هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission
اعتماد
NCAAA
2024
TP-153

Course Specification
(Bachelor)

Course Title:	**Multivariate Analysis**
Course Code:	**STA 1428**
Program:	**Bachelor of Science in Applied Statistics**
Department:	**Mathematics and Statistics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**2024 – V1**
Last Revision Date:	**2 October 2024**

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A. General information about the course:

1. Course Identification

1. Credit hours: (4)					
4 (3 Lectures, 1 Lab, 1 Tutorial)					
2. Course type					
A.	☐University	☐College	☒ Program	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 7 / Year 4)					
4. Course General Description:					
In multivariate statistics, we analyze several variables simultaneously, without saying beforehand that one of them is of more interest than the other ones. This course introduces the basic concepts of multivariate statistics and prosvides an overview of the available methods. All methods will be illustrated with real data sets, using the open-source statistical software.					
5. Pre-requirements for this course (if any)**:**					
STA 1322					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s):					
▪ **To provide students with a comprehensive understanding of key multivariate analysis techniques, including multiple regression, factor analysis, cluster analysis, and principal component analysis.** ▪ **To equip students with the skills to utilize statistical software (e.g., SPSS, R) for performing multivariate analyses and interpreting outputs effectively.** ▪ **To develop students' abilities to interpret multivariate analysis results and communicate findings clearly and accurately in written and oral formats.** ▪ **To guide students in the process of developing and validating multivariate models, ensuring they understand model assumptions and limitations.** ▪ **To foster critical thinking skills that enable students to evaluate existing multivariate studies, identifying methodological strengths, weaknesses, and potential biases.** ▪ **To provide opportunities for students to apply multivariate analysis techniques to real-world datasets, enhancing their problem-solving skills in various fields such as healthcare, finance, and social sciences.**					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**75**	**100%**
2	E-learning	**0**	**0%**

No	Mode of Instruction	Contact Hours	Percentage
3	Hybrid • Traditional classroom • E-learning	0	0%
4	Distance learning	0	0%

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	15
3.	**Field**	0
4.	**Tutorial**	15
5.	**Others (specify)**	0
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**To outline the basic multivariate approaches.**	**K2, K2**	**Lectures, problem solving, Classroom discussions**	**Direct:** Regular Exams, Assignments, Practical exam
1.2	**To label the characteristic features of multivariate data.**	**K2, K3**	**Lectures, problem solving, Classroom discussions**	**Direct:** Regular Exams, Lab Assignments, Practical exam
2.0	**Skills**			
2.1	**To develop techniques of problem solving.**	**S1, S2**	**Lecturing Interactive learning.**	**Direct:** Assignments, Practical exam
2.2	**To use multivariate techniques appropriately, undertake multivariate hypothesis tests, and draw appropriate conclusions.**	**S1, S2, S4**	**Lecturing, Interactive learning.**	**Direct:** Assignments, Practical exam
2.3	**To use statistical software to perform multivariate analyses on the collected data.**	**S3, S5**	**Use of statistical software, Lecturing, Interactive learning.**	**Direct: Lab Exam, Lab Assignments, Practical exam**
2.4	**To use multivariate analysis to solve a real-world problem.**	**S3, S4, S5**	**Use of statistical software, Lecturing, Interactive learning.**	**Lab Exam, Lab Assignments, Practical exam**

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
3.0	**Values, autonomy, and responsibility**			
3.1	**To interpret model results properly and draw conclusions in case studies.**	**V1, V2**	**Interactive learning, Group interaction, Problem solving.**	**Lab Exam, Practical exam, Assignments**
3.2	**To operate meaningfully and productively with others.**	**V1, V3**	**Group interaction, Problem solving.**	**Assignments and Mini-projects**

