

## ECONOMIC FORECASTING

<b>Course code</b>	<i>ECO108</i>
<b>Course title</b>	<i>Economic Forecasting</i>
<b>Type of course</b>	<i>Main</i>
<b>Study level</b>	<i>1<sup>st</sup></i>
<b>Department</b>	<i>Bachelor studies</i>
<b>Year of study</b>	<i>4<sup>th</sup></i>
<b>Semester</b>	<i>Autumn</i>
<b>ECTS credits</b>	<i>6: 24 hours of lectures, 24 hours of practice, 2 hours of consultation, 112 hours of self-study</i>
<b>Coordinating lecturer</b>	<i>Dr. Mindaugas Kavaliauskas</i>
<b>Study form</b>	<i>Full-time</i>
<b>Course prerequisites</b>	<i>Econometrics</i>
<b>Language of instruction</b>	<i>English</i>

### Course Annotation

This course is intended to provide a comprehensive introduction to forecasting methods with an emphasis on application of statistical techniques to analysis and prediction of economic time series. Various relevant topics will be covered, such as: simple and multiple regression, basics of statistical hypothesis testing, model building and evaluation, criteria of forecast accuracy, autoregressive model, testing for stationarity of time series, testing for Granger causality by classical (1969) and Toda-Yamamoto (1995) methods, time series decomposition, seasonality and trend, exponential smoothing, autoregressive integrated moving average (ARIMA) model, Hyndman-Khandakar (2008) method for choosing ARIMA model order, time series intervention analysis by ARIMAX model. Practical examples having real-world relevance will be provided and students will be involved with hands-on experience of modelling and forecasting. Assignments will be solved using R.

### Aims of the course

The course is aimed at the students who need to have a basic knowledge of methods for time series analysis and obtain practical skills of forecasting, with a focus on economic applications.

<b>Subject learning outcomes (SLO)</b>	<b>Study methods</b>	<b>Assessment methods</b>
SLO1. Apply various quantitative methods for economic forecasting;	Lectures, practical exercises and assignments, self-study	Midterm exam, practical assignments, individual project, final exam
SLO2. Construct econometric models and describe their structure;	Lectures, practical exercises and assignments, self-study	Midterm exam, practical assignments, individual project, final exam
SLO3. Evaluate accuracy of the forecast and be able to communicate forecasting results;	Lectures, practical exercises and assignments, self-study	Midterm exam, practical assignments, individual project, final exam
SLO4. Distinguish between short-term and long-term forecasting;	Lectures, practical exercises and assignments, self-study	Midterm exam, practical assignments, individual project, final exam
SLO5. Apply econometric software packages to produce forecasts and forecast confidence intervals.	Lectures, practical exercises and assignments, self-study	Midterm exam, practical assignments, individual project, final exam

## Learning methods

The course is taught entirely in English and is designed to achieve its aims through a combination of lectures and practical exercises, as well as assignments and individual project. Exercises and lectures are designed to encourage active participation, co-operative and creative work, interactive communication, as well as critical and statistical thinking.

## Quality issues

The lecturer assures a variety of teaching and learning methods, interim knowledge assessment, and supply of learning material to students, as well as discussions of practical and individual work in class during the course.

## Cheating issues

Individual testing, supervised practical assignments, and individual project ensure studying quality and are forms to prevent cheating. The ISM regulations on academic ethics, including cheating (see, *ISM Bakalauro studijų reglamentas*) are fully applied in the course during the entire semester.

