

## I COURSE SYLLABUS

<b>1. General information</b>	
Course title	Statistical Modelling of Financial Processes
Full official name of a higher education institution	Sumy State University
Full name of a structural unit	Education and Research Institute for Business Technologies “UAB”. Department of Finance, Banking and Insurance
Course developer	Maryna Brychko, PhD in Economics, Senior Lecturer at the Department of Finance, Banking and Insurance
Cycle/level of higher education	NFQ of Ukraine – 7th level, FQ-EHEA – First Cycle, QFLLL – 6th level
Semester	16 weeks
Credit point/Workload	5 credits ECTS: 150 hours, contact hours – 48 hrs (lectures – 24 hrs; seminars – 24 hrs), private study – 102 hrs
Language of Instruction	English
<b>2. Course outline in relation to curriculum</b>	
Type of Course	Elective
Recommended prerequisites	The student is expected to have the competences in Business and Statistics, Banking Statistics
Additional prerequisites	There are no additional prerequisites
Course restrictions	There are no restrictions
<b>3. Aim of the Course</b>	
This course aims to introduce the basics of the statistical methods and data analytic techniques most relevant and required in the analysis and creating models of financial processes.	
<b>4. Course content</b>	
<p><b>Topic 1. Basic financial data handling.</b> The types of financial data that are commonly used. A brief discussion of the sources from which data can be obtained. An illustration of the types of graphs that are commonly used to present information in a data set. A discussion of simple numerical measures, or descriptive statistics, often presented to summarize key aspects of a data set.</p> <p><b>Topic 2. Financial indicators development and reporting.</b> Establishing the purpose of the financial indicators. Designing the conceptual framework of the financial indicators. Constructing composite financial indicators: data selection, imputation of missing data, multivariate analysis, normalization, weighting and aggregation, robustness</p>	

and sensitivity, back to the real data. Interpreting and reporting of the financial indicators. Maintaining and reviewing the indicators.

**Topic 3. Introduction into correlation analysis.**

Definition, objects and assumption of correlation analysis. Sample correlation coefficient. Understanding correlation through verbal reasoning based on Case study: The correlation between executive compensation and profit. The development of graphical intuition for regression techniques as the fitting of a straight line through an XY-plot. Correlation between several variables. Covariance and population correlation coefficient.

**Topic 4. Introduction to simple regression analysis.**

Definition, objectives and assumptions of regression analysis. The introduction of the regression coefficient as measuring a marginal effect. The description of the OLS estimates as a best fitting line (in terms of minimizing the sum of squared residuals) through an XY-plot. Understanding regression analysis through verbal reasoning based on Case study: The regression of executive compensation on profits (continued from topic 3). Fitted values and  $R^2$ : measuring the fit of a regression model. The introduction of statistical techniques such as confidence intervals and hypothesis tests. Nonlinearity in regression.

**Topic 5. Introduction to multiple regression analysis.**

The introduction of the multiple regression as a best fitting line. Ordinary least squares estimation of the multiple regression model. Understanding multiple regression through verbal reasoning based on Case-study: Explaining house prices. Pitfalls of using simple regression in a multiple regression context of financial processes. Omitted variables bias. Multicollinearity. Multicollinearity illustrated using artificial data.

**Topic 6. Regression with dummy variables.**

Definition, objectives and types of dummy variables in finance, banking and insurance. Simple regression with a dummy variable. Verbal reasoning based on Case-study: The determinants of market capitalization. Multiple regressions with dummy variables. Verbal reasoning based on Case-study: Explaining house prices (continued from topic 5). Multiple regressions with both dummy and non-dummy explanatory variables. Verbal reasoning based on Case-study: Explaining house prices (continued from topic 5 and 6). Interacting dummy and non-dummy variables.

**Topic 7. Regression with lagged explanatory variables.**

Concept of lagged variables in financial process. Understanding regression analysis with lagged explanatory variables through verbal reasoning based on Case-study: The effect of bad news on market capitalization. Selection of lag order.

**Topic 8. Introduction to time series data.**

Common problems and methods in time series analysis. Time series components. Combining time series components. Automatic time series decomposition. Additive decomposition. Multiplicative decomposition. Understanding time series forecasting in Excel.

