Óbuda University John von Neumann Faculty of Informatics	Institute of Software Engineering
Name and code: Probability theory and the basics of mathematical statistics (NMXVS1PMNE) **Credits:** 3 *Computer Science MSc* *Daytime 2020/21 year I. semester*	

Subject lecturers: László Csink				
Prerequisites: (with code)				
Weekly hours:	Lecture: 2	Seminar: 1	Lab. hours: 0	Consultation: 0
Way of assessment:	Examination			

Course description

Goal: To lay the foundations of probability theory and statistics

Course description: The course is organised in the Internet. Students will get an invitation to join classes via video conferencing in the scheduled times.

Kolmogorov probability space; law of total probability; Bayes' theorem. Random variables and their properties; probability distribution function; expectation, variance and moments. Transforms of distributions (generating functions, characteristic function, Laplace-transform). Joint distributions; random vectors; independence; covariance matrix. General definition and properties of conditional expectation; law of total expectation. Types of convergence; Borel-Cantelli lemmas; laws of large numbers; sums of random variables; central limit theorems. Statistical space; sample; statistics; ordered sample; empirical distribution function; Glivenko-Cantelli theorem. Unbiased, efficient and consistent estimator; sufficiency, completeness and ancillarity; Rao-Blackwell theorem. Estimation techniques, maximum-likelihood estimation, method of moments, method of least squares. Bayesian estimation. Hypothesis testing; confidence intervals. NeymanPearson lemma; parametric and nonparametric tests.

Lecture schedule

Education week	Topic
1	Kolmogorov probability space, law of total probability, Bayes' theorem.
2	Random variables and their properties; probability distribution function; expectation, variance and moments.
3	Transforms of distributions (generating functions, characteristic function, Laplace transform).
4	Joint distributions; random vectors; independence; covariance matrix.
5	General definition and properties of conditional expectation; law of total expectation.
6	Types of convergence; Borel-Cantelli lemmas; laws of large numbers; sums of random variables; central limit theorems.
7	Continuation of lecture 6.
8	Statistical space; sample; statistics; ordered sample; empirical distribution function; Glivenko-Cantelli theorem.
9	Unbiased, efficient and consistent estimator; sufficiency, completeness and ancillarity; Rao-Blackwell theorem.
10	Continuation of lecture 9.
11	Estimation techniques, maximum-likelihood estimation, method of moments, method of least squares.
12	Hypothesis testing; confidence intervals
13	Neyman-Pearson lemma; parametric and nonparametric tests
14	Summary

Midterm requirements

Midterm Test Scheduling

Education week	Topic

Midterm grade calculation methods

Method of replacement

cf. TVSZ

Type of exam

Written exam in the Moodle system

Exam grade calculation methods

Final grade calculation methods

Achieved result	Grade
89-100%	excellent (5)
76-88%	good (4)
63-75%	average (3)
51-62%	weak (2)
0-50%	failed (1)

References

Obligatory:

Janko Gravner: Lecture Notes for Introductory Probability.
https://www.math.ucdavis.edu/ gravner/MAT135A/resources/lecturenotes.pdf

Recommended:

Gut, A.: An Intermediate Course of Probability, 2nd ed.; Springer; 2009.
Gut, A.: Probability : A Graduate Course; Springer; 2005.

Others: