



Division of Economic and Financial Studies

STAT371 E1 - 2008: Modern Statistical Concepts

STAT810 E1 - 2008: Statistical Theory

Unit Outline

Year and Semester: 2008 E1

Unit convenor: A/Prof. Andrzej Kozek

Students in this unit should read this unit outline carefully at the start of semester. It contains important information about the unit. If anything in it is unclear, please consult one of the teaching staff in the unit.

ABOUT THIS UNIT

STAT371 E1 - 2008: Modern Statistical Concepts is an undergraduate 3 credit point unit and STAT810 E1 - 2008: Statistical Theory is a postgraduate 4 credit point unit. The unit is run by the Statistics Department in the Division of Economic and Financial Studies.

The unit aims to make you familiar with modern logical and mathematical foundations underlying sciences dealing with randomness and chances, in particular **Probability and Statistics**. You will learn fundamental theorems of Probability and Statistics showing why and how it is possible to extract significant information from noisy data. You will also learn what criteria decide that a particular statistical method is considered good and also how to derive optimal statistical procedures.

Lectures:

Week 1: Introduction to Probability and Statistics. Discrete random variables and their probability distributions.

Week 2: Continuous random variables and their probability distributions. Probability, Moment and Cumulant Generating Functions.

Week 3: Multivariate probability distributions. Functions of random variables.

Weeks 4 – 7: Laws of Large Numbers, Central Limit Theorem, Fundamental Theorem of Statistics, Empirical Functionals, Exploratory Data Analysis, Asymptotic Theory.

Assignment 1 due on 7th April

Weeks 8 – 9: Estimation and properties of estimators.

Assignment 2 due on 5th May

Week 10 – 11: Hypotheses testing and properties of tests. Analysis of Variance.

Week 12 – 13: Linear Models and properties of the Least Squares Estimators.

Assignment 3 due on 26th May

TEACHING STAFF

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CLASSES

Mondays 6-9 p.m. in E5A 119.

Weeks 1 - 13: 25th February - 6th June 2008.

Week 5, Public Holiday: Easter Monday on March 24th

TUTORIALS

Mondays, Weeks 2-13 in E4B 111: 5-6 p.m. E4B102 9-10pm

REQUIRED AND RECOMMENDED TEXTS AND/OR MATERIALS

This will be used not as a precise definition of course material, but rather as a reference point to cover matters which are not directly dealt with in lectures. It should clearly be understood that additional material will be included in lectures, assignments, etc.

Textbook : • **Mathematical Statistics with Applications, Seventh Edition**

D.D. Wackerly, W. Mendenhall, R.L. Scheaffer.

Duxbury Press, distributed by Cengage Learning

ISBN-10: 0495110817 ISBN-13: 9780495110811

Software: Scientific Notebook.TM, Release 3.5 is available in LAB E4B. **Scientific Notebook provides invaluable help in manipulating algebra and calculus formulae, solving equations and plotting graphs.** A one month free evaluation copy of Scientific Notebook is available from MacKichan Software Inc. <http://licensing.mackichan.com/index.html>

Local distributors of Scientific notebook can be found at:

- Hearne Scientific Software Pty Ltd.
http://www.hearne.com.au/products/scientific_notebook/edition/scientific_notebook/
Mail: Level 6, 552 Lonsdale Street
Melbourne 3000 Australia
Phone (03) 9602 5088
- MathStat Software.
<http://www.mathstat.com.au/products/mathematics/maths.htm>

PO Box 786
Mulgrave MDC 3170
Victoria AUSTRALIA Phone 61 3 9562 2766
Fax: 61 3 9561 5524
Email: info@mathstat.com.au

Reading books : • RAO, C.R., Linear statistical inference and its applications,
(QA276.R36/1973)

