STAT683

Introduction to Probability

S2 External 2019

Dept of Mathematics and Statistics

Contents

General Information

Unit convenor and teaching staff
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Credit points
4

Prerequisites
Admission to MAppStat or GradCertAppStat or GradDipAppStat or MSc or MDataSc or MScInnovation

Corequisites
STAT670

Co-badged status
This unit is co-taught with STAT273.

Unit description
This unit consolidates and expands upon the material on probability introduced in STAT670. The emphasis is on the understanding of probability concepts and their application. Examples are taken from areas as diverse as biology, medicine, finance, sport, and the social and physical sciences. Topics include: the foundations of probability; probability models and their properties; some commonly used statistical distributions; relationships and association between variables; distribution of functions of random variables and sample statistics; approximations including the central limit theorem; and an introduction to the behaviour of random processes. Simulation is used to demonstrate many of these concepts.

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:

Be able to describe a probabilistic model for an experiment, calculate probability and conditional probability of an event. Have a deep understanding of the independence of events.

Have a solid understanding of the difference between discrete and continuous random variables.

For discrete or continuous random variables be able to calculate probabilities of events, their expected values and variances. Graph the probability distributions or probability density functions and the cumulative distribution functions. Using moment generating functions for finding of moments of random variables. Generate random numbers from distributions and use these numbers for solving probability problems.

Have a deep knowledge of a bivariate probability distribution, joint, marginal, conditional probabilities and covariance. Have a solid understanding of a bivariate Normal distribution.

Understand limit theorems: the Law of Large Numbers (LLN) and the Central Limit Theorem (CLT).

Be able to generate random data. Be able to organise and summarise any random data. Determine whether a particular model fits random data.

A solid understanding a Markov Chain (MC), a stationary distribution of MC.

Interpretation of MCs with absorbing states.

General Assessment Information

LATE SUBMISSION OF WORK: All assignments and assessment tasks must be submitted by the official due date and time. No marks will be given for 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.

FINAL EXAM POLICY: You are advised that it is Macquarie University policy not to set early 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.

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. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. 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 (bit.ly/FSESupp) for dates, and approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

Assessment Tasks

Name	Weighting	Hurdle	Due
Test 1	15%	No	Week 4
Test 2	15%	No	Week 10
Assignment	20%	No	Week 12
Final Examination	50%	No	University Examination Period

Test 1

Due: **Week 4**
Weighting: **15%**

The test will be made available on the iLearn site of the unit. Students will be given one hour to complete the test and the extra time will be given for submission of the test solutions via iLearn. The test will be made available on August 21 in Week 4 and due on August 22. The test is not supervised, however, it is advisable that students complete the test under general exam conditions (i.e. with no additional help apart from a single page of A4 handwritten notes).

On successful completion you will be able to:

- Be able to describe a probabilistic model for an experiment, calculate probability and conditional probability of an event. Have a deep understanding of the independence of events.
- Have a solid understanding of the difference between discrete and continuous random variables.
- For discrete or continuous random variables be able to calculate probabilities of events,

their expected values and variances. Graph the probability distributions or probability density functions and the cumulative distribution functions. Using moment generating functions for finding of moments of random variables. Generate random numbers from distributions and use these numbers for solving probability problems.

Test 2

Due: **Week 10**
Weighting: **15%**

The test will be made available on the iLearn site of the unit. Students will be given one hour to complete the test and the extra time will be given for submission of the test solutions via iLearn. The test will be made available on October 16 in Week 10 and due on October 17. The test is not supervised, however, it is advisable that students complete the test under general exam conditions (i.e. with no additional help apart from a single page of A4 handwritten notes).

