MODULE HANDBOOK

MULTIVARIATE ANALYSIS

BACHELOR DEGREE PROGRAM

DEPARTMENT OF STATISTICS

FACULTY OF SCIENCE AND DATA ANALYTICS

INSTITUT TEKNOLOGI SEPULUH NOPEMBER

SURABAYA, INDONESIA

ENDORSEMENT PAGE

MODULE HANDBOOK
MULTIVARIATE ANALYSIS
DEPARTMENT OF STATISTICS
INSTITUT TEKNOLOGI SEPULUH NOPEMBER

Proses ***Process***	**Penanggung Jawab** ***Person in Charge***			**Tanggal** ***Date***
	Nama ***Name***	**Jabatan** ***Position***	**Tanda tangan** ***Signature***	
Perumus *Preparation*	Dr. Santi Puteri Rahayu, M.Si.	Dosen *Lecturer*		**March 28, 2019**
Pemeriksa dan Pengendalian *Review and Control*	Dra. Madu Ratna, M.Si Dr. Bambang Widjanarko Otok, M.Si. Muhammad Sjahid Akbar, S.Si, M.Si Santi Puteri Rahayu, M.Si., Ph.D	Tim kurikulum *Curriculum team*		**April 15, 2019**
Persetujuan *Approval*	Dr. Dra. Kartika Fithriasari, M.Si	Koordinator RMK *Course Cluster Coordinator*		**July 17, 2019**
Penetapan *Determination*	Dr. Dra. Kartika Fithriasari, M.Si	Kepala Departemen *Head of Department*		**July 30, 2019**

MODULE HANDBOOK
MULTIVARIATE ANALYSIS

Module name	**Multivariate Analysis**
Module level	Undergraduate
Code	KS184615
Course (if applicable)	Multivariate Analysis
Semester	Sixth Semester (Genap)
Person responsible for the module	Dr. Santi Puteri Rahayu, M.Si.
Lecturer	Dra. Madu Ratna, M.Si Dr. Bambang Widjanarko Otok, M.Si. Muhammad Sjahid Akbar, S.Si, M.Si Santi Puteri Rahayu, M.Si., Ph.D
Language	Bahasa Indonesia and English
Relation to curriculum	Undergraduate degree program, **mandatory**, 6th semester.
Type of teaching, contact hours	Lectures, <50 students
Workload	1. Lectures : 3 x 50 = 150 minutes per week. 2. Practicum : 90 minutes per week. 1. Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) per week. 2. Private learning : 3 x 60 = 180 minutes (3 hours) per week.
Credit points	4 credit points (sks)
Requirements	A student must have attended at least 80% of the lectures to sit in
according to the examination regulations	the exams.

Mandatory prerequisites	• Matrix • Mathematical Statistics I • Mathematical Statistics II	
Learning outcomes and their	CLO.1 Able to understand and explain the use of data exploration concepts in data analysis CLO.2 Able to explain the Data Exploration procedure CLO.4 Able to identify, formulate, and solve statistical problems using data exploration techniques	PLO-03
Content	Multivariate analysis is one of the expertise courses that are part of the field of study in the Statistical Modeling course family. The purpose of studying Multivariate Analysis is to master the theoretical concepts of multivariate analysis in order to understand the multivariate method, both in its development and application. Through this course, it is hoped that students will have a learning experience to think critically and be able to make correct decisions about the multivariate method on a problem and its solution. The learning strategy used is discussion, exercises and assignments.	
Study and examination requirements and forms of examination	● In-class exercises ● Mid-term examination ● Final examination	
Media employed	LCD, whiteboard, websites (myITS Classroom), zoom.	

Reading list	1. Dillon, W.K. and Matthew, G., 1984. *Multivariate Analysis, Methods and Application*. New York : John Wiley dan Sons. 2. Hair, J.F., Anderson, R.E., Tatham, R.L. and Black, W.C., 2006. *Multivariate Data Analysis*. 6th edition. UK: Prentice Hall International. 3. Johnson, R. A. and Dean W. Wichern, D., 2007. *Applied Multivariate Statistical Analysis*, 6th edition. Englewood Cliffs, N.J: Prentice-Hall. 4. Rencher, A.C., 2002. *Method of Multivariate Analysis.* Canada: John Wiley dan Sons. 5. Sharma, S., 1996. *Applied Multivariate Techniques*. New York : John Wiley dan Sons, Inc. 6. Timm, N.H., 2002. Applied Multivariate Analysis. New York : Springer-Verlag.

