

Short Course Description	In this course, the concepts of multivariate statistics will be studied which include the basic concepts of multivariate statistics, matrices, vectors and their operations, as well as classification in multivariate statistics, the concept of normal multivariate distribution, hypothesis testing, the concept of MANOVA, the concept of Principle Component Analysis, Fuzzy and Structural Equation Modeling (SEM), clustering method. Apart from that, students are expected to be able to design problem solutions using techniques in multivariate statistics. Be able to explain the results of problem solving using techniques in multivariate statistics						
References	Main :						
		<ol style="list-style-type: none"> 1. Joseph F. Hair, Multivariate Data Analysis, 8th Ed. Cengage, 2018 2. Härdle, Wolfgang Karl, and Léopold Simar. Applied multivariate statistical analysis. Springer Nature, 2019. 3. Dobson, A. J., & Barnett, A. G. An introduction to generalized linear models. CRC press, 2018. 					
	Supporters:						
	<ol style="list-style-type: none"> 1. Barbara G. Tabachnick, Using Multivariate Statistics, Sixth Edition, Pearson, 2013 						
Supporting lecturer	Riskyana Dewi Intan Puspitasari, M.Kom. Ulfa Siti Nuraini, S.Stat., M.Stat.						
Week-	Final abilities of each learning stage (Sub-PO)	Evaluation		Help Learning, Learning methods, Student Assignments, [Estimated time]		Learning materials [References]	Assessment Weight (%)
		Indicator	Criteria & Form	Offline (offline)	Online (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Students understand the concept and purpose of multivariate analysis	<ol style="list-style-type: none"> 1.Know the application of multivariate methods to real problems. 2.Can differentiate between univariate data and multivariate data. 3.Know the grouping of univariate methods and multivariate methods 	Criteria: Non Test Form of Assessment : Participatory Activities	Collaborative Learning (Lectures, discussions and questions and answers) 150	Collaborative Learning (Lectures, discussions and questions and answers) Independent Learning 150	Material: Basic concepts of multivariate analysis Applications and grouping of multivariate methods References: Joseph F. Hair, Multivariate Data Analysis, 8th Ed. Cengage, 2018	1%
2	Students understand the concepts of vectors, matrices, variance, covariance and their operations	<ol style="list-style-type: none"> 1.Able to explain vector concepts and their operations 2.Able to explain the concept of matrices and their operations 3.Able to explain the concept of variants and their operations 4.Able to explain the concept of covariance and its operations 	Criteria: Non Test Form of Assessment : Participatory Activities	Collaborative Learning (Lectures, discussions and questions and answers) 150	Collaborative Learning (Lectures, discussions and questions and answers) Independent Learning 150	Material: Vectors, Matrices, Variants, Covariance Reference: Joseph F. Hair, Multivariate Data Analysis, 8th Ed. Cengage, 2018	1%
3	Students understand the concepts of symmetric matrices, positive definite, Eigen Value, Eigen Vector	<ol style="list-style-type: none"> 1.Able to explain the concept of Eigen Value 2.Able to explain the concept of Eigen Vector 	Criteria: Non Test Form of Assessment : Participatory Activities	Collaborative Learning (Lectures, discussions and questions and answers) 150	Collaborative Learning (Lectures, discussions and questions and answers) Independent Learning 150	Material: Eigen Value, Eigen Vector Reference: Joseph F. Hair, Multivariate Data Analysis, 8th Ed. Cengage, 2018	2%

4	Students are able to understand the concepts of Principle Component Analysis and Factor Analysis, as well as implement them in real problems	<ol style="list-style-type: none"> 1.Able to explain the concept of Principle Component Analysis 2.Able to explain the concept of Factor Analysis (FA) 	Criteria: Non Test Form of Assessment : Participatory Activities	Collaborative Learning (Lectures, discussions and questions and answers) 150	Collaborative Learning (Lectures, discussions and questions and answers) Independent Learning 150	Material: PCA and FA Reference: <i>Joseph F. Hair, Multivariate Data Analysis, 8th Ed. Cengage, 2018</i>	2%
5	Students are able to understand the concept of the multivariate normal distribution Review	<ol style="list-style-type: none"> 1.Able to explain the concept of univariate normal density 2.Able to explain the concept of Bivariate normal density 3.Able to explain the concept of Multivariate normal density and its properties 4.Able to explain the concept of sampling distribution 5.Able to explain the concept of Assessing the assumption of normality 6.Able to explain the concept of how to handle normality 	Criteria: Non Test Form of Assessment : Participatory Activities	Collaborative Learning (Lectures, discussions and questions and answers) 150	Collaborative Learning (Lectures, discussions and questions and answers) Independent Learning 150	Material: - univariate normal density - Bivariate normal density - Multivariate normal density and its properties - Sampling distribution - Assessing the assumption of normality - handling normality References: <i>Joseph F. Hair, Multivariate Data Analysis, 8th Ed. Cengage, 2018</i>	2%

