	Module Description/Course Syllabi
(Universitas Andalas logo)	Study Programme : Magister of Mathematics Faculty of Mathematics and Natural Sciences. Universitas Andalas

1. *Course number and name*

MAT81233 Multivariate Analysis

2. *Credits and contact hours/Number of ECTS credits allocated*

3 / 4,50 ECTS

3. *Instructors and course coordinator*

1. Prof. Dr. Rahmat Syahni
2. Prof. Dr. Ferra Yanuar, M.Sc

4. *Text book, title, outhor, and year*

   a. Johnson, R. and Winchern, D. 2013. *Applied Multivariate Statistical Analysis* (6th ed). Prentice Hall International, Inc., USA.
   b. Davino, C., Furno, M., and Vistocco, D. 2014. *Quantile Regression Theory and Applications*. John Wiley dan Sons, Ltd., United Kingdom.
   c. Bolstad, W. M. and Curran, J. M. 2017. *Introduction to Bayesian statistics* (3rd ed). John Wiley & Sons, New Jersey.

5. *Recommended reading and other learning resources/tools*

   a. Chatfield, C. and Collins., A. J. 2017. *Introduction to Multivariate Analysis*. Chapman and Hall, London.
   b. (Selected articles based on research topic)

6. *Specific course information*

A. Brief description of the content of the course (catalog description)

Multivariate analysis is an elective course that is included as the part of study group in Statistics and Probability Theory. The purpose of this course is to understand the multivariate methods consisting of the basic concept of multivariate data analysis, multivariate mean vector, variance-covariance and correlation matrix, inferential statistics about mean vector for one and two populations, one way and two ways of multivariate analysis of variance, small area estimation, fuzzy time series analysis, and Bayesian method and its hybrid model with other methods. The theoretical concepts of this course are implemented by using software tools and interpreted the results systematically and rigorously. This course is assessed through assignments, quizzes, participations, midterm examination, and final examination.

B. Prerequisites or co-requisites

MAT81131 Probability Theory

C. Indicate whether a required or elective course in the program

Elective Course

D. Level of course unit (according to EQF: first cycle Bachelor, second cycle Master)	
Second Cycle master	
E. Year of study when the course unit is delivered (if applicable)	
2nd Year	
F. Semester when the course unit is delivered	
Third Semester	
G. Mode of delivery (face-to-face, distance learning)	
Mixture (Face to face and Distance learning)	

7. Intended Leening Outcomes

ILO-2: Mastering mathematical concepts and applications (real analysis, advanced linear algebra, and statistics) in solving complex mathematical problems.

PI-1: Able to explain mathematical concepts (real analysis, advanced linear algebra, and statistics).

PI-2: Able to provide examples that are relevant to the basic concepts of mathematics

PI-3: Able to determine simple problem solutions using basic mathematical concepts.

ILO-3: Able to master one or several mathematical problems in analysis, algebra, applied mathematics, statistics and combinatorics.

PI-1: Able to identify theories used in related mathematical problems.

PI-2: Able to apply theories for advancement in related fields (advanced theory).

PI-3: Able to use advanced theory in solving related mathematical problems.

ILO-4: Mastering scientific techniques and developing them in solving research problems through multidisciplinary or interdisciplinary approaches.

PI-1: Able to apply mathematical techniques in research problem-solving.

PI-2: Able to analyze research problems.

PI-3: Able to formulate theorems/models and prove their validity.

PI-4: Able to use various mathematical software to solve complex mathematical problems.

ILO-5: Able to work and conduct research in mathematics and related fields of science by developing the latest issues independently or collaboratively and communicating them academically.

PI-1. Capable of formally and correctly proving mathematical statements.

PI-2. Able to employ relevant techniques for conducting research.

PI-3. Capable of communicating research findings academically.

8. Course Learning Outcomes *ex. The student will be able to explain the significance of current research about a particular topic.*

1. Students are able to explain about multivariate data and are able to determine the multivariate mean vector, variance-covariance matrix, and correlation matrix (ILO-2: PI-1, PI-2).

