

MODULE HANDBOOK

INTRODUCTION TO SPATIAL STATISTICS



**STATISTICS UNDERGRADUATE PROGRAM
DEPARTMENT OF STATISTICS
FACULTY OF SCIENCE AND DATA ANALYTICS
INSTITUT TEKNOLOGI SEPULUH NOPEMBER
SURABAYA**

ENDORSEMENT PAGE



**MODULE HANDBOOK
INTRODUCTION TO SPATIAL
STATISTICS
STATISTICS UNDERGRADUATE PROGRAM
DEPARTMENT OF STATISTICS
INSTITUT TEKNOLOGI SEPULUH NOPEMBER**

Proses <i>Process</i>	Penanggung Jawab <i>Person in Charge</i>			Tanggal <i>Date</i>
	Nama <i>Name</i>	Jabatan <i>Position</i>	Tanda tangan <i>Signature</i>	
Perumus <i>Preparation</i>	Dr. Sutikno, S.Si, M.Si	Dosen Lecturer		
Pemeriksa dan Pengendalian <i>Review and Control</i>	Dr. Sutikno, S.Si, M.Si Dr. Achmad Choirudin, S.Si., M.Sc	Tim kurikulum Curriculum team		
Persetujuan <i>Approval</i>	Dr. Bambang Widjanarko Otok, M.Si	Koordinator RMK Course Cluster Coordinator		
Penetapan <i>Determination</i>	Dr. Kartika Fithriasari, M.Si	Kepala Departemen Head of Department		

MODULE HANDBOOK

INTRODUCTION TO SPATIAL STATISTICS

Module name	INTRODUCTION TO SPATIAL STATISTICS	
Module level	Undergraduate	
Code	SS234752	
Course (if applicable)	INTRODUCTION TO SPATIAL STATISTICS	
Semester	7	
Person responsible for the module	Dr. Sutikno, S.Si, M.Si	
Lecturer	Dr. Sutikno, S.Si, M.Si Dr. Achmad Choirudin, S.Si., M.Sc	
Language	Bahasa Indonesia and English	
Relation to curriculum	Undergraduate degree program, elective, 7th semester.	
Type of teaching, contact hours	Case method (21.43%) Team based project (7.15%) Other SCL methods (35.71%) Non SCL methods (35.71%)	
Workload	1. Lectures [L] : 3 x 50 = 150 minutes per week. 2. Exercises and Assignments [EA] : 3 x 60 = 180 minutes (3 hours) per week. 3. Independent learning [IL]: 3 x 60 = 180 minutes (3 hours)perweek.	
Credit points	3 credit points (SKS) Equivalent to 4.8 ECTS	
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.	
Mandatory prerequisites	Regression Analysis, Mathematical Statistics	
Learning outcomes and their corresponding PLOs	CLO.1 Able to explain the concept of spatial statistics and its implementation in various fields CLO.2 Be able to explain analytical procedures in spatial statistics and be able to choose the appropriate method CLO.3 Able to use computational techniques and modern computer equipment needed to process spatial data CLO.4 Able to identify, formulate, and analyze spatial data with effective methods and according to the problem	PLO-1 PLO-3 PLO-4
Content	The objectives of the spatial statistics course are the students able to design the data collection based on location and analyze the spatial data particularly in the health and environment sectors, and able to interpret the result. The	

