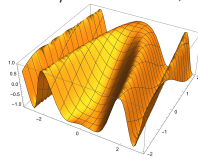# Mathematics 2202: Multivariable Calculus
Fall 2021

Sections 03/ 04

MWF 11-11:50/ 12-12:50, Gasson 202

Dubi Kelmer (Instructor)	Zachary Gardner (TA)
dubi.kelmer@bc.edu	gardneza@bc.edu
Maloney 526, Office Hours MWTh 10-11 (or by appointment)	Office hours TBD

What is Multivariable Calculus?

Welcome to Math 2202!

We do not live in Flatland. Everyday life happens in three dimensions (four, if we consider time) and most of the phenomena we try to understand and predict depend on multiple variables and dimensions.

For example, a physical scientist may want to model the motion of an object through space, or an economist may want to predict the demand for a certain good based on its price and the price of a competitors' good. A chemist might want to model the direction of greatest heat loss at each point on a thin film. A data scientist teaching a machine to distinguish real email from junk mail may search for a plane in n-space that 'best' separates these two sets of points, junk and real.

These questions involve functions beyond the single variable ones we're used to working with, $f : \mathbb{R} \to \mathbb{R}$. For example, the physical scientist is working with a function $f : \mathbb{R} \to \mathbb{R}^3$, the chemist a function $f : \mathbb{R}^2 \to \mathbb{R}^2$, the economist a function $f : \mathbb{R}^2 \to \mathbb{R}$.

So what are we to do? Mathematicians seek ways to generalize concepts and methods to new arenas. That is what we will do in this course - extend fundamental ideas of geometry and calculus of one-variable functions (equations, graphs, limits, derivatives, integrals) to higher dimensions. As we do, we will develop a deeper sense of how to think mathematically: pushing boundaries, exploring and classifying objects, sense-making and justifying, and simplifying situations with creative and reasoned choices. Along the way, we'll see examples of the problems in multiple fields that we might approach with multivariable calculus.

Goals and Topics for the Course

Specific topics include the following, though others may be covered too:

- **Vectors and geometry in two and three dimensions** Chapter 9.1-9.6, 10.1-10.2

- **Differentiation of functions with multiple variables** Chapter 11.1-11.6

- **Finding extreme values of functions with multiple variables** Chapter 11.7, 11.8

- **Integration of functions with multiple variables and its applications** Chapter 12.1-12.7

- **Vector fields, line integrals, Green's Theorem** Chapter 13.1-13.3

Throughout this course, you will work to

- **Problem Solve** Become proficient and flexible in the conceptual and computational aspects of problem-solving (how to think about/set up a problem, how to solve, how to interpret the answer)

- **Communicate** Be able to explain the reasoning and concepts behind the computational tools and theorems you use, using pictures and words

- **Make Connections** Appreciate and articulate the connections to single variable calculus, the new issues that arise in multiple dimensions, and the variety of problems in different disciplines that multivariable calculus is used to solve

- **Be Curious** Ask questions about mathematics

Prerequisites

The primary prerequisites are

- a **willingness to work hard** and **participate pro-actively** in your own learning

- a **solid background in single-variable calculus**, namely the concepts, computations and applications of limits, derivatives, and integrals (see me if you have concerns)

Textbook and Technology

- Text: **Multivariable Calculus: Concepts and Contexts, 4E**, Stewart, James; ISBN-13: 978-0495560548

  (**Note:** The text is in the Bookstore, either used copies or bundled with a study guide. You can also find the text alone online. **The study guide is NOT required.** We won't explicitly reference the study guide in the course.

- Course Website: The Canvas site `https://bostoncollege.instructure.com/courses/1571178`

- No specific calculator is necessary for the course. However, for homework and section, we will use the computing software Mathematica, available at `https://www.bc.edu/software/applications/research/mathematica.html`. You should download this as soon as possible.