RENCANA PEMBELAJARAN SEMESTER (RPS)

SEMESTER LEARNING PLAN

	Program Studi	Sarjana, Departemen Statistika, FSAD-ITS
	Mata Kuliah	Analisis Multivariat
	Kode Mata Kuliah	KS184615
	Semester/SKS	VI/4
	MK Prasyarat	Matriks, Statistika Matematika I, Statistika Matematika II
RP-S1	Dosen Pengampu	Dra. Madu Ratna, M.Si ; Dr. Bambang Widjanarko Otok, M.Si. ; Muhammad Sjahid Akbar, S.Si, M.Si ; Santi Puteri Rahayu, M.Si., Ph.D

Bahan Kajian *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, dan Sosial Humaniora
CPL yang dibebankan MK *PLO*	CPL.1 Mampu menerapkan pengetahuan teori statistika, matematika, dan komputasi CPL.3 Mampu menganalisis data dengan metode statistika yang tepat dan mengintepretasikannya CPL.4 Mampu mengindentifikasi,memformulasi, dan menyelesaikan masalah statistika di berbagai bidang terapan *PLO.1 Able to apply knowledge of statistical theory, mathematics, and computation* *PLO.2 Able to analyze data with appropriate statistical methods and interpret them* *PLO.4 Able to identify, formulate, and solve statistical problems in various applied fields*

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	MK Prasyarat	Matriks, Statistika Matematika I, Statistika Matematika II
RP-S1	Dosen Pengampu	Dra. Madu Ratna, M.Si ; Dr. Bambang Widjanarko Otok, M.Si. ; Muhammad Sjahid Akbar, S.Si, M.Si ; Santi Puteri Rahayu, M.Si., Ph.D

CP-MK *CLO*	CPMK.1 Mampu menerapkan pengetahuan teori statistika, matematika, dan komputasi terkait konsep analisis multivariat CPMK.3 Mampu menganalisis data dengan metode multivariat yang tepat dan mengintepretasikannya CPMK.4 Mampu mengindentifikasi,memformulasi, dan menyelesaikan masalah multivariat di berbagai bidang terapan *CLO.1 Able to apply knowledge of statistical theory, mathematics, and computation related to the concept of multivariate analysis* *CLO.2 Able to analyze data with multivariate methods and interpret them* *CLO.4 Able to identify, formulate, and solve statistical problems in various applied fields*

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Perte muan *Meeting*	**Kemampuan Akhir Sub CP-MK** *Final Ability*	**Keluasan (materi pembelajaran)** *Extent (learning material)*	**Metode Pembelajaran** *Learning methods*	**Estimasi Waktu** *Duration*	**Bentuk Evaluasi** *Evaluation Type*	**Kriteria dan Indikator Penilaian** *Assessment Criteria and Indicators*	**Bobot Penilaian** *Scoring*

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1	Dapat menjelaskan konsep dan tujuan analisis multivariat *Can explain concepts and purpose of multivariate analysis*	Konsep dasar analisis multivariate, Aplikasi dan Pengelompokan metode multivariate, Aljabar matriks dan vector random *The basic concept of multivariate analysis, application and grouping of multivariate methods, matrix algebra and random vectors*	Ceramah Interaksi, Diskusi, Latihan, Seminar *Interactive lectures Discussion and Exercise*	150 menit *150 minutes*	Observasi Aktifitas di kelas *Observation of classroom activities*	1. Mengetahui penerapan metode multivariate di permasalahan riil. 2. Dapat membedakan antara data univariat dan data multivariate. 3. Mengetahui pengelompokan metode univariat dan metode multivariate. 4. Mampu menghitung konsep matriks yang sering digunakan dalam analisis multivariate *1. Knowing the application of the multivariate method to real problems.*	10% /10%

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	MK Prasyarat	Matriks, Statistika Matematika I, Statistika Matematika II
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						2. *Can distinguish between univariate and multivariate data.* 3. *Knowing the grouping of univariate and multivariate methods.* 4. *Able to calculate matrix concepts that are often used in multivariate analysis*	

