MATH 3370-110, 10443, Introduction to Linear Programming
Spring 2023

Texas A&M University-Central Texas

COURSE DATES, MODALITY, AND LOCATION

16-week class, January 17, 2023 – May 12, 2023
This is a 100% online course, and uses the A&M-Central Texas Canvas Learning Management System [https://tamuct.instructure.com/]. Other online resources and software posted on Canvas.

INSTRUCTOR AND CONTACT INFORMATION

Instructor: Jordan Barry
Office: Virtual office (link posted in Canvas)
Phone: 512-593-8218
Email: jbarry@tamuct.edu

Office Hours

I will have office hours on Monday and Wednesday 12pm-1pm at my virtual office, linked in Canvas. I will also have many times available outside of this. Please email me to set up a time, and we will find one that works for both of us.

Student-instructor interaction

Having a course online, especially a mathematics course, can be challenging for many students. It will be very important for you to maintain communication with me. Emails will be returned within 24 hours; if you do not hear back, please resend your email. You are encouraged to ask questions and correspond with me. There are many things that may be unfamiliar to you in this course.

Emergency Warning System for Texas A&M University-Central Texas
SAFEZONE. SafeZone provides a public safety application that gives you the ability to call for help with the push of a button. It also provides Texas A&M University-Central Texas the ability to communicate emergency information quickly via push notifications, email, and text messages. All students automatically receive email and text messages via their myCT accounts.

Downloading SafeZone allows access to push notifications and enables you to connect directly for help through the app.

You can download SafeZone from the app store and use your myCT credentials to log in. If you would like more information, you can visit the SafeZone website [www.safezoneapp.com].

To register SafeZone on your phone, please follow these 3 easy steps*:*

1. Download the SafeZone App from your phone store using the link below:
    - iPhone/iPad: [https://apps.apple.com/app/safezone/id533054756]

- Android Phone / Tablet
  [https://play.google.com/store/apps/details?id=com.criticalarc.safezoneapp]

2. Launch the app and enter your myCT email address (e.g. {name}@tamuct.edu)
3. Complete your profile and accept the terms of service

For updates on COVID information, please monitor the University website
[https://www.tamuct.edu/covid19/]

COURSE INFORMATION

Course Overview and description

This course provides an introduction to linear programming and operations research. Linear programming involves methods for solving optimization problems to maximize/minimize linear objective functions based on constraints in the form of linear inequalities/equations. The first part of the course will focus on 2 variable problems, graphical solutions, and an introduction to modeling, i.e. translating word problems into math problems. The next part of the course will focus on problems with more variables with a focus on modeling as a solver will be used to get final answers. Additional topics in operations research may be studied as time permits.

Course Objective or Goal
Student Learning Outcomes

Upon successful completion of MATH 3370, students will be able to:

a) Producing graphical solutions of systems of linear inequalities.
b) Using graphical solutions of systems of inequalities to solve 2 variable linear programming problems.
c) Identify all decision variables and objective function of real world linear programming problems.
d) Identify all constraints of a real world problem as a linear inequality or equation that must be satisfied by decision variables.
e) Solving higher variable problems step-by-step using a basic version of the simplex method and by using a solver.

Competency Goals Statements (certification or standards)

The student will gain competency in the following Mathematics 7-12 TEKS skills:

1. Competency 001.F. Uses real numbers to model and solve a variety of problems (practice)
2. Competency 003.F. Uses estimation techniques to solve problems and judges the reasonableness of solutions. (practice)
3. Competency 006.A. Understands the concept of slope as a rate of change and interprets the meaning of slope and intercept in a variety of situations.
4. Competency 006.B. Writes equations of lines given various characteristics (e.g., two points, a point and slope, slope and y-intercept).
5. Competency 006.G. Models and solves problems involving linear and quadratic

equations and inequalities using a variety of methods, including technology.

