SEMESTER STUDY PLAN
TIME SERIES ANALYSIS
(ELECTIVE COURSES)

DEPARTMENT OF MATHEMATICS AND DATA SCIENCE
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
UNIVERSITAS ANDALAS
2023

1 Semester Study Plan

	SEMESTER STUDY PLAN **STUDY PROGRAM OF S2 MATHEMATICS** **FACULTY OF MATHEMATICS AND NATURAL SCIENCES** **UNIVERSITAS ANDALAS**				
Course	**Code**	**i-learn URL**	**Credits**	**Semester**	**Compilation Date**
TIME SERIES ANALYSIS	**MAT 81231**	https://sci.ilearn.unand.ac.id	3	3	12 May 2024
Person in Charge	**Study Plan Creator**		**Head of Research Group**	**Head of Study Program**	
	Dr. Dodi Devianto, M.Sc **Dr. Maiyastri, M.Sc**		**Yudiantri Asdi, M.Sc**	**Dr. Ferra Yanuar**	
Intended Learning Outcomes (ILO) and Performance Indicator (PI)	**ILO-Study Program**				
	ILO-2	Mastering mathematical concepts and applications (Real Analysis, Advanced Linear Algebra, and Statistics) in solving complex mathematical problems. PI-1. An ability to explain basic mathematical concepts PI-2. An ability to provide examples that are relevant to basic mathematical concepts PI-3 An ability to determine solutions to simple problems using basic mathematical concepts.			
	ILO-3	Master one or several theories comprehensively for development in the fields of analysis, algebra, applied mathematics, statistics and combinatorial mathematics. PI-1. An ability to identify theories used in related mathematical problems.			

		PI-2. An ability to apply theory for development in related fields (advanced theory) PI-3. An ability to use advanced theory in solving related mathematical problems.
	ILO-4	Mastering scientific techniques and developing them in solving research problems through a multidisciplinary or interdisciplinary approach. PI-1. An ability to use scientific techniques in solving research problems PI-2. An ability to analyze research problems PI-3. An ability to formulate theorems/models and prove their correctness PI-4. An ability to use several mathematical software to solve complex mathematical problems.
	ILO-5	An ability to work and conduct research in the field of mathematics and related fields of science in accordance with developments in current issues independently or collaboratively and communicate it academically. PI-1. An ability to prove mathematical statements formally and correctly. PI-2. An ability to use related techniques to conduct research PI-3. An ability to communicate research results academically.
	Course Learning Outcome (CLO)	
	CLO-1	Students are able to explain the concept of time series analysis in statistical studies. (**ILO-2**: PI-1, PI-2, PI-3)
	CLO-2	Students are able to use advanced time series models with several classical model approaches. (**ILO-3**: PI-1, PI-2, PI-3)
	CLO-3	Students are able to build a hybrid model of time series data with a fuzzy approach and artificial intelligence. (ILO-3: PI-1, PI-2, PI-3)

	CLO-4	Students are able to use software using SPSS, Minitab, Eviews, R and Python applications in the process of estimating model parameters. (ILO-4: PI-1, PI-2, PI-3, PI-4)
	CLO-5	Students are able to reason intuitively and analytically and are able to express the results of their reasoning in writing, systematically and rigorously. (ILO-5: PI-1, PI-2, PI-3)
Brief Description	This course applies Case Based Method (CBM). CBM is a learning method that uses cases as a medium for learning development. Students explore, assess, interpret, synthesize, and information based on cases to produce an analysis and develop a solution plan. Case-Solving Based Learning in this course provides knowledge about the concepts of time series mathematical models which include the basic concepts of time series and autoregressive models, deterministic and stochastic time series models, classical and hybrid models.	
Course Materials	1. Basic concepts of time series and autoregressive models. 2. Deterministic and stochastic time series models. 3. Preferred time series models in the form of volatility, seasonal, long memory and mixed models. 4. Hybrid fuzzy time series and artificial neural networks.	
References	**Main:**	
	1. R. S. Tsay. (2013). *Multivariate Time Series Analysis: With R and Financial Applications*. Wiley, New York. ISBN 978-1118617908. 2. S. G. Makridakis, S. C. Wheelwright, and R. J. Hyndman. (2008). *Forecasting: Methods and Application* (3rd Edition). John Wiley & Sons, New York. ISBN 978-0471532330. 3. P. J. Brockwell and R. A. Davis. (2009). *Time Series: Theory and Methods* (2nd Edition). Springer, New York. ISBN 978-1441903198.	
	Additional:	

