Topics for the diploma examination in second-cycle studies

QUANTITATIVE METHODS IN ECONOMICS AND INFORMATION SYSTEMS

1. Definiteness of quadratic forms.
2. Scalar product and its induced norm. Properties. Examples.
3. Orthogonal projection and its properties. Connection to the method of least squares.
4. Convex sets and convex functions. Properties.
5. Selected methods for solving first-order linear differential equations.
6. Selected methods for solving linear differential equations of order >1 with constant coefficients.
7. Ordinary differential equations. Examples of applications in economics.
8. Linear static models for panel data (OLS, RE, FE, BG approaches): estimation, validation, applications.
9. Dynamic linear models for panel data (FE, GMM-dif, GMM-sys, LSDVC): estimation, validation, applications.
10. Limited dependent variable models for panel data (binary choice, ordered choice, censored data, count dependent variable): approaches, estimation, validation, applications.
11. Econometric modeling under violated assumptions of Gauss-Markov theorem.
12. Seasonality of economic phenomena and its consequences for econometric modeling.
13. State space models.
14. Dynamic models of economic processes in equilibrium.
15. Single- and multidimensional modelling of time series generated by nonstationary stochastic processes.
16. Application of linear and nonlinear systems of equations in modelling economic phenomena and scenario forecasting.
17. Traditional vs. agile software development methodologies. Areas and practical applications of both approaches in software engineering.
18. Software quality from the perspective of developers and end-users. Quality assurance methods and the dilemma of the limitations of its objective measurement.

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19. Requirements analysis in the software engineering process. Classification of requirements and methods and outcomes of their elicitation, modeling, and specification.
20. Software acquisition for enterprise business needs. Comparative analysis of main approaches, their advantages and disadvantages.
21. Cost estimation methods for information systems development – an overview and analysis.
22. The role of software maintenance in the system lifecycle. Main types of maintenance activities and key process challenges.
23. The macroeconomic effects of technological shocks and their impact on key macroeconomic variables (output, consumption, investment, the real interest rate, employment, real wages, savings and the inflation rate).
24. The macroeconomic effects of demand shocks and their impact on key macroeconomic variables (output, consumption, investment, the real interest rate, employment, real wages, savings and the inflation rate).
25. Financial crises: their nature, effects, and impact on key macroeconomic variables (output, consumption, investment, the real interest rate, employment, real wages, savings and the inflation rate).
26. Monetary shocks and their impact on key macroeconomic variables (output, consumption, investment, the real interest rate, employment, real wages, savings and the inflation rate).
27. Sectoral shocks, their essence and impact on key macroeconomic variables (output, consumption, investment, the real interest rate, employment, real wages, savings and the inflation rate).
28. Uncertainty shocks and their impact on key macroeconomic variables (output, consumption, investment, the real interest rate, employment, real wages, savings and the inflation rate).
29. Stabilization policy, its objectives and instruments.
30. Models of binary variables (logit, probit): specification, interpretation, diagnostics and applications.

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31. Categorical variable models (ordered and unordered multinomial logit): assumptions, diagnostics, generalizations and applications.
32. The role of parallel lines assumption and independence of irrelevant alternatives in modelling categorical variables.
33. Methods of quasi-experimental data analysis and the legacy of Nobel prize winners: J. Angrist, D. Card and G. Imbens.
34. Treatment effects and local average treatment effect (ATE, LATE) in instrumental variable (IV) analysis, regression discontinuity design (RDD) and difference in differences (DiD).
35. Difference in differences method: data, assumptions, interpretation of results and example applications.
36. Factors influencing the performance of code written in the R programming language.
37. Main data types in the R programming language and their areas of application.
38. Syntactic constructs of programming languages: similarities and differences between R and Python.
39. Data types and data structures used in the Python programming language and their properties.
40. Programming paradigms used in the Python programming language, including the paradigms of procedural and object-oriented programming, with practical examples of their applications.
41. Characteristic function of a random variable. Applications.
42. Multivariate random variables. Joint distribution and marginal distributions.
43. Independence of random variables.
44. Covariance matrix of a multivariate random variable.
45. Conditional distributions and conditional expectation.
46. Multivariate normal distribution and its properties.
47. Transformations of bivariate distributions.
48. Linear ordering (ranking) of objects: definition and methods.
49. Hierarchical structuring (dendrograms): construction and interpretation; cluster extraction by dendrogram cutting.

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50. Taxonomic grouping methods and optimization of clustering results.
51. Principal Component Analysis (PCA) versus Exploratory Factor Analysis (EFA).
52. Correspondence analysis: classical contingency table analysis and applications to other data sets.
53. Confidence intervals: construction of an exact confidence interval based on the central function, construction of an asymptotic confidence interval based on the asymptotic properties of the maximum likelihood estimator (MLE).
54. Sufficient statistic: the concept of a sufficient statistic and minimal sufficient statistic, interpretation, role and examples, factorization criterion.
55. Point estimation: properties and criteria for assessing estimators along with theories enabling identification of these properties, MLE of a parameter and of a function of a parameter, invariance and asymptotic properties of the MLE.
56. Statistical test: evaluation criteria, properties (consistent test, uniformly most powerful test) and methods for constructing statistical test (the idea behind the construction of a uniformly most powerful test; the idea behind the construction of the likelihood ratio test).