6. Competency 012B. Uses properties of points, lines, planes, angles, lengths and distances to solve problems.
7. Competency 012 C Applies the properties of parallel and perpendicular lines to solve problems.
8. Competency 013 F Uses top, front, side and corner views of three-dimensional shapes to create complete representations and solve problems.
9. Competency 013 G Applies properties of two- and three-dimensional shapes to solve problems across the curriculum and in everyday life.
10. Competency 014 D Applies transformations in the coordinate plane

Required Reading and Textbook(s)

COURSE REQUIREMENTS

- Homework assignments (30%). Written assignments are turned in on Canvas.
- Project (10%)
- Tests (60%). There are 2 tests of weight 30%. Each test will be 2 hours, and must be taken using the Proctorio software.

Grading Criteria Rubric and Conversion

Homework	30% (300 points)	90- 100%= A
Project	10% (100 points)	80- 89%= B
Test 1	30% (300 points)	70- 79%= C
Test 2	30% (300 points)	60- 69%= D
TOTAL	100% (1000 points)	Below 60 % F

Partial credit for homework and test questions will be awarded according to the following guidelines:

100% Perfect
90% Minor careless or technical mistakes
80% Minor procedural error
70% Major conceptual or procedural error.
60% Makes beginning steps towards a solution
30% Some relevant information supplied.

Project: The project in the class will be an opportunity for you to go beyond answering questions for homework and work with a realistic problem. You will be asked to formulate a linear program from a description of the problem. You need to account for all variables that are applicable. You will be required to run a sensitivity analysis on the final solution and gain insight about possible improvements that can be made. Additionally, you will need to show output and graphs (where appropriate), and write about the methodology you used with justification. You will write up a final conclusion that outlines your proposal and the expected benefits of your system.

Grading will be as follows:

20 Pts: Correctly formulated linear program
10 pts: correct solutions to the linear program
20 pts: sensitivity analysis is done correctly
20 pts: appropriate tables and graphs
20 pts: conclusion makes sense in context.
10 pts: All information presented neatly and in a professional manner. Citation of all sources and methodology used.
Total: 100 Pts

Posting of Grades

- Grades will be posted on Canvas. Combined grades will be posted on TAMUCT Canvas after each test.

COURSE OUTLINE AND CALENDAR

Complete Course Calendar

***NOTE: Although the following should be fairly close to the actual schedule, some adjustments may be made to the schedule to accommodate the students' learning speed.

Week	New Material	Competency
#1 1/16/2023	Review Linear Systems and Inequalities	1, 3, 5, 6, 7
#2 1/23/2023	Review Linear Systems and Inequalities	1, 3, 5, 6, 7
#3 1/30/2023	Introduction to Vectors and Matrices	1, 2, 3, 4, 5, 6,7, 8
#4 2/6/2023	7.1 Polyhedral Convex Sets, 7.2 Maxima and Minima	All
#5 2/13/2023	7.3 Linear Programming Problems, Graphical Methods	All
#6 2/20/2023	7.4 Dual Problem, 7.5 Simplex Method	All
#7 2/27/2023	7.6 Duality Interpretation, 7.8 Strictly Determined Games	1,2,5,6
#8 3/6/2023	Review/TEST #1	All
3/13/2023	SPRING BREAK	
#9 3/20/2023	7.9 Matrix Games, 7.10 Solving Matrix Games with Geometry	1, 2, 6
#10 3/27/2023	Introduction to R and RStudio	
#11 4/3/2023	Simplex Method programming	1,2,5,6
#12 4/10/2023	LP using rglpk and CVXR	1,2,3,4,8
#13 4/17/2023	Using CPLEX format in R	All
#14 4/24/2023	MaxFlow problems with R	All
#15 5/1/2023	Project	All
#16 5/8/2023	TEST #2	All

INSTRUCTOR GRADING POLICIES

Late work will be accepted only in case of medical or family emergency: in this case, written verification is required, and the maximum makeup grade is 70%. At most 2 late assignments will be accepted.

Missed exams: If you cannot make an exam session, you must schedule an alternative period beforehand. Missed exams must be taken within a week of the actual exam.

Appeals: If the student wishes to appeal a grade, he/she must do so *within 1 week* of receiving the graded paper. Students should save all their work to ensure that no clerical errors are made in grade reporting. Periodically during the semester, I will release a complete record of your grades so far in the class. If I have made a recording error, you may bring the paper to me and I will record it correctly.

