STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Probabilistic methods and statistics	**1010341551010341003**

Field of study	Profile of study (general academic, practical)	Year /Semester
Mathematics	**general academic**	**3 / 5**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **2** Classes: **2** Laboratory: **2** Project/seminars: **-**	**10**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
major	**university-wide**

Education areas and fields of science and art	ECTS distribution (number and %)
the sciences	**10 100%**
Mathematical sciences	**10 100%**

Responsible for subject / lecturer:

dr Karol Andrzejczak
email: karol.andrzejczak@put.poznan.pl
tel. 61-6652815
Faculty of Electrical Engineering
ul. Piotrowo 3A 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student well understands the role and meaning of the proof in mathematics, as well as the notion and meaning of the gravity of assumptions. He knows basic statements and methods of mathematical logic, set theory, algebra and discreet mathematics. Particularly he knows bases of the differential and integral calculus for the function of one and several variables
2	**Skills**	Student is competent in using the logic and the set theory languages. Is able to examine the convergence of the numerical progression and to calculate the limit of a numerical sequence and of the function. Is able to apply methods of the differential and integral calculus of the function of one or several variables. Is able to write software for basic computational algorithms, using popular programming languages (e.g. MatLab) Is able to extract information from Polish or English language literature, databases and other sources. Is able to synthesize gathered information, draw conclusion, and justify opinions.
3	**Social competencies**	Student knows restrictions of the own knowledge and understands the need of the further education. He is able to formulate questions, serving deepening own understanding the given theme or for finding missing elements of reasoning. Demonstrates responsibility and professionalism in solving technical problems. Is able to participate in collaborative projects.

Assumptions and objectives of the course:

Theoretical and practical taking control of bases of the probability calculus and mathematical statistics.

Purchasing the ability of the modelling of random experience with using adequate probabilistic space.

Achieving the ability of applying random variables and appointing their functional and numerical characteristics. Purchasing the ability to construct models, also for examining the relation between different features.

Understanding nature of limit theorems and their role in the mathematical statistics and practical applications.

Purchasing of the statistical inference ability concerning parameters and the random variable distributions being models of studied features in different statistical populations.

Understanding the need and mastering the ability of applying of statistical packages in the problem solving and the random experiment modelling. Purchasing the ability of convincing other about the need of applying probabilistic methods and mathematical statistics in the problem solving with the incomplete knowledge.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Student knows elements of the probability space and various definitions of the probability and possibilities of their applications as well as understands the role of random variables and their basic distributions in practical applications. - [K_W01(++), K_W02(++), K_W03(+++), K_W05(++)]

2. Knows different ways of applying probabilistic methods in chosen technical and economic fields of science. - [K_W03(++), K_W12(++)]

3. Knows at least one package of the statistical software on the basic level, package for the symbolic computation and spreadsheet - [K_W09(+++)]

Skills:

1. Student familiar with notion the probability space notion; is able to build and to analyse the mathematical model of random experiment. - [K_U30(+++), K_U32(+++)]

2. Is able to give different examples of the discreet and continuous probability distributions as well as is able to discuss chosen random experiments and mathematical models in which these distributions appeared. - [K_U31(+++)]

3. Is able to appoint typical values of the discrete, continuous or mixed random variable; is able to apply limit theorems and laws of large numbers for estimating probability. - [K_U33(+++)]

4. Is able to use sample characteristics of the population and their empirical equivalents. Is able to evaluate simple statistical inference, also with using the software - [K_U34(+++), K_U35(++)]

Social competencies:

1. Student is able to precisely formulate questions, servants the greater depth the own understanding of given theme or the retrieval of lacking elements of reasoning. - [K-K02(+++)]

2. Is able to formulate opinions concerning issues with random elements - [K_K07(++)]

3. Is able to work collectively and he understands a need of the systematic work on all long-term meaning projects. - [K_K03(+++)]

Assessment methods of study outcomes

-lecture

permanent assessing the activity for solving recapitulating lectures problems

evaluation of the knowledge and abilities shown on a written exam in the theoretical and practical range

- classes

assessment of acquired practical skills based on two writing works: half and final (with use teaching materials).

permanent assessing, on every classes - awarding a bonus for the ability of using newly found principles and methods.

- laboratory

evaluation of the knowledge based on two studies of solved problems with computer assistance.

permanent assessing the theoretical and practical knowledge and both the effectiveness and the ability of applications of the solved and discussed problems.

skills assessment of the interpretation, presentation and documentation the result of solved problems.

Course description

Review of the combinatorial techniques. Probability space as the model of random experience with finite or infinite outcomes. Different definitions of the probability: axiomatic, geometric, classical, conditional. Consequences of the Kołmogorow axioms.

