Critical, Analytical and Integrative Thinking

Our postgraduates will be capable of utilising and reflecting on prior knowledge and experience, of applying higher level critical thinking skills, and of integrating and synthesising learning and knowledge from a range of sources and environments. A characteristic of this form of thinking is the generation of new, professionally oriented knowledge through personal or group-based critique of practice and theory.

This graduate capability is supported by:

Learning outcomes

• understand the principles and theory of estimation
• understand the principles and theory of statistical hypothesis testing

Assessment tasks
• Assignment 3
• Mid-year examination

PG - Effective Communication
Our postgraduates will be able to communicate effectively and convey their views to different social, cultural, and professional audiences. They will be able to use a variety of technologically supported media to communicate with empathy using a range of written, spoken or visual formats.

This graduate capability is supported by:

Learning outcomes
• understand the principles and theory of estimation
• understand the principles and theory of statistical hypothesis testing

Assessment tasks
• Assignment 3
• Mid-year examination

PG - Discipline Knowledge and Skills
Our postgraduates will be able to demonstrate a significantly enhanced depth and breadth of knowledge, scholarly understanding, and specific subject content knowledge in their chosen fields.

This graduate capability is supported by:

Learning outcomes
• be familiar with techniques to calculate probabilities, expected values and probability, moment and cumulant generating functions for discrete, continuous and multivariate random variables and know how to apply these concepts in practical problems
• understand fundamental limit theorems of Probability and Statistics and be able to apply them in practical problems
• understand three modes of convergence of random variables and be able to apply them to get practical large sample approximations
• understand and know how to use the Delta Method in practical problems
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Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Mid-year examination

PG - Research and Problem Solving Capability

Our postgraduates will be capable of systematic enquiry; able to use research skills to create new knowledge that can be applied to real world issues, or contribute to a field of study or practice to enhance society. They will be capable of creative questioning, problem finding and problem solving.

This graduate capability is supported by:

Learning outcomes

- be familiar with techniques to calculate probabilities, expected values and probability, moment and cumulant generating functions for discrete, continuous and multivariate random variables and know how to apply these concepts in practical problems
- understand fundamental limit theorems of Probability and Statistics and be able to apply them in practical problems
- understand three modes of convergence of random variables and be able to apply them to get practical large sample approximations
- understand and know how to use the Delta Method in practical problems

Assessment tasks

- Assignment 1
- Assignment 2
- Mid-year examination

PG - Capable of Professional and Personal Judgment and Initiative

Our postgraduates will demonstrate a high standard of discernment and common sense in their professional and personal judgment. They will have the ability to make informed choices and decisions that reflect both the nature of their professional work and their personal perspectives.

This graduate capability is supported by:

Learning outcomes

- understand the principles and theory of estimation
- understand the principles and theory of statistical hypothesis testing
Assessment tasks

- Assignment 3
- Mid-year examination

Changes since First Published

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<tr>
<th>Date</th>
<th>Description</th>
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<tr>
<td>16/01/2014</td>
<td>The Prerequisites was updated.</td>
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