



# Course Specification

— (Postgraduate)

Course Title: **Multivariate Statistical Analysis**

Course Code: **202661-3**

Program: **M.Sc. in Statistics**

Department: **Mathematics and Statistics**

College: **Sciences**

Institution: **Taif University**

Version: **2023**

Last Revision Date: **7/4/1445**



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## A. General information about the course:

### 1. Course Identification:

1. Credit hours: 3

#### 2. Course type

A.  University  College  Department  Track

B.  Required  Elective

3. Level/year at which this course is offered: (N/A)

#### 4. Course general Description:

This course contains some very important topics in statistics. These topics are:  
Matrix algebra and random vector- The multivariate normal distribution -  
Inferences about a Mean vector- Multivariate analysis of variance MANOVA -  
Principal components –Factor Analysis - Canonical correlation analysis.

5. Pre-requirements for this course (if any):

6. Pre-requirements for this course (if any):

#### 7. Course Main Objective(s):

After careful study of this course, student should be able to do the following:

- 1- Understand the decomposition of matrices and vectors and consider the maximization (minimization) of quadratic forms given some constraints.
- 2- Determine useful properties of multivariate distributions.
- 3- Understand the inference statistics about Mean vector.
- 4- Understand the Multivariate analysis of variance MANOVA.
- 5- Determine the principal components, factor analysis and canonical correlation analysis.

### 2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	3	100%
2	E-learning		





No	Mode of Instruction	Contact Hours	Percentage
3	Hybrid <ul style="list-style-type: none"> <li>Traditional classroom</li> <li>E-learning</li> </ul>		
4	Distance learning		

### 3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	45
2.	Laboratory/Studio	
3.	Field	
4.	Tutorial	
5.	Others (specify).....	
	<b>Total</b>	<b>45</b>

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

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
<b>1.0</b>	<b>Knowledge and understanding</b>			
1.1	<b>Recognize</b> the decomposition and properties of matrices	K1	<ul style="list-style-type: none"> <li>Lectures</li> <li>Group discussions</li> </ul>	<ul style="list-style-type: none"> <li>Quizzes</li> <li>Exams</li> <li>Assignments</li> </ul>
1.2	<b>Outline</b> the maximization (minimization) of quadratic model	K1	<ul style="list-style-type: none"> <li>Lectures</li> <li>Group discussions</li> </ul>	<ul style="list-style-type: none"> <li>Quizzes</li> <li>Exams</li> <li>Assignments</li> </ul>
1.3	<b>Describe</b> principal components, factor analysis and canonical correlation analysis.	K3	<ul style="list-style-type: none"> <li>Lectures</li> <li>Group discussions</li> </ul>	<ul style="list-style-type: none"> <li>Quizzes</li> <li>Exams</li> <li>Assignments</li> </ul>
1.4	<b>Describe</b> the inference statistics about Mean vector	K3	<ul style="list-style-type: none"> <li>Lectures</li> <li>Group discussions</li> </ul>	<ul style="list-style-type: none"> <li>Quizzes</li> <li>Exams</li> <li>Assignments</li> </ul>
<b>2.0</b>	<b>Skills</b>			
2.1	<b>Apply</b> the multivariate analysis of variance MANOVA	S2	<ul style="list-style-type: none"> <li>Lectures</li> <li>Group discussions</li> </ul>	<ul style="list-style-type: none"> <li>Quizzes</li> <li>Exams</li> <li>Assignments</li> </ul>
2.2	<b>Explain</b> the properties of	S4	<ul style="list-style-type: none"> <li>Lectures</li> </ul>	<ul style="list-style-type: none"> <li>Quizzes</li> <li>Exams</li> </ul>



Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	multivariate distributions		Group discussions	Assignments
<b>3.0</b>	<b>Values, autonomy, and responsibility</b>			
3.1	<b>Participate</b> effectively within groups and independently.	V1	Projects	Through the oral presentation of the projects.
3.2	<b>Accept</b> critical thinking, communication skills, and mathematical and statistical methods for solving many problems in other disciplines.	V4	Projects	Through the oral presentation of the projects.

### C. Course Content:

Weeks	List of Topics	Contact Hours
1-3	Basic concepts of matrix algebra, properties of vectors and matrices and partitioned matrices, Quadratic forms and matrices.	9
4-6	Multivariate variables, mean, measures of dependence; covariance and correlation, Multivariate distributions, cumulative distribution function, marginal and conditional distributions, independence, moments, characteristic functions and transformations.	9
7-9	The multinormal distribution, properties of the multinormal, sampling distributions and limit theorems, Linear transformations, linear model for two variables, simple analysis of variance and MANOVA and multiple linear model.	9
10-12	Estimation about mean vector, Hypothesis tests about mean vector	9
13-15	Principal components, factor analysis and canonical correlation analysis, Revision	9
<b>Total</b>		<b>45</b>

### D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quizzes + Homeworks+ oral presentation +written test+ group project	Continues	30%
2.	Final exam	16 th	70%

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





## E. Learning Resources and Facilities:

### 1. References and Learning Resources:

<b>Essential References</b>	Härdle, W. K., & Simar, L. (2019). <i>Applied multivariate statistical analysis</i> (pp. 431-442). Springer International Publishing.
<b>Supportive References</b>	Anderson, T. W. (1962). <i>An introduction to multivariate statistical analysis</i> (No. 519.9 A53). New York: Wiley.
<b>Electronic Materials</b>	
<b>Other Learning Materials</b>	<b>Blackboard system</b>

### 2. Educational and Research Facilities and Equipment Required:

Items	Resources
<b>facilities</b> (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	<b>Lecture halls, containing white boards, and electronic monitors - The seats fit the number of students - Laboratories equipped with suitable numbers of computers</b>
<b>Technology equipment</b> (Projector, smart board, software)	<b>Data Show</b>
<b>Other equipment</b> (Depending on the nature of the specialty)	<b>Wi-Fi internet connections</b>

## F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
<b>Effectiveness of teaching</b>	<b>Students</b>	Indirect
<b>Effectiveness of students assessment</b>	<b>Students</b>	Indirect
<b>Quality of learning resources</b>	<b>Students</b>	Indirect
<b>The extent to which CLOs have been achieved</b>	<b>Peer reviewer</b>	Direct
<b>Other</b>		

**Assessor** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify))

**Assessment Methods** (Direct, Indirect)

## G. Specification Approval Data:

<b>COUNCIL /COMMITTEE</b>	<b>DEPARTMENT OF MATHEMATICS AND STATISTICS</b>
<b>REFERENCE NO.</b>	
<b>DATE</b>	<b>7-4-1445H</b>

