University of the Philippines Baguio
College of Science
Department of Mathematics and Computer Science

COURSE SYLLABUS

MATH 181
Mathematical Methods of Operations Research

The University of the Philippines

UP was founded in 1908 with its first campus in Manila. It was followed soon after by the establishment of constituent universities and campuses all over the country. Over the course of a century, UP has established eight constituent universities distributed across 17 campuses.

Vision

The University of the Philippines (UP) envisions itself to be a leading regional and global university in an environment that sustains 21st-century learning, knowledge, creation, and public service for society and humanity.

Mandates

As the national university, UP is mandated to perform its unique and distinctive leadership in higher education and development, in terms of:

- Setting academic standards and initiating innovation in teaching, research, and faculty development in an environment of academic freedom;
- Serving as a graduate university providing advanced and specialized studies, especially to the faculty members of state and private colleges and universities;
- Serving as a research university in various fields of expertise and contributing to the dissemination and application of new knowledge;
- Leading as a public service university by providing different forms of community, public, and volunteer service to the government, the private sector, and civil society;
- Protecting and promoting the professional and economic right and welfare of its academic and non-academic personnel;
- Providing learning opportunities in various forms to promote such special concerns as responsible citizenship, sustainable development, sports and health development, and cultural development;
- Serving as a hub for regional and global academic networks; and
- Applying the highest standards of academic and institutional governance within a meritocracy based on collegiality, representation, accountability, transparency, and active participation of all constituents.

For more information on the University's Vision and Mission, refer to the UP Strategic Plan 2017-2023.

University of the Philippines' Philosophy of Education and Graduate Attributes

A UP education seeks to produce graduates imbued with an abiding sense of responsibility to their people and nation, the skills and mindsets to improve human life, and a commitment to the freedom and welfare of all.

Aside from mastery of knowledge in their specific disciplines, UP graduates must possess breadth of mind, strength of character, and generosity of spirit, fostered by a firm grounding in both the arts and sciences, and such specialist courses as their programs may require.

They must be prepared to inclusively engage with society and the world at large, mindful of their people's needs and capabilities, and keen to the challenges and opportunities of national development in this century of rapid global change.

UP aims to achieve this through its General Education program, one that develops mind, body and spirit, which familiarize all its students with their culture and history and fosters a sense of shared citizenship, while equipping them with critical thinking, discernment and technical skills they will need to excel in their chosen professions.

The University of the Philippines Baguio

Established through the initiative of UP alumni in Baguio and Benguet, the University of the Philippines Baguio was inaugurated as a degree-granting unit of the University on 22 April 1961. A land grant worked out by alumni, the City Council, and by then UP President Vicente Cinco situated the College on its present location, a pine clad-hill offering a scenic view of Baguio. The College went on to make its presence felt as it served as the site of the National Arts Festivals in the coming years. Moves were made to strengthen its research capabilities, culminating in the institution of the Cordillera Studies Center in 1983. Directions towards autonomy began with strategic planning in 1996. The following years saw the College working assiduously in the reformulation and strengthening of its academic programs, primarily. Administration of the College likewise oversaw the development in infrastructure and improvement of services and facilities. Such growth led to the elevation of UP College Baguio to full autonomous status, granted by the Board of Regents in December 2022. UP Baguio is now the seventh constituent university of the UP System.

Vision

As a constituent university of the University of the Philippines System, UP Baguio will sustain its lead position in the delivery of tertiary education in the north. It will continue to nurture and develop innovative programs in the arts and sciences. It will also continue to develop the niche it has created over the past decades in Cordillera Studies.

Mission

Our mission, therefore, as a unit of the U.P. System and as the leading institution of higher learning in Northern Luzon, is to spearhead the offering of the highest standard of education and to contribute to the overall upgrading of the quality of instruction in the region. We seek to create an impact by informing our programs with a regional perspective, at the same time that these are informed by a national and global outlook.

For more information on UP Baguio's Vision and Mission, refer to the official UP Baguio webpage.

