STATISTICS 312
MATHEMATICAL METHODS IN STATISTICS
Course Information

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Lectures: MWF 1:00 - 1:50 CAB 269
Labs: Wed 4:00 - 4:50, CAB 269 & 281
Office hours: whenever I'm in my office, or by appointment

Recommended text

Advanced Calculus with Applications in Statistics; A.I. Khuri, 2nd edition. We will not 'follow' this book – the major reference will be my web-based lecture notes. Although it is but one of a number of books which treat the mathematical topics which we cover in this course, it is unique in that it does so in a statistical context. The book has been around for a while and there are inexpensive copies available from a variety of sources – Google it.

A brief description

Here is the description of STAT 312, as it appears in the university calendar:

> Reviews and extends those topics in the prerequisite courses in calculus and linear algebra which are of particular interest in Mathematical Statistics. These include the basics of mathematical reasoning as evidenced by the presentation of rigorous arguments, notions of continuity, differentiation, Riemann-Stieltjes integration and numerical optimization, and diagonalization results for real symmetric matrices. Applications to statistical theory will include least squares estimation, generating functions, and distribution theory. Prerequisites: MATH 215, 225 and STAT 266.

It will be assumed that students have *successfully* completed the prerequisite courses. There will be a strong emphasis on extending the techniques learned there so as to apply them in Statistics, and in Probability. There will also be a strong emphasis on the presentation of detailed, rigorous arguments and solutions in the labs and exams. (See "Writing aids" on my home page for more on this.)

Assessment

Midterm exams:	40% (All exams are closed book, no notes, no cell phones etc.)
Final exam:	60%
	(Deferred final exams Saturday, January 11, 9:00 - 12:00)

The midterm exam will be in two parts. One part will be written in class, and will consist of a selection of questions, closely based on the lectures, chosen from a list that will be provided in advance. The other will be written in the lab, and will consist of a selection of the problems from the first five labs. The final exam will consist of (i) questions, closely based on the lectures, chosen from a list that will be provided in advance, and (ii) a selection of the problems from the final seven labs. **Thus the twelve labs – see the schedule at the end of this document – are an integral part of the course**. You should come to each lab with at least a selection of the lab problems, and the posted additional problems from the lectures, written up in a manner that you feel would yield a perfect mark on an exam – where you might well have to present your solutions again. We will go over your solutions with you and dispense advice, and will also advise on other methods you might try if you have been unable to solve the problems completely. **We will not merely do the problems ourselves - a basic tenet of this course is that mathematics is learned by doing it, not by watching someone else do it.** Assessment in all exams will take into account the clarity and quality of the writing – which I view as VERY important – as well as the correctness and novelty of the solutions.

See the TIPS FOR SUCCESS on the course web site..

Implementing the grading system

At the end of term I will have a record of each student's raw grades for all lab and in-class exams. I will compute a summary based on these raw grades, and rank everyone in order of merit. After deciding whether the class as a whole is average, above average or below average, I shall determine what percentage of the class should fall into each of the possible grades, and assign the grades accordingly. These grades will reflect my judgements, which will be based on my assessments of both absolute achievement and relative performance in the class. Grades are unofficial until approved by the Department.

There is no pre-determined algorithm for converting raw scores to grades. However, **active participation in classroom discussions, including asking and answering questions, is expected of all students. The extent to which this has been achieved will be considered when scores are converted to grades**.

There is another benefit to class participation, beyond its intrinsic value. I am regularly asked to write letters on behalf of students who are applying for awards, or for admission to further study. If I have had no interaction with you, I can report only your grade, and that beyond that I know nothing about you. Such a letter will surely not be very helpful.

Course web site

Lecture notes and problems to be addressed in the labs and exams are posted on the course web site, at http://www.stat.ualberta.ca/~wiens/stat312/stat312.html.

Missed exams

A student who cannot write an examination due to incapacitating illness, severe domestic affliction or other compelling reasons can apply for an excused absence (for a missed midterm) or a deferred final examination. Such an application must be made to the instructor (missed midterm) or the student's Faculty office (missed final) within 48 hours of the missed examination and must be supported by a Statutory Declaration (in lieu of a medical statement form) or other appropriate documentation (Calendar section 23.5.6). Deferred examinations are a privilege and not a right; there is no guarantee that a concession will be granted. Misrepresentation of facts to gain an excused absence or deferred examination is a serious breach of the Code of Student Behaviour.

Re-examination

A student who writes the final examination and fails the course may apply for a re-examination. Re-examinations are rarely granted in the Faculty of Science. These exams are governed by University (Calendar section 23.5.5) and Faculty of Science Regulations (Calendar section 192.5.9). Misrepresentation of Facts to gain a re-examination is a serious breach of the Code of Student Behaviour.