Required Reading and Textbook(s)

Textbooks:

- Introduction to Finite Mathematics by Kemney, Snell, and Thompson (available on Canvas and https://math.dartmouth.edu/~doyle/docs/finite/cover/cover.html)
- Modeling, Functions, and Graphs by Katherine Yoshiwara (available on Canvas and https://yoshiwarabooks.org/mfg/chap1.html)

Other Online Resources:

http://rtutorial.altervista.org/

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Course Objective or Goal

Student Learning Outcomes

Upon successful completion of MATH 3370, students will be able to:

f) Producing graphical solutions of systems of linear inequalities.
g) Using graphical solutions of systems of inequalities to solve 2 variable linear programming problems.
h) Identify all decision variables and objective function of real world linear programming problems.
i) Identify all constraints of a real world problem as a linear inequality or equation that must be satisfied by decision variables.

j) Solving higher variable problems step-by-step using a basic version of the simplex method and by using a solver.

Competency Goals Statements (certification or standards)

The student will gain competency in the following Mathematics 7-12 TEKS skills:

11. Competency 001.F. Uses real numbers to model and solve a variety of problems (practice)
12. Competency 003.F. Uses estimation techniques to solve problems and judges the reasonableness of solutions. (practice)
13. Competency 006.A. Understands the concept of slope as a rate of change and interprets the meaning of slope and intercept in a variety of situations.
14. Competency 006.B. Writes equations of lines given various characteristics (e.g., two points, a point and slope, slope and y-intercept).
15. Competency 006.G. Models and solves problems involving linear and quadratic equations and inequalities using a variety of methods, including technology.
16. Competency 012B. Uses properties of points, lines, planes, angles, lengths and distances to solve problems.
17. Competency 012 C Applies the properties of parallel and perpendicular lines to solve problems.
18. Competency 013 F Uses top, front, side and corner views of three-dimensional shapes to create complete representations and solve problems.
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- Modeling, Functions, and Graphs by Katherine Yoshiwara (available on Canvas and https://yoshiwarabooks.org/mfg/chap1.html)

Other Online Resources:

http://rtutorial.altervista.org/

Important University Dates

https://www.tamuct.edu/registrar/academic-calendar.html

TECHNOLOGY REQUIREMENTS AND SUPPORT

Technology Requirements

We will make use of online and open-source linear programming solvers throughout the course. You will need to be able to download and use R/R-studio. Instructions for download will be given on Canvas. You will need to have access to a webcam and microphone for testing purposes.

This course will use the A&M-Central Texas Instructure Canvas learning management system. **We strongly recommend the latest versions of Chrome or Firefox browsers. Canvas no longer supports any version of Internet Explorer.**

Logon to A&M-Central Texas Canvas [https://tamuct.instructure.com/] or access Canvas through the TAMUCT Online link in myCT [https://tamuct.onecampus.com/]. You will log in through our Microsoft portal.

Username: Your MyCT email address. Password: Your MyCT password

Canvas Support

Use the Canvas Help link, located at the bottom of the left-hand menu, for issues with Canvas. You can select "Chat with Canvas Support," submit a support request through "Report a Problem," or call the Canvas support line: 1-844-757-0953.

For issues related to course content and requirements, contact your instructor.

Online Proctored Testing

A&M-Central Texas uses Proctorio for online identity verification and proctored testing. This service is provided at no direct cost to students. If the course requires identity verification or proctored testing, the technology requirements are: Any computer meeting the minimum computing requirements, plus web camera, speaker, and microphone (or headset). Proctorio also requires the Chrome web browser with their custom plug in.

Other Technology Support

For log-in problems, students should contact Help Desk Central, 24 hours a day, 7 days a week

Email: helpdesk@tamu.edu
Phone: (254) 519-5466
Web Chat: [http://hdc.tamu.edu]
Please let the support technician know you are an A&M-Central Texas student.

UNIVERSITY RESOURCES, PROCEDURES, AND GUIDELINES

Academic Accommodations

At Texas A&M University-Central Texas, we value an inclusive learning environment where every student has an equal chance to succeed and has the right to a barrier-free education. The Warrior Center for Student Success, Equity and Inclusion is responsible for ensuring that students with a disability receive equal access to the university's programs, services and activities. If you believe you have a disability requiring reasonable accommodations, please contact the Office of Access and Inclusion, WH-212; or call (254) 501-5836. Any information you provide is private and confidential and will be treated as such.

