



INSTITUT TEKNOLOGI SEPULUH NOPEMBER
FAKULTAS SAINS DAN ANALITIKA DATA
PROGRAM STUDI DOKTOR ILMU STATISTIK
DEPARTEMEN STATISTIKA

Kode Dokumen

Rev 1

RENCANA PEMBELAJARAN SEMESTER

MATA KULIAH (MK)		KODE	Rumpun MK	BOBOT (sks)		SEMESTER	Tgl Penyusunan
Analisis Bayesien Lanjut		SS256212	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, Ph.D; Irhamah, Ph.D.		Prof. Drs. Nur Iriawan, M.Ikomp, Ph.D		Irhamah, S.Si, M.Si, Ph.D.	
Capaian Pembelajaran (CP) <i>Learning Outcome (LO)</i>	CPL-PRODI yang dibebankan pada MK						
	CPL-2 <i>PLO-2</i>	Mampu mengembangkan teori / konsepsi / gagasan baru dan memecahkan permasalahan ilmu pengetahuan dan/ atau teknologi dalam bidang keilmuan nya melalui riset dengan pendekatan inter, multi dan transdisiplin hingga menghasilkan karya kreatif, original, dan teruji dalam bentuk disertasi dan makalah yang telah diterbitkan di jurnal internasional bereputasi. <i>Able to develop new theories/concepts/ideas and solve scientific and/or technological problems in their field through research with inter, multi, and transdisciplinary approaches to produce creative, original, and tested works in the form of dissertations and papers that have been approved published in reputable international journals.</i>					
	CPL-6 <i>PLO-6</i>	Mampu merancang dan mengevaluasi sistem komputasi statistik canggih atau algoritma baru untuk pemrosesan data besar, serta mengkaji keefektifannya dibanding pendekatan konvensional. <i>Able to design and evaluate advanced statistical computing systems or novel algorithms for big-data processing, and assess their effectiveness relative to conventional approaches.</i>					
	CPL-7 <i>PLO-7</i>	Mampu menciptakan dan memvalidasi teknik komputasi statistik inovatif serta mengkritisi kekuatan dan kelemahannya dalam konteks data riil yang kompleks. <i>Able to create and validate innovative statistical-computing techniques and critically appraise their strengths and limitations in complex real-world data contexts.</i>					
	CPL-8 <i>PLO-8</i>	Mampu mengembangkan metode statistika atau model teoritis baru, serta mengevaluasi kontribusinya terhadap pengembangan ilmu statistik dan aplikasinya dengan pendekatan interdisipliner <i>Able to develop new statistical methods or theoretical models and evaluate their contribution to the advancement of statistics and its applications through an interdisciplinary approach.</i>					
	CPL-9 <i>PLO-9</i>	Mampu mengintegrasikan dan mengembangkan metode statistika berbasis komputasi dan analitik untuk mengatasi permasalahan riil di bidang bisnis, industri, ekonomi, finansial, sosial dan pembangunan berkelanjutan, lingkungan, kesehatan, serta mengevaluasi dampaknya terhadap pengambilan keputusan					

		Able to integrate and develop computation- and analytics-based statistical methods to address real-world problems in business, industry, economics and finance, social and sustainable development, environment, and health, and to evaluate their impact on decision-making.									
Capaian Pembelajaran Mata Kuliah (CPMK)											
	CPMK-1	Mampu mengkritisi konsep berfikir Bayesian, menganalisis dan pemilihan prior sesuai dengan pola data, menganalisis konsep data augmentation, dan membuat kreasi resampling dengan MCMC. <i>Capable of critically evaluating Bayesian thinking, analyzing and selecting priors based on data patterns, examining the concept of data augmentation, and implementing resampling techniques using MCMC.</i>									
	CPMK-2	Mampu menganalisis dan membangun struktur Bayesian untuk distribusi normal, non-normal ataupun neo-normal <i>Capable of analyzing and constructing Bayesian structures for normal, non-normal, and neo-normal distributions.</i>									
	CPMK-3	Mampu menganalisis dan membangun struktur Bayesian untuk pemodelan GLMs <i>Capable of analyzing and constructing Bayesian structures for Generalized Linear Models (GLMs)</i>									
	CPMK-4	Mampu menganalisis dan membangun struktur Bayesian untuk system pemodelan dengan susunan mixture distribusi dan model linear, non-linear, maupun GLMs. <i>Capable of analyzing and constructing Bayesian structures for modeling systems that incorporate mixture distributions, as well as linear, non-linear, and GLM-based models.</i>									
	CPMK-5	Mampu menganalisis dan membangun beberapa alternatif model Bayesian sebagai pengembangan model secara data driven dan memahami cara pemilihan model Bayesian terbaik. <i>Capable of analyzing and developing alternative Bayesian models—driven by the data—and understanding the criteria for selecting the optimal Bayesian model.</i>									
	Matrik CPL – CPMK										
		CPMK	CPL-1	CPL-2	CPL-3	CPL-4	CPL-5	CPL-6	CPL-7	CPL-8	CPL-9
		CPMK-1		V						V	
		CPMK-2		V				V		V	
		CPMK-3		V				V	V	V	
		CPMK-4		V				V	V	V	V
		CPMK-5		V				V	V	V	V
Deskripsi Singkat MK	<p>Analisis Bayesian merupakan salah satu mata kuliah keahlian yang merupakan bagian dari bidang kajian rumpun mata kuliah Statistika Komputasi. Tujuan mempelajari Analisis Bayesian adalah mahasiswa mampu menjelaskan: filosofi teori Bayes dan Empirical Bayes pada distribusi data driven, filosofi prior dan likelihood dalam membangun posterior, filosofi pemodelan Bayesian untuk data driven (distribusi campuran, regresi linear campuran, model hierarki, dan model linear tergeneralisir), dan filosofi komputasi Bayesian (Markov Chain Monte Carlo, Gibbs Sampling, dan Metropolis Hasting), pemilihan model terbaik (Bayes Faktor dan struktur perkalian distribusi), serta mampu mengembangkan dan menerapkan untuk menyelesaikan permasalahan real secara data driven. Melalui mata kuliah ini diharapkan mahasiswa akan memiliki pengalaman belajar untuk berfikir secara filosofis dan kritis serta mampu menyusun keputusan yang tepat berdasarkan hasil estimasi dan pemodelan Bayesian. Strategi</p>										

