Faculty of Science
School of Mathematics and Statistics

MATH3851

EXPERIMENTAL DESIGN AND CATEGORICAL DATA

Semester 2 2014
MATH3851 – Course Outline

Information about the course

Course Authority: Dr. Feng Chen
E-mail: feng.chen@unsw.edu.au Room: RC-1031
Credits: This course counts for 6 Units of Credit (6UOC).
Lectures: There will be three hours of lectures per week.

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wednesday</td>
<td>16:00-18:00</td>
<td>OMB-G32</td>
</tr>
<tr>
<td>Thursday</td>
<td>16:00-17:00</td>
<td>OMB-G32</td>
</tr>
</tbody>
</table>

Tutorials: There will be one tutorial per week on Thursday 17:00-18:00. It will be held in OMB-G32 in even weeks (Weeks 2,4,6,8,10,12) and in the lab RC-G12C in odd weeks (Weeks 3,5,7,9,11,13).

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

Course aims

The course is divided into two parts: Experimental Design, and Categorical Data Analysis.
In Experimental Design, you will learn about the importance of experimental design and about principles that allow you to extract maximum amount of information for a given sample size from available sources. You will study how to set optimally your factorial and randomised designs in scientific or engineering work.
In Categorical Data Analysis, you will learn about statistical tools and techniques that are specifically tailored towards analysing discrete valued data such as counts, frequencies, survey data. You will be able to answer questions about presence or absence of association between categorical variables using cross-tabulated data. You will also learn how to model the association between the categorical variables by using techniques such as Logistic, Poisson regression and Log-linear models. You will develop an understanding of the methodology and will be able to apply it for practical analysis of real datasets.
Relation to other statistics courses

The course is an optional component of a statistics major. MATH2801/MATH2901 and MATH2831/MATH2931 are required as prerequisites. The course is highly recommended and is required for those who would like to get accredited professionally by the Statistical Society of Australia.

Student Learning Outcomes

- Able to use the terminology, notation and concepts in the theory, methods and application of statistical design and analysis of experiments.
- Able to obtain estimates of the precision of estimates in design problems.
- Able to formulate and solve design problems, to analyse the adequacy of a particular model in a given problem.
- Able to describe the characteristics of different types of categorical data.
- Able to understand probability models useful for analysing categorical data and recognise situations where the models are applicable.
- Apply the models to the analysis of datasets using statistical software packages, interpret the results and draw conclusions.
- Be able to use SAS/R for the statistical applications related to experimental design or to categorical data analysis as discussed in the course.

Relation to graduate attributes

These outcomes are closely related to the graduate attributes “Research, inquiry and analytical thinking abilities” and “Information literacy” (through the computing component of the course).

Teaching strategies underpinning the course

Lecture notes provide a brief reference source for this course. New ideas and skills are first introduced and demonstrated in lectures, then students develop these skills by applying them to specific tasks in tutorials and assessments. Computing skills are developed and practiced in computer lab practical sessions.
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 in tutorials and in assessment tasks, and students are expected to devote the majority of their class and study time to the solving of such tasks.

Effective learning is achieved when students attend all classes, have prepared effectively for classes by reading through previous lecture notes, in the case of lectures, and, in the case of tutorials, by having made a serious attempt at doing for themselves the tutorial problems prior to the tutorials.

Furthermore, lectures should be viewed by students as an opportunity to learn, rather than just copy down or skim over lecture notes.

Assessment

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 analytical and computing skills underpinning this course and the development of analytical thinking.

<table>
<thead>
<tr>
<th>Assessment task</th>
<th>(%)</th>
<th>Available</th>
<th>Due</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment 1</td>
<td>10</td>
<td>Wed Week 3</td>
<td>Start of Week 5 lab</td>
<td>No late assignments!</td>
</tr>
<tr>
<td>Assignment 2</td>
<td>10</td>
<td>Wed Week 9</td>
<td>Start of Week 11 lab</td>
<td>No late assignments!</td>
</tr>
<tr>
<td>Mid-session test</td>
<td>20</td>
<td>Thur lab honour</td>
<td>Week 7</td>
<td>No make up test!</td>
</tr>
<tr>
<td>Final exam</td>
<td>60</td>
<td>TBA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Knowledge and abilities assessed: All assessment tasks will assess the learning outcomes outlined above. In all assessments, marks will be awarded for correct working and appropriate explanations and not just the final answer.

