MATH 145
Course Description and Syllabus
Spring, 2023

Professor: Matthew Neal (nealm@denison.edu)
Office and phone: Olin 202 (6288)
Office Hours: M 2 -4:30,W 2-3:30 R (special see below) F 2-2:30, 3-3:30 in Olin 202 or by appointment
Web site: http://personal.denison.edu/~nealm/

Course

This is a second course in calculus. Unlike Single Variable Calculus (Math 135), Math 145 considers the theory and applications of multivariable functions. We will study probability theory, infinite series, vectors, matrix/linear algebra, partial derivatives and integration, with applications to common probability models, statistical models, differential equation models, optimization models, and computational methods used in the natural and social sciences. These topics are foundational to any math, science or economics major, or any student interested in a serious study of statistics or data analytics. The learning goals are:

To learn to think *clearly* about multivariable mathematical processes and effectively communicate your thoughts

To be able to model real many different multivariable real world processes with mathematics

To be able to understand, prove, and apply important multivariable mathematical results and communicate why they are important

To learn how to use computer software to analyze multivariable mathematical models

To understand and communicate the assumptions and limitations of multivariable mathematical models that are applied to the real world

Audience

This course is recommended for students who have: Completed Math 135 or equivalent with at least a B- **OR** took a calculus class and received a 17 or higher on the Math Placement Test

Book

We will use a free pdf (written by me) with lecture notes and problems.

Grades and Expectations

The grade will be calculated with the following weights:

- 10 % Quizzes
- 5% HW
- 5 % Class participation
- 60 % Three Tests (20 % each)
- 20% Final exam

Grade Scale: 90-100 A 80 - 89 B 66-79 C 50-65 D 0-49 F

Homework, Quizzes and Tests

Homework Problems will be assigned most days. You will be provided solutions. I will then go over some of them in class. Every week on Wednesday I will give a 2 problem quiz drawn from the homework. I will check HW on Wednesdays for completeness only. Tests will be given on Thursday nights from 6-8:30 pm (see schedule below).

Office Hours

Besides the normal office hours scheduled above, we will have special office hours on Tuesdays. I will schedule half hour blocks from 12:30-4:30 for 4-5 students each. This will be devoted to homework and test review on test weeks. You will receive a bonus point (out of 10) on your quiz for that week if you attend.

Class participation

In class I expect that you will try to do the in-class activities and between-class homework and try to communicate with me. I also expect attendance in **all** classes unless you email me beforehand with a good excuse (the validity of which I will determine).

Final Exam

The final exam will occur on **Wed., Dec. 17th 9:00-11:30 am** for the 12:30 class and **Wed., Dec. 17th 6:30-9 pm** for the 11:30 class. It will be taken in our classroom.

Late Work

Late assignments will receive a 20 % point penalty per day late unless there is a PRIOR written note (such as a note from Whistler) that verifies a VERY strong excuse (such as illness or important sports team events). Late quizzes are not accepted at all without a written excuse as above.

Disabilities

Students with a documented disability should complete a Semester Request for Accommodations through their Accommodate MyAccommodations app on MyDenison. It is the student's responsibility to contact me privately as soon as possible to discuss specific needs and make logistic arrangements well in advance of an evaluation. I rely on the Academic Resource Center (ARC) located in 020 Higley Hall, to verify the need for reasonable accommodations based on the documentation on file in that office. Reasonable accommodations cannot be applied retroactively and therefore ideally should be enacted early in the semester as they are not automatically carried forward from a previous term and must be requested every semester.

Academic Integrity

Proposed and developed by Denison students, passed unanimously by DCGA and Denison's faculty, the Code of Academic Integrity requires that instructors notify the Associate Provost of cases of academic dishonesty. Cases are typically heard by the Academic Integrity Board which determines whether a violation has occurred, and, if so, its severity and the sanctions. In some circumstances the case may be handled through an Administrative Resolution Procedure. Further, the code makes students responsible for promoting a culture of integrity on campus and acting in instances in which integrity is violated. Academic honesty, the cornerstone of teaching and learning, lays the foundation for lifelong integrity.

