

Ministry of Education and Science of Ukraine
V. N. Karazin Kharkiv National University

Department of International Economic Relations and Logistics

APPROVED

Director
Education and Research Institute
“Karazin Institute of International
Relations and Travel Business”
Mykola BYSAREVSKYI



27 August 2026

COURSE UNIT WORKING PROGRAMME

ECONOMIC AND MATHEMATICAL MODELLING OF GLOBAL ECONOMIC PHENOMENA

level of higher education: third cycle (educational and research)

field of study: C Social Sciences, Journalism, Information and International Relations

speciality: C1 Economics and International Economic Relations (by specialisation)

educational and research programme: International Economic Relations

specialisation: C1.02 International Economic Relations

course status: compulsory

institute: Education and Research Institute “Karazin Institute of International Relations and Travel Business”

2026/2027 academic year

The Programme was recommended for approval by the Academic Council of the Education and Research Institute "Karazin Institute of International Relations and Travel Business"

27 August 2026, Minutes No. 1

PROGRAMME DEVELOPER: Olena V. Khanova,
PhD in Geography, Associate Professor, Associate Professor of the Department of International Economic Relations and Logistics

The Programme was approved at a meeting of the Department of International Economic Relations and Logistics

Minutes No. 1 dated 26 August 2026

Head of the Department of International Economic Relations and Logistics



Anna ZAITSEVA

The Programme was agreed with the Programme Director of the educational and research programme "International Economic Relations"

Programme Director

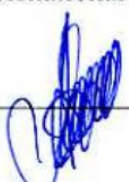


Olena DOVHAL

The Programme was approved by the Academic and Methodological Committee of the Education and Research Institute "Karazin Institute of International Relations and Travel Business",

Minutes No. 1 dated 27 August 2026

Chair of the Academic and Methodological Committee of the Education and Research Institute "Karazin Institute of International Relations and Travel Business"



Hanna PANASENKO

INTRODUCTION

The programme of the academic discipline “Economic and Mathematical Modelling of Global Economic Phenomena” has been developed in accordance with the third-cycle (educational and research) higher education programme in the field of study C Social Sciences, Journalism, Information and International Relations, speciality C1 Economics and International Economic Relations (by specialisation), specialisation C1.02 International Economic Relations, leading to the qualification of Doctor of Philosophy in International Economic Relations.

1. Course Description

1.1. Aim of the Course

The aim of the course “Economic and Mathematical Modelling of Global Economic Phenomena” is to develop third-cycle students’ systematic knowledge and practical skills in applying economic and mathematical methods to the analysis, forecasting and modelling of global economic phenomena, as well as their ability to integrate contemporary statistical and econometric tools into their own research and doctoral projects.

1.2. Principal Learning Objectives

- To acquire the theoretical foundations of economic and mathematical modelling and the methodology for researching global economic processes.
- To master tools for time-series analysis, regression and scenario modelling, clustering and factor analysis.
- To develop practical skills in constructing composite indices and applying them to the assessment of international economic phenomena.
- To develop the ability to integrate statistical, econometric and contemporary computational methods (JASP, Orange, Excel, etc.) into individual research projects.
- To develop competencies in the critical analysis and interpretation of modelling results for doctoral research and academic publications.

1.3. Number of ECTS credits – 7.

1.4. Total study hours – 210

1.5. Course Characteristics
Compulsory
Full-time mode of study
Year of study
1st
Semester
2nd
Lectures
32 hours
Practical and seminar classes
32 hours
Laboratory classes
0 hours
Independent study
146 hours
Individual assignments
0 hours

1.6. Competencies Developed by the Course:

IC. Ability to address complex problems in professional and/or research and innovation activities in the field of international economic relations; to apply the methodology of research and teaching; and to conduct independent research whose results demonstrate scientific novelty and theoretical and practical significance.

GC02. Ability to search for, process and analyse information from various sources.

GC04. Ability to address complex problems on the basis of a systematic scientific worldview, professional ethics and broad cultural awareness.

SC02. Ability to generate new ideas concerning the development of the theory and practice of international economic relations.

SC04. Ability to identify, formulate and address research problems in international economic relations and to evaluate and assure the quality of research undertaken.

SC07. Ability to apply contemporary digital technologies, databases and other electronic resources, as well as specialised software, in research and educational activities in the field of international economic relations.

SC08. Ability to research, analyse and assess integration processes in the world economy and their impact on the development of international economic relations, and to develop strategies for effective participation of countries in international economic groupings, taking into account contemporary trends in globalisation and regionalisation.

1.7. Intended Learning Outcomes Supported by the Course:

LO03. Apply contemporary tools and technologies for searching, processing and analysing information, including statistical methods for analysing large and/or complex datasets, specialised databases and information systems.

LO05. Design, implement and manage research projects that enable complex problems in international economic relations to be addressed and new integrated knowledge to be created, taking into account social, economic, environmental and legal dimensions, on the basis of a systematic scientific worldview and broad cultural awareness, while observing the principles of professional ethics and academic

LO07. Formulate and test hypotheses; use appropriate evidence to substantiate conclusions, including the results of theoretical analysis, empirical research (surveys, observations, etc.), mathematical and/or computer modelling, and available evidence from the literature.

LO08. Plan and conduct theoretical and applied research in international economic relations using contemporary research methods and tools.

LO09. Demonstrate an in-depth understanding of the general principles and methods of economics and of research methodology; apply them in individual research in international economic relations; and critically analyse one's own findings and those of other researchers in the context of the current body of knowledge on the research problem.

LO11. Apply contemporary modelling and forecasting methods using current digital technologies and specialised software to provide scientific justification for, and to confirm or reject, hypotheses.

1.8. Prerequisites:

Research Project Management; Global Challenges in the System of International Economic Relations.

2. Course Content

Topic 1. Methodology of Economic and Mathematical Modelling of Global Economic Phenomena

The nature of economic and mathematical modelling and its role in research. Explanatory, forecasting, optimisation, scenario and simulation models. Problem formulation, hypothesis development and definition of the boundaries of the system being modelled. Selection of variables and modelling methods according to the research question and data structure. Stages in constructing an economic and mathematical model. Model assumptions, limitations, validation, robustness and reproducibility. Requirements for the modelling component of doctoral research. Overview of tools: JASP, Orange Data Mining, gretl, R, Python and Google Colab; Stata, EViews, MATLAB, IBM SPSS Statistics and Statistica as professional software environments.

Topic 2. Preparation of International Data, Exploratory Analysis and Research Reproducibility

Types of economic data: cross-sectional, time-series and panel data. Open statistical resources of the World Bank, IMF, OECD, UNCTAD, WTO, Eurostat and other international organisations. Metadata, units of measurement and cross-country comparability of indicators. Structuring a research dataset. Detection of missing values, outliers and errors. Transformation, normalisation and standardisation of indicators. Descriptive statistics and visualisation of distributions. Correlation analysis and construction of a correlation matrix. Spurious correlations and the limitations of causal interpretation of statistical relationships. Documentation of data sources and processing stages. Tools: Excel, Google Sheets, JASP, R and Python in Google Colab.

Topic 3. Time-Series Modelling and Forecasting of Global Economic Processes

Structure of time series: trend, seasonality, cyclical behaviour and random component. Autocorrelation and partial autocorrelation. Time-series stationarity. ADF and KPSS tests. Trend detection methods. Moving averages and exponential smoothing. ETS and ARIMA models. Selection of forecasting-model parameters. Evaluation of forecast accuracy using MAE, RMSE and MAPE. Prediction intervals and forecast uncertainty. Structural breaks in time series. Cointegration and long-run relationships between economic indicators. Engle–Granger and Johansen tests. Error-correction models. Overview of VAR/VECM and GARCH models. Tools: JASP, gretl, R and Python; overview of EViews and Stata capabilities.

Topic 4. Regression and Panel Data Models in International Economic Research

Simple and multiple linear regression. Dependent and independent variables. Parameter estimation by ordinary least squares. Interpretation of regression

coefficients. Statistical hypothesis testing. t-test, F-test, coefficient of determination and adjusted coefficient of determination. Multicollinearity, heteroskedasticity and autocorrelation. Model specification errors. Robust standard errors. Structural features of panel data. Fixed-effects and random-effects models. Hausman test. Endogeneity and the limits of causal interpretation of regression results. Overview of instrumental variables and difference-in-differences methods. Tools: JASP and gretl; R, Python, Stata and EViews for advanced modelling.

Topic 5. Cluster Analysis in the Study of Global Economic Phenomena

The nature and purposes of cluster analysis. Typological classification of countries, regions, markets and other economic entities. Selection of indicators for clustering. Data normalisation and standardisation. Choice of distance metric. Influence of outliers on clustering results. Hierarchical clustering. k-means method. DBSCAN. Fuzzy clustering. Clustering as an unsupervised machine-learning method. Determining the optimal number of clusters. Elbow method and silhouette coefficient. Assessment of the stability of the clustering solution. Construction of cluster profiles and their substantive interpretation. Dendrograms, maps and other methods of cluster visualisation. Tools: JASP, Orange Data Mining, R and Python; overview of Statistica capabilities.

Topic 6. Factor Models and Dimensionality Reduction of Multivariate Data

The nature and purposes of factor analysis. Latent factors and observed indicators. Principal component analysis and exploratory factor analysis. Differences between PCA and EFA. Requirements for the input data. Kaiser–Meyer–Olkin measure and Bartlett’s test of sphericity. Determining the number of factors. Eigenvalues, scree plot and parallel analysis. Factor loadings and communalities. Orthogonal and oblique factor rotation. Varimax and Promax methods. Calculation of factor scores. Substantive naming and interpretation of factors. Overview of confirmatory factor analysis. Use of factor analysis to determine weights and construct composite indices. Tools: JASP, Orange Data Mining, R and Python; overview of IBM SPSS Statistics and Statistica capabilities.

Topic 7. Methodology for Constructing and Validating Composite Indices

The concept of a composite index and its role in international economic research. Theoretical justification of the phenomenon being assessed. Development of a system of indicators. Verification of indicator availability, comparability and informational relevance. Stimulant and destimulant indicators. Normalisation methods: min–max, z-score standardisation and relative deviations. Weighting methods: equal, expert-based, entropy-based and factor-based weights. Additive and geometric aggregation of indicators. Compensability of a composite index. Construction of rankings and typological classification of entities. Sensitivity analysis with respect to the normalisation method, weights and aggregation method. Assessment of ranking robustness. Internal and external validation of the index.

Examples of international composite indices. Tools: Excel, Google Sheets, JASP, R and Python in Google Colab.

Topic 8. Scenario and Simulation Modelling, Sensitivity Analysis and Robustness of Results

The nature and purpose of scenario modelling. Qualitative and quantitative assumptions underlying scenario development. Baseline and alternative scenarios for global economic phenomena. What-if analysis methods. Stress testing of economic systems and processes. One-way and multi-way sensitivity analysis. Monte Carlo simulation. Distributions of input parameters and modelling outcomes. Assessment of uncertainty. Integration of regression, dynamic, cluster, factor and index models in doctoral research. Comparison of alternative model specifications. Robustness testing of results. Documentation of assumptions, algorithms and calculations. Reproducible presentation of modelling results. Overview of network, input–output and CGE models, and machine-learning forecasting algorithms. Tools: Excel, Google Sheets, R and Python in Google Colab; overview of Stata, EViews and MATLAB capabilities.

3. Course Structure

Sections and topics	Number of hours					
	total	including				
		lect.	prac.	lab.	indiv.	ind. study
Topic 1. Methodology of Economic and Mathematical Modelling of Global Economic Phenomena	26	4	4			18
Topic 2. Preparation of International Data, Exploratory Analysis and Research Reproducibility	26	4	4			18
Topic 3. Time-Series Modelling and Forecasting of Global Economic Processes	26	4	4			18
Topic 4. Regression and Panel Data Models in International Economic Research	26	4	4			18
Topic 5. Cluster Analysis in the Study of Global Economic Phenomena	26	4	4			18
Topic 6. Factor Models and Dimensionality Reduction of Multivariate Data	28	4	4			20
Topic 7. Methodology for Constructing and Validating Composite Indices	26	4	4			18
Topic 8. Scenario and Simulation Modelling, Sensitivity Analysis and Robustness of Results	26	4	4			18
Total hours	210	32	32			146

4. Practical Class Topics

No.	Topic	Number of hours
1-2	Justification of the design of an economic and mathematical study and development of a conceptual model framework	4
3-4	Compilation, preparation and exploratory analysis of international economic data	4
5-6	Time-series modelling and forecasting of a global economic indicator	4
7-8	Construction, diagnostic checking and interpretation of a regression or panel data model	4
9-10	Application of cluster analysis to the typological classification of countries, regions or markets	4
11-12	Application of principal component analysis and factor analysis to identify latent determinants	4
13-14	Construction and validation of an original composite index	4
15-16	Development of a scenario model and assessment of the sensitivity and robustness of results	4
	Total	32

5. Independent Study Assignments

No.	Type and content of independent study	Number of hours
1-4	Independent Study Assignment 1. Collection, systematisation and preparation of international economic data. Select indicators in accordance with the subject of the doctoral research. Collect data from open statistical resources of the World Bank, IMF, OECD, UNCTAD, WTO, Eurostat and other international organisations. Check metadata, units of measurement and the time boundaries of comparability. Identify missing values, outliers and errors. Transform, normalise or standardise indicators. Calculate descriptive statistics, produce visualisations and construct a correlation matrix. Prepare a variable codebook specifying data sources and processing stages.	36
5-6	Independent Study Assignment 2. Modelling dynamics and forecasting economic indicators. Select one or more time series related to the subject of the doctoral research. Analyse trend, seasonality, cyclical behaviour and structural changes. Test for stationarity. Construct at least two forecasting models and compare their accuracy using MAE, RMSE or MAPE. Produce forecasts and prediction intervals. Test related time series for cointegration where a sufficient number of observations is available.	18
7-8	Independent Study Assignment 3. Construction and diagnostic checking of a regression or panel data model. Define the dependent variable and theoretically justified explanatory factors. Construct a baseline model and test the statistical significance of its parameters. Diagnose multicollinearity, heteroskedasticity, autocorrelation and specification errors. Apply robust standard errors where necessary. For panel data, estimate fixed-effects and random-	18

	effects models and conduct the Hausman test. Interpret the results with due regard to the limitations of causal analysis.	
9-12	Independent Study Assignment 4. Cluster and factor analysis of multivariate economic data. Compile a set of indicators for a group of countries, regions, markets or other economic entities. Standardise the source data. Conduct hierarchical clustering and k-means clustering, or another justified clustering method. Determine the number of clusters, assess their stability and construct substantive cluster profiles. Test the suitability of the data for factor analysis. Determine the number of factors, analyse factor loadings and calculate factor scores. Compare the results of cluster and factor analysis.	38
13-14	Independent Study Assignment 5. Construction and validation of an original composite index. Provide a theoretical justification of the phenomenon being assessed and develop a system of indicators. Classify indicators as stimulants or destimulants. Select and apply a normalisation method. Determine weights using an expert or statistical method. Aggregate the indicators and construct a ranking of the entities under study. Test the sensitivity of the results to changes in the normalisation method, weights and aggregation method. Conduct external validation of the index against relevant international indicators.	18
15-16	Independent Study Assignment 6. Development of a scenario model and robustness testing of results. Select a model or system of indicators related to the doctoral research. Develop a baseline and alternative scenarios. Justify quantitative assumptions concerning changes in the factors. Conduct sensitivity analysis and stress testing. Apply Monte Carlo simulation where the method is appropriate to the task. Compare scenario results and assess their uncertainty and robustness. Document the algorithm, source data, assumptions and software used.	18
	Total	146

