GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	TIME SERIES MODELLING, PG_00070483		
Field of study	Economic Analytics		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2026/2027
Education level	second-cycle studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	1	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Statistics and Econometrics -> Faculty of Management and Economics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Michał Pietrzak	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	30.0	0.0	0.0	60

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	60	3.0	37.0	100

Subject objectives

preparing students to apply time series models and panel data models, including their specification, estimation, and critical interpretation, based on knowledge of stochastic processes, econometric modelling of time series and panel data, and selected methods of parameter estimation, in the context of solving economic problems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U03] formulates research hypotheses and select appropriate methods for their verification using advanced it tools.	can specify, estimate, and critically interpret time series models and panel data models, applying selected parameter estimation methods and advanced IT tools in the context of solving selected economic problems.	[SU4] Assessment of ability to use methods and tools
[K7_W04] has an in-depth understanding of analytical methods, reliable data sources, and copyright principles in the context of solving contemporary socio-economic problems.	knows and understands issues related to stochastic processes, econometric modelling of time series, and panel data modelling methods, in the context of potential economic analyses.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture

1. Classical time series analysis (trend, cyclical fluctuations)
2. Stochastic processes and time series
3. Characteristics of stochastic processes, spectral analysis (concepts of stationarity, autocorrelation, white noise)
4. Autocorrelation function and partial autocorrelation function of a stochastic process
5. Testing the stationarity of a time series
6. Autoregressive processes (AR)
7. Moving average processes (MA)
8. Mixed processes (ARMA)
9. Testing stationarity/non-stationarity of a time series
10. Non-stationary mixed autoregressive-moving average processes (ARIMA)
11. Time series modeling using trend-seasonal-autoregressive models
12. Testing properties of econometric models and forecasting time series
13. Panel data models with fixed effects: identification and estimation
14. Panel data models with random effects: identification and estimation
15. Linear dynamic models for panel data
16. Testing properties of panel models, including tests for fixed effects, random effects, and dynamic models

Course content – laboratory

1. Practical identification of trend, seasonality, and autoregression (Classical time series analysis: trend, cyclical fluctuations)
2. Simulation of realizations of stochastic processes (Stochastic processes and time series)
3. Calculation of mean, variance, and autocovariance (Characteristics of stochastic processes)
4. Determination and interpretation of ACF and PACF (Autocorrelation function and partial autocorrelation function of a stochastic process)
5. Stationarity tests (e.g., ADF) and differencing of time series (Testing the stationarity of a time series)
6. Estimation of AR models (Autoregressive processes AR)
7. Estimation of MA models (Moving average processes MA)
8. Selection and estimation of models combining AR and MA and comparison of goodness of fit (Mixed processes ARMA)
9. Stationarity and non-stationarity tests (Testing stationarity/non-stationarity of a time series)
10. Modeling non-stationary data and estimation of ARIMA models (Non-stationary mixed autoregressive-moving average processes ARIMA)
11. Application of trend-seasonal-autoregressive models to describe economic phenomena (Time series modeling using trend-seasonal-autoregressive models)
12. Verification of econometric model properties, residual analysis, and generating short-term and long-term forecasts (Testing properties of econometric models and forecasting time series)
13. Estimation and interpretation of FE models (Panel data models with fixed effects: identification and estimation)
14. Estimation and interpretation of RE models (Panel data models with random effects: identification and estimation)
15. Modeling dynamic relationships with a lagged dependent variable (e.g., GDP growth over time) (Linear dynamic models for panel data)
16. Testing properties of panel models (Testing properties of panel models, analysis of test results for fixed effects, random effects, and dynamic models)

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Computational and decision-making tasks (test 1)	60.0%	30.0%
Test with open questions (written exam)	60.0%	40.0%
Computational and decision-making tasks (test 2)	60.0%	30.0%

Recommended reading

Basic literature

1. Hamilton, J. D. (1994). *Time series analysis*. Princeton: Princeton University Press.
2. Box, G. E. P., Jenkins, G. M., Reinsel, G. C., & Ljung, G. M. (2015). *Time series analysis: Forecasting and control* (5th ed.). Hoboken: Wiley.
3. Enders, W. (2014). *Applied econometric time series* (4th ed.). Hoboken: Wiley.
4. Shumway, R. H., & Stoffer, D. S. (2017). *Time series analysis and its applications: With R examples* (4th ed.). New York: Springer.
5. Mills, T. C. (2019). *Applied time series analysis: A practical guide to modeling and forecasting*. London: Academic Press.
6. Pesaran, M. H. (2015). *Time series and panel data econometrics*. Oxford: Oxford University Press.
7. Baltagi, B. H. (2005). *Econometric analysis of panel data* (3rd ed.). Chichester: Wiley.
8. Neusser, K. (2016). *Time series econometrics*. Cham: Springer.
9. Arellano, M. (2003). *Panel data econometrics*. Oxford: Oxford University Press.

Supplementary literature

1. Tsay, R. S. (2010). *Analysis of financial time series* (3rd ed.). Hoboken: Wiley.
2. Brockwell, P. J., & Davis, R. A. (2016). *Introduction to time series and forecasting* (3rd ed.). Cham: Springer.
3. Greene, W. H. (2018). *Econometric analysis* (8th ed.). New York: Pearson.
4. Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data* (2nd ed.). Cambridge: MIT Press.
5. Stock, J. H., & Watson, M. W. (2020). *Introduction to econometrics* (4th ed.). Boston: Pearson

	eResources addresses	
Example issues/ example questions/ tasks being completed	• What is a stochastic process and a time series? • What do we understand by stationarity of a time series and weak stationarity? • When is an AR(1) process stationary, and what are the consequences of the parameter φ lying in intervals (0;1) and (-1;0)? • How to define an AR(p) process, and what is the significance of its coefficients for model stability? • How to define an MA(q) process and interpret the effect of the error term? • State the stationarity condition of an ARMA(p;q) process and the criteria for model order selection. • In which situations do we use the generalized ARIMA model for time series modeling? • How to identify trend, seasonality, and cyclical components in practical time series analysis? • When do we use panel models with fixed effects, and what are their advantages in controlling unobserved unit-specific characteristics? • When do we use panel models with random effects, and how to interpret variability across units? • What are the steps in building linear dynamic models for panel data, including the selection of lagged dependent variables? • How to interpret autocorrelation function (ACF) and partial autocorrelation function (PACF) in identifying temporal structures? • How to test time series stationarity using ADF, KPSS, or PP tests?	
Practical activites within the subject	Not applicable	