MATH 1310-500: CALCULUS I FALL 2018

1. Course basics

Instructor: Bogdan Krstić
Office: Kerchof 121
Office hours: We 3:30-4:30, Th 4-6, and by appointment (at least a day ahead of time). Further office hours available in Kerchof 121 as outlined in Section 11 below.
Email: bk2fh@virginia.edu
Course website: Available on UVaCollab

Classroom: New Cabell Hall 368
Meeting time: TuTh 12:30-1:45 PM, Fr 10-10:50 AM
LA: Tal Dunne
CRN: 10404
Credits: 4

2. Prerequisites

A background in algebra, trigonometry, exponential and logarithmic functions, and analytic geometry.

3. Course description

Math 1310 is an introductory calculus course for natural-science majors, students planning further work in mathematics, and students intending to pursue graduate work in applied social sciences (but it is open to all students). Calculus might be defined as a mathematical toolkit for analyzing functions. In virtually every area of human endeavor, functions are or can be used to further understanding and to assist in making predictions. Calculus provides two fundamental tools for analyzing functions: the derivative, which represents the rate of change of a function, and the definite integral, which can be used to compute the net change of a function over an interval. Derivatives and definite integrals are defined using the notion of "limit," which is another tool of calculus. This course introduces you to the tools of calculus and their applications.

4. Course design

All sections of Math 1310 are based on active- and cooperative-learning strategies designed to further develop your problem-solving skills applicable in any situation.

During our Tuesday and Thursday class meetings, at least 70% of the time you will be engaged in groupwork with your classmates; the rest of the time will be devoted to mini-lectures (by me), problem-solution discussions (led by students), and whole-class discussions of concepts, techniques and problem-solving principles. During our final class meetings on Fridays, we will review topics from the first two class meetings of the week and typically have a quiz on those topics. For our Tuesday and Thursday class meetings, you'll be expected to familiarize yourself — through online class-prep assignments (accompanied by a video) — with the basic notions and ideas that will play a role in class.

The design of this course is based on research showing:

Students learn best when they take an active role —

- *When they discuss what they are reading*
- *When they practice what they are learning*
- *When they apply practices and ideas.*[1]

Our assessments of the effectiveness of the format of Math 1310 are consistent with the preceding. For example, students in active-learning sections of Math 1310 in Fall 2017, on average, achieved normalized gains on the "Calculus Concept Inventory" 11% higher than those of students in traditionally taught sections and scored between 5.9% and 38.2% higher on multiple choice assessment problems on the common Math 1310 final exam.

[1] From *Tools of Teaching* by B.G. Davis, Jossey-Brass, San Francisco 1993.

5. Course objectives

Upon successful completion of this course, you will

- understand, be able to describe, and be able to apply the fundamental tools that calculus provides for analyzing functions: derivatives, which represent rates of change, and definite integrals, which can be used to compute net change;
- have further developed your problem-solving skills and strategies, including
  - always introducing variables for quantities in your problem that are initially unknown to you,
  - generating different representations of objects in your problem (including pictorial ones when possible),
  - systematically assessing whether tools you have learned, both computational and theoretical, may be applied to solve your problem or provide useful insights,
  - testing special cases, or considering a simpler version of your problem (or a number cases or simpler versions until a pattern emerges),
  - relating your problem to similar ones you've solved before,
  - seeking to understand every aspect of your problem from the most elementary perspective possible,
  - checking answers for plausibility;
- be able to use the tools of calculus to build and analyze mathematical models for real-word systems;
- have the ability to accurately express mathematical ideas;
- have improved your technical reading and writing skills, as well as developed confidence and competence in communicating technical information orally;
- be able to assess the quality of competing solutions to problems based on criteria such as clarity, efficiency, and elegance.

6. Placement

Is this the right calculus class for you? Read the Mathematics Department's Placement Information.