6. Individual Assignments

Not provided for in the curriculum.

Individualisation of learning is ensured through practical assignments and independent study based on the subject matter of each student's doctoral research.

7. Teaching and Learning Methods

Teaching and learning methods in the course “Economic and Mathematical Modelling of Global Economic Phenomena” are designed to develop students’ ability to select, apply and critically evaluate modelling methods independently, in accordance with the research question, data structure and objectives of the doctoral thesis. Course content is addressed through a combination of problem-based teaching, research assignments, computer modelling and analysis of empirical research findings.

Lectures employ problem-based and explanatory-illustrative methods, guided discussion, comparative analysis of methods and demonstrations of calculation algorithms using international statistical data. Theoretical concepts are considered in relation to specific research situations, including model selection, testing of model assumptions, diagnostic checking, accuracy assessment and identification of the limits of interpretation. Examples from academic publications are used to critically examine model specification, methodological justification and the reliability of conclusions.

Practical classes take the form of research workshops using case studies, standard and problem-solving tasks, computer experiments and modelling with real-world data. The work involves reproducing an algorithm step by step on a teaching dataset, independently selecting model parameters, checking the results obtained and applying the method to data relevant to the doctoral research. Analytical presentations, peer review of calculations and evidence-based comparison of alternative models are used to discuss the results.

8. Assessment Methods

The following assessment methods are used in the course:

- continuous assessment is conducted during practical classes and on the basis of independent study through oral questioning, review of source data, calculation files and developed models, as well as oral defence of the results obtained;
- final assessment is conducted as an examination test on the Moodle platform and covers the entire course. The test consists of 40 questions, each with one correct answer and worth 1 mark.

9. Marking Scheme

Continuous assessment and independent study								Total	Examination	Total
T1	T2	T3	T4	T5	T6	T7	T8	60	40	100
7		9	10	16		9	9			

T1, T2, etc. – course topics.

Continuous assessment – 60 marks, comprising:

- Independent Study Assignment 1. Collection, systematisation and preparation of international economic data – 7 marks;
- Independent Study Assignment 2. Modelling dynamics and forecasting economic indicators – 9 marks;
- Independent Study Assignment 3. Construction and diagnostic checking of a regression or panel data model – 10 marks;
- Independent Study Assignment 4. Cluster and factor analysis of multivariate economic data – 16 marks;
- Independent Study Assignment 5. Construction and validation of an original composite index – 9 marks;
- Independent Study Assignment 6. Development of a scenario model and robustness testing of results – 9 marks.

Final assessment – 40 marks (40 test questions × 1 mark).

A student is eligible to take the final semester assessment for the course provided that they have obtained at least 25 marks in continuous assessment.

Assessment Criteria

The assessment criteria for all types of assignments (continuous and final assessment) are provided in the relevant sections of the Moodle course: <https://moodle.karazin.ua/course/view.php?id=2770>

Use of artificial intelligence technologies. The use of AI in this course is governed by the V. N. Karazin Kharkiv National University Policy on the Use of Artificial Intelligence and the University Code of Academic Integrity.

When preparing practical and research assignments, the “AI as an assistant” model may be used to search for and systematise information, conduct preliminary source selection, explain complex concepts, structure the work, generate ideas and assist with language editing. Materials obtained in this way are supplementary. The final text, calculations, argumentation, analysis, interpretation of results, conclusions and decisions must be produced independently by the student. AI-generated

responses are not academic sources, and the student is responsible for the accuracy of all information, references and results presented.

