



# STAT394

## Probability, Random Processes and Statistics for Engineers

S1 Day 2019

*Dept of Mathematics and Statistics*

### Contents

---

<u>General Information</u>	2
<u>Learning Outcomes</u>	2
<u>Assessment Tasks</u>	3
<u>Delivery and Resources</u>	5
<u>Unit Schedule</u>	5
<u>Learning and Teaching Activities</u>	5
<u>Policies and Procedures</u>	6
<u>Graduate Capabilities</u>	7
<u>Changes from Previous Offering</u>	10
<u>Textbooks and other reference material</u>	10

---

#### **Disclaimer**

Macquarie University has taken all reasonable measures to ensure the information in this publication is accurate and up-to-date. However, the information may change or become out-dated as a result of change in University policies, procedures or rules. The University reserves the right to make changes to any information in this publication without notice. Users of this publication are advised to check the website version of this publication [or the relevant faculty or department] before acting on any information in this publication.

## General Information

### Unit convenor and teaching staff

Convenor

Jun Ma

[jun.ma@mq.edu.au](mailto:jun.ma@mq.edu.au)

Contact via Email

12 Wally's Walk Office 5.26

See iLearn

Lecturer

Ayse Bilgin

[ayse.bilgin@mq.edu.au](mailto:ayse.bilgin@mq.edu.au)

Contact via Email

12 Wally's Walk Office 6.35

See iLearn

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
<a href="#"><u>Assignment 1</u></a>	15%	No	3rd April
<a href="#"><u>Assignment 2</u></a>	15%	No	29th May
<a href="#"><u>SGTA Participation</u></a>	10%	No	Weeks 2 to 13
<a href="#"><u>Final Examination</u></a>	60%	No	11 to 12 June, 2019

### Assignment 1

Due: **3rd April**

Weighting: **15%**

Submit a hard copy to your lecturer by 1pm on the due date. There is no “group work” assessment in this unit. All work is to be the student’s own. All assignments must be submitted by the due date and time. No marks will be given for late submission unless an extension has been granted.

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: **29th May**

Weighting: **15%**

Submit a hard copy to your lecturer by 1pm on the due date. There is no “group work” assessment in this unit. All work is to be the student’s own. All assignments must be submitted by the due date and time. No marks will be given for late submission unless an extension has been granted.

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.

## SGTA Participation

Due: **Weeks 2 to 13**

Weighting: **10%**

Students will contribute to discussions in the class.

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: **11 to 12 June, 2019**

Weighting: **60%**

The final Examination will be held during the mid-year Examination period. The final Examination is 2 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 or typed (not photocopied)** 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](http://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](http://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.
- 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.

## Delivery and Resources

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

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

## Unit Schedule

This course covers the following six topics:

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

### STGA

One hour per week

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central \(https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central\)](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 \(https://students.mq.edu.au/support/study/student-policy-gateway\)](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 \(https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central\)](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](https://ask.mq.edu.au) or if you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto: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](https://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](http://ask.mq.edu.au)

If you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto: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/](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
- SGTA 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.
- 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
- SGTA Participation
- Final Examination

## 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.
- Be able to compute the likelihood and maximum likelihood estimators.

## **Assessment tasks**

- Assignment 1
- Assignment 2
- SGTA Participation
- Final Examination

## **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**

- SGTA Participation

## **Learning and teaching activity**

- Three hours per week
- One hour per week

## Changes from Previous Offering

There are only two assignments now.

## 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.