- SERFLING, R.J. Approximation theorems of mathematical statistics (QA276.S45)
- FERGUSON, T.S. Mathematical statistics : a decision theoretic approach, (QA276.F45)
- FERGUSON, T.S. A course in large sample theory (QA276.6.F47)
- LEHMANN, E.L. Theory of point estimation (QA276.8.L43/1991)
- LEHMANN, E.L. Testing statistical hypotheses (QA277.L425)
- LEHMANN, E.L. Elements of Large-Sample Theory (QA276.6.L45)
- LINDGREN, B.W. Statistical theory (QA276.L546)
- McCabe, B. and Tremayne, A. Elements of Modern asymptotic theory with statistical applications (QA277.M376)
- Hogg, R.V., McKean, J.W. and Craig, A.T. Introduction to Mathematical Statistics, Sixth Edition, (QA276.H59/2004)
- ZACKS, S. The theory of statistical inference. (QA276.Z26)
- FREUND J.E. and WALPOLE R.E. Mathematical Statistics, Fifth Edition, (QA276.F692/1992)
- LARSON, H. Introduction to probability theory and statistical inference (QA273.L352)

Nonparametric Statistics:

- BRADLEY, J.V. Distribution free statistical tests (QA278.8.B7)
- CONOVER, W.J. Practical nonparametric statistics (QA278.8.C65)
- DANIEL, W.W. Applied nonparametric statistics (QA278.8.D35)
- LEHMANN, E.L. Nonparametrics: statistical methods based on ranks (QA278.8.L43)

UNIT WEB PAGE

Home page:

Stat371-Stat810: <http://www.stat.mq.edu.au/pg/units/stat/stat371>

Consult the web page frequently. You will find administrative updates, assignments and links to other useful sites, including our WebCT. On WebCT you can find lecture notes, discussion board, copies of assessment tasks and solutions to assignments.

LEARNING OUTCOMES

By the end of Stat371-Stat810, students should

- be familiar with techniques to calculate probabilities, expected values and probability, moment and cumulant generating functions for discrete, continuous and multivariate random variables and know how to apply these concepts in practical problems,
- understand fundamental limit theorems of Probability and Statistics and be able to apply them in practical problems,
- understand three modes of convergence of random variables and be able to apply them to get practical large sample approximations,
- understand and know how to use the Delta Method in practical problems,
- understand principles of optimal estimation and testing hypotheses, including tests of Analysis of Variance and be able to derive optimal estimators and tests,
- understand principles of linear models, be able to test if the models are adequate and estimate and test parameters of these models.
- understand tests of fit and be able to test if parametric models are adequate.

In addition to the discipline-based learning objectives, all academic programs at Macquarie seek to develop students generic skills in a range of areas. One of the aims of this unit is that students develop their skills in the following:

- Foundation skills of literacy, numeracy and information technology
- Communication skills
- Critical analysis skills

- Problem-solving skills

TEACHING AND LEARNING STRATEGY

Students in Stat371-Stat810 will attend **3 hour lecture every week**. It is recommended that you review the previous weeks lecture material before attending the current weeks classes.

Lecture notes.

Lecture notes, new and spare handouts, assignment problems, and their solutions (after the due date) will be available from our WebCT home page and also from the lecturer. Make sure you got your WebCT password at the enrollment. If you have problems with access to the WebCT please contact the Library Information desk.

Lecture notes are delivered by mail to distance students. On campus they can be photo-copied in ERIC, E4B 106, or downloaded from WebCT (2MB pdf file, Acrobat Reader needed. All changes will be announced on WEBCT.

Students are expected to attend all classes and tutorials and return all assignments.

It is also recommended to study our **textbook** *Mathematical Statistics with Applications*, Seventh Edition, by Wackerly & al. The lecture is very close to the program of the textbook but not identical. In the textbook students can find about 1000 additional solved problems and, occasionally, more details on particular problems. The lecture goes also beyond the program presented in the book: some optimality problems, sufficient statistics and asymptotic methods are covered in more detail in the lecture notes.

