PREP SYLLABUS 2023/2024

COURSE: MATHEMATICS

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Office hours: By email.

Course information

The aim of the preparatory mathematics course is to make sure all student are confident in using mathematical concepts necessary to study the core courses at the master's and PhD level.

Course outline

1 Introduction and preliminaries
- Notation
- Misuse of notation
- Numbers

2 Logic
- Logical operators
- Logical equivalence
- Proving things
- Vacuous truths

3 Sets
- Operators on sets
- Important set properties: Rn
- Important set properties: Metric spaces*
- Product sets

4 Sequences
- Series

5 Linear algebra
- Vectors
- Vectors and hyperplanes
- Linear independence
- Matrices
- Matrix calculus
- Determinants
- Matrix definiteness
- Eigenvalues and eigenvectors
- Echelon matrices

6 Functions
- Continuity
- Derivatives
- Concavity and convexity
- Quasiconcavity and quasiconvexity*
- Inverse functions
- Exponents, exponentials, logarithms
- Polynomials and the fundamental theorem of algebra
- Taylor series approximation
- L'Hˆopital's rule

7 Binary relations

8 Optimization
- Unconstrained optimization
- Level sets, tangents, gradients
- Constrained optimization
- Constraint qualification
- Inada conditions

9 Comparative statics
- Implicit function theorem
- Envelope theorem
- Correspondences*
- Theorem of the maximum*

10 Fixed points*
11 Contraction mappings*
12 Dynamic programming*
- Direct approach
- Dynamic programming approach
- Solving the Bellman equation
- Closed-form solution: Policy function
- Closed-form solution: Value function
- Value function iteration

13 Integration
14 Probability
- Events and probability axioms
- Conditional probability
- Independence of events
- Random variables
- Measure theory*
- Moments and percentiles of random variables
- Commonly used distributions
- Multivariate random variables
- Sums, functions and transformations of random variables
- LLN and CLT

15 Inference
- Histogram estimates of pmfs and pdfs
- Hypothesis testing
- Confidence intervals
- Estimation: MLE
- Estimation: OLSs

Requirements and grading

The course grading will be based on the final exam. The students will be required to complete quizzes. The exercise sessions will cover the least understood concepts as revealed by the quizzes.

Readings

The students will be provided with detailed lecture notes.