University of Gdańsk

Subject card

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|---|---|---|---|
| Subject name and code | Stochastic Processes, PG_00206845 | | |
| Field of study | Mathematics | | |
| Date of commencement of studies | October 2026 | Academic year of realisation of subject | 2026/2027 |
| Education level | Master's studies | Subject group | Obligatory subject group in the field of study<br>Optional subject group<br>Subject group related to scientific research in the field of study |
| Mode of study | full-time studies | Mode of delivery | at the university |
| Year of study | 1 | Language of instruction | Polish |
| Semester of study | 1 | ECTS credits | 5.0 |
| Learning profile | academic | Assessment form | exam |
| Conducting unit | Institute of Mathematics -> Faculty of Mathematics, Physics and Informatics -> Rector | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr Monika Wrzosek | |
| | Teachers | | |

**Lesson types**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 30.0 | 30.0 | 0.0 | 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 | 3.0 | 62.0 | 125 |

**Subject objectives**

The aim of the course is to familiarize students with the basics of the theory of stochastic processes, the construction of the Wiener process and its basic properties, the basics of the theory of martingales and Ito stochastic integral.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [MATMU2_U01] is able to construct mathematical reasoning: prove theorems, formulate, test and refute hypotheses by constructing and selecting counterexamples, choosing, if necessary, methods and tools from various areas of mathematics | The student is able to analyze problems in the theory of stochastic processes, construct correct mathematical arguments, use counterexamples, and apply methods of probability theory and mathematical analysis to solve them. | [SU4] test/exam - oral or written |
| [MATMU2_W01] knows and understands in depth the theory of selected areas of mathematics or related fields, the complex relationships between them and their development trends | The student knows and understands the elements of the theory of stochastic processes, in particular the theorems that are the subject of the lecture along with the appropriate definitions, examples, and proofs. | [SW4] test/exam - oral or written |
| [MATMU2_W03] knows and understands to a deep degree a selected field of theoretical or applied mathematics and is able to understand the formulations of issues in this field that are still at the research stage and knows the connections between issues in this field and other areas of mathematics | The student is familiar with the current state of knowledge in the field of stochastic processes theory, knows what problems contemporary researchers are dealing with, and can identify its connections with other branches of mathematics. | [SW4] test/exam - oral or written<br>[SW1] oral statement/ conversation/discussion |

<table>
<tr><td>Subject contents</td><td>1. Stochastic process: definition, process trajectory, independent and stationary increases, Gaussian process.<br>2. Wiener process: definition, construction sketch.<br>3. Properties of the Wiener process (variation and quadratic variation, continuity and non-differentiability of trajectories)<br>4. Conditional expected value: definition, properties.<br>5. Stopping times. Martingales, submartingales, supermartingales. Doob inequality.<br>6. Ito stochastic integral: construction, basic properties.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Probability theory</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>observation of the student's attitude</td><td>51.0%</td><td>0.0%</td></tr>
<tr><td>final exam</td><td>51.0%</td><td>50.0%</td></tr>
<tr><td>tests</td><td>51.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>1. F. Klebaner, Introduction to Stochastic Calculus with Applications, ICP 2005.<br>2. Z. Brzeźniak, T. Zastawniak, Basic Stochastic Processes, Springer 2005.</td></tr>
<tr><td>Supplementary literature</td><td>1. I. Karatzas, S. E. Shreye, Brownian motion and stochastic calculus, Springer-Verlag, Berlin-Heidelberg-New York, 1988.<br>2. I. I. Gichman, A. W. Skorochod, Wstęp do teorii procesów stochastycznych, PWN, 1968.<br>3. J. Jakubowski, R. Sztencel, Wstęp do teorii prawdopodobieństwa, Script, 2000.<br>4. A. D. Wentzell, Wykłady z teorii procesów stochastycznych, PWN 1980.</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 included</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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