MATH2831/2931 – Course Outline

Information about the course

Course Authority:  Dr. Libo Li

Lecturers:  Dr. Libo Li, RC-1035, email libo.li@unsw.edu.au, phone: 9385 7025

Consultation:  TBA.

Credit, Prerequisites, Exclusions:

This course counts for 6 Units of Credit (6UOC).

Prerequisites:  MATH2801 (for MATH2831) or MATH2901 (for MATH2931)

Exclusions:  BEES2041, BIOS2041, MATH2831 (for MATH2931), MATH2931 (for MATH2831).

Lectures:  There will be three lecturers per week:

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>Monday</td>
<td>1 pm</td>
<td>Electrical Eng G24</td>
</tr>
<tr>
<td>Wednesday</td>
<td>4 pm</td>
<td>Electrical Eng G25</td>
</tr>
<tr>
<td>Thursday</td>
<td>1 pm</td>
<td>Electrical Eng G24</td>
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</table>

Tutorial-Labs:  There will be one lab tutorial per week (starting in week 2). Initial tutorial classes are scheduled as:

<table>
<thead>
<tr>
<th>Course</th>
<th>Day</th>
<th>Time</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>MATH2931</td>
<td>Wednesday</td>
<td>11am</td>
<td>Red Center G012A</td>
</tr>
<tr>
<td>MATH2931</td>
<td>Wednesday</td>
<td>3pm</td>
<td>Red Center G012C</td>
</tr>
<tr>
<td>MATH2831</td>
<td>Thursday</td>
<td>2pm</td>
<td>Red Center G012A</td>
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</tbody>
</table>

Moodle:  Further information, skeleton lecture notes, and other material will be provided via Moodle.

Course outline

Statistics is about using probability models to make decisions from data in the face of uncertainty. This course gives an introduction to the process of building statistical models using an important class of models (linear models). In a linear model we try to predict or explain variation in a response variable in terms of related quantities (predictors). The relationship between the expected response and predictors is linear in unknown model parameters. Topics covered in the course include how to estimate parameters in linear models, how to compare models using hypothesis testing, how to select a good model or models when prediction of the response is the goal, and how to detect violations of model assumptions and observations which have undue influence on decisions of interest. Concepts are illustrated with applications from finance, economics, medicine, environmental science and engineering.
Relation to other statistics courses

Building on the foundation statistical inference course MATH2801/2901, linear models are considered a fundamental component of statistical practice. Satisfactorily completing this course will provide a solid background for more advanced statistical courses.

Student Learning Outcomes

This course is expected to give students an understanding of the fundamentals of regression modelling, which is essential for anyone contemplating a career as a professional statistician or higher study in statistics for students majoring in mathematics and statistics.

Relation to graduate attributes

- The problem-solving activities in tutorials and assignments will improve your research, enquiry and analytical thinking abilities (Science Graduate Attribute 1) and your capacity and motivation for intellectual development (Science Graduate Attribute 2);
- Regular coursework assignments will provide you with timely feedback on your progress and improve your Communication skills (Science Graduate Attribute 4);
- Computing skills developed in this course will improve your Information Literacy (Science Graduate Attribute 6)

Teaching strategies underpinning the course

New ideas and skills are introduced and demonstrated in lectures, then students develop these skills by applying them to specific tasks in tutorials and assessments.

Rationale for learning and teaching strategies

We believe that effective learning is best supported by a climate of inquiry, in which students are actively engaged in the learning process. Hence this course is structured with a strong emphasis on problem-solving tasks. Students are expected to devote the majority of their class and study time to the solving of such tasks. New ideas and skills are first introduced and demonstrated in lectures, and then students develop these skills by applying them to specific tasks in tutorials and assessments. This course has a major focus on research, inquiry and analytical thinking as well as information literacy. We will also explore capacity and motivation for intellectual development through the solution of both simple and complex mathematical models of problems arising in finance, economics, medicine, environmental science and engineering, and the interpretation and communication of the results.
Assessment

Assessment in this course will consist of three assignments (10% each) and a final examination (70%).

Knowledge and abilities assessed: All assessment tasks will assess the learning outcomes outlined above, specifically, the ability to derive logical and coherent proofs of relevant results, and the ability to solve a variety of regression problems, both theoretical and in practice.

