STAT273

Introduction to Probability

S2 Day 2019

Dept of Mathematics and Statistics

Contents

General Information

Unit convenor and teaching staff
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Credit points
3

Prerequisites
(STAT170(P) or STAT171 or STAT150) and ((HSC Mathematics Band 2 or Extension 1 or Extension 2) or 3cp from MATH111-MATH339)

Corequisites

Co-badged status
This unit is co-taught with STAT683.

Unit description
This unit consolidates and expands upon the material on probability introduced in statistics units at 100 level. 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. Understand 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 familiar with 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.
Understand a Markov Chain (MC), a stationary distribution of MC and interpretation of MCs with absorbing states.

General Assessment Information

HURDLES: During the small group teaching activity (SGTA) classes you will work (under the supervision of an instructor) on a number of exercises/problems on the topics of the preceding week lectures. Attendance at, and reasonable engagement in, SGTA is compulsory.

To pass the unit, students need to participate in 10 out of 12 SGTA classes from week 2 to week 13.

ATTENDANCE and PARTICIPATION: Please contact the unit convenor as soon as possible if you have difficulty attending and participating in any classes. There may be alternatives available to make up the work. If there are circumstances that mean you miss a class, you can apply for a Special Consideration. Participation in these activities will gain no marks, but is a requirement to pass the unit. Active participation is assessed by instructor and demonstrators through observation of students' work during classes. Attendance, participation and reasonable engagement in the class activities in at least 10 SGTA classes are requirements to pass the unit.

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.
- Please make sure that each page in your uploaded assignment corresponds to only one A4 page (do not upload an A3 page worth of content as an A4 page in landscape). If you are using an app like Clear Scanner, please make sure that the photos you are using are clear and shadow-free.
- 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 one week prior to the exam with the exact date and time of their supplementary examination.

Assessment Tasks

Name	Weighting	Hurdle	Due
SGTA Participation	0%	Yes	During SGTA classes
Test 1	15%	No	Week 4 lecture
Test 2	15%	No	Week 10 lecture
Assignment	20%	No	Week 12
Final Examination	50%	No	University Examination Period

SGTA Participation

Due: **During SGTA classes**
Weighting: **0%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Participation in these activities will gain no marks, but is a requirement to pass the unit. Active participation is assessed by the instructor through observation of students' work during classes. Attendance and participation in the class activities in at least 10 out of 12 SGTA classes are requirements to pass the unit.

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. Understand 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 familiar with 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.

- Understand a Markov Chain (MC), a stationary distribution of MC and interpretation of MCs with absorbing states.

Test 1

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

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. Non-programmable calculators with no text-retrieval capacity are allowed in the tests.

The only excuse for not completing the test at the designated time period is because of documented illness or unavoidable disruption. In these special circumstances you may apply for special consideration via ask.mq.edu.au.

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. Understand 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.

Test 2

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

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. Non-programmable calculators with no text-retrieval capacity are allowed in the tests.

The only excuse for not completing the test at the designated time period is because of documented illness or unavoidable disruption. In these special circumstances you may apply for special consideration via ask.mq.edu.au.

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. Understand 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.
- Be familiar with 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. Understand 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 familiar with 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 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. Understand the independence of events.
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Delivery and Resources

Classes

STAT273 is delivered by lectures and SGTA classes.

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. STAT273 students should attend 3 hours per week. 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. Understand 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.
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and covariance. Understand a bivariate Normal distribution.
- Be familiar with 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.
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Assessment tasks

- SGTA Participation
- 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. Understand 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.

Assessment tasks

- SGTA Participation
- 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.
- Understand a Markov Chain (MC), a stationary distribution of MC and interpretation of MCs with absorbing states.

Assessment tasks

- Assignment
- Final Examination