**5. Course learning objectives**

After completing the course students should be able to:

CLO1.	have a developed knowledge, a good understanding and a good degree of familiarity with the main methodologies and techniques of statistical modelling in the analysis of financial data to solve financial problems.
CLO2.	identify sources, collect analyze the necessary financial information, calculate the indicators and apply different methodological tools to assess the state of financial systems.

CLO3.	carry out computer calculations and simulations for some of the models as covered in the course using statistical software to analyse financial data by various methodologies.
CLO4.	independently and with adequate techniques solve problems, perform calculations and bring the reasoning in the part of statistical modelling of financial processes covered by the course and in oral and writing communicate these solutions, calculations and reasoning with diverse statistical knowledge, appropriately assisted by computer slides.

## 7. Teaching format

### 7.1 Learning activities summary

The course consists of the lectures (L) and computer-based practicals (P).

Topic 1. Basic financial data handling.

L 1. The types of financial data that are commonly used. A brief discussion of the sources from which data can be obtained. An illustration of the types of graphs that are commonly used to present information in a data set.

P 1. Numerical measures, or descriptive statistics, often presented to summarize key aspects of a data set.

Topic 2. Financial indicators development and reporting.

L 2. Establishing the purpose of the financial indicators. Designing the conceptual framework of the financial indicators.

L 3. Constructing composite financial indicators. Interpreting and reporting of the financial indicators. Maintaining and reviewing the indicators.

P 2. Data selection, imputation of missing data, multivariate analysis, normalization, weighting and aggregation, robustness and sensitivity, back to the real data.

P 3. Individual case-based assignment in form of computational and analytical project presentation, reflection and discussion.

Topic 3. Introduction into correlation analysis.

L 4. Definition, objects and assumption of correlation analysis. Sample correlation coefficient. Understanding correlation through verbal reasoning based on Case-study: The correlation between executive compensation and profit. The development of graphical intuition for regression techniques as the fitting of a straight line through an XY-plot. Correlation between several variables. Covariance and population correlation coefficient.

P 4. Computer-based practicals on the development of graphical intuition for regression techniques as the fitting of a straight line through an XY-plot, correlation between several variables, covariance and population correlation coefficient calculation.

Topic 4. Introduction to simple regression analysis.

L 5. Definition, objectives and assumptions of regression analysis. The introduction of the regression coefficient as measuring a marginal effect. The description of the OLS estimates as a best fitting line (in terms of minimizing the sum of squared residuals) through an XY-plot. Understanding regression analysis through verbal reasoning based on Case-study: The regression of executive compensation on profits (continued from topic 3).

L 6. Fitted values and  $R^2$ : measuring the fit of a regression model. The introduction of statistical techniques such as confidence intervals and hypothesis tests. Nonlinearity in regression.

P 5. Computer-based practicals on regression analysis.

P 6. Computer-based practicals on regression analysis.

Topic 5. Introduction to multiple regression analysis.

L 7. The introduction of the multiple regression as a best fitting line. Ordinary least squares estimation of the multiple regression model. Understanding multiple regression through verbal reasoning based on Case-study: Explaining house prices.

L 8. Pitfalls of using simple regression in a multiple regression context of financial processes. Omitted variables bias. Multicollinearity. Multicollinearity illustrated using artificial data.

P 7. Computer-based practicals on multiple regression as a best fitting line, ordinary least squares estimation of the multiple regression model.

P 8. Computer-based practicals on omitted variables bias, multicollinearity in multiple regression analysis.

Topic 6. Regression with dummy variables.

L 9. Definition, objectives and types of dummy variables in finance, banking and insurance. Simple regression with a dummy variable. Verbal reasoning based on Case-study: The determinants of market capitalization. Multiple regressions with dummy variables. Verbal reasoning based on Case-study: Explaining house prices (continued from topic 5). Multiple regressions with both dummy and non-dummy explanatory variables. Verbal reasoning based on Case-study: Explaining house prices (continued from topic 5 and 6). Interacting dummy and non-dummy variables.

P 9. Computer-based practicals on multiple regressions with dummy variables and multiple regressions with both dummy and non-dummy explanatory variables.

Topic 7. Regression with lagged explanatory variables.