2. Students are able to explain inference about the mean vector for one population

and two populations (ILO-2: PI-3).

3. Students are able to explain and use one-way and two-way multivariate analysis of variance (ILO-3: PI-1).

4. Students are able to use multivariate regression analysis (ILO-3: PI-2, PI-3).

5. Students are able to use SAE analysis and its development (ILO-4: PI-1, PI-2, PI-3).

6. Students are able to use Bayesian methods and Bayesian hybrids with other methods (ILO-4: PI-1, PI-2, PI-3).

7. 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).

9. *Brief list of topics to be covered*

1. Multivariate mean vector, variance-covariance matrix, and correlation matrix.

2. Inference about mean vector for one population and two populations.

3. One way and two ways of multivariate analysis of variance.

4. Small area estimation (SAE) method.

5. Fuzzy time series analysis.

6. Bayesian method and its hybrid model with other methods.

7. Implementation of multivariate analysis using software tools and interpretation the results systematically and rigorously.

8. Reviewing articles related to multivariate analysis.

10. *Learning and teaching methods*

Presentation, Small Group Discussion, Directed Learning.

11. *Language of instruction*

Bahasa Indonesia

12. *Assessment methods and criteria*

Summative Assessment :
1. Assignments: 10%
2. Participations: 10%
3. Quiz: 20%
4. Midterm exam: 30%
5. Final exam : 30%

Formative Assessment:
1. Thumb up and thumb down
2. Minutes paper

SEMESTER STUDY PLAN
MULTIVARIATE ANALYSIS
(ELECTIVE COURSES)

DEPARTMENT OF MATHEMATICS AND DATA SCIENCE
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
UNIVERSITAS ANDALAS
2024

1. Semester Study Plan

<table>
<tr><td rowspan="4">UNIVERSITAS ANDALAS</td><td colspan="6">SEMESTE STUDY PLAN

STUDY PROGRAM : MASTER OF MATHEMATICS

FACULTY OF MATHEMATICS AND NATURAL SCIENCES

UNIVERSITAS ANDALAS</td></tr>
<tr><td colspan="6" align="center">SEMESTER LEARNING PLAN</td></tr>
<tr><td align="center">COURSE</td><td align="center">CODE</td><td align="center">i-LEARN COURSE URL</td><td align="center">CREDITS</td><td align="center">SEMESTER</td><td align="center">COMPILATION DATE</td></tr>
<tr><td>MULTIVARIATE ANALYSIS</td><td>MAT 81233</td><td>http://sci.ilearn.unand.ac.id</td><td align="center">3</td><td align="center">3</td><td>May 4th, 2024</td></tr>
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Person in Charge	Study Plan Creator		Head of Research Group	Head of the study program
	Prof. Dr. Ferra Yanuar, M.Sc **Prof. Dr. Rahat Syahni, M.Sc**		**Yudiantri Asdi, M.Sc**	**Prof. Dr. Ferra Yanuar, M.Sc**

Intended Learning Outcomes (ILO) and Performance Indicators (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. Able to explain mathematical concepts (Real Analysis, Advanced Linear Algebra, and Statistics). PI-2. Able to identify complex mathematical problems. PI-3. Able to solve complex mathematical problems.

	ILO-3	Comprehensive mastery of one or several theories for development in the fields of analysis, algebra, applied mathematics, statistics and combinatorial mathematics.
		PI-1. Able to identify theories used in related mathematical problems.
		PI-2. Able to apply theories for advancement in related fields (advanced theory).
		PI-3. Able to use advanced theory to solve related mathematical problems.
	ILO-4	Mastering scientific techniques and developing them in solving research problems through multidisciplinary or interdisciplinary approaches.
		PI-1. Able to apply mathematical techniques in research problem-solving.
		PI-2. Able to analyse research problems.
		PI-3. Able to formulate theorems/models and prove their validity.
		PI-4. Able to use various mathematical software to solve complex mathematical problems.
	ILO-5	Able to work and conduct research in the field of mathematics and related fields of science by developing the latest issues independently or collaboratively and communicating them academically
		PI-1. Capable of formally and correctly proving mathematical statements.
		PI-2. Able to employ relevant techniques for conducting research.
		PI-3. Capable of communicating research findings in an academic manner.
	Course Learning Outcome (CLO)	

1. Students are able to explain multivariate data and are able to determine the multivariate mean vector, variance-covariance matrix and correlation matrix (ILO-2: PI-1, PI-2).

