MASTER'S DEGREE EXAMINATION

Study major: Quantitative Methods in Economics and Information Systems

1. Discuss the selected method for determining the basis on which a bilinear symmetric form has a diagonal matrix.
2. Define the concept of definiteness of a quadratic form, discuss a selected method of testing definiteness and provide an example of its application in optimization problems.
3. Formulate the definition of a scalar product for a real linear space and the properties of the norm induced by this scalar product. Provide examples.
4. Discuss the Gram-Schmidt Orthogonalization Theorem and illustrate it with an example.
5. Discuss the orthogonal projection and its properties. What is the relation between the orthogonal projection and the Least Squares estimation method?
6. Describe the convex set and convex function. Formulate the Epigraph Theorem and illustrate it with an example.
7. Discuss the first order differential equation and the initial value problem, its solution and interpretation.
8. Discuss the initial value problem of an ordinary differential equation and sufficient conditions for the existence and uniqueness of a solution.
9. Discuss a selected method for solving a first order linear differential equation.
10. What is the stability of a differential equation solution? Provide examples.
11. Discuss the assumption of invariability of a function and present methods allowing to repeal it.
12. Describe the issue of dynamics of economic phenomena and methods of taking it into account in econometric models.
13. How do intertemporal relationships affect error autocorrelation? Discuss the COMFAC restrictions.
14. Discuss the seasonality of economic phenomena and their consequences for econometric modelling.
15. Present the concept of dynamic equilibrium and the ECM model.
16. Discuss the econometric modelling of time series generated by non-stationary stochastic processes.
17. Discuss the "from-general-to-specific" modelling strategy and model/hypothesis nesting.
18. Discuss the vector autoregressive model (VAR) and the cointegrated vector autoregressive model (CVAR).
19. Discuss linear and nonlinear multi-equation models.
20. Present the solution methods for nonlinear systems of equations (econometric models).
21. Discuss the forecasting with multi-equation econometric models and corrections of model structure.

22. Discuss the topic of regressor endogeneity as well as the related econometric problems and estimation strategies.
23. How can enterprises acquire an information system? Outline the advantages and disadvantages of these solutions.
24. Discuss the basic problems of software development.
25. Present the development models used in software development and describe one of them in detail.
26. Compare traditional and agile methods of software development.
27. Discuss the reasons to build and implement new IT systems.
28. Characterize techniques for estimating the cost of software development.
29. Characterize the activities related to the software requirements analysis.
30. Software prototyping: provide a definition, discuss the types and explain when it should be used.
31. Implementation. Typical implementation environments. Selection of the programming language.
32. Software testing: discuss goals, types, techniques, phases.
33. Discuss measures (metrics) of a software process and software product.
34. Present models of quality of a software process, a software product and software usability.
35. Discuss the economic effects of a temporary increase in total factor productivity.
36. Discuss the economic effects of an increase in optimism about the future state of an economy and capital productivity.
37. Discuss the economic effects of a permanent increase in total factor productivity.
38. Discuss the economic effects of a temporary increase in government purchases.
39. Discuss the economic effects of a permanent increase in government purchases.
40. Discuss the economic effects of a decrease in the current capital stock, e.g., due to a natural disaster.
41. Discuss the economic effects of an increase in the rate of time preference (i.e., a change in consumer preferences such that they substitute current consumption for future consumption).
42. Discuss the economic effects of a sectoral shock due to a change in the relative total factor productivity across sectors (or a change in the relative demand for goods across markets).
43. Discuss the economic effects of the financial crisis: the impact on output, consumption, investment, savings, employment, the real interest rate, real wages and the price level.
44. Discuss the optimal response of monetary policy to positive output demand and output supply shocks when there is inflation targeting by the central bank.
45. Present monetary neutrality in a neo-Keynesian economy.
46. Discuss the operation of stabilization monetary and fiscal policy in a neo-Keynesian economy.
47. Discuss the field of microeconometrics as a part of econometrics: microdata, modelling strategy, typical applications.
48. Present methods for measuring classification accuracy in binomial models.

