STAT683

Introduction to Probability

S1 External 2016

Dept of Statistics

Contents

General Information

Unit convenor and teaching staff
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Credit points
4

Prerequisites
Admission to MAppStat or GradDipAppStat

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:

Describe a probabilistic model for an experiment. Calculate probability and conditional probability of an event. The independence of events.
Understand 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 a bivariate probability distribution, joint, marginal, conditional probabilities and covariance. Understand a bivariate Normal distribution.
Limit theorems: the Law of Large Numbers (LLN) and the Central Limit Theorem (CLT).
Be able to generate random data. Be able to organize and summarize any random data. Determine whether a particular model fits random data.
Understanding a Markov Chain (MC), a stationary distribution of MC. Interpretation of MCs with absorbing states.
Students will build their knowledge starting from the basic idea of probability. At the end, they will be able to solve complex problems in a creative way.

Assessment Tasks

Name	Weighting	Due
Weekly Tutorial assessment	10%	Weekly
Test 1	10%	Week 3
Assignment	10%	Week 7
Test 2	10%	Week 11
Simulation Project	10%	Week 13
Final Examination	50%	University Examination Period

Weekly Tutorial assessment

Due: **Weekly**
Weighting: **10%**

In weeks 3 to 12 students are required to submit the tutorial work via iLearn. Students will be given a week to complete the task. The cut-off date will be announced on iLearn. Tutorial works are equally weighted and worth 10% of the unit assessment.

On successful completion you will be able to:

- Describe a probabilistic model for an experiment. Calculate probability and conditional probability of an event. The independence of events.
- 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 a bivariate probability distribution, joint, marginal, conditional probabilities and covariance. Understand a bivariate Normal distribution.
- Be able to generate random data. Be able to organize and summarize any random data. Determine whether a particular model fits random data.
- Understanding a Markov Chain (MC), a stationary distribution of MC. Interpretation of MCs with absorbing states.

Test 1

Due: **Week 3**
Weighting: **10%**

You are allowed to use one A4 page of handwritten notes, written on both sides. All necessary statistical tables and the formulae sheet will be provided.

An electronic calculator is essential. Text-returnable calculators are not permitted. The test will be administered via iLearn.

On successful completion you will be able to:

- Describe a probabilistic model for an experiment. Calculate probability and conditional probability of an event. The independence of events.
- Students will build their knowledge starting from the basic idea of probability. At the end, they will be able to solve complex problems in a creative way.

Assignment

Due: **Week 7**
Weighting: **10%**

Students will be given two weeks to complete the Assignment. The Assignment will be administered via iLearn.

No extensions will be granted. Students, who were unable to submit the Assignment on time, will be awarded 0 mark, except for cases in which an application for Disruption to Studies is made and approved.

On successful completion you will be able to:

- Understand 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.
- Students will build their knowledge starting from the basic idea of probability. At the end, they will be able to solve complex problems in a creative way.

Test 2

Due: **Week 11**
Weighting: **10%**

You are allowed to use one A4 page of handwritten notes, written on both sides. All necessary statistical tables and the formulae sheet will be provided. An electronic calculator is essential. Text-returnable calculators are not permitted.The test will be administered via iLearn.

On successful completion you will be able to:

- Describe a probabilistic model for an experiment. Calculate probability and conditional probability of an event. The independence of events.
- Understand 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.
- Students will build their knowledge starting from the basic idea of probability. At the end, they will be able to solve complex problems in a creative way.

Simulation Project

Due: **Week 13**
Weighting: **10%**

Open Book test. The Simulation Project will be administered via iLearn.

No extensions will be granted. Students, who were unable to submit the project on time, will be awarded 0 mark, except for cases in which an application for Disruption to Studies is made and approved.

On successful completion you will be able to:

- Describe a probabilistic model for an experiment. Calculate probability and conditional probability of an event. The independence of events.
- Understand 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.
- Limit theorems: the Law of Large Numbers (LLN) and the Central Limit Theorem (CLT).
- Be able to generate random data. Be able to organize and summarize any random data. Determine whether a particular model fits random data.
- Students will build their knowledge starting from the basic idea of probability. At the end, they will be able to solve complex problems in a creative way.

Final Examination

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

This will be of 3 hours duration plus 10 minutes reading time.

For the final examination you are permitted ONE A4 page of handwritten notes, written on both sides. All necessary statistical tables and the formulae sheet will be provided.

An electronic calculator is essential and will be required. Text-returnable calculators are not permitted.

Students enrolled externally will be notified of the location of external final examination centres by Examinations Manager of Macquarie University. You are expected to present yourself for examination at the time (AEDT) designated in the University Examination Timetable (or at an alternative time arranged for overseas students) at the centre you have agreed to sit the exam.

The timetable will be available in Draft form approximately eight weeks before the commencement of the examinations and in Final form approximately four weeks before the commencement of the examinations (http://www.exams.mq.edu.au).