2. Students are able to explain inference about the mean vector for one population and two populations (ILO-2: PI-3).

3. Students are able to explain and use one-way and two-way multivariate analysis of variance (ILO-3: PI-1).

	4. Students are able to use multivariate regression analysis (ILO-3: PI-2, PI-3).
	5. Students are able to use SAE analysis and its development (ILO-4: PI-1, PI-2, PI-3).
	6. Students are able to use Bayesian methods and Bayesian hybrids with other methods (ILO-4: PI-1, PI-2, PI-3).
	7. 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	The lecture begins by discussing multivariate data, mean vector, variance-covariance matrix, mean vector test, MANOVA. These basic concepts are then used in applicable material, namely the multivariate regression, fuzzy time series analysis, and Bayesian method analysis.
Study Materials	Mean vector, variance-covariance matrix, mean vector test, MANOVA, multivariate regression, fuzzy time series analysis and its development, and Bayesian method analysis.
References	**Main:** Johnson, R. and Winchern, D. 2013. Applied Multivariate Statistical Analysis (6th ed). Prentice Hall International, Inc., USA. Davino, C., Furno, M., and Vistocco, D. 2014. Quantile Regression Theory and Applications. John Wiley dan Sons, Ltd., United Kingdom. Bolstad, W. M. and Curran, J. M. 2017. Introduction to Bayesian statistics (3rd ed). John Wiley & Sons, New Jersey. **Supporting:** Chatfield, C. and AJ Collins. 1980. Introduction to Multivariate Analysis. Chapman and Hall, London
Learning Media	Software: Hardware:

	• LMS Unand (http://sci.ilearn.unand.ac.id/) • Zoom meeting • Whatsapp	• Computer/Laptop • Smartphones
Team Teaching	1. Prof. Dr. Rahmat Syahni, M.Sc 2. Prof. Dr. Ferra Yanuar, M.Sc	
Assessment	Assignment, participation, quiz, midterm exam, final exam.	
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)	

1. **Weekly Study Plan**

WEEK (1)	COURSE LEARNING OUTCOME (CLO) / LESSON LEARNING OUTCOME (LLO) (2)	ASSESSMENT INDICATORS (3)	FORM OF ASSESSMENT (4)	LEARNING ACTIVITIES [Estimated Time]				MEDIA (9)	LEARNING MATERIALS [Reference] (10)	WEIGHT (11)
				Synchronous		Asynchronous				
				Face to Face Offline (5)	Face to Face Online (6)	Independent (7)	Collaborative (8)			
1-2	CLO 1: Students are able to explain multivariate data and are able to determine the mean vector, variance-covariance matrix and correlation matrix (ILO-2: PI-1, PI-2).	• Discipline in implementing the college contract • Accuracy in understanding related material	Midterm exam (5%) Assignment (5%)	Class: – introduction of semester learning plan – discussion about course material [2 x 3 x 50 minutes]	•	○ Student know multivariate data ○ Student find out the references and study lecture materials: mean		LMS (ilearn UNAND)	Multivariate data, mean vector, variance-covariance matrix and correlation matrix	10%

Week	Sub-CLO	Indicators	Assessment	Learning Experience		Time/Activity	Group Discussion	Media	Study Material	Weight
						vectors, variance-covariancem atrix, and correlation matrix [2 x 3 x 120 minutes]				
3-4	CLO 2: Students are able to explain Inference about mean vector for one population and two populations (ILO-2: PI-3).	• Accuracy in understanding related material • Accuracy in answering assignment questions • Neatness of assignment execution • Originality of assignment results	Midterm exam (5%) Quiz (10%) Participation (2.5%)	Class: - explanation of concepts - discussion about course materials [2 x 3 x 50 minutes]		Students find out the references and study materials [2 x 3 x 60 minutes]	Students's discussion in groups [2x3x60] minutes	LMS (ilearn UNAND)	◎ Inference about mean vector for one population ◎ Inference about mean vector for two populations	17.5%

