

SYLLABUS MATH 8190 – Multicriteria Optimization - Fall 2020

T & Th, 12:30 p.m. – 1:45 p.m.

Instructor: Dr. Margaret Wiecek Office: Martin Hall O-208
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Office hours: T & Th, 2:30 p.m. – 3:30 pm or by appointment, both via Zoom.
Zoom Meeting Room id: 8910290823

Modality: This course will be offered fully online and delivered synchronously on Zoom during the entire semester. Use the link posted on Canvas to login to class at the scheduled times. Each class will be recorded and posted on Canvas. Use the same link to meet with the instructor during the office hours.

Class cancellation: A class is canceled 15 minutes after the instructor fails to arrive.

Attendance: Regular attendance is strongly recommended.

Inclement weather and power outages:

- Any assignments or take-home exams due at the time of a class cancellation due to inclement weather will be due at the next class meeting unless the instructor contacts students.
- Any extension or postponement of assignments or exams must be granted by the instructor via email within 24 hours of the weather-related cancellation.

Specific COVID-19 related information:

Students' attendance and participation in the online class may be affected by the pandemic. Students who report testing positive may develop a medical condition that will slow down their ability to work on class assignments and submit them by the scheduled due dates. In these circumstances, the students should contact the instructor to develop an alternative plan of study.

Accessibility statement: Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to a class should let the instructor know and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848 or by emailing studentaccess@lists.clemson.edu. Students who receive Academic Access Letters are strongly encouraged to request, obtain and present these to their instructors as early in the semester as possible so that accommodations can be made in a timely manner. It is the student's responsibility to follow this process each semester." You can access further information here: <http://www.clemson.edu/campus-life/campus-services/sds/>.

Title IX (Sexual Harassment) statement: Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity (e.g., opposition to prohibited discrimination or participation in any complaint process, etc.) in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972. The University is committed to combatting sexual harassment and sexual violence. As a result, you should know that University faculty and staff members who work directly with students are required to report any instances of sexual harassment and sexual violence, to the University's Title IX Coordinator. What this means is that as your professor, I am required to report any

incidents of sexual harassment, sexual violence or misconduct, stalking, domestic and/or relationship violence that are directly reported to me, or of which I am somehow made aware. There are two important exceptions to this requirement about which you should be aware:

- Confidential Resources and facilitators of sexual awareness programs such as "Take Back the Night and Aspire to be Well" when acting in those capacities, are not required to report incidents of sexual discrimination.
- Disclosures about sexual harassment, sexual violence, stalking, domestic and/or relationship violence that are shared as part of an academic project, a research project, classroom discussion, or course assignment, are not required to be disclosed to the University's Title IX Coordinator.

This policy is located at <http://www.clemson.edu/campus-life/campus-services/access/title-ix/>. Ms. Alesia Smith is the Executive Director for Equity Compliance and the Title IX Coordinator. Her office is located at 223 Holtzendorff Hall, phone number is 864.656.3181, and email address is alesias@clemson.edu.

COVID-19 related information: While on campus, face coverings are required in all buildings and classrooms. Face coverings are also required in outdoor spaces where physical distance cannot be guaranteed. Please be familiar with the additional information on the Healthy Clemson website, such as the use of disinfectant wipes for in-person classes.

Preparation for emergency: Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency:

- Ensure you are signed up for emergency alerts (<https://www.getrave.com/login/clemson>),
- Download the Rave Guardian app to your phone (<https://www.clemson.edu/cusafety/cupd/rave-guardian/>)
- Learn what you can do to prepare yourself in the event of an active threat (<http://www.clemson.edu/cusafety/EmergencyManagement/>)

Prerequisite: MATH 8100 or an equivalent graduate-level course in optimization.

Text: M. Ehrgott, *Multicriteria Optimization*, Springer, Berlin, 2005, 2nd edition; The book is optional. It will be used as a reference rather than a textbook. It is available in the campus bookstore.