	<p>theoretical material from basic spatial concepts to various methods of spatial analysis is conveyed through lectures and discussions. Improving the analytical skills, students are given examples of relevant cases. These examples are resolved with and without software through a practicum in class. In addition, students are given assignments both independently and in groups to find out the application of various real problems, particularly in the environmental and health sectors. The objective of these assignments is to prepare students to be able to manage and work in teams and to be responsible for the results of individual and group work.</p>
Assessment and its weight	<p>Project 1 (20%) Midterm Exam (25%) Study Case (25%) Final Project (30%)</p>
Media employed	LCD, whiteboard, websites (myITS Classroom), zoom
Reading list	<ol style="list-style-type: none"> 1. Anselin, L. 1988. Spatial Econometrics: Methods and Models. Dordrecht: Kluwer Academic Publishers. 2. Baddeley, A., Rubak, E., & Turner, R. 2015. Spatial point patterns: methodology and applications with R. CRC press. 3. Fotheringham, A.S., Brundson, C., and Charlton, M. 2002. Geographically Weighted Regression: the analysis of spatially varying relationships. England : John Wiley dan Sons Ltd. 4. Anselin, L. and Rey, S.J., 2010. Perspective on Spatial Data Analysis. Springer. 5. Arbia, G. 2006. Spatial Econometrics: Statistical Foundations and Applications to Regional Convergence. Berlin: Springer. 6. Cressie, N. 2015. Statistics for spatial data. John Wiley & Sons. 7. Ficher, M.M. and Getis, A., 2010. Handbook of Applied Spatial Analysis Software Tools, Methods and Applications. Springer-Verlag Berlin Heidelberg.



INSTITUT TEKNOLOGI SEPULUH NOPEMBER
FAKULTAS SAINS DAN ANALITIKA DATA
PROGRAM STUDI SARJANA STATISTIKA
DEPARTEMEN STATISTIKA

Kode Dokumen

RENCANA PEMBELAJARAN SEMESTER/
SEMESTER LEARNING PLAN

MATA KULIAH (MK)/ <i>Course</i>	KODE/ <i>Code</i>	Rumpun MK/ <i>Course Group</i>	BOBOT (sks)/ <i>Weight (credit)</i>		SEMESTER/ <i>Semester</i>	Tgl Penyusunan/ <i>Drafting Date</i>
PENGANTAR STATISTIKA SPASIAL / <i>INTRODUCTION TO SPATIAL STATISTICS</i>	SS234752	LINGKES	T=3	P=0	V	11 Januari 2023
OTORISASI/ <i>AUTHORIZATION</i>	Pengembang RPS/ <i>RPS Developer</i>		Koordinator RMK/ <i>Course Group Coordinator</i>		Ketua PRODI/ <i>Head of Department</i>	
	Dr. Achmad Choiruddin, M.Sc		Prof. Dr. Bambang W Otok, M.Si		Dr. Kartika Fithriasari, M.Si	
Capaian Pembelajaran (CP)/ <i>Learning Achievement</i>	CPL-PRODI yang dibebankan pada MK/ <i>PLO</i>					
	CPL – 1	Mampu menerapkan pengetahuan teori statistika, matematika, dan komputasi				
	CPL – 3	Mampu menganalisis data dengan metode statistika yang tepat dan menginterpretasikannya				
	CPL – 4	Mampu mengidentifikasi, memformulasi, dan menyelesaikan masalah statistika di berbagai bidang terapan				
	<i>PLO – 1</i>	<i>Able to apply statistical, mathematical, and computational theory knowledge</i>				
	<i>PLO – 3</i>	<i>Able to analyze data with the right statistical methods and interpret it</i>				
	<i>PLO – 4</i>	<i>Able to identify, formulate, and solve statistical problems in various applied fields</i>				
	Capaian Pembelajaran Mata Kuliah (CPMK)/ <i>CLO</i>					
	CPMK.1	Mampu menjelaskan konsep statistika spasial dan implementasinya di berbagai bidang				
	CPMK.2	Mampu menjelaskan prosedur analisis dalam statistika spasial dan mampu memilih metode yang sesuai				
	CPMK.3	Mampu menggunakan teknik komputasi dan perangkat komputer modern yang diperlukan untuk mengolah data spasial				
	CPMK.4	Mampu mengidentifikasi, memformulasi, dan menganalisis data spasial dengan metode yang efektif dan sesuai dengan permasalahan				
		<i>CLO.1 Able to explain the concept of spatial statistics and its implementation in various fields</i>				
		<i>CLO.2 Be able to explain analytical procedures in spatial statistics and be able to choose the appropriate method</i>				
		<i>CLO.3 Able to use computational techniques and modern computer equipment needed to process spatial data</i>				
		<i>CLO.4 Able to identify, formulate, and analyze spatial data with effective methods and according to the problem</i>				

	<p>Matrik CPL – CPMK <i>PLO-CLO Matrix</i></p> <table border="1"> <tr> <td>CPMK</td> <td>CPL-5</td> <td>CPL-8</td> <td>CPL-9</td> <td></td> </tr> <tr> <td>CPMK-1</td> <td>V</td> <td></td> <td>V</td> <td></td> </tr> <tr> <td>CPMK-2</td> <td>V</td> <td></td> <td></td> <td></td> </tr> <tr> <td>CPMK-3</td> <td></td> <td>V</td> <td></td> <td></td> </tr> <tr> <td>CPMK-4</td> <td></td> <td></td> <td>V</td> <td></td> </tr> </table>	CPMK	CPL-5	CPL-8	CPL-9		CPMK-1	V		V		CPMK-2	V				CPMK-3		V			CPMK-4			V	
CPMK	CPL-5	CPL-8	CPL-9																							
CPMK-1	V		V																							
CPMK-2	V																									
CPMK-3		V																								
CPMK-4			V																							
<p>Deskripsi Singkat MK/ Course Description</p>	<p>Statistika Spasial bertujuan agar mahasiswa mampu merancang pengumpulan data berbasis lokasi dan mampu menganalisis data spasial pada bidang khususnya kesehatan dan lingkungan, serta mampu menginterpretasikannya. Materi teori mulai konsep dasar spasial hingga berbagai metode analisis spasial disampaikan melalui ceramah dan diskusi. Untuk mempertajam kemampuan analisis, mahasiswa diberikan contoh kasus yang relevan dan diselesaikan dengan dan tanpa priranti lunak (software) melalui praktikum di kelas. Di samping itu mahasiswa diberikan penugasan baik mandiri maupun kelompok untuk mengetahui penerapan berbagai permasalahan riil, khususnya bidang lingkungan dan kesehatan. Tujuan penugasan ini adalah melatih mahasiswa agar mampu mengelola dan bekerja dalam tim serta bertanggung jawab atas hasil kerja mandiri dan kelompok.</p> <p><i>The objectives of the spatial statistics course are the students able to design the data collection based on location and analyze the spatial data particularly in the health and environment sectors, and able to interpret the result. The theoretical material from basic spatial concepts to various methods of spatial analysis is conveyed through lectures and discussions. Improving the analytical skills, students are given examples of relevant cases. These examples are resolved with and without software through a practicum in class. In addition, students are given assignments both independently and in groups to find out the application of various real problems, particularly in the environmental and health sectors. The objective of these assignments is to prepare students to be able to manage and work in teams and to be responsible for the results of individual and group work.</i></p>																									
<p>Bahan Kajian: Materi Pembelajaran/ Course Material</p>	<p>Dasar Sains, Teori Statistika, Pengumpulan Data, Deskripsi dan Eksplorasi, Komputasi dan Data Processing, Pemodelan, Kesehatan dan Lingkungan <i>Basic Science, Statistical Theory, Data Collection, Description and Exploration, Computing and Data Processing, Modeling, Health and Environment.</i></p>																									
<p>Pustaka/ References</p>	<p>Utama/Primary:</p> <ol style="list-style-type: none"> 1. Anselin, L. 1988. Spatial Econometrics: Methods and Models. Dordrecht: Kluwer Academic Publishers. 2. Baddeley, A., Rubak, E., & Turner, R. 2015. Spatial point patterns: methodology and applications with R. CRC press. 3. Fotheringham, A.S., Brundson, C., and Charlton, M. 2002. Geographically Weighted Regression: the analysis of spatially varying relationships. England : John Wiley dan Sons Ltd. 																									

		Pendukung/Secondary		<p>4. Anselin, L. and Rey, S.J., 2010. Perspective on Spatial Data Analysis. Springer.</p> <p>5. Arbia, G. 2006. Spatial Econometrics: Statistical Foundations and Applications to Regional Convergence. Berlin: Springer.</p> <p>6. Cressie, N. 2015. Statistics for spatial data. John Wiley & Sons.</p> <p>7. Ficher, M.M. and Getis, A., 2010. Handbook of Applied Spatial Analysis Software Tools, Methods and Applications. Springer-Verlag Berlin Heidelberg.</p>			
Dosen Pengampu/ Lecturers		Dr. Sutikno, S.Si, M.Si Dr. Achmad Choirudin, S.Si, M.Sc					
Matakuliah syarat/ Pre-requisite Course		Analisis Regresi, Statistika Matematika <i>Regression Analysis, Mathematical Statistics</i>					
Mg Ke- Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) Final capability for each learning step	Penilaian Evaluation		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka] Learning Material [References]	Bobot Penilaian (%) Evaluation Weight (%)
		Indikator Indicator	Kriteria & Bentuk Criteria and Format	Luring Offline	Daring Online		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	1. Dapat memahami konsep dasar Statistika Spasial 1. <i>Able to understand</i>	1. Dapat menjelaskan pengertian data spasial dan non-spasial 2. Dapat menjelaskan	Tes Observasi Aktifitas di kelas	Ceramah interaktif Diskusi <i>Interactive lectures</i>		Pengertian statistika spasial dan beberapa terapannya diberbagai bidang	7,5%

	<i>the basic concepts of Spatial Statistics</i>	<p>konsep dasar analisis spasial: spatial dependent dan spatial heterogeneity</p> <p>3. Dapat memberikan contoh permasalahan riil yang dapat diselesaikan dengan statistika spasial.</p> <ol style="list-style-type: none"> 1. <i>Can explain the meaning of spatial and non-spatial data</i> 2. <i>Be able to explain the basic concepts of spatial analysis: spatial dependence and spatial heterogeneity</i> 3. <i>Can give examples of real problems that can be solved with spatial statistics.</i> 	<i>Test Observation of activities in class</i>	<p><i>Exercise Discussion</i></p> <p>TM: 3x50" LT: 3x60" BM: 3x60"</p>		<i>Definition of spatial statistics and some of its applications in various fields</i>	
2	<p>2. Dapat memahami struktur data spasial dan proses pengumpulan data spasial</p> <p>2. <i>Able to understand the structure of spatial data and the process of collecting spatial data</i></p>	<ol style="list-style-type: none"> 1. Dapat memahami konsep proses stokastik khususnya dalam spasial. 2. Dapat memahami konsep <i>isotropy</i> dan <i>anisotropy</i>, stasioner dan non-stasioner. 3. Dapat menjelaskan tipe data spasial: spatial point pattern, geostatistics, dan lattice <ol style="list-style-type: none"> 1. <i>Can understand the concept of stochastic processes, especially in spatial.</i> 2. <i>Can understand the</i> 	<p>Tes & Observasi Aktifitas di kelas</p> <p><i>Test Observation of activities in class</i></p>	<p>Ceramah interaktif Diskusi</p> <p><i>Interactive lectures Discussion</i></p> <p>TM: 3x50" LT: 3x60" BM: 3x60"</p>		<p>Struktur data spasial (geostatistics, lattices, dan <i>point patterns</i>), <i>isotropy</i> dan <i>anisotropy</i>, stasioner dan non stasioner</p> <p><i>Spatial data structures (geostatistics, lattices, and point patterns), isotropy and anisotropy, stationary and non-stationary</i></p>	7,5%

