Instructor: Dr. Chris Lee Trexler 270D clee@roanoke.edu (540) 375-2347

Office Hours: I am available for various office hours Monday through Thursday. All office hours are by appointment. To make an appointment, please use the link: **https://drchrislee.youcanbook.me**

Overarching Philosophy: Your ability to do Mathematics is not measured by a number stamped on your forehead at birth. Ability is a direct result of effort, and everything in this course is designed to encourage and reward maximum effort. No matter what your ability or grade is at any given moment, it can be changed through focused effort.

Intended Learning Outcomes: This course introduces Operations Research: a mathematical approach to decision making based on optimization. Topics include the simplex method, sensitivity analysis, duality, transportation problems, and network models. By the end of the course, successful students will be able to understand and use the main models and methods of mathematical programming, formulate practical problems into mathematical programming models, recognize applied problems that can be studied using mathematical programming, use software tools to solve mathematical programming models, and interpret the solutions to mathematical programming models to make good decisions.

Required Materials: Textbook: *Operations Research: Applications and Algorithms.* Winston, 4th Ed. All work should be legible and done in pencil.

Prerequisite: Enrollment in this course requires successful completion of Math 201 Linear Algebra.

Attendance: Attendance is critical to the understanding of the material in the course; it is both required and expected. Any absence that is not discussed with the instructor prior to the missed class is considered unexcused. I will assume that if you accumulate 3 unexcused absences you are not interested in completing the course and will drop you from the class (DF). When absent, excused or unexcused, you are responsible for all material covered in class. You will not be allowed to make up any work missed due to an unexcused absence.

Late Work: Unless specific permission is given in advance of the due date, no late work will be accepted.

Cell Phones: This is very simple - no cells phones are allowed to be used or even visible in our classroom. This includes before, during, and after class. If a cell phone is seen, the student may be asked to leave the classroom and the day will be counted as an unexcused absence.

Computers: Unless it is at the direction of the instructor, laptops with keyboards may not be used during class. Tablets with inking capability may be used for note-taking.

Community: Please feel free to become an active member of our department's community. Each of the three disciplines in our department has a student club and you should join! The Roanoke College Student Chapter of the Mathematical Association of America (or "Math Club" for short) meetings every other week, plays and learns about games and hosts evening events and the annual Pi-Day celebration! In addition, our department offers MCSP Tea every week on Thursdays from 2:15-3:15pm; come by Trexler 271 to talk to and meet other students as well as chat with the MCSP faculty members in a casual setting!

Reading and Participation: The key to learning a topic in mathematics is participation. We will strive to have an active, rather than passive, classroom environment. The last page of the syllabus is a day-by-day outline of the sections that will be discussed in class. You are fully expected to have read the upcoming section before the class meeting! This does not mean you need to understand everything, but rather you should be familiar with the definitions and concepts from the sections; having read the section will allow you to ask better questions and follow along better in class.

MCSP Conversation Series: As you already know from spending a few years here, the MCSP Department offers a series of discussions that appeal to a broad range of interests related to these fields of study. These are known as the talks and lectures in the MCSP Conversation Series. You are invited to be involved with all talks; however, participation **at least three** of these sessions is mandatory. After attending, submit a one-page paper reflecting on the discussion. This should not be a regurgitation of the content, but rather a personal contemplation of the experience. These reaction papers will be submitted through Inquire; your final grade will be reduced by 2% for each paper not submitted.

Academic Integrity: Students are expected to adhere to the Academic Integrity policies of Roanoke College. All work submitted for a grade is to be your own work! No electronic devices other than calculators can be taken out during any class.

Course Schedule: This course expects you to spend at least 12 hours of work each week inside and outside of class.

Grading Components

Testing: As described in more detail on the next page, we will be making use of mastery-based testing.

Problems of the Day: At the end of each class period during which content is discussed, practice problems will be assigned. It is expected that students work all these problems. To keep you from procrastinating and to measure understanding, an overwhelming majority of class days will begin with a "problem of the day". When you enter the classroom there will be a problem displayed for you to work and turn in. This problem will be due at 1:16pm regardless of when you enter the classroom.

Projects: There will be both a mini and a full project in this course. Both will require group work and a written report. The first mini project is prior to break and focuses on problem formulation. The second full project builds on this and requires formulation, solution, and analysis.

Grading: Components of a student's grade will be weighted as follows:

Mastery: 80% Problem of the Day: 10% Projects: 10%

Grading Scale: A grade scale will be determined after final averages are computed but will be no lower than the scale given below.

0	*60*	*63*	*67*	*70*	*73*	*77*	*80*	*83*	*87*	*90*	*93*
F	*D-*	*D*	*D+*	*C-*	*C*	*C+*	*B-*	*B*	*B+*	*A-*	*A*

We will be making use of **mastery-based testing** rather than a points-based system. Mastery-based testing is very different from what you are used to – do not hesitate to ask me questions.