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2-5	Dapat menjelaskan konsep pengujian hipotesis vector rata-rata untuk satu dan dua populasi (metode dasar pada awal perkembangan analisis multivariate dengan asumsi distribusi normal multivariat) serta dapat menerapkan dalam problem riil *Can explain the concept of hypothesis testing about mean vector for one and two populations (the basic method at the beginning of the development of multivariate analysis assuming a multivariate normal distribution) and can apply it in real problems*	1. Untuk satu populasi 2. Untuk dua populasi 3. Pemeriksaan asumsi *1. For one population* *2. For two populations* *3. Assumption check*	Ceramah Interaktif Diskusi Praktikum Latihan Soal Observasi (CIPLSO) *Interactive lectures* *Discussion* *Practicum* *Exercise* *Observation (CIPLSO)*	600 menit 6*00 minutes*	Tugas Kuis *Assignment, Quiz,*	1. Dapat menentukan, menghitung dan menginterpretasikan uji hipotesis vektor rata-rata satu dan dua populasi normal multivariat 2. Dapat melakukan uji hipotesis vektor rata-rata menggunakan piranti lunak serta menginterpretasikannya 3. Dapat melakukan uji asumsi: - *normality* - *homoscedacity*	25% /35%

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	MK Prasyarat	Matriks, Statistika Matematika I, Statistika Matematika II
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						4. Dapat mendeteksi *missing value* dan data *outlier* *1. Can determine, calculate and interpret the average vector hypothesis test of one and two multivariate normal populations* *2. Can test the average vector hypothesis using software and interpret it* *3. Can perform assumption tests:* *- normality (univariate and multivariate)* *- homoscedacity*	

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						5. Can detect data outlier both univariate and multivariate	

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6-7	Dapat menjelaskan konsep MANOVA dan dapat menerapkan dalam problem riil *Can explain the concepts of MANOVA and MANACOVA and can apply it to real problems*	1. Pemeriksaan asumsi 2. One way MANOVA/ MANACOVA 3. Interpretasil hasil analisis MANOVA/ MANACOVA *1. Assumption check* *2. One way MANOVA / MANACOVA* *3. Interpretation of the results of the MANOVA / MANACOVA analysis*	Ceramah Interaktif Diskusi Praktikum Latihan Soal Observasi (CIPLSO) *Interactive lectures* *Discussion* *Practicum* *Exercise* *Observation (CIPLSO)*	300 menit *300 minutes*	Observasi Aktifitas di kelas *Observation of classroom activities*	1. Dapat melakukan pemeriksaan asumsi dalam MANOVA dan MANACOVA serta cara mengatasi 2. Dapat melakukan analisis MANOVA dan MANACOVA baik secara manual maupun menggunakan piranti lunak *1. Can check assumptions in MANOVA and MANACOVA and how to overcome them* *2. Can perform MANOVA and MANACOVA*	15% /50%

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						analysis either manually or using software	
8	**ETS**						

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9	Dapat menjelaskan konsep PCA dan dapat menerapkan dalam problem riil *Can explain the PCA concept and can apply it in real problems*	1. Aplikasi PCA di problem riil 2. Pemeriksaan kelayakan sebelum menerapkan PCA dan intepretasi 1. Aplikasi PCA di problem riil 2. Pemeriksaan asumsi PCA dan intepretasi *1. The PCA application is a real problem* *2. Checking of PCA assumptions and interpretations*	CIPLSO *(CIPLSO)*	150 menit *150 minutes*	Observasi Aktifitas di kelas *Observation of classroom activities*	1. Dapat melakukan pemeriksaan asumsi dalam PCA dan cara mengatasi 2. Dapat melakukan analisis PCA baik secara manual maupun piranti lunak *1. Can perform assumption checks in PCA and how to solve them* *2. Can perform PCA analysis either manually or using software*	10% /60%