The use of AI is prohibited during oral questioning, examinations and other assessment activities. The exception is where the lecturer explicitly specifies tasks that require the “AI as a tool” model for data analysis, creation of visualisations, comparison of outputs from different models or educational experiments. The conditions and permitted scope of its use are communicated before the task begins.

Every written assignment must include a statement on the use of AI. If such technologies were not used, the following statement must be included: “Artificial intelligence technologies were not used in completing this assignment.” Otherwise, the student must state the name of the service or model, the date, the nature of the assistance received and the elements of the work for which it was used. At the lecturer’s request, the student must provide the prompts used, generated responses, intermediate materials, source data or calculation files.

To verify that the work was completed independently and that the required practical skills have been developed, the lecturer may conduct additional oral questioning or ask the student to explain the sequence of actions, reproduce a calculation, process data, create a visualisation or demonstrate the use of the relevant digital tool. The results of this verification are taken into account in assessment. Automated AI-detection tools are used only as supplementary information.

Properly declared use of AI within the permitted limits does not affect the mark. Undeclared or prohibited use, submission of generated material as the student’s own work, or inability to demonstrate independent completion of the main part of an assignment constitutes grounds for awarding 0 marks and requiring the assignment to be resubmitted. The decision is based on the full body of verification evidence, in accordance with the assessment criteria and the University’s internal regulations.

Grading Scale

Total marks for all learning activities during the semester	Grade on the four-level grading scale
90 – 100	excellent
70 – 89	good
50 – 69	satisfactory
0 – 49	unsatisfactory

Recognition of Non-formal Learning

Students may receive additional marks for learning outcomes achieved through non-formal learning, provided that these are substantively aligned with the subject matter of the course and its intended learning outcomes. Eligible activities may include online courses on leading educational platforms (Coursera, Prometheus and others), certified training courses, seminars, professional education programmes,

and learning activities organised by higher education institutions, international organisations, professional associations and other recognised institutions.

For non-formal learning outcomes to be considered for recognition, the student must provide documentary evidence of successful completion of the relevant course, training programme or other learning activity. Students are advised to agree the choice of activity with the lecturer in advance in order to establish its correspondence with the course content, the volume of material covered and the learning outcomes specified in this working programme.

Each application for recognition of non-formal learning outcomes is considered individually. Recognition is carried out in accordance with the Procedure for Recognition of Learning Outcomes Obtained through Non-formal Education at V. N. Karazin Kharkiv National University. The decision on recognition is made by the Academic and Methodological Committee of the Education and Research Institute “Karazin Institute of International Relations and Travel Business” on the basis of the documentation submitted by the student.

The number of marks that may be awarded for non-formal learning is determined with reference to the content, volume and level of the learning outcomes achieved. Irrespective of the number of additional learning activities, the total continuous-assessment mark, including recognised non-formal learning outcomes, may not exceed 60 marks.

10. Recommended Reading

Core Reading:

1. Khanova O. V. Moodle course “Economic and Mathematical Modelling of Global Economic Phenomena”. URL: <https://moodle.karazin.ua/course/view.php?id=2770>
2. Kapustian V. O., Mazhara H. A., Chernousova Zh. T. Modelling of Socio-Economic Systems and Processes: Lecture Notes: Teaching Manual [Electronic resource]. Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2024. 84 p. URL: <https://ela.kpi.ua/handle/123456789/67213> (accessed 18 August 2026).
3. Wickham H., Çetinkaya-Rundel M., Grolemund G. R for Data Science: Import, Tidy, Transform, Visualize, and Model Data. 2nd ed. Sebastopol : O’Reilly Media, 2023. 576 p. URL: <https://r4ds.hadley.nz/> (accessed 18 August 2026).
4. Hyndman R. J., Athanasopoulos G. Forecasting: Principles and Practice. 3rd ed. Melbourne : OTexts, 2021. URL: <https://otexts.com/fpp3/> (accessed 18 August 2026).
5. Hsiao C. Analysis of Panel Data. 4th ed. Cambridge : Cambridge University Press, 2022. XIX, 516 p. DOI: <https://doi.org/10.1017/9781009057745> .
6. Hair J. F., Black W. C., Babin B. J., Anderson R. E. Multivariate Data Analysis. 8th ed. Hampshire : Cengage Learning EMEA, 2019. 832 p. URL: <https://au.cengage.com/c/multivariate-data-analysis-8e-hair-babin-anderson-black/9781473756540/> (accessed 18 August 2026).

