

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. Soumyarup Sadhukhan

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. Germany: Springer.
- (2) Ramachandra Rao, A., Bhimasankaram, P. (2000). Linear Algebra. Germany: 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, INC.
- (5) Harville, D. A., (2008). Matrix Algebra from a Statistician's Perspective. United States: 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.

Dr. Soumyarup Sadhukhan

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7. Schedule and Venue.

Lecture: M (L01) W (L02) F (L02) 10:00-11:00

Tutorial: Th (L01) 10:00-11:00

8. Evaluation

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

9. Grading Policy:

- Above 90% marks **and** depending on the impression in the class – A* Grade (Out-standing, Grade Points 10)
- Above 80% marks – A Grade (Excellent, Grade Points 10)
- Above 70% marks – B+ Grade (Very Good, Grade Points 9)
- Above 60% marks – B Grade (Good, Grade Points 8)
- Above 50% marks – C+ Grade (Fair, Grade Points 7)
- Above 45% marks – C Grade (Satisfactory, Grade Points 6)
- Above 40% marks – D+ Grade (Marginal, Grade Points 5)
- Above 35% marks – D Grade (Pass, Grade Points 4)
- Above 30% marks – E Grade (Exposure but Fail, Grade Points 0)
- Less than 30% marks – F Grade (Fail, Grade Points 0).