5-6	CLO 3: Students are able to explain and use one-way and two-ways multivariate analysis of variance (ILO-3: PI-1).	• Accurate understanding of related material • Accuracy in answering assignment questions • Neatness in completing assignments • Originality of assignment results	Midterm exam (10%) Assignment (5%)	- Quiz, - discussion about course materials [2 x 3 x 50 minutes]		Students find out references and study material [2 x 3 x 60 minutes]	Students discuss in groups [2x3x60]		One-way and two-ways multivariate analysis of variance	15%
7	CLO 4: Students are able to use multivariate regression analysis (ILO-3: PI-2, PI-3).	• Accurate understanding of related material • Accuracy in answering assignment questions • Neatness in completing assignments • Originality of assignment results	Midterm exam (10%) Participation (2.5%) Assignment (5%)	- Quiz, - discussion about course materials [1 x 3 x 50 minutes]		Students find out references and study material [1 x 3 x 60 minutes]	Students discuss in groups [1x3x60]		Multivariate regression analysis	17.5%

Midterm exam								
8-10	CLO 5: Students are able to use SAE analysis and its development (ILO-4: 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 (10%) Participation (5%)	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	SAE (Small Area Estimation) Analysis	15%
11-14	CLO 6: Students are able to use Bayesian methods and Bayesian hybrids with other methods (ILO-4: PI-1, PI-2, PI-3). CLO 7: Students are able to reason intuitively and	• Accuracy in understanding of related material • Accuracy in answering assignment questions • Neatness in completing assignments	Final exam (10%+10%) Assignment (2.5% +2.5%)	Class: - Explanation the concepts, - discussion about course materials [4 x 3 x 50 minutes]		Students find out references and study material [4x 3 x 60 minutes]	Students discuss in groups [4x3x60]	• LMS • Zoom	◉ Bayesian method ◉ Quantile regression ◉ Bayesian quantile method	25%

analytically and are able to express the results of their reasoning in writing, systematically and rigorously (ILO-5: PI-1, PI-2, PI-3).	• Originality of assignment results								
Final exam									

II. Indicators, Criteria and Proportions of Assessment

NO	FORM OF ASSESSMENT	PROPORTION (%)
1	Assignment	20%
2	Participation	10%
3	Quiz	10%
4	Midterm exam	30 %
4	Final exam	30%
TOTAL		**100**

Assessment proportion for each Course Learning Outcome (CLO):
- CLO 1: 15 %
- CLO 2: 12%
- CLO 3: 12 %
- CLO 4: 12 %
- CLO 5: 12 %
- CLO 6: 12 %
- CLO 7: 25 %

III. Assessment Plan Table

Form of assessment / Course Learning Outcomes (CLO)	Assignment	Participation	Quiz	Midterm Exam	Final Exam	Total of Proportion
1. Students are able to explain about multivariate data and are able to determine the multivariate mean vector, variance-covariance matrix, and correlation matrix (ILO-2: PI-1, PI-2).	5%			5%		10%
2. Students are able to explain inference about the mean vector for one population and two populations (ILO-2: PI-3).		2.5%	10%	5%		17.5%
3. Students are able to explain and use one-way and two-way multivariate analysis of variance (ILO-3: PI-1).	5%			10%		15%
4. Students are able to use multivariate regression analysis (ILO-3: PI-2, PI-3).		2.5%		10%		17.5%
5. Students are able to use SAE analysis and its development (ILO-4: PI-1, PI-2, PI-3).		5%			10%	15%
6. Students are able to use Bayesian methods and Bayesian hybrids with other methods (ILO-4: PI-1, PI-2, PI-3).	2.5%				10%	12.5%
7. 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).	2.5%				10%	12.5 %
Total of Proportion	30%	30%	20%	10%	10%	100%