



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

Kode Dokumen

REV-1

RENCANA PEMBELAJARAN SEMESTER

MATA KULIAH (MK)		KODE	Rumpun MK	BOBOT (sks)		SEMESTER	Tgl Penyusunan
Proses Stokastik Lanjut		SS255213	Statistika Komputasi dan Sains Data	T=3	P=0	II	Agustus 2026
OTORISASI		Pengembang RPS		Koordinator RMK		Kepala PRODI	
		Prof. Drs. Nur Iriawan, M.Ikomp, M.Si		Prof. Drs. Nur Iriawan, M.Ikomp, M.Si		Irhamah, S.Si, M.Si, Ph.D.	
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CPL-PRODI yang dibebankan pada MK						
	CPL-6 <i>PLO-6</i>	Mampu mengintegrasikan perangkat komputasi modern untuk mengembangkan solusi statistik yang efisien, dengan mengevaluasi keandalan dan ketepatan hasil komputasi. <i>Able to integrate modern computing tools to develop efficient statistical solutions, while assessing the reliability and accuracy of computational results.</i>					
	CPL-7 <i>PLO-7</i>	Mampu menganalisis dan mengevaluasi teknik komputasi statistik untuk memecahkan permasalahan statistika yang kompleks berbasis data <i>Able to analyze and evaluate statistical computing techniques to address complex, data-driven statistical problems</i>					
	CPL-8 <i>PLO-8</i>	Mampu menganalisis dan mengevaluasi metode statistika untuk merumuskan solusi pada permasalahan teoritis dan riil dengan pendekatan multidisipliner <i>Able to analyze and evaluate statistical methodologies to formulate solutions for theoretical and real-world problems using a multidisciplinary approach.</i>					
	CPL-9 <i>PLO-9</i>	Mampu menganalisis dan mengevaluasi metode statistika berbasis komputasi atau analitik yang inovatif untuk mengatasi permasalahan riil di bidang bisnis, industri, ekonomi, finansial, sosial dan pembangunan berkelanjutan, lingkungan, kesehatan, serta mengevaluasi dampaknya terhadap pengambilan keputusan <i>Able to analyze and evaluate innovative computation- or analytics-based statistical methods to address real-world problems in business, industry, economics and finance, social and sustainable development, environment, and health, and to assess their impact on decision-making.</i>					
	Capaian Pembelajaran Mata Kuliah (CPMK)						
		CPMK-1	Mampu menganalisis dan memformulasikan proses stokastik tingkat lanjut melalui sintesis variabel state dan parameter sistem <i>Able to analyze and formulate advanced stochastic processes through the synthesis of state variables and system parameters</i>				

	<i>transition matrices, derive n-step probabilities, and evaluate systems using First Step Analysis. By the end of the course, students are able to integrate and optimize stochastic process models to solve queuing systems and random phenomena across applied fields.</i>	
Bahan Kajian: Materi Pembelajaran	Matematika, Teori Statistika, Pengumpulan Data, Komputasi dan Processing, Pemodelan, Bisnis dan Industri, Kesehatan dan Lingkungan <i>Mathematics, Statistical Theory, Data Collection, Computing and Processing, Modeling, Business and Industry, Health and Environment</i>	
Pustaka	Utama :	
	1. Box, G. E. P. dan Tiao, G. C.: (1973), Bayesian Inference in Statistical Analysis, Reading, MA : Addison-Wesley. 2. Carlin, B. P. dan Louis, T. A.: (1996), Bayes and Empirical Bayes Methods for Data Analysis, Chapman & Hall, London. 3. Casella, G. dan Berger, R. L., (1990) Statistical Inference, Duxbury, Belmont California, USA. 4. Gelman, A., Carlin, J. B., Stern, H. S. dan Rubin, D. B.: (2004), Bayesian Data Analysis, 2nd Ed., Chapman & Hall, London. 5. Martz, H.F. dan Waller, R. A., (1982) Bayesian Reliability Analysis, John Wiley & Sons, New York. 6. McLachlan G. dan Basford K. (1988) Mixture models: inference and application to clustering. Marcel and Decker Inc. 7. Tanner, M. A.: (1996), Tools for Statistical Inference : Methods for the Exploration of Posterior Distributions and Likelihood Functions, 3 rd edn, Springer-Verlag, New York. 8. Titterington M., Makov G., dan Smith A.F.M. (1985) Statistical analysis of finite mixtures. Willey, UK 9. Ntzoufras, I., (2009) Bayesiaan Modeling Using WinBUGS, Wiley, New York 10. Zellner, A.: (1971), An Introduction to Bayesian Inference in Econometrics, Wiley, New York. 11. Albert, J. (2009) Bayesian Computation with R, 2nd Ed., Springer, New York 12. Iriawan, N. (2012) Pemodelan dan Analisis Data Driven, ITS Press, Surabaya	
	Pendukung :	
Dosen Pengampu	Prof. Drs. Nur Iriawan, M.Ikomp, M.Si	
Matakuliah syarat		

Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (<i>offline</i>)	Daring (<i>online</i>)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mampu menjelaskan pengertian proses stokastik dengan memadukan informasi variabel state dan parameternya <i>Able to explain the definition of stochastic processes by combining state variable information and parameters</i>	1. Mampu menjelaskan perbedaan proses stokastik dengan parameter dan state spacenya 2. Mampu mengidentifikasi ruang keadaan (state space) dan waktu keadaan (parameter space) dari suatu proses atau sistem stokastik <i>1. Able to explain the difference between stochastic processes with parameters and state space</i> <i>Able to define the state space and the parameter space of a stochastic or system process</i>	Tes tulis Tugas Observasi dan presentasi di kelas <i>Written test Assignment Observations and presentations in class</i>	Ceramah, diskusi dan latihan soal <i>Lectures, discussions and exercises</i>	150 menit <i>150 minutes</i>	Pengertian Proses Stokastik dan Rantai Markov <i>Definition of Stochastic Processes and Markov Chains</i>	5%/5%
2	Mampu menjelaskan Rantai Markov dan menyusun matriks transisi probabilitas	Mampu mengidentifikasi transisi-transisi yang mungkin antar ruang keadaan sesuai waktu proses, dan mampu	Tes tulis Tugas Observasi di kelas <i>Written test Assignment</i>	Ceramah, diskusi dan latihan soal <i>Lectures, discussions and exercises</i>	150 menit <i>150 minutes</i>	- Probabilitas transisi 1 langkah - Matriks transisi dari kasus tertentu - Persamaan Chapman-Kolmogorov untuk	5%/10%

Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (<i>offline</i>)	Daring (<i>online</i>)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	hingga n langkah dari suatu masalah riil yang memenuhi sifat Markov <i>Able to explain the Markov Chain and arrange a probability transitions matrix up to n steps from a real problem that meets Markov's properties</i>	menyusun matriks stokastiknya untuk 1 langkah hingga n langkah dari suatu masalah riil yang memenuhi sifat Markov <i>Able to identify possible transitions between state spaces corresponding to time processes, and be able to construct their stochastic matrix for 1 step to n steps from a real problem that meets Markov's properties</i>	<i>Observation in class</i>			menghitung probabilitas transisi n langkah <i>- Transition Probability of a 1-step</i> <i>- Transition matrix of a certain case</i> <i>Chapman-Kolmogorov equation for calculating transition probability of n steps</i>	
3-4	- Mampu menghitung probabilitas dan ekspektasi waktu suatu proses (sistem) akan mencapai keadaan tertentu pertama	- Dapat menganalisis apakah matriks stokastik P mencapai kondisi <i>steady-state</i> dan mempunyai distribusi limit pada langkah ke-n bila $n \rightarrow \infty$. - Dapat menentukan, Misal T adalah waktu	Tes tulis Tugas 2 Observasi di kelas <i>Written test</i> <i>Task 2</i> <i>Observation in class</i>	Ceramah, diskusi dan latihan soal <i>Lectures, discussions and exercises</i>	300 menit <i>300 minutes</i>	- <i>First Step Analysis</i> dengan absorbing dan non absorbing state - Distribusi Limit <i>- First Step Analysis with absorbing and non absorbing state</i> <i>- Limit Distribution</i>	10%/35%

Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	kalinya (<i>First Step Analysis</i>) - Mampu menghitung distribusi limit suatu matriks stokastik bila distribusi limit itu ada - <i>Able to calculate the probability and time expectations of a process (system) will reach a certain state at the first time (First Step Analysis)</i> <i>Able to calculate the limit distribution of a stochastic matrix when the limit</i>	pertama kali sistem masuk ke state - <i>Able to analyze whether the P stochastic matrix reaches a steady-state condition and has a limit distribution at n^{th} step when $n \rightarrow \infty$</i> - <i>Able to determine, for example T is the first time the system enters the state</i>					

Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (<i>offline</i>)	Daring (<i>online</i>)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	<i>distribution exists</i>						
5-6	- Mampu menghitung probabilitas dan ekspektasi waktu kepunahan generasi suatu proses - Mampu menjelaskan sifat-sifat dan klasifikasi rantai Markov - <i>Able to calculate the probability and expectation of the time of extinction of a generation of a process</i> - <i>Able to explain the properties and classification of the Markov chain</i>	- Mampu memodelkan kasus Branching Process dan menghitung probabilitas kepunahannya berdasar pada kecepatan pertumbuhan suatu spesies per generasi - Mampu menjelaskan dan mengklasifikasikan kelas-kelas dalam matriks transisi Markov - <i>Able to model branching process cases and calculate the probability of extinction based on the growth speed of a species per generation</i> - <i>Able to explain and classify classes in the Markov transition matrix</i>	Tes tulis Tugas 2 Observasi di kelas <i>Written test Task 2 Observation in class</i>	Ceramah, diskusi, latihan soal, dan presentasi di kelas <i>Lectures, discussions, exercises, and presentations in the class</i>	300 menit <i>300 minutes</i>	- Markov pada Branching Process - Probabilitas kepunahan keturunan - Klas Transient, klas absorbing, klas recurrent dalam sebuah matrik transisi Markov - Ergodicity Markov Chain - Reducible Markov Chain - <i>Markov in the Branching Process</i> - <i>Probability of hereditary extinction</i> - <i>Transient class, absorbing class, recurrent class in a Markov transition matrix</i> - <i>Ergodicity Markov Chain</i> - <i>Reducible Markov Chain</i>	10%/45%

Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (<i>offline</i>)	Daring (<i>online</i>)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
7-8	- Mampu menjelaskan Sifat <i>Stationary and independent increment</i> dalam proses poisson serta menghitung peluang dari $F(x)$ dan $R(x)$ serta peluang dari proses poisson - ETS - <i>Able to explain the properties of stationary and independent increments in the poisson process and calculate the probability of $F(x)$ and $R(x)$ and the probability of</i>	- Memahami dan menguasai konsep Model Markov Kontinyu serta mampu membedakannya dengan Model Markov Diskrit. - Mampu menyusun matriks rate dan mampu mendapatkan matriks stokastik dari matriks rate untuk analisis transient. - Mampu menyusun sistem persamaan beda-diferensial untuk Proses Poisson dan mampu menyelesaikannya - Mampu menjelaskan Doubly-stochastic pada proses Poisson spatial - <i>Understand and know the concept of the Continuous Markov Model and be able to distinguish it from the</i>	Tes tulis Tugas 2 Observasi <i>Written test Task 2 Observation</i>	Ceramah, diskusi, latihan soal <i>Lectures, discussions, exercises</i>	300 menit <i>300 minutes</i>	- Homogen dan non-homogenous - Poisson process Point process, <i>spatial Poisson Process, compound & Marked Poisson Processes</i> - <i>Homogeneous and non-homogeneous</i> - <i>Poisson process Point process, spatial Poisson Process, compound & Marked Poisson Processes</i>	10%/55%

Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	<i>the poisson process ETS</i>	<i>Discrete Markov Model.</i> - Able to construct the rate matrix and be able to obtain a stochastic matrix from the rate matrix for transient analysis. - Able to construct a system of differential equations for the Poisson Process and be able to solve it Able to explain Doubly-stochastic in the Poisson spatial process					
9-10	- Mampu menjelaskan konsep dan mampu menerapkan model proses input-output (<i>birth-death process</i>) - Mampu menjelaskan konsep <i>Brownian Motion</i>	- Mampu menjelaskan Continuous time Poisson processes - Mampu memahami proses birth-death - Mampu menjelaskan Poisson processes with Markov intensity - Mampu menjelaskan gerak Brown sebagai bentuk proses Gaussian	Tes tulis Tugas 3 Observasi dan presentasi di kelas <i>Written test Task 3 Observations and presentations in class</i>	Ceramah, diskusi, latihan soal, dan presentasi di kelas <i>Lectures, discussions, exercises, and presentations in the class</i>	300 menit <i>300 minutes</i>	- Pure-birth & linear death process - Sojourn times - Birth and Death processes with absorbing states - Antrian sebagai proses Birth-Death - Brownian Motion sebagai proses Gaussian - Absorb Brownian motion - Brownian motion with drift	10%/65%

Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	- Able to explain concepts and apply input-output process model (birth-death process) Able to explain the concept of Brownian Motion	- Able to explain Continuous Time Poisson processes - Able to understand the birth-death process - Able to explain Poisson processes with Markov intensity Able to explain Brown's motion as a form of Gaussian process				- Pure-birth & linear death process - Sojourn times - Birth and Death processes with absorbing states - Queues as a Birth-Death process - Brownian Motion as a Gaussian process - Absorb Brownian motion - Brownian motion with drift	
11	Mampu menjelaskan konsep Brownian Motion Able to explain the concept of Brownian Motion	Mampu menjelaskan Brownian motion yang terdapat kondisi absorb atau terdapat drift dalam prosesnya Able to explain Brownian motion that there is a absorb conditions or there is a drift in the process	Tes tulis Tugas 4 Observasi di kelas Written test Task 4 Observation in class	Ceramah, diskusi dan latihan soal Lectures, discussions and exercises	150 menit 150 minutes	-Brownian Motion sebagai proses Gaussian -Absorb Brownian motion -Brownian motion with drift -Brownian Motion as a Gaussian process -Absorb Brownian motion -Brownian motion with drift	10%/75%
12	Mampu menjelaskan konsep renewal theory	- Mampu menjelaskan konsep Excess Life untuk proses renewal berpola Exponential pada antar kejadiannya	Tes tulis Tugas 4 Observasi Presentasi di kelas Written test	Ceramah, diskusi, latihan soal, dan presentasi/ diskusi Lectures, discussions, exercises, and presentations/discussions	150 menit 150 minutes	-excess life, -Renewal sebagai Poisson Process -renewal-reward process -excess life,	10%/85%

Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	<i>Able to explain the concept of renewal theory</i>	- Mampu memilih antara individual atau Block replacement, - Mampu menjelaskan keberadaan delay renewal process - <i>Able to explain the concept of Excess Life for the exponential patterned renewal process between events</i> - <i>Able to choose between individual or Block replacement, Able to explain the existence of delay renewal process</i>	<i>Task 4 Presentation Observation in class</i>			<i>-Renewal as Poisson Process renewal-reward process</i>	
13-14	Mampu menjelaskan konsep proses difusi <i>Able to explain the concept of diffusion process</i>	- Mampu menjelaskan kemanfaatan stochastic calculus dalam proses Ito - Mampu menjelaskan proses Wiener geometric - Mampu menjelaskan kemanfaatan proses Wiener dan proses Ito dalam option pricing	Tes tulis Tugas Observasi Presentasi di kelas <i>Written test Assignment Observation Presentation in class</i>	Ceramah, diskusi, latihan soal, dan presentasi <i>Lectures, discussions, exercises, and presentations</i>	300 menit <i>300 minutes</i>	- <i>stochastic calculus,</i> - <i>Ito process,</i> - <i>option pricing</i> - <i>stochastic calculus,</i> - <i>Ito process,</i> - <i>option pricing</i>	5%/90%

Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring (<i>offline</i>)	Daring (<i>online</i>)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		- <i>Able to explain the advantages of stochastic calculus in the Ito process</i> - <i>Able to explain the wiener geometric process</i> <i>Able to explain the advantages of the Wiener process and the Ito process in option pricing</i>					
15 – 16	- Mampu menghitung kinerja berbagai proses random pada beberapa sistem yang berproses secara stokastik yang dijumpai sehari-hari - EAS - <i>Able to calculate the performance of</i>	Mampu mengidentifikasi sistem gerak Brown/kasus renewal/B-D Processes Mampu menghitung kinerja performansi keputusan dalam sistem option pricing - <i>Able to identify Brown motion system/case renewal/B-D Processes</i>	Tes tulis Tugas Observasi Presentasi di kelas <i>Written test</i> <i>Assignment</i> <i>Observation</i> <i>Presentation in class</i>	Ceramah, diskusi, latihan soal, dan presentasi <i>Lectures, discussions, exercises, and presentations</i>	270 menit <i>270 minutes</i>	Pengalaman memodelkan/menyelesaikan kasus riil dengan proses stokastik <i>Experience modeling/solving real cases with stochastic processes</i>	10%/100%

