SCHEDULE (GEMAK131-BL)
For the course *Probability Theory and Mathematical Statistics*
Computer Science Engineering,
2+2 lesson per week, signature + colloquium

week1: Sets, Basic cases of combinatorics, Classical probability space.

week 2: Drawing balls from an urn with and without replacement, Geometric method of probability calculation, Kolmogorov probability space and its properties.

week Concept and properties of conditional probability, Bayes' formula, Complete system of events, Theorem of total probability, Bayes' theorem, Pairwise and complete independence of event sequences.

week 4: Random variables, Discrete and absolutely continuous random variables, Moments and central moments of random variables. Transformation formulas for the expectation, Expectation and its properties, Independence and uncorrelatedness of two random variables, Variance and its properties.

week 5: Notable discrete random variables: Bernoulli, Pascal, negative binomial, hypergeometric, binomial, Poisson distributions. Generating functions and their applications.

week 6: Notable absolutely continuous random variables: uniform, exponential, normal, chi-square, Student's t, Fisher's F, lognormal, Cauchy distributions. Characteristic function of random variables.

week 7: Random vectors (two-dimensional case), Joint distribution function and its properties, Discrete and absolutely continuous random vectors, Determining marginal distributions from the joint distribution, Concept and properties of covariance, Relationship between independence and uncorrelatedness, Correlation coefficient and its properties.

1st in-class test

week 8: Random vectors (n-dimensional case), Discrete and absolutely continuous random vectors, Expectation vector, Variance–covariance matrix and their properties, Notable discrete random vectors: multinomial and multivariate hypergeometric distributions, Notable absolutely continuous random vectors: multivariate uniform, multivariate normal distributions.

week 9: Inequalities: Markov's and Chebyshev's inequalities, Weak and strong laws of large numbers, Central limit theorem, Moivre–Laplace theorem. Additional measures: quartiles and quantiles, mode and median.

week 10: Sample and sample realization, Statistics, Unbiased, asymptotically unbiased, and consistent estimators of unknown parameters, Point estimators, Basic statistics: mean, empirical variance, Steiner's formula, corrected empirical variance, sample median, median absolute deviation, empirical distribution function, Glivenko–Cantelli theorem, Maximum likelihood estimation. Histograms and boxplots.

week 11: Interval estimation, Construction of confidence intervals at $(1-\alpha)$ confidence level in various cases.

week 12: Hypothesis testing, Sample space, critical region, significance level, Type I and Type II errors, Tests: one-sample u-test, one-sample t-test, two-sample u-test, two-sample t-test, F-test, χ^2-test, goodness-of-fit test.

week 13: 2nd in-class test.

week 14: Retake in-class tests.

Conditions for semester signature: At least 40% performance in one in-class test. In week 14, students have the opportunity to write a retake test. During the exam period, students may also obtain the signature by writing a replacement test. The course concludes with a colloquium.

Miskolc, 4 September 2025.

Dr. Tamás Glavosits
Course coordinator