STAT2372
Probability
Session 1, Special circumstances 2021
Department of Mathematics and Statistics

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Notice
As part of Phase 3 of our return to campus plan, most units will now run tutorials, seminars and other small group activities on campus, and most will keep an online version available to those students unable to return or those who choose to continue their studies online.

To check the availability of face-to-face activities for your unit, please go to timetable viewer. To check detailed information on unit assessments visit your unit’s iLearn space or consult your unit convenor.
## General Information

<table>
<thead>
<tr>
<th>Unit convenor and teaching staff</th>
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<tbody>
<tr>
<td>Lead Unit Convenor/Lecturer</td>
</tr>
<tr>
<td>Georgy Sofronov</td>
</tr>
<tr>
<td><a href="mailto:georgy.sofronov@mq.edu.au">georgy.sofronov@mq.edu.au</a></td>
</tr>
<tr>
<td>Contact via Email</td>
</tr>
<tr>
<td>please refer to iLearn</td>
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<table>
<thead>
<tr>
<th>Second Unit Convenor/Lecturer</th>
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<tbody>
<tr>
<td>Jun Ma</td>
</tr>
<tr>
<td><a href="mailto:jun.ma@mq.edu.au">jun.ma@mq.edu.au</a></td>
</tr>
<tr>
<td>Contact via Email</td>
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<td>please refer to iLearn</td>
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</table>

| Jun Ma                          |
| jun.ma@mq.edu.au                |

<table>
<thead>
<tr>
<th>Credit points</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
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<table>
<thead>
<tr>
<th>Prerequisites</th>
</tr>
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<tbody>
<tr>
<td>(STAT171 or STAT1371) and (MATH1020 or MATH1025 or MATH133 or MATH135)</td>
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<table>
<thead>
<tr>
<th>Corequisites</th>
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<table>
<thead>
<tr>
<th>Co-badged status</th>
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<table>
<thead>
<tr>
<th>Unit description</th>
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<tr>
<td>This unit introduces the foundation concepts of probability theory. The unit develops probability concepts, including discrete and continuous random variables and distributions, independence, covariance and correlation, joint and conditional distributions, moments, generating functions, transformations, order statistics, distributions of sums of independent random variables and the Central Limit Theorem.</td>
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## Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at [https://students.mq.edu.au/important-dates](https://students.mq.edu.au/important-dates)

## Learning Outcomes

On successful completion of this unit, you will be able to:
ULO1: Understand and synthesize the foundation concepts in probability, including conditional probability, random variables, moments, discrete and continuous probability distributions.

ULO2: Derive the distributions of transformed random variables and sums of independent random variables.

ULO3: Apply generating functions to determine key characteristics of probability distributions.

ULO4: Analyse sequences of random variables by applying convergence concepts and the Central Limit Theorem.

ULO5: Analyse jointly distributed random variables by applying covariance and correlation, order statistics, joint and conditional distributions.

General Assessment Information

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 assessment tasks must be submitted by the official due date and time. In the case of a late submission for a non-timed assessment (e.g. an assignment), if special consideration has NOT been granted, 20% of the earned mark will be deducted for each 24-hour period (or part thereof) that the submission is late for the first 2 days (including
Assessment Tasks

<table>
<thead>
<tr>
<th>Name</th>
<th>Weighting</th>
<th>Hurdle</th>
<th>Due</th>
</tr>
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<tbody>
<tr>
<td>iLearn Quiz</td>
<td>5%</td>
<td>No</td>
<td>Week 5</td>
</tr>
<tr>
<td>Test</td>
<td>20%</td>
<td>No</td>
<td>Week 8</td>
</tr>
<tr>
<td>Assignment</td>
<td>15%</td>
<td>No</td>
<td>Week 11</td>
</tr>
<tr>
<td>Final Examination</td>
<td>60%</td>
<td>No</td>
<td>University Examination Period</td>
</tr>
</tbody>
</table>

iLearn Quiz

Assessment Type: Quiz/Test
Indicative Time on Task: 1 hours
Due: Week 5
Weighting: 5%

On successful completion you will be able to:
  - Understand and synthesize the foundation concepts in probability, including conditional probability, random variables, moments, discrete and continuous probability distributions.
Test
Assessment Type 1: Quiz/Test
Indicative Time on Task 2: 1 hours
Due: Week 8
Weighting: 20%

Mid-semester Test

On successful completion you will be able to:
  • Understand and synthesize the foundation concepts in probability, including conditional
    probability, random variables, moments, discrete and continuous probability distributions.
  • Derive the distributions of transformed random variables and sums of independent
    random variables.

Assignment
Assessment Type 1: Problem set
Indicative Time on Task 2: 10 hours
Due: Week 11
Weighting: 15%

Assignment

On successful completion you will be able to:
  • Understand and synthesize the foundation concepts in probability, including conditional
    probability, random variables, moments, discrete and continuous probability distributions.
  • Derive the distributions of transformed random variables and sums of independent
    random variables.
  • Apply generating functions to determine key characteristics of probability distributions.
  • Analyse sequences of random variables by applying convergence concepts and the
    Central Limit Theorem.
  • Analyse jointly distributed random variables by applying covariance and correlation,
    order statistics, joint and conditional distributions.
Final Examination

Assessment Type: Examination
Indicative Time on Task: 3 hours
Due: University Examination Period
Weighting: 60%

Formal invigilated examination testing the learning outcomes of the unit.

On successful completion you will be able to:

- Understand and synthesize the foundation concepts in probability, including conditional probability, random variables, moments, discrete and continuous probability distributions.
- Derive the distributions of transformed random variables and sums of independent random variables.
- Apply generating functions to determine key characteristics of probability distributions.
- Analyse sequences of random variables by applying convergence concepts and the Central Limit Theorem.
- Analyse jointly distributed random variables by applying covariance and correlation, order statistics, joint and conditional distributions.

1 If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Learning Skills Unit for academic skills support.

2 Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation.

Delivery and Resources

Technologies used and required

The unit is delivered by lectures (2 hours per week, starting in Week 1) and SGTA's (1 hour per week, starting in Week 2). All teaching material will be available on iLearn.

SGTA exercises will be available from iLearn prior to the SGTA. Students are expected to have attempted these prior to the SGTA. Solutions will be explained, with emphasis on any area students had trouble with. At the end of the week, these solutions will then be placed on iLearn. The web address is https://ilearn.mq.edu.au.
The R software (freely available online) will be used in the unit. Students need to practice how to use the software and be expected to use R for the assignment. Students should also note that the test and the final examination may contain inline R codes and output that students need to interpret to answer the questions.

**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)


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)


CASELLA, G. & BERGER, R.L. Statistical Inference (QA276.C37)

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 bring a hard or soft copy of the lecture notes to lectures.

**Unit Schedule**

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>MATERIAL COVERED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sample space, events. Axioms of probability, conditional probability. Bayes Theorem. Random variables and probability distributions.</td>
</tr>
<tr>
<td>TOPIC</td>
<td>MATERIAL COVERED</td>
</tr>
<tr>
<td>-------</td>
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</tr>
<tr>
<td>2</td>
<td>Discrete Distributions and their applications (Bernoulli, geometric, negative binomial, binomial, hypergeometric, multinomial). The Poisson process and the Poisson distribution.</td>
</tr>
<tr>
<td>3</td>
<td>Continuous random variables and distributions with applications (uniform, exponential, triangular, normal, gamma, beta etc.). Discrete and continuous cumulative distribution functions.</td>
</tr>
<tr>
<td>4</td>
<td>Expected values (discrete and continuous) and properties of the expectation operator. Measures of variation.</td>
</tr>
<tr>
<td>5</td>
<td>Moments: raw and central. Interpretation of moments (skewness, kurtosis etc.).</td>
</tr>
<tr>
<td>6</td>
<td>Sums of independent random variables. Discrete and continuous convolutions with applications.</td>
</tr>
<tr>
<td>7</td>
<td>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.</td>
</tr>
<tr>
<td>8</td>
<td>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.</td>
</tr>
<tr>
<td>9</td>
<td>Chebyshev’s inequality. Convergence concepts. The central limit theorem and applications.</td>
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<tr>
<td>11</td>
<td>Order statistics, specifically the distributions of the minimum, maximum and median.</td>
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### 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.)*

Students seeking more policy resources can visit the [Student Policy Gateway](https://students.mq.edu.au).
Student Support

Macquarie University provides a range of support services for students. For details, visit [http://students.mq.edu.au/support/](http://students.mq.edu.au/support/)

**Learning Skills**

Learning Skills ([mq.edu.au/learningskills](http://mq.edu.au/learningskills)) provides academic writing resources and study strategies to help you improve your marks and take control of your study.

- Getting help with your assignment
- Workshops
- StudyWise
- Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

**Student Enquiry Service**

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)

**Equity Support**

Students with a disability are encouraged to contact the [Disability Service](http://disability.mq.edu.au) who can provide appropriate help with any issues that arise during their studies.

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*Unit guide* STAT2372 Probability

[q.edu.au/support/study/student-policy-gateway](http://q.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](http://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/admin/other-resources/student-conduct](https://students.mq.edu.au/admin/other-resources/student-conduct)

**Results**

Results published on platform other than [eStudent](http://es.student.mq.edu.au), (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](http://es.student.mq.edu.au). For more information visit [ask.mq.edu.au](http://ask.mq.edu.au) or 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/.

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.