



OUTCOMES-BASED EDUCATION (OBE) COURSE SYLLABUS

Stat 145
Multivariate Statistics

Quality Goals of the Faculty of Natural and Mathematical Sciences

1. Provide quality instruction, research, extension, and innovation for global competitiveness;
2. Develop knowledgeable, skilled, and innovative individuals who value and pursue the advancement of scientific knowledge for the betterment of society; and
3. Produce future- proof graduates and workforce in biology, biotechnology, chemistry, mathematics, meteorology, physics, and statistics.

Quality Objectives of the Department Statistics

1. Produce highly trained graduates in Statistics;
2. Undertake quality instruction, research, and extension activities in statistics and allied fields;
3. Actively promote the appropriate utilization of statistics among scientists, technologists, and development workers; and
4. Maintain productive linkages and cooperation with statistical units and agencies locally and internationally.

I. PROGRAM INFORMATION

1. Name of the Program	Bachelor of Science in Statistics
2. CHED CMO Reference	CMO No. 42 s2017
3. BOR Approval	BOR Resolution No. 61 s2018

4. Program Educational Objectives and Relationship to Institution Mission

Program Educational Objectives	Mission*		
	a	b	c
1. A number of graduates hold key statistical positions in government line agencies.	✓	✓	✓
2. Some of the graduates become regular instructors in High School.	✓	✓	✓
3. The top-ranking graduates are teaching in HEIs with at least an MS degree.	✓	✓	✓
4. A fraction of the graduates are employed as statisticians and/or researchers in research centers and private companies with research units.	✓	✓	✓
5. Some of the graduates are engaged in consultancy services in market research and project monitoring, and evaluation work.	✓	✓	✓

*a - produce graduates equipped with advanced knowledge and lifelong learning skills, b - ethical standards through high-quality instruction and innovative research, c – impactful community engagements



III. COURSE INFORMATION

1. Course Code	STAT 145
2. Course Title	Multivariate Statistics
3. Pre-requisite	Stat 134 (Regression Analysis)
4. Co-requisite	None
5. Credit	4 units
6. Semester Offered	1 st Semester
7. Number of hours	3 hours lecture & 3 hours laboratory per week
8. Course Description	Multivariate normal distribution; inference on mean vector and dispersion matrices; principal component analysis; canonical correlation analysis; discriminant analysis; factor analysis; cluster analysis; other multivariate techniques; applications
9. Sustainable Development Goals	SDG 4 – Ensure Inclusive and Equitable Quality Education and Promote Lifelong Learning Opportunities for All
10. 4th Industrial Revolution (4IR)	Artificial Intelligence (AI) -- Gemini
11. Education 5.0	Collaborative Learning, Technology at its Core, and Lifelong Learning.

12. Program Outcomes and Relationship to Program Educational Objectives						
Program Outcomes (POs)		Program Educational Objectives				
		1	2	3	4	5
Common to All Baccalaureate Programs						
a	Articulate and discuss the latest developments in the practice of Statistics (PQF Level 6 descriptor)			✓	✓	✓
b	Effectively communicate orally and in writing using both the English and Filipino languages.	✓		✓	✓	✓
c	Work effectively and independently in multi-disciplinary and multi-cultural teams (PQF Level 6 descriptor)	✓		✓	✓	✓
d	Demonstrate professional, social, and ethical responsibility, especially in practicing intellectual property rights and sustainable development.	✓		✓	✓	✓
e	Preserve and promote “ <i>Filipino historical and cultural heritage</i> ” (based on RA 7722)					
Common to the Science and Mathematics Programs						
f	Demonstrate broad and coherent knowledge and understanding in the core areas of the physical and natural sciences and mathematics					
g	Apply critical and problem-solving skills using the scientific method	✓		✓	✓	✓
h	Interpret scientific data and make judgments that include reflection on relevant scientific and ethical issues	✓		✓	✓	✓
i	Carry out basic mathematical and statistical computations and use appropriate technologies in the analysis of data	✓		✓	✓	✓
j	Communicate information, ideas, problems, and solutions, both orally and in writing, to other scientists, decision-makers, and the public	✓		✓	✓	✓
k	Relate science and mathematics to the other disciplines			✓	✓	✓

