האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

Probability for CS students - 52006

Last update 01-02-2025

HU Credits: *4*

Degree/Cycle: *1st degree (Bachelor)*

Responsible Department: *Statistics*

Academic year: *0*

Semester: *2nd Semester*

Teaching Languages: *Hebrew*

Campus: *E. Safra*

Course/Module Coordinator: *Prof. Yan Dolinsky*
Mr. Gavriel Honig

Coordinator Email: *yan.dolinsky@mail.huji.ac.il*

Coordinator Office Hours: *Monday 13-14*

Teaching Staff:
Prof. Yan Dolinsky,
Mr. Niv Brosh

Course/Module description:
The course enhances the basic knowledge acquired in the course "Introduction to Probability and Statistics" (80430). Topics presented in the introductory course will be developed and generalized, and new topics will be presented, while using a more advanced level of mathematical formalism

Course/Module aims:
To enhance the knowledge in probability theory as part of building the statistician's toolbox. To strengthen the mathematical ability in handling problems in probability

Learning outcomes - On successful completion of this module, students should be able to:
1. Recall the definitions given in the course and quote them. 2. Solve basic problems in probability and carry out theoretical calculations. 3. Implement the theorems and results, and give at least one example to demonstrate each of those. 4. Use the results taught in class to derive simple conclusions

Attendance requirements(%):
No attendance requirement

Teaching arrangement and method of instruction: Lectures and TA sessions

Course/Module Content:
1. Introduction and probability spaces
2. Random variables
2.1 Cumulative distribution function. Discrete and continuous random variables
2.2 Expectation
2.3 Moment generating function
2.4 Basic inequalities: Markov, Chebyshev, Jensen, Lyapunov
2.5 Sampling from a distribution with a random number generator
3. Random vectors
3.1 Joint distribution of a random vector
3.2 Expectation of random vectors and matrices. Covariance matrix
3.3 Moment generating function of a random vector
3.4 Independence and linear independence. The correlation coefficient. The Cauchy-

Schwarz inequality. Best linear prediction
4. Conditioning
4.1 Conditional distributions
4.2 Conditional expectation of a r.v. and best prediction. Conditional variance of a r.v.
4.3 Law of total expectation. Law of total variance
4.4 Extensions to the multivariate case
5. Transformations
5.1 Density of a function of a continuous random variable
5.2 Density of a function of a continuous random vector
5.3 Density of functions of independent random variables. Sum of independent random variables. Distribution of order statistics
6. The multivariate normal distribution.
6.1 Definition, properties, conditional distributions
6.2 Related distributions (Chi-square distribution; t distribution; F distribution), distribution of normal quadratic form
7. Convergence of sequences of random variables
7.1 Types of convergence of random sequences. Convergence in distribution. Convergence in . Convergence in probability. Convergence with probability one (almost surely).
7.2 Limit theorems
7.2.1 The law of large numbers and the central limit theorem
7.2.2 The strong law of large numbers

Required Reading:
Course notes

Additional Reading Material:
1. Introduction to Probability, second edition, by Bertsekas and Tsitsiklis

2. A first course in statistics, 8th edition, by Sheldon Ross

Grading Scheme:
Written / Oral / Practical Exam 100 %

Additional information: