

## Subject card

|                                             |                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                          |                                         |                                     |                                                |            |     |
|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------|-------------------------------------|------------------------------------------------|------------|-----|
| Subject name and code                       | Mathematics for Economics, PG_00178423                                                                                                                                                                                                                                                                                                                                                                                    |                                                          |                                         |                                     |                                                |            |     |
| Field of study                              | Finance and Accounting, Management                                                                                                                                                                                                                                                                                                                                                                                        |                                                          |                                         |                                     |                                                |            |     |
| Date of commencement of studies             | October 2025                                                                                                                                                                                                                                                                                                                                                                                                              |                                                          | Academic year of realisation of subject |                                     | 2025/2026                                      |            |     |
| Education level                             | Bachelor's studies                                                                                                                                                                                                                                                                                                                                                                                                        |                                                          | Subject group                           |                                     | Obligatory subject group in the field of study |            |     |
| Mode of study                               | part-time studies                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          | Mode of delivery                        |                                     | at the university                              |            |     |
| Year of study                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          | Language of instruction                 |                                     | Polish                                         |            |     |
| Semester of study                           | 1                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          | ECTS credits                            |                                     | 6.0                                            |            |     |
| Learning profile                            | academic                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                          | Assessment form                         |                                     | credit                                         |            |     |
| Conducting unit                             | Department of Econometrics -> Faculty of Management -> Rector                                                                                                                                                                                                                                                                                                                                                             |                                                          |                                         |                                     |                                                |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                                                                                                                                                                                                                                                                                                                                                                        |                                                          | mgr Tomasz Jastrzębski                  |                                     |                                                |            |     |
|                                             | Teachers                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                          |                                         |                                     |                                                |            |     |
| Lesson types                                | Lesson type                                                                                                                                                                                                                                                                                                                                                                                                               | Lecture                                                  | Tutorial                                | Laboratory                          | Project                                        | Seminar    | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                                                                                                                                     | 16.0                                                     | 16.0                                    | 0.0                                 | 0.0                                            | 0.0        | 32  |
|                                             | 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                                                                                                                                                                                                                                                                                                                                                                                                     | 32                                                       |                                         | 2.0                                 |                                                | 116.0      | 150 |
| Subject objectives                          | Leveling the knowledge of students and then developing knowledge of mathematical methods necessary for further education. Learning about the possibilities of using mathematical methods in economics. Learning about the principles of calculating the value of capital over time and using them to: determine the value of capital at any time, update the payment sequence at any time, draw up a debt repayment plan. |                                                          |                                         |                                     |                                                |            |     |

| Learning outcomes               | Course outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Subject outcome                                                                                                                                                                                                                                                                                                                                                                                                                                 | Method of verification            |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
|                                 | [ZARZL3_U02] The student can identify problems related to the organization's functioning, its processes, and its relations with the environment and propose adequate solutions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | The student presents quantitative problems related to the functioning of an organization using the tools of linear algebra (in particular systems of equations and matrices) and mathematical analysis tools (in particular, knows and applies the concepts of: function, limit of a function, derivative of a function, monotonicity of a function and local extremum of a function), and knows and applies methods of solving these problems. | [SU4] test/exam - oral or written |
|                                 | [FiRL3_W02] The student has advanced knowledge and understanding of the functioning of the domestic and international financial market and financial instruments and institutions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | The student recognizes and analyzes various models of changes in the value of capital over time using appropriate sequences, thereby describing some aspects of the activities of financial market entities.                                                                                                                                                                                                                                    | [SW4] test/exam - oral or written |
|                                 | [FiRL3_U02] The student can identify, analyze or design adequate solutions to problems in finance and accounting.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | The student presents problems in the field of finance and accounting using the tools of linear algebra (in particular systems of equations and matrices) and the tools of mathematical analysis (in particular, knows and applies the concepts of: function, limit of a function, derivative of a function, monotonicity of a function and local extremum of a function), and knows and applies methods of solving these problems.              | [SU4] test/exam - oral or written |
|                                 | [ZARZL3_W02] To an advanced degree, the student knows and understands the essence and functioning of different types of organizations, their articulations, functional areas and processes, and their connections with the environment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | The student recognizes and analyzes various models of changes in the value of capital over time using appropriate sequences, indicating the significance of these changes for the functioning of the organization and its relations with financial market entities.                                                                                                                                                                             | [SW4] test/exam - oral or written |
| Subject contents                | <p><b>Elements of linear algebra:</b></p> <ol style="list-style-type: none"> <li>1. Matrices: the concept of a matrix, types of matrices, operations on matrices and their properties, determinant of a matrix and its properties, elementary operations on matrices, determining the inverse matrix. Examples of applications of matrices in economic problems.</li> <li>2. Systems of linear equations: matrix form of a system of linear equations, solving systems of linear equations. Examples of systems of linear equations in economic problems.</li> </ol> <p><b>Elements of mathematical analysis:</b></p> <ol style="list-style-type: none"> <li>1. Number sequences: arithmetic and geometric sequences, limits of sequences, convergent and divergent sequences, sequences convergent to the number <math>e</math>.</li> <li>2. Functions of one variable: examples of functional dependencies in economics, limit of a function. Differential calculus of a function of one variable: difference quotient, derivative of a function at a point, geometric interpretation of the derivative, properties of the derivative, higher-order derivatives, monotonicity of a function and the sign of the derivative, necessary and sufficient condition for the existence of a local extremum of a function, the largest and smallest value of a function. Examples of the use of differential calculus in economics.</li> </ol> <p><b>Financial mathematics:</b></p> <ol style="list-style-type: none"> <li>1. Simple interest: capital revaluation, average interest rate, account in hundred and from hundred, simple real discount, simple commercial (bank) discount.</li> <li>2. Compound interest: capital revaluation, equivalence of capitals, equivalence of interest terms, nominal interest rate, effective interest rate, interest intensity, average interest rate, compound real discount, compound commercial discount, condition of equivalence of interest and discount rates. The impact of inflation on the purchasing power of capital: periodic inflation rate, average inflation rate, real value of capital.</li> <li>3. Annuity account: temporary and perpetual annuities, annuities payable in arrears and in advance, deferred annuities, annuities with fixed installments, annuity value at any time.</li> <li>4. Installment repayment of debts: interest and principal payments, debt repayment plan with fixed principal installments and fixed payment amounts, loans with delayed repayment period, cost of debt.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                   |
| Prerequisites and co-requisites |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                   |

