MATH2099 Mathematics 2B - Statistics strand

Course staff
Lecturer: A/Prof Jake Olivier (RC-2051), phone 9385 6656, email j.olivier@unsw.edu.au

You will also be assigned a tutor for tutorials/laboratories, who should be your first point of contact for any questions about the course.

Lectures
From Week 1 through to Week 12:

Monday 10-12 Physics Theatre

Tutorials and Laboratory classes
These are held at a variety of times and locations as indicated on your timetable through myUNSW. Students are expected to attend tutorials/laboratory classes, and rolls will be kept.

They start in Week 1 with an introduction to Matlab. The computer labs run weeks 2, 4, 6 and 8, and the classroom tutorials in weeks 3, 5, 7, 9, 11, 12, and 13.

The computer labs are all held in the School of Mathematics and Statistics’ computer laboratories (ground floor, RC-G012) in the Red Centre. Because of the block lab test in Week 10, your regular Statistics computer laboratory will not be held that week.

Before the start of the session, you should make sure you can logon to the computers in the laboratories using your zID and zPass. You can activate or unlock your zPass using the UNSW Identity Manager. If you are having difficulties please go to the Computing Centre helpdesk on the mezzanine level of the Red Centre. You must have set your password and be able to login to the Mathematics & Statistics computer laboratories BEFORE the first lab in Week 1.

You are advised to start, as soon as possible, the preliminary online Matlab Quizzes which are available through Maple TA from the UNSW Moodle course website. This is designed to get you started using Matlab, and they form part of your assessment (see below).

Course Web Site
The MATH2099 course web site will be made available through the Moodle web portal:

https://moodle.telt.unsw.edu.au/

You should check the course web site regularly for new and updated information.
**Announcements**
Announcements may be made in lectures or through the course web site.

**Course description**
This course gives an introduction to statistical methods essential in a wide range of engineering disciplines. This includes:

- Exploratory data analysis; Probability and distribution theory including the Binomial, Poisson, Exponential and Normal distributions;
- Large sample theory including the Central Limit Theorem;
- Elements of statistical inference including estimation, confidence intervals and hypothesis testing;
- One sample and two-sample t-tests;
- Linear regression and analysis of variance.

Applications drawn from a variety of engineering disciplines will be illustrated.

Many statistical problems require the use of a computer software package. In this course, students are required to become familiar with Matlab. Matlab will be used extensively in this course.

**Expected Learning Outcomes**
The Statistics strand of MATH2099 will enable you to understand the various ways in which random variation arises in engineering contexts and to develop facility at:

- applying various graphical and data analysis methods for summarising and understanding data;
- applying various statistical models and methods for drawing conclusions and making decisions under uncertainty in engineering contexts; and,
- using Matlab for graphical and statistical analysis.

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 in lectures, in tutorials and laboratories, and in assessment 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. Computing skills are developed and practised in regular computer laboratory sessions.

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 engineering, and the interpretation and communication of the results.

**Course Evaluation and Development**

Feedback on the course is gathered, using among other means, UNSW’s Course and Teaching Evaluation and Improvement (CATEI) Process. Student feedback is taken seriously, and continual improvements are made to the course based on part such feedback. Past comments have highlighted the critical importance of gaining competence in Matlab as early as possible.

**Assessments**

Besides the final exam, there are **two tests** during the session – a mid-session test during the tutorial in Week 7, and a lab test in Week 10. There will also be introductory Matlab quizzes which are due to be completed by the end of Week 2 and then three online statistics quizzes due in at the end of Weeks 5, 9 and 12.

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Details</th>
<th>Weighting</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory Matlab quizzes</td>
<td>Available via Maple TA from Moodle web page. Start as early as possible from Week 1. Must be completed by the end of Week 2</td>
<td>4%</td>
<td>Before 4pm Friday 4 August</td>
</tr>
<tr>
<td>Statistics online quizzes</td>
<td>3 quizzes over the semester, available via Maple TA from Moodle web page, each worth 2%</td>
<td>6%</td>
<td>Before 1) 4pm Friday 25 August, 2) 4pm Friday 22 September and 3) 4pm Friday 20 October</td>
</tr>
<tr>
<td>Mid-session test</td>
<td>Test administered during Week 7 tutorials. You must sit the test in the tutorial in which you are enrolled</td>
<td>15%</td>
<td>Week 7 tutorial</td>
</tr>
<tr>
<td>Matlab computer Test</td>
<td>Lab test held in blocks in computer laboratory, arrange a time to do it at your convenience (after mid-session break)</td>
<td>15%</td>
<td>Week 10</td>
</tr>
<tr>
<td>Final Examination</td>
<td>1.5 hours</td>
<td>60%</td>
<td>Exam period (November)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

