# STAT7310

## Statistical Theory

Session 1, Special circumstances 2021

*Archive (Pre-2022) - Department of Mathematics and Statistics*

# Contents

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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

Unit convenor and teaching staff
Lead Unit Convenor/Lecturer
Georgy Sofronov
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Contact via Contact via Email
please refer to iLearn

Second Unit Convenor/Lecturer
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Credit points
10

Prerequisites
Admission to MRes

Corequisites

Co-badged status
STAT8310

Unit description
This unit introduces the foundation concepts of probability and statistics. The unit develops
probability concepts, including random variables and distributions, independence, joint and
conditional distributions, expectations, generating functions, distributions of sums of
independent random variables and the Central Limit Theorem. The principles of statistical
inference are discussed with a particular focus on point estimators, confidence intervals and
hypothesis testing.

## 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:

> **ULO1:** Apply concepts related to probability and statistics including random variables

and distributions, independence, joint and conditional distributions, expectations, generating functions, distributions of sums of independent random variables and the Central Limit Theorem.

**ULO2:** Summarise data using appropriate statistical analysis, descriptive statistics and graphical presentation.

**ULO3:** Evaluate the appropriateness of a variety of statistical models/methods for various types of data, apply them, and interpret the results.

**ULO4:** Apply concepts related to statistical inference including point estimators, confidence intervals and hypothesis testing.

# 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 weekends and/or public holidays). For example, if an assignment is submitted 25 hours late, its mark will attract a penalty equal to 40% of the earned mark. After 2 days (including weekends

and public holidays) a mark of 0% will be awarded. Timed assessment tasks (e.g. tests, examinations) do not fall under these rules.

**FINAL EXAM POLICY:** 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. 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 this 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.

# Assessment Tasks

| Name | Weighting | Hurdle | Due |
|------|-----------|--------|-----|
| iLearn Quiz | 5% | No | Week 5 |
| Test | 20% | No | Week 7 |
| Assignment | 15% | No | Week 11 |
| Final Examination | 60% | No | University examination period |

## iLearn Quiz

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 1 hours
Due: **Week 5**
Weighting: **5%**

iLearn Quiz

On successful completion you will be able to:
- Apply concepts related to probability and statistics including random variables and distributions, independence, joint and conditional distributions, expectations, generating functions, distributions of sums of independent random variables and the Central Limit Theorem.

## Test

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 1 hours
Due: **Week 7**
Weighting: **20%**


Mid-Semester Class Test


On successful completion you will be able to:

- Apply concepts related to probability and statistics including random variables and distributions, independence, joint and conditional distributions, expectations, generating functions, distributions of sums of independent random variables and the Central Limit Theorem.

## Assignment

Assessment Type [1]: Quantitative analysis task
Indicative Time on Task [2]: 8 hours
Due: **Week 11**
Weighting: **15%**


Assignment


On successful completion you will be able to:

- Summarise data using appropriate statistical analysis, descriptive statistics and graphical presentation.
- Evaluate the appropriateness of a variety of statistical models/methods for various types of data, apply them, and interpret the results.
- Apply concepts related to statistical inference including point estimators, confidence intervals and hypothesis testing.

## Final Examination

Assessment Type [1]: Examination
Indicative Time on Task [2]: 3 hours
Due: **University examination period**
Weighting: **60%**

Invigilated Final Examination

On successful completion you will be able to:

- Apply concepts related to probability and statistics including random variables and distributions, independence, joint and conditional distributions, expectations, generating functions, distributions of sums of independent random variables and the Central Limit Theorem.
- Summarise data using appropriate statistical analysis, descriptive statistics and graphical presentation.
- Evaluate the appropriateness of a variety of statistical models/methods for various types of data, apply them, and interpret the results.
- Apply concepts related to statistical inference including point estimators, confidence intervals and hypothesis testing.

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[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 Writing Centre 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 SGTAs (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)

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)

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

| TOPIC | MATERIAL COVERED |
|---|---|
| 1 | Sample space, events. Axioms of probability, conditional probability. Bayes Theorem. |
| 2 | Random variables and probability distributions. Standard discrete and continuous distributions and their key characteristics. The Poisson process. |
| 3 | Expected values (discrete and continuous) and their properties. Measures of variation. Quantiles. Moments (raw and central). Interpretation of moments (skewness, kurtosis etc.). |

| 4 | Sums of independent random variables. Discrete and continuous convolutions with applications. 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. |
|---|---|
| 5 | Probability generating functions and moment generating functions with properties and applications. The moment generating function of a sum of independent random variables. The Central Limit Theorem and applications. |
| 6 | Multivariate (particularly bivariate) random variable theory (continuous and discrete). Marginal and conditional distributions and expectations. Covariance and correlation. |
| 7 | Exploratory data analysis including measures of association and principal component analysis. |
| 8 | Random sampling and sampling distributions. |
| 9 | Point estimators and their properties. MLEs and asymptotic results and bootstrapping. |
| 10 | Interval estimators, their properties. |
| 11 | Hypothesis testing, including likelihood ratios and goodness of fit. |

# Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). 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

Students seeking more policy resources can visit Student Policies (https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

## 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

## 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 or if you are a Global MBA student contact 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) 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 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

If you are a Global MBA student contact 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.