COURSE DESCRIPTION CARD - SYLLABUS

Course name
Regression models [S1MNT1>MR]

Course

Field of study
Mathematics of Modern Technologies

Year/Semester
4/7

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
15

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Probability theory, mathematical statistics, multivariate statistics, matrix algebra, basic skills in R.

Course objective

The aim of the course is to introduce students to statistical learning methods based on regression models.

Course-related learning outcomes

Knowledge:
• the student knows and understands to an advanced degree selected branches of mathematics and has detailed knowledge of the applications of mathematical methods and tools in engineering and technical sciences [K_W01(P6S_WG)];
• the student knows and understands the concepts, theorems and methods for mathematical modeling [K_W02(P6S_WG)];
• the student knows and understands issues in computer science, including numerical methods; knows at least one software package or programming language [K_W07(P6S_WG)];
• the student nows and understands to an advanced degree the techniques for making measurements, acquiring, processing and analyzing data or signals [K_W08(P6S_WG)].

Skills:
• the student is able to use the knowledge of higher mathematics [K_U01(P6S_UW)];
• the student is able to build and analyze simple mathematical models [K_U02(P6S_UW)];
• the student is able to apply modern technologies to solve mathematical and engineering problems [K_U05(P6S_UW)];
• the student is able to apply mathematical tools to support and develop modern technologies used in engineering and technical sciences [K_U06(P6S_UW)];
• the student is able to formulate an engineering problem, conduct a detailed study using analytical or simulation or experimental methods, interpret the results obtained and draw conclusions [K_U 07(P 6S_U W)];
• the student is able to select the appropriate method and use the measurement apparatus to perform the measurement of basic measurands; is able to use basic methods of data or signal processing and analysis [K_U09(P6S_UW)];
• the student is able to work individually and in a team, as well as cooperating with others; he/she is able to estimate the time needed to complete the commissioned task; he/she is able to develop and implement a work schedule ensuring that the deadline is met [K_U16(P6S_UO)].

Social competences:
• the student is ready to critically evaluate the level of his/her knowledge in relation to the conducted research in science, natural sciences and engineering [K_K01(P6S_KK)];
• the student is ready to deepen and broaden his knowledge to solve newly created technical problems [K_K02(P6S_KK)].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures: final test covering the issues presented on lectures;

Laboratory classes: test covering the issues presented on labs (with the use of R package);

Projects/seminars: preparation and presentation of a project related to the modeling of real data.

Programme content

• multiple regression models - revisited;
• biased estimators;
• nonlinear regression;
• regression in classification;
• growth curve models.

Course topics

• multiple regression models - revisited;
 - estimation of parameters (unbiased estimators);
 - testing significance of regression coefficients;
 - basic criteria of model fit;
• biased estimators;
 - variance-bias trade-off;
 - shrinking estimators;
 - variables selection;
 - cross-validation and bootstrap;
• nonlinear regression;
 - polynomial regression;
 - step and basis functions;
 - regression splines and smoothing;
 - generalized additive models;
• regression in classification;
 - logistic model, multiple regression, and multinomial regression;
 - discriminant analysis;

- generalized linear models;
• growth curve models;
- multivariate multiple regression;
- estimation.

Teaching methods

Lectures: theory presented in connection with the current knowledge of students, presentation of new topic preceded by a reminder of related content, known to students from other subjects;

Laboratory classes: individual and team programming, computational experiments (using R package).

Projects/seminars: advisory role of a teacher regarding the project under preparation.

Bibliography

Basic:
• Hastie, T.J., Tibshirani, R.J., Friedman, J.H. (2016) The elements of statistical learning : data mining, inference, and prediction (2nd edition). Springer.

Additional:
• James, G., Witten, D., Hastie, T., Tibshirani, R. (2021). An Introduction to Statistical Learning with Applications in R (2nd edition). Springer.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00