UNIVERSITAS GADJAH MADA

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Bachelor in Computer Science

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MODULE HANDBOOK

Module name	**Probability and Stochastic Processes**
Module level	Undergraduate
Code	MII-2001
Courses (if applicable)	Probability and Stochastic Processes
Semester	Fall (Odd)
Contact person	Dr.-Ing. Reza Pulungan, M.Sc.
Lecturer	Dr.-Ing. Reza Pulungan, M.Sc. Dr. Agus Sihabuddin, M.Kom.
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program, compulsory, 3rd semester. 2. International undergraduate program, compulsory, 3rd semester.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 30 students.
Workload	1. Lectures: 2 x 50 = 100 minutes (1 hour 40 minutes) per week. 2. Exercises and assignments: 2 x 60 = 120 minutes (2 hours) per week. 3. Individual study: 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 credit points (sks).
Requirements according to the Examination regulations	A student must have attended at least 75% of the lectures to sit in the exams.
Recommended prerequisites	Discrete Mathematics
Learning outcomes (course outcomes) and their corresponding PLOs	After completing this module, students are expected to: CO1 Comprehend and be able to explain the basic concepts of probability, dependency, random variables, expectation, variance, and limit theorem. CO2 Comprehend and be able to explain the concepts of stochastic processes, especially Bernoulli, Poisson, and Markov processes. CO3 Comprehend and be able to explain the concepts statistical inferences, both classical and Bayesian. CO4 Apply the concepts of probability, stochastic processes, and statistical inferences to model real-life problems.

PLO		CO1	CO2	CO3	CO4
Program Learning	PLO1				
	PLO2	√	√		

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<tr><td rowspan="3">Outcome (PLO)</td><td>PLO3</td><td></td><td></td><td>√</td><td></td></tr>
<tr><td>PLO4</td><td></td><td></td><td></td><td>√</td></tr>
<tr><td>PLO5</td><td></td><td></td><td></td><td></td></tr>
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<tr><td>Contents</td><td>
(a) Sample space and probability: sets, probabilistic models, conditional probability, total probability theorem and Bayesian rule, independence, and counting.
(b) Discrete random variables: basic concepts, probability density functions (PDF), functions of random variables, expectation, mean, and variance, joint PDF of several random variables, conditioning, and independence.
(c) General random variables: continuous random variables and PDF, cumulative distribution functions (CDF), normal random variables, joint PDF of several random variables, conditioning, continuous Bayesian rule, derived distributions, covariance and correlation, expectation and conditional variance, transformation, random sums of several independent random variables.
(d) Limit theorem: Markov and Chebyshev inequalities, weak law of large numbers, convergence in probability, central limit theorem, strong law of large numbers.
(e) Bernoulli dan Poisson processes.
(f) Markov chain: discrete-time Markov chains, state classification, steady-state behavior, absorption probability and absorption time estimation, continuous-time Markov chains.
(g) Bayesian statistical inferences: Bayesian inference and posterior distribution, point estimation, hypothesis test, MAP rule, Bayesian least mean squares estimation, and Bayesian linear least mean squares estimation.
(h) Classical statistical inferences: classical parameter estimation, linear regression, binary hypothesis test, significance testing.
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<tr><td>Study and examination requirements and forms of examination</td><td>
Evaluation is done in 3 forms, namely:
1. Two examinations, mid-term and final,
2. Two individual assignments, and
3. Two group assignments.

Assessment is done using benchmark assessment, with the aim of measuring the level of students' understanding related to the target and class rank.
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<tr><td>Media employed</td><td>LCD, blackboard, videos, and websites.</td></tr>
<tr><td>Assessments and Evaluation</td><td>
<table>
<tr><th>Type</th><th>Percentage</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Individual assignment 1</td><td>15%</td><td>√</td><td></td><td></td><td></td></tr>
<tr><td>Group task 1 (application)</td><td>10%</td><td></td><td>√</td><td></td><td>√</td></tr>
<tr><td>Mid-term exam</td><td>25%</td><td>√</td><td></td><td></td><td></td></tr>
<tr><td>Individual assignment 2</td><td>15%</td><td></td><td>√</td><td>√</td><td></td></tr>
<tr><td>Group task 2 (application)</td><td>10%</td><td></td><td></td><td>√</td><td>√</td></tr>
<tr><td>Final exam</td><td>25%</td><td></td><td>√</td><td>√</td><td></td></tr>
<tr><td>Total</td><td>100%</td><td></td><td></td><td></td><td></td></tr>
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Reading List	1. Dimitri P. Bertsekas and John N. Tsitsiklis: Introduction to Probability, 2nd Edition, Athena Scientific, 2008. 2. Sheldon M. Ross: A First Course in Probability, 10th Edition, Pearson, 2018. 3. Eric Lehman, F. T. Leighton, and Albert R Meyer: Mathematics for Computer Science, Samurai Media Limited, 2017. 4. Roy D. Yates and David J. Goodman: Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers, John Wiley & Sons, Inc., 2017.

Created date : May 28, 2021

Revision date : June 28, 2022