Description: You only receive credit for answers that demonstrate you completely understand (have mastered) a topic. But, you get many chances to display mastery throughout the semester with no penalty whatsoever for earlier attempts.

- The course has been boiled down to 16 essential types of questions, or "topics".
- Your mastery of questions on these topics is assessed through the working of problem each Friday and during the scheduled final exam period.
- Each problem submitted is graded as either "Mastery" or "Not Mastered". A grade of Mastery indicates that you have demonstrated full understanding of the concept being tested and further work on the topic is not necessary.
- Once you have mastered a problem you need not ever attempt it again.
- There is no penalty whatsoever for multiple attempts taken to achieve mastery.
- Mastery does not mean perfect, it means you understand and can demonstrate all fundamentals of the topic and are proficient at the level desired for the course – you do not need to study the topic further.

Your overall test grade is then determined by the number of topics you have mastered.

#Mastered	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Exam Grade	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25

Notes on Master-Based Testing (in no specific order)

- Clear content objectives, students continually know exactly what they need to work on to improve.
- Credit only for eventual mastery. No partial credit. Multiple attempts with complete forgiveness.
- A points-based system sets arbitrary deadlines by which time perfection must be attained.
- Perseverance: Points – try a problem once, maybe twice, hope for the best.
  Mastery – Keep trying until you succeed (and I know you can)
- Use of feedback: Points – do I agree with the instructors grading
  Mastery – what can I do to demonstrate that I understand the concept (improvement!)
- Reduced Test Anxiety: Points – every test has the potential to damage your GPA.
  Mastery – no one test can harm your grade.
- Intelligent Test Preparation: You may choose to skip problems on a test. Better to achieve mastery on some than to demonstrate mediocrity on all.
- No longer will any of us have to wonder just what exactly a 7/10 means on a problem compared to an 8/10…
- A "broad and superficial" strategy may earn a C or D in a points-based system, in mastery you will fail.

Course Schedule and Topics

Date		Section	Title	Mastery
Tue	Jan 15	1.1-1.5	Introduction to Model Building	
Thu	Jan 17	2.1-2.6, 3.1	Review, Intro to Linear Programming	
Tue	Jan 22	3.2, 3.3-3.6	Graphical Solutions and Applied Examples	
Thu	Jan 24	4.1-4.3	Linear Programming Problems - Concepts	
Tue	Jan 29	4.5	The Simplex Algorithm	
Thu	Jan 31	4.5	The Simplex Algorithm	
Tue	Feb 5			Mastery In-Class & Take-home
Thu	Feb 7	4.6-4.8	Variations of the Simplex Algorithm	
Tue	Feb 12	4.11-4.13	Degeneracy and Basic Feasible Solutions	
Thu	Feb 14	6.1, 6.2	Into to Sensitivity Analysis	
Tue	Feb 19	6.3	Sensitivity Analysis	
Thu	Feb 21	6.3	Sensitivity Analysis	
Tue	Feb 26	6.5, 6.6	The Dual of an LP	Mastery Take-home
Thu	Feb 28			
Spring Break				
Tue	Mar 12	6.7	The Dual Theorem / Shadow Prices	
Thu	Mar 14	6.8, 6.9, 6.10	Duality and Sensitivity Analysis	
Tue	Mar 19	6.11	Dual Simplex Method	
Thu	Mar 21	7.1	Transportation Problems	
Tue	Mar 26	7.1, 7.2	Transportation Problems	Mastery Take-home
Thu	Mar 28	7.3	Transportation Simplex Method	
Tue	Apr 2	8.1, 8.2	Network Models	
Thu	Apr 4	8.3, 8.5	Variations of Network Flow Models	
Tue	Apr 9	9.1, 9.2	Integer Programming	
Thu	Apr 11	17.1, 17.2	Markov Chains	
Tue	Apr 16	17.3	Markov Chains	Mastery Take-home
Thu	Apr 18	Wrapup		

1. Linear Programming Models 3.1
2. Graphical Solutions 3.2
3. Applied Problem Formulation 3.3-3.7
4. Linear Programming Problems – Concepts 4.1-4.3
5. The Simplex Algorithm 4.5
6. Variations in the Simplex Algorithm 4.6-4.8
7. Difficult Basic Feasible Solutions 4.11-4.12
8. Sensitivity Analysis 6.1-6.4
9. The Dual – Find and Interpret 6.5-6.7
10. The Dual Theorem / Shadow Prices 6.8, 6.9, 6.10
11. The Dual Simplex Method 6.11

12.	Transportation Problems – Formulation	7.1, 7.2
13.	Transportation Problems – Solving	7.3
14.	Network Models	8.1-8.3
15.	Integer Programming	9.1-9.2
16.	Markov Chains	17.1-17.3