		<p><i>concept of isotropy and anisotropy, stationary and non-stationary.</i></p> <p>3. <i>Be able to explain spatial data types: spatial point patterns, geostatistics, and lattice</i></p>					
3	<p>3. Dapat melakukan analisis eksplorasi data spasial serta menyajikan deskripsi data spasial melalui peta</p> <p>3. <i>Able to perform exploratory analysis of spatial data and present descriptions of spatial data through maps</i></p>	<p>1. Dapat melakukan analisis eksplorasi data spasial (<i>Box plot, Histogram, scatter plot</i>)</p> <p>2. Dapat menyajikan deskripsi data spasial melalui peta dengan software spasial</p> <p>1. <i>Can perform exploratory analysis of spatial data (Box plot, Histogram, scatter plot)</i></p> <p>2. <i>Can present a description of spatial data through maps with spatial software</i></p>	<p>Tes & Observasi Aktifitas di kelas</p> <p><i>Test</i></p> <p><i>Observation of activities in class</i></p>	<p>Ceramah interaktif Latihan Soal Diskusi</p> <p><i>Interactive lectures</i> <i>Exercise</i> <i>Discussion</i></p> <p>TM: 3x50" LT: 3x60" BM: 3x60"</p>		<p>Eksplorasi data spasial (<i>Exploratory Spatial Data Analysis: ESDA</i>)</p> <p><i>Spatial data exploration</i> <i>(Exploratory Spatial Data Analysis: ESDA)</i></p>	7,5%
4	<p>4. Dapat memahami data berbasis titik .</p> <p>4. <i>Able to understand point-based data</i></p>	<p>1. Dapat memahami karakteristik data berbasis titik</p> <p>2. Dapat memahami Poisson point process</p> <p>3. Dapat melakukan analisis eksplorasi data berbasis titik dengan bantuan software</p> <p>1. <i>Can understand the characteristics of</i></p>	<p>Tes & Observasi Aktifitas di kelas</p> <p><i>Test</i></p> <p><i>Observation of activities in class</i></p>	<p>Ceramah interaktif Diskusi</p> <p><i>Interactive lectures</i> <i>Discussion</i></p> <p>TM: 3x50" LT: 3x60" BM: 3x60"</p>		<p>1. Introduction to spatial point process</p> <p>2. Properties of spatial point process: first and second order moment</p> <p>3. Poisson point process</p> <p><i>1. Introduction to spatial point process</i> <i>2. Properties of spatial</i></p>	

		<ul style="list-style-type: none"> <i>point - based data</i> 2. <i>Can understand the Poisson point process</i> 3. <i>Able to perform point - based data exploration analysis with the help of software</i> 				<ul style="list-style-type: none"> <i>point process: first and second order moment</i> 3. <i>Poisson point process</i> 	
5-7	<ul style="list-style-type: none"> 5. Dapat menganalisis data <i>spatial point pattern</i> 5. <i>Able to analyze spatial point pattern data</i> 	<ul style="list-style-type: none"> 1. Dapat melakukan pemodelan intensity dari spatial point process 2. Dapat memahami analisis second order moment dari spatial point process (K-function dan pair correlation function) 3. Dapat menerapkan analisis spatial point pattern dengan bantuan software 1. <i>Be able to do intensity modeling from spatial point processes</i> 2. <i>Be able to understand second order moment analysis from spatial point process (K - function and pair correlation function)</i> 3. <i>Able to apply spatial point pattern analysis with the help of software</i> 	<p>Tes & Observasi Aktifitas di kelas</p> <p><i>Test Observation of activities in class</i></p>	<p>Ceramah interaktif Diskusi</p> <p><i>Interactive lectures Discussion</i></p> <p>TM: 3x 3x50" LT: 3x 3x60" BM: 3x 3x60"</p>		<ul style="list-style-type: none"> 1. Intensity modeling 2. K-function and pair correlation function 3. Cox point process 1. <i>Intensity modeling</i> 2. <i>K-function and pair correlation function</i> 3. <i>Cox point process</i> 	7,5%
8	ETS/Midterm						
9-10	6. Dapat menganalisis data dengan	1. Dapat menjelaskan konsep interpolasi	Tes & Observasi Aktifitas di kelas	Ceramah interaktif Latihan Soal		Prediksi dan interpolasi (<i>geostatistic: ordinary</i>)	15%

