DE LA SALLE UNIVERSITY
College of Science
Mathematics and Statistics Department

EXPEDES – *Experimental Design Analysis*
Prerequisite: LINMODE *Prerequisite to:*

Instructor: **Contact details:**
Consultation Hours: **Class Schedule and Room:**

Course Description

This is an introductory course on the design and analysis of experiments. It deals with planning and conducting experiments and about analyzing the resulting data so that valid and objective conclusions are obtained.

Learning Outcomes

On completion of this course, the student is expected to present the following learning outcomes in line with the Expected Lasallian Graduate Attributes (ELGA) and the outcomes prescribed by the CHED Memorandum Order for the BS Mathematics program.

ELGA	Learning Outcome	Program Outcome													
	At the end of the course, the student will	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Critical and Creative Thinker Effective Communicator Lifelong Learner	explain the principles of designing experiments for statistical analysis	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	design experiments for statistical analysis	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	analyze statistically designed experiments	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	use statistical software for analyzing statistically designed experiments	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓

Program Outcomes (BS Statistics)
A graduate of the program should be able to
1. Demonstrate broad and coherent knowledge and understanding of the core areas of statistical theory and statistical modeling .
2.Apply critical and problem solving skills using the scientific method.
3.Interpret scientific data and make judgments that include reflection on relevant scientific and ethical issues.
4.Carry out basic mathematical and statistical computations and use appropriate technologies in (a) the analysis of data; and (b) In pattern recognition, generalization, abstraction, critical analysis and problem solving.
5.Communicate information, ideas problems and solutions, both, orally and in writing, to other scientists, decision makers and the public.
6.Relate science and mathematics with other disciplines.
7.Design and perform safe and responsible techniques and procedures in laboratory or field practices.
8.Critically evaluate input from others.
9.Appreciate the limitations and implications of science in everyday life.
10.Commit to the integrity of data.
11.Demonstrate broad and coherent knowledge and understanding in the core areas of statistics, computing and mathematics.
12.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.
13.Translate real-life problems into statistical problems.
14.Identify appropriate statistical tests and methods and their proper use for the given problems, select optimal solutions to problems and make decision in the face of uncertainty.

Final Course Output

As evidence of attaining the above learning outcomes, the student is required to do and submit the following during the indicated dates of the term.

Learning Outcome	Required Output	Due Date
At the end of the course, the student will apply appropriate statistical concepts, processes, tools, and technologies in the solution to various conceptual and real-world problems.	An inquiry-based individual and group presentations highlighting the appropriate usage of experimental design methods using real empirical data	Week 13

Rubric for assessment

CRITERIA	Excellent (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
Formulation of the Research Problem and Objectives (10%)	Research problem and objectives are clearly defined and significant; Demonstrates evidence that the research problem was researched and designed well.	Research problem and objectives are clearly defined and significant.	Research problem is clearly defined but some objectives are insignificant.	Research problem and objectives are vague and insignificant.
Correct Application of the Statistical Concepts (35%)	Statistical analyses are appropriate with correct interpretations and relevant conclusions.	Statistical analyses are appropriate with correct interpretations.	Some statistical analyses are inappropriate.	Statistical analyses are inappropriate
Depth of Analysis (30%)	The analysis convinces the reader about the wisdom of conclusions, implications and consequences on the basis of statistical methods and findings	The analysis engages the reader to appreciate the wisdom of conclusions, implications and consequences on the basis of statistical methods and findings	The analysis have limited ideas that do not explain the wisdom of conclusions, implications and consequences on the basis of statistical methods and findings	The analysis has incorrect ideas and conclusions.
Clarity and Organization of Written Report (10%)	Written report is organized logically and presented clearly with effective transitions.	Written report is organized logically and presented clearly.	Written report is organized and some discussions are not clear.	Written report is not organized.
Oral Presentation (15%)	Overall presentation is creative and well organized with innovative ideas.	Overall presentation is creative and well organized.	Overall presentation is organized	Overall presentation is not organized

Additional Requirements

Aside from the final output, the student will be assessed at other times during the term by the following:

- Quizzes and Problem Sets
- Class Participation (seatwork and group exercises, homework, recitation, group reports)
- Computer hands-on exercises using SAS
- Final Examination

Grading System

	FOR EXEMPTED STUDENTS (w/out Final Exam)	FOR STUDENTS with FINAL EXAM	
		with no missed quizzes	*with one missed quiz*
Average of quizzes	90%	60%	50%
Other requirements	10%	10%	10%
Final exam	-	30 %	40%

Scale:

95-100%	4.0
89-94%	3.5
83-88%	3.0
78-82%	2.5
72-77%	2.0
66-71%	1.5
60-65%	1.0
<60%	0.0

