Module Description/Course Syllabi

Study Programme : Magister of Mathematics
Faculty of Mathematics and Natural Sciences.
Universitas Andalas

1. *Course number and name*

MAT81131 Probability Theory

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

3 / 4,50 ECTS

3. *Instructors and course coordinator*

1. Dr. Dodi Devianto, M.Sc; 2. Dr. Maiyastri, M.Si

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

1. Howard G. Tucker. A Graduate Course in Probability. Academic Press, New York, 2014.
2. Kai Lai Chung. A Course in Probability Theory. Academic Press, San Diego, 2014.

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

3. Bert E. Fristedt and Lawrence F. Gray. A Modern Approach to Probability Theory. Springer, New York. 1997.
4. William Feller. An Introduction to Probability Theory and Its Aplication. Jhon Willey and Son, Canada. 2008.
5. Allan Gut. Probability: A Graduate Course. Springer, New York, 2012.
6. Eugene Lukacs. Characteristic Functions. Hafner Publishing Company. 1970.

6. *Specific course information*

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

In this course material is given about sigma fields, sigma borel fields, probability spaces, random variables, probability distributions and their properties, special random variables and their properties, convergence, law of large numbers, transformation and convolution, characteristic functions, infinitely divisible distributions, stable distribution, and some application of infinitely divisible distribution and stable distribution.

B. Prerequisites or co-requisites

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

Required

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)
1st Year
F. Semester when the course unit is delivered
First 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 identify complex mathematical problems. 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 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.
8. *Course Learning Outcomes* *ex. The student will be able to explain the significance of current research about a particular topic.*
1. Students will be able to explain the concept of probability theory including definition and its properties. 2. Students will be able to use the concept of probability theory and its properties and developing them as the basic tools in solving related research problem. 3. Students will be able to construct, modify, analyze/think in a structured manner on mathematical problems of a phenomenon in probability theory, and interpret and communicate orally or in writing, systematic and rigorous.
9. *Brief list of topics to be covered*
Measure theory, probability space, random variables and distribution functions, expected Value, variance and moment generating function, conditional probability and conditional expectations, special distribution and their properties, convergence, the law of large numbers, transformation and convolution, characteristics function, infinitely divisible distribution, stable distributions.

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. Tasks and Quiz : 20% 2. Project : 20% 3. Presentation : 20 % 4. Mid Semester : 20% 5. Final Semester : 20% **Formative Assessment**: 1. Thumb up and thumb down 2. Minutes paper

SEMESTER STUDY PLAN

PROBABILITY THEORY

(COMPULSORY 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**

SEMESTER STUDY PLAN

Course	Code	i-learn URL	Credits	Semester	Compilation Date
PROBABILITY THEORY	**MAT 81131**	**http://sci.ilearn.unand.ac.id**	3	1	November 01, 2023
Person in Charge	**Study Plan Creator**		**Head of Research Group**	**Head of Study Program**	
	1. Dr. Dodi Devianto, M.Sc **2. 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 probl5ems. PI-1. Able to explain basic mathematical concepts PI-2. Able to provide examples that are relevant to basic mathematical concepts PI-3 Able 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 combinatoric mathematics. PI-1. Able to identify theories used in related mathematical problems. PI-2. Able to apply theory for development 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 a multidisciplinary or interdisciplinary approach. PI-1. Able to use scientific techniques in solving research problems PI-2. Able to analyze research problems PI-3. Able to formulate theorems/models and prove their correctness PI-4. Able to use several 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 in accordance with developments in current issues independently or collaboratively and communicate it academically. PI-1. Able to prove mathematical statements formally and correctly. PI-2. Able to use related techniques to conduct research PI-3. Able to communicate research results academically.
	Course Learning Outcome (CLO)	
	CLO-1	Students are able to explain the concept of probability theory in mathematical statistics, that are measure theory and probability space. (**ILO-2**: PI-1, PI-2, PI-3)
	CLO-2	Students are able to explain the concept of random variables and distribution functions with their properties. (**ILO-3**: PI-1, PI-2, PI-3)

	CLO-3	Students are able to explain the concepts of convergence, expectation, and transformation of random variables with their properties. (ILO-3: PI-1, PI-2, PI-3)
	CLO-4	Students are able to use the concepts of probability theory and characterization of characteristic functions in infinitely divisible distribution and stable distributions. (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	In this course, material is given about sigma field, sigma Borel field, probability space, random variables, probability distribution functions and their properties, special random variables and their properties, convergence, large number law, convolution, characteristic functions, infinitely divided distribution, stable distribution, and applications of infinitely divided distribution and stable distribution.	
Course Materials	1. Measure theory and probability space 2. Random variable and distribution functions 3. Expectation value, variance and moment generating function 4. Conditional probability and expectations 5. Special distribution and its properties 6. Convergence and the large numbers law 7. Joint transformation and convolution 8. Characteristics function and its properties 9. Infinitely divisible distribution and stable distribution	
References	**Main:**	
	1. H. G. Tucker. (2014). *A graduate course in probability*. Dover Publications Inc., New York.	