Note that **students must sit the test in Week 7 in the tutorial in which they are enrolled** unless they have prior written approval from the lecturer. Students who are unable to attend the test must give a medical certificate to the lecturer. **There will be no opportunity to resit a test.**
The Matlab part of MATH2099 (Statistics) is assessed in the following ways:

- Introductory Matlab quizzes, to get you started with the basics of Matlab.
- Laboratory test in Week 10.

The introductory Matlab quizzes will be administered through UNSW Moodle and Maple TA. They are due by the end of Week 2. You are allowed as many attempts as you want. Your best mark will count.

You will be required to arrange a time to do your lab test through the School of Mathematics and Statistics’ ‘Student Web Portal’, to which there will be a link on Moodle. Further details of the Matlab test will be made available on Moodle and in lectures closer to the time. Students are advised to arrange the time for the Matlab test as soon as possible as there are limited places available at each time.

Students who are unable to attend the test at the time at which they have booked due to illness must give a medical certificate to the lecturer. **There will be no opportunity to resit a test.**

The **statistics online quizzes** over the semester will be administered through UNSW Moodle and Maple TA. Here are some guidelines you should follow when taking each quiz:

- You are allowed a maximum of **3 attempts**. Your best mark will count.
- Once you begin an attempt at a quiz, you have a fixed time to finish that attempt.
- You should only start an attempt at a quiz if you plan to finish it in that sitting. Be careful starting a quiz in The Red Centre computer labs. You will be kicked out if a tutorial has already booked the lab regardless if you have finished the quiz or not.
- Once you answer a question, select **Save your answer**. You will still be allowed to modify your response. Selecting **Finish** submits your responses to Maple TA which cannot be changed.
- Do not close Maple TA or your web browser during a quiz. You will not be able to continue that attempt the next time you login.
- It is expected that you work on each quiz alone.

**Rationale for assessment**
The class tests will give students an opportunity to get feedback on their progress and mastery of the material during the session. Details of the material to be assessed in the tests will be clarified in the couple of weeks before each of the tests. The preliminary quizzes due at the end of Week 2 are designed to make sure students start using Matlab at the start of
the course. The quizzes due at the end of Weeks 5, 9 and 12 are designed to give continuing feedback about understanding of new concepts developed in the course. The final exam will assess student mastery of the material covered in the lectures, tutorials and laboratory classes.

**Recommended Text**

**Additional readings**

**Lecture slides**
Lecture slides in pdf format will be made available via the UNSW Moodle web site. They are not a substitute for attendance at lectures. In addition, laboratory and tutorial material will also be made available on this website.

**Matlab software**
Matlab R2013b is available on the computers in the School of Mathematics and Statistics computer laboratories on the mezzanine level and ground floor of the Red Centre. A Matlab Student Version is also available through the UNSW bookshop for $99.95. It will be useful not only in this course but also in other courses. At [http://www.bookshop.unsw.edu.au/computing](http://www.bookshop.unsw.edu.au/computing) do a quick search for “Matlab student”.

Matlab references:

- School of Mathematics and Statistics, Introduction to Matlab, 2012, available through the course web site
- School of Mathematics and Statistics, Statistics using Matlab (SUM), available through the course web site
- Gilat, A., Matlab: an introduction with applications, Wiley, New York, 2005
- Pratap, R., Getting started with Matlab 7, Oxford University Press, 2005

**Consultation**
Your lecturer will have regular consultation times which will be advertised in lectures and
on Moodle. There will also be additional regular consultation times advertised with other members of the statistics department. At these times you are welcome to just turn up! For other consultation times, please email your lecturer for an appointment.

**Peer Support in Statistics**
There will be a peer support session through the Student Support scheme in the School of Mathematics and Statistics, where you can get help with statistics. Details will be announced in lectures and on Moodle.

