#### Card of course

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| 1. Subject name | Mathematical statistics |

1. Location of the subject in the system of studies

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| --- | --- |
| 1.1. Programme | Management |
| 1.2. Mode of study | Full time studies / ~~Part time studies~~ |
| 1.3. Level of degree | 2 degree |
| 1.4. Profile | Practical |

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| --- | --- |
| 1.5. Specialty | - |
| 1.6. Lecturer responsible for the subject | Paweł Wlaź |

2. general characteristics of course

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| --- | --- |
| 2.1. Connection with a subject group | Directional/practical |
| 2.2. Total credits (ECTS) | 3 |
| 2.3. Language of instruction | English |
| 2.4. Semesters in which the subject is carried out | 2 |
| 2.5. Criterion for selection of listeners | - |

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

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| --- | --- |
| Lp. | Aim of the subject |
|
| C1 | To acquaint students with the concept of probabilistic space, the concept of a random variable and its distribution, as well as the basic probability distributions and their properties |
| C2 | To acquaint students with the basic concepts of mathematical statistics: statistical feature, population, simple random sample, sample statistics, distribution of sample statistics, empirical distribution |
| C3 | To acquaint students with the issue of point and interval estimation, with particular emphasis on various models of interval estimation and the problem of the necessary number of measurements |
| C4 | To familiarize students with the theory of verification of statistical hypotheses and to review the most commonly used one- and two-parameter significance tests, significance tests in correlation and regression analysis, non-parametric tests (randomness, consistency, homogeneity) |

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

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| --- | --- | --- |
| Lp. | Description of learning outcomes | Reference to the learning outcomes |
| After completing the subject, student in the range of **KNOWLEDGE**,can | | |
| W1 | Knows and understands the basic concepts of probability and mathematical statistics | Z2\_W03 |
| W2 | Knows and understands the basic methods and computational techniques used in mathematical statistics | Z2\_W03 |
| W3 | Understands the concept of estimation, recognizes the estimated parameters, is able to choose the appropriate model of the construction of confidence intervals and determine the necessary sample size | Z2\_W03 |
| W4 | Formulates statistical hypotheses, selects correct models for their verification on the basis of a sample, knows the stages of verification of statistical hypotheses | Z2\_W03 |
| After completing the subject, student in the range of **SKILLS**, can | | |
| U1 | Can correctly use the basic concepts of probability and mathematical statistics | Z2\_U03  Z2\_U04  Z2\_U06  Z2\_U10 |
| U2 | Recognizes selected probability distributions of random variables, knows their parameters, can determine the appropriate critical values of the distributions based on statistical tables | Z2\_U03  Z2\_U04  Z2\_U06  Z2\_U10 |
| U3 | Defines research problems and selects an appropriate statistical research scheme | Z2\_U03  Z2\_U04  Z2\_U06  Z2\_U10 |
| U4 | It determines the confidence intervals for unknown values of the parameters of the distribution of the examined feature and determines the necessary number of measurements | Z2\_U03  Z2\_U04  Z2\_U06  Z2\_U10 |
| U5 | Has the ability to verify basic statistical hypotheses and conducts statistical inference | Z2\_U03  Z2\_U04  Z2\_U06  Z2\_U10 |
| After completing the subject, student in the field of **SOCIAL COMPETENCES**, can | | |
| K1 | understand the limitations of his/her knowledge and the need for further education | Z2\_K01 |

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Mode of study | Lecture | Exercises | project | workshops | Lab | Seminar | lectureship | Additional Online  ……….  (form) | Others | **ECTS** |
| **ST** | **15** | **30** |  |  |  |  |  |  |  | **3** |

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

TYPE OF CLASSES: lectures

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| --- | --- | --- | --- | --- | --- |
| Lp. | Content of classes | Form of teaching | | | |
| full time studies | | Part time studies | |
| CLASSES | PLATFORM | CLASSES | PLATFORM |
| 1. | The concept of a probabilistic space, the concept of a random variable and its distribution | X |  | X |  |
| 2. | Basic probability distributions of random variables and their properties | X |  | X |  |
| 3. | Basic concepts of mathematical statistics: statistical feature, population, simple random sample, sample statistics, distribution of sample statistics, empirical distribution | X |  | X |  |
| 4. | Point and interval estimation; confidence interval models for the mean, variance, standard deviation and structure ratio; the necessary number of measurements | X |  | X |  |
| 5. | 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 |  | X |  |

