

## The Department of Mathematics

2021–22–B term

**Course Name** Statistical methods for big data

**Course Number** 201.1.9131

**Course web page**

<https://www.math.bgu.ac.il/en/teaching/spring2022/courses/demography>

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**Office Hours** <https://www.math.bgu.ac.il/en/teaching/hours>

### Abstract

### Requirements and grading<sup>1</sup>

### Course topics

1. Review of probability: a. Basic notions. b. Random variables, Transformation of random variables, Independence. c. Expectation, Variance, Covariance. Conditional Expectation.
2. Probability inequalities: Mean estimation, Hoeffding's inequality.
3. Convergence of random variables: a. Types of convergence. b. The law of large numbers. c. The central limit theorem.
4. Statistical inference: a. Introduction. b. Parametric and non-parametric models. c. Point estimation, confidence interval and hypothesis testing.
5. Parametric point estimation: a. Methods for finding estimators: method of moments; maximum likelihood; other methods. b. Properties of point estimators: bias; mean square error; consistency. c. Properties of maximum likelihood estimators. d. Computing of maximum likelihood estimate

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<sup>1</sup>Information may change during the first two weeks of the term. Please consult the webpage for updates



6. Parametric interval estimation a. Introduction. b. Pivotal Quantity. c. Sampling from the normal distribution: confidence interval for mean, variance. d. Large-sample confidence intervals.
7. Hypothesis testing concepts: parametric vs. nonparametric a. Introduction and main definitions. b. Sampling from the Normal distribution. c. p-values. d. Chi-square distribution and tests. e. Goodness-of-fit tests. f. Tests of independence. g. Empirical cumulative distribution function. Kolmogorov-Smirnov Goodness-of fit test.
8. Regression. a. Simple linear regression. b. Least Squares and Maximum Likelihood. c. Properties of least Squares estimators. d. Prediction.
9. Handling noisy data, outliers.