COURSE DESCRIPTION CARD - SYLLABUS

Course name
Probability calculus and random variables [S2EJ1>RPiZL]

Course

Field of study
Nuclear Power Engineering

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
0

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

2,00

Coordinators

dr hab. Karol Andrzejczak prof. PP
karol.andrzejczak@put.poznan.pl

Lecturers

Prerequisites

The student starting this subject should have basic knowledge of mathematical logic, set theory, number series, matrix calculus and differential and integral calculus of functions of one and two variables. He/she should precisely formulate questions aimed at deepening understanding of a given topic or finding missing elements of reasoning. He/she should be aware of the variety of problems that appear in particular phases of the life cycle of technical objects. He/she should also have the ability to obtain information from the indicated literature in both Polish and English and be open to cooperation within a team.

Course objective

The aim of the course is to provide students with basic knowledge of probabilistics and mathematical statistics necessary to correctly solve problems with random events and to formulate and verify statistical hypotheses in technical issues using appropriately selected tests. Developing students' skills in building scenarios for solving practical problems using the learned definitions, properties and theorems.

Course-related learning outcomes

Knowledge:
1. The student has extended knowledge of mathematical operations on random events.

2. The student has knowledge about the possibility of using selected distributions of random variables to model the values of the examined feature.
3. The student has knowledge of the possibilities of using functional and numerical characteristics of modeled random quantities.
4. The student has knowledge of the possibility of making type 1 and type 2 errors.
5. The student has knowledge of statistical inference methods.
6. The student has additional knowledge in the field of mathematics, probabilistics and statistics useful in research applied to the energy industry.

Skills:
1. The student is able to determine the probabilities of random events and examine the independence of events.
2. The student is able to determine the expected value, variance, quantiles and modal value of a random variable.
3. The student is able to solve problems using conditional random variables.
4. The student is able to examine the strength of interdependence between features.
5. The student is able to estimate unknown population parameters and formulate and verify parametric and non-parametric statistical hypotheses.
6. The student is able to select appropriate tools and probabilistic methods to solve energy problems and use them effectively.

Social competences:
1. The student is aware of initiating activities related to the formulation and transfer of information and cooperation in society in the field of energy.
2. The student is ready to critically evaluate his knowledge and the need to expand it.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures
Knowledge is verified on an ongoing basis in the form of activities (40%) and on the basis of the final colloquium (60%). The condition for receiving a positive grade is to obtain at least 50% of the possible points..
Exercise auditorium
The skills acquired during practical classes are verified on the basis of a written test assessed on a scale of 0-80 points and based on current activity 0-20 points. The colloquium consists of solving 4 technical tasks. The condition for receiving a positive grade is to obtain at least 45 possible points. Further marks for each additional 10 points.

Programme content

Lectures
Probabilistic space as a model of planned experiments and random phenomena. Operation on events. Conditional probability and stochastic independence of events. One- and two-dimensional random variables and their functional characteristics (cumulative distribution function, density function, quantile function, hazard function) and numerical characteristics (expected value, variance, quantiles, covariance, correlation). Selected discrete (Bernoulli, binomial, Pascal) and continuous (uniform, Poisson, normal, lognormal, Weibull) distributions and their practical applications. Conditional random variables and their applications in predicting the lifetime of tested objects. Theorems on the distribution of mean and variation from a random sample and their engineering applications. Point and interval estimation of parameters of studied characteristics in populations. Formulating and verifying parametric and non-parametric statistical hypotheses regarding contemporary technical problems.
Auditorium exercises
The scope of topics and issues covered coincides with the theory presented in subsequent lectures. Students solve practical tasks and problems related to engineering issues, in particular in the field of energy, using the definitions, properties, theorems learned during the lecture, as well as the methodology of cognitive conduct and generalization of the obtained results.
Update: 14/06/2024

Course topics

T01: Random variables as models of the studied features
T02: Numerical characteristics of random variables
T03: Review of basic probability distributions used in statistics
T04: Probabilistic foundations of statistical inference
T05: Methods of estimating the parameters of the studied features
T06: Parametric significance tests
T07: Non-parametric significance tests.

Teaching methods

Lectures: traditional form referring to the previous lecture, supported by a multimedia presentation supplemented with practical examples solved on the board. Lectures are conducted in an interactive manner, with questions being formulated by both the lecturer and students. Presentation made available after each lecture.
Auditorium exercises: students solve open tasks and practical problems on a blackboard, as well as discuss and formulate contextual conclusions. Students receive sets of tasks one week in advance. Students' activity during classes is taken into account when assigning the final grade.

Bibliography

Basic:
1. Bobrowski D., Probabilistyka w zastosowaniach technicznych. WNT, Warszawa.
2. Devore Jay L., Probability and Statistics for Engineering and the Sciences.

Additional:
1. Aczel Amir D., Statystyka w zarządzaniu. Wydawnictwo Naukowe PWN, Warszawa.
2. Andrzejczak K., Statystyka elementarna z wykorzystaniem systemu Statgraphics. Wyd. PP, Poznań 1997.
3. Bobrowski D., Łybacka K., Wybrane metody wnioskowania statystycznego. Wydawnictwo Politechniki Poznańskiej, Poznań.
4. Krysicki W., Bartos J., Dyczka W., Królikowska K., Wasilewski M., Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach, cz. I, II. Wydawnictwo PWN, Warszawa.

Breakdown of average student's workload

	Hours	ECTS
Total workload	55	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	25	1,00