



The Hebrew University of Jerusalem

Syllabus

High dimensional statistics - 80629

Last update 02-09-2021

HU Credits: 3

Degree/Cycle: 2nd degree (Master)

Responsible Department: Mathematics

Academic year: 2022

Semester: 1st Semester

Teaching Languages: Hebrew

Campus: E. Safra

Course/Module Coordinator: Zemer Kosloff

Coordinator Email: zemer.kosloff@mail.huji.ac.il

Coordinator Office Hours:

Teaching Staff:

Prof Zemer Kosloff

Course/Module description:

The course will serve as an introduction to the methods of analyzing high dimensional statistical models. The first part will deal with the basic of tail and concentration bounds, sub-Gaussian random variables, entropic methods and uniform laws of large numbers.

After that we aim to apply these methods to some problems such as covariance estimators, sparse-linear regression and the Lasso algorithm.

Course/Module aims:

Learning outcomes - On successful completion of this module, students should be able to:

Be familiar with the mathematical foundations and methods underlying modern research in the rapidly evolving field of high-dimensional statistics.

Attendance requirements(%):

0

Teaching arrangement and method of instruction: Lectures

Course/Module Content:

- 0) Introduction and some nice examples.
- 1) Basic tail bounds (Chernoff, Hoeffding inequalities and martingale difference methods).
- 2) SubGaussian random variables, equivalent definitions and the sub-Gaussian norm.
- 3) Uniform laws of large numbers, Rademacher complexity and Vapnik-Chernovakis dimension.
- 4) Metric entropy and its uses: Covering, Packing, chaining and Dudley's integral.
- 5) Random matrices and covariance estimation.
- 6) Sparse linear regression.

Required Reading:

none

Additional Reading Material:

a) M.J. Wainwright. *High-Dimensional Statistics, A Non-Asymptotic Viewpoint*. Cambridge university press.

b) R. Vershynin, *Introduction to the non-asymptotic analysis of random matrices*. Cambridge University Press,

c) *A New Look at Independence – Special Invited Paper*, by M. Talagrand, the *Annals of Applied Probability*, 24(1),1-34, 1996.

Course/Module evaluation:

End of year written/oral examination 0 %

Presentation 50 %

Participation in Tutorials 0 %

Project work 0 %

Assignments 50 %

Reports 0 %

Research project 0 %

Quizzes 0 %

Other 0 %

Additional information:

The interested students must have completed the course "introduction to probability theory and statistics. Knowledge in measure theory and continuous probability is an advantage.