STAT273
Introduction to Probability
S2 Day 2013
Statistics

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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

<table>
<thead>
<tr>
<th><strong>Unit convenor and teaching staff</strong></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Suzanne Curtis</td>
<td><a href="mailto:suzanne.curtis@mq.edu.au">suzanne.curtis@mq.edu.au</a></td>
</tr>
<tr>
<td>Contact via <a href="mailto:suzanne.curtis@mq.edu.au">suzanne.curtis@mq.edu.au</a></td>
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<td>E4A 552</td>
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<tr>
<th><strong>Unit Convenor</strong></th>
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<tbody>
<tr>
<td>Maurizio Manuguerra</td>
<td><a href="mailto:maurizio.manuguerra@mq.edu.au">maurizio.manuguerra@mq.edu.au</a></td>
</tr>
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<tr>
<th><strong>Prerequisites</strong></th>
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<tr>
<td>[(STAT170(P) or STAT171(P)) and (HSC Mathematics or 3cp from MATH123-MATH339) and (STAT175(P) or GPA of 1.50)] or admission to GradCertSc</td>
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<table>
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<th><strong>Corequisites</strong></th>
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## 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 http://students.mq.edu.au/student_admin/enrolmentguide/academicdates/
Learning Outcomes

1. Have a solid understanding of introductory probability theory,
2. Understand the difference between discrete and continuous random variables,
3. Understand the difference between theoretical and empirical probability,
4. For various discrete and continuous random variables, o Be familiar with the distributions, o Write the function and the cumulative distribution functions, o Graph the distribution and the cumulative distribution function, o Calculate probabilities, expected values, variances and standard deviations, o Generate Distributions, o Generate random numbers from Distributions, o Solve probability problems,
5. For bivariate probability distributions (discrete and continuous), find o Joint, marginal and conditional probabilities, o Covariance,
6. Understand basic anatomy of homogeneous Markov Chains and o Find stationary distribution, if one exists, o Manipulate and interpret Markov Chains with absorbing states.
7. Be able to generate probability distributions and cumulative distributions, and graph these distributions; Be able to simulate random numbers from probability distributions; Be able to organise and summarize random data; Determine whether random data fits a particular model; Be able to find probabilities, expected values etc, using an appropriate statistical package.
8. Students will build their knowledge starting from the basic idea of probability. At the end, they will be able to solve complex problems in a creative way.

Assessment Tasks

<table>
<thead>
<tr>
<th>Name</th>
<th>Weighting</th>
<th>Due</th>
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<tbody>
<tr>
<td>Weekly Tutorial assessment</td>
<td>10%</td>
<td>1 hour before the next lecture</td>
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<tr>
<td>Test 1</td>
<td>10%</td>
<td>22 August</td>
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<tr>
<td>Test 2</td>
<td>10%</td>
<td>12 September</td>
</tr>
<tr>
<td>Assignment 1</td>
<td>10%</td>
<td>17 October</td>
</tr>
<tr>
<td>Test 3 (PC-Lab)</td>
<td>10%</td>
<td>6 November</td>
</tr>
<tr>
<td>Final Examination</td>
<td>50%</td>
<td>TBA</td>
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</tbody>
</table>

http://unitguides.mq.edu.au/unit_offerings/13258/unit_guide/print
Weekly Tutorial assessment

Due: 1 hour before the next lecture
Weighting: 10%

Every week students must submit the results of their work through iLearn. Students may submit their results anytime during the 7-days after the lecture (the due date is Thursday at 8am). Attendance to tutorial classes is recommended but not compulsory. Late submissions won’t be accepted by the automated system.

Marking: every tutorial quiz will have the same weight; the total will be scaled to the 10% of the unit assessment.

This Assessment Task relates to the following Learning Outcomes:

- Have a solid understanding of introductory probability theory,
- Understand the difference between theoretical and empirical probability,
- For various discrete and continuous random variables, be familiar with the distributions, write the function and the cumulative distribution functions, graph the distribution and the cumulative distribution function, calculate probabilities, expected values, variances and standard deviations, generate distributions, generate random numbers from Distributions, solve probability problems,
- For bivariate probability distributions (discrete and continuous), find joint, marginal and conditional probabilities, covariance,
- Understand basic anatomy of homogeneous Markov Chains and find stationary distribution, if one exists, manipulate and interpret Markov Chains with absorbing states.
- Be able to generate probability distributions and cumulative distributions, and graph these distributions; be able to simulate random numbers from probability distributions; be able to organise and summarise random data; determine whether random data fits a particular model; be able to find probabilities, expected values etc, using an appropriate statistical package.

Test 1

Due: 22 August
Weighting: 10%

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. Text-returnable calculators are not permitted in the tests or exam.
This Assessment Task relates to the following Learning Outcomes:

• Have a solid understanding of introductory probability theory,
• Understand the difference between theoretical and empirical probability,
• Students will build their knowledge starting from the basic idea of probability. At the end, they will be able to solve complex problems in a creative way.

Test 2
Due: 12 September
Weighting: 10%

This Assessment Task relates to the following Learning Outcomes:

• Have a solid understanding of introductory probability theory,
• Understand the difference between discrete and continuous random variables,
• Understand the difference between theoretical and empirical probability,
• For various discrete and continuous random variables, o Be familiar with the distributions, o Write the function and the cumulative distribution functions, o Graph the distribution and the cumulative distribution function, o Calculate probabilities, expected values, variances and standard deviations, o Generate Distributions, o Generate random numbers from Distributions, o Solve probability problems,
• Students will build their knowledge starting from the basic idea of probability. At the end, they will be able to solve complex problems in a creative way.

Assignment 1
Due: 17 October
Weighting: 10%

This Assessment Task relates to the following Learning Outcomes:

• Understand the difference between discrete and continuous random variables,
• Understand the difference between theoretical and empirical probability,
• For various discrete and continuous random variables, o Be familiar with the distributions, o Write the function and the cumulative distribution functions, o Graph the distribution and the cumulative distribution function, o Calculate probabilities, expected values, variances and standard deviations, o Generate Distributions, o Generate random numbers from Distributions, o Solve probability problems,
• Students will build their knowledge starting from the basic idea of probability. At the end, they will be able to solve complex problems in a creative way.
Test 3 (PC-Lab)
Due: 6 November
Weighting: 10%

This Assessment Task relates to the following Learning Outcomes:
• Understand the difference between theoretical and empirical probability,
• For bivariate probability distributions (discrete and continuous), find o Joint, marginal and conditional probabilities, o Covariance,
• Understand basic anatomy of homogeneous Markov Chains and o Find stationary distribution, if one exists, o Manipulate and interpret Markov Chains with absorbing states.
• Students will build their knowledge starting from the basic idea of probability. At the end, they will be able to solve complex problems in a creative way.

Final Examination
Due: TBA
Weighting: 50%

This will be of 3 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. Text-returnable calculators are not permitted in the tests or exam.

The University Examination period for Second Half Year 2013 is from Monday 11th to Friday 29th November 2013. You are expected to present yourself for examination at the time and place designated in the University Examination Timetable. The timetable will be available in Draft form approximately eight weeks before the commencement of the examinations and in Final form approximately four weeks before the commencement of the examinations (http://www.exams.mq.edu.au)

Extension requests for assessments
If for any reason students need an extension for their assessment tasks, they have to contact the lecturer in advance. Late submissions won’t be accepted unless satisfactory documentation outlining illness or misadventure is submitted (see Policies and Procedures section).

This Assessment Task relates to the following Learning Outcomes:
• Have a solid understanding of introductory probability theory,
• Understand the difference between discrete and continuous random variables,
• Understand the difference between theoretical and empirical probability,
• For various discrete and continuous random variables, o Be familiar with the
distributions, o Write the function and the cumulative distribution functions, o Graph the
distribution and the cumulative distribution function, o Calculate probabilities, expected
values, variances and standard deviations, o Generate Distributions, o Generate random
numbers from Distributions, o Solve probability problems,
• For bivariate probability distributions (discrete and continuous), find o Joint, marginal and
conditional probabilities, o Covariance,
• Understand basic anatomy of homogeneous Markov Chains and o Find stationary
distribution, if one exists, o Manipulate and interpret Markov Chains with absorbing
states.
• Be able to generate probability distributions and cumulative distributions, and graph
these distributions; Be able to simulate random numbers from probability distributions;
Be able to organise and summarize random data; Determine whether random data fits a
particular model; Be able to find probabilities, expected values etc, using an appropriate
statistical package.
• Students will build their knowledge starting from the basic idea of probability. At the end,
they will be able to solve complex problems in a creative way.