l	Design and perform safe and responsible techniques and procedures in laboratory or field practices	✓		✓	✓	✓
m	Critically evaluate inputs from others	✓		✓	✓	✓
n	Appreciate the limitations and implications of science in everyday life	✓		✓	✓	✓
o	Commit to the integrity of data					
Specific to the BS Statistics Program						
p	Demonstrate broad and coherent knowledge and understanding in the core areas of statistics, computing, and mathematics	✓	✓	✓	✓	✓
q	Generate information involving the conceptualization of a strategy for generating timely and accurate/reliable data, organizing a process for putting together or compiling the needed data, and transforming available data into relevant and useful forms	✓		✓	✓	✓
r	Translate real-life problems into statistical problems	✓		✓	✓	✓
s	Identify appropriate statistical tests and methods and use these properly for the given problems, select optimal solutions to problems, and make decisions in the face of uncertainty	✓		✓	✓	✓

13. Course Outcomes (COs) and Relationship to Program Outcomes (POs)																			
Program Outcomes Addressed by the Course Outcomes By the end of the course, the students must be able to:	Program Outcomes																		
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s
CO1: Describe multivariate data and the multivariate normal distribution	L	P	P	P		L	L	P	L	P	O			L		L	L	L	L
CO2: Perform inference on mean vectors and variance-covariance matrices	L	P	P	P		L	L	P	L	P	O			L		L	L	L	L
CO3: Apply various multivariate statistical methods to real-life data	L	P	P	P		L	L	P	L	P	O			L		L	L	L	L

Level: L: facilitates learning of competency

P: allows student to practice competency (no input, but competency is evaluated)

O: opportunity for development (no input or evaluation, but competency is practiced)

14. OBTL Course Content and Plan					
Week	Topics	Learning Outcomes	Teaching and Learning Activities		Assessment Tasks
			Teaching Activities	Learning Activities	

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1	Class Orientation <ul style="list-style-type: none"> VSU Vision Mission, and Quality Policy Statement OBE Course Syllabus (Course Content, Class Policies, Requirements, Grading System, etc.) Values Integration: Open-mindedness and proper netiquette 	<ol style="list-style-type: none"> State the VSU Vision, Mission and Quality Policy. Describe and explain the important features of the course Apply proper netiquette during virtual classes 	<ul style="list-style-type: none"> Conduct virtual lecture classes/ meetings Conduct face-to-face (f2f) laboratory classes Solicit questions and feedback from students 	<ul style="list-style-type: none"> Asking questions about the course Sharing of expectations 	Quiz No. 0 (warm-up essay-type quiz)
CO1: Describe multivariate data and the multivariate normal distribution					
2-5	Introduction to Multivariate Data Analysis and the Multivariate Normal Distribution <ul style="list-style-type: none"> Introduction to Multivariate Analysis The Multivariate Normal Distribution Distribution of Functions of Multivariate Normal Random Variables Marginal and Conditional Distribution of Multivariate Normal Random Variables 	<ul style="list-style-type: none"> Enumerate real-life applications of multivariate data analysis Compute the mean vector and variance-covariance matrix of multidimensional random variables Describe the properties of the multivariate normal distribution Derive the marginal and conditional distribution of functions of multivariate normal random variables 	<ul style="list-style-type: none"> Weekly virtual lectures Weekly (f2f) laboratory class 	<ul style="list-style-type: none"> Answering quizzes Doing the laboratory exercises in pairs 	<ul style="list-style-type: none"> Quiz No. 1 Quiz No. 2 Lab Exercise No. 1 Lab Exercise No. 2 First Long Exam
CO2: Perform inference on mean vectors and variance-covariance matrices					
6-10	Inference on Mean Vectors <ul style="list-style-type: none"> Inference on One Mean Vector Inference on Two Mean Vectors 	<ol style="list-style-type: none"> Test hypothesis on one and two mean vectors Construct simultaneous 	<ul style="list-style-type: none"> Weekly virtual lectures Weekly (f2f) 	<ul style="list-style-type: none"> Answering quizzes Doing the laboratory 	<ul style="list-style-type: none"> Quiz No. 3 Quiz No. 4 Lab