On successful completion you will be able to:

- Be able to describe a probabilistic model for an experiment, calculate probability and conditional probability of an event. Have a deep understanding of the independence of events.
- Have a solid understanding of the difference between discrete and continuous random variables.
- For discrete or continuous random variables be able to calculate probabilities of events, their expected values and variances. Graph the probability distributions or probability density functions and the cumulative distribution functions. Using moment generating functions for finding of moments of random variables. Generate random numbers from distributions and use these numbers for solving probability problems.
- Understand limit theorems: the Law of Large Numbers (LLN) and the Central Limit Theorem (CLT).

Assignment

Due: **Week 12**
Weighting: **20%**

Students will be given two weeks to complete the assignment. Assignment submission is via iLearn.

All assignments and assessment tasks must be submitted by the official due date and time. No marks will be given for 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.

On successful completion you will be able to:

- Be able to describe a probabilistic model for an experiment, calculate probability and conditional probability of an event. Have a deep understanding of the independence of events.
- Have a solid understanding of the difference between discrete and continuous random variables.
- For discrete or continuous random variables be able to calculate probabilities of events, their expected values and variances. Graph the probability distributions or probability density functions and the cumulative distribution functions. Using moment generating functions for finding of moments of random variables. Generate random numbers from distributions and use these numbers for solving probability problems.
- Have a deep knowledge of a bivariate probability distribution, joint, marginal, conditional probabilities and covariance. Have a solid understanding of a bivariate Normal distribution.
- Understand limit theorems: the Law of Large Numbers (LLN) and the Central Limit Theorem (CLT).
- Be able to generate random data. Be able to organise and summarise any random data. Determine whether a particular model fits random data.

Final Examination

Due: **University Examination Period**
Weighting: **50%**

The examination will be of 2 hours duration with 10 minutes reading time.

For the Final examination you are allowed to bring in one A4 page of handwritten notes, written on both sides. All necessary statistical tables and formulae will be provided. An electronic calculator is essential and will be required. Non-programmable calculators with no text-retrieval capacity are allowed in the tests or exam.

On successful completion you will be able to:

- Be able to describe a probabilistic model for an experiment, calculate probability and conditional probability of an event. Have a deep understanding of the independence of events.
- Have a solid understanding of the difference between discrete and continuous random variables.
- For discrete or continuous random variables be able to calculate probabilities of events, their expected values and variances. Graph the probability distributions or probability

density functions and the cumulative distribution functions. Using moment generating functions for finding of moments of random variables. Generate random numbers from distributions and use these numbers for solving probability problems.

- Have a deep knowledge of a bivariate probability distribution, joint, marginal, conditional probabilities and covariance. Have a solid understanding of a bivariate Normal distribution.
- Understand limit theorems: the Law of Large Numbers (LLN) and the Central Limit Theorem (CLT).
- Be able to generate random data. Be able to organise and summarise any random data. Determine whether a particular model fits random data.
- A solid understanding a Markov Chain (MC), a stationary distribution of MC. Interpretation of MCs with absorbing states.

Delivery and Resources

Classes

STAT683 is delivered by lectures and SGTA classes.

There is no on-campus session scheduled for external students in this unit. The timetable for classes can be found on the University web site at:

https://timetables.mq.edu.au

Required and Recommended Texts and/or Materials

There is no set textbook for this subject. Lecture notes will be available from iLearn at least the night before the lecture. Students should read the lecture notes before the lecture. All teaching materials will be available via iLearn.

References that may be useful

- Wackerly, D. D., Mendenhall, W., Scheaffer, R. L. Mathematical Statistics with Applications (4th,5th, 6th or 7th Editions)
- Ross, S. A First Course in Probability, Pearson (5th, 6th, 7th, 9th or 9th Editions)
- Ward, M. D. and Gundlach, E. (2016) Introduction to Probability, W. H. Freeman and Company
- Kinney, J.J. (1997) Probability - An Introduction with Statistical Applications, John Wiley and Sons
- Scheaffer R.L. (1994) Introduction to Probability and Its Applications, (2nd Edition) Duxbury Press
- Sincich,T., Levine, D.M., Stephan, D. (1999) Practical Statistics by Example using Microsoft Excel

Technology Used and Required

iLearn

There will be an iLearn site for this unit where weekly information, online discussions, lecture notes, iLectures, practice exercises and solutions will be posted.

