Math Prep for FPM 2018

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Instructor:	Abhishek Rishabh	**Time:**	10am-12:15pm
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Course Outline

The aim of this course is to introduce you to the mathematics required for Ph.D. courses in management science. Based on your specialization, the usefulness of the topics might vary.

Course Material

I will provide my slides or handouts for the course.

Textbooks

You might find the following books useful.

- C. P. Simon and L. Blume, 1994. Mathematics for Economists, Norton, New York.
- W. Rudin, 1976. Principles of Real Analysis, McGraw-Hill, London.
- R. K. Sundaram, 1996. A First Course in Optimization, Cambridge University Press, New York.

Assessment

I might share some assignments. You may or may not attempt them. However, doing these assignment might help in your understanding of the topics. *Apriori there will be no exam.* I might give a collective set of problems in the end and you can enjoy them at your leisure. If you are interested and have attempted the problems, I will share my solutions with you. Essentially, nothing is imposed on you. You can assess yourself by solving assignments and collective problem sets. If most students want an exam then we can have an exam.

Topics

**I will spend more time on ♣ topics.*

Logic and doing proofs.

• Words and symbols used in writing logic. • Main methods for proofs: Deduction, Contraposition, Induction, Contradiction.

Calculus

• Derivative of a Real Function • Mean Value Theorems • L'Hospital's Rule and Taylor's Theorem • Integral of a Real Valued Function • Integration and Differentiation: Fundamental Theorem of Calculus • Integration by Parts and Leibniz Integral Rule • Inverse Function Theorem and The Implicit Function Theorem

Real Analysis ♣

• Sets • Relations • Functions • Numbers • Countability and Cardinality • Metric Spaces • Topology • Sequences and Convergence • Compactness • Cauchy Sequences and Completeness

Linear Algebra

• Vectors, Vector Operations • Linear Dependence • Basis, Vector Spaces and Subspaces • Matrices and Matrix Algebra • Inner Product and Projection • Linear Transformations • Rank and Determinant • Solutions to Systems of Linear Equations: Gaussian Elimination and Cramer's Rule

Convexity ♣

• Convex Set, Convex Hull, Extreme Points and Convex Cone • Carathedory's Theorem • Convex, Concave, Quasiconvex and Quasiconcave Functions • Separating Hyperplane Theorem

Optimisation ♣

• Unconstrained Optimisation • Equality Constraints: The Method of Lagrange • Inequality Constraints: The Method of Kuhn-Tucker • Linear Programming • Mixed Integer Linear Programming • Case : Portfolio Optimisation • Bellman - Principle • Optimal Control Theory

Numerical Methods using R ♣

. *(This part is not relevant for most students. Students interested in quantitative marketing or computational economics might find this session more useful.)*

• Introduction to R. • Floating point arithmetic. • Linear Algebra and Iterative Methods. • Optimisation -One dimensional -Multi-dimensional -Constrained Optimisation. -Application: Dynamic Optimisation - Consumption and saving example • Numerical Calculus. • Monte Carlo Simulation. • Finite Difference Methods for initial value problems.