

MA22003: Statistics & Discrete Mathematics Guide 2008 – 2009

Organisation

The MA22003 module contains components of Statistics & Discrete Mathematics which run concurrently for 11 teaching weeks. The members of the teaching team are

Statistics:	Dr David Pontin, Mathematics Division, Room 1.43C,	Discrete Mathematics :	Dr David Griffiths Mathematics Division Room 1.43A,
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who are responsible for the entire organisation and teaching. The Module Leader is Dr David Griffiths.

You may bring matters of concern about the course to the attention of the Mathematics Division Staff/Student Committee, which meets once each semester. A volunteer will act as class representative to sit on the Staff–Student Committee; their name will be posted on BlackBoard.

Timetable

	Lectures & Workshops
Statistics	Mondays (10.00am) Wednesdays (10.00am) & Fridays (10.00am)
Discrete Mathematics	Tuesdays (10.00am), Thursdays (10.00am) & Fridays (2.00pm)

All lectures and Workshops will take place in the Carnelley Small Lecture Theatre.

Your Commitment

You should attend all lectures and workshops except on medical grounds or with the special permission of the lecturer concerned. If you are absent from a Class Test on account of medical problems, you should submit a medical certificate to your Faculty Office.

You should also complete all the homework exercises and keep a record of all your work requiring use of the software package Scientific Notebook.

About 13 hours per week of your study time, including timetabled hours, should be devoted to this module.

Study Support

If you are having difficulty with the course work you are encouraged to seek help at an early stage at the Workshops or from your lecturers.

Syllabus

This module involves 170 hours of student effort, including 66 contact hours (44 lectures and 22 other meetings for workshops).

Statistics component

Data Analysis (6-7 lectures)

- Populations and samples
- Random selection, using random digits (optional)
- Types of data: nominal, ordinal, measurement
- Data presentation: histograms, stem-and-leaf displays
- Data summaries: (central) location and spread
- Median, quartiles (5 number summary)
- Mean, standard deviation (SD)
- Transforming to symmetry (optional)

Statistical Relationships (4 lectures)

- Simple linear regression: interpretation
- Least squares fit (no details)
- Residual SD
- Strength: R^2 , correlation coefficient
- Residual plots (optional)

Probability (6-7 lectures)

- Simple selection problems
- Events, compound events: complements
- Addition rules
- Counting (optional)
- Conditional probability
- Multiplication rules: Bayes' Theorem
- Independent events
- Selection with/without replacement (optional)

Binomial and Normal (Gaussian) Distributions (4-5 lectures)

- Binomial distribution (tables); mean and variance
- Normal distribution (tables)
- Sums and differences of independent normals
- Normal approximation to binomial (Central Limit Theorem)

Algebra component

Discrete Mathematics component

Difference Equations (11 lectures)

One-step (two-level) equations: homogeneous form, inhomogeneous forms with right hand sides: polynomial, α^n , $\sin(an)$, $\cos(an)$.

Second order equations: general solution of homogeneous equations (simple, double and complex roots of characteristic equation).

Inhomogeneous forms with right hand sides: polynomial, α^n , $\sin(an)$, $\cos(an)$.

Homogeneous equations of higher order.

Generating functions: the connection between the difference equation $u_{n+2} + pu_{n+1} + qu_n = 0$, the power series $u_0 + xu_1 + x^2u_2 + \dots$ and the Maclaurin expansion of $\frac{ax + b}{1 + px + qx^2}$.

One-step nonlinear difference equations: $x_{n+1} = g(x_n)$.

Fixed points, linearization, stability.

Roots of a Single Nonlinear Equation $f(x) = 0$ (4 lectures)

Bisection Method.

Simple iteration: $x_{n+1} = g(x_n)$, conditions for convergence.

Newton-Raphson method. Secant Method.

Markov Chains (3 lectures)

Probability vectors, stochastic matrices, long time behaviour.

Contemporary Linear Algebra, H. Anton & R.C. Busby (Wiley, 2003). Sections 5.1 (pp 225–235).

Also show connection with second order difference equations and discuss stability in \mathbb{R}^2 .

Game Theory (4 lectures)

Restrict attention to the strategic form of two-person, zero-sum games. Theoretically, such games have clear-cut solutions, thanks to a fundamental mathematical result known as the minimax theorem. Each such game has a value, and both players have optimal strategies that guarantee the value.

Elementary Linear Algebra, H. Anton & C. Rorres (Wiley, 2003). Sections 11.8 (pp 629–639).

Game Theory—Introduction, Thomas S. Ferguson, UCLA.

http://www.math.ucla.edu/~tom/Game_Theory/intro.pdf

Two-person zero-sum games, Thomas S. Ferguson, UCLA.

http://www.math.ucla.edu/~tom/Game_Theory/mat.pdf

Assessment

There will be Homeworks, Class Tests and a Degree Examination in the May diet of examinations. These contribute to the overall assessment as shown in the Table below.

Homeworks	20%
Mid-semester Tests (Weeks 6 & 7)	20%
Degree Examination	60%

Marks in these assessments will be deducted for work if the presentation is deemed unsatisfactory or not handed in by the deadline given.

To pass this module in May it is necessary to gain at least 40% in the overall assessment **and** hand in all work requested **and** attempt all class tests. There will be penalties for late submission of work.

For those who fail the module in May there will be a two-hour examination paper at the August Examination diet. The overall assessment will be based on 60% of the mark gained at the resit examination with the remaining 40% coming from homework/class test marks in the second semester.

The Head of Division may debar a student not performing at a satisfactory level in the continuous assessments from entering the Degree Examination in May.

Awards

A medal may be awarded to the best student in the class.

Feedback

At the end of each section of the module you will be asked to complete a confidential questionnaire regarding the content and presentation of the module. This is an important element in the University's Academic Standards procedures.

Recommended Books

Linear Algebra by David Poole
(Brooks/Cole, ISBN 0-53434174-8).

Many similar textbooks may be found in the University Library.

Web Resources

Advance@Dundee <http://www.dundee.ac.uk/advancedundee/>

This is the University of Dundee Transferable Skills Website and is divided into eight key skill areas and over 60 specific topics giving access to hundreds of interlinked articles about personal transferable skills. The eight skill areas include pages on Basic Maths & Stats. There are many other resources available on the web that are relevant to these modules.

Study Skills online: <http://people.brunel.ac.uk/~mastmmg/ssguide/sshome.htm>

A useful set of pages written by Martin Greenhow of Brunel University. We suggest you use Google or some other search engine to discover further web resources.