For more information, please visit our Access & Inclusion Canvas page (log-in required) [https://tamuct.instructure.com/courses/717]

Academic Integrity

Texas A&M University-Central Texas values the integrity of the academic enterprise and strives for the highest standards of academic conduct. A&M-Central Texas expects its students, faculty, and staff to support the adherence to high standards of personal and scholarly conduct to

preserve the honor and integrity of the creative community. Any deviation by students from this expectation may result in a failing grade for the assignment and potentially a failing grade for the course. All academic misconduct concerns will be referred to the Office of Student Conduct. When in doubt on collaboration, citation, or any issue, please contact your instructor before taking a course of action.

For more information regarding the student conduct process, [https://www.tamuct.edu/student-affairs/student-conduct.html].

If you know of potential honor violations by other students, you may submit a referral, [https://cm.maxient.com/reportingform.php?TAMUCentralTexas&layout_id=0].

Drop Policy

If you discover that you need to drop this class, you must complete the Drop Request Dynamic Form through Warrior Web.

[https://federation.ngwebsolutions.com/sp/startSSO.ping?PartnerIdpId=https://eis-prod.ec.tamuct.edu:443/samlsso&SpSessionAuthnAdapterId=tamuctDF&TargetResource=https%3a%2f%2fdynamicforms.ngwebsolutions.com%2fSubmit%2fStart%2f53b8369e-0502-4f36-be43-f02a4202f612].

Faculty cannot drop students; this is always the responsibility of the student. The Registrar's Office will provide a deadline on the Academic Calendar for which the form must be completed. Once you submit the completed form to the Registrar's Office, you must go into Warrior Web and confirm that you are no longer enrolled. If you still show as enrolled, FOLLOW-UP with the Registrar's Office immediately. You are to attend class until the procedure is complete to avoid penalty for absence. Should you miss the drop deadline or fail to follow the procedure, you will receive an F in the course, which may affect your financial aid and/or VA educational benefits.

Important information for Pregnant and/or Parenting Students

Texas A&M University-Central Texas supports students who are pregnant, experiencing pregnancy-related conditions, and/or parenting. In accordance with requirements of Title IX and related guidance from US Department of Education's Office of Civil Rights, the Dean of Student Affairs' Office can assist students who are pregnant and/or parenting in seeking accommodations related to pregnancy and/or parenting. Students should seek out assistance as early in the pregnancy as possible. For more information, please visit Student Affairs [https://www.tamuct.edu/student-affairs/pregnant-and-parenting-students.html]. Students may also contact the institution's Title IX Coordinator. If you would like to read more about these requirements and guidelines online, please visit the website [http://www2.ed.gov/about/offices/list/ocr/docs/pregnancy.pdf].

Title IX of the Education Amendments Act of 1972 prohibits discrimination on the basis of sex and gender–including pregnancy, parenting, and all related conditions. A&M-Central Texas is able to provide flexible and individualized reasonable accommodation to pregnant and parenting students. All pregnant and parenting students should contact the Associate Dean in the Division of Student Affairs at (254) 501-5909 to seek out assistance. Students may also contact the University's Title IX Coordinator.

Tutoring

Tutoring is available to all A&M-Central Texas students, both virtually and in-person. Student success coaching is available online upon request.

If you have a question, are interested in becoming a tutor, or in need of success coaching contact the Warrior Center for Student Success, Equity and Inclusion at (254) 501-5836, visit the Warrior Center at 212 Warrior Hall, or by emailing WarriorCenter@tamuct.edu.

To schedule tutoring sessions and view tutor availability, please visit Tutor Matching Services [https://tutormatchingservice.com/TAMUCT] or visit the Tutoring Center in 111 Warrior Hall.

Chat live with a remote tutor 24/7 for almost any subject from on your computer! Tutor.com is an online tutoring platform that enables A&M-Central Texas students to log in and receive online tutoring support at no additional cost. This tool provides tutoring in over 40 subject areas except writing support. Access Tutor.com through Canvas.