The College of Science

After the reorganization of UP Baguio during its institution as the seventh constituent university of the UP system in 2002, the College of Science (CS), being one of the three colleges emerging from the reorganization, evolved from the merger of the Division of Natural Sciences and Mathematics and the Sports, Physical Education and Recreation Division. The College offers four undergraduate degree programs: BS Biology, BS Computer Science, BS Mathematics, and BS Physics program. All these programs are regularly reviewed and upgraded to prepare students for careers in education, research, or postgraduate studies.

The CS Dean, together with the Faculty Assembly and in cooperation with the College Executive Board (CEB), leads the Department of Biology, the Department of Physical Sciences, the Department of Mathematics and Computer Science, and the Human Kinetics Program towards academic excellence and public service.

Vision

The College of Science aims to continue offering high standard and relevant quality education through good practices in program implementation that follow innovative pedagogical strategies that utilize appropriate technology in supporting this endeavor. It will further its objectives by initiating interdisciplinary programs anchored on disciplinary specializations in its efforts to enhance the efficiency of research conduct and management. It will continue to encourage and reward scientific productivity by conducting research responsive to the needs of the region, nation, and the global community.

The College envisions itself moving towards a more inclusive and equitable environment that enables faculty members to lead on with exemplary qualifications – mindful of scholarly research and dedicated to public service.

Furthermore, it will support UP Baguio's wellness program for both academic and support staff to guarantee efficiency in service to the university and the society.

Lastly, the College, together with the University, will take initiative to continue, strengthen and widen the reach of its involvement in public service by sharing individual and collective expertise with other academic institutions, local government units, NGOs, peoples' organizations, and indigenous communities in the region and other areas.

Mission

In line with the college's vision, it is our mission, therefore, to produce scientific leaders and civic-minded citizens with high regard for integrity, compassion, and genuine service who lead in a research study that follows ethical standards and excellence in instruction, research, and public service.

It is our mission to improve on basic facilities and design where researchers can work more collaboratively and efficiently. We pursue to guarantee the safety of researchers, to minimize adverse impact to the environment, to respect research protocols involving indigenous communities, and to ensure professional conduct as we encourage good instruction, research, and public service in upholding the University's banner of *Honor and Excellence*.

Goals

In accordance with the mission and vision of the University, the college aims to accomplish the following goals:

- To continue formulating new degree programs while regularly upgrading existing ones;
- To encourage interdisciplinary research across programs;
- To institutionalize the Science Research Center in continuing research responsive to the need of the region, and in the enhancement of interdisciplinary collaboration within the departments of the College and even with other faculty members in other colleges of the University of the Philippines Baguio;
- To have a closer linkage with the Cordillera Studies Center as the university's research center and as an aid in putting up the biodiversity and innovation research center;
- To foster an environment suitable for the growth of the academic and support staff; and,
- To provide public service based on each academic and support staff's specialization.

For more information on CS' Vision, Mission, and Goals, refer to the official CS website.

Department of Mathematics and Computer Science
COLLEGE OF SCIENCE
UNIVERSITY OF THE PHILIPPINES BAGUIO
Governor Pack Road, 2600 Baguio City
Tel: +63 74 442 7231 Fax: +63 74 444 3128

The Department of Mathematics and Computer Science

The Department of Mathematics and Computer Science (DMCS) grew from a discipline to a department in 2002 when UP Baguio became the seventh constituent university of the UP System. The Department offers two undergraduate programs (BS Mathematics and BS Computer Science) and two graduate programs (MS Mathematics and PhD Mathematics). The Department pioneered the PhD Mathematics Program in Northern Luzon.

Vision

The DMCS adheres to the highest standards of excellence in all aspects of teaching, research, and extension service. It will build and maintain nationally and internationally recognized experts in the core and emerging areas of study in mathematics, statistics, and computer science. It will set the standards for promoting quality instruction, interdisciplinary research, teacher training, and other extension programs within the University, the Northern Luzon region, and the country.

Further, it aspires to become a Center of Excellence in mathematics both in the country and in the ASEAN region.

