

OPERATIONS RESEARCH APPLICATIONS IN CIVIL ENGINEERING
CEE 762

University of Nevada, Las Vegas
Civil and Environmental Engineering and Construction Department

Course Information:

Semester:
Lecture Day:
Lecture Time:
Lecture Location:
Credit Hours: 3

Instructor Information:

Instructor:
Email:
Office:
Phone:
Office Hours:

2020-2021 Graduate Catalog Description: Analysis of civil engineering systems using operations research methods and techniques. Methods covered include optimization models in deterministic systems, network models, and queuing theory. Applications drawn from various civil engineering contexts.

Prerequisites by Topic: Graduate standing

Required Skills: Proficiency in word processing, spreadsheet, and presentation software

Computer Usage: Use of electronic spreadsheets, presentation graphics, and word processing

Course Format: This course will be conducted in a lecture/discussion format. Students are encouraged to read appropriate material before it is covered in lecture.

Learning Outcomes:

- Understand the basic concepts of building mathematical programming models
- Understand how to model engineering problems as linear programming problems
- Understand how to solve linear programming problems, and interpret and analyze their solutions
- Understand special linear programming models, including network optimization models, CPM models, transportation and traffic assignment models
- Understand the basic concepts and types of non-linear programming models

- Have the ability to solve and analyze non-linear programming problems using special software
- Understand queuing theory concepts and models and their applications
- Understand the fundamentals of building computer simulations models
- Apply the concepts learned in this course to a real-world engineering problem

Required Textbook:

Hillier and Lieberman, *Introduction to Operations Research*, McGraw Hill, 10th Edition, 2015.

Other References:

1. ReVelle and McGarity, Editors, *Design and Operation of Civil and Environmental Engineering Systems*, John Wiley & Sons, 1997.
2. *Interfaces*, A technical journal published by INFORMS (Call No. HD 28.I45)

The *Interfaces* journal is an excellent source of documentation of real-world problems that people have solved or attempted to solve using OR. Please note that there are several other suitable reference materials in the library that you are encouraged to find and consult.

Course Requirements: Students will engage in the following activities:

- Attend classes
- Read assigned material prior to class sessions
- Complete and submit course assignments
- Participate in class discussions
- Complete examinations
- Complete semester project

Course Topics:

A. Introduction

1. Introduction to OR (Chap 1)
2. Overview of modeling approach (Chap 2)

B. Deterministic Modeling

3. Introduction to Linear Programming (Chap 3)
4. The Simplex method (Chap 4)
5. Duality theory and Sensitivity Analysis (Chap 6)
6. Using the OR Courseware and Excel Solver
7. Integer Programming (Chap 12)
8. Transportation and Assignment Problems (Chap 9)
9. Network Optimization Problems (Chap 10)
10. Non-linear Programming (Chap 13)

C. Stochastic Modeling

11. Queuing Theory and Applications (Chap 17)

12. Simulation (Chap 20)

Assignment Weights:

- Midterm Exam 20%
- Final Exam 20%
- Assignments 40%
- Term Project 20%

Grading Scale:

<i>Letter Grade</i>	<i>Score Range</i>	<i>Subjective Criteria</i>
A	≥ 90%	Superior knowledge
B+	≥ 87%	Good knowledge
B	≥ 83%	
B-	≥ 80%	
C	≥ 70%	Minimum knowledge
D	≥ 60%	Did not meet minimum knowledge standards
F	Below 60%	Did not meet minimum knowledge standards

Assignment Policy:

Assignments should be submitted in class on their due dates. In general, you will have about a week or two to work on each assignment. Assignments submitted late without pre-approval by the instructor will be subject to penalty or may not be accepted. Late submissions will not be accepted after solutions have been distributed or discussed in class.

Students are encouraged to discuss the assignments with fellow students. They should use such discussions to better understand the questions, the issues involved and/or alternative methods of solving the problems. However, the final submittal must be the result of the student's individual effort. Please be sure to provide proper credit (reference citations) where appropriate.

