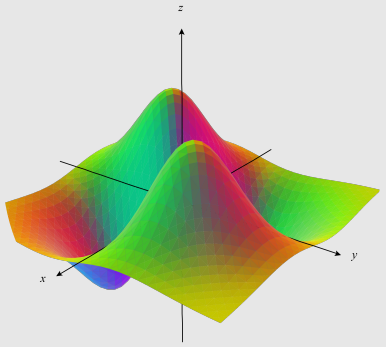

Multivariable Calculus

Math 1800-B

Instructor Info

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Course Info

Mon, Wed, & Fri
10:40a - 11:35a
Searles TBA

Lab Info

Thurs
2:50p-4:15p
Searles TBA

Course Description

The emphasis of the course will be on developing an understanding of the calculus of functions of two and three variables, as well as the geometry of associated curves and surfaces in two and three dimensions. Multivariable calculus is a fundamental pillar for many other things:

- It *extends single variable calculus to higher dimensions*. You will see that the structures are much richer than in single variable and that the fundamental theorem of calculus generalizes to higher dimensions.
- It *provides vocabulary* for understanding fundamental processes and phenomena. Examples are planetary motion, economics, waves, heat, finance, epidemiology, quantum mechanics or optimization.
- It *teaches important background* needed in social sciences, life sciences and economics. But it is rigorous enough that it is also suited for students in core sciences like physics, mathematics or computer science.
- It *builds tools for describing geometrical objects* like curves, surfaces, solids and intuition which is needed in other fields like linear algebra or data analysis. Geometry is currently an extremely popular topic: tomography methods in medicine, computer games, Google earth, social network analysis all use geometry.
- It *relates to culture and history*. The quest for answering questions like "where do we come from", "what will future bring us", "how can we optimize our time in between" all use calculus. The history of calculus contains fascinating stories, starting from Archimedes, 2300 years ago up to the modern times, where new branches of multivariable calculus are developed to understand the structure of nature.
- It *develops problem solving methods*. Examples are optimization problems with and without constraints (which is the bread and butter for economics), geometric problems, computations with scalar and vector fields, area and volume computations.
- It *makes you acquainted with a powerful computer algebra system* which allows you to see the mathematics from a different perspective. Such systems are more and more needed for visualization, experimentation and to build laboratories for your own research.
- It *prepares you for further study in other fields*. Not only in mathematics and its applications, but also in seemingly unrelated fields like game theory, probability theory, discrete mathematics, sociology, or number theory, where similar structures and problems appear, even in a discrete setting. Without geometric intuition and paradigms learned in calculus, it is rather hard to work in those fields.
- It *improves thinking skills*, problem solving skills, visualization skills as well as computing skills. You will see the power of logical thinking and deduction and why mathematics is timeless.

Required Course Materials

Textbook

Calculus: Multivariable, 7^{th} edition, by Hughes-Hallet, Gleason, McCallum et al.

Software

Mathematica, for your own computer.

Prerequisites

In order to be considered for admission into Math 1800 you must either have

1. completed Bowdoin's Math 1700 or Math 1750, or
2. been given a mathematics placement of Math 1800 when you entered Bowdoin.

If you do not satisfy at least one of these two conditions you will need the permission of the Chair of the Mathematics Department in order to register for Math 1800. No prior experience with Mathematica is required but a familiarity with mathematical computing softwares is encouraged.

FAQs

Where can I find Mathematica?

Bowdoin has a license allowing students to download the program onto their personal computers for free! To learn how to download Mathematica from the Bowdoin network, follow the steps at this link.

What is the late submission and make-up exam policy?

In general, late submission (even 15 mins late) of homework assignments will NOT be accepted. You may turn in *up to two* homeworks late, with no questions asked, so long as you notify me before the time the homework is due. Please see me in case of other extenuating circumstances.
You can make up an exam if certain unavoidable reasons prevent you from taking it and if you inform me in advance. Contact me as soon as possible if you are going to miss an exam. Missed exams can only be made up at my discretion, and are subject to a lost fraction of the grade.

Do I need to attend every class?

Although attendance is not directly part of your grade, it is very easy in a math class to fall behind after skipping even one class. You cannot be an effective and involved member of the class unless you are present! If you miss multiple classes in a row, you may expect a comment card.