L 10. Concept of lagged variables in financial process. Understanding regression analysis with lagged explanatory variables through verbal reasoning based on Case-study: The effect of bad news on market capitalization. Selection of lag order.

P 10. Computer-based practicals on regression analysis with lagged explanatory variables.

Topic 8. Introduction to time series data.

L 11. Common problems and methods in time series analysis. Time series components. Combining time series components. Automatic time series decomposition. Additive decomposition.

L 12. Multiplicative decomposition. Understanding time series forecasting in Excel.

P 11. Computer-based practicals on an automatic time series decomposition, additive decomposition, multiplicative decomposition

P 12. Final-term examination.

## **7.2 Learning methods and activities**

LA 1. Individual case-based assignment in form of computational and analytical project.

LA 2. Group problem-based assignment in form of computational and analytical project.

LA 3. Computer-based practicals with contemporary statistical computer software.

LA 4. Impromptu quizzes, challenges or voting games via online platforms, such as Kahoot!, Quizziz, Quizlet and Socrative.

LA 5. Final-term examination.

## **8. Teaching methods**

The course involves learning through:

TM 1. interactive lectures;

TM 2. computer-based practicals;

TM 3. group problem-based assignment;

TM 4. individual case-based assignment.

Interactive lectures help to develop knowledge, a good understanding and a good degree of familiarity with the main methodologies and techniques of statistical modelling in the analysis of financial data to solve financial problems (CLO 1). Interactive lectures combine «lecture-visualization», «discussion-based lecture» and «case-based lecture» to ensure active students involvement and interaction. Interactive lectures supplemented by computer-based practicals aimed at applying theoretical knowledges into practice for carry out computer calculations and simulations for some of the main methodologies and techniques of statistical modelling as covered in the course using statistical software to analyse financial data to solve financial problems (CLO 1-3). In order to utilize collaborative learning, facilitate the integration of learning, developing students' intrinsic and extrinsic motivation to learn, encourage learner self-reflection and critical reflection, integrate knowledge and practice, and support the development of a variety of learning skills the course implies case-study learning by carrying out individual case-based assignment with oral presentation of the results, discussion, and conclusions of the project (CLO2-4). Group problem-based assignment organizes the problem-solving process into building the problem base, analyzing the problem, synthesizing the findings, and communicating the results. Building the problem base includes choosing, defining, and structuring financial problem analysis is breaking down of a problem into understandable components. Synthesis is the re-integration of the parts in a way that helps better understand the whole. Communication is the translation of results into a form relevant to stakeholders, broadly defined as the extended peer community (CLO2-4).

## 9. Course assessment

### 9.1. Grading scale

Rating scale ECTS	Explanation	Rating a national scale	Rating in scores
A	Excellent performance with small number errors	Perfectly	$90 \leq RD \leq 100$
B	Above average some mistakes	Good	$82 \leq RD < 89$
C	Overall correct fulfillment of certain significant number of errors		$74 \leq RD < 81$
D	Not bad, but with significant number of defects	Satisfactorily	$64 \leq RD < 73$
E	Satisfies minimum criteria		$60 \leq RD < 63$
FX	Unsatisfactorily with the possibility of re-assembly	Unsatisfactorily	$35 \leq RD < 59$
F	Unsatisfactorily with the obligatory repeated course		$RD < 34$

### 9.2 Formative assessment

In classrooms, formative assessment refers to frequent, interactive assessments of student progress and understanding to identify learning needs and adjust teaching appropriately, and includes the following methods:

FA 1: Impromptu quizzes, challenges or voting games via online platforms, such as Kahoot!, Quizziz, Quizlet and Socrative with feedback given for the correct/incorrect answer, including why the answer they selected was correct/incorrect.

FA 2: Turn in a group problem-based assignment in form of computational and analytical project in stages for early feedback.

FA 3: Oral in-class frequent descriptive feedback on individual and group problem-based assignment in form of computational and analytical project, final-term examination.

FA 4: In-class discussions computer-based practicals.

### 9.3 Summative assessment

Assessment of how student fulfills the objectives is achieved through:

SA 1: Individual case-based assignment in form of computational and analytical project – 50%

SA 2: Group problem-based assignment in form of computational and analytical project – 20%

SA 3: Final-term examination – 30%

To pass, the student is required to achieve the expected learning outcomes of the course.

