

**MODULE HANDBOOK
NON PARAMETRIC
REGRESSION**



**BACHELOR DEGREE PROGRAM
DEPARTEMENT OF STATISTICS
FACULTY OF SCIENCE AND DATA ANALYTICS
INSTITUT TEKNOLOGI SEPULUH NOPEMBER**

ENDORSEMENT PAGE



MODULE HANDBOOK NON PARAMETRIC REGRESSION 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>	Tandatangan <i>Signature</i>	
Perumus <i>Preparation</i>	Prof. Dr. Drs. I Nyoman Budiantara	Dosen <i>Lecturer</i>		March 28, 2019
Pemeriksa dan Pengendalian <i>Review and Control</i>	Prof. Dr. Drs. I Nyoman Budiantara, M.Si ; Dra. Madu Ratna, M.Si	Tim kurikulum <i>Curriculum team</i>		April 15, 2019
Persetujuan <i>Approval</i>	Dr. Santi Wulan Purnami, M.Si	Koordinator RMK <i>Course Cluster Coordinator</i>		July 17, 2019
Penetapan <i>Determination</i>	Dr. Kartika Fithriasari, M.Si	Kepala Departemen <i>Head of Department</i>		July 30, 2019

MODULE HANDBOOK

NON PARAMETRIC REGRESSION

Module name	Non Parametric Regression	
Module level	Undergraduate	
Code	KS184625	
Course (if applicable)	Non Parametric Regression	
Semester	Sixth Semester	
Person responsible for the module	Prof. Dr. Drs. I Nyoman Budiantara	
Lecturer	Prof. Dr. Drs. I Nyoman Budiantara, M.Si ; Dra. Madu Ratna, M.Si	
Language	Bahasa Indonesia and English	
Relation to curriculum	Undergraduate degree program, Optional , 6 th semester.	
Type of teaching, contact hours	Lectures, <50 students	
Workload	<ol style="list-style-type: none"> 1. Lectures : 3 x 50 = 100 minutes per week. 2. Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) per week. 3. Private learning : 3 x 60 = 130 minutes (3 hours) per week. 	
Credit points	3 credit points (sks)	
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	
Learning outcomes and their corresponding PLOs	<p><i>CLO. 1 Able to understand the basic concepts of parametric regression, nonparametric regression (Spline, Kernel, Fourier Series and Local Polynomials)</i></p> <p><i>CLO. 2 Able to distinguish between parametric regression and nonparametric regression, as well as their use in modeling.</i></p> <p><i>CLO. 3 Able to model paired data using models nonparametric regression that fits the data pattern, and is able to choose the best model.</i></p> <p><i>CLO. 4 Able to make the right decisions using various nonparametric regression methods according to the data pattern.</i></p> <p><i>CLO. 5 Able to use computational techniques and modern computer equipment required in the non-parametric regression field</i></p>	<p>PLO-01</p> <p>PLO-03</p>

	<p><i>LO. 6 Having knowledge of current and future issues related to the field of non-parametric regression</i></p> <p><i>CLO. 7 Able to communicate effectively and cooperate in an interdisciplinary team and multidisciplinary teams.</i></p> <p><i>CLO. 8 Have professional responsibility and ethics</i></p> <p><i>CLO. 9 Able to motivate oneself to think creatively and learn throughout life</i></p>	PLO-04
Content	<p><i>Nonparametric Regression is a method in regression analysis to model data patterns that do not follow certain patterns. The material of this course begins with an introduction to parametric regression, distinguishing Parametric Regression, Spline Truncated Nonparametric Regression and Spline Truncated Semiparametric Regression. Furthermore, it is discussed in depth data modeling using Spline Truncated Regression in univariable, multivariable nonparametric regression and selecting the best model, along with its application. In addition, a Spline Truncated semiparametric regression model is presented and the best model selection accompanied by its application is presented. Furthermore, the generalization of the Spline Truncated model in nonparametric and semiparametric regression for longitudinal data is discussed, and its application in various fields.</i></p>	
Study and examination requirements and forms of examination	<ul style="list-style-type: none"> • In-class exercises • Assignment 1, 2, 3 • Mid-term examination • Final examination 	
Media employed	LCD, whiteboard, websites (myITS Classroom), zoom.	
Reading list	<ol style="list-style-type: none"> 1. Bilodeau, M., 1992. Fourier Smoother and Additive Models, The Canadian Journal of Statistics. 3. 257-269. 2. Eubank, R. L., 1988. Spline Smoothing and Nonparametric Regression. New York: Mercel Dekker. 3. Green, P. J., and Silverman, B. W., 1994. Nonparametric Regression and Generalized Linear Models. London: Chapman and Hall. 4. Hardle, W., 1990. Applied Nonparametric Regression. New York: Cambridengane University Press. 5. Hardle, W., 1991. Smoothing Tecniques With Implementation in S. New York: Springger Verlag. 6. Rupert, D., Wand, M.P, and Carrol, R.J., 2003. Semiparametric Regression. New York: Cambridengane University Presss. 7. Wahba, G., 1990. Spline Models for Observational Data. Pennsylvania: SIAM. 8. Wu, H. and Zhang, J. T., 2006. Nonparametric Regression Method for Longitudinal Data Analisys: Mixed Effects Modeling 	

