

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

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**1. Course Content**

- **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.
- **Projection:** idea of projection, projection matrix and related results, orthogonal projection matrix, finding orthogonal projection matrix numerically.
- **Fisher-Cochran Theorem:** the theorem and related results.
- **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) Rao, C. R., (1965). Linear Statistical Inference and its Applications. JOHN WILEY & SONS, INC.
- (4) 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 (L10) W (L10) F (L10) 10:00-11:00

Tutorial: Th (L10) 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](#)).

The above policy is tentative and may change depending on the class performance.