Grading Scheme

Weekly assignments + Labs	20%
Projects	10%
Quizzes	15%
Midterms	15% each
Final exam	25%

Scores will NOT be curved. However, the cutoff percentage for letter grades will be set at my discretion. The weights are tentative and subject to change on an individual basis.

Important Dates

Quiz # 1	Thursday, Feb 6
Midterm # 1	Thursday, Feb 20
Quiz # 2	Wednesday, Mar 25
Midterm # 2	Thursday, Apr 16
Final Exam	Saturday, May 16, 8:30-11:30am

Please let me know immediately of any problems with these dates. Please note that the date of the final exam is set by the Registrar's office and cannot be altered. Individual changes in final exam dates are allowed only for particularly serious situations such as three exams in a two-day period.

Student Accommodations

- If you are a student with learning needs that require special accommodation, please see Lesley Levy in the Office of Student Accessibility as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please email me as soon as possible in order to set up a time to discuss your learning preferences, challenges you may face learning this semester, and how we can create an effective learning experience for you. *In particular, I understand that the quizzes at the beginning of class can present a challenge, and I'm eager to discuss options with you.*
- As a student, you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduced ability to participate in daily activities. Bowdoin College is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. You can learn more about the broad range of confidential mental health services available on campus at: `https://www.bowdoin.edu/counseling/`

Diversity and Inclusion Statement

I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability - and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

No student is required to take an examination or fulfill other scheduled course requirements on recognized religious holidays. Please declare your intention to observe these holidays at the beginning of the semester.

Title IX

As a faculty member I am considered a Responsible Employee, per the Student Sexual Misconduct and Gender Based Violence Policy. While my goal is for you to be able to share information related to your life experiences through discussion and written work, I want to be make sure you understand that as a Responsible Employee I am required to report disclosures of sexual misconduct, dating violence, stalking, and/or sexual and gender-based harassment to the University's Title IX Coordinator, Benje Douglas. My reporting to Benje does NOT mean that any actions will be taken beyond him reaching out to you and trying to schedule a time to talk to see what assistance you might need to be successful as a student here at Bowdoin.

Academic Integrity

I support and adhere to the principles of The Bowdoin College Academic Honor Code. Your work should never be directly copied from another student and I will expect that *you are not reading solution manuals* for this textbook. In particular, I will assume all members of the class are trustworthy in their dealings with me as well as their fellow classmates. However, should a violation of this trust be discovered, it will be reported to the Judiciary Board. The goal is not vengeance against those who violate the Code but fairness for those who adhere to it. If you have any questions about the appropriateness of a particular situation, please communicate with me.

Components of the Course

- You will need to read the textbook. Several homework and suggested review problems will come directly from the book, and possibly quiz or exam problems. Some in class examples will be similar or identical to the book, but many will be different. The overall topic choice and course philosophy will be from the book.
- Individual assignments will contain questions based on the textbook readings and class work. These assignments with their due dates will be regularly posted on Blackboard. The typical due date pattern is:
  - Monday's homework is due Friday same week,
  - Wednesday and Friday's homeworks are due Wednesday next week.
- You are encouraged to work on the weekly assignments with others, but you must write your final solution in your own words and you must complete and attach an Assignment Cover Sheet with every submission.
- As is typical for multivariable calculus courses in the Mathematics Department, homework will generally be corrected by student graders who work under my supervision; this is done to ensure that you regularly receive graded assignments in a timely manner. *Please inform me immediately if you find any mistake in graded homeworks.*
- Around six longer collaborative projects will be built around more challenging questions. Electronic copies of the assignment details will be available on Blackboard. These will be due typically within seven to ten days. The teams for the projects (of size 3-4) will be decided in second week and will change several times over the semester.
- All members of the group must not only participate in the analysis of the project but should discuss the specific phrasing and organization of the final submission. Final submissions must include a Project Report Cover Sheet that contains the signatures of all participants along with *brief but substantive* discussions of any issue confronted at your meetings. If any group member did not participate in an important aspect of the assignment, this must be stated in the Report. *A single submission for your entire group will suffice.*
- In the computer lab sessions you will work on Mathematica projects designed to deepen your understanding of the primary course concepts. Depending on your familiarity with Mathematica, you may find that you complete labs during the lab period, or you may find that you need some more time to complete them as homework. Either way is fine.
- Student participation and collaboration is an integral part of this class and is highly valued. Everyone will be expected to make thoughtful contributions in the form of questions (even if unprompted), statements, and reasoned arguments. You might be also occasionally invited to present something on the board. Whenever possible, there will be opportunities for you to work through practice problems in small groups during our class meetings. Paper copy of worksheets will be provided and an electronic copy will be available on Blackboard.
- Additionally, there will be two quizzes and two Midterms given during the semester as well as a Final Examination at the end of the semester. The quizzes are not cumulative but the midterms are semi-cumulative. The final will be all-inclusive. I will explain the syllabus for reach exam in more details in class.