**Syllabus and approximate schedule**
Below is the intended course schedule. However, lectures may fall slightly behind or get slightly ahead of this timetable. Any variation from this will be indicated by the lecturer.

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Text Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29/07/2015</td>
<td>Presentation and Introduction</td>
<td>1.1</td>
</tr>
<tr>
<td>2</td>
<td>05/08/2015</td>
<td>Descriptive Statistics</td>
<td>1.2, 1.3, 2.1, 2.2, 2.3</td>
</tr>
<tr>
<td>3</td>
<td>12/08/2015</td>
<td>Elements of Probability</td>
<td>5.1, 5.2, 5.3</td>
</tr>
<tr>
<td>4</td>
<td>19/08/2015</td>
<td>Random variables</td>
<td>5.4</td>
</tr>
<tr>
<td>5</td>
<td>26/08/2015</td>
<td>Special discrete and continuous probability distributions</td>
<td>1.5, 1.6</td>
</tr>
<tr>
<td>6</td>
<td>02/09/2015</td>
<td>The Normal distribution. Sampling distributions.</td>
<td>1.4, 5.5, 5.6</td>
</tr>
<tr>
<td>7</td>
<td>09/09/2015</td>
<td>Inferences concerning a mean (confidence intervals)</td>
<td>7.1, 7.2, 7.4</td>
</tr>
<tr>
<td>8</td>
<td>16/09/2015</td>
<td>Inferences concerning a mean (hypothesis tests)</td>
<td>8.1, 8.2</td>
</tr>
<tr>
<td>9</td>
<td>23/09/2015</td>
<td>Inferences concerning proportions, variances and differences in means.</td>
<td>7.3, 7.5, 8.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Midsession break</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>07/10/2015</td>
<td>Regression analysis (I)</td>
<td>11.1, 11.2, 11.3</td>
</tr>
<tr>
<td>11</td>
<td>14/10/2015</td>
<td>Regression analysis (II)</td>
<td>11.4, 11.5, 11.6</td>
</tr>
<tr>
<td>12</td>
<td>21/10/2015</td>
<td>Analysis of Variance</td>
<td>Chapter 9</td>
</tr>
</tbody>
</table>
Course information

Credit, Prerequisites, Exclusions. This course counts for 6 units of credit (6UOC). The prerequisite for enrolling in this course is MATH1231 or MATH1241 or MATH1251. Exclusions: MATH2501, MATH2509, MATH2601, MATH2801, MATH2841, MATH2859, MATH2901. This course is only available to students for whom it is specifically required as part of their program.

Course structure. This course consists of two strands, one on linear algebra and one on statistics. The linear algebra strand has two hours of lectures each week and a one-hour tutorial each week.

Lecturer for the linear algebra strand: Lee Zhao, l.zhao@unsw.edu.au, Red Centre 4106.

You will be assigned a tutor for the linear algebra tutorials. Your tutor should be your first point of contact for any questions about this course.

Lectures. Algebra lectures will be held on Thursdays from 4 to 6 pm, each week from week 1 to week 12, in the Keith Burrows Theatre (K-J14-G5).

Tutorials. There will be one tutorial per week, from week 2 to week 13. Times available are Wednesdays at 12noon, Fridays at 10am and 4pm.

Consultation. Preferred consultation times will be announced early in semester.

Web. Further information, lecture notes, problems and other material will be provided via moodle.telt.unsw.edu.au.

Course aims

This course gives an introduction to linear algebra and statistics essential in a wide range of engineering disciplines.

Linear algebra is a key tool in all of mathematics and its applications. For example, the output of many electrical circuits depends linearly on the input (over moderate ranges of input), and successfully correcting the trajectory of a space probe involves repeatedly solving systems of linear equations in hundreds of variables. Linear methods are vital in ecological population models, and in mathematics itself. You have begun to understand systems of linear equations and matrices, vector spaces and linear transformations in first year mathematics courses. In MATH2099, you will learn about geometric transformations: projections (which can also be viewed as least squares approximations), rotations and reflections. You will see how to view many linear transformations as being made up of “stretches” in various directions, (the diagonalisation process), and the more general Jordan form. This will allow you to calculate functions of matrices (such as the exponential of a matrix) and
hence to solve systems of linear differential equations.