7. James G., Witten D., Hastie T., Tibshirani R., Taylor J. An Introduction to Statistical Learning: with Applications in Python. Cham : Springer, 2023. XV, 607 p. DOI: <https://doi.org/10.1007/978-3-031-38747-0>.
8. OECD, European Union, European Commission, Joint Research Centre. Handbook on Constructing Composite Indicators: Methodology and User Guide. Paris : OECD Publishing, 2008. 162 p. DOI: <https://doi.org/10.1787/9789264043466-en>.
9. Saltelli A., Ratto M., Andres T. et al. Global Sensitivity Analysis: The Primer. Chichester : John Wiley & Sons, 2008. 304 p. DOI: <https://doi.org/10.1002/9780470725184>

Supplementary Reading:

1. Baltagi B. H. Econometric Analysis of Panel Data. 6th ed. Cham : Springer, 2021. XX, 424 p. DOI: <https://doi.org/10.1007/978-3-030-53953-5>.
2. Wooldridge J. M. Econometric Analysis of Cross Section and Panel Data. 2nd ed. Cambridge, MA : The MIT Press, 2010. 1096 p. URL: <https://mitpress.mit.edu/9780262232586/econometric-analysis-of-cross-section-and-panel-data/> (accessed 18 August 2026).
3. Cunningham S. Causal Inference: The Mixtape. New Haven : Yale University Press, 2021. 584 p. URL: <https://mixtape.scunning.com/> (accessed 18 August 2026).
4. Jolliffe I. T., Cadima J. Principal component analysis: a review and recent developments. Philosophical Transactions of the Royal Society A. 2016. Vol. 374, No. 2065. Article 20150202. DOI: <https://doi.org/10.1098/rsta.2015.0202>.
5. Chudik A., Pesaran M. H. Theory and practice of GVAR modelling. Journal of Economic Surveys. 2016. Vol. 30, No. 1. P. 165–197. DOI: <https://doi.org/10.1111/joes.12095>.
6. Gygli S., Haelg F., Potrafke N., Sturm J.-E. The KOF Globalisation Index – revisited. The Review of International Organizations. 2019. Vol. 14. P. 543–574. DOI: <https://doi.org/10.1007/s11558-019-09344-2> .
7. Masini R. P., Medeiros M. C., Mendes E. F. Machine learning advances for time series forecasting. Journal of Economic Surveys. 2023. Vol. 37, No. 1. P. 76–111. DOI: <https://doi.org/10.1111/joes.12429>.
8. Kuhn M., Johnson K. Feature Engineering and Selection: A Practical Approach for Predictive Models. Boca Raton : CRC Press, 2019. URL: <https://bookdown.org/max/FES/> (accessed 18 August 2026).