## Weekly course content

Week	TOPIC	IN CLASS-HOURS		READINGS
		Theory	Practice	
1	1. Forecasting perspective: time series, explanatory, judgmental approaches. Forecasting horizon, main steps of forecasting task.	2	2 [ Exercises ]	[1] 1.1-1.7, 3.1-3.8, [2] 1, [3] 1.1, [7] 5.1-5.3
2	2. Quantitative foundations: descriptive statistics, plots, correlation. Basics of statistical hypothesis testing, evaluating obtained p-value.	2	2 [ Exercises ]	[1] 2.1-2.2, 5.7, 4.6; [3] 2.5-2.6
3	3. Data preparation: transformation, outliers, adjustments. Simple forecasting, accuracy, prediction intervals, residual diagnostics.	2	2 [ Assignment 1 ]	[1] 2.3-2.7, [6] 2, [7] 5.4, [10] 3
4	4. Simple regression: intercept, slope, ordinary least squares estimation, goodness-of-fit, statistical inference, forecasting.	2	2 [ Exercises ]	[1] 4.1-4.6, 4.8, [7] 4.1-4.7
5	5. Multiple regression: dummy / spike / step variables, seasonality, trend, distributed lag, forecasting. Explanatory (causal) models.	2	2 [ Exercises ]	[1] 4.7, 5.1-5.2, 5.4-5.5; [2] 6, [7] 4.8-4.12
6	6. Variable and model selection: adjusted $R^2$ , AIC, BIC, CV. Using time series decomposition (trend-seasonal components), additive / multiplicative type, moving averages. Non-linear regression. Intervention, interrupted time series analysis, Chow test.	2	2 [ Assignment 2 ]	[1] 5.3, 5.5, 5.6. 6.1-6.6, [7] 5.5, 7.2
7	MIDTERM EXAM	2	2 [ Exercises ]	
8	7. Exponential smoothing methods and their taxonomy: SES, Holt's linear / exponential / damped trend, Holt-Winters seasonal, ETS.	2	2 [ Exercises ]	[1] 7.1-7.7
9	8. Autoregressive moving average (ARMA) processes. Stationarity of the time series, differencing, testing for unit root, cointegration.	2	2 [ Exercises ]	[1] 8.1-8.4; [2] 14, [3] 1-2, 4, 6
10	9. Regression with ARIMA errors. Basic and seasonal ARIMA variants, few methodologies for model selection. ARIMA vs ETS. ARIMAX model, time series intervention analysis using pulse / step functions.	2	2 [ Assignment 3 ]	[1] 8.5-8.10, [3] 5.1-5.4, [2] 14.5, [8] 4
11	10. Dynamic regression, Multivariate time-series, VAR model, forecasting using VAR. Granger causality testing.	2	2 [Exercises, Consultations]	[1] 8.5-8.10, 9.1-9.2, [2] 16, [3] 5.5-5.6
12	11. Additional topics. Final project presentations. Discussion.	2	2 [ Final Project ]	
Se- ssion	FINAL EXAM	2	-	
Total hours:		24	24	

## Course assignments and assessment of achievements

TYPE	DUE DATE	TOPICS	TOTAL HOURS	EVALUATION, %
Assignment 1	Week 3	1 – 3	10	10
Assignment 2	Week 6	3 – 5	10	10
Midterm Exam	Week 7	1 – 6	25	27
Assignment 3	Week 10	6 – 9	10	10
Final Project	Week 12	1 – 10	20	15
Final Exam	Session	7 – 11	27	28
<b>Total:</b>			<b>112</b>	<b>100</b>

## Course requirements

The course final mark and overall assessment involves 4 tasks, which are described below:

1. Practical **assignments** will count for the **30%** of the final mark. There will be 3 assignments, each worth 10%.
2. A two-hour **midterm exam** in written form, which will include open and multiple-choice questions on the topics discussed during the lectures of the first half of the course. Midterm exam will be held in the middle of the course at the time of a lecture and will count for the **27%** of the final mark.
3. Group **final project** will count for the **15%** of the final mark. The defence of projects will be held during the last week of the course, where students will be encouraged to present their findings in front of a class.
4. A two-hour **final exam** in written form, which will include open and multiple-choice questions on the topics discussed during the lectures of the second half of the course. Final exam will be held in the end of the course at the time of session period and will count for the **28%** of the final mark.

Students must score for all 4 tasks of the semester (midterm exam, practical assignments, individual final project and final exam) at the specified time (see, *Weekly Course Content*). Some postponing (for example, lag of 1 week) is possible for exercises and practical assignments but is not recommended. Postponing of the individual project is impossible and explicit retake of the midterm exam will not be allowed. Only in case of the negative final evaluation student has a possibility of overall retake. Retake exam topics will cover the material of the whole course and will comprise **55%** of the final mark, while previous evaluations of exams (midterm and final) are annulled. Precision of composite evaluations is left intact (up to 2 decimal places) until the end of semester and only the final evaluation will be subject to rounding. Collective self-study (consultation) could be planned with lecturer upon demand, for example, to prepare for assessment or discuss its results.

## Literature:

### *Obligatory readings:*

1. Hyndman, R.J., Athanasopoulos, G. (2018). Forecasting: principles and practice. <http://otexts.com/fpp2/>.
2. Stock, James H., Watson Mark W. (2007). Introduction to Econometrics. Boston: Pearson Education, Inc.
3. Enders, W. (2009). Applied Econometric Time Series (3rd Edition). New York: John Wiley & Sons, Inc.