Learning Plan

LEARNING OUTCOME	TOPIC	WEEK NO.	LEARNING ACTIVITIES
At the end of the course, the student will apply appropriate statistical concepts, processes, tools, and technologies in the solution to various conceptual and real-world problems	1. Introduction 1.1 Experimental Designs versus Survey Sampling 1.2 Some Typical Applications of Experimental Designs 1.3 Basic Principles 1.4 Planning an Experiment	2 hours / Week 1	Prior knowledge and beliefs survey Concept mapping Library work Group discussion and presentations Computer laboratory activities (SAS) Skills exercises Student self-assessment and reflection
	2. 2. Simple Comparative Experiments 2.1 Review of Estimation and Statistical Hypothesis Testing in Normal Populations a. Confidence Intervals b. Sample Size Computation c. Hypothesis Testing 2.2 Paired Comparison Designs 2.3 Inferences About the Variances of Normal Distributions	4 hours / Week 1 – 2	
	3. Experiments with a Single Factor 3.1 Completely Randomized Designs (CRD) 3.2 One-Way Analysis of Variance (ANOVA) 3.3 Analysis of Fixed-Effects Models 3.4 Diagnostic Checking and Model Adequacy Checking 3.5 Choice of Sample Size	8 hours / Week 2 – 4	
	Quiz No. 1 & Problem Set 1	2 hours / Week 4	
	4. Randomized Blocks, Latin Squares and Related Designs 4.1 Randomized Complete Block Design (RCBD) a. Analysis b. Model Adequacy Checking c. Parameter Estimation and the Significance Test 4.2 Latin Square Design (LSD) 4.3 Graeco and Hyper-Graeco Latin Square Design 4.4 Balanced Incomplete Block Designs a. Analysis b. Least Squares Estimation	8 hours / Week 5 - 6	

	c. Recovery of the Interblock Information		
	Quiz No. 2 & Problem Set 2	2 hours / Week 7	
	5. Factorial Experiments 5.1 Basic Definitions and Principles 5.2 The Two-Factor Factorial Designs 5.3 The General Factorial Design 5.4 The 2k Factorial Design 5.5 Blocking and Confounding in the 2k Factorial Design 5.6 Two-Level Fractional Factorial Designs	10 hours / Week 7 - 9	
	Quiz No. 3 & Problem Set 3	2 hours / Week 10	
	6. Analysis of Covariance (ANACOVA) 7. Repeated Measures	6 hours / Week 10 - 11	
	Group Reports/Projects	8 hours / Week 12 - 13	
	Final Examination	2.0 hours / Week 14	

*Skills exercises/ computer laboratory activities are given weekly and the students are expected to work on the solutions for their fourth hour activity. At the end of the term, the solutions to the problems will be compiled and submitted as one of the course outputs.

References

Montgomery, Douglas C. Design and Analysis of Experiments, 7th edition. New York: Wiley, 2009.

Neter, Kutner, Natchsheim and Wasserman. Applied Linear Statistical Models (4th edition).Chicago: Irwin, 1996.

Box, Hunter and Hunter. Statistics for Experimenters NY: Wiley, 1978.

Cochran, William G. and Cox, Gertrude M. Experimental Designs, 2nd edition. New York: Wiley Classics, 1992.

Hair Jr., Joseph F. et. al. Multivariate Data Analysis, 7th edition. New Jersey: Prentice Hall, 2010.

Milliken, George A. and Johnson, Dallas E. Analysis of Messy Data. New York: Van Nostrand Reinhold, 1984.

Johnson, Richard A. and Wichern, Dean W. Applied Multivariate Statistical Analysis, 6th edition. NJ: Pearson Prentice Hall, 2007.

Online Resources

Concepts of Experimental Design: Design Institute for Six Sigma: http://support.sas.com/resources/papers/sixsigma1.pdf

Basic Experimental Design: http://liutaiomottola.com/myth/expdesig.html

DoE & Analysis of Experimental Data (using R): http://cran.r-project.org/web/views/ExperimentalDesign.html

What is Experimental Design?: http://www.itl.nist.gov/div898/handbook/pri/section1/pri11.htm

A Field Guide to Experimental Designs: http://www.tfrec.wsu.edu/anova/index.html

Class Policies

1. The required minimum number of quizzes for a 3-unit course is 3, and 4 for 4-unit course. No part of the final exam may be considered as one quiz.
2. Cancellation of the lowest quiz is not allowed even if the number of quizzes exceeds the required minimum number of quizzes.
3. As a general policy, no special or make-up tests for missed exams other than the final examination will be given. However, a faculty member may give special exams for
   A. approved absences (where the student concerned officially represented the University at some function or activity).
   B. absences due to serious illness which require hospitalization, death in the family and other reasons which the faculty member deems meritorious.
4. If a student missed two (2) examinations, then he/she will be required to take a make up for the second missed examination.
5. If the student has no valid reason for missing an exam (for example, the student was not prepared to take the exam) then the student receives 0% for the missed quiz.
6. Students who get at least 89% in every quiz are exempted from taking the final examination. Their final grade will be based on the average of their quizzes and other prefinal course requirements. The final grade of exempted students who opt to take the final examination will be based on the prescribed computation of final grades inclusive of a final examination. Students who missed and/or took any special/make-up quiz will not be eligible for exemption.
7. Learning outputs are required and not optional to pass the course.
8. Mobile phones and other forms of communication devices should be on silent mode or turned off during class.
9. Students are expected to be attentive and exhibit the behavior of a mature and responsible individual during class. They are also expected to come to class on time and prepared.
10. Sleeping, bringing in food and drinks, and wearing a cap and sunglasses in class are not allowed.
11. Students who wish to go to the washroom must politely ask permission and, if given such, they should be back in class within 5 minutes. Only one student at a time may be allowed to leave the classroom for this purpose.
12. Students who are absent from the class for more than 5 meetings will get a final grade of 0.0 in the course.
13. Only students who are officially enrolled in the course are allowed to attend the class meetings.

Approved by:

DR. JOSE TRISTAN F. REYES
Chair, Mathematics and Statistics