TYPE OF CLASSES: exercises

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Lp. | Content of classes | Form of teaching | | | |
| full time studies | | Part time studies | |
| CLASSES | PLATFORM | CLASSES | PLATFORM |
| 1. | Random variable, determining the distribution of random variables; determining the parameters of these distributions | X |  | X |  |
| 2. | Examples of statistical features; tasks for determining the population, simple random sample, sample statistics; determining the distribution of sample statistics, determining empirical distribution functions | X |  | X |  |
| 3. | Determining confidence intervals for the mean value, variance, standard deviation and the structure index; determining the minimum sample size | X |  | X |  |
| 4. | Formulating and verifying single-parameter and two-parameter hypotheses (mean, variance, fraction) | X |  | X |  |

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

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

3.6. Criteria for assessing the achieved learning outcomes

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| --- | --- | --- | --- |
| 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 in the field of probability and mathematical statistics | He knows all the concepts of probability and mathematical statistics presented during the classes | He knows all the concepts of probability and mathematical statistics presented during classes, understands and explains their meaning |
| W2 | He knows only selected methods and computational techniques used in mathematical statistics | He knows all the computational methods and techniques used in mathematical statistics presented during the course | He knows all the computational methods and techniques used in mathematical statistics presented during the course; additionally describes them in detail and explains their applications |
| W3 | Recognizes the estimated parameters; sometimes it needs help in selecting an appropriate model for the construction of confidence intervals | Correctly recognizes estimated parameters and is able to choose an appropriate model of the construction of confidence intervals; understand the issue of minimum sample size | Correctly recognizes 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 can explain the estimation of parameters and the problem of the necessary number of measurements |
| W4 | 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 hypothesis verification model on the basis of a sample, exhaustively justifies his choice |
| U1 | He can correctly use only some of the basic concepts of the theory of probability and mathematical statistics | Can correctly use all the basic concepts of probability and mathematical statistics learned during the classes | Can efficiently use all the basic concepts of probability calculus and mathematical statistics presented during classes; can justify in detail the subsequent stages of using concepts and explain their meaning |
| U2 | Recognizes only some probability distributions of random variables; needs help in determining the appropriate values of the critical distributions on the basis of statistical tables | Recognizes the known probability distributions of random variables; is able to determine the values of critical distributions on the basis of statistical tables | Recognizes the known probability distributions of random variables, can explain the meaning of the parameters of these distributions; is able to determine the critical values of distributions on the basis of statistical tables |
| U3 | Most often, he is able to define a research problem, but sometimes he needs help in selecting a statistical research scheme | He correctly defines the research problem and selects the appropriate statistical research scheme | Defines the research problem correctly and selects the appropriate statistical research scheme; moreover, it exhaustively justifies its choice |
| U4 | Determines the confidence intervals for the unknown values of the parameters of the distribution of the examined feature in the simplest cases | Determines confidence intervals for unknown values of the parameters of the distribution of the examined feature and in simple cases can determine the minimum sample size | Determines confidence intervals for unknown values of the parameters of the distribution of the examined feature and is able to determine the minimum sample size; can fully explain the correctness of the model selection and the relationship between the sample size and the length of the confidence interval |
| U5 | Formulates simple statistical hypotheses and knows the stages of hypothesis verification; needs help in choosing the right model | Formulates statistical hypotheses and knows the stages of hypothesis verification; correctly selects the appropriate model of hypothesis verification based on a sample | Formulates statistical hypotheses and knows the stages of hypothesis verification; correctly selects the appropriate hypothesis verification model on the basis of a sample, exhaustively justifies his choice |
| 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. 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)

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| --- | --- | --- |
| **Activity** | **Student workload** | |
| **Full time studies** | **Part time studies** |
| **CONTACT HOURS (activities that require direct participation of an academic teacher)** | **45** |  |
| Participation in classes | 45 |  |
| Consultations (min. 10% of hours provided for any form of classes) | 5 |  |
| **STUDENT'S OWN WORK** | **30** |  |
| Independent study on the subject of lectures and completion of homework | 15 |  |
| Preparation for evaluation and passing an exam | 15 |  |
| **TOTAL STUDENT WORKLOAD** | **75** |  |
| **Credits (ECTS) for a subject** | **3** |  |

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| --- | --- |
| Date of last change | 23.03.2022 |
| Zmiany wprowadził | *Paweł Wlaź* |
| Zmiany zatwierdził |  |