	<ul style="list-style-type: none"> • Multivariate analysis of variance • Test on a Single Variance-Covariance Matrix • Test on a Single Variance-Covariance Matrix • Test for Equality of Several Variance-Covariance Matrices 	<p>confidence intervals for one and two mean vectors</p> <p>3. Explain the principles behind multivariate analysis of variance</p> <p>4. Apply multivariate analysis of variance to commonly used experimental designs</p> <p>5. Perform a test of the hypothesis about variance-covariance matrices</p>	laboratory class	exercises in pairs	<p>Exercise No. 3</p> <ul style="list-style-type: none"> • Lab Exercise No. 4 • Lab Exercise No. 5 • Second Long Exam
CO3: Apply various multivariate statistical methods to real-life data.					
11-12	<p>Multivariate Methods for Data Reduction</p> <ul style="list-style-type: none"> • Principal Component Analysis (PCA) • Exploratory Factor Analysis (EFA) • Confirmatory Factor Analysis (CFA) 	<p>1. Explain the purpose of data reduction</p> <p>2. Discuss the concepts and principles of PCA, EFA, and CFA</p> <p>3. Apply PCA, EFA, and CFA to real-life data sets using freeware</p>	<ul style="list-style-type: none"> • Weekly virtual lectures • Weekly (f2f) laboratory class 	<ul style="list-style-type: none"> • Answering quizzes • Doing the laboratory exercises in pairs 	<ul style="list-style-type: none"> • Quiz No. 5 • Quiz No. 6 • Quiz No. 7 • Lab Exercise No. 6 • Lab Exercise No. 7 • Lab Exercise No. 8 • Third Long Exam
CO3: Apply various multivariate statistical methods to real-life data.					
16-18	<p>Multivariate Methods for Classification</p> <ul style="list-style-type: none"> • Linear Discriminant Analysis (LDA) • Logistic Regression Analysis (LRA) 	<p>1. Explain the classification problem</p> <p>2. Discuss the concepts and principles of</p>	<ul style="list-style-type: none"> • Weekly virtual lectures • Weekly (f2f) 	<ul style="list-style-type: none"> • Answering quizzes • Doing the laboratory 	<ul style="list-style-type: none"> • Quiz No. 8 • Quiz No. 9

	<ul style="list-style-type: none"> Cluster Analysis (CA) <i>Special Topic:</i> Canonical Correlation Analysis (CCA) 	LDA, LRA, and CA, and CCA 3. Apply LDA, LRA, and CA, and CCA using freeware	laboratory class	exercises in pairs	<ul style="list-style-type: none"> Lab Exercise Set 9 Lab Exercise Set 10 Fourth Long Exam
15. Life-long Learning Opportunities Students are encouraged to apply the knowledge they gained in the course in industry-related applications, such as predictive analytics and machine learning.					
16. Contribution of Course to Meeting the Professional Component					
General Education: 0 % Mathematical Component: 0% Statistical Component: 100%					
17. References and Other Learning Resources					
A. Textbooks					
1. Hair, J. F., Black, W. C., Babin, B. J., and Anderson, R. E. (2019). <i>Multivariate Data Analysis, 8th Ed.</i> Cengage Learning EMEA. 2. Johnson, R. and Wichern, D. (2014). <i>Applied Multivariate Statistical Analysis, 6th Ed.</i> 3. Schumacker, R. E. (2016). <i>Using R With Multivariate Statistics.</i> SAGE Publications, Inc. 4. James, G., Witten, D., Hastie, T., and Tibshirani, R. (2021). <i>An Introduction to Statistical Learning with Applications in R, 2nd Ed.</i> Springer. 5. Hastie, T., Tibshirani, R., and Friedman, J. (2021). <i>Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd Ed.</i> Springer.					
B. Learning Guide					
1. Milla, N. E. (2025). Student Learning Guide in Stat 145 (Multivariate Analysis)					
C. Other Learning Resources (Journals, Videos, Websites, Webinars, Open Educational Resources, etc.)					
1. https://online.stat.psu.edu/stat505/ 2. https://rich-d-wilkinson.github.io/MATH3030/index.html					
18. Course Assessment and Evaluation					
The performance of students will be assessed and evaluated based on the following:					
Item No.	Assessment Tasks	Percentage Contribution (1)	No. of Times in the Semester (2)	Individual Task % Contribution (1/2)	
1	Quizzes (Q)	15	6	2.5/Q	
2	Laboratory Exercises (Lab)	25	10	2.5/PS	
3	Long Examinations (LE)	60	4	15/LE	