Academic dishonesty is intellectual theft. It includes, but is not limited to, providing or receiving assistance in a manner not authorized by the instructor in the creation of work to be submitted for evaluation. This standard applies to all work ranging from daily homework assignments to major exams. Students must clearly cite any sources consulted—not only for quoted phrases but also for ideas and information that are not common knowledge. Neither ignorance nor carelessness is an acceptable defense in cases of plagiarism. It is the student's responsibility to follow the appropriate format for citations. Students should ask their instructors for assistance in determining what sorts of materials and assistance are appropriate for assignments and for guidance in citing such materials clearly.

Note on Technology: Unauthorized use of technology (including, but not limited to, artificial intelligence sites and translation programs) in the preparation or submission of academic work can be considered a form of cheating and/or plagiarism. Instructors may at their discretion create assignments that incorporate the use of supporting technologies and will inform students of acceptable uses of technology in their courses. It is the responsibility of the student to ask the instructor for clarification whenever they are unclear about the parameters of a specific assignment and to understand that presenting the work of artificial intelligence as your own constitutes a violation of Denison's Code. Cases of suspected inappropriate use of technology may be submitted to the Academic Integrity Board to initiate an investigation of academic dishonesty.

For further information about the Code of Academic Integrity, see http://denison.edu/academics/curriculum/integrity.

Multilingual Support

Students who use English in addition to other languages are welcome to use the resources available at the Multilingual Learning Office. Kaly Thayer, the Assistant Director of Multilingual Learning; Anna Adams, the English Language Support Specialist; and the student consultants who work with them are trained and experienced in helping students address the different issues that arise when working in more than one language.
If English is not your first or only language, please consider utilizing this resource, which is available to ALL Denison students. Ms. Thayer, Ms. Adams, and the student consultants offer a variety of support for L2 students, including consulting with you about your written language (grammar, syntax, word-choices), developing strategies to manage your reading assignments, assisting with class conversation and presentations, and helping to devise ways to develop and effectively use all your skills in English. You can set up an appointment via https://denisonuappointments.as.me/mlo, or by emailing the Multilingual Learning Office directly at english-help@denison.edu.

Reporting Sexual Assault

Essays, journals, and other coursework submitted for this class are generally considered confidential pursuant to the University's student record policies. However, students should be aware that University employees are required by University policy to report allegations of discrimination based on sex, gender, gender identity, gender expression, sexual orientation, or pregnancy to the Title IX Coordinator. This includes reporting all incidents of sexual misconduct, sexual assault, and suspected abuse/neglect of a minor. Further, employees are to report these incidents that occur on campus and/or that involve students at Denison University whenever the employee becomes aware of a possible incident in the course of their employment, including via coursework or advising conversations. There are others on campus to whom you may speak in confidence, including clergy and medical staff and counselors at the Wellness Center. More information on Title IX and the University's Policy prohibiting sex discrimination, including sexual harassment, sexual misconduct, stalking and retaliation, including support resources, how to report, and prevention and education efforts, can be found at: https://denison.edu/campus/title-ix.

Topics and Schedule

Course topics for Multivariable Calculus by week.

- **Week 1:** Discrete random variables, Expected value, Variance, Infinite sums (Section 6)
- **Week 2:** More discrete random variables (Section 6), Continuous random variables (Section. 7)
- **Week 3:** Continuous random variables and integration (Section 7)
- **Week 4:** Continuous random variables (Section 7), Maximum Likelihood Estimation (Section 8) **Test #1 Thursday, September 25th 6pm**
- **Week 5:** Partial derivatives (Section 11) Unconstrained non-linear optimization,(Section 11)
- **Week 6:** Vector algebra, Correlation (Section 12)
- **Week 7**: Vector algebra (Section 12)
- **Week 8:** Matrix Algebra, Multivariable Statistical Modeling, Newton's Method
- **Week 9:** Critical points, Gradients, Directional derivatives (Section 12) **Test #2 Thursday, October 30th 6pm**
- **Week 10:** Lines and planes, Constrained Optimization (Lagrange Multipliers) (Section 12)
- **Week 11:** Chain Rule (Section 12), Parametric curves (Section 13)
- **Week 12:** Double integrals (Section 13)
- **Week 13:** Parametric curves and double integrals (Section 13) Row reduction (Section 14.3) **Test #3 Thursday, December 4th 6pm**
- **Week 14:** Linear Systems and Matrix Theory (Section 14.3)