The final grade is determined by home assignments and written final-term examination in the end of the course.

An aggregate final score of at least 60% is required to pass the course.

### 10. Learning resources

<b>10.1 Learning tools</b>	Learning process requires the use of multimedia, video and audio, projection equipment (LT 1), computers, computer systems and networks (LT 2), software packages (LT 3).
<b>10.2 Required reading and additional course material</b>	<p>Required reading:</p> <ol style="list-style-type: none"><li>1. Denis, D. J. (2016). Applied Univariate, Bivariate, and Multivariate Statistics. Hoboken, New Jersey: Wiley. Retrieved from <a href="http://search.ebscohost.com/login.aspx?direct=true&amp;site=eds-live&amp;db=edsebk&amp;AN=1091881">http://search.ebscohost.com/login.aspx?direct=true&amp;site=eds-live&amp;db=edsebk&amp;AN=1091881</a></li><li>2. Stowell, S. (2014). Using R for Statistics. Berkeley, CA: Apress. Retrieved from <a href="http://search.ebscohost.com/login.aspx?direct=true&amp;site=eds-live&amp;db=edsebk&amp;AN=1174344">http://search.ebscohost.com/login.aspx?direct=true&amp;site=eds-live&amp;db=edsebk&amp;AN=1174344</a></li><li>3. Koop, G. (2006). Analysis of Financial Data, Hoboken, New Jersey: Wiley. Retrieved from <a href="https://epdf.pub/analysis-of-financial-data.html">https://epdf.pub/analysis-of-financial-data.html</a></li><li>4. Organisation for Economic Co-operation and Development., European Commission., &amp; SourceOECD (2008). Handbook on constructing composite indicators: Methodology and user guide. Paris: OECD. Retrieved from <a href="https://www.oecd.org/sdd/42495745.pdf">https://www.oecd.org/sdd/42495745.pdf</a></li><li>5. IMF (2019). Financial soundness indicators: A compilation guide. Washington, DC, USA: International Monetary Fund. Retrieved from <a href="https://www.imf.org/en/Data/Statistics/FSI-guide">https://www.imf.org/en/Data/Statistics/FSI-guide</a></li></ol> <p>Recommended supplementary reading:</p> <ol style="list-style-type: none"><li>1. Valaskova, K., Klietk, T., Svabova, L., &amp; Adamko, P. (2018). Financial risk measurement and prediction modelling for sustainable development of business entities using regression analysis. Sustainability, 10(7), 2144.</li><li>2. Giudici, P. (2018). Financial data science. Statistics &amp; Probability Letters, 136, 160-164.</li><li>3. Brychko, M., Polách, J., Kuzmenko, O., &amp; Olejarz, T. (2019). Trust Cycle of the Finance</li></ol>

	<p>Sector and its Determinants: The Case of Ukraine. Journal of International Studies, 12(4), 300-324.</p> <p>Additional web resources:</p> <ol style="list-style-type: none"> <li>1. Balance of Payments Manual. – International Monetary Fund. – URL:  <a href="http://www.imf.org/external/pubs/cat/longres.cfm?sk=157.0">http://www.imf.org/external/pubs/cat/longres.cfm?sk=157.0</a></li> <li>2. External Debt Statistics: Guide for Compilers and Users. – International Monetary Fund. – URL:  <a href="http://www.imf.org/external/russian/pubs/ft/eds/guide/guider.pdf">http://www.imf.org/external/russian/pubs/ft/eds/guide/guider.pdf</a></li> <li>3. Monetary and Financial Statistics Manual. – International Monetary Fund, 2000. – URL:  <a href="http://www.imf.org/external/pubs/ft/mfs/manual/rus/mfsmr.pdf">http://www.imf.org/external/pubs/ft/mfs/manual/rus/mfsmr.pdf</a></li> <li>4. System of National Accounts. – European Commission, International Monetary Fund, Organization for Economic Co-operation and Development, United Nation, World Bank. – URL:  <a href="http://unstats.un.org/unsd/nationalaccount/sna2008.asp">http://unstats.un.org/unsd/nationalaccount/sna2008.asp</a></li> </ol>
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