49. Discuss the causes of endogeneity in microeconometric models. How does the method of instrumental variables help in presence of endogeneity?
50. List and briefly characterize at least two methods in microeconometrics for estimating the treatment effect.
51. Provide an example of a randomized controlled trial (RCT) in the social sciences and explain why it allows inference of causal relationships.
52. Discuss the mechanism of matching estimator.
53. List and discuss the application of two selected limited-dependent variables models.
54. Discuss the independence of irrelevant alternatives (IIA) assumption.
55. Compare nested multinomial models with other models of discrete choice.
56. Discuss ordered multinomial models and methods for estimating their parameters.
57. Discuss the regression discontinuity design (RDD) and its applications.
58. Discuss the curse of dimensionality in the context of assumptions of conditional independence and overlap in the assessment of treatment effects.
59. Provide examples of continuous probability distributions and discuss their applications in economic modelling.
60. Provide examples of discrete probability distributions and discuss their applications in economic modelling.
61. State the definition of the characteristic function of a random variable and examples of its application.
62. Discuss the joint and marginal distributions of a multivariate random variable.
63. Discuss the concept of independence of random variables. Present a selected method for determining the distribution of the sum of independent random variables.
64. Discuss the properties of the covariance of random variables. What is the relation between the absence of correlation and independence of random variables?
65. State the definition of a Markov chain and provide examples of Markov chain applications in economic modelling.
66. Discuss the properties of the Poisson process and provide an example of its application in economic modelling.
67. Discuss the properties of the Wiener process and provide an example of its application in economic modelling.
68. Discuss stationary processes.
69. Discuss the concept of a statistical model. Characterize a parametric and nonparametric statistical model.
70. Discuss the concept of sufficient statistics.
71. Present basic qualitative characteristics of estimators.
72. Discuss the most important criteria for assessing the quality of estimators.
73. Discuss the concept of efficiency of an estimator.
74. Discuss the Cramér-Rao inequality.
75. Present basic methods of construction of estimators.
76. Confidence intervals: discuss the concept and construction method (pivotal function method).
77. Statistical tests: discuss the construction and the Neyman-Pearson lemma.
78. Discuss the quality criteria of a statistical test (type I and II errors, power of a test).

79. Present the main differences between unidimensional and multidimensional approaches to poverty measurement
80. Characterize the key aggregate poverty indices.
81. Discuss the concept of measuring the quality of life in the European Statistical System.
82. Characterize and compare the Scandinavian and American concepts of quality of life.
83. List and characterize methods of unpaid household work evaluation.
84. Disposable income and consumption as measures of well-being: key problems in their measurement based on random household surveys.
85. Present concentration curves and coefficients in social policy analysis. Discuss similarities and differences between the Lorenz curve and the Gini coefficient.
86. Discuss Engel curves application in income and consumption analysis, their advantages and disadvantages.
87. Discuss the Leiken index of social policy efficiency: definition, advantages and disadvantages. Present theoretical methods to relax the disadvantages of this indicator.
88. Present the procedure of the poverty line calculation using a fixed share of the median or mean and present its principal advantages and disadvantages.
89. Present directions of outflow of people from employment and characterize their causes.
90. Explain the reasons for differences between the economic unemployment rate and the registered unemployment rate in Poland.
91. Characterize taxonomic methods and present their practical applications.
92. Discuss the substantive and formal criteria for the variable selection in multivariate comparative analysis.
93. Discuss the statistical criteria for the variable selection in multivariate comparative analysis.
94. Discuss measures of object similarity. Explain the differences between measures of object distance and measures of object proximity.
95. Discuss the basic types of transformations of variables in multivariate comparative analysis and the purposes of the transformations.
96. Characterize the methods of linear ordering. Describe the basic groups of these methods.
97. Characterize objects clustering methods and the main groups of these methods.
98. Discuss theoretical differences between factor analysis and principal components analysis. Submit examples of application of both methods.
99. Explain when and why it is justified to use correspondence analysis. Submit two examples of applications.
100. Characterize the discriminant methods and classification methods. Submit examples of application of both groups of methods.

