# STAT 7140
# Linear Models
# Fall Term 2012

**Instructor:**  Dr. Saumen Mandal

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**Time, Location & CRN:**  Mondays, Wednesdays 11:30 a.m. – 12:45 p.m., 316 Machray Hall. CRN: 11267.

**Office Hours:**  Mondays, Wednesdays: 1:00 p.m. – 2:30 p.m.
<u>and</u> by appointment <u>or</u> whenever I am in.

**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 $26.95 (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 two assignments and two term tests. The dates of the term tests will be given later. You can check the information/announcements in the U of M JUMP: http://jump.umanitoba.ca/
Also note the instructor's web page: http://home.cc.umanitoba.ca/~mandals/ for any additional information.

**Marks Breakdown:**

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|---|---|
| Assignments: | 20% |
| Term Test 1: | 15% |
| Term Test 2: | 15% |
| 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/science/undergrad/resources/webdisciplinedocuments.html
umanitoba.ca/admin/governance/governing_documents/students/278.html
umanitoba.ca/calendar/

**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. In most instances we will also be extending the breadth and depth of the coverage.

## 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)