

SYLLABUS

SUBJECT: Probabilistic methods and elements of mathematical statistics

TEACHER: Prof. dr hab. Stanisław Drożdż, dr Rafał Rak

COURSE DESCRIPTION:

The purpose of the course is to provide the most fundamental as well as the most useful concepts and methods of the probability theory and mathematical statistics with a special emphasize on their interdisciplinary implications and relevance for the contemporary science.

Lecture:

Theory of probability: notion of probability, probabilities and combinatorics, probability algebras, axiomatic formulation of probability, conditional probabilities, independence of events.

Theory of random variables: discrete random variables, continuous random variables, distribution functions and probability density functional, moments of distribution, medians and quantiles, most useful examples of distributions: uniform, Cauchy, binomial, Gaussian and q-Gaussian, Poisson, distribution of a function of random variables, several random variables, covariance matrix, complex random variables, characteristic function, convolution of random variables, Bayes' theorem.

Limit theorems: stable distributions, central limit theorem, Chebyshev inequality, law of large numbers, generalized central limit theorem, Levy distributions, power-law distributions, natural examples, fractals.

Classes: Training of skills by practical exercises on elements such as probabilities and combinatorics, random variables, generators of random variables, probability distributions (Gaussian, q-Gaussian, Poissonian), standard deviation, asymmetry coefficient, kurtosis, modal value, median, quantile, two-dimensional random variable, probability distribution of two-dimensional random variable, covariance, correlation coefficient, linear regression, regression coefficients, linearization, estimation and confidence intervals, testing of hypotheses, some applications in financial time series.

LEARNING OUTCOMES:

A student should acquire a basic knowledge about the most fundamental and useful notions, concepts and methods of the mathematical statistics.

GRADING POLICY:

Lecture: Written test.

Classes: Two written tests and short questions before every classes.

TIMETABLE

Number of hours:

Lecture: 2h x 15 weeks = 30 hours (1 semester)

Classes: 2h x 15 weeks = 30 hours (1 semester)

TEXTBOOK AND REQUIRED MATERIALS:

- Renyi A., Probability Theory, North Holland, Amsterdam 1970 (available also in French as “Calcul des probabilités”, Dunod, Paris, 1966)
- Alon N., Spencer J.H., Erdos P., The Probabilistic Methods, Chichester Wiley, 1992
- Fabian V., Hannan J., Introduction to Probability and Mathematical Statistics, J.Wiley & Sons, 1985
- Schroeder M., Fractals, Chaos, Power Laws, W.H. Freeman and Company, New York 1991
- Brandt S., Data Analysis (*Analiza danych*), PWN, Warszawa 1998 (in Polish)
- Platt Cz., Probability Calculus and Mathematical Statistics in Exercises (*Problemy rachunku prawdopodobieństwa i statystyki matematycznej*), PWN Warszawa 1978 (in Polish)
- Kryszicki W., Bartos J., Dyczka W., Królikowska K., Wasilewski M., Probability Calculus and Mathematical Statistics in Exercises (*Rachunek Prawdopodobieństwa i Statystyka Matematyczna w Zadaniach*) Volume 1 and 2, PWN Warszawa 2007 ((in Polish)

PREREQUISITES:

High school course in mathematics