	<p>geostatistik</p> <p>6. <i>Able to analyze data with geostatistics</i></p>	<p>dengan kriging.</p> <p>2. Dapat menjelaskan prosedur interpolasi kriging.</p> <p>3. Dapat menjelaskan variogram teoritik dan variogram eksperimental</p> <p>4. Dapat menerapkan metode kriging pada permasalahan riil dengan dan tanpa software</p> <p>1. <i>Can explain the concept of interpolation with kriging.</i></p> <p>2. <i>Be able to explain kriging interpolation procedures.</i></p> <p>3. <i>Can explain the theoretical variogram and experimental variogram</i></p> <p>4. <i>Can apply the kriging method to real problems with and without software</i></p>	<p>Tugas 1</p> <p><i>Test</i></p> <p><i>Observation of activities in class</i></p> <p><i>Task 1</i></p>	<p>Diskusi</p> <p><i>Interactive lectures</i></p> <p><i>Exercise</i></p> <p><i>Discussion</i></p> <p>TM: 2x 3x50"</p> <p>LT: 2x 3x60"</p> <p>BM: 2x 3x60"</p>		<p><i>kriging, variogram)</i></p> <p><i>Prediction and interpolation</i></p> <p><i>(geostatistics: ordinary kriging, variogram)</i></p>	
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11-12	<p>7. Dapat menganalisis data spasial dengan regresi spasial basis area</p> <p><i>7. Can analyze spatial data with spatial basis area regression</i></p>	<p>1. Dapat menjelaskan formulasi model regresi spasial basis area</p> <p>2. Dapat menjelaskan estimasi dan pengujian parameter pada regresi spasial basis area</p> <p>3. Dapat menerapkan regresi spasial basis area di berbagai bidang dengan bantuan software</p> <p><i>1. Be able to explain the formulation of the area basis spatial regression model</i></p> <p><i>2. Can explain the estimation and testing of parameters on the basis area spatial regression</i></p> <p><i>3. Be able to apply spatial basis area regression in various fields with the help of software</i></p>	<p>Tes & Observasi Aktifitas di kelas Tugas 2 <i>Test</i> <i>Observation of activities in class</i> <i>Task 2</i></p>	<p>Ceramah interaktif Latihan Soal Diskusi</p> <p><i>Interactive lectures</i> <i>Exercise</i> <i>Discussion</i></p> <p>TM: 2x 3x50" LT: 2x 3x60" BM: 2x 3x60"</p>		<p>Pemodelan regresi spasial dengan basis area (SAR, SEM, SARMA)</p> <p><i>Spatial regression modeling with area basis (SAR, SEM, SARMA)</i></p>	20%
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13-15	<p>8. Dapat menganalisis data spasial dengan regresi spasial berbasis titik</p> <p>8. <i>Can analyze spatial data with point - based spatial regression</i></p>	<p>1. Dapat menjelaskan formulasi model regresi spasial basis titik</p> <p>2. Dapat menjelaskan estimasi dan pengujian parameter pada regresi spasial basis titik</p> <p>3. Dapat menerapkan regresi spasial basis titik di berbagai bidang dengan bantuan software</p> <p>1. <i>Be able to explain the formulation of point basis spatial regression models</i></p> <p>2. <i>Be able to explain parameter estimation and testing on point basis spatial regression</i></p> <p>3. <i>Be able to apply point basis spatial regression in various fields with the help of software</i></p>	<p>Tes & Observasi Aktifitas di kelas Tugas 2 <i>Test</i> <i>Observation of activities in class</i> <i>Task 2</i></p>	<p>Ceramah interaktif Latihan Soal Diskusi</p> <p><i>Interactive lectures</i> <i>Exercise</i> <i>Discussion</i></p> <p>TM:3x 3x50" LT: 3x 3x60" BM: 3x 3x60"</p>		<p>Pemodelan regresi spasial dengan basis titik (GWR, GWLR, GWPR) <i>Spatial regression modeling on a point basis (GWR, GWLR, GWPR)</i></p>	20%
16	Evaluasi Akhir Semester / Ujian Akhir Semester/ <i>final exam</i>						

