STAT394

Probability, Random Processes and Statistics for Engineers

S1 Day 2018

Dept of Statistics

Contents

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General Information

Unit convenor and teaching staff
Convenor
Barry Quinn
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Level 6, 12 Wally's Walk
TBA

Credit points
3

Prerequisites
6cp at 200 level including MATH235(P)

Corequisites

Co-badged status

Unit description
This unit develops the probabilistic and statistical ideas needed to apply the theory of random processes to engineering fields such as signal processing and communications. Topics covered include probability, random variables, expectation, random processes, stationarity, ergodicity, spectral density, limit theorems, markov chains, estimation theory.

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:

Understand and compute probabilities, conditional probabilities, random variables.
Understand and work with probability density functions, expectations, moment generating functions.
Be able to compute the joint distributions and expectations of functions of more than one random variable.
Understand and use the concepts of hypothesis testing, probability of false alarm.
Be able to compute the likelihood and maximum likelihood estimators.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 1	10%	No	Wednesday 21st March
Assignment 2	10%	No	Wednesday 2nd May
Assignment 3	10%	No	Wednesday 30th May
Tutorial Participation	10%	No	Weeks 2 to 13
Final Examination	60%	No	TBA

Assignment 1

Due: **Wednesday 21st March**
Weighting: **10%**

Submit to Prof Barry Quinn by 1pm on the due date. There is no “group work” assessment in this unit. All work is to be the student’s own. In the case of the late submission of an assignment, if no special consideration has been granted, 10% of the earned mark will be deducted for each day that the assignment is late, up to a maximum of 50%. After 5 days, including weekends and public holidays, a mark of 0% will be awarded for the assignment.

On successful completion you will be able to:

- Understand and compute probabilities, conditional probabilities, random variables.
- Understand and work with probability density functions, expectations, moment generating functions.

Assignment 2

Due: **Wednesday 2nd May**
Weighting: **10%**

Submit to Prof Barry Quinn by 1pm on the due date. There is no “group work” assessment in this unit. All work is to be the student’s own. In the case of the late submission of an assignment, if no special consideration has been granted, 10% of the earned mark will be deducted for each day that the assignment is late, up to a maximum of 50%. After 5 days, including weekends and public holidays, a mark of 0% will be awarded for the assignment.

On successful completion you will be able to:

- Understand and work with probability density functions, expectations, moment generating functions.
- Be able to compute the joint distributions and expectations of functions of more than one

random variable.

Assignment 3

Due: **Wednesday 30th May**
Weighting: **10%**

Submit to Prof Barry Quinn by 1pm on the due date. There is no “group work” assessment in this unit. All work is to be the student’s own. In the case of the late submission of an assignment, if no special consideration has been granted, 10% of the earned mark will be deducted for each day that the assignment is late, up to a maximum of 50%. After 5 days, including weekends and public holidays, a mark of 0% will be awarded for the assignment.

On successful completion you will be able to:

- Be able to compute the joint distributions and expectations of functions of more than one random variable.
- Understand and use the concepts of hypothesis testing, probability of false alarm.
- Be able to compute the likelihood and maximum likelihood estimators.

Tutorial Participation

Due: **Weeks 2 to 13**
Weighting: **10%**

Students will contribute to discussions and hand in at least one handwritten page of tutorial problem solutions per tutorial.

On successful completion you will be able to:

- Understand and compute probabilities, conditional probabilities, random variables.
- Understand and work with probability density functions, expectations, moment generating functions.
- Be able to compute the joint distributions and expectations of functions of more than one random variable.
- Understand and use the concepts of hypothesis testing, probability of false alarm.
- Be able to compute the likelihood and maximum likelihood estimators.

Final Examination

Due: **TBA**
Weighting: **60%**

The final Examination will be held during the mid-year Examination period. The final Examination is 3 hours long (with an additional 10 minutes’ reading time). It will cover all topics in the unit. The final examination is closed book. Students may take into the final Exam **TWO** A4 pages of notes **handwritten (not typed)** on **BOTH** sides. Calculators will be needed but must not be of the text/

programmable type.

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.

On successful completion you will be able to:

- Understand and compute probabilities, conditional probabilities, random variables.
- Understand and work with probability density functions, expectations, moment generating functions.
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- Understand and use the concepts of hypothesis testing, probability of false alarm.
- Be able to compute the likelihood and maximum likelihood estimators.

Delivery and Resources

There are four contact hours per week, comprised of three lectures and one tutorial. Check the timetable for the times and locations of classes.

Please consult iLearn or the Unit webpage for details of consultation hours.

Unit Schedule

Topic 1	Probability, conditional probability, independence, mutually exclusive events
Topic 2	Random variables, distribution function, discrete and continuous random variables, expectation, moments, moment generating function
Topic 3	Bivariate cdf and pdf, independent rvs, transformations, sums of rvs, central limit theorem, conditional expectation, distributions derived from the normal
Topic 4	Unbiased estimation, likelihood function, maximum likelihood, Cramer-Rao lower bound, asymptotic behaviour
Topic 5	Simple and composite hypotheses, critical regions, Neyman-Pearson lemma, significance levels, power, false alarm rates

Topic 6	Inequalities, laws of large numbers, order statistics

Learning and Teaching Activities

Lecture

Three hours per week

Tutorial

One hour per week

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 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

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

- Understand and compute probabilities, conditional probabilities, random variables.
- Understand and work with probability density functions, expectations, moment generating functions.
- Be able to compute the joint distributions and expectations of functions of more than one random variable.
- Understand and use the concepts of hypothesis testing, probability of false alarm.
- Be able to compute the likelihood and maximum likelihood estimators.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Tutorial Participation
- Final Examination

Learning and teaching activities

- Three hours per week
- One hour per week

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

- Understand and compute probabilities, conditional probabilities, random variables.
- Understand and work with probability density functions, expectations, moment generating functions.
- Be able to compute the joint distributions and expectations of functions of more than one random variable.
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Learning and teaching activities

- Three hours per week
- One hour per week

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

- Understand and compute probabilities, conditional probabilities, random variables.
- Understand and work with probability density functions, expectations, moment generating functions.
- Be able to compute the joint distributions and expectations of functions of more than one random variable.
- Understand and use the concepts of hypothesis testing, probability of false alarm.
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Assessment tasks

- Assignment 1
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Learning and teaching activities

- Three hours per week
- One hour per week

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 task

- Tutorial Participation

Learning and teaching activity

- Three hours per week
- One hour per week

Changes from Previous Offering

There is no class test in 2018. Instead, the exam is worth 60%.

Textbooks and other reference material

Students should access springerlink via the library website (type springer in the search bar and click on the online access button) and look for suitable texts to download (free). One such book, that has more content than we need, is

Probability with Applications in Engineering, Science, and Technology, by Carlton and Devore.

Another is

Introduction to Probability and Statistics for Engineers, by Milan Holický.

A textbook that has been used in the past is

Richard H. Williams, *Probability, Statistics, and Random Processes for Engineers*, Cengage Learning, 2003.

Other good references are

A. Leon-Garcia, *Probability, Statistics, and Random Processes for Electrical Engineering*, 3 ed. Upper Saddle River, New Jersey: Prentice-Hall, 2008

and

A. Papoulis, *Probability, Random Variables, and Stochastic Processes*. New York: McGraw-Hill, 2002.

There are many introductory mathematical statistics and/or random (stochastic) processes books, and many are suitable references.

The notes in iLearn will be fairly exhaustive, and will be put up approximately one week in

advance of their delivery, or earlier.