Presentation: Submitted assignment pages should be stapled together neatly, with a **title page** that has your name, date, class, and homework #. *Please be neat and show your work very clearly. Homework solutions that present only the final answers without showing the necessary solution steps will get no or only partial credit even if the answers are correct.*

Term Project:

Students will be required to identify a real-world engineering problem that can be solved with the application of OR principles and techniques presented in the course. It could be a design problem, an operations or a planning problem in any area of engineering. Students

shall identify their own problems with the assistance of the instructor. Project milestones shall include submission of proposal, progress report, final report and oral presentation in class the last week of class.

Project schedule and deadlines will be discussed later in the semester. In the meantime, you are strongly encouraged to start thinking and exploring possible problems preferably *in your area of interest*. Feel free to discuss with the instructor and/or your academic advisor any ideas you might have.

Final Date: to drop or withdraw from this class without a refund, or change from credit to audit, is

Date, Time, and Location of Final Examination: TBD.

Disclaimer: The contents of this document are to be considered “tentative” and subject to change as the instructor deems necessary.

UNIVERSITY POLICIES

Public Health Directives

Face coverings are mandatory for all faculty and students in the classroom. Students must follow all active UNLV public health directives while enrolled in this class. [UNLV public health directives](https://www.unlv.edu/coronavirus/health-requirements) are found at <https://www.unlv.edu/coronavirus/health-requirements>. Students who do not comply with these directives may be asked to leave the classroom. Refusal to follow the guidelines may result in further disciplinary action according to the [UNLV Code of Student Conduct](https://www.unlv.edu/sites/default/files/page_files/27/StudentConduct-Code.pdf), https://www.unlv.edu/sites/default/files/page_files/27/StudentConduct-Code.pdf, including being administratively withdrawn from the course.

Academic Misconduct

Academic integrity is a legitimate concern for every member of the University community. We all share in upholding the fundamental values of honesty, trust, respect, fairness, responsibility, and professionalism. By choosing to join the UNLV community, students accept the expectations of the Student Academic Misconduct Policy, and are encouraged to always take the ethical path whenever faced with choices. Students enrolling at UNLV assume the obligation to conduct themselves in a manner compatible with UNLV’s educational mission. An example of academic misconduct is plagiarism. Plagiarism is using the words or ideas of another person, from the Internet or any other source without proper citation of the source(s). See the [Student Conduct Code](https://www.unlv.edu/studentconduct/student-conduct), <https://www.unlv.edu/studentconduct/student-conduct>.

Auditing Classes

Auditing a course allows a student to continue attending the lectures and/or laboratories and discussion sessions associated with the course, but the student will not earn a grade for

any component of the course. Students who audit a course receive the same educational experience as students taking the course for a grade, but will be excused from exams, assessments, and other evaluative measures that serve the primary purpose of assigning a grade.

Classroom Conduct

Students have a responsibility to conduct themselves in class and in the libraries in ways that do not interfere with the rights of other students to learn, or of instructors to teach. Use of electronic devices such as pagers, cellular phones, or recording devices, or potentially disruptive devices or activities are only permitted with the prior explicit consent of the instructor. The instructor may rescind permission at any time during the class. If a student does not comply with established requirements or obstructs the functioning of the class, the instructor may initiate an administrative withdrawal of the student from the course.

Copyright

The University requires all members of the University Community to familiarize themselves with, and to follow copyright and fair use requirements. You are individually and solely responsible for violations of copyright and fair use laws. The University will neither protect nor defend you, nor assume any responsibility for employee or student violations of fair use laws. Violations of copyright laws could subject you to federal and state civil penalties and criminal liability, as well as disciplinary action under University policies. Additional [copyright policy information](https://www.unlv.edu/provost/copyright) is available at <https://www.unlv.edu/provost/copyright>.

