# STUDY MODULE DESCRIPTION FORM

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| Name of the module/subject<br>**Statistics for engineers** | | Code<br>**1010341751010349408** |
| Field of study<br>**Mathematics in Technology** | Profile of study (general academic, practical)<br>**(brak)** | Year /Semester<br>**3 / 5** |
| Elective path/specialty<br>**-** | Subject offered in:<br>**Polish** | Course (compulsory, elective)<br>**obligatory** |
| Cycle of study:<br>**First-cycle studies** | Form of study (full-time,part-time)<br>**full-time** | |
| No. of hours<br>Lecture: **30** Classes: **-** Laboratory: **30** Project/seminars: **-** | | No. of credits<br>**4** |
| Status of the course in the study program (Basic, major, other)<br>**(brak)** | (university-wide, from another field)<br>**(brak)** | |
| Education areas and fields of science and art<br>**technical sciences** | | ECTS distribution (number and %)<br>**4 100%** |

## Responsible for subject / lecturer:

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## Prerequisites in terms of knowledge, skills and social competencies:

| | | |
|---|---|---|
| 1 | **Knowledge** | 1.Student knows the basic concepts of probability theory (random variable, probability function, density function, distribution function, expected value of a random variable, the variance of the random variable)<br>2.Student knows the basic probability distributions of discrete random variables and density of continuous random variables.<br>3.Student knows the concepts of two-dimensional random variable, the correlation coefficient of random variables, dispersion matrix.<br>4.Student knows the basic concepts of linear algebra.<br>5.Student knows the basic concepts of mathematical analysis (including in the field of differential and integral calculus) |
| 2 | **Skills** | 1.Student knows how to determine the cumulative distribution function of a random variable<br>2.Student can determine the expected value, variance and standard deviation of the random variable (discrete and continuous)<br>3.Student knows how to calculate the correlation coefficient of random variables.<br>4.Student is able to think logically.<br>5.Students can use the calculator.<br>6.Student is able to operate a computer. |
| 3 | **Social competencies** | The student is aware of the purpose of learning. |

## Assumptions and objectives of the course:

The aim of the course is to acquaint students with selected issues of statistical inference and the introduction into the environment program of the statistical calculations and visualize the results of R, as well as acquiring the ability to apply knowledge using statistical program R in the technique.

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

### Knowledge:

1. Student knows the basic sample statistics. Student knows the basic theorem of mathematical statistics ? sampling distribution of the mean (Central Limit Theorem) - [K_W03]

2. Student has a basic knowledge of statistical inference: the estimation theory; the theory of statistical hypothesis testing; the theory of regression analysis. Student knows the ways of the use of known statistical methods in technical sciences. - [K_W09]

3. Student knows the basics of software for statistical computing and visualization (R). Student knows the ways of their use in solving technical problems. - [K_W09]

| **Skills:** |
|---|
| 1. Student is able to analyze and interpret statistical data. Student knows how to use the statistical characteristics of the population and their counterparts from the sample. - [K_U17 ] |
| 2. Knows how to make a data visualization. (Also using the program R) - [K_U05] |
| 3. Sudent knows how to lead a simple statistical inference in respect of: - point and interval estimation of parameters - parametric hypothesis testing - nonparametric hypothesis testing - correlation analysis - regression analysis (Also using the program R) - [K_U17] |
| **Social competencies:** |
| 1. Student knows the limitations of their knowledge and understands the need for further education - [K_K01] |
| 2. Student is able to think and work in a creative way. Student understands the need to work systematically on all tasks. - [K_K03] |

| **Assessment methods of study outcomes** |
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| -Lecture: |
| Valuation of knowledge and skills during written completion of lectures. |
| -Laboratory: |
| Assessment of the knowledge and skills based on a test conducted in the middle and at the end of the semester. |
| **Course description** |

