Course 002: INTRODUCTORY MATHEMATICAL ECONOMICS
M.A. Economics
Semester I, 2013-14
Delhi School of Economics

❖ **Objectives:** To learn some of the tools that frequently feed into Micro, Macro and Econometrics.

❖ **Instructors:** Two instructors will cover the entire syllabus.

- Abhijit Banerji [AB]. Contact: 27666533/4/5 Extn: 110, email: a.banerji@econdse.org
- Sugata Bag [SB]. Contact: 27666533/4/5 Extn: 115, email: sugata@econdse.org

❖ **Time and Location:** Room # Lecture Theatre. Tuesday-Wednesday-Thursday @ 10:25-11:40

❖ **Exams and Grading:** There will be two midterm exams and a final exam. They will count toward the grade as follows -

- Midterm 1 : 15 percent → Mid September
- Midterm 2 : 15 percent → End October
- Final : 70 percent → Mid November

❖ **Prerequisites:** Mathematical content at the level of Sydsaeter and Hammond, the undergraduate Mathematics for Economics textbook in the University of Delhi.

❖ **Course Modules**: There are 3 parts to the course.

1. Preliminaries (e.g. Logic, Set Theory, Functions) and Linear Algebra. *Lectures by Sugata Bag*
2. Multivariate Differentiation, Implicit Function Theorem, Optimization in; Envelope Theorem; Differential Equations. *Lectures by Abhijit Banerji*
3. Dynamic Optimization. *Lectures by By Sugata Bag*

❖ **Textbooks:**

i. **Treil**, Sergei . 2010. Linear Algebra Done Wrong. (**LADW**). [free ebook available at www.math.brown.edu/~treil/papers/LADW/LADW_intro.pdf]
ii. **Strang**, Gilbert. 2003. Linear Algebra And It's Application, (3rd Ed). (**GS**)
iii. **Simmons**, G. F.1963. Introduction to Topology & Modern Analysis. (**S1**)
iv. **Sundaram**, Rangarajan. 1996. A First Course in Optimization Theory. (**RS**)
v. **Simmons**, George F. Differential Equations. (2nd ed.) (**S2**)
vi. **Dixit**, Avinash. 1990. Optimization in Economic Theory (2nd ed.).
vii. **Chiang**, Alpha C. 1999. Elements of Dynamic Optimization. (**AC**)
viii. **Simon and Blume**. 1994. Mathematics for Economists. (**SB**)

TOPICS in Part 1:

15 lectures, will be covered by Sugata Bag

❖ Preliminaries. Logical Implications, Sets, Relations, Functions etc.
- ♦ [Reference: Simmons (S1) → ch.1; Sundaram (RS) → Appendix A; Handout.

❖ Linear Algebra: Basic concepts (e.g. linear spaces, linear combinations, subspaces, basis, dimension, linear transformation, Fundamental theorem of linear algebra); Systems of linear equations; Spectral Theory; Inner Product Spaces (mainly Orthogonal Projections); Quadratic Forms.
- ♦ [Reference: - LADW → as text for theory, GS → for numericals].

❖ **Note 1**. We shall use chapter 1 of S and Appendix A of RS for preliminary stuff. While we won't use chapter 1 of RS, that chapter covers very nicely but tersely a lot of the material that is considered a prerequisite for Optimization. For Linear Algebra, we shall use stuff from both LADW & GS, but not exclusively from these two. While it is difficult to pinpoint the source of every proof for every

result, alternative textbooks include those by Helson, and the classic by Halmos. Ordinarily, it is best to study from a single textbook, besides following and working through the lectures.

- **Note 2.** Simon and Blume is a useful book covering most of the material in the course (all 3 parts), save for Dynamic Optimization. While it is not the main reference for the above topics, it is a reasonable alternative reference. Moreover, if you haven't read Sydsaeter and Hammond seriously, it may be a good idea to cover most of Simon and Blume (on your own) alongside this course.

TOPICS in Part 2:

20 lectures, will be covered by Abhijit Banerji

- Standard applications of Optimization; Weierstrass Theorem; Unconstrained Optimization; Optimization with Equality Constraints and Inequality Constraints; Envelope Theorem.
  - Reference: RS → Chapters 2-6.
- Differential Equations. Ordinary first order differential equations, systems of differential equations (in particular, systems of 2 differential equations), Stability.
  - Reference: Simmons (S2) → Material sourced from Chapter 3.

Topics in Part 3:

7 lectures, will be covered by Sugata Bag

- Dynamic Optimization: Introduction to DO, Optimal Control Theory - Pontryagin Maximum Principal, Finite and Infinite Horizon Problems.
  - Reference: Chiang (AC) → chapters 1, 7-9.