

## Subject card

|                                             |                                                                                                                                                                                                                                                                                                             |                                                          |                                         |                                     |                                                                                                                      |            |     |
|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------|------------|-----|
| Subject name and code                       | Parametric Models, PG_00157331                                                                                                                                                                                                                                                                              |                                                          |                                         |                                     |                                                                                                                      |            |     |
| Field of study                              | Informatics and Econometrics                                                                                                                                                                                                                                                                                |                                                          |                                         |                                     |                                                                                                                      |            |     |
| Date of commencement of studies             | October 2024                                                                                                                                                                                                                                                                                                |                                                          | Academic year of realisation of subject |                                     | 2024/2025                                                                                                            |            |     |
| Education level                             | Master's studies                                                                                                                                                                                                                                                                                            |                                                          | Subject group                           |                                     | Obligatory subject group in the field of study<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                           | 2                                                                                                                                                                                                                                                                                                           |                                                          | ECTS credits                            |                                     | 4.0                                                                                                                  |            |     |
| Learning profile                            | academic                                                                                                                                                                                                                                                                                                    |                                                          | Assessment form                         |                                     |                                                                                                                      |            |     |
| Conducting unit                             | Department of Statistics -> Faculty of Management -> Rector                                                                                                                                                                                                                                                 |                                                          |                                         |                                     |                                                                                                                      |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                                                                                                                                                                                                                                                          |                                                          | dr hab. Beata Jackowska                 |                                     |                                                                                                                      |            |     |
|                                             | Teachers                                                                                                                                                                                                                                                                                                    |                                                          | dr hab. Beata Jackowska                 |                                     |                                                                                                                      |            |     |
| Lesson types                                | Lesson type                                                                                                                                                                                                                                                                                                 | Lecture                                                  | Tutorial                                | Laboratory                          | Project                                                                                                              | Seminar    | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                       | 15.0                                                     | 15.0                                    | 0.0                                 | 0.0                                                                                                                  | 0.0        | 30  |
|                                             | 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                                                                                                                                                                                                                                                                                       | 30                                                       |                                         | 20.0                                |                                                                                                                      | 50.0       | 100 |
| Subject objectives                          | Gaining knowledge about the construction and verification of generalized linear models, especially logistic models. Learning about the possible applications of these models. Acquiring skills in estimating and verifying parametric models based on empirical data and interpreting the obtained results. |                                                          |                                         |                                     |                                                                                                                      |            |     |

| Learning outcomes | Course outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Subject outcome                                                                                                                                                                                                                                       | Method of verification                                                                                              |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
|                   | [liEMU2_K02] The student can communicate freely with the public on specialised topics in the field of computer science and econometrics in and outside the workplace, communicate his knowledge and share his skills through various media. Culturally participates in discussions, is not afraid to ask questions and knows how to give constructive criticism.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | The student understands the need to continuously supplement and deepen acquired knowledge; is prepared to further expand acquired knowledge; is aware of the need to conduct research and the responsibility for its proper implementation.           | [SK2] presentation/project/paper/report                                                                             |
|                   | [liEMU2_U07] The student is able to build advanced formal models of complex economic phenomena and processes, estimate them, carry out their verification and apply them to modeling, forecasting and optimization of resources of economic institutions of varying degrees of complexity, their structure and the course of processes in them.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | The student is able to select the appropriate form of the model for studying various types of phenomena. On the basis of empirical data, the student is able to estimate and verify the learned parametric models and interpret the obtained results. | [SU2] presentation/project/paper/report                                                                             |
|                   | [liEMU2_U06] The student is able to forecast complex economic phenomena and processes at an advanced level and check the properties of the obtained forecasts.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | The student is able to use parametric models to identify cause-and-effect relationships and search for regularities occurring in the analyzed data set.                                                                                               | [SU2] presentation/project/paper/report<br>[SU3] text preparation/written work<br>[SU4] test/exam - oral or written |
|                   | [liEMU2_K03] The student is able to communicate freely with the public inside and outside the workplace, transfer his knowledge and share his skills through various media.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | The student is able to transfer his/her knowledge and share his/her skills in the field of construction, verification and interpretation of parametric models.                                                                                        | [SK2] presentation/project/paper/report<br>[SK3] text preparation/written work<br>[SK4] test/exam - oral or written |
|                   | [liEMU2_U05] The student is able to make a statistical description of basic and detailed economic categories at an advanced level, formulate and verify hypotheses about their formation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | The student is able to identify a research problem, formulate research hypotheses, select and apply appropriate modeling methods to solve the researched problem.                                                                                     | [SU2] presentation/project/paper/report                                                                             |
|                   | [liEMU2_W04] The student has an in-depth knowledge of advanced mathematical, statistical, econometric and IT methods that enable the acquisition, processing and analysis of data reflecting the functioning and growth of the national economy and its components, as well as the phenomena and processes occurring in their environment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | The student knows the principles of construction, verification and application possibilities of generalized linear models, in particular logistic models.                                                                                             | [SW4] test/exam - oral or written<br>[SW2] presentation/project/paper/report<br>[SW3] text preparation/written work |
| Subject contents  | <p><b>Generalized linear models</b></p> <p>Model form: random component, systematic component, a link function connecting random and systematic components. Distribution of the response variable and link function. Canonical link functions for selected distributions. Essence and application possibilities of generalized linear models for response variables: continuous, dichotomous (binary), count, ordinal. Method of estimation model parameters. Stages of model construction (preparation of variables, choice of model form, estimation of model parameters, model verification).</p> <p><b>Logistic model</b></p> <p>Logistic model as a generalized linear model for a qualitative response variable (dichotomous or with more than two categories). Quantitative and qualitative explanatory variables (preparation of variables and method of introduction to the model). The concept of odds and odds ratio. Estimation of model parameters. Statistical inference in logistic regression. Evaluation of the logistic model: assessment of model fit (pseudo-R<sup>2</sup> measures), information criteria, assessment of classification performance (measures based on the confusion matrix and measures based on the ROC curve). Taking into account the interactions of explanatory variables. Interpretation of the resulting model. Use of the binary logistic model to assess the risk of an event depending on the characteristics of the object (e.g. to assess credit risk, insurance risk, unemployment risk). Use of the binary and multinomial logistic model in survey studies to analyze questions with two or more answer variants (e.g. survey of preferences, opinions, satisfaction).</p> |                                                                                                                                                                                                                                                       |                                                                                                                     |