Software: MATLAB, CPLEX, AMPL, any optimization software approved by the instructor

Course description: Multicriteria optimization addresses decision making problems with multiple and conflicting objective functions. For example, in choosing a graduate school the student typically considers the curriculum, location, living expenses, and stipend as some of the main criteria. It is rather uncommon to receive an offer from a graduate school at which all these criteria are at their best because, for example, a school with an excellent curriculum may have an unattractive location. In portfolio management, the investor desires high returns under reduced risk. Unfortunately, the stocks that have the potential of bringing high returns typically carry high risk of losing money. In engineering design, the designer often trades innovation for the cost of manufacturing of a new product because novelty is too expensive. In each of the situations the process of taking a decision on how to proceed is challenging because of the accompanying conflict. It is easy to realize that such situations are perpetually around people at every level of our activity. In the course, models, theories, methodologies, and applications of multicriteria optimization will be presented.

Student learning outcomes: Upon successful completion of this course, a student will be able to

- identify applications areas of multicriteria optimization in real-life decision-making
- develop multicriteria models for real-life decision-making problems
- describe properties of the solution sets for several classes of these models
- solve real-life decision-making problem with multiple goals and objectives with software

Communication:

- Feel free to email the instructor anytime. Emails will generally be answered within 24 hours. Any email sent after 5pm is not guaranteed to be answered before the next business day.
- All exchange of documents such as homework assignments, reports, exams, etc., between the instructor and the students will be done electronically via Canvas or by email.

Class Formats and Grading:

Homework **30%**

5 assignments are anticipated
Each assignment will be given two weeks

Team Project 1: Applications **20%**

Choose article by **September 1, 2020**
Submit 3-4 page report by **September 22, 2020**
Team might be invited to give 10-minute presentation in class

Team Project 2: Methodology **20%**

Choose article by **October 6, 2020**
Submit 3-4 page report by **October 27, 2020**
Team might be invited to give 10-minute presentation in class

Team Project 3: Methodology and Computation **30%**

Choose method for implementation by **November 10, 2020**
Submit 5-6 page report by Monday, **December 7, 2020, 5:30 p.m.**

- Homework assignments:
 - Students are encouraged to discuss the homework assignments with one another but are expected to individually write the document they submit
 - All assignments will be collected
 - All or some assignments will be graded
 - Solutions will not be posted but assignments will be discussed in class as needed
 - Scores will be lowered for illegible writing
- Team Projects:
 - Detailed information on each project will be posted
 - Teams will be formed by the instructor
 - Projects 1 and 2 will be based on existing literature
 - Each team shall obtain instructor's approval for the selected article
 - It is planned that every team will give one presentation in class either on Project 1 or Project 2
 - Project reports shall be typed
 - All Project 1 reports will be posted on Canvas
- Please submit each assignment as one file in the pdf format
- For each graded assignment, scores will be lowered for late submission

Grading scale: A (86-100), B (71-85), C (56-70), D (≤ 55); The scale will be strictly followed.

Topical outline (The actual pace of the class may be adjusted at the instructor's discretion):

Introduction

 Biobjective programs, Elements of convex analysis

Preference modeling

 Preferences and binary relations, Preferences and cones

Theory of multiobjective programs (MOPs)

 General and Pareto MOPs, Solution concepts, Algebra of efficient and nondominated sets,

 Weighted-sum method, Kuhn-Tucker conditions

Methodology for MOPs

 Scalarization methods, Approximation methods

Specially structured MOPs

 Linear MOPs, Discrete MOPs, MOPs on networks, Mixed-integer MOPs

Multicriteria decision-making (MCDM), Applications

Class attendance policy: Attending/missing classes will be given no credit/penalty.

Extra credit policy: opportunities for extra credit will not be given.

Academic Integrity Policy will be strictly enforced (see Student Handbook). *As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a high seminary of learning. Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond appropriately to charges of violations of academic integrity.* For more information refer to the graduate academic integrity policy at <http://gradspace.editme.com/AcademicGrievancePolicyandProcedures#intergritypolicy>