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MODULE HANDBOOK

# STATISTICAL MACHINE LEARNING

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

# ENDORSEMENT PAGE

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| | **MODULE HANDBOOK**<br>**STATISTICAL MACHINE LEARNING**<br>**DEPARTMENT OF STATISTICS**<br>**INSTITUT TEKNOLOGI SEPULUH NOPEMBER** |

| **Proses**<br>***Process*** | **Penanggung Jawab**<br>***Person in Charge*** | | | **Tanggal**<br>***Date*** |
|---|---|---|---|---|
| | **Nama**<br>***Name*** | **Jabatan**<br>***Position*** | **Tandatangan**<br>***Signature*** | |
| Perumus<br>*Preparation* | Dr. rer pol Dedy Dwi Prastyo, M.Si | Dosen<br>*Lecturer* | | **March 28, 2019** |
| Pemeriksa dan Pengendalian<br>*Review and Control* | Dr. Dra. Kartika Fithriasari, M.Si ; Irhamah, S.Si, M.Si, Ph.D ; Adatul Mukarromah, S.Si. M.Si ; Dra. Wiwiek Setya Winahju, M.S. | Tim kurikulum<br>*Curriculum team* | | **April 15, 2019** |
| Persetujuan<br>*Approval* | Prof. Drs. Nur Iriawan, M.Ilkom., Ph.D | Koordinator RMK<br>*Course Cluster Coordinator* | | **July 17, 2019** |
| Penetapan<br>*Determination* | Dr. Kartika Fithriasari, M.Si | Kepala Departemen<br>*Head of Department* | | **July 30, 2019** |

# MODULE HANDBOOK

# STATISTICAL MACHINE LEARNING

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| Module name | **Statistical Machine Learning** |
| Module level | Undergraduate |
| Code | KS184749 |
| Course (if applicable) | Statistical Machine Learning |
| Semester | Seventh Semester (Odd) |
| Person responsible for the module | Dr. rer pol Dedy Dwi Prastyo, M.Si |
| Lecturer | Dr. Dra. Kartika Fithriasari, M.Si ; Irhamah, S.Si, M.Si, Ph.D ; Adatul Mukarromah, S.Si. M.Si ; Dra. Wiwiek Setya Winahju, M.S. |
| Language | Bahasa Indonesia and English |
| Relation to curriculum | Undergradute degree program, **mandatory**, 3rd semester. |
| Type of teaching, contact hours | Lectures, <50 students |
| Workload | 1. Lectures : 3 x 50 = 150 minutes per week.<br>2. Practicum : 135 minutes per week.<br>3. Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) perweek.<br>4. Private learning : 3 x 60 = 180 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 | 1. Time Series Analysis<br>2. Multivariate Analysis |
| Learning outcomes and their corresponding PLOs | *CLO.1 Can explain the concept of machine learning and its applications in various fields* — PLO - 3<br>*CLO. 2 Able to explain Machine Learning modeling procedures ranging from pre-processing to presenting information*<br>*CLO. 3 Able to identify, formulate, and solve statistical problems using machine learning methods.* — PLO - 4<br>*CLO. 4 Able to use the computing techniques and modern computer devices required in Machine Learning* — PLO - 5<br>*CLO. 5 Have knowledge of current and upcoming issues related to machine learning* — PLO - 6 |
| Content | *Statistical Machine Learning (SML) course, how computers can be made to behave intelligently. In this lecture, a theoretical and practical approach to SML will be discussed, with topics including search methods, artificial neural network methods and fuzzy methods.* |

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| Study and examination requirements and forms of examination | • In-class exercises<br>• Assignment 1, 2, 3<br>• Mid-term examination<br>• Final examination |
| Media employed | LCD, whiteboard, websites (myITS Classroom), zoom. |
| Reading list | 1. Haykin, S. 1999, Neural Networks, 2nd ., ed., Prentice Hall<br>2. Fausett, L., 1994, Fundamental of Neural Networks, Prentice Hall<br>3. Limin Fu, 1994, Neural Network in Computer Intelligence, McGraw Hill<br>4. Sivanandam, S.N., Sumathi, S., and Deepa, S. N., 2006, Introduction to Neural Networks using MATLAB 6, McGraw-Hill<br>5. Hastie, T., Tibshirani, R., and Friedman, J., 2017, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Second Edition, Springer New York<br>6. James, G., Witten, D., Hastie, T., and Tibshirani, R., 2014, An Introduction to Statistical Learning (with Application in R), Springer<br>7. Cristianini, N and Shawe-Taylor, J., , 2000, An Introduction to Support Vector Machines and Other Kernel-based Learning Methods, 1st Edition, Cambridge University Press<br>8. Goodfellow, Ian; Bengio,Yoshua and Aaron. 2016. *Deep Learning*. |