	<p>pembelajaran yang digunakan adalah diskusi dan latihan serta tugas.</p> <p><i>Bayesian Analysis is one of the expertise courses that is part of the field of study of the Computational Statistics course group. The purpose of studying Bayesian Analysis is that students are able to explain: the philosophy of Bayes and Empirical Bayes theory in the distribution of Driven data, the Philosophy of Prior and Like in building posteriors, the Philosophy of Bayesian modeling for Data Driven (mixed distributions, mixed linear regression, hierarchical models, and generalized linear models), and the Philosophy of Bayesian Computation (Markov Chain Monte Carlo, Gibbs Sampling, and Metropolis Hastings), Selection of the best model (Bayes Factor and Multiplicative Joint Density for Model Selection – MSMJD—), and are able to develop and apply to solve real problems in a Data Driven manner. Through this course, students are expected to have the learning experience to think philosophically and critically and be able to make the right decisions based on the results of Bayesian estimation and modeling. The learning strategies used are discussions and exercises and assignments.</i></p>
Bahan Kajian: Materi Pembelajaran	<p>Filosofi pemodelan Bayesian dan pemodelan data driven, Bayesian pada data Normal dan neo-normal, Bayesian linear model, Bayesian GLMs, Bayesian Model Mixture, Pemilihan model terbaik, Prospek pengembangan metodologi Bayesian, Bayesian Komputasi dan Data Prosessing dengan WinBUGS, R2WinBUGS, dan RStan.</p> <p><i>Bayesian modeling philosophy and data driven modeling, Bayesian on Normal and neo-normal data, Bayesian linear models, Bayesian GLMs, Bayesian Model Mixture, Selection of the best model, Prospects for the development of Bayesian methodology, Bayesian Computation and Data Processing with WinBUGS, R2WinBUGS, and RStan.</i></p>
Pustaka	<p>Utama :</p> <ol style="list-style-type: none"> 1. Kaplan, D. (2024) Bayesian Statistics for the Social Sciences. The Guilford Press, New York. 2. Gelman, A., Carlin, J. B., Stern, H. S. Dunson, D.B., Vehtari, A. dan Rubin, D. B., 2014, Bayesian Data Analysis, Chapman & Hall, London. 3. Albert, J., 2009, <i>Bayesian Computation with R</i> 2nd Edition, Springer, London. 4. Robert, C. P., 2007, <i>The Bayesian Choice from Decision-Theoretic Foundations to Computational Implementation</i> 2nd Edition, Springer, New York 5. Software: WinBUGS 1.4, R2WinBUGS, RStan. <p>Pendukung :</p> <ol style="list-style-type: none"> 1. Carlin, B. P. dan Louis, T. A., 1996, <i>Bayes and Empirical Bayes Methods for Data Analysis</i>, Chapman & Hall, London 2. Ntzoufras, N. (2009) Bayesian Modeling Using WinBUGS., John-Wiley & Sons, New Jersey. 3. Svetlozar T. Rachev, S. T., Hsu, J. S., J., Bagasheva, B., S., dan Fabozzi, F., J., 2008, <i>Bayesian Methods in Finance</i>, John Wiley & Sons, New Jersey 4. Kruschke, J., K., 2010, <i>Doing Bayesian Data Analysis: A Tutorial with R and BUGS</i>, Academic Press / Elsevier 5. McLachlan, G. and Basford, K., 1988, <i>Mixture models: inference and application to clustering</i>, Marcel and Decker Inc. 6. Tanner, M. A., 1996, <i>Tools for Statistical Inference: Methods for the Exploration of Posterior Distributions and Likelihood Functions</i>, 3rd Edition, Springer-Verlag: New York. 7. Box, G. E. P. and Tiao, G. C., 1973, Bayesian Inference in Statistical Analysis, Reading, MA, Addison-Wesley. 8. Casella, G. and Berger, R. L., 1990, Statistical Inference, Duxbury, Belmont California, USA. 9. Zellner, A., 1971, An Introduction to Bayesian Inference in Econometrics, Wiley, New York. 10. Titterington, M., Makov, G., and Smith A.F.M., 1985, Statistical analysis of finite mixtures, John Wiley & Sons, UK. 11. Martz, H.F. and Waller, R. A., 1982, <i>Bayesian Reliability Analysis</i>, John Wiley & Sons, New York

