GENERAL:

Introduction to Mathematical Statistics II is a one-semester subject which provides you with the mathematical foundations underpinning modern statistical inference and applications. It is an important subject for students who are planning further studies in statistics or applied probability, and for students who are using or who will use statistics in other disciplines. The emphasis throughout the subject is on learning through explanations and problem solving, rather than on the formal theory.

Statistics is a coherent, integrated discipline, which relies on mathematical tools (most notably probability theory) but is so much more in its demand for: scientific thinking, an understanding of the nature of variability, the need to be able to make appropriate modelling choices and to develop new models tailored to specific situations, and the ability to draw inferences about real-world problems. Statistics is what we refer to as a 'sequential discipline', and in this sense it is much more akin to Pure Mathematics than it is to Applied Mathematics.

A BRIEF GUIDE TO RECOMMENDED PROGRAMS IN STATISTICS:

1. If you already know that you want to study Honours in Statistics, then you should complete all 6 units of Level II Statistics, i.e.
   Introduction to Mathematical Statistics II
   Statistical Practice II, and
   Statistical Theory and Modelling II.

   If your program can only include 4 units of Level II Statistics subjects, then we recommend that you choose the 'core' subjects
   Introduction to Mathematical Statistics II, and
   Statistical Theory and Modelling II.

   In third year, you should enrol in the 2 core statistics subjects in first semester,
   Theory of Statistics III and
   Statistical Modelling III.

   These total 6 units. We strongly recommend that you also take the principal
   semester 2 Statistics electives which this year are Sampling Theory and Practice III and
   Biostatistics III, plus Applied Probability III, Life Contingencies III, or other subjects
   according to your interests and strength. If these are in Pure Mathematics, then
   Multivariable Calculus II or Integration III are good choices for statisticians.

2. If you are aiming to complete a Statistics Major but may not go onto Honours
   Statistics, then you should complete all 6 units of Level II Statistics as listed above.
   Again, if you can only do 4 units, they should be made up of
   Introduction to Mathematical Statistics II, and
   Statistical Theory and Modelling II.
In third year, the highest quality Major includes the first semester core Statistics subjects
Theory of Statistics III and
Statistical Modelling III,
plus the semester 2 principal elective Statistics subjects.

A reasonable Statistics Major can still be obtained by including one of Theory of Statistics III or Statistical Modelling III (plus Statistics electives), and the choice will depend on your background and interests.

Students who intend applying for an Australian Bureau of Statistics scholarship are expected to complete a Statistics Major.

3. If you are planning to take some Statistics electives in third year, but not complete a Major, then we recommend that you complete at least 4 units of Level II Statistics. We recommend the two core subjects Introduction to Mathematical Statistics II, and Statistical Theory and Modelling II. This will keep your options open, and provide sufficient background for the following examples of subject choices:

- Maths and Computer Science students who plan to enrol in Theory of Statistics III or Statistical Modelling III, or one or more of the Level III elective subjects in Statistics.

- Engineering students who wish to enrol in Sampling Theory and Practice III.

- Economics or Finance Students who plan to enrol in Time Series III (when it is offered).

- Genetics students who plan to enrol in Bioinformatics III (currently called Biostatistics III).

- Psychology students who plan to enrol in Statistical Modelling III.

In certain circumstances, it may be possible to study the Level III Statistics elective subjects having taken IMS II and Statistical Practice II only, or IMS II alone, but this is not usually recommended. If you are planning such a scenario, we strongly encourage you to seek advice in advance from the Statistics staff.

4. If you simply want basic practical statistics that includes analysis of variance and regression modelling and do not plan to study statistics beyond that, then Statistical Practice II is the subject for you.

In summary, Introduction to Mathematical Statistics II is essential for students who

- are enrolled or who plan to enrol in Statistical Theory and Modelling II;

- are planning to enrol in the core third year Statistics subjects Statistical Modelling III and/or Theory of Statistics III;

- are enrolled in or who plan to enrol in the elective Level III Statistics subjects (this year, the principal ones are Biostatistics III and Sampling Theory and Practice III); or

- are planning to apply for an Australian Bureau of Statistics Undergraduate Scholarship in Statistics.
UNITS VALUE: 2

PREREQUISITES AND ASSUMED KNOWLEDGE:

There is a prerequisite of either Mathematics I or Mathematics IM. Most students will also have done either Statistical Practice I or Mathematical Applications I. Students who haven't done either will need to spend extra time with the first two chapters of the textbook over the first few weeks of the subject.