### *Optional readings:*

4. Makridakis, S., Wheelwright S.C., Hyndman, R.J. (1998). Forecasting Methods and Applications (3rd Edition). New York: John Wiley & Sons, Inc.
5. Adkins, L.C. (2013). Using gretl for Principles of Econometrics (4th Edition). Version 1.041
6. Evans, M.K. (2008). Practical Business Forecasting. Oxford: Blackwell Publishers.
7. Render, B., Stair, R.M., Hanna, M.E. (2011). Quantitative Analysis for Management (11th Edition). Prentice Hall.
8. Hayes, A.F., Slater, M.D., Snyder, L.B. (2008). The SAGE Sourcebook of Advanced Data Analysis Methods for Communication Research. SAGE Publications.
9. Tabachnick, B.G., Fidell, L.S. (2012). Using Multivariate Statistics (6th Edition). Pearson.
10. Stevenson, W.J. (2012). Operations Management (11th Edition). McGraw-Hill Higher Education.
11. Eckbo, B.E. (2007). Handbook of Corporate Finance: Empirical Corporate Finance (Handbooks in Finance #1). North Holland.
12. Diebold, F. X. (2007). Elements of Forecasting. Thomson/South-Western College Pub.
13. Brockwell, P.J., Davis, R.A. (2002). Introduction to Time Series and Forecasting. New York: Springer-Verlag.
14. Hanke, J., Wichern D. (2009). Business Forecasting. Prentice-Hall.
15. Tsay, R. S. (2010). Analysis of Financial Time Series. Wiley-Interscience.
16. Lütkepohl, H., Krätzig, M. (2004). Applied Time Series Econometrics. Cambridge University Press.
17. Lütkepohl, H. (2005). New Introduction to Multiple Time Series Analysis. Springer-Verlag.
18. Patterson, K. (2000). An Introduction to Applied Econometrics: A Time Series Approach. London: Palgrave Macmillan.
19. Abelson, P.W., Joyeux, R. (2000). Economic Forecasting. Singapore: South Wind productions.
20. Armstrong, J. S. (2001). Principles of Forecasting: a handbook for researchers and practitioners. London: Kluwer Academic.
21. DeLurgio, S.A. Jr. (1998). Forecasting Principles and Applications. New York: Irwin/McGraw-Hill.
22. Franses P.H. (1998). Time Series Models for Business and Economic Forecasting. Cambridge University Press.
23. Mariano, R., Tse, Y.-K. (2008). Econometric Forecasting and High-Frequency Data Analysis. World Scientific Publishing.
24. Harris, R., Sollis, R. (2003). Applied Time Series Modelling and Forecasting. John Wiley & Sons.
25. Hyndman, R.J., Koehler, A.B., Ord, J.K., Snyder, R.D. (2008). Forecasting with Exponential Smoothing: the State Space Approach. Berlin: Springer-Verlag.
26. Brown, R.G. (2004). Smoothing, forecasting and prediction of discrete time series. Dover Publications.
27. Cuthbertson, K., Nitzsche, D. (2004). Quantitative Financial Economics: Stocks, Bonds and Foreign Exchange. New York: John Wiley & Sons.
28. Zellner, A. (2004). Statistics, Econometrics and Forecasting. Cambridge University Press.
29. Zellner, A., Palm, F.C. (2011). The Structural Econometric Time Series Analysis Approach. Cambridge University Press.
30. Liu, L.-M. (2009). Time Series Analysis and Forecasting. Scientific Computing Associates Corp.
31. Box, G.E.P., Jenkins G.M., Reinsel G.C. (2008). Time Series Analysis: Forecasting and Control. Wiley-Blackwell.
32. Clements, M.P., Hendry, D.F. (2005). A Companion to Economic Forecasting. Wiley-Blackwell.
33. Clements, M.P. (2005). Evaluating Econometric Forecasts of Economic and Financial Variables. Palgrave Macmillan.
34. Clements, M.P., Hendry, D.F. (2011). The Oxford Handbook of Economic Forecasting. Oxford University Press.
35. Elliot, G., Granger, C.W.J., Timmerman, A.G. (2006). Handbook of Economic Forecasting (Handbooks in Economics #24). North Holland.
36. Rao, C. R. (2012). Handbook of Statistics: Time Series Analysis: Methods and Applications (Handbook of Statistics #30). North-Holland.
37. Baumohl, B. (2007). Secrets of Economic Indicators, The Hidden Clues to Future Economic Trends and Investment Opportunities. Pearson Education.
38. Porter, A.L., Cunningham, S.W., Banks, J., Roper, A.T., Mason, T.W., Rossini, F.A. (2011). Forecasting and Management Technology.
39. Carnot, N., Koen, V., Tissot, B. (2011). Economic Forecasting and Policy. London: Palgrave Macmillan.