Dosen Pengampu	Prof. Drs. Nur Iriawan, M.Ikomp, Ph.D; Irhamah, Ph.D.
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	Memahami konsep berfikir Bayesian dan mengetahui bedanya dengan konsep berfikir frekuentis Understand the concept of Bayesian thinking and know the difference with the concept of frequency thinking	1. Memahami konsep hukum Bayes 2. Memahami perbedaan cara berfikir Bayesian vs frequentist 1. Understand the concept of Bayes' law 2. Understanding the difference in Bayesian vs frequentist thinkin	Tugas 1, Observasi di kelas Task 1, Observation in class	Ceramah, diskusi dan latihan soal 150 Menit Lectures, discussions and exercise 150 Minutes		Pendahuluan: Teorema Bayes dan Bayesian inference Introduction: Bayes' theorem and Bayesian inference (1) Bab 2 (2) Bab 1	5 %
2	Memahami konsep prior, pemilihan prior sesuai dengan pola data. Understanding the concept of priors, prior selection according to data patterns.	1. Mampu memilih prior yang tepat untuk sebuah model Bayesian 2. Mampu memodelkan fenomena riil dengan Bayesian 3. Mampu menghitung probabilitas posterior suatu event 1. Be able to choose the right prior for a Bayesian model 2. Able to model phenomena with Bayesian 3. Be able to calculate the posterior probability of an event	Tugas 2, Observasi di kelas Task 2, Observation in class	Ceramah, diskusi dan latihan soal 150 Menit Lectures, discussions and exercise 150 Minutes		Prior, posterior, dan Bayesodds Prior, Posterior and Bayesodds (1) Bab 3 (2) Bab 2 dan Bab 3 (3) Bab 2	10 %
3 & 4	Memahami konsep data augmentation dan resampling dengan MCMC dan HMC Understand the concept of data augmentation and resampling with MCMC and HMC	1. Mampu mengimplementasikan model Bayesian dengan MCMC, khususnya Gibbs sampler dan Metropolis Hasting 2. Mampu menggunakan WinBUGS, R2WinBUGS, dan RStan untuk penyederhanaan pemodelan Bayesian dengan MCMC dan HMC 1. Able to implement Bayesian model with MCMC, especially Gibbs	Tugas 3, Observasi di kelas Task 3, Observation in class	Ceramah, diskusi dan latihan soal 300 Menit Lectures, discussions and exercise 300 Minutes		Data augmentation dan Markov Chain Monte Carlo (MCMC) Data augmentation and Markov Chain Monte Carlo (MCMC) (1) Bab 4 (2) Bab 10, Bab 11, Bab 12, & Bab 13	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 (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		sampler and Metropolis Hasting 2. Able to use WinBUGS, R2WinBUGS, and RStan for Bayesian modeling simplification with MCMC and HMC				(3) Bab 5, Bab 6, Bab 10, dan Bab 11 (4)	
5 & 6	Memahami struktur posterior untuk single dan multiple parameter yang tersusun secara hierarchy ataupun tidak Understand the posterior structure for single and multiple parameters that are arranged in a hierarchy or not	1. Mampu membedakan dan memodelkan permasalahan dengan Bayesian single dan multipleparameter 2. Mampu mengkonstruksikan pemodelan Bayesian dengan struktur Hierarchy 1. Able to distinguish and model problems with Bayesian single and multiple parameters 2. Able to construct Bayesian modeling with Hierarchy structure	Tes tulis Tugas 2 Observasi di kelas Writing test Task 2 Observation in class	Ceramah, diskusi dan latihan soal 300 Menit Lectures, discussions and exercise 300 Minutes		Single-parameter model dan Multi-parameter model Single-parameter model and Multi-parameter model (1) Bab 3 dan Bab 5 (2) Bab 5, Bab 14, dan Bab 15 (3) Bab 3, Bab 4, dan Bab 7	10 %
7	Memahami struktur Bayesian untuk distribusi normal, non-normal ataupun neo-normal Understand Bayesian structures for normal, non-normal or neo-normal distributions	1. Mampu membedakan permasalahan normal, non-normal, dan neo-normal 2. Mampu menyusun, mengimplementasikan model Bayesian normal, non-normal, dan neo-normal dengan MCMC 1. Able to distinguish normal, non-normal, and neo-normal problems 2. Able to compose, implement normal, non-normal, and neo-normal Bayesian models with MCMC	Tes tulis Tugas 2 Observasi di kelas Writing test Task 2 Observation in class	Ceramah, diskusi dan latihan soal 150 Menit Lectures, discussions and exercise 150 Minutes		Bayesian non-Normal dan neo-Normal model Bayesian non-Normal and neo-Normal models	5 %
8, 9, & 10	Memahami struktur Bayesian untuk model-model dalam GLMs Understanding Bayesian structures for GLMS models	1. Memahami konsep estimasi model GLMs dengan Bayesian 2. Mampu memodelkan fenomena riil dalam kategori GLMs dengan Bayesian	Tes tulis Tugas 3 Observasi di kelas Writing test Task 3	Ceramah, diskusi dan latihan soal 450 Menit Lectures, discussions and exercise		Bayesian GLMs Bayesian GLMs (1) Bab 5 dan Bab 10 (2) Bab 16	15 %