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| | Program Studi | Sarjana, Departemen Statistika, FMKSD-ITS |
| | Mata Kuliah | Statistical Machine Learning |
| | Kode Mata Kuliah | KS184341 |
| | Semester/SKS | III/3 |
| | MK Prasyarat | - |
| **RP-S1** | Dosen Pengampu | Dr. Dra. Kartika Fithriasari, M.Si ; Irhamah, S.Si, M.Si, Ph.D ; Adatul Mukarromah, S.Si. M.Si ; Dra. Wiwiek Setya Winahju, M.S. |

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| **Bahan Kajian**<br>*Study Materials* | Dasar Sains, Teori Statistika, Pengumpulan Data, Deskripsi dan Eksplorasi, Komputasi dan Data Processing, Pemodelan, Industri dan Bisnis, Pemerintahan dan Kependudukan, Ekonomi dan Manajemen, Kesehatan dan Lingkungan<br>*Basic Science, Statistical Theory, Data Collection, Description and Exploration, Computing and Data Processing, Modeling, Industry and Business, Government and Population, Economics and Management, Health and Environment* |
| **CPL yang dibebankan MK**<br>*PLO* | CPL-3 Mampu menganalisis data dengan metode statistika yang tepat dan mengintepretasikannya<br>CPL-4 Mampu mengindentifikasi,memformulasi, dan menyelesaikan masalah statistika di berbagai bidang terapan<br>CPL-5 Mampu menggunakan teknik komputasi dan perangkat komputer modern yang diperlukan dalam bidang statistika dan sains data<br>CPL-6 Memiliki pengetahuan tentang isu terkini dan mendatang yang berkaitan dengan bidang statistika dan sains data<br>*PLO-3 Able to analyze data with the right statistical methods and interpret it*<br>*PLO-4 Able to identify, formulate and solve statistical problems in various applied fields*<br>*PLO-5 Able to use the computing techniques and modern computer devices required in the field of statistics and data science*<br>*PLO-6 Have knowledge of current and upcoming issues related to the field of statistics and data science* |
| **CP-MK**<br>*CLO* | CPMK.1 Dapat menjelaskan konsep pembelajaran mesin (*Machine Learning*) dan aplikasinya di berbagai bidang<br>CPMK.2 Mampu menjelaskan prosedur pemodelan *Machine Learning* mulai dari pre-processing sampai menyajikan informasi<br>CPMK.3 Mampu mengindentifikasi, memformulasi, dan menyelesaikan masalah statistika menggunakan metode *Machine Learning*.<br>CPMK-4 Mampu menggunakan teknik komputasi dan perangkat komputer modern yang diperlukan dalam *Machine Learning*<br>CPMK-5 Memiliki pengetahuan tentang isu terkini dan mendatang yang berkaitan dengan bidang *Machine Learning*<br>*CLO.1 Can explain the concept of machine learning and its applications in various fields*<br>*CLO.2 Able to explain Machine Learning modeling procedures ranging from pre-processing to presenting information*<br>*CLO.3 Able to identify, formulate, and solve statistical problems using machine learning methods.*<br>*CLO.4 Able to use the computing techniques and modern computer devices required in Machine Learning*<br>*CLO.5 Have knowledge of current and upcoming issues related to machine learning* |

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| | MK Prasyarat | - |
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| TM ke- | Kemampuan Akhir Sub CP-MK | Keluasan (materi pembelajaran) | Metode Pembelajaran | Estimasi Waktu | Bentuk Evaluasi | Kriteria dan Indikator Penilaian | Bobot Penilaian |
|---|---|---|---|---|---|---|---|
| 1 | 1. Memahami konsep Konsep dasar *Machine Learning* untuk pemodelan Statistik dan perkembangan terkini<br>*1. Understanding the basic Concepts of Machine Learning for Statistical modeling and the latest developments* | Konsep *Machine Learning*<br>*Machine Learning Concept* | Ceramah interaktif Diskusi (CID)<br>*Interactive lectures Discussions (CID)* | 150 menit<br>*150 Minutes* | Observasi Aktifitas di kelas (TOA)<br>*Observation Activities in the classroom (TOA)* | 1.1 Dapat menjelaskan dan memahami dasar *Machine Learning*<br>1.2 Dapat mengidentifikasi permasalahan yang cocok untuk diselesaikan dengan *Machine Learning*<br>1.3 Perkembangan terkini metode Statistika untuk *Machine Learning*<br>*1.1 Can explain and understand the basics of Machine Learning*<br>*1.2 Can identify issues that are suitable for solving with Machine Learning*<br>*1.3 Latest developments in Statistics methods for Machine Learning* | 10%/10% |
| 2-3 | 2 Mampu menjelaskan dan menerapkan metode Jaringan Syaraf Tiruan (JST) untuk klasifikasi | 1. Konsep dasar JST.<br>2. Membangun arsitektur JST untuk klasifikasi<br>*1. The basic concept of JST.* | CID, Latihan Soal (L)<br>*Interactive lectures Discussions (CID) , Exercises* | 300 menit<br>*300 Minutes* | Tes<br>Tugas1 (ObservasiAktifitas di kelas)<br>*Test Task 1* | 2.1 Dapat mengidentifikasi permasalahan klasifikasi yang diselesaikan dengan JST<br>2.2 Dapat menyelesaikan kasus klasifikasi dengan menggunakan metode JST | 10%/20% |

