# STAT272

## Probability

S1 Day 2018

*Dept of Statistics*

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# General Information

Unit convenor and teaching staff
Unit Convenor
Georgy Sofronov
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12 Wally's Walk (E7A), Room 535

Credit points
3

Prerequisites
STAT171 and (MATH133(P) or MATH136(P))

Corequisites

Co-badged status

Unit description
This unit is a mathematically-based introduction to probability theory. Emphasis is placed on the theoretical development of the subject matter. Students should be mathematically competent, especially in the areas of integration, differentiation and the summation of infinite series. Students who are not confident about their ability in these areas should consider enrolling in the more general unit, STAT273. Topics include: conditional probability; discrete and continuous random variables; transformations; convolutions; moments and moment generating functions; central limit theorem; sampling distributions; order statistics; and bivariate distributions.

## 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:

> This unit is an introduction to the mathematical foundations of the theory of probability, and thus provides the basic mathematical techniques needed for the theory of statistics. By the end of this unit, students will have an understanding of the foundation concepts in probability, including conditional probability, random variables and discrete and continuous probability distributions

Students will be able to derive key charateristics of probability distributions, including moments and moment generating functions.
Students will have an understanding of the distributions of sums of independent random variables, the Central Limit Theorem and convolutions.
Students will also understand and be able to derive the distributions of transformed random variables, order statistics, compound random variables and multivariate random variables.

# Assessment Tasks

| Name | Weighting | Hurdle | Due |
|---|---|---|---|
| Test | 10% | No | Week 7 |
| Assignments | 30% | No | Week 4, 9, 12 |
| Final examination | 60% | No | University Examination Period |

## Test

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

There will be a mid-semester test of 50 minutes duration held during the first lecture of week 7. Students are permitted to take in to the test one sheet of A4 paper containing the student's personal summary. One or both sides of the sheet may be used. The material thereon may be in the student's own handwriting (scanned copies are not permitted) and not typed.

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## Assignments

Due: **Week 4, 9, 12**
Weighting: **30%**

There will be three assignments, the first one due in week 4, Assignment 2 due in week 9 and Assignment 3 due in week 12.

Assignment submission: Assignments are to be submitted to your tutor, in your tutorial in the week in which they are due. No extensions will be considered unless satisfactory documentation outlining illness or misadventure is submitted. In these special circumstances you may apply for special consideration via ask.mq.edu.au.

In the case of a late submission for an assignment, if no special consideration has been granted, 10% of the earned mark will be deducted for each day that an assignment is late, up to a maximum of 50%. After 5 days, counted including weekends and public holidays, a mark of 0% will be awarded. NOTE: It is not the intention of this late penalty policy to cause a student to fail the unit when they have submitted their assignment no more than 5 days after the due date and they would have otherwise passed. In this case, if deductions for late assignments result in the final unit mark for a student being less than 50, when otherwise it would have been 50 or greater, the student's final mark will be exactly 50.

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## Final examination

Due: **University Examination Period**
Weighting: **60%**

The duration of the final examination is three hours plus ten minutes' reading time. An electronic calculator and two A4 sheets of paper (written on one or both sides) may be taken in to the exam room. All material thereon must be in the student's own handwriting (scanned copies are not permitted) and not typed.

You are expected to present yourself for examination at the time and place designated in the University examination timetable, which will be available at https://timetables.mq.edu.au.

Only documented illness or unavoidable disruption may be used as reasons for not sitting an examination at the designated time. In these circumstances you may wish to consider applying for special consideration via ask.mq.edu.au.

Information about the Special Consideration Policy is available at:

https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/special-consideration

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 Special Consideration 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.

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# Delivery and Resources

## Technologies used and required

All unit materials, including administrative updates, lecture notes, tutorials and assignments, will be posted on the Unit website on iLearn. The web address is https://ilearn.mq.edu.au.

Students will attend three one-hour lectures and one one-hour tutorial per week. The notes shown in lectures will be available on iLearn before the lecture is given, but note that corrections may be made after the lecture. Tutorial exercises will be set weekly and will be available on iLearn before the tutorial. Students are expected to have attempted all questions before the tutorial. A plan of the topics to be covered is at the end of this document.

## Required and Recommended texts and/or materials

There is no required textbook for this unit. Students may benefit from having access to the following background reference for additional reading and problems:

“Mathematical Statistics with Applications” W Mendenhall, D Wackerly and R Scheaffer (6th or 7th edition) - library call number is QA276.M426.

The following books may also be useful background references:

ROSS, S. A First Course in Probability (QA273.R83)

SCHEAFFER, R. L. Introduction to Probability and Its Applications (QA273.S357)

SMITH, P. J. Into Statistics (QA276.S615)

FREUND, J. E. Mathematical Statistics (QA276.F692)

HOEL, P. Introduction to Mathematical Statistics (QA276.H57)

HOGG, R.V. & TANIS, E.A. Probability and Statistical Inference (QA273.H694)

LARSON, H. Introduction to Probability Theory and Statistical Inference (QA273.L352)

SPIEGEL, M.R., SRINIVASAN, J. & SCHILLER, J.J. Schaum's outline of theory and problems of probability and statistics (QA273.25.S64)

WALPOLE, R.E. & MYERS, R.H. Probability and Statistics for Engineers and Scientists (TA340.W35)

HOGG, R.V. & CRAIG, A.T. Introduction to Mathematical Statistics (QA276.H59)

At least one copy of each of these is available in the Library, and extra copies may be available on the shelves for borrowing purposes.

It should be understood that there are variations in notation (and even in definition) from one reference book to another, and that the lecture material alone defines recommended notation. Note that all lecture notes will be available in pdf form on the Unit website on iLearn before the lecture. You are required to print out your own copy and bring this to lectures.

## Changes since the last offering of this unit

None.

# Unit Schedule

| TOPIC | MATERIAL COVERED |
|---|---|
| 1 | Sample space, events. Axioms of probability, conditional probability. Bayes Theorem. Random variables and probability distributions. |
| 2 | Discrete Distributions and their applications (Bernoulli, geometric, negative binomial, binomial, hypergeometric, multinomial). The Poisson process and the Poisson distribution. |

| | |
|---|---|
| **3** | Continuous random variables and distributions with applications (uniform, exponential, triangular, normal, gamma, beta etc.). Discrete and continuous cumulative distribution functions. |
| **4** | Expected values (discrete and continuous) and properties of the expectation operator. Measures of variation. |
| **5** | Moments: raw and central. Interpretation of moments (skewness, kurtosis etc.). |
| **6** | Sums of independent random variables. Discrete and continuous convolutions with applications. |
| **7** | Transformations (monotonic and non-monotonic) of continuous random variables. Transformation of a continuous random variable to one with a uniform distribution, with applications to simulation. |
| **8** | Probability generating functions and moment generating functions (raw and central) with properties and applications. The moment generating function of a sum of independent random variables. The uniqueness theorem. Characteristic functions. |
| **9** | Chebyshev's inequality. The central limit theorem and applications. |
| **10** | Multivariate (particularly bivariate) random variable theory (continuous and discrete). Marginal and conditional distributions and expectations. Covariance and correlation. Compound distributions. |
| **11** | Order statistics, specifically the distributions of the minimum, maximum and median. |

# 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

# 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 outcomes

- This unit is an introduction to the mathematical foundations of the theory of probability, and thus provides the basic mathematical techniques needed for the theory of statistics. By the end of this unit, students will have an understanding of the foundation concepts in probability, including conditional probability, random variables and discrete and continuous probability distributions
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## Assessment tasks

- Test
- Assignments
- 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.

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# 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.

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# 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.

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