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. Understand the concepts of estimating GLMs using Bayesian 2. Able to model real phenomena using Bayesian	Observation in class	450 Minutes		(3) Bab 9	
11 & 12	Memahami struktur Bayesian untuk system pemodelan dengan susunan mixture distribusi, model linear atau non-linear, maupun GLMs. Understand Bayesian structure for modeling system containing mixture of density, linear or non-linear model, and even GLMs.	1. Mampu mengidentifikasi permasalahan yang mempunyai struktur model mixture 2. Mampu memodelkan fenomena mixture dalam struktur Bayesian 3. Mampu menerapkan MCMC dalam penyelesaian Bayesian mixture 1. Able to identify problems that have a mixture model structure 2. Able to model mixture phenomena in Bayesian structure (mixture of density, of linear/non-linear model, and GLMs) 3. Able to apply MCMC in solving Bayesian mixture	Tes tulis Tugas 4 Observasi di kelas Writing test Task 4 Observation in class	Ceramah dan, diskusi 300 Menit Lectures and discussions 300 Minutes		Bayesian Mixture Model Bayesian Mixture Model (2) Bab 22 dan Bab 23	15 %
13 & 14	Memahami cara pembentukan beberapa alternatif model Bayesian dan memahami cara pemilihan model Bayesian terbaik Understand how to form several alternative Bayesian models and understand how to choose the best Bayesian model	1. Mampu menyusun model struktur perkalian distribusi 2. Mampu menerapkan Bayes faktor dalam pemilihan model 3. Mampu membangun HPD dan Credible Interval 4. Mampu menentukan jumlah komponen mixture dengan MCMC dan reversible jump 1. Able to construct a multiplication distribution structure model 2. Able to apply Bayesian factors in model selection 3. Able to determine the number of mixture components with MCMC and reversible jump	Tes tulis Tugas 4 Observasi di kelas Writing test Task 4 Observation in class	1. Ceramah interaktif 2. Diskusi 3. Latihan 4. Praktikum 5. PBL 300 Menit 1. Interactive lecture 2. discussion 3. exercise 4. Practice 5. PBL 300 Minutes		Pemilihan model terbaik dengan Bayesian Selection of the best model with Bayesian (1) Bab 6 (2) Bab 6 dan Bab 7	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 (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
15 & 16	Memahami materi yang ditugaskan dan memahami alternatif model Bayesian yang paling tepat untuk digunakan. Understand the assigned material and understand the most appropriate alternative Bayesian model to use	Mampu menerapkan Bayesian untuk menyelesaikan masalah riil dengan Bayesian dan MCMC menggunakan program WinBUGS atau R2WinBUGS atau RStan Able to apply Bayesian to solve real problems with Bayesian and MCMC using WinBUGS or R2WinBUGS or RStan programs	Kemampuan pemaparan hasil proyek, Aktifitas diskusi, dan Laporan proyek Ability to present project results, discussion activities, and project reports	300 Menit 300 Minutes		Presentasi Proyek Bayesian Bayesian Project Presentation (1) Bab 9, Bab 10, dan Bab 11	20 %