Literature

1. J. D. Angrist, J. S. Pischke, *Mastering Metrics. The Path from Cause to Effect*, Princeton University Press, 2015

2. J. Bartoszewicz, *Wykłady ze statystyki matematycznej*, PWN, Warszawa 1996
3. P. Bocij, A. Greasley, S. Hickie, *Business information systems*, 5th ed., Pearson 2015
4. S. Cunningham, *Causal Inference: The Mixtape*, Yale University Press, 2021; wersja on-line: https://mixtape.scunning.com/
5. S. Dorosiewicz, J. Kłopotowski, D. Kołatkowski, *Matematyka II*, Oficyna Wydawnicza SGH, Warszawa 2003
6. M. Ekes, J. Kłopotowski, *Zbiór zadań z algebry liniowej, cz. II,* wyd. II, BEL Studio, Warszawa 2011
7. L. Gajek, M. Kałuszka, *Wnioskowanie statystyczne*, wyd. 4, WN-T, Warszawa 1999
8. M. Gruszczyński (red. nauk.) *Mikroekonometria. Modele i metody analizy danych indywidualnych*, Wolters Kluwer, Warszawa 2012
9. A. Iwanik, J. K. Misiewicz, *Wykłady z procesów stochastycznych z zadaniami. Część pierwsza: Procesy Markowa*, SCRIPT, Warszawa 2015
10. J. Jakubowski, R. Sztencel, *Rachunek prawdopodobieństwa dla (prawie) każdego*, SCRIPT, Warszawa 2017
11. A. Jaszkiewicz, *Inżynieria oprogramowania*, Helion, Warszawa 2000
12. J. Kłopotowski, *Algebra liniowa*, Oficyna Wydawnicza SGH, wyd. V, 2013
13. J. Kłopotowski, *Rachunek prawdopodobieństwa*, BEL Studio, Warszawa 2011
14. J. Kłopotowski, J. Winnicka, *Równania różniczkowe zwyczajne. Teoria i zadania,* BEL Studio, Warszawa 2017
15. W. Krysicki, L. Włodarski, *Analiza matematyczna*, PWN, Warszawa 2006
16. G. S. Maddala, *Ekonometria*, PWN, Warszawa 2006
17. *Manifest programowania zwinnego*, https://agilemanifesto.org/iso/pl/manifesto.html
18. W. Niemiro, *Statystyka I*, http://dydmat.mimuw.edu.pl/statystyka-i
19. T. Panek (red.) *Statystyka społeczna: procesy społeczne, źródła danych i metody analizy*, Polskie Wydawnictwo Ekonomiczne, Warszawa 2020
20. T. Panek, J. Zwierzchowski, *Statystyczne metody wielowymiarowej analizy porównawczej. Teoria i zastosowania*, Oficyna Wydawnicza SGH, 2013
21. Sacha T., *Inżynieria oprogramowania*, WN PWN, Warszawa 2021
22. S. D. Silvey, *Wnioskowanie statystyczne*, PWN, Warszawa 1978
23. I. Sommerville, *Inżynieria oprogramowania*, WN PWN, Warszawa 2020
24. P. B. Sørensen, H. J. Whitta-Jacobsen, *Introducing advanced macroeconomics*. *Growth and business cycles*, Maidenhead: McGraw-Hill Education, 2010
25. A. Welfe, *Ekonometria*, PWE, Warszawa 2018
26. S. D. Williamson, *Macroeconomics*, Harlow: Pearson Education Ltd., 2018
27. R. Zieliński, *Siedem wykładów wprowadzających do statystyki matematycznej*, PWN, Warszawa 1990; aktualizacja i uzupełnienia 2005, zadania - autor odpowiedzi A. Boratyńska: www.impan.gov.pl/~rziel/7ALL.pdf