

STAT 7140 - Linear Models
Fall Term 2015

Course Outline

- Instructor:** Dr. Saumen Mandal
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- Time, Location & CRN:** Tuesdays, Thursdays 1:00 p.m. – 2:15 p.m., 316 Machray Hall. CRN: 10845.
- Office Hours:** Tuesdays, Thursdays: 11:30 a.m. – 1:00 p.m., or by appointment.
- Primary Text:** Myers, R. H. and Milton, J. S. (1991). *A First Course in the Theory of Linear Statistical Models*. PWS-KENT Publishing Company, Boston.
ISBN: 0-534-91645-7.

Note that this book is out of print. With the copyright permission from the publisher, our bookstore has made copies of this text for you. You can buy it from the bookstore for only about \$30.95 (plus applicable taxes).

Some notes will be provided.
- Supplementary References:** Searle, S. R. (1971). *Linear Models*. Wiley, New York.
Rencher, A. C. and Schaalje, G. B. (2008). *Linear Models in Statistics*. 2nd Edition, Wiley-Interscience.
- Assignments and Tests:** There will be no formal assignments for this course. I will provide a number of exercises and questions, which you can practice. There will be two in-class midterm tests and the final exam. The dates of the midterm tests will be given later. The midterm tests and final exam are closed book. The final exam will cover entire course. A formula sheet and relevant statistical tables will be provided if required. A non-programmable calculator will be needed. Note that graphing calculators are not permitted. There will be no make-up term test. Students who miss a term test with legitimate reasons will have the term test weight added to the final exam. Course materials will be posted in UM Learn System: www.umanitoba.ca/d21
- Marks Breakdown:**
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|-----------------|-----|
| Midterm Test 1: | 25% |
| Midterm Test 2: | 25% |
| Final Exam: | 50% |
- Calendar Description:** (Formerly 005.714) Theory of linear models, regression analysis, and analysis of variance. *Prerequisite:* Consent of instructor.
- Computer Packages:** If needed, you can use any software of your choice. Some software output in the textbook may be used.
- Academic Integrity:** I have been asked to draw your attention to the sections in the *University of Manitoba Academic Calendar* regarding academic integrity and dealing with academic dishonesty including “plagiarism and cheating” and “examination personation”. Links to resources that describe academic dishonesty can be found at: umanitoba.ca/faculties/graduate_studies/media/academic_dishonesty.pdf
umanitoba.ca/faculties/science
umanitoba.ca/calendar

Voluntary Withdrawal: The voluntary withdrawal deadline is November 18, 2015.

Course Contents: The following is a non-exhaustive list of topics to be covered in the course. In the beginning, you will notice that we will be revisiting some topics in Linear/Matrix Algebra and Multivariate Statistics. Then we will start advanced topics. Our primary goal will be to reinforce the fundamental concepts, and to have a solid understanding of Linear Models.

1. Introduction - Matrix Algebra (Chapter 1)

- Matrix Operations
- Matrix Inverse and Orthogonality
- Eigen values, Rank and Trace
- Idempotent Matrices and Properties
- Row and Column spaces

2. Quadratic Forms and Their Distributions (Chapter 2)

- Quadratic Forms
- Differentiation of Quadratic Forms
- Expectation and Variance of Vectors and Matrices
- Distribution of Quadratic Forms
- Independence of Quadratic Forms

3. Estimation in the Full Rank Model (Chapter 3)

- Least Squares Estimation, Gauss-Markoff Theorem
- Maximum Likelihood Estimation
- Interval Estimation
- Joint Confidence Region on the Regression Coefficients
- Generalized Least Squares

4. Hypothesis Testing in the Full Rank Model (Chapter 4)

- Testing for Model Adequacy
- Testing for a subvector of the regression coefficients
- Partial and Sequential Tests
- The General Linear Hypothesis
- Likelihood Ratio Tests

5. Estimation in the Less Than Full Rank Model (Chapter 5)

- Model and Reparameterization
- Generalized Inverse and Properties
- Estimability of Parametric Functions, Gauss-Markoff Theorem
- Interval Estimation

6. Hypothesis Testing in the Less Than Full Rank Model (Chapter 6)

- Hypothesis Testing in a General Setting
- Reparameterization: One-Way Classification
- Testing for a Treatment Contrast
- Two-Way Analysis of Variance
- Randomized Complete Block Designs

If time permits, the following topic will be considered.

7. Analysis of Covariance (ANOCOVA) (Chapter 7)