7. Course text

The course text is *Single Variable Calculus: Early Transcendentals*, 7th edition, by James Stewart (Publisher: Brooks/Cole Cengage Learning). The course will cover nearly all the material in Chapters 1–5 as well as a few sections from Chapter 6.

An electronic edition of the text is provided through the online homework system WebAssign, to which you must purchase access. Acquisition of a physical copy of the text is optional. You have a number of different purchase options:

(1) purchase WebAssign single-term access online through the WebAssign website,
(2) purchase a single-term WebAssign-access card at the UVA Bookstore,
(3) purchase a physical copy of the text, bundled with a multi-term WebAssign-access card, at the UVA Bookstore, or
(4) purchase WebAssign via (1) or (2) and, if you want a hard-copy of the text, buy a used copy.
(5) purchase Cengage Unlimited

There is a two week grace period at the beginning of the term during which you have free WebAssign access to the text as well as course homework sets. Go to webassign.net/uva/login.html and enter our class key: **virginia 6339 5850**.

8. Assessments

8.1. **Homework.** You wil be completing both on-line homework and written homework. Online homework will be delivered through WebAssign (webassign.net/uva/login.html). Some online homework —"class-prep" assignments — will include videos Math 1310 instructors have created, which you will view from within WebAssign. The submission deadline for class-prep assignments will be thirty minutes before our class meeting time.

Because the WebAssign system will evaluate only your final answers, it is important that you have opportunities (other than on quizzes and exams) to have your work evaluated as well your final answers. Thus, roughly every other week, I will collect written homework. Problem sets will be posted on Collab and some of the problems appearing in these sets will be drawn from old common exams for Math 1310. I strongly encourage you to work in groups (of up to four students) on written homework assignments. Research shows that students learn more and learn more deeply when they discuss their problem-solving ideas with other students (as well as evaluate other students' problems-solving ideas). *If you choose to work in a group, you still must write up your own final solutions; moreover, in the top margin of the first page of your submission, you must record and sign the following statement, "I worked on this assignment in a group with [name the other members of your group — up to 3]. We wrote-up our own final solutions, and we checked each other's solutions for correctness."*

If you contact me at least 24 hours (exceptional circumstances aside) before a WebAssign assignment is due, you may obtain an extension without any penalty. You may also obtain automatic extensions via WebAssign on your homework if the above 24 hour deadline has passed; you will receive a 25% penalty on problems you have not completed before the usual homework deadline, and you will have 48 hours after the time the assignment is due to obtain such an extension. Prior arrangements aside, late written homework will not be accepted.

8.2. **Quizzes.** Quizzes will be given during Thursday class-meetings (except the first one). They will consist of two to three problems that will help you to assess whether you learned the basic concepts and problem-solving techniques treated earlier in the week. One problem on each quiz will be an in-class groupwork problem considered earlier in the week. If you are not satisfied with your performance on a given quiz, you may choose to submit for evaluation a "quiz-augmentation set" consisting of three problems that you will complete as written homework problems, submitting them at the beginning of the next class meeting. Quiz-augmentation problems count as if they were quiz problems and can have a big impact on your quiz score. For instance, suppose a quiz consisted of two problems and your score, based on those two problems, is 5/10. If you submit the associated quiz augmentation set, answering correctly all three of its problems, your final grade (out of 10) on the quiz would be $(2/5)(5) + (3/5)(10) = 8$. Quiz augmentation work can only boost a quiz score; in other words, if an augmented-quiz score is lower than your original quiz score, then the original score will stand. In computing your final quiz average, your lowest quiz score will be dropped.

