Course description

Course title	Course code
Time series analysis	

Lecturer	Department where the course is delivered
Prof. Remigijus Leipus	Department of Statistical Analysis Institute of Applied Mathematics Faculty of Mathematics and Informatics Naugarduko St. 24, LT-03225 Vilnius, Lithuania

Cycle		Type of course
Second		Compulsory

Mode of delivery	Semester or period when the course is delivered	Language of instruction
Face-to-face	1st semester (Fall)	Lithuanian, English

Prerequisites and corequisites	
Prerequisites: Mathematical statistics, Probability theory	**Corequisites (if any):**

Number of ECTS credits	Student's workload	Contact hours	Individual work hours
5	125	40	85

Course objectives: programme competences to be developed		
The course provides advanced time series methods and models, their applications, modeling, forecasting of a real world (financial) data.		
Learning outcomes **At the end of the course a student should:**	**Learning methods**	**Assessment methods**
- Know advanced time series models; - Operate with the main concepts and methods of the time series theory.	*Lectures* covering time series theory. *Seminars* for time series problem solving, analysis of specific questions or used case analysis. *Individual work* for additional problem solving and confirmation of theoretical knowledge.	Tests, midterm and final exam.
- Be able to identify, state, and solve applied problems in economics, finance, and other fields using time series methods; - Be able to select appropriate time series model.	*Lectures* covering applications of time series, employing used case analysis. *Practical training* for encouraging students state problems and find strategies for solutions.	Tests, practical tasks midterm and final exam.
- Be able to use time series literature and deepen theoretical knowledge.	*Individual work* for recommended reading.	Midterm and final exam.

Course content: breakdown of the course	Contact hours					Individual work hours and assignments	
	Lectures	Consultations	Seminars	Practical training	**Total contact hours**	**Individual work hours**	**Assignments**
1. Estimation and elimination of time series trend and seasonal component.	3		2		**5**	**6**	Individual study of recommended readings and solving appointed exercises
2. Stochastic processes. Stationary time series. Autocovariance function. Spectral analysis.	3		2		**5**	**6**	Individual study of recommended readings and solving appointed exercises
3. Long memory time series	2		1		**3**	**4**	Individual study of recommended readings and solving appointed exercises
4. Autoregressive moving average time series models (ARMA). Nonstationary ARIMA, SARIMA models.	4		3		**7**	**8**	Individual study of recommended readings and solving appointed exercises
5. Stylized facts of financial time series.	2		1		**3**	**5**	Individual study of recommended readings and solving appointed exercises
6. Models of conditional heteroskedasticity. ARCH and GARCH models. Volatility.	4		3		**7**	**9**	Individual study of recommended readings and solving appointed exercises
7. Parameter estimation of ARMA and GARCH models.	3		2		**5**	**6**	Individual study of recommended readings and solving appointed exercises
8. Tests			1		**1**	**7**	Prepare for the tests
9. Midterm exam	2				**2**	**17**	Recall theory and problem solving
10. Final exam	2				**2**	**17**	Recall theory and problem solving
Total	**25**		**15**		**40**	**85**	

Assessment strategy	Weight	Time of assessment	Criteria
4 tests: 20-30 min written test (each=10%). First includes problems from topic 1; second – topic 2, third - topics 3-4, fourth - topics 5-7. Solutions are given points.	40%	During seminars, when corresponding theoretical and practical part is finished	**Mark 10** – student got no less than 90 % points **Mark 9** – student got no less than 80 % points **Mark 8** – student got no less than 70 % points **Mark 7** – student got no less than 60 % points **Mark 6** – student got no less than 50 % points **Mark 5** – student got no less than 40 % points **Mark 1-4** – student got less than 40 % points

Midterm exam: 2-hour written exam, consisting of theoretical problems and exercises from topics 1-4. Solutions are given points.	30%	During lectures, when corresponding theoretical and practical part is finished	**Mark 10** – student has perfectly mastered the material, is able to analyze and generalize it. Understands and suitably uses concepts, knows main results of time series. Has gathered not less than 90% of points. **Mark 8-9** – student has mastered the material very well, is able to systemize and generalize it. Understands and suitably uses concepts, knows majority of the main results of time series. Has gathered not less than 80% (mark 9); 70% (mark 8) of points. **Mark 6-7** – student understands major time series concepts, knows main results of time series. Has gathered not less than 60% (mark 7); 50% (mark 6) of points. **Mark 5 –** students understanding of time series concepts is superficial, she knows some results of time series. Has gathered not less than 40% of points. **Mark 1-4** – student does not know the material. The usage of terms and concepts is unsuitable. Has gathered less than 40% of points.
Final exam: 2-hour written exam, consisting of theoretical problems and exercises from topics 5-7. Solutions are given points.	30%	During exam session	**Mark 10** – student has perfectly mastered the material, is able to analyze and generalize it. Understands and suitably uses concepts, knows main results of time series. Has gathered not less than 90% of points. **Mark 8-9** – student has mastered the material very well, is able to systemize and generalize it. Understands and suitably uses concepts, knows majority of the main results of time series. Has gathered not less than 80% (mark 9); 70% (mark 8) of points. **Mark 6-7** – student understands major time series concepts, knows main results of time series. Has gathered not less than 60% (mark 7); 50% (mark 6) of points. **Mark 5 –** students understanding of time series concepts is superficial, she knows some results of time series. Has gathered not less than 40% of points. **Mark 1-4** – student does not know the material. The usage of terms and concepts is unsuitable. Has gathered less than 40% of points.

Author	**Publication year**	**Title**	**Volume and/or publication number**	**Publication place and publisher**
Required reading				
P.J. Brockwell, R. A. Davis	2002	Introduction to Time Series and Forecasting.	2nd ed.	New York: Springer.
P.J. Brockwell, R. A. Davis	1991	Time Series: Theory and Methods	2nd ed.	New York: Springer

R. S. Tsay	2010	Analysis of Financial Time Series	3rd ed.	New York: Wiley.
Additional reading				
J.D. Hamilton	1994	Time Series Analysis		Princeton, N.J. Princeton University Press.
Chan N.H.	2010	Time Series: Applications to Finance with R and S-Plus	2nd ed.	N.Y. Wiley.