

University of New Mexico-Math 162: Calculus I

Spring 2019

Course Description

Limits. Continuity. Derivative: definition, rules, geometric interpretation and as rate-of-change, applications to graphing, linearization and optimization. Integral: definition, fundamental theorem of calculus, substitution, applications such as areas, volumes, work, averages. Meets NM-CCN 1614.

Required Materials

- *Calculus*, Stewart, 7e

Prerequisites/Corequisites

- ACT 28–31 or SAT 640-700 or Next Gen AccuPlacer AAF 284-300

Course Objectives

1. State, motivate and interpret the definitions of continuity, the derivative, and the definite integral of a function, including an illustrative figure, and apply the definition to test for continuity and differentiability. In all cases, limits are computed using correct and clear notation. Student is able to interpret the derivative as an instantaneous rate of change, and the definite integral as an averaging process.
2. Use the derivative to graph functions, approximate functions, and solve optimization problems. In all cases, the work, including all necessary algebra, is shown clearly, concisely, in a well organized fashion. Graphs are neat and well-anotated, clearly indicating limiting behavior. English sentences summarize the main results and appropriate units are used for all dimensional applications.

3. Graph, differentiate, optimize, approximate and integrate functions containing parameters, and functions defined piecewise. Differentiate and approximate functions defined implicitly.
4. Apply tools from precalculus and trigonometry correctly in multi-step problems, such as basic geometric formulas, graphs of basic functions, and algebra to solve equations and inequalities.
5. State the main theorems of calculus correctly, including all conditions, and give examples of applications. These include the Intermediate Value Theorem, the Mean Value Theorem, the Extreme Value Theorem, and the Fundamental Theorem of Calculus.
6. Solve simple first and second order differential equations, either initial or boundary value problems, including problems where the derivative is given by a piecewise function, or when the initial value problem is described in words, such as in applications from physics, biology and engineering. Be familiar with the harmonic oscillator and describe period, amplitude, phaseshift of the trigonometric functions that appear.
7. Compute integrals using the method of substitution, including changing the bounds in the case of definite integrals.

Grading Policy

You grade will be based on the following:

- **3 in-class exams** (100 points each). Exams will be based on homework and examples discussed in class. No calculators, notes, or any kind of electronic device may be used on exams. There are **NO EARLY OR MAKEUP EXAMS UNDER ANY CIRCUMSTANCES OUTSIDE OF A UNIVERSITY-EXCUSED ABSENCE OR A VERIFIABLE DOCUMENTED EMERGENCY OR ILLNESS.**
- **Written Homework** (50 points) HW is due at the beginning of class. e-mailed HW will not be accepted. Your written work should be neatly organized, showing all steps and using proper mathematical notation. Your papers must be stapled. In order to ensure that assignments are graded promptly, and to discourage students from falling behind, **LATE ASSIGNMENTS WILL NOT BE ACCEPTED UNDER ANY CIRCUMSTANCES OUTSIDE OF A UNIVERSITY-EXCUSED ABSENCE OR A VERIFIABLE DOCUMENTED EMERGENCY OR ILLNESS.** However, in recognition of the fact that unavoidable issues sometimes arise, the lowest of each student's homework grades (including zeros for unsubmitted assignments) will be dropped when calculating final semester grades. Despite this policy, you should complete every assignment, even if you miss a deadline, because understanding the homework will help you perform well on exams.
- **Recitation** (100 points) Students will receive a grade for each recitation that will be based partially on attendance, and partially on quizzes, participation, group problem-solving, or any combination of these. See the Recitation Handout for more information. There will be 12 quizzes with the lowest score dropped. There are **NO MAKEUP QUIZZES UNDER ANY CIRCUMSTANCES OUTSIDE OF A UNIVERSITY-EXCUSED ABSENCE OR A VERIFIABLE DOCUMENTED EMERGENCY OR ILLNESS.**

- **Final Exam** (200 points) The final exam will be cumulative and held on Monday, May 6th at 7:30 AM. **NO EARLY FINAL EXAMS NOR MAKE UP EXAMS WILL BE GIVEN UNDER ANY CIRCUMSTANCES OUTSIDE OF A UNIVERSITY-EXCUSED ABSENCE OR A VERIFIABLE DOCUMENTED EMERGENCY OR ILLNESS.**

Course Policies

Student Behavior

All students must abide by the Student Code of Conduct: pathfinder.unm.edu. According to the Code of Conduct, student activities that interfere with the rights of others to pursue their education or to conduct their University duties and responsibilities will lead to disciplinary action. This includes any activities that are disruptive to the class and any acts of academic dishonesty. Students are expected to behave in a courteous and respectful manner toward the instructor and their fellow students. The use of cell phones, headphones, smart watches, etc. is not permitted during class or exams.