8.3. **In-class work.** At the beginning our Tuesday and Thursday class meetings, I will describe the learning goals you should have for the class; then I will distribute a classwork assignment designed to help you reach these goals. You will be completing classwork assignments collaboratively, in a small group of fellow students. Each classwork assignment begins with a multiple-select problem with four possible choices, at least one of which is correct. Each group member considers (at least) one of the choices for correctness. After a minute or two of individual thought, group members make a case for selecting or not selecting the choices they have analyzed. The group collaboratively decides which choices are correct and each member records the group's "final decision" on their own classwork assignment. The following course policies reward students for fully engaging in classwork activities:

- One problem on each quiz will be an in-class groupwork problem.
- I will occasionally collect classwork assignments. Assuming all group members have been actively collaborating, one member's assignment will be chosen for collection by a random process. Problems will be graded as follows:
  - If a problem has been presented/discussed by the class as a whole, then the problem will be graded for correctness — both the answer and the work.[2]
  - Multiple-select problems will always be discussed in class. If your group has the correct answer to the multiple-select problem, put a big checkmark by the answer (honor system!) and your group will get a bonus point on the collected assignment.
  - If a problem has not been discussed by the class as a whole, then you may earn credit for the problem even if you haven't obtained a correct solution — your work must show you have explored a least one potential path to a solution (e.g. on an abstract problem, you've worked through a concrete example shedding light on the problem; or, on a difficult concrete problem, you've considered a simpler version of the problem).

  Points earned on collected classwork assignments are counted as points earned on the next course exam. See the section "Exam-Credit Points" below.

8.4. **Piazza.** As you read the text, view instructor-produced videos, and complete online homework assignments, it's likely that questions will occur to you. Those that occur to you will likely also occur to other students You should raise these questions at our class's Piazza Q & A site, accessed through Collab. (The name *Piazza* comes from the Italian word for plaza—a common city square where people can come together to share knowledge and ideas.) Your Piazza activity can lead to up to five exam-credit points on the next course exam (see the Exam-Credit-Points section).

Piazza is intended for discussions of questions relating to

- online homework (including class-prep assignments),
- problems appearing on practice exams, and
- general questions about course concepts.

Piazza is not the right forum for questions about specific written homework problems or about problems on a course exam you recently completed.

[2]thus, if a discussion of a classwork problem reveals errors or incompleteness in the work you have recorded, you should correct your work. which might mean inserting a needed step or erasing and replacing a portion of your work; or perhaps, even scratching out incorrect work and squeezing in correct work.

8.5. **Reflections.** During the first two class meetings of each week, you will be exploring new course topics through collaborative problem solving with your classmates. During the final class meeting of the week, we'll be revisiting topics, concepts, and problem-solving techniques that students believe require further discussion. Students will identify what course material needs to be revisited through weekly submissions of course-related reflections. Responses to the following prompts are to be submitted through Collab after the 2nd class meeting of the week and at least one hour before the final class meeting of the week:

- What is the most important thing you learned so far this week?
- What topics/concepts/techniques, if any, would you like to revisit during our final class meeting this week?
- Identify specific classwork problems on this week's assignments (if any) that you found especially challenging and would like to discuss further.
- What is going well — what aspects of the class are facilitating your learning? What is not going well? If you have any suggestions that you believe would improve the course, feel free to share them.

For each thoughtful reflection-statement you submit, you will earn one exam-credit point.

8.6. **Exams.** Recall that one objective of the course is improvement of your problem-solving skills. To motivate you to develop these skills as well as to give you an opportunity to show you understand how to choose and apply appropriate calculus tools in your problem solving, exams will include some problems that are somewhat different from those you have solved before (but for which you have learned tools and strategies that will produce solutions).

There will be two evening midterm exams given during the semester. The exams are common to all sections of Math 1310. The dates of these exams are as follows:

- **Midterm Exam 1:** Thursday, October 4th, 7-8:30 PM[3]
- **Midterm Exam 2:** Thursday, November 15th, 7-8:30 pPM

For those students who have a time conflict with another course, a make-up exam will be given the following morning beginning at 7:20 AM. If you have a direct conflict with either of the above listed exam times, please notify me as soon as possible AND at least one week before the exam date. If proper notice cannot be given, then a request for the make-up exam will be honored only in cases of extreme emergencies and at my discretion. Midterm and final exams will be graded in common, with all Math 1310 instructors participating.