Operations and relations with events. Indicator as the idea of the elementary event classification by means of a dichotomy. Independence and dependence events. The exclusion-inclusion formula. The multiplication rule, the total probability formula and Bayes? theorem with engineering applications. Sequences of trials.

One and two-dimensional real random variables and their probability distributions ? marginal and join cumulative distribution function (CDF), probability mass function (PMF) and probability density function (PDF). Three types of random variables and application of the Stieltjes integration. Conditional distribution.

Numerical characteristics of the two-dimensional random variables and their property. Moment-generating function and the characteristic function of a random variable. Chebyshev?s and Markov?s inequalities.

ISO norms concerning the probability calculus and the mathematical statistics. The review of the distributions of the discreet and continuous type and examples of their applications.

Sequences of random variables and limit theorems. The law of large numbers and the de Moivre-Laplace theorem. Some application of central limit theorem (CLT). The Poisson and normal approximations.

Basic functions of random variables and their application in statistics. Some important distributions in statistics (normal, chi-square, Student t, F distribution). The quantile function as inverse of CDF.

Introduction to simulation methods (Monte Carlo). Implementation bases of stochastic processes (Markov process).

Simple random sample (SRS). The review of basic statistics, their properties and applications in the parameter estimation and the statistical hypotheses testing for one and two populations.

Chosen applications of nonparametric methods. Goodness of fit. Testing normal distributions. The Pearson chi-square test.

Linear regression for normal distributions.

The inspection of statistical packages and their practical use in the solving of probabilistic and statistical problems -

The compare of Poznań University of Technology and Cambridge University examination questions from previous years in first course of Probability and Statistics.

Basic bibliography:

1. Plucińska Agnieszka, Edmund Pluciński: Probabilistyka. WNT, Warszawa 2000.
2. Jakubowski Jacek, Rafał Stencel: Wstęp do teorii prawdopodobieństwa. SCRIPT, Warszawa 2000.
3. Suhov Yuri, Kelbert Mark: Probability and Statistics by Example. I and II. Cambridge University Press 2005, 2008.
4. Bobrowski Dobiesław: Probabilistyka w zastosowaniach technicznych. WNT, Warszawa 1986.
5. Kordecki Wojciech: Rachunek prawdopodobieństwa i statystyka matematyczna. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2003.
6. Jasiulewicz Helena, Wojciech Kordecki: Rachunek prawd. i statystyka matematyczna. Przykłady i zadania. Oficyna Wydawnicza GiS, Wrocław 2004.
7. Iwanik Anzelm, Misiewicz Jolanta: Wykłady z procesów stochastycznych z zadaniami. Część 1. Procesy Markowa. Oficyna Wydawnicza Uniwersytetu Zielonogórskiego, Zielona Góra.
8. Krysicki Włodzimierz i inni: Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach, cz. I i cz. II. PWN Warszawa.
9. Statistics Toolbox For Use with MATLAB.
10. Symbolic Math Toolbox For Use with MATLAB.

Additional bibliography:

1. Andrzejczak Karol: Statystyka elementarna z wykorzystaniem systemu Statgraphics. Wyd. PP, Poznań 1997.
2. Bartoszewicz Jarosław: Wykłady ze statystyki matematycznej. Wydawnictwo Naukowe PWN, Warszawa 1996
3. Bobrowski Dobiesław, Krystyna Maćkowiak-Łybacka: Wybrane metody wnioskowania statystycznego. Wyd. PP, Poznań 2004.
4. Brandt Siegmund: Analiza danych. Wydawnictwo Naukowe PWN, Warszawa 1998.
5. Feller William: Wstęp do rachunku prawdopodobieństwa. PWN, T1 2008, T2 2009.
6. Gajek Lesław, Kałuszka Marek: Wnioskowanie statystyczne. Modele i metody. WNT Warszawa.
7. Krzyśko Mirosław: Wykłady z teorii prawdopodobieństwa. WNT 2000.
8. Krzyśko Mirosław: Statystyka matematyczna. WN UAM 1996.
9. Żygierewicz Jarosław Ćwiczenia ze statystyki http://brain.fuw.edu.pl/~jarek/STATYSTYKA/SKRYPT.pdf

Result of average student's workload

Activity	Time (working hours)
1. participate in lecture	30
2. participate in classes	30
3. participate in laboratory	30
4. consultations	5
5. preparation for classes	30
6. preparation for laboratory	30
7. preparation to classes test	20
8. drawing up reports on laboratory classes	30
9. preparing for the exam and the presence at the examination	25

Student's workload

Source of workload	hours	ECTS
Total workload	230	10
Contact hours	98	4
Practical activities	170	6