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|---|---|---|---|---|---|---|---|
| | *2. Able to explain and apply artificial neural network (JST) method for classification* | *2. Building JST architecture for classification* | | | *Observation Activities in the classroom (TOA)* | *2.1 Can identify classification issues resolved with JST*<br>*2.2 Can resolve classification cases by using JST method* | |
| 4-5 | 3. Mampu menjelaskan dan menerapkan metode Jaringan Syaraf Tiruan (JST) untuk regresi<br>*3. Able to explain and apply Artificial Neural Network (JST) method for regression* | 1. Konsep dasar JST.<br>2. Membangun arsitektur JST untuk regresi<br>*1. The basic concept of JST.*<br>*2. Building JST architecture for regression* | CIDL,<br>Latihan Soal (L)<br>*Interactive lectures Discussions (CID)*<br>, *Exercises* | 300 menit<br>*300 Minutes* | Tes &Observasi Aktifitas di kelas(TOA)<br>*Test & Observation Activities in the classroom (TOA)* | 3.1 Dapat mengidentifikasi permasalahan regresi yang diselesaikan dengan JST<br>3.2 Dapat menyelesaikan kasus regresi dengan menggunakan metode JST<br>*3.1 Can identify regression issues resolved with JST*<br>*3.2 Can resolve regression cases by using JST method* | 10%/30% |
| 6 | 4. Mampu menjelaskan dan menerapkan metode Jaringan Syaraf Tiruan (JST) untuk time series<br>*4 Able to explain and apply Artificial Neural Network (JST) method for Time Series* | 1. Konsep dasar JST.<br>2. Membangun arsitektur JST untuk time series<br>*1. The basic concept of JST.*<br>*2. Building JST architecture for Time Series* | CIDL,<br>Latihan Soal (L)<br>*Interactive lectures Discussions (CID)*<br>, *Exercises* | 150 menit<br>*150 Minutes* | Tes &Observasi Aktifitas di kelas(TOA)<br>*Test & Observation Activities in the classroom (TOA)* | 4.1 Dapat mengidentifikasi permasalahan time series yang diselesaikan dengan JST<br>4.2 Dapat menyelesaikan kasus time series dengan menggunakan metode JST<br>*4.1 Can identify time series issues resolved with JST*<br>*4.2 Can resolve time series cases by using JST method* | 10%/40% |

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|---|---|---|---|---|---|---|---|
| 7 | 5. Mampu menjelaskan dan menerapkan metode Jaringan Syaraf Tiruan (JST) untuk cluster analysis<br>6. *Able to explain and apply Artificial Neural Network (JST) method for cluster analysis* | 1. Konsep dasar JST.<br>2. Membangun arsitektur JST untuk cluster analysis<br>*1. The basic concept of JST.*<br>*2. Building JST architecture for cluster analysis* | CIDL, Latihan Soal (L)<br>*Interactive lectures Discussions (CID)*, *Exercises* | 150 menit<br>*150 Minutes* | Tes &Observasi Aktifitas di kelas(TOA)<br>*Test & Observation Activities in the classroom (TOA)* | 5.1 Dapat mengidentifikasi permasalahan cluster yang diselesaikan dengan JST<br>5.2 Dapat menyelesaikan kasus cluster dengan menggunakan metode JST<br>*5.1 Can identify cluster issues resolved with JST*<br>*5.2 Can resolve cluster cases by using JST method* | 10%/50% |
| 8 | **ETS/*Midterm*** | | | | | | |
| 9-10 | 6 Mampu menjelaskan dan menerapkan metode SVM untuk klasifikasi<br>*7 Able to explain and apply SVM method for classification* | 1. Konsep dasar SVM.<br>2. Pemodelan SVM untuk klasifikasi<br>*1. The basic concept of SVM.*<br>*2. SVM modeling for classification* | CIDL, Latihan Soal (L)<br>*Interactive lectures Discussions (CID)*, *Exercises* | 300 menit<br>*300 Minutes* | Tes &Observasi Aktifitas di kelas(TOA)<br>*Test & Observation Activities in the classroom (TOA)* | 6.1 Dapat mengidentifikasi permasalahan klasifikasi yang diselesaikan dengan SVM<br>6.2 Dapat menyelesaikan kasus klasifikasi dengan menggunakan metode SVM<br>*6.1 Can identify classification issues resolved with SVM*<br>*6.2 Can solve classification cases by using SVM method* | 10%/60% |

