DE LA SALLE UNIVERSITY
College of Science
Mathematics and Statistics Department

LINPROG – *Linear Programming*
Prerequisite: LINEALG

Prerequisite to:

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

Course Description

As an introductory course in Operations Research, this course focuses on the basic models, the analysis and the solution of linear optimization models. The thrust is in the analysis of problems and their solution approaches. This course provides a firsthand exposure to vast and highly relevant area of operations research.

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
Critical and Creative Thinker Effective Communicator Lifelong Learner	apply appropriate analysis concepts, thinking processes, tools, and technologies in the solution to various conceptual or real-world problems.	✓	✓	✓	✓	✓		✓		✓

Program Outcomes (BS Mathematics)

A graduate of the program should be able to

1. Apply analytical, critical and problem solving skills using the scientific method.
2. Carry out basic mathematical and/or statistical computations and use appropriate technologies in the analysis of data, and in pattern recognition, generalization, abstraction, critical analysis, and problem solving.
3. Demonstrate broad and coherent knowledge and understanding in the core areas of mathematics
4. Gain mastery in the core areas of mathematics: algebra, analysis and geometry
5. Demonstrate skills in pattern recognition, generalization, abstraction, critical analysis, problem-solving and rigorous argument.
6. Develop an enhanced perception of the vitality and importance of mathematics in the modern world, including the interrelationships within mathematics and its connection to other disciplines
7. Appreciate the concept and role of proof and reasoning and demonstrate knowledge in reading and writing mathematical proofs.
8. Make and evaluate mathematical conjectures and arguments and validate their own mathematical thinking
9. Communicate mathematical ideas orally and in writing using clear and precise language

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 develop an understanding and appreciation of linear programming concepts as effective tools in addressing real world problems especially those that are relevant to decision making in business, economics and other related areas.	• A portfolio of the computer laboratory exercises performed during the course. • A group write-up on a Case Study of a real life situation solvable by using linear programming methods. Students may form groups of 2-3	Week 13

Rubric for assessment

Portfolio of Computer Laboratory Exercises

CRITERIA	Excellent (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
Completeness (40%)	*The submitted work includes all the prescribed exercises and the required parts of the solutions.*	*The submitted work has a few omissions but includes at least 85% of the prescribed exercises and the required components of the solutions.*	*The submitted work has some omissions but includes between 70%-84% of the prescribed exercises and the required components of the solutions. Certain aspects are either incomplete or incorrect.*	*The submitted work contains many omissions and satisfiesless than 70% of the exercises and the required components of the solutions.*
Accuracy (45%)	*The submitted work implemented the prescribed methods correctly and showed the correct results to all exercises.*	*The submitted work implemented the required methods but with some errors.*	*The submitted work partially manifests the required qualities.Certain aspects are either incomplete or incorrect.*	*The submitted work does not manifest the required qualities. Exercises were either done in haste or not done at all.*
Organization (15%)	*The write-ups for the laboratory exercises are all in order, and follow the prescribed format.*	*The write-ups for the laboratory exercises have minor errors and the prescribed format is followed in at least 85% of the items in the portfolio.*	*The write-ups for the laboratory exercises contain occasional errors and the prescribed format is followed in 70-84% of all write-ups.*	*The write-ups for the laboratory exercises contain occasional errors and the prescribed format is followed in less than 70% of the exercise write-ups.*

Written Group Report

CRITERIA	Excellent (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
Understanding of Mathematical Concepts (60%)	*Shows complete mastery of the concepts and processes studied in the course as well as their inter-relationships with one another*	*Shows an almost complete mastery of the concepts and processes studied in the course as well as their inter-relationships with one another.*	*Shows a moderate degree of under-standing of the concepts and processes studied in the course as well as their inter-relationships with one another.*	*Shows a limited degree of under-standing of the concepts and processes studied in the course as well as their inter-relationships with one another.*
Clarity of Presentation (30%)	*The ideas present-ed are easily understood and the existing inter-rela-tionships among the concepts and processes are clearly indicated.*	*Except for a few minor details, the ideas presented are easily under-stood and the existing inter-rela-tionships among the concepts and processes are clearly indicated.*	*Some ideas are not clearly presented and some inter-rela-tionships are either lacking or not correctly presented,*	*Many of the ideas presented and inter-relationships among concepts and processes are incorrect or lacking.*
Bibliography (10%)		*All resources cited*	*Some of the resources not cited*	*Majority of the resources not cited*

