UNSW
AUSTRALIA

Faculty of Science
School of Mathematics and Statistics

MATH3811/MATH3911

STATISTICAL INFERENCE/HIGHER STATISTICAL INFERENCE

Semester 1 2014

MATH3811/MATH3911 – Course Outline

Information about the course

Course Authority: Associate Professor S. Penev

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Room: RC-1038

Consultation: Tuesday 9:00-10:30, Wednesday 15:00-16:30.

Credit, Prerequisites, Exclusions:

This course counts for 6 Units of Credit (6UOC). It has an ordinary and higher version. Lectures are the same for both the ordinary and the higher level course. Assessment in assignments and in the final exam will be different for the two courses, MATH3811 and MATH3911.

Lectures: There will be three hours of lectures per week:[1]

Tuesday	11:00-12:00	OMB145
Wednesday	17:00-18:00	Macauley
Thursday	10:00-11:00	Macauley

Tutorials: There will be one tutorial per week. Tutorials start in Week 2 and finish in Week 13. Tutorial time slots are:

Thursday 14:00-15:00	RC-3085	MATH3811
Thursday 14:00-15:00	RC-2060	MATH3911 H14A
Thursday 14:00-15:00	RC-1042	MATH3911 H14B

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

Course aims

The aim of the course is to introduce the main ideas and principles behind the parametric and non-parametric inference procedures. The basic methods of inference used throughout Statistics will be discussed rigorously. Students will learn how to choose the appropriate inference procedure and how to perform inference using the chosen procedure.

[1] Some Thursday classes will be located in computing lab G012C, as advised closer to the time.

Relation to other statistics courses

The course is a compulsory component of a Statistics major. MATH2801/MATH2901 and MATH2831/MATH2931 are required as prerequisites. The course provides a good background for MATH3821, MATH3841 and MATH3851.

Student Learning Outcomes

- Learn how Statistical Inference arises from the first principles of Probability Theory.
- Learn the concepts of finite-sample and asymptotic efficiency of Inference Procedure.
- Able to estimate key population parameters of interest, to test hypotheses about them and to construct confidence regions.
- Able to use in practice the Nonparametric estimation and testing procedures.
- Learn how to use the R/SPLUS packages to generate output for the most common Inference Procedures. More specifically, learn how to perform computer-intensive calculations such as bootstrapping, robust estimation and nonparametrics within R/SPLUS.

Relation to graduate attributes

These outcomes are closely related to the graduate attributes "Research, inquiry and analytical thinking abilities", "Communication" 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 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 consist of two assignments (10% each), one mid-session test (20%), and a final examination (60%).

Knowledge and abilities assessed: All assessment tasks will assess the learning outcomes outlined above.

Assessment task	%	Available	Due	Notes
Assignment 1	10	Week 4	10 April (Week 6)	No late assignments!
Assignment 2	10	Week 10	29 May (Week 12)	No late assignments!
Mid-session test	20	N/A	Tuesday 29 April (Week 8) during lecture (11:00-12:00) (Room: TBA)	Bring your own calculator
Final exam	60	N/A	TBA	

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: Two hours for MATH3811 and two and a half hours for MATH3911.

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`

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

GJJ Garthwaite, P., Jolliffe, I., Jones, B. (GJJ), *Statistical Inference*. Second Edition. Oxford University Press (2002). This is the recommended text.

HMcKC Hogg, R., McKean, J., Craig, A. (HMcKC) *Introduction to Mathematical Statistics*, Sixth Edition. Pearson Education (2005).

D Davidson, A. C., *Statistical models*, Cambridge University Press (2003).

ZL Zwanzig, S. , Liero, H. *Introduction to the Theory of Statistical Inference*, Taylor and Francis (2011).

YS* Young, G. and Smith, R., *Essentials of Statistical Inference*, Cambridge University Press (2005).

G Gibbons, J.D. and Chakraborti, S., *Nonparametric Statistical Inference*, Fourth Edition, Marcel Dekker (2003).

C Conover, W.J., *Practical Nonparametric Statistics*, Third Edition, Wiley (1999).

Most of the material will be in the lecture notes!

From the textbooks, the recommended text **GJJ** will be most useful! Two copies of the book are available in the library. The bookshop also has it but it may be expensive to buy and you could try to buy cheaper used copies from Amazon.

HMcKC is your Second year Statistics text. Some topics and tutorial examples from this text can be useful. However, **HMcKC** does not cover all topics deeply enough for the purpose of this course. The text **ZL** is a good compact textbook which also contains useful exercise problems, some of them with complete solutions.

The other references are suitable as additional reading for the interested students. They complement the lecture notes and the recommended text. The course consists basically of two parts: parametric inference and nonparametric inference. **G** and **C** are suitable for the nonparametric part. The text **YS** has a star attached to it. It is a little bit more advanced text and is recommended to those students who want to challenge themselves "to the limit".

Moodle

Most course materials will be available on Moodle 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

School Rules and Regulations

Fuller details of the general rules regarding attendance, release of marks, special consideration, additional assessment policies etc. are available via the School of Mathematics and Statistics Web page at
`http://www.maths.unsw.edu.au/currentstudents/assessment-policies`.

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.maths.unsw.edu.au/currentstudents/assessment-policies`.

Occupational Health and safety

Please refer to the UNSW Occupational Health and Safety policies and expectations:
`http://www.gs.unsw.edu.au/policy/documents/ohspolicy.pdf`.

Equity and diversity

Any equity and diversity issues should be directed to the Student Equity Officers (Disability) in the Student Equity and Diversity Unit (9385-4734). Further information for students with disabilities is available at
`http://www.studentequity.unsw.edu.au/`.

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.

	Topic	Week (approx)	Useful texts
1.	The General Inference Problem	1	GJJ chap 1
2.	Some principles in Statistical Inference	1 and 2	Notes, GJJ chap 2
3.	Information and Likelihood. Likelihood Inference.	3	GJJ chap 3
4.	Classical Estimation Theory. Cramer-Rao Bound. Uniform Minimum Variance Unibiased Estimators.	4	Notes, GJJ chap 2
5.	Maximum Likelihood Estimation. Asymptotic properties of estimators	5	GJJ chap 3
6.	Hypothesis Testing. Neyman-Pearson theory. Generalized Likelihood Ratio Tests	6	GJJ chap 4.
7.	Bayesian Inference	7	GJJ chap 7
8.	An Introduction to the Bootstrap and other computationally intensive methods	8	GJJ chap 9
9.	An Introduction to Robustness.	9	GJJ chap 8
10.	Properties of order statistics.	9	Notes, GJJ chap 8
11.	Rank-based Inference	10	GJJ chap 10
12.	Goodness of Fit tests. Contingency tables.	11	Notes, GJJ chap 8
13.	K-sample problems for $K > 2$. Measures of association.	12	GJJ chap 8