	Approaches. New York : John Wiley and Sons.
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Bahan Kajian <i>Study Materials</i>	Dasar Sains, Teori Statistika, Deskripsi dan Eksplorasi, Komputasi dan Data Processing, Pemodelan, Industri dan Bisnis, Pemerintahan dan Kependudukan, Ekonomi dan Manajemen, Kesehatan dan Lingkungan, Sosial Humaniora <i>Basic of Science, Statistical Theory, Description and Exploration, Computing and Data Processing, Modeling, Industry and Business, Government and Population, Economics and Management, Health and Environment, Social Humanities</i>
CPL yang dibebankan 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 Able to apply knowledge of statistical theory, mathematics, and computation</i> <i>PLO-3 Able to analyze data with appropriate statistical methods and interpret it</i> <i>PLO-4 Able to identify, formulate, and solve statistical problems in various applied fields</i>
CP-MK <i>CLO</i>	CPMK.1 Mampu memahami konsep dasar regresi parametrik, regresi nonparametrik (Spline, Kernel, Deret fourier dan Polinomial lokal) CPMK.2 Mampu membedakan regresi parametrik dan regresi nonparametrik, serta penggunaannya dalam pemodelan CPMK.3 Mampu memodelkan data berpasangan menggunakan model regresi nonparametrik yang sesuai dengan pola data, serta mampu memilih model terbaik CPMK.4 Mampu mengambil keputusan yang tepat menggunakan berbagai metode regresi nonparametrik sesuai dengan pola data CPMK.5 Mampu menggunakan teknik komputasi dan perangkat komputer modern yang diperlukan dalam bidang regresi non parametrik CPMK.6 Memiliki pengetahuan tentang isu terkini dan mendatang yang berkaitan dengan bidang regresi non parametrik CPMK.7 Mampu berkomunikasi secara efektif dan bekerjasama dalam tim yang interdisiplin dan multidisiplin CPMK.8 Memiliki tanggung jawab dan etika profesi CPMK.9 Mampu memotivasi diri untuk berpikir kreatif dan belajar sepanjang hayat <i>CLO. 1 Able to understand the basic concepts of parametric regression, nonparametric regression (Spline, Kernel, Fourier Series and Local Polynomials)</i> <i>CLO. 2 Able to distinguish between parametric regression and nonparametric regression, as well as their use in modeling.</i> <i>CLO. 3 Able to model paired data using models nonparametric regression that fits the data pattern, and is able to choose the best model.</i> <i>CLO. 4 Able to make the right decisions using various nonparametric regression methods according to the data pattern.</i> <i>CLO. 5 Able to use computational techniques and modern computer equipment required in the non-parametric regression field</i> <i>CLO. 6 Having knowledge of current and future issues related to the field of non-parametric regression</i> <i>CLO. 7 Able to communicate effectively and work together in interdisciplinary and multidisciplinary teams</i> <i>CLO. 8 Have the responsibility and professional ethics</i> <i>CLO. 9 Able to motivate oneself to think creatively and learn throughout life</i>