Delivery and Resources

Changes made to previous offerings

The Second Offering 2013 sees the confirmation of a test done during the tutorial time of week
13 using a PC (this assessment task has been introduced in the First Offering 2013).

A new "reading game" is introduced, in which students will have the duty to produce (and
answer) questions that could be used in the mid-semester tests.

A mid-semester test has been replaced by an assignment.

The first module is now 3 weeks long instead of 2 weeks (the final review in week 13 has been
cancelled).

Classes

STAT273 is delivered by lectures and tutorials.

The timetable for classes can be found on the University web site at:

http://www.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

Copies of these books are held in the Reserve section of the library.

Technology Used and Required
iLearn
There will be an iLearn site for this unit where weekly information, online discussions, lecture notes, iLectures, practice exercises, quizzes 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 http://ilearn.mq.edu.au).

The website for the iLearn login is https://ilearn.mq.edu.au/login/MQ/. You can only access the material if you are enrolled in the unit.

Software
We will be using Microsoft Office for Windows (especially Excel) 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 must be brought to the lectures each week. These will be available on iLearn the night before the lecture.
Tutorials

Tutorials begin in Week 2 and are based on work from the previous week’s lecture. The aim of tutorials is to apply techniques learnt in lectures to solve problems using a statistical package. The material is available on iLearn.

Students are free to attend ONE 1-hour tutorial a week. Students must submit their work on iLearn before the due date indicated in the assessment page on iLearn.

Additional Exercises

Additional exercises will also be made available on iLearn. It is expected that students will attempt all the questions. The exercises will not be discussed during the tutorial, although some may be discussed during the lectures. A solution will be made available on the website.

Unit Schedule

Lecture: Thursday 9am-12pm, C4A 315 Theatrette

Tutorial: Wednesday 3-4pm (and 4-5 if the number of students exceeds the room capacity), E4B 214

Students are expected to attend lectures and tutorials weekly.

Lectures and assessment timetable

<table>
<thead>
<tr>
<th>WEEK</th>
<th>LECTURE TOPIC</th>
<th>ASSESSMENT</th>
</tr>
</thead>
</table>
| W1   | Introduction, Experiments, sample spaces, Probability Rules. | • Tutorials are due the day after the class (Thursday 11:59pm)  
  • Tests 1 and 2 are done during the first hour of the lecture. Test 3 is done during the tutorial hour of week 13. |

Module 1: Introduction to first probability concepts
| W2 | Permutations and Combinations Theoretical vs. Empirical probability, Conditional probability. | Tutorial 1 (not compulsory) |
| W3 | Conditional Probability (cont'd), Independence, Bayes’ Theorem | Tutorial 2 |

**Module 2: Discrete random variables**

| W4 | Random Variables Probability Functions, Discrete Probability Distributions, Cumulative Distribution functions, Expected value and Variance | Test on Module 1 |
| W5 | Important Discrete Distributions Bernoulli, Binomial, Geometric and Poisson D. | Tutorial 4 |
| W6 | More Discrete Distributions Negative Binomial and Hypergeometric D. | Tutorial 5 |

**Module 3: Continuous random variables**

| W7 | Introduction to Continuous random variables Cumulative distribution function | Test on Module 2 |
| W8 | Important Continuous Distributions Uniform, Exponential and Normal D. | Tutorial 6 |

**Mid semester Break**

| W9 | More Discrete Distributions Gamma and Beta D. Tchebysheff’s Theorem | Tutorial 7 |

**Module 4: Samples and tests**

| W10 | Functions of Random Variables Model checking, Central Limit Theorem, Normal Approximations | Assignment on Module 3 |
|     | Tutorial 8 |
Learning and Teaching Activities

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.

