#### Card of course

|  |  |
| --- | --- |
| 1. Subject name | Probability calculus and statistics |

1. Location of the subject in the system of studies

|  |  |
| --- | --- |
| 1.1. Programme | Computer Science |
| 1.2. Mode of study | Full time studies / Part time studies |
| 1.3. Level of degree | 1 degree |
| 1.4. Profile | Practical |

|  |  |
| --- | --- |
| 1.6. Specialty | - |
| 1.7. Lecturer responsible for the subject | Paweł Wlaź |

2. general characteristics of course

|  |  |
| --- | --- |
| 2.1. Connection with a subject group | practical |
| 2.2. Total credits (ECTS) | 3 |
| 2.3. Language of instruction | English |
| 2.4. Semesters in which the subject is carried out | 3 |
| 2.5. Criterion for selection of listeners | - |

1. Learning outcomes and method of conducting classes
   1. Aim of the subject

|  |  |
| --- | --- |
| Lp. | Aim of the subject |
|
| C1 | Acquisition by students of the ability to correctly use the concept of probabilistic space and calculating the probabilities of random events. |
| C2 | Acquiring by students the ability to study probability distributions and to determine parameters of random variables. |
| C3 | The acquisition by students of the ability to analyze basic experimental patterns and probabilistic modeling of simple random phenomena. |
| C4 | To acquaint students with the issue of point and interval estimation. |
| C5 | Getting to know the theory of verification of statistical hypotheses and reviewing the most commonly used one- and two-parameter significance tests |

3.2. Learning outcomes, divided into KNOWLEDGE, SKILLS AND COMPETENCIES, with reference to learning outcomes for an area (s) and a field of study

|  |  |  |
| --- | --- | --- |
| Lp. | Description of learning outcomes | Reference to the learning outcomes |
| After completing the subject, student in the range of **KNOWLEDGE**,can | | |
| W1 | student knows and understands the basic concepts and theorems of probability | INF\_W02 |
| W2 | student knows the basic methods and computational techniques used in theory probabilities | INF\_W02 |
| W3 | student knows the measures of descriptive statistics and interprets the obtained values | INF\_W02 |
| W4 | student understands the concept of estimation, recognizes the estimated parameters and is able to choose the appropriate model of the construction of confidence intervals | INF\_W02 |
| W5 | student formulates statistical hypotheses, selects correct models for their verification on the basis of a sample, knows the stages of verification of statistical hypotheses | INF\_W02 |
| After completing the subject, student in the range of **SKILLS**, can | | |
| U1 | correctly use the basic concepts and theorems of the probability theory | INF\_U03 |
| U2 | determine selected probability distributions and basic parameters of discrete and continuous random variables | INF\_U03 |
| U3 | describe the surveyed population using statistical measures and provides a graphic illustration | INF\_U01, INF\_U03 |
| U4 | determine the confidence intervals for unknown values of the parameters of the distribution of the examined feature and determines the necessary number of measurements | INF\_U03 |
| U5 | verify basic statistical hypotheses and conducts statistical inference | INF\_U03 |
| After completing the subject, student in the field of **SOCIAL COMPETENCES**, can | | |
| K1 | understand the limitations of their own knowledge and the need for further education | INF\_K02, INF\_K06 |

* 1. 3.3. Type of classes and number of hours – Full time studies (ST), Part time studies (NST)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Mode of study | Lecture | Exercises | project | workshops | Lab | Seminar | lectureship | Additional Online  ……….  (form) | Others | **ECTS** |
| **ST** | **8** | **15** |  |  |  |  |  |  |  | **3** |

3.4. Curriculum content (separately for each type of classes: (Lecture, Discussions, project workshops, Lab, Seminar, lectureship)