There will be **three assignments** (A1, A2, A3) which should help students to control their progress in preparing for the examination. The assignments do not have much weight, rather they aim to provide students feedback on their study. Solutions to the assignments will be given after the due date for the assignment and should be studied carefully and compared with student work. The solutions aim to give students some feedback on their learning process in the unit. The final examination makes a very significant component of the final grade.

Tutorials will be run weekly, where problems similar to assignment problems will be solved and discussed.

Independent Work. In Stat371-Stat810 you are also expected to spend some time each week working on your own. This may include revision of lecture and tutorial material, attempts at extra examples (from lectures, your textbook or other text books) and completion of homework tasks and assignments. At Macquarie University it is expected that the average student would spend approximately 3 - 4 hours per week for each credit point in a unit. This means that you should expect to spend approximately 12 hours per week in both formal classes and independent work.

RELATIONSHIP BETWEEN ASSESSMENT AND LEARNING OUTCOMES

A student must have satisfactory performance in both the final examination and coursework material to pass the course. The final grade depends on overall interpretation of the data, however the numerical evaluation is an important component of the final assessment.

Stat371 and Stat810 are based on the same course material, however undergraduate students in Stat371 and postgraduate students in Stat810 will be assessed independently. Postgraduate students are expected to show on assignments and on the final exam better and deeper understanding of the course material than the undergraduate students.

The Course Rules :

- **There will be three assignments (A1, A2, A3) due in class.**
- Failure to submit assignments may result in exclusion from the unit in accordance with Bachelor Degree Regulation 10(1).
- Your attention is drawn to University's policies on collusion and collaboration.
- Students may and should benefit from discussing assignment work with other students. However, the actual work submitted must be a student's personal effort, and copying or plagiarism will result in a disciplinary action. Disciplinary proceedings will be taken against offenders without any further warning being given.

Assessment :

- 3 assignments 5% each, due on 7th April, on 5th May and on 26th May, respectively,
- for internal students: active participation in tutorials and participation in discussion of assignment and related problems on our Bulletin Board on WEBCT 5%
- for external students: solving tutorials problems and participation in discussion of assignment and related problems on our Bulletin Board on WEBCT 5%
- Mid-Year Examination 80% (3 hours)

The University Examination period in the First Half Year 2008 is from 11th June to 27th June.

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.

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.reg.mq.edu.au/Forms/APScons.pdf>

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.

PLAGIARISM

The University defines plagiarism in its rules: "Plagiarism involves using the work of another person and presenting it as one's own." Plagiarism is a serious breach of the University's rules and carries significant penalties. You must read the University's practices and procedures on plagiarism. These can be found in the Handbook of Undergraduate Studies or on the web..

The policies and procedures explain what plagiarism is, how to avoid it, the procedures that will be taken in cases of suspected plagiarism, and the penalties if you are found guilty. Penalties may include a deduction of marks, failure in the unit, and/or referral to the University Discipline Committee.

UNIVERSITY POLICY ON GRADING

Academic Senate has a set of guidelines on the distribution of grades across the range from fail to high distinction. Your final result will include one of these grades plus a standardised numerical grade (SNG).

On occasion your raw mark for a unit (i.e., the total of your marks for each assessment item) may not be the same as the SNG which you receive. Under the Senate guidelines, results may be scaled to ensure that there is a degree of comparability across the university, so that units with the same past performances of their students should achieve similar results.

It is important that you realise that the policy does not require that a minimum number of students are to be failed in any unit. In fact it does something like the opposite, in requiring examiners to explain their actions if more than 20% of students fail in a unit.

The process of scaling does not change the order of marks among students. A student who receives a higher raw mark than another will also receive a higher final scaled mark.

For an explanation of the policy see **GUIDELINES FOR GRADING - Brief Explanation** and **GUIDELINES FOR GRADING - Detailed Explanation** at <http://www.mq.edu.au/senate/issues.html>

STUDENT SUPPORT SERVICES

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