Mission and Goals

The DMCS is committed to pursuing excellence in teaching, research, and extension service within the University, the Northern Luzon region, and the country.
The Department identified these five major goals to help realize its mission:

1. Strengthen its graduate and undergraduate programs;
2. Aggressively promote and maintain high standards of quality education;
3. Lead in research capability building and research-generating activities in the mathematical and computing sciences and in mathematics education in the region;
4. Upgrade the quality of mathematics and computing education in the primary, secondary, and tertiary levels in Northern Luzon; and
5. Make quality mathematics and computer science education accessible to the people in the region.

The BS Mathematics Program

The BS Mathematics Program is one of the undergraduate programs that UP Baguio (then UP College Baguio) has offered since 1975. Evolving from the BS Physics-Mathematics program, the first batch graduated in 1977. The original BS Mathematics program provided training for teaching, research, or jobs related to statistics, operations research, business management, and more. The current BS Mathematics program is a four-year program that provides solid undergraduate preparation in mathematics. The curriculum covers fundamental and abstract concepts in mathematics and important and emerging fields in applied mathematics. The program allows the students to study different fields in Mathematics, such as Algebra (linear, abstract), Analysis (elementary, advanced, real, complex, numerical), and other areas like Statistics (elementary, mathematical, applied), Modern Geometry, Number Theory, Combinatorics, and Topology.

For more information on DMCS' Vision, Mission and Goals, and the BS Mathematics Program, refer to the official DMCS website.

Department of Mathematics and Computer Science
COLLEGE OF SCIENCE
UNIVERSITY OF THE PHILIPPINES BAGUIO
Governor Pack Road, 2600 Baguio City
Tel: +63 74 442 7231 Fax: +63 74 444 3128

A. COURSE DETAILS

Course Number:	Math 181	
Course Name:	Mathematical Methods of Operations Research	
Course Description:	Introduction to mathematical programming problem; graphical method; optimization in networks; dynamic programming; game theory; stochastic models; and simulation.	
Credit Units:	3 units (3h lec)	
Prerequisite:	Math 122 (Linear Algebra and Matrix Theory)	
Requirements:	Three Long Examinations	40%
	Report (Written and Oral)	20%
	Quizzes/Assignments/Recitation/Attendance	10%
	Final Examination	30%
	Total	**100%**
Passing Grade:	60% (3.0)	
Software:	MATHPROG (shareware)	

B. PROGRAM LEARNING OUTCOMES (PLO)

The Program Learning Outcomes (PLOs) of the BS Mathematics Program are as follows:

PLO 1 Promote engagement in lifelong learning towards excellence in the field of expertise.
PLO 2 Apply professional, social, and ethical responsibilities as active and participative citizens.
PLO 3 Develop social and professional skills to build healthy, productive, and ethical working relationships with peers.
PLO 4 Develop mastery in the core and applied areas of mathematics.
PLO 5 Develop skills in pattern recognition, abstraction, critical analysis, and problem-solving, and in making generalizations, synthesis, and rigorous arguments.
PLO 6 Develop an enhanced perception of the strength and importance of mathematics in the modern world including inter-relationships within mathematics and its connections to the natural sciences, humanities and the arts, and the social sciences.
PLO 7 Analyze current advances in mathematics research and propose conjectures that extend the theory.

C. COURSE LEARNING OUTCOMES (CLO)

At the end of this course, the students must be able to:

CLO1 Describe the nature, origin, major phases, and applications of operations research.
CLO2 Obtain and interpret optimal solution for linear programming models for real life problems.
CLO3 Apply the principle of duality in solving linear programming problems.
CLO4 Demonstrate proficiency in using appropriate mathematical software in solving problems.