<table>
<tr><td></td><td colspan="2">2. K. L. Chung. (2001). A course in probability theory. Academic Press, San Diego.
3. A. Gut. (2013). Probability: a graduate course. Springer, United States.</td></tr>
<tr><td></td><td colspan="2">Additional:</td></tr>
<tr><td></td><td colspan="2">1. M. Loeve. (2012). Probability theory I. Springer, United States.
2. B. E. Fristedt and L. F. Gray. (2018). A modern approach to probability theory. Springer, United States.
3. W. Feller. (1971). An introduction to probability theory and its application – Volume II. John Wiley & Sons, Canada.
4. G. Casella G and R. L. Berger. (2002). Statistical inference. Duxbury Press, United States.
5. E. Lukacs. (1970). Characteristic functions. Charles Griffin & Co, London.
6. Eugene Lukacs and R. G. Laha. (1971). Applications of characteristics functions. Hafner Publishing Company, US.
7. K. Sato. 1991. Lévy processes and infinitely divisible distributions. Cambridge University Press, England.
8. R. V. Hogg, J. W. McKean, and A. T. Craig. (2019). Introduction to mathematical statistics. Pearson, London.
9. A. N. Kolmogorov and Nathan Morrison. (2018). Foundations of the theory of probability. Dover Publications Inc., New York.
10. Manan Gajjar. (2019). The Characteristics Function. ASIN: B07N972WFJ.</td></tr>
<tr><td>Instructional Media</td><td>Software:</td><td>Hardware:</td></tr>
<tr><td></td><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>
<tr><td>Required courses</td><td colspan="2">-</td></tr>
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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)

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 probability theory in mathematical statistics, that are measure theory and probability space. (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		Students find and read the references about measure theory and probability theory (probability space and sigma-field set in relation to the probability distribution with their properties.		LMS (ilearn UNAND)	• Introduction to Lectures (Assessment, Semester Study Plan, Syllabus, Tuition Contract) • Measure theory • Probability theory	**15%**

				[2 x 3 x 50 minutes]		- Independent work [2 x 3 x 120 minutes]				
3-7	CLO 2: Students are able to explain the concept of random variables and distribution functions with their properties. (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 and read the references about the random variable and distribution function with their properties. [5 x 3 x 60 minutes]	Students's discussion in groups [5x3x60] minutes	LMS (ilearn UNAND)	• Random variable • Distribution functions and their properties	**20%**
8	**Midterm exam**									
9-11	CLO 3: Students are able to explain the concepts of convergence, expectation, and transformation of random variables with their properties. (ILO-3: PI-1, PI-2, PI-3)	• Accuracy in understanding of related material • Accuracy in answering assignment questions • Neatness in completing assignments	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	• Convergence • Conditional expectation • Transformation of random variable	**20%**

		• Originality of assignment results								
12-13	CLO 4: Students are able to use the concepts of probability theory and characterization of characteristic functions in infinitely divisible distribution and stable distributions. (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 • Originality of assignment results	Final exam (5%) Assignment (10%)	Class: - Explanation the concepts, - discussion about course materials [2 x 3 x 50 minutes]		Students find out references and study material [2x 3 x 60 minutes]	Students discuss in groups [2x3x60]	• LMS	• Characteristic function • Infinitely divisible distribution	**15%**
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	• Canonical representation model based on specific distribution • Implementation of canonical representation.	**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
Students are able to explain the concept of probability theory in mathematical statistics, that are measure theory and probability space. (ILO-2: PI-1, PI-2, PI-3)		10%	5%		15%
Students are able to explain the concept of random variables and distribution functions with their properties. (ILO-3: PI-1, PI-2, PI-3)		10%	10%		20%
Students are able to explain the concepts of convergence, expectation, and transformation of random variables with their properties. (ILO-3: PI-1, PI-2, PI-3)	5%		10%	5%	20%
Students are able to use the concepts of probability theory and characterization of characteristic functions in infinitely divisible distribution and stable distributions. (ILO-4: PI-1, PI-2, PI-3, PI-4)	5%		10%		15%
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	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													✓	✓	✓			