# Indian Institute of Technology Kanpur

**Department of Mathematics and Statistics**

**First Course Handout (FCH)**

**Course:** MTH207M: Matrix Algebra and Linear Estimation (Module II)
**Instructor:** Dr. Satya Prakash Singh

## 1. Course Content

- Rank Factorization: definition and related results.
- Left/Right Inverse and Generalized Inverse (g-inverse): definition, existence, properties, finding a g-inverse, reflexive g-inverse, minimum norm g-inverse, least squares g-inverse, and Moore-Penrose g-inverse, finding orthogonal projection matrix numerically.
- Multivariate Normal Distribution and Cochran Theorem: definition and some properties of MVN, Cochran Theorem and related results.
- Various Matrix Decomposition: LU decomposition, SVD, and eigen decomposition.
- Vector and Matrix Differentiation: basic idea of vector differentiation and matrix differentiation, chain rule, maxima, minima of functions of several variables.
- Linear Models: introduction, estimability, the least squares theory of estimation – properties of least square estimators, Gauss-Markov theorem, best linear unbiased estimator, normal equations, residual sum of squares, estimation subject to restrictions.

## 2. Credits

6 credits.

## 3. Prerequisite

A course in Linear Algebra is a prerequisite for this course.

## 4. References


1. Bapat, R. (2012). *Linear Algebra and Linear Models*. Springer.
2. Ramachandra Rao, A., Bhimasankaram, P. (2000). *Linear Algebra*. Hindustan Book Agency.
3. Banerjee, S., Roy, A. (2014). *Linear Algebra and Matrix Analysis for Statistics*. CRC Press.

4. Rao, C. R. (1965). *Linear Statistical Inference and its Applications*. John Wiley & Sons.

5. Harville, D. A. (2008). *Matrix Algebra from a Statistician's Perspective*. Springer.

# 5. Assignments

Assignments will be given every alternate week. The purpose of this is to get a better understanding of the subject through solving problems. There is no need to submit the assignments. Some of the problems may be discussed in the tutorial class.

# 6. Contact Instructor

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Phone: 0512-259-2254

# 7. Schedule and Venue

Lecture: M (L02), W (L02), F (L02) 10:00–11:00
Tutorial: Th (L02) 10:00–11:00

# 8. Evaluation

- Final Exam (end semester): 60%
- Quizzes: 40%