Disability Resource Center (DRC)

The [UNLV Disability Resource Center](https://www.unlv.edu/drc) (SSC-A, Room 143, <https://www.unlv.edu/drc>, telephone 702-895-0866) provides resources for students with disabilities. Students who believe that they may need academic accommodations due to injury, disability, or due to pregnancy should contact the DRC as early as possible in the academic term. A Disabilities Specialist will discuss what options may be available to you. If you are registered with the UNLV Disability Resource Center, bring your Academic Accommodation Plan from the DRC to the instructor during office hours, so that you may work together to develop strategies for implementing the accommodations to meet both your needs and the requirements of the course. Any information you provide is private and will be treated as such. To maintain the confidentiality of your request, please do not approach the instructor in front of others to discuss your accommodation needs.

Final Examinations

The University requires that final exams given at the end of a course occur on the date and at the time specified in the Final Exam schedule. The Final Exam schedule is typically available at the start of the semester, and the classroom locations are available approximately one month before the end of the semester. See the [Final Exam Schedule](https://www.unlv.edu/registrar/calendars), <https://www.unlv.edu/registrar/calendars>.

Identity Verification in Online Courses

All UNLV students must use their Campus-issued ACE ID and password to log in to WebCampus-Canvas.

UNLV students enrolled in online or hybrid courses are expected to read and adhere to the [Student Academic Misconduct Policy](#),

<https://www.unlv.edu/studentconduct/misconduct/policy>, which states that “acting or attempting to act as a substitute for another, or using or attempting to use a substitute, in any academic evaluation or assignment” is a form of academic misconduct. Intentionally sharing ACE login credentials with another person may be considered an attempt to use a substitute, and could result in investigation and sanctions, as outlined in the Student Academic Misconduct Policy.

UNLV students enrolled in online courses are also expected to read and adhere to the

[Acceptable Use of Computing and Information Technology Resources Policy](#), <https://www.it.unlv.edu/policies/acceptable-use-computing-and-information-technology-resources-policy>, which prohibits sharing university accounts with other persons without authorization.

To the greatest extent possible, all graded assignments and assessments in UNLV online courses should be hosted in WebCampus-Canvas or another UNLV-managed platform that requires ACE login credentials for access.

Incomplete Grades

The grade of “I” (Incomplete) may be granted when a student has satisfactorily completed three-fourths of course work for that semester/session, but cannot complete the last part of the course for reason(s) beyond the student’s control and acceptable to the instructor, and the instructor believes that the student can finish the course without repeating it. For undergraduate courses, the incomplete work must be made up before the end of the following regular semester. Graduate students receiving “I” grades in 500-, 600-, or 700-level courses have up to one calendar year to complete the work, at the discretion of the instructor. If course requirements are not completed within the period indicated, a grade of “F” will be recorded, and the student’s GPA will be adjusted accordingly. Students who are fulfilling an Incomplete grade do not register for the course, but make individual arrangements with the instructor who assigned the “I” grade.

Library Resources

Librarians are available to consult with students on research needs, including developing research topics, finding information, and evaluating sources. To make an appointment with a subject expert for this class, please visit the [Libraries’ Research Consultation](#) website,

<https://guides.library.unlv.edu/appointments/librarian>. You can also [ask the library staff](https://ask.library.unlv.edu/) questions via chat and text message at <https://ask.library.unlv.edu/>.

Missed Classwork

Any student missing class, quizzes, examinations, or any other class or laboratory work because of observance of religious holidays will be given an opportunity during that semester to make up the missed work. The make-up opportunity will apply to the religious holiday absence only. It is the responsibility of the student to notify the instructor within the first 14 calendar days of the course for Fall and Spring courses (except for modular courses), or within the first 7 calendar days of the course for Summer and modular courses, of their intention to participate in religious holidays which do not fall on state holidays or periods of class recess. For additional information, please visit the Missed Work policy, under Registration Policies, on the [Academic Policies](https://catalog.unlv.edu/content.php?catoid=29&navoid=7326) webpage, <https://catalog.unlv.edu/content.php?catoid=29&navoid=7326>.