11. Online Information Resources, Video Lectures and Other Learning Resources

International Statistical Databases

1. World Development Indicators / World Bank. URL: <https://databank.worldbank.org/source/world-development-indicators> (accessed 18 August 2026).
2. IMF Data Explorer / International Monetary Fund. URL: <https://data.imf.org/en/Data-Explorer> (accessed 18 August 2026).
3. UNCTAD Data Hub / United Nations Conference on Trade and Development. URL: <https://unctadstat.unctad.org/> (accessed 18 August 2026).
4. WTO Data Portal / World Trade Organization. URL: <https://data.wto.org/> (accessed 18 August 2026).
5. UN Comtrade Database / United Nations Statistics Division. URL: <https://comtradeplus.un.org/> (accessed 18 August 2026).
6. Trade Map / International Trade Centre. URL: <https://www.trademap.org/> (accessed 18 August 2026). Some functions require registration or a subscription.
7. OECD Data Explorer / Organisation for Economic Co-operation and Development. URL: <https://data-explorer.oecd.org/> (accessed 18 August 2026).
8. Eurostat Data Browser / European Commission. URL: <https://ec.europa.eu/eurostat/databrowser/> (accessed 18 August 2026).
9. ILOSTAT / International Labour Organization. URL: <https://ilostat.ilo.org/data/> (accessed 18 August 2026).
10. Global SDG Indicators Database / United Nations Statistics Division. URL: <https://unstats.un.org/sdgs/dataportal/database> (accessed 18 August 2026).

International Indices and Rankings

11. Human Development Data Center / United Nations Development Programme. URL: <https://hdr.undp.org/data-center> (accessed 18 August 2026).
12. Global Innovation Index / World Intellectual Property Organization. URL: <https://www.globalinnovationindex.org/> (accessed 18 August 2026).
13. KOF Globalisation Index / ETH Zürich. URL: <https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html> (accessed 18 August 2026).
14. Sustainable Development Report and SDG Index / Sustainable Development Solutions Network. URL: <https://dashboards.sdgindex.org/> (accessed 18 August 2026).
15. Worldwide Governance Indicators / World Bank. URL: <https://www.worldbank.org/en/publication/worldwide-governance-indicators> (accessed 18 August 2026).
16. ICT Development Index / International Telecommunication Union. URL: <https://www.itu.int/en/ITU-D/Statistics/Pages/IDI/default.aspx> (accessed 18 August 2026).
17. Digital Decade DESI Visualisation Tool / European Commission. URL: <https://digital-decade-desi.digital-strategy.ec.europa.eu/> (accessed 18 August 2026).

18. Network Readiness Index / Portulans Institute. URL: <https://networkreadinessindex.org/> (accessed 18 August 2026).
19. Environmental Performance Index / Yale University. URL: <https://epi.yale.edu/> (accessed 18 August 2026).
20. Corruption Perceptions Index / Transparency International. URL: <https://www.transparency.org/en/cpi/2025> (accessed 18 August 2026).
21. Global Talent Competitiveness Index / INSEAD, Portulans Institute. URL: <https://www.insead.edu/global-talent-competitiveness-index> (accessed 18 August 2026).

Software and Computing Resources

22. R Project for Statistical Computing. URL: <https://www.r-project.org/> (accessed 18 August 2026). Free software environment.
23. Google Colaboratory. URL: <https://colab.research.google.com/> (accessed 18 August 2026). Free cloud-based environment for working with Python.
24. gretl: Gnu Regression, Econometrics and Time-series Library. URL: <https://gretl.sourceforge.net/> (accessed 18 August 2026). Free software for econometric analysis.
25. JASP Statistical Software. URL: <https://jasp-stats.org/> (accessed 18 August 2026). Free software for statistical and multivariate analysis.
26. Orange Data Mining. URL: <https://orangedatamining.com/> (accessed 18 August 2026). Free platform for visual data analysis, clustering and dimensionality reduction.
27. Microsoft Excel for the Web. URL: <https://www.microsoft.com/en-us/microsoft-365/free-office-online-for-the-web> (accessed 18 August 2026). Free web version; advanced features are available by subscription.
28. Stata Statistical Software. URL: <https://www.stata.com/> (accessed 18 August 2026). Commercial software for regression, panel-data and time-series analysis.
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