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<tr><td></td><td colspan="2">
C. Chatfield. (2003). The Analysis of Time Series: An Introduction (3rd Edition). Chapman and Hall, London. ISBN 978-0203491683.
G. Kitagawa. (2010). Introduction to Time Series Modeling. Chapman & Hall/CRC, Boca Raton. ISBN 978-1584889212.
W. S. Wei. (2006). Time Series Analysis: Univariate and Multivariate Method (2nd Edition). Pearson Addison-Wesley, New York. ISBN 978-0321322166.
G. E. P. Box, G. M. Jenkins, G. C. Reinsel, and G. M. Ljung. (2015). Time Series Analysis. Forecasting and Control. Wiley, New York. ISBN 978-1118675021.
J. D. Cryer and K. Chan. (2010). Time Series Analysis with Application in R. Springer, USA. ISBN 978-0387759586
A. Gharehbaghi. (2023). Deep Learning in Time Series Analysis. CRC Press, New York. ISBN 978-0367321789.
B. Auffarth. (2021). Machine Learning for Time-Series with Python: Forecast, predict, and detect anomalies with state-of-the-art machine learning methods. Packt Publishing, New York. ISBN 978-1801819626.
S. Sharma and V. Kumar. (2019). Neural Network and Fuzzy Time Series: Forecasting using neural network and fuzzy time. LAP LAMBERT Academic Publishing, London. ISBN 978-6200284990.
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<tr><td rowspan="2">Instructional Media</td><td>Software:</td><td>Hardware:</td></tr>
<tr><td>• LMS Unand (http://sci.ilearn.unand.ac.id/)
• Zoom meeting
• Whatsapp</td><td>• Computer/Laptop
• Smartphones</td></tr>
<tr><td>Team Teaching</td><td colspan="2">1. Dr. Dodi Devianto, M.Sc
2. Dr. Maiyastri, M.Sc</td></tr>
<tr><td>Assessment</td><td colspan="2">Assignment, Participation, Mid-Term exam, Final exam</td></tr>
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Required courses	MAT81131 Probability Theory
Academic Norms	Follow the Academic Regulations of Undergraduate Program, Universitas Andalas (https://akademik.unand.ac.id/images/2022-03-30%20Peraturan%20Rektor%20Nomor%207%20Tahun%202022%20Penyelenggaraan%20Pendidikan-khusus%20Bab%20II.pdf)

Weekly Study Plan

Week (1)	Course Outcome (2)	Indicators (3)	Form of Assessment (4)	Learning Activities [Estimated Time]					Learning Materials [Reference] (10)	Weight (11)
				Synchronous		Asynchronous		Media (9)		
				Face to Face Offline (5)	Face to Face Online (6)	Individual (7)	Collaboration (8)			
1-2	CLO 1: Students are able to explain the concept of time series analysis in statistical studies (**ILO-2**: PI-1, PI-2, PI-3).	• Discipline in implementing the college contract • Accuracy in understanding related material	Midterm exam (10%) Independent assignment (5%)	Class: - introduction of semester learning plan - discussion about course material [2 x 3 x 50 minutes]		Students find the references and learn material on basic concepts in statistics and time series analysis in the form of autoregressive models, as well as		LMS (ilearn UNAND)	• Introduction to Lectures (Assessment, Semester Study Plan, Syllabus, Tuition Contract) • Basic concepts of time series and autoregressive models.	**15%**

						time series models are deterministic and stochastic. [2 x 3 x 120 minutes]			● The concept of deterministic and stochastic time series models.	
3-7	CLO 2: Students are able to use advanced time series models with several classical model approaches (ILO-3: PI-1, PI-2, PI-3).	• Accuracy in understanding related material • Accuracy in answering assignment questions • Neatness of assignment execution • Originality of assignment results	Midterm exam (10%) Assignment (10%)	Class: - explanation of concepts - discussion about course materials [5 x 3 x 50 minutes]		Students find out the references and study materials [5 x 3 x 60 minutes]	Students's discussion in groups [5x3x60] minutes	LMS (ilearn UNAND)	● Basic concepts of advanced classical time series models with volatility, seasonal and long memory models and exogenous variables.	**20%**