Attendance Policy

Attendance is mandatory. If a student has four or more unexcused absences he/she may be dropped from the course. Tardiness or early departure may be regarded as an absence. After the Withdrawal deadline the instructor will not drop any student. Please note that it is the student's responsibility to drop the course if he/she stops attending. A failing grade of F may be assigned if the student stops attending and does not drop before the posted deadline. **No early final exams** will be given except in documented emergencies: flight reservations, weddings, vacations, birthdays, non-NCAA sporting events etc. are not considered emergencies.

Policies on Grading Options

You must select your grade mode (Letter Grade, CR/NC, or Audit) within the first 2 weeks of the semester. We will not give permission to change the grade mode after the deadline. Students who are in the regular grade mode and who withdraw after the end of week 3 will receive a grade of W. If you do not withdraw, you will receive a letter grade of A, B, C, D, or F (not a W). Students who are in the CR/NC grade mode and who withdraw after the end of week 3 will receive a grade of W. If you do not withdraw, you will receive a letter grade of NC (not a W). See the list of all deadlines: registrar.unm.edu.

Deadlines

The Department of Mathematics and Statistics will adhere to all of the registration deadlines published by the Office of the Registrar in the schedule of classes: registrar.unm.edu. We will not give permission to override any deadline except in documented emergencies.

Academic Integrity and Honesty

Cheating of any kind will not be tolerated. Examples are: looking at a neighbor's exam, plagiarizing, using a calculator when not permitted, using the book and/or a cheat sheet, modifying an exam after it is graded, etc. The instructor may warn an offending student, the score of the exam may be reduced, the score may be set to zero, the student may be dropped from the class, the student may get a grade of F for the class, and in most cases the incident will be reported to the Dean of Students..

Accommodations for Disabilities

We will accommodate students with documented disabilities through the Accessibility Resource Center (ARC). During the first two weeks of the semester, those students should inform the instructor of their particular needs.

Title IX

In an effort to meet obligations under Title IX, UNM faculty, Teaching Assistants, and Graduate Assistants are considered "responsible employees" by the Department of Education. This designation requires that any report of gender discrimination which includes sexual harassment, sexual misconduct and sexual violence made to a faculty member, TA, or GA must be reported to the Title IX Coordinator at the Office of Equal Opportunity, oeo.unm.edu. For more information on the university policy regarding sexual misconduct, see: <https://policy.unm.edu/university-policies/2000/2740.html>.

Schedule and Weekly Learning Goals

This schedule is tentative and subject to change. The learning goals below should be viewed as the key concepts you should grasp after each week, and also as a study guide before each exam, and at the end of the semester. Each exam will test on the material that was taught up until the review day prior to the exam. The applications in the second half of the semester tend to build on the concepts in the first half of the semester though, so it is still important to review those concepts throughout the semester.

Week 01, 01/14 - 01/18: § 1.4 Tangent Lines; § 1.5 Limits Using Graphs and Tables; § 1.6 Limit Laws

- Explain what $\lim_{x \rightarrow a} f(x) = L$ means. Illustrate with a sketch.
- Explain how left and right hand limits are related to the existence of a general limit.
- Give an example of a piecewise function $f(x)$ such that $\lim_{x \rightarrow 1} f(x) = 2$ but $\lim_{x \rightarrow 0} f(x)$ does not exist.
- Estimate $\lim_{x \rightarrow a} f(x)$ using a table.
- Use the slope of a secant line to determine the average velocity of a particle over a given interval.
- Use the limit of the secant slope to estimate the instantaneous velocity of a particle at a given time $t = a$.
- Use proper notation when applying limit laws to calculate a limit (pay particular attention to your use of equal signs). Even if your answer is correct, you will lose points for incorrect notation.
- Give an example of a limit that cannot be evaluated using direct substitution but can be computed after an algebraic simplification.
- Determine when a limit exists or does not exist, algebraically and/or graphically.

Week 02, 01/21 - 01/25: NO CLASS MONDAY; § 1.8 Continuity § 2.1 Definition of Derivative; § 2.2 Derivative as a Function; Friday is the last day to change grade mode on LoboWEB

- Be able to define continuity of $f(x)$ at $x = a$.
- Determine where a function is continuous.
- There are two ways we defined the slope of the tangent line to the graph of a function $f(x)$ at $x = a$. Be able to state both definitions and sketch a graph that illustrates how we obtain the slope of the tangent line from the slope of the secant line.
- State the two equivalent definitions of the derivative of $f(x)$ at a number $x = a$. Provide a physical example of what $f'(a)$ represents.
- Use the graph of a function $f(x)$ to sketch the graph of $f'(x)$ (or vice versa).
- Give an example of a function that is not differentiable at $x = a$. Explain why.