The **final exam** will be held during the time specified by the university, which this semester is Monday, Dec. 17th, 7:00-10:00 PM. It is University policy that finals may not be taken early. The final exam is comprehensive.

8.7. **Exam credit points.** As noted above, you can earn exam-credit points (on the next course exam) for

- collected classwork assignments (up to eight points per assignment, plus possible bonus point for multiple-select problem),
- Piazza activity (five points), and
- for thoughtful Reflection statements (two per submission).

Regarding Piazza points: you will earn a five-point Piazza credit on the next course exam for five "helpful posts," where a *helpful post* is defined to be "a good question" or "a thoughtful response to another post."

Exam-credit points are added to the numerator and denominator of your exam score. Example: If your raw score on Exam 1 is 75/100, but you have 37 exam-credit points, then your final score on Exam 1 would be $112/137 \approx 82$.

9. Course grade

The course grade will be determined as follows:

Written homework	10 points
Online homework	10 points
Quizzes	10 points
Midterm 1	20 points
Midterm 2	20 points
Final exam	30 points
Total	100 points

The grading scale for the course is:

[3] *Fall reading days begin two days later (Saturday the 6th)* : **No student may take any exam early and no student will be allowed to postpone Exam 1 until after reading days because they've already made travel arrangements.**

Grade	Percentage
A+	[98,100]
A	[93, 98)
A-	[90, 93)
B+	[87, 90)
B	[83, 87)
B-	[80, 83)
C+	[77, 80)
C	[73, 77)
C-	[70, 73)
D	[60, 70)
F	[0, 60)

In borderline cases, your letter grade may be higher — the one assigned to the interval immediately above the one your point total lies in.

10. Calculus concept inventory

This fall, as part of an ongoing evaluation of the effectiveness of its Calculus I course (Math 1310), the Mathematics Department will be administering a two-part test: the Calculus Concept Inventory (CCI). Every student enrolled in Math 1310 this term is expected to complete both parts of the test as well as two attitude surveys.

You may complete Part 1 of the test the evening of August 28th, 29th, or 30th. Choose the evening most convenient for you and report to Wilson Hall, Room 402 between 7 and 8:30 PM. Completing the test and attitude survey should require no more than one hour. Part 2 of the test will be offered during the final week of classes, December 4th, 5th, and 6th.

Calculators may not be used during CCI testing. The only thing you need to bring with you to a testing session is a pencil.

Failing to complete either part of the test will negatively impact your course average, perhaps resulting in your receiving a lower final grade. Specifically:

- If you fail to take Part 1 of the test (and complete the attitude survey), you will be assigned a score of 0 on the first quiz of the term and lose 2 points on the first common exam of the term.
- Your work on Part 2 of the CCI and associated attitude survey will account for 5 of the 100 points on the Math 1310 common final exam as follows—you will receive 1 point for taking Part 2, 1 point for completing the associated attitude survey, and may earn up to 3 performance-based points.

11. Office hours

In addition to my office hours (Wednesdays 3:30-4:30, Thursdays 4-6), you are also welcome to come to the office hours of 1310 instructors Mark Shrecengost on Fridays, 12-1 or Andrew Kobin on Mondays, 10-11; their office is also Kerchof 121.

12. Policies

12.1. **Attendance and classroom etiquette.** Regular attendance is expected as is full engagement in classwork activities. Please arrive on time, turn off your cell phone, and stay for the entire class period. You may not use any electronic device during class. (One exception: if you are using a laptop to run *WolframAlpha* or another mathematics utility.) Studies suggest that student multi-tasking during class through use of smart phones and laptops hinders classroom learning for both users and *nearby peers*.

During the Tuesday and Thursday class meetings of this course at least 70% of the time you will be engaged in groupwork with your classmates. Here are a few comments concerning the format of Math 1310 classes that students have provided on course evaluations:

- I was intrigued about doing pretty much all group work. It works and creates bonding.
- This course was great. I liked the group work aspect of the course instead of merely lecturing.
- Though challenging, I enjoyed this course thoroughly and felt the atmosphere of the class was friendly.