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|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| Prerequisites and co-requisites                                | Statistics/Econometrics - basics of correlation analysis and regression analysis                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                               |
|                                                                | Mathematical statistics - basics of point and interval estimation and hypothesis testing                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                               |
| Assessment methods and criteria                                | Subject passing criteria                                                                                                                       | Passing threshold                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Percentage of the final grade |
|                                                                | Written exam with open questions and tasks                                                                                                     | 51.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 50.0%                         |
|                                                                | Final project – realization a final project in teams in the form of a written study of data analysis results using regression analysis methods | 51.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 50.0%                         |
| Recommended reading                                            | Basic literature                                                                                                                               | <ol style="list-style-type: none"><li>1. Gruszczyński M. (red.), <i>Mikroekonometria. Modele i metody analizy danych indywidualnych</i>, Oficyna Wolter Kluwer business, Warszawa 2010</li><li>2. Jackowska B., <i>Efekty interakcji między zmiennymi objaśniającymi w modelu logitowym w analizie zróżnicowania ryzyka zgonu</i>, "Przegląd Statystyczny", nr 1-2/2011, p. 24-41</li><li>3. Stanisław A., <i>Przystępny kurs statystyki z zastosowaniem STATISTICA.PL na przykładach z medycyny</i>. Tom 2. Modele liniowe i nieliniowe, StatSoft, Kraków 2007 (chapters 6, 21)</li></ol>                                                                                                                                                                                                                                                              |                               |
|                                                                | Supplementary literature                                                                                                                       | <ol style="list-style-type: none"><li>1. Agresti A., <i>Categorical Data Analysis</i>, John Wiley &amp; Sons, New Jersey 2002 (chapters 4-7)</li><li>2. Harrell F.E., <i>Regression Modeling Strategies with Applications to Linear Models, Logistic and Ordinal Regression, and Survival Analysis</i>, Second Edition, Springer 2015</li><li>3. Jong P., Heller G., <i>Generalized Linear Models for Insurance Data</i>, Cambridge University Press, Cambridge 2008</li><li>4. Kleinbaum D.G., <i>Logistic Regression. A Self-Learning Text</i>, Springer-Verlag, New York 1996</li><li>5. McCullagh P., Nelder J. A., <i>Generalized Linear Models</i>, Chapman &amp; Hall, London 1989</li><li>6. Stanisław A., <i>Modele regresji logistycznej. Zastosowania w medycynie, naukach przyrodniczych i społecznych</i>, StatSoft, Kraków 2016</li></ol> |                               |
|                                                                | eResources addresses                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                               |
| Example issues/<br>example questions/<br>tasks being completed |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                               |
| Work placement                                                 | Not applicable                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                               |

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