Week 03, 01/28 - 02/01: § 2.2 Derivative as a Function; §§ 2.3, 2.4, 6.2 Differentiation Rules; Friday is the last day to drop without a "W" grade.

- Know when and how to apply the power, sum/difference, product/quotient, and constant multiple rules.
- Know the derivatives of $\sin x$ and $\cos x$ and be able to derive the derivatives of $\sec x$, $\csc x$, $\tan x$, $\cot x$ using the quotient rule.
- Know the derivative of the exponential function.
- Be able to find the velocity and acceleration of a particle whose position at time t is modeled by any of the functions covered so far.

Week 04, 02/04 - 02/08: § 2.5 Chain Rule; § 2.6 Implicit Differentiation; Review for Exam 1

- Know when and how to apply the chain rule.
- Find the derivative of a relation using implicit differentiation and compute the line tangent to its graph at a given point.
- Give an example of a relation where computing dy/dx REQUIRES you to use implicit differentiation.
- Compute the derivative of a function of the form $f(x) = \frac{g(x)}{h(x)}$ using both the product rule AND the quotient rule.

Week 05, 02/11 - 02/15: Exam 1 (Monday); § 2.7 Rates of Change; § 2.8 Related Rates

- Interpret the derivative of a function at a point as the instantaneous rate of change in the quantity modeled and state its units.
- Set up and solve related rates problems.

Week 06, 02/18 - 02/22: § 2.9 Linearization and Differentials; § 3.1 Extrema

- Interpret the tangent line geometrically as the local linearization of a function.
- Use linearization/differentials to estimate an error that occurs because of approximation measurements in applications. For example, if the radius of a sphere is measured with a certain possible error in measurement, how will this effect the approximation of the volume of the sphere?
- Use derivatives/critical numbers to find where a function is increasing or decreasing on certain intervals.

Week 07, 02/25 - 03/01: § 3.3 Derivatives and the Shape of a Graph ; § 3.4 Infinite Limits; § 3.5 Summary of Curve Sketching

- Use derivatives to find relative extrema, points of inflection, and intervals where the graph of a function is concave up or down.
- Use the first and second derivative tests to find extrema of functions.
- State the Extreme Value Theorem and use it to find the absolute extreme values of a function on a closed interval. Be able to draw a sketch that illustrates the theorem.
- Use limits to determine the asymptotes of rational functions.
- Sketch the graphs of algebraic, trigonometric and exponential functions using all the information obtained using derivatives and limits.

Week 08, 03/04 - 03/08: § 3.5 Summary of Curve Sketching; Review for Exam 2; Exam 2 (Friday)

- Sketch the graphs of algebraic, trigonometric and exponential functions using all the information obtained using derivatives and limits.

Week 09, 03/11 - 03/15: SPRING BREAK**Week 10, 03/18 - 03/22: § 3.7 Optimization; § 3.9 Antiderivatives and Applications**

- Set up and solve optimization problems using a domain restriction appropriate in the context of the problem.
- State the definition of an antiderivative and give several examples involving algebraic, trigonometric, and exponential functions.
- Know the antiderivatives of b , x^n ($n \neq -1$), $\sin(bx)$, $\cos(bx)$, $\sec^2(bx)$, $\sec(bx)\tan(bx)$, e^{bx} where b is any real number.
- Use antiderivatives to solve initial value problems and applications (including applications modeled by piecewise functions).

Week 11, 03/25 - 03/29: § 4.1 Approximating Area; § 4.2 Definite Integrals; § 4.3 Fundamental Theorem Parts 1 and 2

- Interpret the area under a curve in context, stating the units.
- Use left/right endpoints and midpoints to estimate the area under a curve. Identify whether or not an approximation is an overestimate or underestimate.
- Estimate the distance traveled by an object using a table of position/time values.
- State the definition of the definite integral and know its basic properties.
- Approximate the value of a definite integral using left/right endpoint and midpoint approximations.
- Compute the exact value of a definite integral using a Riemann sum. For example, $\int_0^1 (x^2 + 5) dx$
- State and use the Fundamental Theorem of Calculus, Part 1 to find the derivative of a function defined as an integral. Be sure to know what conditions are required in order to apply the theorem!
- Interpret differentiation and antidifferentiation as inverse operations.
- State and use the Fundamental Theorem of Calculus, Part 2 to find the exact value of a definite integral (this includes piecewise functions). Be sure to know what conditions are required in order to apply the theorem!
- Compute indefinite integrals of functions and explain why we add a constant when computing them.