You are expected to contribute to making the atmosphere in this class "friendly". Freely share your ideas with members of your group and be encouraging and supportive as they are sharing theirs. Making unsuccessful attempts at solving problems is a natural part of the problem-solving process and ideas applied in unsuccessful work can often contribute to the discovery of a solution. Thus, when a "solution" presented within your group or to the class of as whole turns out to be flawed, it's a learning experience for everyone that should be valued not belittled.

12.2. **Learning needs.** UVA is committed to creating a learning environment that meets the needs of its diverse student body. If you anticipate or experience any barriers to learning in this course, please feel welcome to discuss your concerns with me. If you have a disability, or think you may have a disability, you may also contact the Student Disability Access Center (SDAC), to request an official accommodation. You can find more information about SDAC, including how to apply online, through their website at https://studenthealth.virginia.edu/sdac. If you have already been approved for accommodations through SDAC, please make sure to send me your accommodation letter and meet with me so we can develop an implementation plan. Accommodations for test-taking (e.g., extended time) should be arranged at least 5 business days before an exam.

12.3. **Calculators.** Calculators will not be allowed on the quizzes, midterms, or finals.

12.4. **Exam grading concerns.** After receiving a graded exam, you have 1 week (7 days) to raise concerns about grading errors.

12.5. **Honor Code.** The Honor Code will be strictly observed in this class.[4]

13. Tips for success

- Use class time wisely: fully engage yourself in class activities, asking and answering questions when appropriate.
- Seek understanding rather than trying to rely on memorized formulas.
- Take advantage of your instructor's and TA's office hours as well as the Mathematics Tutoring Center.

14. Course content

Topics to be covered in Math 1310:

(1) Functions and models. Just-in-time review, during first weeks of course, of the following: Four Ways to Represent a Function. Mathematical Models: A Catalog of Essential Functions. New Functions from Old Functions. Exponential Functions. Inverse Functions and Logarithms.
(2) Limits and derivatives. The Tangent and Velocity Problems. The Limit of a Function. Calculating Limits Using the Limit Laws. The Precise Definition of a Limit. Continuity. Limits at Infinity; Horizontal Asymptotes. Derivatives and Rates of Change. The Derivative as a Function.
(3) Differentiation rules. Derivatives of Polynomials and Exponential Functions. The Product and Quotient Rules. Derivatives of Trigonometric Functions. The Chain Rule. Implicit Differentiation. Derivatives of Logarithmic Functions. Rates of Change in the Natural and Social Sciences. Related Rates. Linear Approximations and Differentials.
(4) Applications of differentiation. Maximum and Minimum Values. The Mean Value Theorem. How Derivatives Affect the Shape of a Graph. Indeterminate Forms and l?Hospital?s Rule. Summary of Curve Sketching. Optimization Problems. Antiderivatives.
(5) Integrals. Areas and Distances. The Definite Integral. The Fundamental Theorem of Calculus. Indefinite Integrals and the Net Change Theorem. The Substitution Rule.
(6) Applications of integration. Areas Between Curves. Volume by Slicing. Average Value of a Function.

15. Important dates (College of Arts & Sciences)

- Classes start: Tuesday, August 28
- Add deadline: Tuesday, September 11
- Drop deadline: Wednesday, September 12
- Midterm 1: Thursday, October 4, 7-8:30 PM
- Withdrawal deadline: Tuesday, October 23
- Midterm 2: Thursday, November 15, 7-8:30 PM
- Last day of classes: Tuesday, December 7
- Final exam: Tuesday, December 17, 7-10 PM

[4]Recent honor violations committed by calculus students include: falsifying a doctor's note in order to postpone a scheduled exam; presenting a false excuse for postponing an exam; and, seeking to boost an exam score by correcting mistakes on a graded, returned exam and then reporting "grading errors" on the exam. Note that calculus instructors scan graded exams. Please remember to pledge each quiz and exam.