



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

Kode Dokumen

RENCANA PEMBELAJARAN SEMESTER

MATA KULIAH (MK)		KODE	Rumpun MK	BOBOT (sks)		SEMESTER	Tgl Penyusunan
Proses Stokastik Lanjut		SS235113	Statistika Komputasi dan Sains Data	T=3	P=0		Februari 2023
OTORISASI		Pengembang RPS		Koordinator RMK		Ketua PRODI	
				Prof. Drs. Nur Iriawan, M.lkomp, M.Si		Dr.rer.pol. Dedy Dwi Prastyo, S.Si, M.Si	
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CPL-PRODI yang dibebankan pada MK						
	CPL-1 <i>PLO-1</i>	Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan, menjunjung tinggi penegakan hukum mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, ekselensi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal. <i>Able to demonstrate attitudes and characters that reflect: being pious to God Almighty, having ethics and integrity, virtuous character, sensitive and concern with social and environmental issues, respecting cultural differences and pluralism, upholding law enforcement, prioritizing the interests of the nation and the wider community, through creativity and innovation, excellence, strong leadership, synergy, and other potentials to achieve maximum results.</i>					
	CPL-2 <i>PLO-2</i>	Mampu mengembangkan dan memecahkan permasalahan ilmu pengetahuan dan teknologi dalam bidang keilmuan nya melalui riset dengan pendekatan inter atau multidisiplin hingga menghasilkan karya inovatif dan teruji dalam bentuk tesis dan makalah yang telah diterima di jurnal ilmiah nasional terakreditasi atau diterima di seminar internasional bereputasi. <i>Able to develop and solve science and technology problems in their field through research with an inter or multidisciplinary approach to produce innovative and tested works in the form of theses and papers that have been accepted in accredited national journals or accepted at reputable international seminars.</i>					
	CPL-3 <i>PLO-3</i>	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan. <i>Able to manage their own learning and develop themselves as personal lifelong learners to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to the principle of sustainability.</i>					
	CPL-4 <i>PLO-4</i>	Mampu menerapkan Teori Statistika pada Metode Statistika. <i>Able to apply Statistical Theory to Statistical Methods</i>					
	CPL-5	Mampu merancang, melaksanakan, dan mengevaluasi pengumpulan data dengan metodologi yang tepat.					

	<i>PLO-5</i>	<i>Able to design, implement, and evaluate data collection with appropriate methodology</i>						
	CPL-6 <i>PLO-6</i>	Mampu menggunakan perangkat komputasi modern untuk menyelesaikan permasalahan statistik. <i>Able to use modern computing devices to solve statistical problems</i>						
	CPL-7 <i>PLO-7</i>	Mampu menerapkan dan mengevaluasi teknik komputasi untuk menyelesaikan permasalahan statistik. <i>Able to apply and evaluate computational techniques to solve statistical problems</i>						
	CPL-8 <i>PLO-8</i>	Mampu menerapkan metode statistika dengan tepat serta mengevaluasinya untuk menganalisis permasalahan teoritis dan riil <i>Able to apply statistical methods appropriately and evaluate them to analyze theoretical and real problems</i>						
	CPL-9 <i>PLO-9</i>	Mampu menerapkan metode Statistika Bisnis, Industri, Ekonomi Finansial, Sosial Kependudukan, Lingkungan atau Kesehatan yang berbasis Komputasi pada permasalahan riil. <i>Able to apply Computing-based Business, Industrial, Financial Economics, Social-Population, Environmental, or Health Statistics methods to real problems</i>						
	Capaian Pembelajaran Mata Kuliah (CPMK)							
		Matrik CPL – CPMK						
		CPMK	CPL-1		CPL-6	CPL-7	CPL-8	CPL-9
		CPMK-1					V	V
		CPMK-2					V	V
		CPMK-3			V	V		V
		CPMK-4			V	V		V
		CPMK-5			V	V		V
		CPMK-6						
Deskripsi Singkat MK								
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,Bellmont 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 (offline)	Daring (online)		
(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 mengindentifikasi 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</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%

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>space of a stochastic or system process</i>					
2	Mampu menjelaskan Rantai Markov dan menyusun matriks transisi probailitas 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>	Mampu mengindentifikasi transisi-transisi yang mungkin antar ruang keadaan seuai waktu proses, dan mampu 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>	Tes tulis Tugas Observasi di kelas <i>Written test Assignment Observation in class</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 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>	5%/10%

Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bentuk 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)
3-4	- Mampu menghitung probabilitas dan ekspektasi waktu suatu proses (sistem) akan mencapai keadaan tertentu pertama 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>	- 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 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>	Tes tulis Tugas 2 Observasi di kelas <i>Written test Task 2 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)
	<i>Able to calculate the limit distribution of a stochastic matrix when the limit 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</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</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>	10%/45%

Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuan 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>extinction of a generation of a process Able to explain the properties and classification of the Markov chain</i>	<i>cases and calculate the probability of extinction based on the growth speed of a species per generation Able to explain and classify classes in the Markov transition matrix</i>				- <i>Ergodicity Markov Chain Reducible Markov Chain</i>	
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</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	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		Bentuk 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>increments in the poisson process and calculate the probability of $F(x)$ and $R(x)$ and the probability of the poisson process</i> ETS	- 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 Discrete Markov Model.</i> - <i>Able to construct the rate matrix and be able to obtain a stochastic matrix from the rate matrix for transient analysis.</i> - <i>Able to construct a system of differential equations for the Poisson Process and be able to solve it</i> <i>Able to explain Doubly-stochastic in the Poisson spatial process</i>					
9-10	- Mampu menjelaskan konsep dan mampu	- Mampu menjelaskan Continuous time Poisson processes - Mampu memahami	Tes tulis Tugas 3 Observasi dan	Ceramah, diskusi, latihan soal, dan presentasi di kelas	300 menit <i>300 minutes</i>	- Pure-birth & linear death process - Sojourn times	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)
	menerapkan model proses input-output (<i>birth-death process</i>) - Mampu menjelaskan konsep <i>Brownian Motion</i> - <i>Able to explain concepts and apply input-output process model (birth-death process)</i> <i>Able to explain the concept of Brownian Motion</i>	proses birth-death - Mampu menjelaskan Poisson processes with Markov intensity - Mampu menjelaskan gerak Brown sebagai bentuk proses Gaussian - <i>Able to explain Continuous Time Poisson processes</i> - <i>Able to understand the birth-death process</i> - <i>Able to explain Poisson processes with Markov intensity</i> <i>Able to explain Brown's motion as a form of Gaussian process</i>	presentasi di kelas <i>Written test</i> <i>Task 3</i> <i>Observations and presentations in class</i>	<i>Lectures, discussions, exercises, and presentations in the class</i>		- <i>Birth and Death processes with absorbing states</i> - <i>Antrian sebagai proses Birth-Death</i> - <i>Brownian Motion sebagai proses Gaussian</i> - <i>Absorb Bronian motion</i> - <i>Bronian motion with drift</i> - <i>Pure-birth & linear death process</i> - <i>Sojourn times</i> - <i>Birth and Death processes with absorbing states</i> - <i>Queues as a Birth-Death process</i> - <i>Brownian Motion as a Gaussian process</i> - <i>Absorb Bronian motion</i> <i>Bronian motion with drift</i>	
11	Mampu menjelaskan konsep <i>Brownian Motion</i> <i>Able to explain the concept of Brownian Motion</i>	Mampu menjelaskan <i>Bronian motion</i> yang terdapat kondisi absorb atau terdapat drift dalam prosesnya <i>Able to explain Bronian motion that there is a</i>	Tes tulis Tugas 4 Observasi di kelas <i>Written test</i> <i>Task 4</i> <i>Observation</i>	Ceramah, diskusi dan latihan soal <i>Lectures, discussions and exercises</i>	150 menit <i>150 minutes</i>	-<i>Brownian Motion sebagai proses Gaussian</i> -<i>Absorb Bronian motion</i> -<i>Bronian motion with drift</i> -<i>Brownian Motion as a Gaussian process</i> -<i>Absorb Bronian motion</i>	10%/75%

Mg Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bantuan 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>absorb conditions or there is a drift in the process</i>	<i>in class</i>			<i>Brownian motion with drift</i>	
12	Mampu menjelaskan konsep <i>renewal theory</i> <i>Able to explain the concept of renewal theory</i>	- Mampu menjelaskan konsep Excess Life untuk proses renewal berpola Exponential pada antar kejadiannya - 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>	Tes tulis Tugas 4 Observasi Presentasi di kelas <i>Written test Task 4 Presentation Observation in class</i>	Ceramah, diskusi, latihan soal, dan presentasi/ diskusi <i>Lectures, discussions, exercises, and presentations/discussions</i>	150 menit <i>150 minutes</i>	-<i>excess life,</i> -<i>Renewal sebagai Poisson Process</i> -<i>renewal-reward process</i> -<i>excess life,</i> -<i>Renewal as Poisson Process</i> <i>renewal-reward process</i>	10%/85%
13-14	Mampu menjelaskan	- Mampu menjelaskan kemanfaatan	Tes tulis Tugas	Ceramah, diskusi, latihan soal, dan presentasi	300 menit	- <i>stochastic calculus,</i> - <i>Ito process,</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 (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	konsep proses difusi <i>Able to explain the concept of diffusion process</i>	stochastic calculus dalam proses Ito - Mampu menjelaskan proses Wiener geometric - Mampu menjelaskan kemanfaatan proses Wiener dan proses Ito dalam option pricing <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>	Observasi Presentasi di kelas <i>Written test</i> <i>Assignment</i> <i>Observation</i> <i>Presentation in class</i>	<i>Lectures, discussions, exercises, and presentations</i>	<i>300 minutes</i>	- <i>option pricing</i> - <i>stochastic calculus,</i> - <i>Ito process, option pricing</i>	
15 – 16	- Mampu menghitung kinerja berbagai proses random pada beberapa sistem yang berproses	Mampu mengidentifikasi sistem gerak Brown/kasus renewal/B-D Processes Mampu menghitung kinerja performasi	Tes tulis Tugas Observasi Presentasi di kelas <i>Written test</i> <i>Assignment</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%