In accordance with the policy approved by the Faculty Senate regarding missed class time and assignments, students who represent UNLV in any official extracurricular activity will also have the opportunity to make up assignments, provided that the student provides official written notification to the instructor no less than one week prior to the missed class(es).

The spirit and intent of the policy for missed classwork is to offer fair and equitable assessment opportunities to all students, including those representing the University in extracurricular activities. Instructors should consider, for example, that in courses which offer a “Drop one” option for the lowest assignment, quiz, or exam, assigning the student a grade of zero for an excused absence for extracurricular activity is both contrary to the intent of the Faculty Senate’s policy, and an infringement on the student’s right to complete all work for the course.

This policy will not apply in the event that completing the assignment or administering the examination at an alternate time would impose an undue hardship on the instructor or the University that could be reasonably avoided. There should be a good faith effort by both the instructor and the student to agree to a reasonable resolution. When disagreements regarding this policy arise, decisions can be appealed to the Department Chair/School Director, College/School Dean, and/or the Faculty Senate Academic Standards Committee.

For purposes of definition, extracurricular activities may include, but are not limited to: academic recruitment activities, competitive intercollegiate athletics, fine arts activities, liberal arts competitions, science and engineering competitions, and any other event or activity sanctioned by a College/School Dean, and/or by the Executive Vice President and Provost.

Rebelmail

Rebelmail is UNLV's official email system for students and by University policy, instructors and staff should only send emails to students' Rebelmail accounts. Rebelmail is one of the primary ways in which students receive official University communications, information about deadlines, major Campus events, and announcements. All UNLV students receive a Rebelmail account after they have been admitted to the University. Emailing within WebCampus-Canvas is also acceptable.

Tutoring and Coaching

The Academic Success Center (ASC) provides tutoring, academic success coaching, and other academic assistance for all UNLV undergraduate students. For information regarding tutoring subjects, tutoring times, and other ASC programs and services, please visit the [ASC website](https://www.unlv.edu/asc), <https://www.unlv.edu/asc>, or call 702-895-3177. The ASC building is located across from the Student Services Complex (SSC). Academic success coaching is located on the second floor of SSC A, Room 254. Drop-in tutoring is located on the second floor of the Lied Library, and on the second floor of the College of Engineering building (TBE A 207).

UNLV Writing Center

One-on-one or small group assistance with writing is available free of charge to UNLV students at the [Writing Center](https://writingcenter.unlv.edu/), <https://writingcenter.unlv.edu/>, located in the Central Desert Complex, Building 3, Room 301 (CDC 3-301). Walk-in consultations are sometimes available, but students with appointments receive priority assistance. Students may make appointments in person or by calling the Center, telephone 702-895-3908. Students are requested to bring to their appointments their Rebel ID Card, a copy of the instructions for their assignment, and two copies of any writing they have completed on their assignment.

Diversity Statement

As an institution of higher learning, UNLV represents a rich diversity of human beings among its faculty, staff, and students, and is committed to aspiring to maintain a Campus environment that values that diversity. Accordingly, the University supports understanding and appreciation of all members of its community, regardless of race, sex, age, color, national origin, ethnicity, creed, religion, disability, sexual orientation, gender, gender identity, marital status, pregnancy, genetic information, veteran status, or political affiliation. Please see [University Statements and Compliance](https://www.unlv.edu/about/statements-compliance), <https://www.unlv.edu/about/statements-compliance>.

A successful learning experience requires mutual respect and trust between the students and the instructor. Accordingly, the instructor asks that students be willing to listen to one another's points of view, acknowledging that there may be disagreements, keep discussion and comments on topic, and use first person, positive language when expressing their perspectives.