C. Course Content

No	List of Topics	Contact Hours
1.	**Aspects of Multivariate Analysis:** Introduction, Application of Multivariate Techniques. The organization of Data, Data Displayed and Pictorial Representations, Distance, Final Comment.	**5**
2.	**Matrix Algebra and Random Vectors:** Introduction, Some Basic of Matrix and Vector Algebra, Positive Definite Matrices, A Square-Root Matrix, Random Vectors and Matrices, Mean Vectors and Covariance Matrices, Matrix inequalities and Maximization.	**10**
3.	**Sample Geometry and Random Sampling:** Introduction, The Geometry of the Sample, Random Samples and Expected Values of the Sample mean and Covariance Matrix, Generalized Variance, Sample Mean, Covariance, and Correlation as Matrix Operations, Sample Values of Linear Combinations Variables.	**15**
4.	**The Multivariate Normal Distribution:** Introduction, The Multivariate Normal Distribution Density Function and Its Properties, Sampling from a Multivariate Normal Distribution and Maximum Likelihood Estimation, The Sampling distribution $\bar{X}$ and S, Large Sample Behavior of $\bar{X}$ and S, Assessing the Assumption of Normality, Detecting Outliers and Cleaning data. Transformations to Near Normality.	**15**
5.	**Inferences About a mean Vector:** Introduction, The Plausibility of μ_0 as a Vector for a Normal Population Mean, Hotelling's T^2 and the Likelihood Ratio test, Confidence Regions and Simulations Comparisons of Component Means, Large Sample Inferences about a Population Mean Vector, Multivariate Quality Control Chart, Inferences about Mean Vectors, Difficulties Due to Time Dependence in Multivariate Observations.	**15**
6.	**Comparisons of Several Multivariate Means:** Introduction, Paired Comparisons and a Repeated Measures Design, Comparing Mean Vectors from Two Populations, comparing Several Multivariate Population Means, Simultaneous Confidence intervals for Treatment Effects, Testing for Equality of Covariance Matrices, Profile Analysis, Repeated Measures Designs and Growth Curve, Perspective and a Strategy for Analyzing Multivariate Model.	**15**
Total		**75**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homeworks, Quizzes, Mini-projects	During the term	10%
2.	First Midterm	Week 5-6	25%
3.	Second Midterm (Lab Exam)	Week 10-11	25%
4.	Final Exam	Week 15	40%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	***Applied Multivariate Statistical Analysis;*** 6th Edition, Richard, A. Johnson and Dean, W. Wichern; Pearson Prentice Hall., 2007.
Supportive References	1. ***Multivariate Statistical Methods: A Primer;*** 3rd Edition, B.F.J. Manly, Chapman & Hall/CRC, 2005. 2. ***Methods of Multivariate Analysis;*** 2nd Edition, Alvin C. Rencher, J. Wiley, 2003. 3. ***Applied Regression Analysis and Multivariable Methods;*** 5th Edition, D. G. Kleinbaum, L. L. Kupper, A. Nizam, and E. S. Rosenberg, Cengage Learning, 2013.
Electronic Materials	**Course Website: Learning Management Systems (Blackboard)**
Other Learning Materials	**None**

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	▪ **Each class room should be equipped with a whiteboard and a projector.** ▪ **Laboratories should be equipped with computers and an internet connection.**
Technology equipment (projector, smart board, software)	**The rooms should be equipped with data show and Smart Board.** **All computers should be equipped with the following software:** • **Microsoft Excel** • **IBM SPSS** • **R-Project** • **MATLAB**
Other equipment (depending on the nature of the specialty)	**See the attached file**

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Student and teaching staff	Surveys and Questionnaires
Effectiveness of Students assessment	Course Coordinator	Peer Reviews
Quality of learning resources	Students and teaching staff	Classroom Observations
The extent to which CLOs have been achieved	Student Representatives	Student Performance Evaluations (exams, projects) CLOs Excel sheet.
Other	None	

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL
REFERENCE NO.	8/1446
DATE	(08/10/2024) 05/04/1446