STAFF:

The lecturer for this subject is Associate Professor Patty Solomon, Room 121 Mathematics Wing, Phone: 8303 3033, email: patty.solomon@adelaide.edu.au

Ms Ann Coultas (Mathematics Building Room G23a) is the tutor-in-charge. Email: ann.coultas@adelaide.edu.au

TUTORIALS:

Tutorials are held fortnightly in the even-numbered weeks starting in Week 2. Students are expected to have attempted the questions prior to their tutorial. All students should fill in their timetable and return the sheet to Ann Coultas, Room G23a as soon as possible. You will then be allocated to a Tutorial group.

Tutorial allocation lists, notices, exam results, etc will be posted on the Statistics Notice-board outside lecture theatre G02 on the ground floor of the Mathematics building.

TEXTBOOK:

The textbook for this subject is


This book will also be used in the other Level II subjects in Statistics this year and is a good investment if you are planning further study in Statistics. Copies are available from Unibooks ($88.95 before discount), or you may be able to obtain a copy of the 5th edition second-hand. There will be 3 copies in the Barr Smith Library: 1 on 7-day loan, and 2 on Reserve.

You may also find the following books useful reading:


A more extensive and slightly higher-level book. This is one of my favourite undergraduate statistics texts because of its emphasis on applications of realistic complexity whilst presenting the basic underlying mathematics and statistical theory.


This book covers material in the first two-thirds of the subject. As the title implies, it is a book about basic probability for statistics.

CONSULTING TIMES: These will be announced shortly.

ASSIGNMENTS:

There will be three assignments, due on Wednesdays by 9.10am in Weeks 5, 9 and 13. The average mark for the three assignments will count 20% towards the
final assessment if your final mark is higher than taking your exam result alone (see Examination below). Questions will be drawn from those handed out as Tutorial questions.

Unless negotiated prior to the due date, late assignments attract a 20% penalty per day.

Not all questions will be marked on all assignments. Your assignments should be placed in the boxes marked 'Level II Statistics' on the ground floor of the Mathematics Building, in the stairwell opposite Room G03. The outside of your assignment should include your Name, Tutorial Time and Subject on the front. We will make every effort to mark and return your assignments within a fortnight of the due date. Solutions to the assignments will be provided.

EXAMINATION:

There will be a two-hour examination at the end of the subject in the June examination period, comprising 80% of the final mark. However, if your final mark is higher using the examination result alone, then this will be 100% of your final mark. The exam will be based on the work covered in the lectures, assignments and other set exercises. In the exam, any required statistical tables will be provided. You may take your hand calculator to the exam, but the use of alpha memory is not permitted.

The supplementary examination will be held in July 2002. Students should refer to the Departmental Policy on supplementary examinations.
SUBJECT OUTLINE:

1. **Introduction**: what statistics is about and why it is important.

2. **Probability**: probability theory needed for mathematical statistics; sample spaces, events, equally likely outcomes, odds and odds ratio; relative frequency and different interpretations of probability, conditional probability and independence, Bayes' Rule, sequences of events; an introduction to named and empirical distributions. *(This chapter is mostly revision.)*

3. **Discrete random variables**: expectation, expectations of functions of random variables, random sampling with and without replacement, the binomial distribution, normal approximation to binomial, geometric, hypergeometric and Poisson distributions. Moment generating functions, probability generating functions, Markov's Inequality, Tchebychev's Inequality.

4. **Continuous distributions**: probability density functions, expectation, uniform, normal and Cauchy distributions. The exponential distribution, the hazard function and survival functions and half-life. Poisson processes, gamma and chi-square distributions. Moment generating functions.

5. **Multivariate probability distributions**: bivariate and multivariate distributions; marginal and conditional distributions; independence; expectations; covariance and correlation; multinomial distribution, bivariate normal distribution; conditional expectation.

6. **Functions of random variables**: the three different methods for finding the distribution of a function of random variables: distribution functions, transformations, and moment generating functions.

The lecture notes, tutorial sheets and other handouts for this subject will be available from My Uni at www.myuni.adelaide.edu.au

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**Associate Professor Patty Solomon**
Department of Applied Mathematics and Special Research Centre for the Molecular Genetics of Development.
25 February 2002