Grading System (60% Passing)			
Range	Grade	Range	Grade
98-100	1.00	53-59	3.25
95-97	1.25	46-52	3.50
90-94	1.50	39-45	3.75
85-89	1.75	32-38	4.00
80-84	2.00	25-31	4.25
75-79	2.25	18-24	4.50
70-74	2.50	11-17	4.75
65-69	2.75	0-10	5.0
60-64	3.00		

19. Course Policies

- A. Instructional materials such as lecture guides and assessment tasks are made available to all students via GitHub (<https://github.com/bertmilla76/Stat-145-Multivariate-Data-Analysis>). Students are encouraged to read the lecture guides before coming to class.
- B. Classes are conducted **face-to-face**, but under rare circumstances, class sessions may be delivered virtually using either ZOOM or Google Meet. The FB Messenger Chat Group will be used for easy and faster communication and consultations.
- C. **Submission of Course Requirements.** Quizzes, problem sets, and long examinations are administered during face-to-face class sessions. Instructions on how to submit the answers to quizzes, problem sets, and long examinations are provided in each course requirement.
- D. **Queries and Clarifications.** For queries, clarifications, or urgent questions, a student may contact the course instructor during the official class schedule, Monday to Friday only, using the contact information given at the last part of this document or via the FB Messenger Group Chat.
- E. All students are reminded to observe all policies, regulations, and rules of the university (particularly on attendance and cheating) and other related laws of the land and are advised to read, understand, and practice the provisions of the VSU Student Manual.
- F. **NO REMOVAL EXAMINATION!** INC mark shall be given to students per BOR-Approved Policies.

These class policies shall serve as our written agreement for the whole semester. The students will be informed immediately of any changes to these policies that may arise for reasons of improving the delivery of the quality of instruction for the betterment of the Teaching and Learning process.

20. Course Materials and Facilities Available

Student Learning Guide (online via GitHub)
Facebook Messenger Group Chat
Statistics Computing Laboratory

21. Revision History

Revision number	Date of Revision	Date of implementation	Highlights of Revision	Revised by
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1	August 7, 2025	1 st Sem., AY 2025-2026	<ul style="list-style-type: none"> Updated VSU's vision and mission, the course content, the references, and adjusted the class policies to suit flexible learning Revised the grading scheme Updated to conform with form TP-IMD-08 v04 01-23-2025 	Norberto E. Milla, Jr.
0	September 7, 2022	1 st Sem., AY 2022-2023	<ul style="list-style-type: none"> Original OBE'd syllabus in Stat 145 (Multivariate Data Analysis) incorporating the topics indicated in the CMO for BS Statistics. 	Norberto E. Milla, Jr.

22. Preparation

Prepared by	Name	Signature	Date Signed
	NORBERTO E. MILLA, JR.		

IV. INSTRUCTOR/PROFESSOR INFORMATION

1. Name of Instructor/Professor	NORBERTO E. MILLA, JR.
2. Office and Department	Faculty Room No.1 (Annex), Department of Statistics
3. Telephone/Mobile Numbers	+63 9473941899
4. Email Address	bertmilla@vsu.edu.ph
5. Consultation Time	

23. Department Instructional Materials Review Committee:

Committee	Name	Signature	Date Signed
Member:	VIRGELIO M. ALAO		
Member:	NORBERTO E. MILLA, JR.		
Chairperson:	DONNA C. CUYNO		

	Name	Signature	Date Signed
Noted by:	REV RHIZZA L. AURE Dean, FNMS		
Verified by:	MARK GIL A. VEGA Head, IMDO		
Validated by:	MA. RACHEL KIM L. AURE Director, IEO		



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