D. MAPPING OF CLO with the PLO

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	F	I		F	M	F	I
CLO2	F	M	M	F	M	F	I
CLO3	M			I	M	M	I
CLO4	M	M	M	M	I	M	M

LEGEND: I-Introduced; M-Moderately achieved; F-Fully achieved

E. CLASS RULES

1. Students are expected to have a copy of any of the textbooks. Lectures and exercises will be based on the textbooks.
2. The University rule on class attendance (Article 346 of the University Code) shall be strictly enforced in the class.
3. If a student misses a short quiz, his/her grade in that quiz is zero. If a student misses a long examination for a valid reason (this requires documentation), his/her grade in the final exam will also account as his/her grade for the missed exam. This applies to no more than one long exam missed. A student who fails to take any examination for invalid reasons will get a grade of 0% for that exam.
4. Cheating, in any form, will not be tolerated.

F. GRADING SCHEME

Grading System:

1.0	[95,100]
1.25	[90,95)
1.5	[85,90)
1.75	[80,85)
2.0	[75,80)
2.25	[70,75)
2.5	[65,70)
3.0	[60,65)
4.0	[55,60)
5.0	[0,55)

UP Classification:

1.0-1.25	Excellent
1.50-1.75	Very Good
2.0-2.25	Good
2.5-2.75	Satisfactory
3.0	Passing
4.0	Conditional
5.0	Fail
DRP	Dropped
INC	Incomplete

G. COURSE OUTLINE

Timeline	Course Learning Outcomes	Topics	Learning Activities	Assessment Tools
Week 1	CLO1: Describe the nature, origin, major phases, and applications of operations research (OR) CLO4: Demonstrate proficiency in using appropriate mathematical software in solving problems.	**CHAPTER 1: Introduction** 1.1 The Origins of Operations Research 1.2 The Nature of Operations Research 1.3 The Impact of Operations Research 1.4 Algorithms and OR Courseware	Lectures Computer demonstrations Computer Laboratory sessions	Reporting Problem Sets
Weeks 2-3	CLO2: Obtain and interpret optimal solution for linear programming (LP) models for real life problems CLO3: Apply the principle of duality in solving LP problems CLO4: Demonstrate proficiency in using appropriate mathematical software in solving problems.	**CHAPTER 2: Overview of the Operations Research Modeling Approach** 2.1 Defining the Problem and Gathering Data 2.2 Formulating a Mathematical Model 2.3 Deriving Solutions from the Model 2.4 Testing the Model 2.5 Preparing to Apply the Model 2.6 Implementation	Group Discussions Reading Assignments Think-Pair-Share Class Reporting Group Evaluations	Quizzes Reporting Assignment
Weeks 4 – 5	ALL CLOs	**CHAPTER 3: Introduction To Linear Programming** 3.1 Introduction to Linear Programming 3.2 The Simplex Methods 3.3 Duality and Sensitivity Analysis		Assignment Board Exercises

		3.4 Transportation Model and its Variance		
FIRST LONG EXAMINATION				
Weeks 6 – 8	CLO3: Apply the principle of duality in solving LP problems CLO4: Demonstrate proficiency in using appropriate mathematical software in solving problems.	**CHAPTER 4** 4.1 Network Models 4.2 Advance Linear Programming 4.3 Goal Programming 4.4 Integer Linear Programming 4.5 Deterministic Dynamic Programming 4.6 Deterministic Inventory Models	Lectures Computer demonstrations Computer Laboratory sessions	Seatwork Quizzes Recitation
Weeks 9 – 11	CLO2: Obtain and interpret optimal solution for linear programming (LP) models for real-life problems CLO3: Apply the principle of duality in solving LP problems	**CHAPTER 5: Probabilistic Models** 5.1 Review of Basic Probability 5.2 Forecasting Models 5.3 Decision Analysis and Games 5.4 Probabilistic Analysis and Games	Group Discussions Reading Assignments Think-Pair-Share Class Reporting Group Evaluations	Problem Set Reporting
SECOND LONG EXAMINATION				
Weeks 12 – 13	CLO4: Demonstrate proficiency in using appropriate mathematical software in solving problems.	**CHAPTER 6** 6.1 Probabilistic Inventory Models 6.2 Queueing Systems 6.3 Simulating Models 6.4 Markovian Decision Process	Lectures Computer demonstrations	Seatwork Quizzes Recitation
Weeks 14 – 16		**CHAPTER 7: Nonlinear Models** 7.1 Classical Optimization Theory 7.2 Nonlinear Programming Algorithm	Computer Laboratory sessions Group Discussions Reading Assignments Think-Pair-Share Class Reporting Group Evaluations	Reporting
		THIRD LONG EXAMINATION		
FINAL EXAMINATION ***(as scheduled by the Office of the University Registrar)***				