Group Member Assessment

CRITERIA	Excellent (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
Contribution	*Group member completed an equal share of work and strived to maintain that equity throughout the project*	*Group member contributed significantly, but other members clearly contributed more*	*Group member contributed little toward the project*	*Group members contributions were insignificant or nonexistent*
Dependability	*Group member provided contributions with 100% punctuality and always appeared for group work*	*Group member contributions were mostly punctual and almost always appeared for group work*	*Group member contributions were regularly late and often missed scheduled group work*	*Group member was undependable forcing other members to take up the slack*
Efficiency	*Work performed was very useful and contributed significantly to the final product*	*Participation was inefficient and thus contributions were less than expected*	*Work performed was inappropriate and mostly useless toward the final product*	*Work performed was completely ineffective and useless in the final product*
Attitude	*Group member was very positive and pleasant to work with*	*Group member didn't complain but offered little enthusiasm*	*Group member sometimes complained and was somewhat of a burden*	*Group member often complained and generally demoralized the group*

Additional Requirements

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

- Skills Check (Seatwork/Quizzes/Laboratory Work)
- Individual/Group Report
- Individual/Group Problem Set

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	95%	65%	55%
Other requirements	5%	5%	5%
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 develop an understanding and appreciation of linear programming concepts as effective tools in addressing real world problems especially those that are relevant to decision making in	I. **Introduction and Overview of Linear Programming** 1.1 The Linear Decision Model 1.2 Applications and Purpose of LP	1	Recitation / Class Discussion Group discussions Library work
	II. **The Conventional Linear Programming Model** 2.1 Models and Model Types 2.2 General Guidelines in Model Building	1-2	

business, economics and other related areas.	2.3 Basic Steps in LP Model Formulation 2.4 The General Form of the LP Model 2.5 Assumptions of the LP Model 2.6 Model Validity		
	III. Foundations of the Simplex Method 3.1 Converting an LP Program into Standard Form 3.2 Graphical Solution of the Two-Dimensional LP 3.3 Convex Sets and Polyhedral Sets 3.4 Basic Feasible Solutions and Extreme Points	3-6	
	QUIZ 1		
	IV. The Simplex Method: Tableaux and Computation 4.1 Algebra of the Simplex Method 4.2 The Simplex Method in Tableau Form 4.3 Finding an Initial Basic Feasible Solution 4.4 Unrestricted Variables and Variables with Negative Lower Bounds 4.5 Degeneracy and Cycling	7-10	
	QUIZ 2		
	V. Duality and Sensitivity Analysis 5.1 Formulation of the LP Dual 5.2 Relationships in Duality 5.3. Economic Interpretation of the Dual 5.4 The Dual Simplex Algorithm 5.5 Sensitivity Analysis in LP	11-12	
	QUIZ 3		
	5.6 Parametric Programming	13	
	Final Examination	14	

The students will be instructed to form permanent groups of 3 – 5 students. These groups will have regular weekly meetings where the primary task is to discuss the material covered during the week. The results of their discussion will be documented since it will be their fourth hour activity. These written reports will be organized into a final report to be submitted at the end of the 13th week.

References

Taha, Hamdy.(2006) Operations Research: An Introduction, 5th edition, Macmillan Publishing Company

McNickel Donald C., Daellenbach Hans and George John A., (1983) Introduction to Operations Research, Alyn And Bacon Inc.

Lieberman Gerald and Hillier Frederick.,(2005) Introduction to Operations Research, 8th Edition, Mc-Graw –Hill Science Engineering.

Online Resources

http://www2.isye.gatech.edu/~spyros/Lp/Lp.html

http://people.hotstra.edu/Stefan_waner/RealWorld/Summary4.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