האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

PROBABILITY THEORY AND APPLICATIONS - 80312

Last update 30-10-2024

HU Credits: 4

Degree/Cycle: 1st degree (Bachelor)

Responsible Department: Mathematics

Academic year: 0

Semester: 1st Semester

Teaching Languages: Hebrew

Campus: E. Safra

Course/Module Coordinator: Boris Begun

Coordinator Email: begun@math.huji.ac.il

Coordinator Office Hours: by appointment

Teaching Staff:

Dr. Boris Begun,
Prof. Alex Retzker,
Mr. Yuval Marcus,
Mr. Ilan Michael

Course/Module description:
A basic course in Probability an Statistics.
The semester is split between the Probability and Statistics parts - 8-9 and 4-5 weeks respectively (approximately).

Course/Module aims:
To introduce the principal notions and tools of Probability Theory. To help students in developing Probabilistic Thinking.
To teach methods of analyzing experimental data. To show the confrontation of data with observation via parameter estimation.

Learning outcomes - On successful completion of this module, students should be able to:
1. Explain and apply the basic concepts of probability, including conditional probability, Bayes' Formula and the notion of independence.
2. Describe and apply the concepts of discrete and continuous random variables and probability distributions, including standard distributions such as binomial, geometric, Poisson, exponential, normal. Perform calculations involving jointly distributed random variables.
3. Interpret and apply two limit theorems – the Weak Law of Large Numbers and the Central Limit Theorem. Prove a version of the Weak Law of Large Numbers.
4. Conceptual and practical know-how of experimental/observational data analysis.

Attendance requirements(%):
Attendance recommended; not required

Teaching arrangement and method of instruction: Weekly lectures + recitations + home assignment

Course/Module Content:
-- SOME MODIFICATIONS POSSIBLE --

PART 1 - PROBABILITY

1. The notion of probability. Probability space. Elementary combinatorics and applications in symmetric probability spaces.
2. Notion of conditional probability, Law of total probability, Bayes' formula. Independence of two or more events. Bernoulli trials.
3. Notion of a random variable. Discrete and continuous random variables. Special distributions: binomial, geometric, Poisson, exponential. Distribution of a function of a random variable.
4. Notion of expectation. Properties of expectation. Expectation of a function of a random variable. Variance. Expectations and variances of special distributions.
5. Weak Law of Large Numbers.
6. Normal distribution and its properties.
7. Random vectors. Covariance. Correlation coefficient. Expectation of a function of several random variables. Distribution of a sum of independent random variables.
8. Central Limit Theorem. Normal approximation.
9. (time permitting) Conditional distribution. Law of total expectation.

PART 2 - STATISTICS

1. Monte Carlo simulations.
2. Bayesian inference.

Required Reading:
N/A

Additional Reading Material:
For the Probability part of the course:

1. Lecture notes at the moodle course site.

2. Sheldon Ross: A First Course in Probability.

No suggested reading for the Statistics part.

Grading Scheme:
Written / Oral / Practical Exam 70 %
Submission assignments during the semester: Exercises / Essays / Audits / Reports / Forum / Simulation / others 30 %

Additional information: