



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Probabilistics and statistics in telecommunications [S1Teleinf1>PiSwT]

### Course

Field of study

Teleinformatics

Year/Semester

1/2

Area of study (specialization)

–

Profile of study

general academic

Level of study

first-cycle

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

### Number of hours

Lecture

30

Laboratory classes

0

Other

0

Tutorials

30

Projects/seminars

0

### Number of credit points

5,00

### Coordinators

prof. dr hab. inż. Maciej Stasiak  
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### Lecturers

### Prerequisites

The student should have a basic knowledge of mathematics with basic set theory, combinatorics and mathematical analysis. Be able to extract information from English language literature, databases and other sources and he is committed to further self-study.

### Course objective

The aim of the course is to familiarise students with the basics of probability and probabilistic methods used in engineering practice of ICT.

### Course-related learning outcomes

Knowledge:

1. Students are able to use theory of probability concepts to solve basic problems in ICT.
2. Students are capable of studying autonomously.

Skills:

1. Students have a systematic knowledge of theory of probability.

Social competences:

1. Students are aware of the limitations of their current knowledge and skills.
2. Students are committed to further self-study.

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:

Knowledge acquired during the tutorials is verified on the basis of a test. Students solve 5-6 tasks, scored differently depending on the level of difficulty of the problems. Passing threshold: 50% of points. Depending on the degree of difficulty of the test, the scoring may be changed.

Knowledge acquired during lecture is verified on the basis of a test. The test includes 25-30 equally scored questions. Each question has 4 answers, one of which is true. Passing threshold: 50% of points (correct answers). Depending on the degree of difficulty of the test, the scoring may be changed. In the case of a small number of students, the credit may be given on the basis of a direct conversation with the lecturer.

### Programme content

The program covers issues in the field of probability theory and statistics: basics of data analysis, basic notions and rules of probability theory, characteristics of one-dimensional random variables, the most important discrete and continuous distributions, characteristic functions and generating functions, characteristics of two-dimensional random variables, regression, laws of large numbers and limit theorems, basic notions and elements of statistics, examples of distributions used in statistics, elements of statistical estimation and inference, confidence intervals, introduction to stochastic processes, fundamentals of modeling of ICT systems.

### Course topics

1. Historical overview; data reduction: graphical presentation of data; numerical characteristics of sets of data.
2. Algebra of sets and combinatorial analysis: fundamentals of set theory; elements of combinatorics; permutations, variations, combinations.
3. Basic notions and rules of probability theory: random events, probability definitions; algebra of events and probabilities; conditional probability; law of total probability; Bayes' theorem; independence of events.
4. Properties and characteristics of one-dimensional random variables: cumulative distribution function and its properties; probability density function and its properties; moments and central moments of random variable; expected value; variance and standard deviation; coefficient of skewness; coefficient of excess.
5. Distributions of random variables; discrete random variables: Dirac distribution, two point distribution, Bernoulli distribution, Poisson distribution, geometric distribution, hypergeometric distribution, Pascal distribution; continuous random variables: rectangular distribution, exponential distribution, normal distribution; gamma distribution.
6. Characteristic functions: properties of characteristic functions; generation of moments; properties of moment-generating functions; properties of probability generating functions; characteristic and moment-generating functions of basic probability distributions.
7. Properties and characteristics of two-dimensional random variables: cumulative distribution function and probability density function of two-dimensional random variable; marginal distributions; conditional distributions; independence of random variables; raw and central moments, covariance and correlation coefficient; characteristics of conditional distributions; regression of type I; regression of type II; least-squares method; two-dimensional normal distribution.
8. Laws of large numbers and limit theorems: Markov inequality; Chebyshev inequality; "three sigma" rule; law of large numbers: Bernoulli law of large numbers; Chebyshev law of large numbers; integral and local limit theorems.
9. Basic notions and elements of statistics: empirical cumulative distribution function; empirical moments; distribution series; empirical moments; chosen distributions used in statistics: standard normal distribution, Chi-square distribution, Student distribution; estimators; properties of estimators; confidence intervals; basic concepts of hypothesis testing.
10. Introduction to stochastic processes: Poisson process; Markov process; Kolmogorov equations;

steady states; state equations.

11. Application of elements of probability in electronic and telecommunications issues: Fundamentals of analytical modelling of network systems; birth and death process; Erlang model for full availability resources; Fundamentals of simulation modelling of network systems; embedded Markov chain and Monte Carlo method.

## Teaching methods

1. Lecture: multimedia presentation illustrated with examples and supplemented with additional explanations on the blackboard.
2. Tutorials: multimedia presentation illustrated with examples; solving problems given by the teacher with appropriate explanations on the board.

## Bibliography

Basic:

1. Plucińska A., Pluciński E., Probabilistyka: procesy stochastyczne, statystyka matematyczna, rachunek prawdopodobieństwa, WNT, Warszawa, wydania 2000, 2005, 2006, 2015, 2017.
2. Kryszicki W., Bartos J., Dyczka W., Królikowska K., Wasilewski M., Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach, część I i II, PWN, Warszawa, wydania 1998, 2000, 2002, 2007.

Additional:

1. Materiały dydaktyczne do wykładów udostępniane studentom w formie plików pdf.
2. Feller W., Wstęp do rachunku prawdopodobieństwa, PWN, Warszawa, 2006.
3. Benjamin J.R., Cornell C.A., Rachunek prawdopodobieństwa, statystyka matematyczna i teoria decyzji dla inżynierów, WNT, Warszawa, (dowolne wydanie)
4. Bobrowski D., Probabilistyka w zastosowaniach technicznych, WNT, Warszawa, 1986.
5. Bobrowski D., Łybacka K., Wybrane metody wnioskowania statystycznego, Wydawnictwo Politechniki Poznańskiej, Poznań, wydania 1988, 1995, 2001, 2002, 2004, 2006.
6. Stasiak M., Głąbowski M., Hanczewski S., Zwierzykowski P.: Podstawy inżynierii ruchu i wymiarowania sieci teleinformatycznych, Wydawnictwo Politechniki Poznańskiej, Poznań, 2009.

## Breakdown of average student's workload

|                                                                                                                                         | Hours | ECTS |
|-----------------------------------------------------------------------------------------------------------------------------------------|-------|------|
| Total workload                                                                                                                          | 120   | 5,00 |
| Classes requiring direct contact with the teacher                                                                                       | 64    | 3,00 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 56    | 2,00 |