NDSU NORTH DAKOTA STATE UNIVERSITY

INDUSTRIAL & MANUFACTURING ENGINEERING DEPARTMENT

IME 470(670) OPERATIONS RESEARCH I, 3 CREDITS, SPRING 2023

Instructor's name:	Harun Pirim
Office location:	Engineering 108
Office hours:	M,W 10-11(pls. e-mail otherwise)
Phone Number:	701 231 7285
Email Address:	harun.pirim@ndsu.edu

CATALOG DESCRIPTION

Techniques to optimize and analyze industrial operations. Use of linear programming, transportation models, networks, integer programming, goal programming, dynamic programming, and non-linear programming.

Pre-req: MATH 129. Co-req: IME 460
Also offered for graduate credit - see IME 670

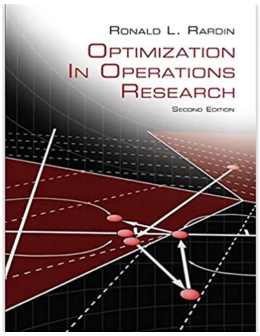
COURSE OBJECTIVES

Develop and solve optimization models, comprehend computer sensitivity results, formulate transportation, and network models, distinguish between linear and non-linear optimization, experiment using simplex and branch and bound algorithms, employ software to solve optimization problems, gain familiarity with goal programming and dynamic programming.

REQUIRED STUDENT RESOURCES

Text book: R. L. Rardin, Optimization in Operations Research, Pearson, 2016

Lecture notes and provided software



TENTATIVE COURSE SCHEDULE

Days	Topic	Notes
J 11,13	Introduction to Model Formulation	2.1-2
18,20	Large Scale Optimization	2.3
23,25,27	Introduction to AMPL	2.8
30, F 1,3	LP Models and Simplex Search	4.3,5.1-3
6,8,10	Duality, Sensitivity	6.1-2, Review, Test1
13,15,17	Duality, Sensitivity	6.3-5
22,24	Goal Programming	8.4
27, M 1,3	Shortest Path and DP	9.1-2
6,8,10	Network Flows and Graphs	10.1,6
20,22,24	Discrete Optimization Models	11.1-2, Review, Test2
27,29,31	Discrete Optimization Models	11.3-6
A 3,5	Exact Methods	12.1-2
12,14	Exact Methods	12.3
17,19,21	Unconstrained NLP	16.1-3
24,26,28	Unconstrained NLP	16.4, Review Test3
M 1,3,5	Unconstrained NLP	16.5-6
Project report submission due: May 7th		

EVALUATION AND GRADING CRITERIA

Weekly assignments:	30%	Letter grades will be assigned using a traditional 10 pt scale (e.g., 90 – 100% = A, 80 – 89.999...% = B, 70 – 79.999...% = C, etc.).
Three in class tests:	45%	
Project:	25%	

Responsibilities of the students include timely submission of assignments (posted on Wednesdays and one week due) and the project report to Blackboard. Both typed and handwritten, scanned documents are accepted. The project scope and topic will be made available after the first test. Collaboration with a friend for the assignments and the project is allowed. In case of collaboration, a single submission with both names on it is sufficient. A rubric for the project will be provided. Tests will be conducted in class. A review lecture will be conducted before each test. Calculator and one-page formula sheet are permitted during the tests. All notes and electronic resources are allowed for use in the assignments. Students are responsible for citing any resources used in the assignments to avoid plagiarism.

Graduate students will have additional responsibilities, including solving additional or different problems in tests and the project.

To be successful, it is important to follow lectures, submit assignments on time, understand review lectures before in-class tests, and start the project early. Additionally, scheduling project tasks with your team and reviewing feedback from assignments is critical. Remember, you are already successful!

TEACHING APPROACH

Weekly assignments are intended to formatively foster learning the concepts, theories, and applications introduced in class, while encouraging collaborative work. Tests and the project are designed for summative assessment; tests assess individual learning, while the project encourages collaborative investigation. A discussion board on the blackboard will be available for students to ask and discuss problems, examples, and codes presented in class, supporting course objectives. To enhance the learning experience, two games, "Lego" and "Burrito Optimization," will be introduced to leverage the learning of linear and integer programming. Individual feedback will be provided to improve learning and contribute to course objectives. The AMPL software will be introduced in a computer lab to facilitate hands-on learning. The project will require data collection, modeling, and problem-solving to achieve the modeling, sensitivity, and solving objectives of the course. I will be asking intriguing questions in the class; we can use *Pointsolutions* software to incorporate your inputs.

ATTENDANCE STATEMENT

According to NDSU Policy 333 (www.ndsu.edu/fileadmin/policy/333.pdf), attendance in classes is expected. *Pointsolutions* software will be used for attendance. It will be opened at the beginning of the class and closed at the end. NO make-up assignments, tests, and the project will be given for any reason except university-excused ones. See NDSU Policy 333 for faculty and student responsibilities related to attendance, including for university-sponsored activities. Veterans and student service members with special circumstances or who are activated are encouraged to notify the instructor as soon as possible and are encouraged to provide Activation Orders.

STUDENTS WITH SPECIAL NEEDS STATEMENT

Any students with disabilities or other special needs, who need special accommodations in this course, are invited to share these concerns or requests with the instructor and contact the Disability Services Office (www.ndsu.edu/disabilityservices) as soon as possible.

ACADEMIC HONESTY STATEMENT

The academic community is operated on the basis of honesty, integrity, and fair play. NDSU Policy 335: Code of Academic Responsibility and Conduct applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the Office of Registration and Records. Informational resources about academic honesty for students and instructional staff members can be found at www.ndsu.edu/academichonesty.

Accreditation Board for Engineering and Technology (ABET)

Accreditation assures confidence that a collegiate program has met standards essential to prepare graduates to enter critical STEM fields in the global workforce. Graduates from an ABET-accredited program have a solid educational foundation and are capable of leading the way in innovation, emerging technologies, and in anticipating the welfare and safety needs of the public.

NDSU IME Criterion Program Outcomes Based on ABET Criterion 3
Upon graduation, the NDSU IME program graduates demonstrate the following: 1. An ability to **identify, formulate, and solve complex engineering problems** by applying principles of engineering, science, and mathematics 2. An ability to **design** to produce solutions that meet specified needs with consideration **apply engineering** of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors 3. An ability to **communicate effectively** with a range of audiences 4. An ability to recognize **ethical and professional responsibilities** in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts 5. An ability to **function effectively on a team** whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives 6. An ability to **develop and conduct appropriate experimentation, analyze and interpret dat**a, and use engineering judgment to draw conclusions 7. An ability to **acquire and apply new knowledge as needed**, using appropriate learning strategies.

IME 470 Student Learning Outcomes Related to ABET Criterion 3

At the successful completion of this course, the students should be able to:

1. Develop mathematical programming models and solve (1,2)
2. Collaborate to accomplish assignments and the project with a report (3,4,5,7)
3. Conduct sensitivity analysis on linear programming models (6)
4. Solve linear and integer linear programming models using simplex and branch and bound algorithms (1,2)
5. Use deterministic dynamic programming to solve some discrete optimization problems (1,2)
6. Solve unconstrained non-linear optimization problems (1)
7. Use software to solve mathematical programming problems (1,6)

	Level of Contribution to Criteria Using the Scale shown Below: (5) very high (4) high (3) average (2) low (1) very low (0) not applicable						
Criteria	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Contribution Level	5	5	3	1	3	5	3