6	Students are able to explain the concept of mean vector hypothesis testing, ANOVA and ANCOVA, MANOVA, MANCOVA, and can apply it to real problems	<ol style="list-style-type: none"> 1. Able to determine, calculate and interpret hypothesis tests for the average vector of one and two multivariate normal populations 2. Can carry out mean vector hypothesis testing and its interpretation 3. Can carry out assumption tests 4. Able to understand the concepts of ANOVA and ANCOVA 5. Able to carry out ANOVA and ANCOVA analysis in real problem analysis 	Criteria: Non Test Form of Assessment : Participatory Activities	Collaborative Learning (Lectures, discussions and questions and answers) 150	Collaborative Learning (Lectures, discussions and questions and answers) Independent Learning 150	Material: - Hypothesis testing for one population - Hypothesis testing for two populations - ANOVA - ANCOVA - MANOVA - MANCOVA - Interpretation of analysis results References: <i>Joseph F. Hair, Multivariate Data Analysis, 8th Ed. Cengage, 2018</i>	2%
7	Students are able to explain the concept of hierarchical clustering and can apply it to real problems	<ol style="list-style-type: none"> 1. Able to carry out cluster analysis with several cluster analysis methods 2. Can evaluate the results of cluster analysis 3. Can check assumptions in cluster analysis 	Criteria: Non Test Form of Assessment : Participatory Activities	Collaborative Learning (Lectures, discussions and questions and answers) 150	Collaborative Learning (Lectures, discussions and questions and answers) Independent Learning 150	Material: Clustering Concept and Hierarchical Approach Reference: <i>Joseph F. Hair, Multivariate Data Analysis, 8th Ed. Cengage, 2018</i>	2%
8	Students are able to explain the concept of non-hierarchical clustering and can apply it to real problems	<ol style="list-style-type: none"> 1. Able to carry out cluster analysis with several cluster analysis methods 2. Can evaluate the results of cluster analysis 3. Can check assumptions in cluster analysis 	Criteria: Non Test Form of Assessment : Participatory Activities	Collaborative Learning (Lectures, discussions and questions and answers) 150	Collaborative Learning (Lectures, discussions and questions and answers) Independent Learning 150	Material: Clustering Concept and Hierarchical Approach Reference: <i>Joseph F. Hair, Multivariate Data Analysis, 8th Ed. Cengage, 2018</i>	2%
9	Midterm exam	Test	Criteria: Test Form of Assessment : Test	UTS 150	UTS 150	Material: Clustering Concept and Hierarchical Approach Reference: <i>Joseph F. Hair, Multivariate Data Analysis, 8th Ed. Cengage, 2018</i>	15%

10	Students are able to understand distributional and numerical based parameter estimation	<ol style="list-style-type: none"> 1.Able to estimate parameters with MLE 2.Able to estimate parameters using EM 	Criteria: Non Test Form of Assessment : Participatory Activities	Collaborative Learning (Lectures, discussions and questions and answers) 150	Collaborative Learning (Lectures, discussions and questions and answers) Independent Learning 150	Material: - Least Square - Maximum Likelihood Estimation - Expectation Maximization (EM) Reference: Joseph F. Hair, <i>Multivariate Data Analysis, 8th Ed.</i> Cengage, 2018	2%
11	Students are able to understand the concept of Generalized Linear Models	<ol style="list-style-type: none"> 1.Able to understand the concept of Exponential Family 2.Able to understand the concept of Generalized Linear Models 3.Able to apply GLM to real data 	Criteria: Non Test Form of Assessment : Participatory Activities	Collaborative Learning (Lectures, discussions and questions and answers) 150	Collaborative Learning (Lectures, discussions and questions and answers) Independent Learning 150	Material: - Exponential Family - Generalized Linear Models - Logistic Regression - Poisson Regression Reference: Joseph F. Hair, <i>Multivariate Data Analysis, 8th Ed.</i> Cengage, 2018	2%
12	Students understand the concept and implementation of Structural Equation Modeling (SEM) and Partial Least Square (PLS)	<ol style="list-style-type: none"> 1.Able to explain the concept of Structural Equation Modeling (SEM) 2.Able to explain the concept of Partial Least Square (SEM) 	Criteria: Non Test Form of Assessment : Participatory Activities	Collaborative Learning (Lectures, discussions and questions and answers) 150	Collaborative Learning (Lectures, discussions and questions and answers) Independent Learning 150	Material: - Exponential Family - Generalized Linear Models - Logistic Regression - Poisson Regression Reference: Joseph F. Hair, <i>Multivariate Data Analysis, 8th Ed.</i> Cengage, 2018	2%
13	Students can implement multivariate analysis on real problems and realize creative ideas, as well as explain the results of the analysis scientifically	<ol style="list-style-type: none"> 1.Able to formulate research questions from real world problems that will be solved using multivariate statistics 2.Able to conduct literature studies related to research questions 3.Able to design problem solving methods using multivariate statistics 	Criteria: Non Test Form of Assessment : Project Results Assessment / Product Assessment	Collaborative Learning (Lectures, discussions and questions and answers) 150	Collaborative Learning (Lectures, discussions and questions and answers) Independent Learning 150	Material: - Method Implementation - Results Analysis - Conclusion Literature:	10%