TYPE OF CLASSES: lectures

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Lp. | Content of classes | Form of teaching | | | |
| full time studies | | Part time studies | |
| CLASSES | PLATFORM | CLASSES | PLATFORM |
| 1. | Definition of a random variable, distribution of a random variable, probability function and probability density of a random variable; distribution function of a random variable and its properties. | X |  |  |  |
| 2. | Parameters of distributions of random variables. Independence of random variables. | X |  |  |  |
| 3. | Step distribution: one-point, two-point, Bernoulli, Poisson, geometrical; continuous distributions: uniform, exponential, normal; standardization of the normal distribution. | X |  |  |  |
| 4. | Basic statistical concepts. Elements of descriptive statistics (statistical series, analysis of the structure of statistical communities). | X |  |  |  |
| 5. | Interval Estimation. Confidence interval models for the mean, variance and standard deviation, and the structure index. Necessary number of measurements. | X |  |  |  |
| 6. | General principles of testing statistical hypotheses. Significance tests for mean value, variance, and structure index, and two mean values, two variances, and two structure indexes. | X |  |  |  |

TYPE OF CLASSES: exercises

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Lp. | Content of classes | Form of teaching | | | |
| full time studies | | Part time studies | |
| CLASSES | PLATFORM | CLASSES | PLATFORM |
| 1. | Calculating event probabilities using conditional probability; applications of the total probability theorem and Bayes' formula; event independence testing. | X |  |  |  |
| 2. | Random variable, determining the distributions of random variables of discrete and continuous type; determining the parameters of these distributions | X |  |  |  |
| 3. | Examples of applications of discrete and continuous distributions. | X |  |  |  |
| 4. | Building detailed or interval statistical series, creating histograms, determining and interpreting the basic parameters of the empirical distribution of the examined feature. | X |  |  |  |
| 5. | Determining confidence intervals for the mean value, variance and standard deviation as well as the structure index. Determination of the necessary number of measurements. | X |  |  |  |
| 6. | Formulating and verifying single-parameter hypotheses. | X |  |  |  |
| 7. | Formulating and verifying two-parameter hypotheses. | X |  |  |  |

3.5 Methods of evaluation of learning outcomes (in relation to particular effects)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Learning outcome | Form of evaluation | | | | | | | |
| Oral exam | Written exam | Project | Test | Homework | Paper  Report | Discussion | Others |
| W1 |  | X |  |  |  |  |  |  |
| W2 |  | X |  |  |  |  |  |  |
| W3 |  | X |  |  |  |  |  |  |
| W4 |  | X |  |  |  |  |  |  |
| W5 |  | X |  |  |  |  |  |  |
| U1 |  | X |  |  |  |  |  |  |
| U2 |  | X |  |  |  |  |  |  |
| U3 |  | X |  |  |  |  |  |  |
| U4 |  | X |  |  |  |  |  |  |
| U5 |  | X |  |  |  |  |  |  |
| K1 |  | X |  |  |  |  |  |  |