1.Population and sample.
Empirical distribution.
Position and dispersion measures
Distributions of sample statistics
The Central Limit Theorem.
Boxplots, Violin plots, Pie Charts, histograms.
2.Estimation (point and interval)
3.Hypothesis testing
Hypotheses testing of the expected value (mean)
Hypotheses testing of variance
Hypotheses testing of proportion
4.Comparison of two populations
Tests for two expected values (means)
Test for two variances
Tests for the two fractions
5.Correlation
The correlation coefficient of the sample. Testing the correlation coefficient. Test for two correlation coefficients. Spearman rank correlation coefficient. Kendall's rank correlation coefficient.
6.Regression
Testing the significance of the regression coefficient
Analysis of variance in regression
Confidence intervals in regression analysis, Curves confidence
7.Analysis of variance
Experimental factor. Experimental treatment. Experimental Unit.
Completely random design.
A one-way classification model
8.Tests for multiple comparisons (t-test (Fisher method), Tukey - test , Scheffe? -test)
9.Nonparametric tests (independence test, chi-squared test, tests for randomness)
10. Subject complementary: Generalized linear models
11. Introduction to the environment R. Carry out the above statistical analyses using R. The visualization of data using R.

Applied methods of education:
a) lectures:
- lecture with multimedia presentation supplemented by examples given on the blackboard
- Interactive lecture with questions to students
- Presenting a new topic preceded by a reminder of related content known to students from other subjects
b) laboratories:
- Use of tools to enable students to perform tasks at home (program R)
- Presenting a new topic preceded by a reminder of related content known to students from other subjects

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## Basic bibliography:

1. D. Bobrowski, (1986) Probabilistyka w zastosowaniach technicznych, Wydawnictwo Naukowo Techniczne.
2. D. Bobrowski, K. Maćkowiak-Łybacka, (2006) Wybrane metody wnioskowania statystycznego, Wydawnictwo Politechniki Poznańskiej.
3. J. Koronacki, J. Melniczuk (2001) Statystyka dla studentów kierunków technicznych i przyrodniczych. WNT, Warszawa.
4. W. Kordecki (2010) Rachunek prawdopodobieństwa i statystyka matematyczna, Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS.
5. H. Jasiulewicz, W. Kordecki, (2003) Rachunek prawdopodobieństwa i statystyka matematyczna, Przykłady i zadania Oficyna Wydawnicza GiS.
6. T. Górecki (2011), Podstawy statystyki z przykładami w R, Wydawnictwo BTC.
7. D.A. MacQuarrie, (2005) Matematyka dla przyrodników i inżynierów I i II, WN PWN.

## Additional bibliography:

1. R. Kala, (2005) Statystyka dla przyrodników, Wydawnictwo Akademii Rolniczej w Poznaniu.
2. H. Chudzik, H. Kiełczewska, I. Mejza, (2006) Statystyka matematyczna w przykładach i zadaniach, Wydawnictwo Akademii Rolniczej w Poznaniu.
3. R. L. Scheaffer, J. T. McClave (1995) Probability and Statistics for Engineers, Duxbury.

| **Result of average student's workload** | |
|---|---|
| **Activity** | **Time (working hours)** |
| 1. participation in lectures (15 x 2h.) | 30 |
| 2. participation in laboratory classes (15 x 2h.) | 30 |
| 3. participation in the consultations related to the implementation of the education process, in laboratory (2 x 2h) | 4 |
| 4. completion (own work) reports on laboratory exercises: (13 x 1h). | 13 |
| 5. . prepare for the test and participate in the colloquium (6h. + 4h) | 10 |
| 6. familiarization with the indicated literature / teaching materials (11h) | 11 |
| 7. preparing to pass the course and participation in completion of lectures: (10h. + 2h) | 12 |

| **Student's workload** | | |
|---|---|---|
| **Source of workload** | **hours** | **ECTS** |
| Total workload | 110 | 4 |
| Contact hours | 70 | 3 |
| Practical activities | 43 | 2 |