General comments

You might think that, since the entire grade is based on exams, and the exams are entirely based on problems which are posted in advance, you can get away with doing very little until exam time. You would do so at your peril. Some general advice:

- Rewrite your notes as soon as possible after each lecture. Writing up material in one's own words is the best way to see if the material has been understood.
- If you find that you don't understand what has gone on in class, *see me right away.* Don't start drifting from one lecture to another, understanding less each time.
- After each class, do the problems which are based on that lecture. Attend the labs regularly, and ask me or one of the lab assistants to check your written solutions. You will be asked to present written solutions to many of these problems on the exams.
- In preparing the write-ups of your problems, don't merely do them 'in rough' and hope that you can polish them during the exam. Rewrite your solutions properly – the rewriting stage is the most important one for finding errors in one's work, and for deepening one's understanding of it.
- In your written work I will want to see that you understand what you are writing, not merely that you arrive at the correct answer.

YOU ARE EXPECTED TO WRITE UP YOUR OWN WORK IN YOUR OWN WORDS, using full sentences and proper English grammar. Copying the ideas or words of another is plagiarism, and is a serious offence. More generally:

> The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behaviour (online at www.governance.ualberta.ca) and avoid any behaviour which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.
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> All forms of dishonesty are unacceptable at the University. Any offense will be reported to the Senior Associate Dean of Science who will determine the disciplinary action to be taken. Cheating, plagiarism and misrepresentation of facts are serious offenses. Anyone who engages in these practices will receive at minimum a grade of zero for the exam or paper in question and no opportunity will be given to replace the grade or redistribute the weights. As well, in the Faculty of Science the sanction for cheating on any examination will include a disciplinary failing grade (no exceptions) and senior students should expect a period of suspension or expulsion from the University of Alberta.

- Students who require accommodations in this course due to a disability affecting mobility, vision, hearing, learning, or mental or physical health are advised to discuss their needs with Specialized Support and Disability Services, 2-800 Students' Union Building, 492-3381 (phone) or 492-7269 (TTY).

- Students who want to improve their learning and academic capacity (such as better time management, study skills or examination skills) are encouraged to contact the Student Success Centre (2-300 Students' Union Building).

- **Decima Robinson Support Centre for Mathematical & Statistical Sciences:** Students who require additional help with assignments or have questions about the course material in general are encouraged to visit the Decima Robinson Support Centre (528 Central Academic Building). Graduate students will be available to provide one-on-one help. In order to get maximum help during each visit, students are asked to be specific about the problem with which they are seeking help. The Centre is open Monday to Friday, 9:00–15:00.

Policy about course outlines can be found in Section 23.4(2) of the University Calendar.

Tentative Fall 2013 course outline; important dates			
Lec #	**DATE**	**COMMENTS**	
1	W Sept 4	Intro to matrices...	**No lab**
2	F Sept 6	... and more	
3	M Sept 9	Regression; Vector spaces, subspaces	
4	W Sept 11	Column spaces, dimension, rank	**Lab 1**
5	F Sept 13	Orthogonality; projections	
6	M Sept 16	Gram-Schmidt; QR-decomposition	
7	W Sept 18	Least squares; eigenvalues, eigenvectors	**Lab 2**
8	F Sept 20	Spectral decomposition	
9	M Sept 23	Spectral decomposition: examples	
10	W Sept 25	More examples; Block matrices	**Lab 3**
11	F Sept 27	Block matrices II, LU decomposition	
12	M Sept 30	Further examples and applications	
13	W Oct 2	Review notions of limits, continuity ...	**Lab 4**
14	F Oct 4	...and differentiation	
15	M Oct 7	Mean Value theorem	
16	W Oct 9	Probability spaces and random variables	**Lab 5**
17	F Oct 11	Convergence in probability, Jensen's inequality	
	M Oct 14	**Thanksgiving Day**	
18	W Oct 16	Taylor's theorem	**Midterm I**
	F Oct 18	**Midterm Part II**	
19	M Oct 21	Transforming r.v.s; Order statistics	
20	W Oct 23	Variance stabilization; Convergence in law	**Lab 6**
21	F Oct 25	Sequences and series	
22	M Oct 28	Sequences/series of functions; Power series	
23	W Oct 30	Power series II; probability generating functions	**Lab 7**
24	F Nov 1	Moment generating functions I	
25	M Nov 4	Riemann Integration I	
26	W Nov 6	Riemann Integration II	**Lab 8**
27	F Nov 8	Moment generating functions II	
	M Nov 11	**Remembrance Day**	
28	W Nov 13	Cauchy-Schwarz, Chebyshev, WLLN	**Lab 9**
29	F Nov 15	Central Limit Theorem	
30	M Nov 18	Multidimensional calculus	**course evaluations**
31	W Nov 20	Extrema, Lagrange multipliers	**Lab 10**
32	F Nov 22	Normal sampling distributions	
33	M Nov 25	Maximum likelihood I: Estimation	
34	W Nov 27	Maximum likelihood II: Asymptotics, examples	**Lab 11**
35	F Nov 29	Numerical optimization I: Newton-Raphson, M-estimation	
36	M Dec 2	Numerical optimization II: Gauss-Newton, nonlinear regression	
37	W Dec 4	Maximum likelihood III: Example; computations	**Lab 12**
	F Dec 13	**Final Exam 2:00 - 5:00 (But check this on Bear Tracks – that is the only official source)**	