Note: The precise range of material covered by each test will be announced in lectures before each test.

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 must be YOUR OWN WORK, or severe penalties will be incurred.

You should consult the University web page on plagiarism.
Late assignments will not be accepted.

Mid-session Test

Rationale: The Mid-session Test will give students feedback on their progress and mastery of the material.

Both short answer questions and some longer questions requiring clear and logical presentation of correct solutions will be given.

If you are absent from the test, you must provide a medical certificate. No further test will be offered.

Examination

Duration: Time allowed: two hours.

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

Further details about the final examination will be available in class closer to the time.

Only calculators on the list of approved calculators may be used in the end of semester exams. The page [http://www.maths.unsw.edu.au/currentstudents/exam-information-and-timetables](http://www.maths.unsw.edu.au/currentstudents/exam-information-and-timetables) contains updated exam information and a link to the list of approved calculators for use in final exams.

Additional resources and support

Tutorial Exercises

A set of tutorial exercises will be available on Moodle. These problems are for YOU to do to enhance mastery of the course.

SOME of the problems will be done in tutorials, but you will learn a lot more if you try to do them before the tutorial.

Lecture notes

A set of skeleton notes will be provided on Moodle.
Textbooks


LN Lecture notes: Lecture notes will be on the Moodle.

Most of the material will be in the lecture notes. From the textbooks, the two recommended ones (M and L) would be most useful for the first and the second part of the course, respectively. The other references are suitable as additional reading for the interested students. They complement the lecture notes and the recommended text.

Moodle

Most course materials (lectures, tutes, labs) will be available on Blackboard and you should check regularly for updates. However some tutorial solutions may be handed out as a hard copy only.

Computer laboratories

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

Course Evaluation and Development

The School of Mathematics and Statistics evaluates each course each time it is run. We carefully consider the student responses and their implications for course development. It is common practice to discuss informally with students how the course and their mastery of it are progressing.
Administrative matters

Additional Assessment


School Rules and Regulations


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/index.html](http://www.lc.unsw.edu.au/plagiarism/index.html).

Detailed course schedule

It is intended that the following topics will be covered in the given order. Any variation from this will be indicated by the lecturer. However, lectures may fall slightly behind or get slightly ahead of this timetable. At the discretion of the lecturer, part of some lectures may be used as a Problem Class where instead of new theoretical material, just some examples are shown.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Week (approx)</th>
<th>Lab</th>
<th>Useful texts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Principles of Good Experimental Design</td>
<td>1</td>
<td>2</td>
<td>M, Chap 1</td>
</tr>
<tr>
<td>2. Completely Randomised Designs (CRD) (One-Way Analysis of Variance)</td>
<td>1</td>
<td>2</td>
<td>M, Chap 3</td>
</tr>
<tr>
<td>3. Multiple Comparison Techniques</td>
<td>2</td>
<td>4</td>
<td>M, Chap 3</td>
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<tr>
<td>4. Estimating and testing contrasts</td>
<td>3</td>
<td>4</td>
<td>M, Chap 3</td>
</tr>
<tr>
<td>5. Randomised Complete Block Designs (RCBD)</td>
<td>3</td>
<td>5</td>
<td>M, Chap 4</td>
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<tr>
<td>6. Latin square designs</td>
<td>4</td>
<td>5</td>
<td>M, Chap 4</td>
</tr>
<tr>
<td>7. Analysis of two and three way factorial experiments</td>
<td>5</td>
<td>6</td>
<td>M, Chap 5</td>
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<tr>
<td>8. Analysis of $2^k$ factorial experiments. Random effect models</td>
<td>6</td>
<td>6</td>
<td>M, Chap 6, 13</td>
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<tr>
<td>9. Two-way contingency tables</td>
<td>7, 8</td>
<td>8</td>
<td>L, Chap 1, 2</td>
</tr>
<tr>
<td>10. Log-linear models for two- and three-way tables</td>
<td>9</td>
<td>10</td>
<td>L, Chap 3</td>
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<tr>
<td>11. Logistic regression</td>
<td>10, 11</td>
<td>12</td>
<td>L, Chap 4</td>
</tr>
<tr>
<td>12. Methods for matched data</td>
<td>12</td>
<td>12</td>
<td>L, Chap 5</td>
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