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| Assessment methods and criteria                                | Subject passing criteria | Passing threshold                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Percentage of the final grade |
|                                                                | 2 or 3 written tests     | 51.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 100.0%                        |
| Recommended reading                                            | Basic literature         | <div>1. Bażańska T., Nykowska M., <i>Matematyka w zadaniach dla wyższych zawodowych uczelni ekonomicznych</i>, Wydawnictwo Branta 2003</div> <div>2. Podgórska M., Klimkowska J., <i>Matematyka finansowa</i>, PWN, Warszawa 2000.</div> <div>3. Wycinka E., Szreder M. (red.), <i>Zastosowanie metod ilościowych w ubezpieczeniach</i>, Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk 2020 (rozdz. 8-11).</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                               |
|                                                                | Supplementary literature | <div>1. Bednarski T., <i>Elementy matematyki w naukach ekonomicznych</i>, Oficyna Ekonomiczna, Kraków 2004</div> <div>2. Chiang A. C., <i>Podstawy ekonomii matematycznej</i>, PWN, Warszawa 1994</div> <div>3. Krysicki W., Włodarski L., <i>Analiza matematyczna w zadaniach, część I i II</i>, PWN, Warszawa 2003</div> <div>4. Matłoka M. (red), <i>Matematyka dla ekonomistów</i>, Wydawnictwo AE w Poznaniu, Poznań 2000</div> <div>5. Piszczala J., <i>Matematyka i jej zastosowanie w naukach ekonomicznych</i>, Wydawnictwo AE w Poznaniu, Poznań 1998</div> <div>6. Piszczala J., Piszczala M., Wojcieszyn B., <i>Matematyka z zadaniami</i>, PWN, Warszawa 1981</div> <div>7. Sadowski M, Spanily T., <i>Matematyka w zadaniach dla studentów kierunków ekonomicznych</i>, Wydawnictwo UG, Gdańsk, 1999</div> <div>8. Dobija M., Smaga E., <i>Podstawy matematyki finansowej i ubezpieczeniowej</i>, PWN 1995.</div> <div>9. Bieszk-Stolorz B., <i>Matematyka finansowa z arkuszem kalkulacyjnym</i>, CEDEWU, Warszawa 2021.</div> <div>10. Kozubski J., <i>Matematyczne modelowanie wybranych procesów finansowych</i>, Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk, 2002.</div> <div>11. Redo M., Prewszyn-Kwitno P., <i>Matematyka finansowa. Teoria i praktyka</i>, PWN, Warszawa 2021.</div> <div>12. Sobczyk M., <i>Matematyka finansowa</i>, Agencja Wydawnicza Placet, Warszawa 2000.</div> |                               |
|                                                                | eResources addresses     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                               |
| Example issues/<br>example questions/<br>tasks being completed |                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                               |
| Work placement                                                 | Not applicable           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                               |

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