**Linear Algebra Preparation.** The Linear Algebra stream builds on the substantial amount of linear algebra included in first year Mathematics courses. This material will be reviewed in MATH2099, but only briefly. If you did not do first year Mathematics at UNSW or if you have had a gap of a year or more since you did MATH1131 and MATH1231, it is very important that you make yourself familiar with the first year work at the beginning of session so that you are not left behind. Note that first year background includes not only manipulation of matrices and systems of equations but also important concepts such as spanning, linear independence and linearity of transformations.

**Student Learning Outcomes**

For the linear algebra strand, students are expected to:

- understand the basic theory of linear algebra; and
- increase their problem solving abilities.

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 in lectures, in tutorials and laboratories, and in assessment 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. We will also explore capacity and motivation for intellectual development through the solution of both simple and complex mathematical models of problems arising in engineering, and the interpretation and communication of the results.

For each hour of contact it is expected that you will put in at least 1.5 hours of private study.

**Assessment**

The final grade in MATH2099 will be based on the sum of the scores from each of the assessment components in each of the linear algebra and statistics strands. Final grades may be adjusted by scaling with the approval of the appropriate departmental meeting. Note that to pass MATH2099, you must obtain a mark of at least 40% in both the linear algebra strand and the statistics strand.
Class tests

The linear algebra strand will have five short class tests (approximately 15 minutes each), held in your tutorial in weeks 3, 5, 7, 9 and 12. You must sit the test in the class in which you are officially enrolled. Any student sitting a test in the wrong class, without having obtained permission beforehand, will receive a mark of zero for the test. Unless there are exceptional circumstances, permission for a change of class will not be given in the week of the test – students must ask at least one full week beforehand. The class tests will contribute to 30% of your linear algebra mark.

Examination

The final examination for MATH2099 will be held in the examination period at the end of semester 2, 2016. There will be one three–hour paper, shared between linear algebra and statistics. The algebra part will contribute up to 70% of your linear algebra mark.

Further details about the examination will be available in class closer to the time. Note that all students receiving a final mark in the range 45–49 are entitled to attempt to convert their mark into a pass by sitting the deferred exam.

Additional resources and support

Tutorial Exercises

Sets of tutorial exercises will be available on Moodle. These problems are for YOU to do to enhance mastery of the course. Problems of similar types will be done in tutorials, but you will learn a lot more if you try to do the problems yourself before the tutorial.

Lecture material

Lecture material will be available through Moodle. Please bring a hard (or soft) copy to all lectures. Note that some sections of these notes, particularly those parts which are revision of first year, will consist of exercises to be worked through in lectures, and not of detailed theoretical exposition. It is therefore unlikely that these notes will be useful for individual study.
Textbooks

There is no set textbook for this course and we shall not produce a coursepack, but the following references may be useful.

- First year algebra notes.
- R.O. Hill, “Elementary Linear Algebra with Applications”.

Course Evaluation and Development

The School of Mathematics evaluates each course each time it is run. Feedback on the course is gathered, using among other means, UNSW’s Course and Teaching Evaluation and Improvement (CATEI) Process. Student feedback is taken seriously, and continual improvements are made to the course based in part on such feedback.

Administrative matters

All general administrative information including course and tutorial enrolment, attendance requirements, student email, cheating and plagiarism, applications for special consideration and additional assessment may be found at www.maths.unsw.edu.au/currentstudents/assessment-policies.

Academic Misconduct

The University of New South Wales has rules relating to academic misconduct. They can be found at www.maths.unsw.edu.au/currentstudents/policy-academic-misconduct.

Rules for the Conduct of Examinations

The University of New South Wales has rules for the conduct of examinations. They can be found at www.maths.unsw.edu.au/currentstudents/rules-exams.

Equity and Diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course
convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit (contact details: 93854734 or www.studentequity.unsw.edu.au). Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

**Linear algebra syllabus in brief**

It is intended that the following topics will be covered in the given order. Any variation from this will be indicated by the lecturer.

1. Linear equations and matrices.
2. Vector spaces.
3. Linear transformations.
4. Orthogonality and least squares.
5. Determinants.
6. Eigenvalues and eigenvectors.
7. Symmetric matrices and quadratic forms.
8. Jordan forms.