Students are required to login to iLearn using their Student ID Number and myMQ Portal Password (note, information about how to get hold of your password is provided by the weblink https://ilearn.mq.edu.au). You can only access the material if you are enrolled in the unit.

Software

We will be using Microsoft Office for Windows (especially Excel), R and Wolfram Alpha, freely available online.

Audio/Video recordings of lectures will be available on iLearn soon after the lecture is delivered.

Course notes are available on iLearn before the lecture. Students should familiarise themselves with the notes before the lecture and bring a copy (in paper or electronic form) to class.

Teaching and Learning Strategy

Lectures

Lectures begin in Week 1. STAT683 students should listen to the audio recordings available on iLearn. The lecture notes will be available on iLearn before the lecture.

SGTA Classes

SGTA classes begin in Week 2 and are based on work from the previous week's lecture. The aim of SGTAs is to apply techniques learnt in lectures to solve problems using a statistical package. The material is available on iLearn.

Additional Exercises

Additional exercises may also be made available on iLearn. It is expected that students will attempt all questions. The exercises will not be discussed during the SGTA classes, although some may be discussed during the lectures. A solution will be made available on the website.

Unit Schedule

WEEK	LECTURE TOPIC
W1	Experiments, sample spaces, Probability Rules, Permutations and Combinations
W2	Conditional Probability. Independence, Bayes' Theorem
W3	Random Variables. Probability Functions, Discrete Probability Distributions, Cumulative Distribution functions, Expected value and Variance. Moments
W4	Important Discrete Distributions: Bernoulli, Binomial, Geometric and Poisson

W5	Moment generating functions. More Discrete Distributions: Negative Binomial and Hypergeometric.
W6	Introduction to Continuous random variables. Cumulative distribution function.
W7	Continuous Distributions: Uniform, Exponential.
	Mid-semester break
W8	Normal distribution.
W9	Continuous Distributions: Gamma and Beta Distributions. Chebyshev's Theorem.
W10	Sampling Distributions.
W11	Joint Distributions: Discrete and Continuous cases.
W12	Introduction to Markov Chains. States, Transition probabilities, State vectors, Equilibrium, Absorbing States.

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.)*

Undergraduate 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 improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

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.

Graduate Capabilities

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge,

scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Be able to describe a probabilistic model for an experiment, calculate probability and conditional probability of an event. Have a deep understanding of the independence of events.
- Have a solid understanding of the difference between discrete and continuous random variables.
- For discrete or continuous random variables be able to calculate probabilities of events, their expected values and variances. Graph the probability distributions or probability density functions and the cumulative distribution functions. Using moment generating functions for finding of moments of random variables. Generate random numbers from distributions and use these numbers for solving probability problems.
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- Be able to generate random data. Be able to organise and summarise any random data. Determine whether a particular model fits random data.
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Assessment tasks

- Test 1
- Test 2
- Assignment
- Final Examination

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to

critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Be able to describe a probabilistic model for an experiment, calculate probability and conditional probability of an event. Have a deep understanding of the independence of events.
- Have a solid understanding of the difference between discrete and continuous random variables.
- For discrete or continuous random variables be able to calculate probabilities of events, their expected values and variances. Graph the probability distributions or probability density functions and the cumulative distribution functions. Using moment generating functions for finding of moments of random variables. Generate random numbers from distributions and use these numbers for solving probability problems.

Assessment tasks

- Test 1
- Test 2
- Assignment
- Final Examination

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Be able to generate random data. Be able to organise and summarise any random data. Determine whether a particular model fits random data.
- A solid understanding a Markov Chain (MC), a stationary distribution of MC. Interpretation of MCs with absorbing states.

Assessment tasks

- Assignment

- Final Examination