University Library & Archives

The University Library & Archives provides many services in support of research across campus and at a distance. We offer over 350 electronic databases containing approximately 631,525 eBooks and 75,149 journals, in addition to the 97,443 items in our print collection, which can be mailed to students who live more than 50 miles from campus. Research guides for each subject taught at A&M-Central Texas are available through our website to help students navigate these resources. On campus, the library offers technology including cameras, laptops, microphones, webcams, and digital sound recorders.

Research assistance from a librarian is also available 24 hours a day through our online chat service, and at the reference desk when the library is open. Research sessions can be scheduled for more comprehensive assistance, and may take place virtually through WebEx, Microsoft Teams or in-person at the library. Schedule an appointment here [https://tamuct.libcal.com/appointments]. Assistance may cover many topics, including how to find articles in peer-reviewed journals, how to cite resources, and how to piece together research for written assignments.

Our 27,000-square-foot facility on the A&M-Central Texas main campus includes student lounges, private study rooms, group work spaces, computer labs, family areas suitable for all ages, and many other features. Services such as interlibrary loan, TexShare, binding, and laminating are available. The library frequently offers workshops, tours, readings, and other events. For more information, please visit our Library website [https://tamuct.libguides.com/index]

University Writing Center

University Writing Center: Located in Warrior Hall 416, the University Writing Center (UWC) at Texas A&M University–Central Texas (A&M–Central Texas) is a free service open to all A&M–Central Texas students. The hours of operation are from 10:00 a.m.-5:00 p.m. Monday thru Thursday in Warrior Hall 416 (with online tutoring available every hour as well) with satellite

hours available online only Monday thru Thursday from 6:00-9:00 p.m. and Saturday 12:00-3:00 p.m.

Tutors are prepared to help writers of all levels and abilities at any stage of the writing process. While tutors will not write, edit, or grade papers, they will assist students in developing more effective composing practices. By providing a practice audience for students' ideas and writing, our tutors highlight the ways in which they read and interpret students' texts, offering guidance and support throughout the various stages of the writing process. In addition, students may work independently in the UWC by checking out a laptop that runs the Microsoft Office suite and connects to WIFI, or by consulting our resources on writing, including all of the relevant style guides. Whether you need help brainstorming ideas, organizing an essay, proofreading, understanding proper citation practices, or just want a quiet place to work, the UWC is here to help!

Students may arrange a one-to-one session with a trained and experienced writing tutor by making an appointment via WCOnline [https://tamuct.mywconline.com/]. In addition, you can email Dr. Bruce Bowles Jr. at bruce.bowles@tamuct.edu if you have any questions about the UWC, need any assistance with scheduling, or would like to schedule a recurring appointment with your favorite tutor.

OTHER POLICY STATEMENTS

A Note about Sexual Violence at A&M-Central Texas

Sexual violence is a serious safety, social justice, and public health issue. The university offers support for anyone struggling with these issues. University faculty are mandated reporters, so if someone discloses that they were sexually assaulted (or a victim of Domestic/Dating Violence or Stalking) while a student at TAMUCT, faculty members are required to inform the Title IX Office. If you want to discuss any of these issues confidentially, you can do so through Student Wellness and Counseling (254-501-5955) located on the second floor of Warrior Hall (207L).

Sexual violence can occur on our campus because predators often feel emboldened, and victims often feel silenced or shamed. It is incumbent on ALL of us to find ways to actively create environments that tell predators we don't agree with their behaviors and tell survivors we will support them. Your actions matter. Don't be a bystander; be an agent of change. For additional information on campus policy and resources visit the Title IX webpage [https://www.tamuct.edu/compliance/titleix.html].

Behavioral Intervention

Texas A&M University-Central Texas cares about the safety, health, and well-being of its students, faculty, staff, and community. If you are aware of individuals for whom you have a concern, please make a referral to the Behavioral Intervention Team. Referring your concern shows you care. You can complete the referral online

[https://cm.maxient.com/reportingform.php?TAMUCentralTexas&layout_id=2].

Anonymous referrals are accepted. Please see the Behavioral Intervention Team website for

more information [https://www.tamuct.edu/bit]. If a person's behavior poses an imminent threat to you or another, contact 911 or A&M-Central Texas University Police at 254-501-5805.

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