IENG 350: Introduction to Operations Research
Fall 2017

Course Information

IENG 350: Introduction to Operations Research (Fall 2017)
Class Schedule: Tuesday/Thursday 3:30 PM - 4:45 PM
Class Location: National Research Center 101
Exam 1: Tuesday, October 3, 3:30 PM - 4:45 PM (tentative)
Exam 2: Tuesday, October 24, 3:30 PM - 4:45 PM (tentative)
Final Exam: Monday, December 11, 8 AM - 10 AM

An introduction to basic principles and techniques of operations research. Topics include linear programming, integer programming, transportation and assignment problems, project scheduling, queueing theory, and computer applications.

Instructor

Behrooz Kamali, Ph.D.
Email: b.kamali@mail.wvu.edu
Office: Engineering Sciences Building (ESB) 339
Office hours: Tuesday 5:00 PM - 6:30 PM, Thursday 1:30 PM - 3:00 PM, or by appointment

Textbook

Required:

- Winston, W. L., Venkataramanan, M., & Goldberg, J. B. (2003). *Introduction to mathematical programming* (Vol. 1). Thomson/Brooks/Cole.

Other useful resources:

- Taha, H. A. (2007). *Operations research: an introduction*. Pearson/Prentice Hall.
- Bazaraa, M. S., Jarvis, J. J., & Sherali, H. D. (2011). *Linear programming and network flows*. John Wiley & Sons.

Prerequisites

IENG 213 - Engineering Statistics, minimum grade of D

Student Learning Outcomes

Having successfully completed this course, the student will be able to do the following:

1. Formulate linear programming and network models that represent deterministic problem situations in a variety of contexts, including societal and humanitarian problems;
2. Optimize the performance of systems using linear programming and network models to support system design and operational decisions;
3. Identify redundant constraints, infeasible solution spaces, unbounded solutions, and apply methods that can be used to resolve such issues;
4. Identify technical issues regarding LP solution methodologies;
5. Implement algorithms to solve linear programming and network models;
6. Solve linear programming or network problems using modeling languages and optimization software;
7. Analyze problem solutions using the concept of duality and perform sensitivity analysis;
8. Use duality theory for bounding the optimal solution value; and
9. Communicate effectively in a written project report.

Relationship to Program Educational Outcomes

The course relates strongly to the following program educational outcomes.

1. The course enables the students to acquire the ability to use modern and classical industrial engineering methodologies pertaining to operations research (Outcome 1). The key abilities the students will acquire are as follows:
    - Linear programming
    - Project management
    - Queueing theory
    - Transportation & assignment problems
2. The course enables the students to apply knowledge of math, science, and general engineering (Outcome 2). The key abilities students acquire are as below:
    - General engineering principles in modeling production and service systems
3. The course enables the students to acquire the ability to work individually and on teams to formulate and solve operations research problems (Outcome 4). The key abilities the students will acquire are as follows:
    - Identify, formulate, and solve problems.

Item	Weight
Exams (3)	75%
Project (1)	10%
In Class Work (5) & Homework (5)	15%
Total	100%

Grading

The final course grade is based on the total weighted points and the following scale. Final scores are calculated to the hundredths decimal and rounded to the nearest whole number. (e.g. 89.50 = A- and 89.49 = B+, no exceptions)

Range	Letter Grade	Range	Letter Grade
97-100	A+	77 - 79	C+
93 - 96	A	73 - 76	C
90 - 92	A-	70 - 72	C-
87 - 89	B+	67 - 69	D+
83 - 86	B	63 - 66	D
80 - 82	B-	60 - 62	D-

Course Policies

Homework

Homework is intended to enhance your understanding of course material. It is an opportunity to execute concepts covered in class, and serves as a gauge for your comprehension of course material. Additionally, exam questions will reflect homework questions; therefore, successfully completing homework will greatly help you succeed in the course.

Homework assignments are individual, but discussion with other students is encouraged. The exchange of opinions and discussion with your peers is a valuable learning opportunity. However, it is expected that each student completes their homework on their own and shows independent work. It is not acceptable to directly copy parts of other students' final work as there is no independent thought in copying. If you cannot create your own solution, you are not learning or benefiting from your education opportunity.