H. REFERENCES

1. Introduction to Operations Research by Frederick s. Hillier and Gerard Lieberman
2. Operations Research an Introduction by Hamdy A. Taha
3. Taha. Operations Research: An Introduction
4. Gass. Linear Programming (Methods and Applications)
5. Gillet. Introduction to Operations Research

Department of Mathematics and Computer Science
COLLEGE OF SCIENCE
UNIVERSITY OF THE PHILIPPINES BAGUIO
Governor Pack Road, 2600 Baguio City
Tel: +63 74 442 7231 Fax: +63 74 444 3128

I. RUBRICS FOR ASSESSMENT

A. PROBLEM SET

CRITERIA	Unacceptable 0	Poor 1	Basic 2	Fair 3	Acceptable 4	Exemplary 4
Interpretation of the Problem 30%	Incorrect interpretation of the problem. A major misinterpretation of what is given or what is to be shown.	There is at least some sign of relevant ideas regarding the problem.	Correct but incomplete interpretation of the problem. *May overlook significant details in the statement of the problem. Might be stated for indirect proof but direct proof is given or vice-versa.	Correct but with major incorrect or unnecessary concepts for its solutions.	Correct but with minor incorrect or unnecessary concepts for its solutions.	Correct statement with the hypothesis (given) and conclusion (to show) clearly stated.
Correctness of Proof 70%	Mainly incorrect consequences Improperly deduced from the given. Little or no sense of how to prove the result.	Unconnected, mostly true statements properly deduced from the given. Listing facts without a sense of how to link them to get a correct proof. May just jump to the conclusion without justification.	Statements linked into a reasonable (though perhaps misguided) attempt to prove the theorem. The proof may be left incomplete or may depend upon a major Unjustified leap.	A correct approach to proving the theorem is attempted but with major incorrect use of mathematical concepts.	A correct approach to proving the theorem is attempted. Some statements may be unjustified or improperly justified, but errors are minor and could be fixed without substantially changing the proof.	A correct and complete proof is given. Some irrelevant information may be included, particularly on timed work where the student is unable to polish up the presentation.

B. REPORTING

Criteria	Needs Improvement 1	Satisfactory 2	Good 3	Exemplary 4
Organization 10%	Audience cannot understand the presentation because there is no sequence of information.	Audience has difficulty following the presentation because the student jumps around.	Students present information in logical sequence which the audience can follow.	Students present information in logical, interesting sequences which the audience can follow.
Content Knowledge 50%	Students shows no understanding of mathematical concepts within the presentation	Students are visibly uncomfortable with the mathematical concepts of the presentation	Students are at ease with the mathematical concepts of the presentation but lack a deep conceptual understanding	Students demonstrate a complete and comprehensive understanding of the mathematical concepts in the presentation
Visuals 10%	Students use no visuals	Students occasionally use visuals that rarely support the presentation and audience understanding	Students use visuals that are related to the presentation but did not completely support audience understanding	The visuals used supported audience understanding
Mechanics 10%	Students presentation contained four or more spelling, grammatical or mathematical errors	Presentation had three spelling, grammatical or mathematical errors	Presentation had no more than two spelling, grammatical or mathematical errors	Presentation had no spelling, grammatical or mathematical errors
Delivery 20%	Students mumbles, incorrectly pronounces terms, and speaks too quietly for students in the back of class to hear.	Students incorrectly pronounce terms. Audience members have difficulty hearing presentations.	Student's voice is clear. Students pronounce most words correctly.	Students used a clear voice and correct, precise pronunciation of terms.

***** NOTHING FOLLOWS *****

Updated as of May 2022