8	**Mid-term exam**									
9-11	CLO 3: Students are able to build a hybrid model of time series data with a fuzzy approach and artificial intelligence (ILO-3: PI-1, PI-2, PI-3).	• Accuracy in understanding of related material • Accuracy in answering assignment questions • Neatness in completing assignments • Originality of assignment results	Final exam (5%) Participation (5%) Assignment (10%)	Class: - Explanation the concepts, - discussion about course materials [3 x 3 x 50 minutes]		Students find out references and study material [3x 3 x 60 minutes]	Students discuss in groups [3x3x60]	● LMS	●Basic concept of hybrid model of time series data a fuzzy approach and artificial intelligence.	**20%**
12-13	CLO 4: Students are able to use software using SPSS, Minitab, Eviews, R and Python applications in the process of estimating model parameters (ILO-4: PI-1, PI-2, PI-3, PI-4).	• Accuracy in understanding of related material • Accuracy in answering assignment questions • Neatness in completing assignments	Final exam (5%) Assignment (10%)	Class: - Use of SPSS, Minitab, EViews, R and Python applications. - Discussion about course materials.		Students find out references and study material [2x 3 x 60 minutes]	Students discuss in groups [2x3x60]	● LMS	●Data analysis using SPSS, Minitab, and EViews apps ●R or Python codes for estimating model (select estimated method that	**15%**

		• Originality of assignment results		[2 x 3 x 50 minutes]					have been learned).	
14-15	CLO 5: Students are able to reason intuitively and analytically and are able to express the results of their reasoning in writing, systematically and rigorously (ILO-5: PI-1, PI-2, PI-3).	• Accuracy in understanding of related material • Accuracy in answering assignment questions • Neatness in completing assignments • Originality of assignment results	Assignment (15%) Final exam (10%) Participation (5%)	Practice: Discussion about course materials. Presentation group [2 x 3 x 50 minutes]		Students find out references and study material [2x 3 x 60 minutes]	Students discuss in groups [2x3x60 minutes]	● LMS	● Time series hybrid method with fuzzy and artificial neural networks ● Bayesian hybrid implementation with data cases using SPSS, Minitab, EViews, R and Python	**30%**
16	**Final exam**									

II. Indicators, Criteria and Proportions of Assessment

NO	FORM OF ASSESSMENT	PROPORTION (%)
1	Assignment	50%
2	Participation	10%
3	Midterm exam	20 %
4	Final exam	20%
TOTAL		**100**

Assessment proportion for each Course Learning Outcome (CLO):

- CLO 1: 15 %
- CLO 2: 20%
- CLO 3: 20 %
- CLO 4: 15 %
- CLO 5: 30 %

III. Assessment Plan Table

Form of assessment Course Learning Outcomes (CLO)	Final exam	Mid-term exam	Assignments	Participation	Total of Proportion
1. Students are able to explain the concept of time series analysis in statistical studies (ILO-2: PI-1, PI-2, PI-3).		10%	5%		15%
2. Students are able to use advanced time series models with several classical model approaches (ILO-3: PI-1, PI-2, PI-3).		10%	10%		20%
3. Students are able to build a hybrid model of time series data with a fuzzy approach and artificial intelligence (ILO-3: PI-1, PI-2, PI-3).	5%		10%	5%	20%
4. Students are able to use software using SPSS, Minitab, EViews, R and Python applications in the process of estimating model parameters (ILO-4: PI-1, PI-2, PI-3, PI-4).	5%		10%		15%

5. Students are able to reason intuitively and analytically and are able to express the results of their reasoning in writing, systematically and rigorously (ILO-5: PI-1, PI-2, PI-3).	10%		15%	5%	30%
Total of Proportion	20%	20%	50%	10%	100%

Matrix of CLO and ILO

CLO	ILO																	
	1		2			3			4				5			6		
	PI		PI			PI			PI				PI			PI		
	1	2	1	2	3	1	2	3	1	2	3	4	1	2	3	1	2	3
1			✓	✓	✓													
2						✓	✓	✓										
3						✓	✓	✓										
4									✓	✓	✓	✓						

5													✓	✓	✓			
6																		