(*faculty stamp*)



**COURSE DESCRIPTION**

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|---|---|
| **1. Course title: STATISTICAL METHODS** | **2. Course code** |
| **3. Validity of course description:** 2018/2019 | |
| **4. Level of studies:** BSc programme | |
| **5. Mode of studies:** intramural studies | |
| **6. Field of study**: COMPUTER SCIENCE | AEII |
| **7. Profile of studies: general academic** | |
| **8. Programme:** | |
| **9. Semester: 3, 4** | |
| **10. Faculty teaching the course:** Institute of Informatics, RAu2 | |
| **11. Course instructor**: of. dr hab. inż. Katarzyna Stąpor | |
| **12. Course classification: common subjects** | |
| **13. Course status:** compulsory | |
| **14. Language of instruction:** English | |
| **15. Pre-requisite qualifications: mathematical analysis and linear algebra** | |
| **16. Course objectives:** to study principles of probability and statistics and statistical methods of data analysis. | |

**17. Description of learning outcomes:**

| Nr | Learning outcomes description | Method of assessment | Teaching methods | Learning outcomes reference code |
|---|---|---|---|---|
| W1 | Student knows and understands basic facts and theorems of probability theory as well as basic types of main distribution of random variables | Exam, tests | Lectures, exercises | K1A_W02 |
| W2 | Student knows and understands methods of statistical inference: estimation and hypothesis testing | Exam, tests | Lectures, exercises | K1A_W02 |
| W3 | Student has knowledge on modern statistical methods beeing the basis for data mining | Exam, tests, Doing data analysis | Lectures, exercises | K1A_W13 |
| U1 | Student can construct probability spaces for different real problems | Exam, tests | Lectures, exercises | K1A_U01 |
| U2 | Student can compute parametric estimators of parameters of distributions and conducts hypothesis testing about them as well as computes nonparametric estimators of probability density function | Exam, tests | Lectures, exercises | K1A_U08, K1A_U12 |
| U3 | Student can use learned statistical methods in complex data analysis in reality (e.g. banking) | doing data analysis | Lectures, exercises | K1A_U08, K1A_U12 |
| K1 | Student can work in analytic team | doing data analysis | exercises | K1A_K02 |
| K2 | Student does statistical analysis in responsible way (knowing consequences of bad practices on data, i.e. not lying) | doing data analysis | exercises | K1A_K01 |

**18. Teaching modes and hours**

**Lecture / BA /MA Seminar / Class / Project / Laboratory**

(Sem. 3.) Lecture 30 h., Class 15 h, (Sem. 4) Laboratory 45h

**19. Syllabus description:**

**Lectures:**

*Elements of the probability theory.* Probabilistic space, probability, Bernoulli's experimental scheme, Bayes problem, discrete and continuous random variable and its characteristics, random vector and its characteristics, concept of combined, boundary and condition distribution, basic types of distributions (binomial, Poisson, geometric, exponential, normal ), the law of large numbers (LLN), central limit theorem, stochastic process, time series.

*Elements of mathematical statistics.* Basic concepts: population, feature (variable), variable types, sample, empirical distribution and its description, distribution lists, histograms, descriptive statistics; Statistical model: sample space and parameter space, parametric and nonparametric model, statistics and its distribution; Point estimation: definition of the estimator and examples, properties of estimators – unbiasedness, conformity, estimators of the greatest credibility; Confidence intervals: their design and examples for specific parameters; Nonparametric model: nuclear density estimation of density function; Verification of statistical hypotheses: zero and alternative hypothesis, statistical test, critical area, 1st and 2nd type errors, test power, examples of test construction for expected value and variance in normal distribution, chi-square and Kolmogorov compatibility tests, independence test , tests for comparing two populations; One-way analysis of variance and its non-parametric equivalent – Kruskal Wallis test; The classic linear regression model, parameter estimation, model diagnostics, multiple regression. Elements of time series analysis.

**Classes:**

1. The construction of probabilistic spaces for specific applications, calculation of probabilities related to Bernoulli's experience, Bayes theorem
2. Finding distributions of random variables, calculating their basic characteristics and parameters
3. Obtaining the estimators with the most credibility method, testing the properties of estimators
4. Parametric and non-parametric tests of significance in a population with normal distribution, estimation of parameters in the classical linear regression model

**Laboratory:**

1. Excel spreadsheet - selected elements. Basics of Visual Basic language, writing macros, implementation of algorithms for generating pseudorandom numbers for basic distributions, simulation of random experiments.
2. Determination of basic characteristics of the empirical distribution, statistical inference using selected methods of estimation and verification of hypotheses
3. Advanced data analysis: analysis of variance, i.e. the study of differences between many populations
4. Correlation and regression analysis

**20. Examination:** after 3rd semester – written exam

**21. Primary sources:**

1. K. Stąpor: Wykłady z metod statystycznych dla informatyków. Wyd. Polit. Śl., Gliwice 2008

2. J. Koronacki, J. Mielniczuk: Statystyka dla kierunków technicznych i przyrodniczych. WNT, Warszawa 2006

3. W. Krysicki i in.: Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach. Cz.1, 2, PWN Warszawa 2008

**22. Secondary sources:**

1. R. Zieliński: Siedem wykładów wprowadzających do statystyki matematycznej. PWN Warszawa 1990

2. M. Maliński, J. Szymszal: Statystyka matematyczna wspomagana komputerowo. Wyd. Polit. Śl., Gliwice 2000

**23. Total workload required to achieve learning outcomes**

| Lp. | Teaching mode : | Contact hours / Student workload hours |
|---|---|---|
| 1 | Lecture | 30/30 |
| 2 | Classes | 15/30 |
| 3 | Laboratory | 15/15 |
| 4 | Project | / |
| 5 | BA/ MA Seminar | / |
| 6 | Other | 5/0 |
| | Total number of hours | 65/75 |

**24. Total hours:**140

**25. Number of ECTS credits:** 5

**26. Number of ECTS credits allocated for contact hours: 3**

| |
|---|
| **27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects):1** |
| **26. Comments:** |

Approved:

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*(date, Instructor's signature)* (*date , the Director of the Faculty Unit signature)*