3.6. Criteria for assessing the achieved learning outcomes

|  |  |  |  |
| --- | --- | --- | --- |
| Learning outcome | Student receiving a grade 3 is able to: | Student receiving a grade 4 is able to: | Student receiving a grade 5 is able to: |
| W1 | He knows only selected concepts and theorems in the field of probability | He knows all the notions and theorems in the field of probability presented during the classes | Knows and understands all the notions and theorems in the field of probability presented during the classes |
| W2 | He knows only selected methods and computational techniques used in the theory of probability | He knows all the computational methods and techniques used in the theory of probability presented during the course | He knows all the computational methods and techniques used in the theory of probability presented during the course; additionally, he can describe them in detail and justify their meaning |
| W3 | He knows the basic measures of descriptive statistics | He knows the discussed measures of descriptive statistics and is able to interpret some of them | He knows and understands all the discussed measures of descriptive statistics and is able to correctly interpret them |
| W4 | Recognizes the estimated parameters; sometimes it needs help in selecting an appropriate model for the construction of confidence intervals | Correctly recognizes the estimated parameters and is able to choose an appropriate model of the construction of confidence intervals | Correctly recognizes the estimated parameters and is able to choose an appropriate model of the construction of confidence intervals; additionally, it exhaustively justifies the choice of the model and is able to explain what the parameter estimation is |
| W5 | Formulates simple statistical hypotheses and knows the stages of hypothesis verification; sometimes it needs help in selecting the appropriate model to verify a hypothesis on a sample basis | Formulates statistical hypotheses and knows the stages of hypothesis verification; correctly selects a hypothesis verification model based on a sample | Formulates statistical hypotheses and knows the stages of hypothesis verification; correctly selects the appropriate model of hypothesis verification on the basis of a sample, exhaustively justifies his choice |
| U1 | Can correctly use only some of the basic concepts and theorems of probability | Can correctly use all the basic concepts and theorems of the probability theory | Can very efficiently use all the basic concepts and theorems of the probability theory; can justify in detail the subsequent stages of the use of concepts and theorems |
| U2 | He can determine only the simplest discrete probability distributions and only some basic parameters of discrete random variables | Can determine selected discrete probability distributions and basic parameters of discrete and continuous random variables | Can determine selected discrete and continuous probability distributions and basic parameters of discrete and continuous random variables |
| U3 | Can describe the statistical population based on the basic statistical measures | Can describe the statistical population based on the known statistical measures and present the appropriate graphic interpretation | Can describe the statistical population based on the known statistical measures and present the appropriate graphic interpretation; additionally, it extensively interprets the values ​​of the obtained measures |
| U4 | Determines the confidence intervals for unknown values ​​of the parameters of the distribution of the examined feature - for the most basic statistical models | Determines the confidence intervals for unknown values ​​of the parameters of the distribution of the examined feature - for various statistical models and parameters | Determines confidence intervals for unknown values ​​of the parameters of the distribution of the examined feature and determines the necessary number of measurements - for various statistical models and parameters |
| U5 | Can verify a simple statistical hypothesis | Can verify any one- or two-parameter hypothesis | Can verify any one- or two-parameter hypothesis and formulate an answer directly related to the content of the task |
| K1 | He is present at the class and rarely asks questions | In addition, he is active in class, asks for verification of his own ideas of solutions, broadens his knowledge, sometimes reaching for literature | He is very active in classes, and in the case of his own solutions, he discusses their correctness and quality, broadens his knowledge by reading specialist literature |

3.7. Literature

**Basics**

1. J.R. Movellan. *Introduction to Probability Theory and Statistics* [available online]
2. Prasanna Sahoo. *Probability and Mathematical Statistics* [available online]
3. F.M. Dekking, C. Kraaikamp, H.P. Lopuhaa, L.E. Meester. *A Modern Introduction to Probability and Statistics* [available online]

**Supplementary**

1. D.M. Lane at al. *Online Statistics Education: An Interactive Multimedia Course of Study* [available online]
2. Robert Johnson. *Elementary statistics*

4. Student’s workload – balance of credits (ECTS)

|  |  |  |
| --- | --- | --- |
| **Activity** | **Student workload** | |
| **Full time studies** | **Part time studies** |
| **CONTACT HOURS (activities that require direct participation of an academic teacher)** | **23** |  |
| Participation in classes | 23 |  |
| Consultations (min. 10% of hours provided for any form of classes) | 3 |  |
| **STUDENT'S OWN WORK** | **52** |  |
| Independent study on the subject of lectures and completion of homework | 20 |  |
| Self-preparation for other classes than lecture (project etc.) | 10 |  |
| Preparation for evaluation | 10 |  |
| Preparation for evaluation and passing an exam | 12 |  |
| **TOTAL STUDENT WORKLOAD** | **75** |  |
| **Credits (ECTS) for a subject** | **3** |  |

|  |  |
| --- | --- |
| Date of last change | 30.09.2021 |
| Zmiany wprowadził | *Paweł Wlaź* |
| Zmiany zatwierdził |  |