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|---|---|---|---|---|---|---|---|
| 11-12 | 7 Mampu menjelaskan dan menerapkan metode SVM untuk regresi<br>*8 Able to explain and apply SVM method for regression* | 1. Konsep dasar JST.<br>2. Pemodelan SVM untuk regresi<br>*1. The basic concept of SVM.*<br>*2. SVM modeling for regression* | CIDL, Latihan Soal (L)<br>*Interactive lectures Discussions (CID) , Exercises* | 150 menit<br>*150 Minutes* | Tes &Observasi Aktifitas di kelas(TOA)<br>*Test & Observation Activities in the classroom (TOA)* | 7.1 Dapat mengidentifikasi permasalahan regresi yang diselesaikan dengan SVM<br>7.2 Dapat menyelesaikan kasus regresi dengan menggunakan metode SVM<br>*7.1 Can identify regression issues resolved with SVM*<br>*7.2 Can resolve regression cases by using SVM method* | 10%/70% |
| 13 | 8 Mampu menjelaskan dan menerapkan metode SVM untuk time series<br>*9 Able to explain and apply SVM method for time series* | 1. Konsep dasar JST.<br>2. Pemodelan SVM untuk time series<br>*1. The basic concept of SVM.*<br>*2. SVM modeling for time series* | CIDL, Latihan Soal (L)<br>*Interactive lectures Discussions (CID) , Exercises* | 150 menit<br>*150 Minutes* | Tes &Observasi Aktifitas di kelas(TOA)<br>*Test & Observation Activities in the classroom (TOA)* | 8.1 Dapat mengidentifikasi permasalahan time series yang diselesaikan dengan SVM<br>8.2 Dapat menyelesaikan kasus time series dengan menggunakan metode SVM<br>*8.1 Can identify time series issues resolved with SVM*<br>*8.2 Can solve time series cases by using SVM method* | 10%/80% |

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|---|---|---|---|---|---|---|---|
| 14-15 | 9 Mengetahui Perkembangan terkini metode SVM dan JST<br>*9. Know the latest developments in SVM and JST methods* | 1. Perkembangan terkini metode SVM dan JST<br>2. Hybrid SVM (Fuzzy, ensemble)<br>3. Deep Learning NN<br>*1. Latest developments in SVM and JST methods*<br>*2. Hybrid SVM (Fuzzy, ensemble)*<br>*3. Deep Learning NN* | CIDL, Latihan Soal (L)<br>*Interactive lectures Discussions (CID)*, *Exercises* | 150 menit<br>*150 Minutes* | Tes &Observasi Aktifitas di kelas(TOA)<br>*Test & Observation Activities in the classroom (TOA)* | 9.1 Dapat memahami perkembangan terkini pada SVM<br>9.2 Dapat memahami perkembangan terkini pada JST<br>*9.1 Can understand the latest developments in SVM*<br>*9.2 Can understand the latest developments in JST* | 20%/100% |
| **16** | **EAS/*Finalterm*** | | | | | | |

Pustaka/*References*


1. Haykin, S. 1999, Neural Networks, 2nd ., ed., Prentice Hall
2. Fausett, L., 1994, Fundamental of Neural Networks, Prentice Hall
3. Limin Fu, 1994, Neural Network in Computer Intelligence, McGraw Hill
4. Sivanandam, S.N., Sumathi, S., and Deepa, S. N., 2006, Introduction to Neural Networks using MATLAB 6, McGraw-Hill
5. Hastie, T., Tibshirani, R., and Friedman, J., 2017, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Second Edition, Springer New York
6. James, G., Witten, D., Hastie, T., and Tibshirani, R., 2014, An Introduction to Statistical Learning (with Application in R), Springer
7. Cristianini, N and Shawe-Taylor, J., , 2000, An Introduction to Support Vector Machines and Other Kernel-based Learning Methods, 1st Edition, Cambridge University Press
8. Goodfellow, Ian; Bengio,Yoshua and Aaron. 2016. *Deep Learning*.