University of Gdańsk

Subject card

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|---|---|---|---|
| Subject name and code | Mathematical Modelling, PG_00204165 | | |
| Field of study | Informatics | | |
| Date of commencement of studies | October 2026 | Academic year of realisation of subject | 2027/2028 |
| Education level | Bachelor's studies | Subject group | Obligatory subject group in the field of study |
| Mode of study | full-time studies | Mode of delivery | at the university |
| Year of study | 2 | Language of instruction | Polish |
| Semester of study | 3 | ECTS credits | 4.0 |
| Learning profile | practical | Assessment form | exam |
| Conducting unit | | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr Joanna Czarnowska | |
| | Teachers | | |

**Lesson types**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 30.0 | 0.0 | 30.0 | 0.0 | 0.0 | 60 |

E-learning hours included: 0.0

**Learning activity and number of study hours**

| Learning activity | Participation in didactic classes included in study plan | Participation in consultation hours | Self-study | SUM |
|---|---|---|---|---|
| Number of study hours | 60 | 0.0 | 40.0 | 100 |

**Subject objectives**

The objective of the course is to introduce students to selected methods of mathematical modeling, particularly probabilistic methods that serve as an introduction to machine learning, as well as selected numerical algorithms.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [INFPL3_U01] can apply mathematical knowledge to formulate, analyse and solve tasks related to computer science, design and analyze algorithms in terms of their correctness and computational complexity | The student is able to apply mathematical knowledge to model a practical data analysis problem, including parameter estimation and fitting of probability distributions. They can select appropriate tools and critically assess the quality of the results. | [SU2] presentation/project/paper/ report |
| [INFPL3_U04] is able to use the acquired knowledge when creating, running and testing programs using dedicated tools and design patterns | Is able to implement and test a simple statistical or probabilistic model (e.g., parameter estimation, linear regression) using .computing environments. | [SU2] presentation/project/paper/ report |
| [INFPL3_K02] is ready to recognize the importance of knowledge in solving cognitive problems and practical and seeking opinions experts in case of difficulties with independent problem solving | Is able to correct an incorrect or incomplete solution to a problem related to mathematical modeling. | [SK4] test/exam - oral or written |
| [INFPL3_W02] knows and understands advanced concepts in artificial intelligence, formal languages, and numerical methods. | Has general knowledge of probability theory as an introduction to machine learning, particularly covering: discrete and continuous distributions and regression models. Knows basic algorithms for interpolation and approximation. | [SW4] test/exam - oral or written [SW2] presentation/project/paper/ report |

<table>
<tr><td>Subject contents</td><td>1. Discrete and continuous random variables and their parameters. Parameter estimation, model building, and testing. Bayesian inference.<br>2. Modeling multivariate dependencies - multivariate normal distribution. Examples of Monte Carlo approximations and bootstrap methods in modeling distributions and their parameters.<br>3. Selected interpolation and approximation methods, including the least squares problem.<br>4. Basics of regression. Model regularization.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>basics of algebra and mathematical analysis</td></tr>
<tr><td>Assessment methods and criteria</td><td><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>tasks on laboratory</td><td>51.0%</td><td>60.0%</td></tr>
<tr><td>exam</td><td>51.0%</td><td>40.0%</td></tr>
</table></td></tr>
<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>• R.L. Burden, J.D. Faires, Numerical Analysis, Cangag Learning<br>• K. P. Murphy, Machine Learning A Probabilistic Perspective, The MIT Press Cambridge<br>• A modern approach to regresion with R, Simon J.Sheather, Springer<br>• Data Wrangling with R, Bradley C. Boehmke, Springer</td></tr>
<tr><td>Supplementary literature</td><td>W. H. Press, S. A. Teukolsky, W. T. Vetterling, B. P. Flannery, Numerical Recipes: The Art of Scientific Computing</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
</table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>not applicable</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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