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10	Dapat menjelaskan konsep analisis faktor dan dapat menerapkan dalam problem riilDapat menjelaskan konsep analisis faktor dan dapat menerapkan dalam problem riil *Can explain the factor analysis concept and can apply it in real problems*	1. Konsep dasar dan aplikasi di problem riil 2. Pemeriksaan asumsi Analsis factor dan interpretasi *1. The basic concept and application in real problems* *2. Checking of factor analysis assumptions and interpretations*	CIPLSO *(CIPLSO)*	150 menit *150 minutes*	Observasi Aktifitas di kelas *Observation of classroom activities*	1. Dapat melakukan pemeriksaan asumsi dalam analisis faktor dan cara mengatasi 2. Dapat melakukan analisis factor baik secara manual maupun menggunakan piranti lunak *1. Can perform assumption checks in factor analysis and how to solve them* *2. Can perform factor analysis analysis either manually or using software*	10% /70%

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11-13	Dapat menjelaskan konsep analisis cluster, analisis diskriminan dan dapat menerapkan dalam problem riil *Can explain the cluster analysis, discriminant analysis concepts and can apply it in real problems*	1. Pendekatan hirarki 2. Pendekatan non hirarki 3. Evaluasi hasil analisis 4. Konsep dasar dan aplikasi di problem riil 5. Pemeriksaan asumsi 6. Estimasi model diskriminan dan interpretasi *1. Hierarchical approach* *2. Non Hierarchical approach* *3. Evaluation of analysis results*	CIPLSO *(CIPLSO)*	450 menit *450 minutes*	Tugas Kuis *Assignment, Quiz,*	1. Dapat melakukan analisis cluster baik secara manual maupun menggunakan piranti lunak 2. Dapat mengevaluasi hasil analisis cluster 3. Dapat melakukan pemeriksaan asumsi dalam analisis diskriminan dan cara mengatasi 4. Dapat melakukan analisis diskriminan baik secara manual maupun	10% /80%

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		4. Basic concepts and applications in real problems *5. Assumption check* *6. Discriminant model estimation and interpretation*				menggunakan piranti lunak *1. Can perform cluster analysis either manually or using software* *2. Can evaluate the results of cluster analysis* *3. Able to check assumptions in discriminant analysis and how to overcome them* *4. Can perform discriminant analysis either manually or using software*	

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14	Dapat menjelaskan serta menerapkan analisis koreDapat menerapkan analisis korespondensi dan MDS dalam problem riil *Can explain the correspondence analysis and MDS and can apply it in real problems*	1. Konsep dasar AK dan MDS, serta aplikasinya 2. AK dan MDS menggunakan piranti lunakDapat menerapkan analisis korespondensi dan MDS dalam problem riil *Can explain the correspondence analysis and MDS and can apply it in real problems*	CIPLSO *(CIPLSO)*	150 menit *150 minutes*	Observasi Aktifitas di kelas *Observation of classroom activities*	Dapat melakukan analisis korespondensi dan MDS menggunakan piranti lunak dan menginterpretasikan hasilnyaDapat melakukan analisis korespondensi menggunakan piranti lunak dan menginterpretasikan hasilnya *Can perform correspondence analysis using software and interpret the results*	10% /90%

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15	Dapat menerapkan *Structural Equation Modelling* (SEM) dalam problem riil Dapat menerapkan analisis biplot dalam problem riil *Can explain the Structural Equation Modelling (SEM) and can apply it in real problems*	1. Konsep dasar SEM dan aplikasinya 2. SEM menggunakan AMOS *1. Basic concepts of SEM and their applications* *2. SEM use AMOS*	CIPLSO *(CIPLSO)*	150 menit *150 minutes*	Observasi Aktifitas di kelas *Observation of classroom activities*	Dapat melakukan analisis SEM menggunakan AMOS dan menginterpretasikan hasilnya *Can perform SEM using AMOS and interpret the results*	10% /100%
16	**EAS**						

PUSTAKA/ REFERENCES:

1. Johnson, R.A and Wichern, D.W, 2007. *Applied Multivariate Statistical Analysis,6th Edition,* Prentice Hall, New York.
2. Rencher, A.C. *Methods of Multivariate Analysis*, 2nd Edition, John Wiley
3. Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E, 2010. *Multivariate Data Analysis*, *7th Edition, Prentice-Hall, UK*
4. Sarma, S. 1996. *Applied Multivariate Techniques*, John Wiley
5. Mardia, K.V, Kent, J.T, Bibby, J.M, 2000. Multivariate Analysis, 7th Edition. Academic Press.
6. Purnami, S.W. dan Otok, B.W., Modul Praktikum Analisis Multivariat, 2012

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7. Anderson, T.W, 2003, *An Introduction to Multivariate Statistical Analysis*, Wiley Interscience
8. Morison, D.F, 2005, *Multivariate Statistical Method,* McGraw-Hill Inc., Tokyo.
9. Byrne, B.M, 2001, Structural Equation Modelling with AMOS: Basic Concept, Applications and Programming, Lawrence Erlbaun Associates Inc., New Jersey.