Electronics Policies

- Be courteous when using mobile devices. Make sure your cell phone is turned fully off, or silent. If you must make or receive a call, please go outside the classroom.
- Use of laptops or tablets is permitted for note-taking and labs. Please turn off your Wi-fi and sound.

Class Schedule

The following is a preliminary outline of the topics that we hope to cover. This is an idealized plan, and it *may be adjusted as the semester progresses.* But it should give some indication of the major topics to be covered in this class.

Monday	Wednesday	Thursday	Friday
	22-Jan Syllabus Overview + 3D Coordinate Geometry + 13.1 (Vectors in 3D)	23-Jan **Lab 0 (Intro to Mathematica + Vectors)**	24-Jan 13.3 (Dot Product, Angle, Projection)
27-Jan 13.4 (Cross Product, Area, Volume)	29-Jan Lines and Planes	30-Jan **Lab 1 (Lines and Planes) + Distances**	31-Jan **Practice Problems**
3-Feb 12.1-12.2(Functions of several variables)	5-Feb 12.3, 12.5 (Contour Plots) + **Conic Sections and Quadric Surfaces**	6-Feb **Quiz 1**	7-Feb **Lab 2 (3D Graphing and Contour Plots, Linear Functions)**
10-Feb 17.1 (Parametrized Curves - Straight line, Circle, Helixes)	12-Feb 17.2 (Motion, Velocity, Speed and Distance, Cycloid)	13-Feb **Lab 3 (Parametric Plotting)**	14-Feb **Epicycloid and the Rotary Engine**
17-Feb **Practice Problems**	19-Feb **Review**	20-Feb **Midterm 1**	21-Feb Polar Coordinate System and Some Interesting Parametric Curves
24-Feb 14.1-14.2 (Partial Derivatives)	26-Feb 14.3 (Tangent Plane and Local Linearity)	27-Feb **Practice Problems**	28-Feb 14.4 (Gradients and Directional Derivatives)
2-Mar 14.5 (Three dimensional Gradient and Tangent Plane)	4-Mar **Practice Problems**	5-Mar **Lab 4 (Gradient Vector, Tangent Plane, and Directional Derivative)**	6-Mar 14.6 (Chain Rule)
Mar 7 - Mar 22			
Spring Break			
23-Mar **Practice Problems**	25-Mar **Quiz 2**	26-Mar 15.1 (Local Optimization)	27-Mar **Taylor Approximation and Second Derivative Test**
30-Mar 15.3 (Constrained Optimization) + **Rocket Science**	1-Apr 15.2 (Global Optimization)	2-Apr **Lab 5 (Linear Regression - Ordinary Least Square vs Gradient Descent)**	3-Apr 16.1-16.2 (Definite Integral of Functions of Two Variables)
6-Apr 16.2-16.3 (Type I/II regions, Triple Integrals)	8-Apr 16.4 (Double Integral in Polar Coordinates) + **Normal Probability Distribution**	9-Apr **Lab 6 (Volume Integration)**	10-Apr Polar Volume Integration (Cylindrical Coordinates)
13-Apr **Practice Problems**	15-Apr **Review**	16-Apr **Midterm 2**	17-Apr 17.3 (Vector Fields)
20-Apr 17.4 (Flow of a Vector Field)	22-Apr 18.1-18.2 (Line Intergrals on Parameterized Curves)	23-Apr **Practice Problems**	24-Apr 18.3 (Gradient Fields - Path-Independent)
1-Apr 18.4 (Path-dependent fields, Circulation, Curl)	29-Apr 18.4 (Path-Dependent Fields and Green's Theorem)	30-Apr **Practice Problems**	1-May Applications and Generalizations of Green's Theorem
4-May **Practice Problems**	6-May **Review**	**Reading Period**	**Reading Period**