The Macquarie University Final Examination policy details can be viewed at http://www.mq.edu.au/policy/docs/examination/policy.htm

On successful completion you will be able to:

- Describe a probabilistic model for an experiment. Calculate probability and conditional probability of an event. The independence of events.
- Understand 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 a bivariate probability distribution, joint, marginal, conditional probabilities and covariance. Understand a bivariate Normal distribution.
- Be able to generate random data. Be able to organize and summarize any random data. Determine whether a particular model fits random data.
- Understanding a Markov Chain (MC), a stationary distribution of MC. Interpretation of MCs with absorbing states.
- Students will build their knowledge starting from the basic idea of probability. At the end, they will be able to solve complex problems in a creative way.

Delivery and Resources

STAT683 is delivered by three hours of lectures and one hour of tutorial per week. Tutorials start in the second week of the Session.

The timetable for classes can be found at http://www.timetables.mq.edu.au

iLearn

All unit related materials, lecture notes, tutorials, additional exercises, the assessment and administrative updates, will be posted on the unit site on iLearn at

https://ilearn.mq.edu.au/login/MQ/ .

The lecture notes will be made available on iLearn before the lecture.

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

Software

In this unit Microsoft Excel and **R** will be used.

The link to online answer engine Wolfram Alpha is available for verifying results of your calculations:

http://www.wolframalpha.com/

Recommended Texts and/or Materials

There is not the textbook set for this unit.

Recommended references available at Macquarie University library include:

- Wackerly, D., Mendenhall W. Scheaffer. Mathematical Statistics with Applications (4th,5thor 6thEditions) QA276 .M426 2002
- Kinney, J.J. (1997) Probability - An Introduction with Statistical Applications, John Wiley and Sons QA273.K493/1997
- Scheaffer R.L. (2010) Introduction to Probability and Its Applications, (3rd Edition) Duxbury Press, *QA273 .S357* 2010
- (*) Stowell S. (2014). Using R for Statistics. APress.
- (*) Fraser C. (2013). Business Statistics for Competitive Advantage with Excel 2013. Springer.

(*) Electronic copy is available from Macquarie University library.

Teaching and Learning Strategy

Lectures

Lectures begin in Week 1.

Tutorials

Tutorials begin in Week 2.

Every week, from Week 3 to Week 12, students must submit their tutorial work on iLearn. Tutorials are based on the material from the previous week's lecture. The aim of tutorials is to solve problems applying analytical techniques learnt in lectures or using a statistical software.

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, Cumulative Distribution functions, Expected value, Variance and Moments.

W4	**Public Holiday**
W5	Special Discrete Distributions: Bernoulli, Binomial, Geometric and Poisson. Moment generating functions.
W6	More Special Discrete Distributions: Negative Binomial and Hypergeometric. Introduction to Continuous random variables.
	Mid-semester break
W7	Special Continuous Distributions: Uniform, Exponential. Moment generating functions.
W8	Normal Distribution. More Special Continuous Distributions: Gamma and Beta Distributions. Chebyshev's Theorem.
W9	Limit Theorems. Chi-squared Distribution, Distribution of a sample variance. F-Distribution.
W10	t-Distribution, Distribution of a sample mean (the variance is unknown). A discrete bivariate distribution.
W12	A continuous bivariate distribution. A bivariate Normal Distribution. The moment generating function.
W13	Introduction to Markov Chains: states, transition probabilities, state vectors, stationary distribution, absorbing states.

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:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

New Assessment Policy in effect from Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy_2016.html. For more information visit http://students.mq.edu.au/events/2016/07/19/new_assessment_policy_in_place_from_session_2/

Assessment Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Complaint Management Procedure for Students and Members of the Public http://www.mq.edu.au/policy/docs/complaint_management/procedure.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

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/

Results

Results shown in *iLearn*, 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.

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

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

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcome

- Students will build their knowledge starting from the basic idea of probability. At the end, they will be able to solve complex problems in a creative way.

Assessment tasks

- Weekly Tutorial assessment
- Test 1
- Assignment
- Test 2
- Simulation Project
- Final Examination

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Assessment tasks

- Assignment
- Final Examination

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcome

- Students will build their knowledge starting from the basic idea of probability. At the end, they will be able to solve complex problems in a creative way.

Assessment tasks

- Weekly Tutorial assessment

- Test 1
- Assignment
- Test 2
- Simulation Project
- Final Examination

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

- 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 a bivariate probability distribution, joint, marginal, conditional probabilities and covariance. Understand a bivariate Normal distribution.
- Limit theorems: the Law of Large Numbers (LLN) and the Central Limit Theorem (CLT).
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Assessment tasks

- Weekly Tutorial assessment
- Test 1
- Assignment
- Test 2
- Simulation Project
- 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

- Describe a probabilistic model for an experiment. Calculate probability and conditional probability of an event. The independence of events.
- Understand the difference between discrete and continuous random variables.
- Be able to generate random data. Be able to organize and summarize any random data. Determine whether a particular model fits random data.

Assessment tasks

- Weekly Tutorial assessment
- Test 1
- Assignment
- Test 2
- Simulation Project
- 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 outcome

- Be able to generate random data. Be able to organize and summarize any random data. Determine whether a particular model fits random data.

Assessment tasks

- Weekly Tutorial assessment
- Test 1
- Assignment
- Test 2
- Simulation Project
- Final Examination

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Assessment tasks

- Assignment
- Final Examination

Changes from Previous Offering

Some lecture and tutorial materials will be updated with new exercises.