A. RENCANA ASESMEN DAN EVALUASI (RAE)
A. ASSESSMENT AND EVALUATION PLAN (RAE)

	RENCANA ASSESSMENT & EVALUASI *Assesment and Evaluation Plan* Prodi Sarjana Statistika/ *Statistics Bachelor* **MK ANALISIS MULTIVARIAT/** *MULTIVARIATE ANALYSIS*		**RA& E** SLK-13
Kode: KS184615 *Code:* *KS184615*	**Bobot sks (T/P):** 4 *CREDITS : 4*	**Rumpun MK:** Statistika Teori dan Pemodelan *Course cluster:* *Theory and Modelling Statistics*	Smt: 6 *Semester VI*
OTORISASI *AUTHORIZATION*	**Penyusun RA & E** *Author* Dr. Santi Puteri Rahayu, M.Si	**Koordinator RMK** *Coordinator*	**Ka PRODI** *Head of Department* Dr. Kartika F, M.Si

Mg ke *Meeting* **(1)**	**Sub CP-MK** *Sub CLO* **(2)**		**Bentuk Asesmen (Penilaian)** *Evaluation Type (Scoring)* **(3)**	**Bobot (%)** **(4)**
	No	**Kemampuan akhir** *Final Ability*		
1	1	Dapat menjelaskan konsep dan tujuan analisis multivariat *Can explain concepts and purpose of multivariate analysis*	Kuis ETS *Quiz* *Mid Term Exam*	5 5

2-5	2	Dapat menjelaskan konsep pengujian hipotesis vector rata-rata untuk satu dan dua populasi (metode dasar pada awal perkembangan analisis multivariate dengan asumsi distribusi normal multivariat) serta dapat menerapkan dalam problem riil *Can explain the concept of hypothesis testing about mean vector for one and two populations (the basic method at the beginning of the development of multivariate analysis assuming a multivariate normal distribution) and can apply it in real problems*	Tugas Kuis ETS *Assignment* *Quiz* *Mid Term Exam*	10 10 10
6-7	3	Dapat menjelaskan konsep MANOVA dan dapat menerapkan dalam problem riil *Can explain the concepts of MANOVA and MANACOVA and can apply it to real problems*	ETS *Mid Term Exam*	10
8		Evaluasi Tengah Semester *Mid Term Exam*		
9	4	Dapat menjelaskan konsep PCA dan dapat menerapkan dalam problem riil *Can explain the PCA concept and can apply it in real problems*	Kuis EAS *Quiz* *Final Exam*	5 5
10	5	Dapat menjelaskan konsep analisis faktor dan dapat menerapkan dalam problem riil *Can explain the factor analysis concept and can apply it in real problems*	Tugas Kuis EAS *Assignment* *Quiz* *Final Exam*	5 5 5
11-13	6	Dapat menjelaskan konsep analisis cluster, analisis diskriminan dan dapat menerapkan dalam problem riil *Can explain the cluster analysis, discriminant analysis concepts and can apply it in real problems*	Tugas Kuis EAS *Assignment* *Quiz* *Final Exam*	5 5 5
14	7	Dapat menerapkan analisis korespondensi dan MDS dalam problem riil *Can explain the correspondence analysis and MDS and can apply it in real problems*	EAS *Final Exam*	5

15	8	Dapat menerapkan *Structural Equation Modelling* (SEM) dalam problem riil *Can explain the Structural Equation Modelling (SEM) and can apply it in real problems*	EAS *Final Exam*	5
16		Evaluasi Akhir Semester *Final Exam*		
		Total bobot penilaian /*Total Score*		**100%**