

## **MTHK 5311-110, CRN 10446 OPERATIONS RESEARCH**

Spring 2023 rev. 01.15.2023

Texas A&M University - Central Texas

### **COURSE DATES, MODALITY, AND LOCATION**

Jan 17, 2023 - May 12, 2023

The instructional method is online, and uses the A &M-Central Texas Canvas Learning Management System [<https://tamuct.instructure.com/>].

### **INSTRUCTOR AND CONTACT INFORMATION**

**Instructors:** Christopher Thron

**Office:** All contact is online

**Phone, text, and WhatsApp:** (585) 204-0314

**Email:** Please email instructor via Canvas email.

**Google Meet** (for online meetings): [chris.thron@gmail.com](mailto:chris.thron@gmail.com)

*You may contact me at any time by email or text. Often I can respond immediately, and if necessary we can meet online to answer your question right away. WhatsApp is also OK, but I may not see it right away.*

### **Office Hours**

The instructor is generally available online from 9 A.M.-1 P.M. and from 4 P.M.-6 P.M. on weekdays and Saturday. *Students are encouraged to make appointments to discuss issues with homework (both before and after grading). Each student is entitled to an average of ½ hour of face-to-face time with the instructor (besides questions you may have with the homework).*

### **Student-instructor interaction**

Aside from the above, the instructor will schedule two regular online sessions per week for discussion and problem-solving. Sessions will be accessed within Canvas, and will be recorded.

### **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](http://www.safezoneapp.com) website [[www.safezoneapp.com](http://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:
  - o [iPhone/iPad](https://apps.apple.com/app/safezone/id533054756): [<https://apps.apple.com/app/safezone/id533054756>]
  - o [Android Phone / Tablet](https://play.google.com/store/apps/details?id=com.criticalarc.safezoneapp)  
[<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/)  
[<https://www.tamuct.edu/covid19/>]

## **COURSE INFORMATION**

### **Course Overview and description**

This course provides an introduction to linear programming and operations research. The course begins with an intensive review of necessary concepts from and applications of linear algebra: Properties of vectors and matrices; vector and matrix products and their role in formulating linear constraints and optimization functions; using matrices to solve systems of linear equations; row reduction and matrix inverse; regular and absorbing Markov chains. Following this, the theoretical and practical basis of linear programming will be introduced including: linear inequalities and hyperplanes; polyhedral convex sets; feasible regions; optimization and extreme points; tableau formulation of linear programming problems; duality; the simplex method; solution of matrix games as a linear programming problem. Next, we will cover applications of linear programming to the behavioral and managerial sciences including network optimization, the Leontief model in economics, etc. With the remaining time in the course, students will work on individualized projects which may involve either computer implementation or pedagogical development.

### **Student Learning Outcomes:**

Upon successful completion of MATH 5311, students will be able to:

- a) State and contextualize fundamental mathematical definitions
- b) Recognize and compare properties of mathematical structures
- c) Recognize and interpret hypotheses and conclusions of theorems.
- d) Evaluate the truth of mathematical statements based on definitions and theorems.
- e) Perform standard computations related to the material, and interpret the results of those computations.
- f) Compose and critique mathematical proofs using sound logical argument and appropriate notation.
- g) Demonstrate the use of the theoretical results and computational aspects on required applications; and
- h) Connect the material to concepts in other courses.

### **Required Reading and Textbook(s)**

An Introduction to Linear Programming and Game Theory, by Paul R. Thie and Gerard E. Keough, 3rd edition, Wiley 2008. ISBN 978-0-470-23286-6 Available on Amazon (used under \$10, rental under \$20): <https://www.amazon.com/Introduction-Linear-Programming-Game-Theory/dp/0470232862>

Linear Programming Playlist, Wen Shen (Penn State University)

[https://www.youtube.com/playlist?list=PLbxFfU5GKZz1Tm\\_9RR5M\\_uvdOXpJJ8LC3](https://www.youtube.com/playlist?list=PLbxFfU5GKZz1Tm_9RR5M_uvdOXpJJ8LC3)

### *Supplementary materials*

Additional materials will be kept in the following Google Drive folder:

[https://drive.google.com/drive/folders/10RHPaXmHMSSfQdgRFTks8Ifldy7FgZ-?usp=share\\_link](https://drive.google.com/drive/folders/10RHPaXmHMSSfQdgRFTks8Ifldy7FgZ-?usp=share_link)