Unless otherwise stated, all homework should be handed in at the beginning of the class; late homework get 30% penalty if turned in up to 1 day after due date, 60% for up to 2 days, and no credit after 2 days. All homework should be either typed or clearly handwritten as illegible handwriting may get no points, at the discretion of the grader.

Exams

There are three exams, comprised of two mid-term exams and a final. For each exam you are allowed one page of notes, but no calculators, computers, other electronics, or books. Mid-term exams will not be rescheduled for excused or unexcused absences. Instead, if you

miss an exam, the final will serve as a make-up if requested via email to the Instructor prior to the exam with a valid reason/documentation.

Requests for re-grading an exam will be accepted for mid-term and final exams. Requests must be submitted in writing with the appropriate form (posted on eCampus). The test and form must be turned in together to the instructor within one week of when the exam are available for pick-up. **Tests submitted for re-grading are subject to points being subtracted or added.**

Any suspicious activity on exams, during or after with a re-grade, will result in automatic submission for an honor code violation.

Project

There is a class project intended to familiarize students with real-world operations research problems. The project can be done in groups of 2 or 3. Students should clearly define the problem from a given description, make proper assumptions, and formulate the problem. Next, the formulated problem should be coded and solved using one of the suggested solver packages, and a sensitivity analysis should be conducted on the results.

Each group should prepare a report explaining problem description, assumptions, code, and suggested solutions in details. Each project report should be handed in at the beginning of the class on the due date.

Class Participation

You are expected to participate in class, which will be only partially lecture based, so please prepare and try to answer questions posed by the instructor in class. Additionally, several in-class exercises (mostly team based), are part of your participation grade, and an important part of the learning process.

Also, please be respectful of your colleagues and understand that your electronic activities are distracting to those around you.

Academic Integrity

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the West Virginia University Academic Catalog at:
http://catalog.wvu.edu/undergraduate/coursecreditstermsclassification/#academicintegritytext.

Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see me before the assignment is due to discuss the matter.

Accommodations

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, you must make appropriate arrangements through Disability Services (304-293-6700). They will identify the nature of the accommodation your disability requires.

Statement on Social Justice

West Virginia University is committed to social justice. I concur with that commitment. I expect to foster a nurturing learning environment that is based upon open communication, mutual respect, and non-discrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration.

Miscellaneous

This syllabus is subject to change.

Course Topics

Introduction to Operations Research (1 week)

- Overview of Operations Research (Chapters 1 & 2).

Linear Programming (LP) (5 weeks)

- Formulations (Sections 3.1 & 3.4),
- Solution Techniques Graphical Method (Section 3.2), Algebraic Method (Section 3.3), Simplex Method and Solution Types: Unique, Unbounded, Multiple, Degenerate, and Infeasible Solutions (Sections 4.1-4.8).
- Duality and Sensitivity Analysis Dual Problems and Solutions, Sensitivity Analysis (Chapters 5 & 6).
- Computer Applications Solving LP models using Microsoft Excel Solver (handout).

Special Types of Linear Programming Models (Network Models) (3 weeks)

- Transportation Problems Formulations, Obtaining Initial Solutions, and Transportation Algorithm (Sections 7.1-7.4).
- Assignment Problem Formulations and Hungarian Algorithm (Section 7.5).
- Other Network Models Transshipment Model (Section 7.6), Minimum Flow Cost Model (handout), Shortest-Route Problem (Sections 8.1-8.2), and Maximum-flow Problem (Section 8.3).

Project Scheduling (2 weeks)

- Critical Path Method (CPM) and Gantt Chart (Section 8.4 & handout)
- Program Evaluation and Review Technique (PERT) (Section 8.4).

Integer/Mixed Integer Linear Programming (ILP, MILP) (2 weeks)

- Formulations (Section 9.1).
- Traveling Salesperson Problem (TSP) Applications, Model, Solution (Section 9.2 & handout).
- Other Problems/Models Knapsack Problem, Vehicle Routing Problem, etc. (Section 9.2 & handout).

Queueing Theory (2 weeks)

- Modeling arrival and service processes (Sections 20.1 & 20.2)
- Overview of different types of queuing systems (Sections 20.3-20.9)