Course Web Site:  http://www.stat.osu.edu/~goel

Instructor:  
Prof. Prem Goel,  
204C Cockins Hall, Tel. 2-8110  
E-mail:  goel@stat.osu.edu  
Office Hours: M: 3:30-4:30PM, T, R: 2:30-3:30PM or by appointment.

Graduate Teaching Assistant:  
Mr. Di Cao,  
MA 422, Tel. 2-9236  
E-mail:  cao.93@osu.edu  
Office Hours: TBA

Course Objectives:  
- Develop a critical understanding of the theoretical basis of statistical methods for linear models.  
  - Build a foundation for all statistical modeling, including Generalized linear models, Econometric Models, Non-linear models, Dynamic linear models, and Time Series Analysis  
    - Extensive problem solving is critical for a thorough understanding of a wide range of topics.  
    - Active in-class participation, solving Home Work problems, as well as additional problems in Supplementary books will help you achieve this goal.

Prerequisites:  
- Knowledge of basic theoretical statistics at the level of STAT 620-622  
- Linear Algebra (Finite dimensional vector spaces and matrices): Math 568

Desirable Background:  Prior exposure to applied regression analysis and/or design of experiments (e.g., Stat 645 and 641) is highly desirable.  
(Next year, the Pre-requisite will include at least one of these two courses, as well as STAT 6860 – Foundations of the Linear Model)

Text Book:  
  - Details of the Numerical Examples in the Text Book are available at http://www.stat.uconn.edu/~nalini/
Homework Assignments:

- Assigned problems will include further details on important theoretical facts and examples illustrating the theory outlined in lecture.
- You are encouraged to discuss homework problems in your study team. However, you must write your solutions by yourselves, independently of others.
- Due to the lack of available grader resource, only two randomly selected problems in each assignment will be checked for accuracy. Remaining problems will be counted as just yes/no.

Homework assignments will normally be given on Wednesday, and will be due on Wednesday in the following week, unless it is a holiday, with a total of ten homework assignments according to the following schedule.

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<tbody>
<tr>
<td>Assignment date</td>
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<tr>
<td>Due date</td>
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- Your lowest score on one of the assignment will not be counted towards the grade.
- Please submit your homework upon entering the classroom.
- To be fair to everyone, late homework submission will not be accepted.

Examinations: The course will have two Examinations as follows:

- **Midterm Exam:** In Class on Wednesday, October 3 (Closed book, Closed notes). You can bring in one, 8.5”x11” two-sided, cheat sheet.

- **Comprehensive Final Exam:**
  - **In-class** on Wednesday, Dec. 12, 12:00 Noon - 1:45PM (Closed book, Closed notes). You can bring in two, 8.5”x11” two-sided, cheat sheets.

Course Grading: Grades will be assigned based on clusters in the overall course scores derived by using the following weights:

- Home Work Assignments - 30%
- Mid Term Exam - 25%
- Final Exam - 40%
- In Class Participation - 5%
Course Outline - Tentative

Introduction
- Linear Model – Definition and Examples (Sec 4.1)

I. Background Material
- Review of Vector and Matrix Algebra (Chap. 1)
- Special Matrices (Chap. 2)
- Solutions to Linear Systems and Generalized Inverses (Chap. 3)

II. The General Linear Model - Estimation
- Least Square Estimation (Sec. 4.2)
- Estimable Functions in Non-full rank case (Sec.4.3)
- Gauss Markov Theorem (Sec. 4.4)
- Estimation subject to Linear Restrictions (Sec. 4.6)
- Generalized Least Squares (\( \sigma^2 I \) to \( \sigma^2 V \)) (Sec. 4.5)

III. Relevant Distribution Theory for Inference
- Multivariate distributions (Sec. 5.1)
- Multivariate Normal Distributions (Sec. 5.2)
- Noncentral Chi-Square, T, and F Distributions (Sec. 5.3)
- Distributions of Quadratic Forms (Sec 5.4)

IV. Inference for the General Linear Model
- Distributional Properties of Least Squares Estimates and Residuals (Sec. 7.1)
- General Linear Hypotheses (Sec. 7.2)
- Testing Several Hypotheses (Sec. 7.4)
  1. Nested Hypotheses
  2. Underfitting, Overfitting and Lack of Fit Test
  3. Non-Testable Hypotheses
- Connections with Multiple Regression Models
  1. Departure from model assumption (Sec. 8.1.2-8.1.3)
  2. Orthogonal and Collinear Predictors (Sec. 8.3.1-8.3.3)
  3. Dummy Variables in Regression (Sec. 8.6)

V. Simultaneous Confidence Intervals and Multiple Comparisons
- Joint and Marginal Confidence Intervals (Sec. 7.3.1)
- Introduction to Multiple Comparison Procedures (Sec. 7.3.2)
  - Scheffe Procedure, Bonferroni t-intervals
- Other Multiple Comparison Procedures (Sec. 7.3.3)

VI. Fixed Effects Linear Models
- Checking model Assumptions (Sec. 9.1)
- Inference for Unbalanced ANOVA models (Sec. 9.2)
- Analysis of Covariance (Sec. 9.3)
VII. Random-Effects and Mixed Effects Models

- One-factor random-effects model (Sec. 10.1)
- Mixed-Effects Linear Models (Sec. 10.2)

VIII. Special Topics (*Time Permitting*)

- Generalized Linear Models (Sec. 11.4.1-11.4.2)

Supplementary Books:

  - On line readable copy [http://mechmath.org/books/12916](http://mechmath.org/books/12916)
  - Google search provides links for downloading the book.