

Mathematics - Preparatory Course
Academic Year 2026-2027 (Fall 2026)

Course Description:

- This course is a preparatory mathematics course for the incoming PhD students in accounting/economics/finance and business administration and management programs. This course (and its followup course, Introduction to Mathematics) aims to cover the core mathematical techniques which are used in subsequent PhD courses. The preparatory course has three units. First, we go over a brief introduction to basic probability theory. We then move on to study the basics of both differential and integral calculus and their applications to both constrained and unconstrained optimization. We conclude the course with an introduction to the mathematical foundation of choice theory, both with and without risk.
- This course will cover both mathematics in the abstract as well as its applications to economics, finance, etc. This means that for certain topics lectures and problem sets will be primarily proof based. For other topics, the emphasis will be on applying mathematical results to applied settings.

Prerequisites:

- Undergraduate-level set theory, calculus, matrix/linear algebra, and probability required for social sciences

Instructor:

- Christopher Turansick (Department of Decision Sciences)
- Office: 3-e1-05

Course Outline:

1. Probability Theory

- Probability spaces, random variables, conditional probability, conditional expectations, Bayes rule

2. Calculus

- Differentiation: Derivatives and partial derivatives, standard techniques (Chain rule, inverse functions)
- Integration: Indefinite and definite integrals, some examples, fundamental theorem of calculus, standard integration techniques (integration by parts and integration by substitution)
- Applications to Optimization: Solving Lagrangian equations, introduction to Kuhn-Tucker

3. Introduction to Choice Theory

- Riskless choice: Preferences, utilities, axiomatic foundations, equivalence
- Choice under risk: Objective expected utility, axiomatic foundation, geometric properties and optimization, introduction to subjective expected utility

Course materials and textbooks:

- There are no required textbooks for the course. The course material will draw from lecture notes/slides which will be made available on the course website. For those who wish to consult a textbook in addition to lecture materials, a list of suggested textbooks will be provided on the course website.