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.

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.

<table>
<thead>
<tr>
<th>W11</th>
<th>Chi-squared Distribution, Distribution of sample variance, F-Distribution, Test for Equality of Variance, t-Distribution, Distribution of sample mean (σ unknown)</th>
<th>Tutorial 10</th>
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<tbody>
<tr>
<td>Module 5: Joint distributions and Markov chains</td>
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<tr>
<td>W12</td>
<td>Joint Distributions: Discrete and Continuous cases</td>
<td>Tutorial 11</td>
</tr>
<tr>
<td>W13</td>
<td>Introduction to Markov Chains States, Transition probabilities, State vectors, Equilibrium Absorbing States</td>
<td>Practical Test</td>
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</table>

http://unitguides.mq.edu.au/unit_offerings/13258/unit_guide/print
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.

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Special Consideration Policy: http://www.mq.edu.au/policy/docs/special_consideration/policy.html

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

Of interest to students are the policies and associated procedures on:

- Assessment
- Feedback and unit evaluation
- Special consideration
- Appeal Against Final Grade Policy / Procedures / Guidelines
- Academic honesty

You should in particular familiarise yourself with University policy on Special Consideration and Academic Honesty.

Misadventure and Special Consideration process

The only exception to not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In these circumstances you may wish to consider applying for Special Consideration. Information about unavoidable disruption and the
special consideration process is available at: http://www.mq.edu.au/policy/docs/special_consideration/policy.html

Information on how to submit a student requests to the Faculty of Science can be found at: http://web.science.mq.edu.au/undergraduate_programs/current/admin_central/

As a result of a granted Special Consideration, students can be required to undertake additional assessable work, or receive an extension of the due date of tutorial assessment. If a Supplementary Examination is granted as a result of the Special Consideration process the examination will be scheduled after the conclusion of the official examination period.

You are advised that it is Macquarie University policy not to set early 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.

**Academic Honesty Policy**

Academic honesty is an integral part of the core values and principles contained in the Macquarie University Ethics Statement. Its fundamental principle is that all staff and students act with integrity in the creation, development, application and use of ideas and information. You must read the University’s policy on Academic Honesty. This can be found on the MQ web site at: http://www.mq.edu.au/policy/docs/academic_honesty/policy.html. Penalties may include a deduction of marks, failure in the unit, and/or referral to the University Discipline Committee.

**Student Support**

Macquarie University provides a range of Academic Student Support Services. Details of these services can be accessed at: http://students.mq.edu.au/support/

**UniWISE provides:**

- Online learning resources and academic skills workshops [http://www.students.mq.edu.au/support/learning_skills/](http://www.students.mq.edu.au/support/learning_skills/)
- Personal assistance with your learning & study related questions.
- The Learning Help Desk is located in the Library foyer (level 2).
- Online and on-campus orientation events run by Mentors@Macquarie.

**Student Enquiry Service**

Details of these services can be accessed at http://www.student.mq.edu.au/ses/.

**Equity 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.
IT Help
If you wish to receive IT help, we would be glad to assist you at http://informatics.mq.edu.au/help/.

When using the university’s IT, you must adhere to the Acceptable Use Policy. The policy applies to all who connect to the MQ network including students and it outlines what can be done.

Graduate Capabilities

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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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Learning outcomes

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Learning outcome

- Be able to generate probability distributions and cumulative distributions, and graph these distributions; Be able to simulate random numbers from probability distributions; Be able to organise and summarize random data; Determine whether random data fits a particular model; Be able to find probabilities, expected values etc, using an appropriate statistical package.

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Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships...
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**Learning outcome**

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### Changes since First Published

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<tr>
<th>Date</th>
<th>Description</th>
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<tbody>
<tr>
<td>24/07/2013</td>
<td>The first module is now 3 weeks long instead of 2 weeks.</td>
</tr>
<tr>
<td>23/07/2013</td>
<td>Change of assessment plan: a mid-semester test has been replaced by an assignment.</td>
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<tr>
<td>23/11/2012</td>
<td>The Prerequisites was updated.</td>
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