

## High Dimensional Probability and Nonasymptotic Statistics

**Description of Course:** It presents some crucial probabilistic methods, which are useful in modern statistics and data science but not covered in a first graduate level probability course. It covers concentration inequalities for vectors and matrices with applications to networks, covariance estimation, clustering, matrix completion, machine learning, compressed sensing, dimension reduction, and sparse regression. We will cover first 6 chapters (and additional chapters if time permitted) of the textbook.

### Instructor and Contact Information

**Professor/Lecturer:** Ning Hao

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**Textbook:** *High-Dimensional Probability -- An Introduction with Applications in Data Science* by Roman Vershynin (**Electronic copy available in author's web**)

ISBN 9781108231596; Cambridge University Press

**Learning Outcomes:** Students will be able to:

- Learn key probabilistic methods and results, which are essential in modern statistics and data science.
- Apply probabilistic methods to other topics including covariance estimation, clustering, networks, dimension reduction, matrix completion, sparse regression, etc.
- Implement statistical and probabilistic methods by R program.

**Prerequisite:** Math 564, 566 (or Math 563 and undergraduate level statistics, e.g. MATH 466); Undergraduate linear algebra.

**Homework:** Weekly/biweekly homework.

**Final Project:** We will have a final project with a written report and in-class presentation. More information to follow.

**Tentative schedule:** 1-2 lectures for chapter 1; 3-4 lectures for each of chapters 2-6; 4-8 lectures for Chapter 9 and/or 10; 2 lectures for student presentation.

**Course grade:** Homework (50%), project (50%). Final percentages above 90, 80, 70, or 60 guarantee letter grades of A, B, C, or D, respectively.

**This is a tentative syllabus and all information contained is subject to change.**