14	Students can implement multivariate analysis on real problems and realize creative ideas, as well as explain the results of the analysis scientifically	<ol style="list-style-type: none"> 1.Able to formulate research questions from real world problems that will be solved using multivariate statistics 2.Able to conduct literature studies related to research questions 3.Able to design problem solving methods using multivariate statistics 	Criteria: Non Test Form of Assessment : Project Results Assessment / Product Assessment	Collaborative Learning (Lectures, discussions and questions and answers) 150	Collaborative Learning (Lectures, discussions and questions and answers) Independent Learning 150	Material: - Method Implementation - Results Analysis - Conclusion Literature:	10%
15	Students can implement multivariate analysis on real problems and realize creative ideas, as well as explain the results of the analysis scientifically	<ol style="list-style-type: none"> 1.Able to formulate research questions from real world problems that will be solved using multivariate statistics 2.Able to conduct literature studies related to research questions 3.Able to design problem solving methods using multivariate statistics 	Criteria: Non Test Form of Assessment : Project Results Assessment / Product Assessment	Collaborative Learning (Lectures, discussions and questions and answers) 150	Collaborative Learning (Lectures, discussions and questions and answers) Independent Learning 150	Material: - Method Implementation - Results Analysis - Conclusion Literature:	15%
16	Students can implement multivariate analysis on real problems and realize creative ideas, as well as explain the results of the analysis scientifically	<ol style="list-style-type: none"> 1.Able to formulate research questions from real world problems that will be solved using multivariate statistics 2.Able to conduct literature studies related to research questions 3.Able to design problem solving methods using multivariate statistics 	Criteria: Non Test Form of Assessment : Project Results Assessment / Product Assessment, Portfolio Assessment	Collaborative Learning (Lectures, discussions and questions and answers) 150	Collaborative Learning (Lectures, discussions and questions and answers) Independent Learning 150	Material: - Method Implementation - Results Analysis - Conclusion Literature:	30%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	20%

2.	Project Results Assessment / Product Assessment	50%
3.	Portfolio Assessment	15%
4.	Test	15%
		100%

Notes

1. **Learning Outcomes of Study Program Graduates (PLO - Study Program)** are the abilities possessed by each Study Program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the level of their study program obtained through the learning process.
2. **The PLO imposed on courses** are several learning outcomes of study program graduates (CPL-Study Program) which are used for the formation/development of a course consisting of aspects of attitude, general skills, special skills and knowledge.
3. **Program Objectives (PO)** are abilities that are specifically described from the PLO assigned to a course, and are specific to the study material or learning materials for that course.
4. **Subject Sub-PO (Sub-PO)** is a capability that is specifically described from the PO that can be measured or observed and is the final ability that is planned at each learning stage, and is specific to the learning material of the course.
5. **Indicators for assessing** abilities in the process and student learning outcomes are specific and measurable statements that identify the abilities or performance of student learning outcomes accompanied by evidence.
6. **Assessment Criteria** are benchmarks used as a measure or measure of learning achievement in assessments based on predetermined indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
7. **Forms of assessment:** test and non-test.
8. **Forms of learning:** Lecture, Response, Tutorial, Seminar or equivalent, Practicum, Studio Practice, Workshop Practice, Field Practice, Research, Community Service and/or other equivalent forms of learning.
9. **Learning Methods:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, and other equivalent methods.
10. **Learning materials** are details or descriptions of study materials which can be presented in the form of several main points and sub-topics.
11. **The assessment weight** is the percentage of assessment of each sub-PO achievement whose size is proportional to the level of difficulty of achieving that sub-PO, and the total is 100%.
12. TM=Face to face, PT=Structured assignments, BM=Independent study.