Assessment criteria: The main criteria for marking all assessment tasks will be clear and logical presentation of correct solutions.

MATH2931 assessment: Students in the higher level course (MATH2931) will receive additional, and more challenging assignment and examination problems.

Assignments

Rationale: Assignments will give an opportunity for students to try their hand at more difficult problems requiring more than one line of argument and also introduce them to aspects of the subject which are not explicitly covered in lectures. Assignments are also intended to give regular feedback on a students progress and mastery of the material, to identify as soon as possible any problems that students may have. Assessment in this course will use problem-solving tasks of a similar form to those practiced in tutorials, to encourage the development of the core skills underpinning this course and the development of analytical thinking

You should consult the University web page on plagiarism

www.lc.unsw.edu.au/plagiarism

<table>
<thead>
<tr>
<th>Task</th>
<th>Date Avail.</th>
<th>Date Due</th>
<th>Form of Submission</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment 1</td>
<td>Week 2</td>
<td>Week 5</td>
<td>Written</td>
<td>10%</td>
</tr>
<tr>
<td>Assignment 2</td>
<td>Week 6</td>
<td>Week 8</td>
<td>Written</td>
<td>10%</td>
</tr>
<tr>
<td>Assignment 3</td>
<td>Week 9</td>
<td>Week 11</td>
<td>Written</td>
<td>10%</td>
</tr>
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Late assignments will not be accepted.

Examination

Duration: Two hours.

Rationale: The final examination will assess student mastery of the material covered in the lectures, assignments and tutorials.

Weighting: 70% of your final mark.

Further details about the final examination will be available in class and on Moodle closer to the time.
Additional resources and support

Tutorial Exercises

All tutorials will be held in the computing labs in the Red Center. Weekly tutorial exercises and datasets will be provided on Moodle. These problems are for YOU to do to enhance mastery of the course, even if you require longer than the allocated tutorial to complete them. Final examination questions may be along similar lines.

Computer laboratories

Computer laboratories (RC-M020 and RC-G012) are open 9:00am – 5:00pm Monday – Friday on teaching days. RC-M020 has extended teaching hours (usually 8:30am – 9:00pm Monday – Friday, and 9:00am – 5:00pm Monday-Friday on non-teaching weeks).

Lecture notes

A set of skeleton lecture slides will be provided on Moodle. These notes are insufficient to understand the course material. There is a coursepack MATH2831/2931 Linear Models containing course notes is available from the University Bookshop.

Textbooks

• Raymond H. Myers (1990). Classical and Modern Regression of Applications. PWS-KENT.

Moodle

Many additional course materials will be available on Moodle. You should check regularly for new materials.
Administrative matters

School Rules and Regulations

Fuller details of the general rules regarding attendance, release of marks, special consideration etc are available via the School of Mathematics and Statistics Web page at http://www.maths.unsw.edu.au/students/current/policies/studentpolicy.html.

Plagiarism and academic honesty

Plagiarism is the presentation of the thoughts or work of another as one’s own. Issues you must be aware of regarding plagiarism and the university’s policies on academic honesty and plagiarism can be found at http://www.lc.unsw.edu.au/plagiarism and http://www.lc.unsw.edu.au/plagiarism/plagiarism_STUDENTBOOK.pdf.

Detailed course schedule

Weeks 1 and 2 – Simple linear regression
Formulation of the simple linear regression model; least squares estimation; estimation of error variance; maximum likelihood; confidence intervals; hypothesis testing; prediction; model criticism.

Weeks 3–5 – The general linear model
Formulation of the general linear model; least squares; maximum likelihood; estimation of error variance; interval estimation; hypothesis testing; multicollinearity.

Weeks 6 and 7 – Model selection
The model selection problem; PRESS; cross validation, \( C_p \), sequential procedures; limitations of automated model selection procedures.

Weeks 8 and 9 – Residuals and diagnostics
Residual plots; outlier detection; partial regression and residual plots; testing for normality; influence measures; transformations.

Weeks 9 and 10 – Categorical predictors
Categorical predictor variables; dummy variables; hypothesis testing; interactions.

Weeks 11 and 12 – Less than full rank models
One-way classification model with fixed effects; randomised complete block designs; factorial experiments.