Expectations and Policies

Class Participation

Classes are MWF (11-11:50 for section 03 and 12-12:50 for section 04). TA sections are on Thursday, and time depends on registration. **Attendance and active participation is key! Students taking the course remotely should still participate online via zoom**

Weekly Section

Section, which takes place each Thursday, is **a chance for you to strengthen and deepen your learning of the material with the support of peers and the TA.**

Sections will generally begin with **a short quiz on material from the previous week, graded on completion only**. You must be **on time** to receive credit for the quiz. After briefly going over the quiz, the rest of time will be spent working on harder problems in small groups and as a section and asking further questions. Section is **NOT** a place to ask about homework - there are other resources for this - see below.

Homework and Assignments

I hear, I forget.
I see, I remember.
I do, I understand.

<div align="center">Confucius</div>

- **What, Why, When and Where** As the proverb above suggests, doing the required homework is one of the most important ways you can make the material your own. Homework will be assigned most classes and submitted online weekly, generally on Friday. The majority of homework is graded on correctness, including explanations. The other problems will be graded on completeness. Homework assignments can be found on the Canvas course website and will not be announced in class.

- **Collaboration on Homework** You are encouraged to discuss the problems with other students, the teaching assistant and myself, **but you should always write your homework solutions out yourself in your own words.** If you do collaborate, please make note of your collaborators on your homework paper in the upper right hand corner, under your name.

  Homework that is copied from classmates or other sources or otherwise not your own will be considered a violation of academic integrity.

- **Format** Please be reasonably neat and legible. If it is unreadable, no credit. Use standard size paper and an application of your choice to scan your work into a PDF.

- **Late homework is not accepted** out of fairness to the other students and the grader. If you cannot complete or turn in a problem set due to documented illness or other personal circumstance, let me know immediately. Appropriate documentation means a note from a doctor, University Health/Counseling Services or dean.

Quizzes

In addition to HW there will be several quizzes Posted on Canvas composed of a few short multiple choice questions. The goal of the quizzes is to make sure you review the material of the lecture and be ready for the next one.

Exams

The three exams and final exam for this course are a chance for you to **take stock** of what you've learned so far and to **show what you know**. We will generally review for exams during the class before. The exam schedule is here.

Exam I	Friday, 9/24
Exam II	Friday, 10/22
Exam III	Friday 11/19
Final Exam	see exam schedule

There will be no makeup examinations. If you have a serious reason for missing an in-class exam, then you must let me know prior to the examination time. Note: Non-BC sponsored travel is not such a reason. **The final exam is scheduled by the College and may not be changed.** If you are enrolled in MATH 2202 then you must go to the final exam at the time corresponding to your section, no exceptions. (Questions on this go through the Dean's office.)

Grading

The grading breakdown is as follows. Homework 20%, Quizzes 15%, Midterms 30%, Final Exam 35%.

Getting Help in the Courses

You are strongly encouraged to make use of resources of this course and the math department. Talking about math with others is one of the best ways to strengthen your learning and have fun in the process!

- Make use of Office Hours, both mine and those of the TA!

- Your Peers: Find a group of people to work with together (safely). Just be sure to submit your own work always!

- The Academic Development Center, in O'Neill Library, offers tutoring most afternoons and evenings.

- The Connors Family Learning Center provides peer tutoring for all Boston College Students.

Academic Integrity

As the College's policy on academic integrity states, "Presentation of others' work as one's own is not only intellectual dishonesty, but it also undermines the educational process." Don't do it. If you are unsure of something concerning academic integrity, please talk to me. If you feel like you are struggling in the course, come get help.

Cheating on assignments or exams will result in no credit for that assignment or exam. It may also be reported to your Class Dean and reviewed by the Academic Integrity Committee to determine further penalties that can include failure in the course or more severe sanctions, depending on the seriousness and circumstances of the violation.

Disabilities Requiring Accommodation

If you are a student with a documented disability seeking reasonable accommodations in this course, please contact Kathy Duggan, (617) 552-8093, dugganka@bc.edu, at the Connors Family Learning Center regarding learning disabilities and ADHD, or Paulette Durrett, (617) 552-3470, paulette.durrett@bc.edu, in the Disability Services Office regarding all other types of disabilities, including temporary disabilities. Advance notice and appropriate documentation are required for accommodations.

Welcome again to Math 2202!