Pertemuan <i>Meeting</i>	Kemampuan Akhir Sub CP-MK <i>Final Ability</i>	Keluasan (materi pembelajaran) <i>Extent (learning material)</i>	Metode Pembelajaran <i>Learning methods</i>	Estimasi Waktu <i>Duration</i>	Bentuk Evaluasi <i>Evaluation Type</i>	Kriteria dan Indikator Penilaian <i>Assessment Criteria and Indicators</i>	Bobot Penilaian <i>Scoring</i>
1	1. Mampu memahami konsep Konsep dasar regresi parametrik dan nonparametrik dan mampu membedakan regresi parametrik dan nonparametrik	Konsep dasar regresi parametrik dan nonparametrik, serta perbedaan dengan regresi parametrik.	CIDLSP	150 menit	Tes Tulis, Tugas Soal	1. Mampu menyelidiki pola data yang berpola tertentu dan tidak berpola. 2. Mampu mengidentifikasi data yang mengikuti model regresi parametrik dan model regresi nonparametrik.	10% / 10%
1	1. <i>Able to understand the basic concepts of parametric and nonparametric regression concepts and to be able to distinguish between parametric and nonparametric</i>	<i>regression Basic concepts of parametric and nonparametric regression, as well as differences with parametric regression</i>	<i>CIDLSP</i>	<i>150 minutes</i>	<i>Writing Test, Task Assignment</i>	<i>1. Able to investigate data patterns with specific and non-patterned data. 2. Able to identify data that follows parametric regression models and nonparametric regression models.</i>	<i>10% / 10%</i>
2-3	2. Mampu melakukan estimasi kurva regresi nonparametrik Spline	Estimasi kurva regresi nonparametrik dengan pendekatan Spline.	CIDLSP	300 menit	Tes Tulis, Tugas Soal	1. Mampu mencari estimasi parameter model regresi spline dengan metode LS, PLS, MLE ataupun PL. 2. Mampu mencari estimasi model regresi spline.	15% / 25%
2-3	2. <i>Able to estimate nonparametric regression curve Spline Nonparametric regression curve estimation using Spline</i>	<i>Nonparametric regression curve estimation using the Spline approach.</i>	<i>CIDLSP</i>	<i>300 minutes</i>	<i>Writing Test, Task Task</i>	<i>1. Able to find parameter estimation of spline regression model using LS, PLS, MLE or PL method. 2. Able to find spline regression model estimation.</i>	<i>15% / 25%</i>
4	3. Mampu melakukan estimasi kurva regresi nonparametrik Kernel	Estimasi kurva regresi nonparametrik dengan pendekatan Kernel.	CIDLSP	150 menit	Tes Tulis, Tugas Soal.	Mampu mencari estimasi kurva regresi nonparametrik Kernel	10% / 35%
4	3. <i>Able to estimate nonparametric regression curve</i>	<i>Kernel nonparametric regression curve estimation using Kernel approach.</i>	<i>CIDLSP</i>	<i>150 minutes</i>	<i>Writing Test, Question Task.</i>	<i>Able to find nonparametric regression curve estimation. Kernel</i>	<i>10% / 35%</i>

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5-6	4. Mampu melakukan estimasi kurva regresi nonparametrik Deret Fourier	Estimasi kurva regresi nonparametrik dengan pendekatan Deret Fourier.	CIDLSP	300 menit	Tes Tulis, Tugas Soal.	Mampu mencari estimasi model regresi Deret Fourier	15% / 50%
5-6	4. <i>Able to estimate the nonparametric regression curve for Fourier Series</i>	<i>Nonparametric regression curve estimation using the Fourier Series approach.</i>	<i>CIDLSP</i>	<i>300 minutes</i>	<i>Writing Test, Question Task.</i>	<i>Able to find Fourier Series regression model estimation</i>	<i>15% / 50%</i>
7	5. Mampu melakukan estimasi kurva regresi nonparametrik Polinomial Lokal	Estimasi kurva regresi nonparametrik dengan pendekatan Polinomial Lokal	CIDLSP	150 menit	Tes Tulis, Tugas Soal.	Mampu mencari estimasi model regresi Polinomial Lokal	10% / 60%
7	5. <i>Able to estimate nonparametric regression curve Local Polynomial</i>	<i>Nonparametric regression curve estimation using Local Polynomial Approach</i>	<i>CIDLSP Approach</i>	<i>150 minutes</i>	<i>Writing Test, Problem Task.</i>	<i>Able to find local polynomial regression model estimates</i>	<i>10% / 60%</i>
8	ETS						
9	6. Mampu memahami konsep dasar tentang titik knot dan parameter penghalus (bandwidth) dalam regresi nonparametrik spline, kernel, deret fourier dan polinomial lokal	Konsep dasar tentang titik knot dan parameter penghalus (bandwidth) dalam regresi nonparametrik spline, kernel, deret fourier dan polinomial lokal.	CIDLSP	150 menit	Tes Tulis, Tugas Soal.	Mampu memahami peran dan konsep dasar tentang : 1. Titik knot. 2. Parameter penghalus (bandwidth)	10% / 70%
9	6. <i>Able to understand the basic concept of knot points and smoothing parameters (bandwidth) in nonparametric regression of spline,</i>	<i>Basic concept of knot point and smoothing parameter (bandwidth) in the nonparametric regression of the</i>	<i>CIDLSP</i>	<i>150 minutes</i>	<i>Writing Test, Question Task.</i>	<i>Able to understand roles and basic concepts about:</i> 1. <i>Point knots.</i> 2. <i>Smoothing parameter (bandwidth)</i>	<i>10% / 70%</i>

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	<i>kernel, Fourier series and local polynomials.</i>	<i>spline, kernel, Fourier series and local polynomials.</i>					
10-11	7. Mampu memilih titik knot dan parameter penghalus (bandwith) optimal dalam regresi nonparametrik dengan berbagai metode	Pemilihan titik knot dan parameter penghalus (bandwith) optimal dalam regresi nonparametrik dengan berbagai metode	CIDLSP	300 menit	Tes Tulis, Tugas Soal.	Mampu menggunakan metode: 1. GCV 2. CV 3. GML 4. UBR	10% / 80%
10-11	7. <i>Able to select optimal knot points and smoothing parameters (bandwidth) in nonparametric regression with various methods</i>	<i>Selection of optimal knot points and smoothing parameters (bandwidth) in nonparametric regression with various methods</i>	<i>CIDLSP</i>	<i>300 minutes</i>	<i>Written Test, Question Task.</i>	Dalam pemilihan titik knot dan parameter penghalus (bandwith) optimal dalam regresi nonparametrik <i>Able to use the following methods:</i> 1. GCV 2. CV 3. GML 4. UBR <i>In selecting optimal knot points and smoothing parameters (bandwidth) in nonparametric regression</i>	<i>10% / 80%</i>
12-13	8. Mampu memodelkan berbagai hubungan pola data dalam berbagai bidang ilmu menggunakan pendekatan regresi nonparametric	Aplikasi model regresi nonparametrik Spline, Kernel, Deret Fourier dan Polinomial Lokal.	CIDLSP	300 menit	Tes Tulis, Tugas Soal.	Mampu memodelkan berbagai hubungan pola data dalam dunia nyata menggunakan regresi nonparametrik : 1. Spline, 2. Kernel, 3. Deret Fourier dan 3. Polinomial Lokal.	10% / 90%
12-13	8. <i>Able to model various data pattern relationships in various fields of science using the approach Nonparametric regression</i>	<i>Application of nonparametric regression models of Spline, Kernel, Fourier Series and Local Polynomials.</i>	<i>CIDLSP</i>	<i>300 minutes</i>	<i>Writing Test, Question Task.</i>	<i>Able to model various data pattern relationships in the real world using nonparametric regression:</i> 1. Spline, 2. Kernel, 3. Fourier Series and 3. Local Polynomials.	<i>10% / 90%</i>

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14-15	9. Mampu mengembangkan model regresi nonparametrik sederhana, menjadi model regresi nonparametrik yang lebih kompleks	Model regresi nonparametrik multivariabel, multirespon dan Data longitudinal, serta regresi semiparametrik.	CIDLSP	300 menit	Tes Tulis, Tugas Soal.	Mampu mengembangkan model regresi nonparametrik sederhana menjadi model-model : 1. Model regresi nonparametrik multivariabel, 2. Model regresi nonparametrik multirespon dan 3. Model regresi nonparametrik untuk Data longitudinal 4. Model regresi Semiparametrik.	10% / 100%
14-15	10. <i>Able to develop simple nonparametric regression model, to become a more complex</i>	<i>nonparametric regression model. Multivariable nonparametric regression model, multiresponse and longitudinal data, and semiparametric regression.</i>	<i>CIDLSP</i>	<i>300 minutes</i>	<i>Writing Test, Question Task.</i>	<i>Able to develop simple nonparametric regression models into models:</i> <i>1. Multivariable nonparametric regression models,</i> <i>2. nonparametric regression models</i> <i>3. Nonparametric regression models for longitudinal data</i> <i>Multiresponse</i> <i>4. Semiparametric regression models.</i>	<i>10% / 100%</i>
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PUSTAKA/REFERENCES :

1. Bilodeau, M., 1992, Fourier Smoother and Additive Models, *The Canadian Journal of Statistics*, 3, 257-269.
2. Eubank, R. L., 1988, *Spline Smoothing and Nonparametric Regression*, MerceL Dekker, New York.
3. Green, P. J., and Silverman, B. W., 1994, *Nonparametric Regression and Generalized Linear Models*, Chapman and Hall, London.
4. Hardle, W., 1990, *Applied Nonparametric Regression*, Cambridge University Press, New York
5. Hardle, W., 1991, *Smoothing Techniques With Implementation in S*, Springer Verlag, New York.
6. Rupert, D., Wand, M.P, and Carrol, R.J., 2003, *Semiparametric Regression*, Cambridge University Press, New York
7. Wahba, G., 1990, *Spline Models for Observational Data*, SIAM, Pennsylvania.
8. Wu, H. and Zhang, J. T., 2006, *Nonparametric Regression Method for Longitudinal Data Analysis : Mixed Effects Modeling Approaches*, John Wiley and Sons, New York.