



**Universitas Brawijaya**  
**Faculty of Mathematics and Natural Sciences**  
**Department of Statistics / Bachelor Statistics Study Programme**

**Module Handbook**

Module Name:	Introduction to Numerical Analysis (MAS62114)	
Module Level:	Bachelor	
Abbreviation, if applicable:	-	
Sub-heading, if applicable:	-	
Courses included in the module, if applicable:	-	
Semester/term:	4th/ Second Year	
Module Coordinator(s):	Achmad Efendi, S.Si., M.Sc.	
Lecturer(s):	Achmad Efendi, S.Si., M.Sc. Luthfatul Amaliana, S.Si., M.Si	
Language:	Indonesian	
Classification within the curriculum:	Compulsory course	
Teaching format / class per week during semester:	2 × 50 minutes + 100 minutes laboratory session	
Workload:	1.67 hours lectures, 2 hours structural activities, 2 hours individual studies for 16 weeks + 1.67 hours laboratory session, 2 hours structural activities, 2 hours individual studies for 8 weeks and total 136 hours per semester 4.50 ECTS	
Credit Points:	3	
Requirements:	Mathematics I (MAS62112), Basics of Programming (MAS61131)	
Learning goals / competencies:	<b>General Competence (Knowledge):</b>	
	ILO1	The students are able to master basic scientific concepts and statistical analysis methods applied on computing, social science, humanities, economics, industry and life science.
	ILO4	The students are able to master at least two statistical softwares, including based on open source.
	ILO5	The students are able to apply logical, critical, systematic, and innovative thinking independently when applied to science and technology that contain humanities values, based on scientific principles, procedures and ethics with excellent and measurable results.
	ILO7	The students are able to improve and develop a job networks, then supervise and evaluate the team's performance they lead.

	ILO8	The students are able to apply and internalize the spirit of independence, struggle, entrepreneurship, based on values, norms, and academic ethics of Pancasila in all aspects of life.
	<b>Specific Competence:</b>	
	M1	Students are able to understand concepts of mathematics that play a role in statistics (ILO1, ILO5).
	M2	Students are able to find numerical solutions of mathematical equations that cannot be solved exactly using R or manually (ILO1, ILO4, ILO5).
	M3	Students are able to numerically solve problems related to certain mathematical subjects used in statistics with different methods (ILO1, ILO5).
	M4	Students are able to convey understanding of mathematical concepts that cannot be solved exactly and play a role in statistics both in writing and orally, in the form of individual or group assignments (ILO1, ILO5, ILO7, ILO8).
	M5	Students are able to submit results of mathematical equation calculation that cannot be solved exactly using R software or manually both written and oral, in the form of individual or group assignments (ILO4, ILO5, ILO7, ILO8).
Contents:	1	Introduction (The role of numerical analysis in statistics, definition of error)
	2	Linear Equation System (Gauss Elimination, Cholesky Factorization)
	3	Computation in Regression analysis (Givens transformation for solving least squares function)
	4	Non-Linear Equation Solution (Bisection Method (For Two), Newton-Raphson Method, Secant Method)
	5	Eigen problems (eigenvalues and eigenvectors, Singular Value Decomposition (SVD))
	6	Numerical Derivatives (Fundamental definitions of Derivatives, Partial Derivatives using Richardson's Extrapolation Method, Estimation of Maximum Likelihood)
	7	Numerical Integration (Basic integration in R, Trapezoidal Rules, Parabolic Rules / Simpson Rules)
Soft skill attribute:	Responsible, independently, and discipline	

Study/exam achievement:	<p>Final score (NA) is calculated as follow: 5% Attitude, 10% Assignments, 25% Tutorial Class,10% Quiz, 25% Midterm Exam, 25% Final Exam</p> <p>Final index is defined as follow:</p> <p>A : &gt; 80 - 100</p> <p>B+ : &gt; 75 - 80</p> <p>B : &gt; 69 - 75</p> <p>C+ : &gt; 60 - 69</p> <p>C : &gt; 55 - 60</p> <p>D+ : &gt; 50 - 55</p> <p>D : &gt; 44 - 50</p> <p>E : 0 - 44</p>
Forms of media:	Software (R), Laptop, LCD projector,
Learning methods:	Lecture, assessments, and discussion
Literature:	<p><b>Main:</b></p> <ol style="list-style-type: none"> <li>1. Anton, H &amp; Rorres, C. 2005. Elementary Linear Algebra, 9th Ed. John Wiley &amp; Sons, Inc. New York.</li> <li>2. Mathews, J.H. &amp; Fink, K.D. 1999. Numerical Methods Using MATLAB, 3th Ed. Prentice Hall. New Jersey.</li> <li>3. Monahan, J.F. 2011. Numerical Methods of Statistics. Cambridge University Press. Cambridge.</li> <li>4. Purcell E.J. and Varberg, D. 2003. Calculus, 9th Ed. Prentice Hall and Inc. New Jersey.</li> </ol> <p><b>Support:</b></p> <ol style="list-style-type: none"> <li>1. Bloomfield, V. A. 2014. Using R for Numerical Analysis in Science and Engineering, CRC Press Taylor &amp; Francis Group, New York</li> <li>2. Henningsen, A dan Toomet, O. 2011. maxLik: A Package for Maximum Likelihood Estimation in R. Comput Stat, 26:443–458. DOI 10.1007/s00180-010-0217-1.</li> </ol>
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