## **COURSE REQUIREMENTS**

- Homework (50%) will be assigned on a weekly or bi-weekly basis. Solutions will be provided. Students are expected to self-check. Selected homework questions will be graded.
- Exam 1: 20%
- Exam 2/project (30%). This may be a combination of take-home test and project, as determined by the instructor

### **Grading Criteria Rubric and Conversion**

Homework	50% (50 points)	90- 100%= A
Exam 1	20% (20 points)	80- 89%= B
Exam 2/Project	30% (30 points)	70- 79%= C
		60- 69%= D
TOTAL	100% (100 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.
- 40% Makes beginning steps towards a solution
- 20% Some relevant information supplied.

### **Posting of Grades**

I will attempt to post grades on Canvas within one week of submissions. If I am late and you want to know your grade, please email me and I will respond as soon as possible. If you want feedback on your homework, I'm always happy to schedule an appointment and look through it together.

### **Grading Policies**

Late work is only accepted with written documentation of exceptional circumstances.

Examples of exceptional circumstances include family emergency, hospitalization, funeral, etc.

Late work also receives a maximum B grade, regardless of circumstances.

If your overall grade (on a scale from 0 to 100) is within 1 point of the next highest grade level, I will increase your grade if you have done all of the quizzes. Otherwise you will be graded strictly according to the numbers. That means that if your average is 89.99 and you didn't do all the quizzes, then you still get a B.

## **COURSE OUTLINE AND CALENDAR**

### **Complete Course Calendar**

'Videos' refers to the videos in the required playlist given above. They are keyed to different chapters in the book (i.e. V3 refers to Chapter 3). The videos we'll be using start at #28 in the playlist. The later videos are out of order (see below, beginning with section 5.06).

Note that this schedule is subject to change , depending on course pacing. *Videos should be watched at the beginning of the week, before the problem sessions.*

*First day of the week (Monday)*

**16 Jan** Videos 28-37 (V1.1-V2.09) Linear programming graphical approach and modeling

**23 Jan** Videos 38-46 (V3.01-3.09 Standard form, canonical form, intro to simplex method

**30 Jan** Videos 47-54(V3.10-V3.17) Theory of simplex method; simplex tableaux

**6 Feb** Videos 55-62 (V3.18-V3.25) Artificial variables

**13 Feb** Videos 63 -72(V3.26-V3.35)- Redundant system and convergence proof

**20 Feb** Videos 73-82 (V4.01-V4.10) Duality and Duality Theorem

**27 Feb** Videos 83-89 (V4,12-V5,05) Complementary slackness, Sensitivity and matrix representation

**6 Mar** Exam 1 (covers Chapters 1-4)

**13 Mar** **SPRING BREAK**

**20 Mar** Videos 102,97,100,95,104,106 (V5.06-5.11) Changes in the objective function

**27 Mar** Videos 107,99,101,103, 98,105,108 (V6.01-6.07) Integer linear programming

**3 Apr** Videos 94,96,93,92,91,90(V7.01-V7.06) Distribution and transportation problems

**10 April** Test/Project TBD

**17 April** Test/Project TBD

**24 April** Test/Project TBD

**1 May 2<sup>nd</sup>** Test/Project TBD

**8 May 2<sup>nd</sup>** Test/Project TBD

### **Important University Dates**

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

## **TECHNOLOGY REQUIREMENTS AND SUPPORT**

### **Technology Requirements**

You will need a computer that can be used for videoconferencing.

Any software used during the course will be open-source and free.

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*Note: The following material is generic and is included in all TAMUCT syllabi.*

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](mailto:helpdesk@tamu.edu)

Phone: (254) 519-5466

[Web Chat](http://hdc.tamu.edu): [http://hdc.tamu.edu]

*Please let the support technician know you are an A&M-Central Texas student.*

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## **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](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?PartnerIdId=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](mailto:WarriorCenter@tamuct.edu).

To schedule tutoring sessions and view tutor availability, please visit [Tutor Matching Services](https://tutormatchingservice.com/TAMUCT) [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) [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) [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 [WCOonline](https://tamuct.mywconline.com/) [https://tamuct.mywconline.com/]. In addition, you can email Dr. Bruce Bowles Jr. at [bruce.bowles@tamuct.edu](mailto: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) [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](https://www.tamuct.edu/bit) 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.