Week 12, 04/01 - 04/05: § 4.4 Indefinite Integrals and the Net Change Theorem; § 4.5 Substitution

- State and apply the Net Change Theorem in context.
- Given the velocity of a particle over a time interval, compute the displacement and distance traveled. Explain the differences in how you compute displacement and distance traveled.
- Explain how the substitution rule works. Give several examples.
- Solve definite integrals using the substitution rule. Change the limits of integration as in example 6 on page 334.

Week 13, 04/08 - 04/12: § 5.1 Area Between Curves; Review for Exam 3; Exam 3 (Friday); Friday is the last day to drop without Dean's permission.

- Sketch a region in the plane enclosed by two curves and determine the area of the region.

Week 14, 04/15 - 04/19: § 5.2 Solids of Revolution; § 5.4 Work

- Determine the volume of a solid of revolution (about a horizontal or vertical line) using the disk/washer method.
- Use a definite integral to compute the work done by a piecewise continuous variable force on a particle moving along a straight line. Be sure to interpret the units of area under the curve.

Week 15, 04/22 - 04/26: § 8.1 Arc Length; § 5.5 Average Value

- Use a definite integral to compute the length of a piecewise smooth curve.
- Use a definite integral to compute the work done by a piecewise continuous variable force on a particle moving along a straight line. Be sure to interpret the units of area under the curve.
- Use a definite integral to compute the average value of a piecewise continuous function over a closed interval.
- Derive the formulas for work and average value using a Riemann sum.

Week 16, 04/29 - 05/03: Review Week; Friday is the last day to change grade mode with form and last day to drop with Dean's permission.**Week 17, 05/06 - 05/10:** Final Exam on Monday 5/6 at 7:30am, Room TBA

Weekly Homework

This schedule is tentative and subject to change. The "Hand in" problems are to be turned in for a grade (Week 01 problems are turned in on Monday of Week 02 class, etc.). These problems are graded so that you can receive feedback regarding your understanding of concepts and use of notation. The "Self-Check" problems are odd problems in the book that test your basic knowledge of the material. It is imperative that you do **ALL** of the Self-Check problems as well. It may be tempting to skip the Self-Check Problems because they are not turned in. However, the primary goal of this course is to learn to solve problems and demonstrate that knowledge on exams, and the best way to accomplish this goal is by understanding all of the homework. The collected problems alone are not intended to give you enough practice to learn calculus, so if you ignore the Self-Check Problems, you will make the course far more difficult for yourself. The recitation quizzes, midterms, and final exam will be based on both sets of problems.

Week 01, 01/14 - 01/18: § 1.4 Tangent Lines; § 1.5 Limits Using Graphs and Tables; § 1.6 Limit Laws

- § 1.4 Self-Check: 1-9, **Hand in:** 2, 6, 7, 8
- § 1.5 Self-Check: 1-7, 11, 13, 19, 23, 33, 35, **Hand in:** 8, 10, 12, 24, 28, 44
- § 1.6: Self-Check: 1-31, 49, **Hand in:** 2, 8, 18, 22, 32, 50, 54

Week 02, 01/21 - 01/25: NO CLASS MONDAY; § 1.8 Continuity § 2.1 Definition of Derivative; § 2.2 Derivative as a Function

- § 1.8: Self-Check: 1-27, **Hand in:** 10, 12, 18, 20, 22, 42, 44, 46
- § 2.1: Self-Check: 1-17, 25, 31, 43, **Hand in:** 4, 10, 14, 18, 30, 32, 44, 48, 50
- § 2.2: Self-Check: 1-13, 19-29, 43, **Hand in:** 2, 10, 14, 22, 24, 26, 36, 51

Week 03, 01/28 - 02/01: § 2.2 Derivative as a Function; §§ 2.3, 2.4, 6.2 Differentiation Rules; Friday is the last day to drop without a "W" grade.

- § 2.3: Self-Check: 1-43, **Hand in:** 2, 6, 14, 20, 38, 44, 58, 72, 74, 94
- § 2.4: Self-Check: 1-25, **Hand in:** 2, 8, 12, 24, 34, 36, 38, 40, 51
- § 6.2: Self-Check: 3, 15, 31, 33, 47, **Hand in:** 16, 18, 28, 32, 38, 52, 101

Week 04, 02/04 - 02/08: § 2.5 Chain Rule; § 2.6 Implicit Differentiation; Review for Exam 1

- § 2.5: Self-Check: 7-51, **Hand in:** 10, 14, 24, 32, 34, 46, 60, 65, 78
- § 2.6: Self-Check: 1-21, **Hand in:** 6, 10, 12, 20, 26, 45, 55
- § 6.2: Self-Check: 31-51, **Hand in:** 42, 44, 50, 63

Week 05, 02/11 - 02/15: Exam 1 (Monday); § 2.7 Rates of Change; § 2.8 Related Rates

- § 2.7: Self-Check: 1-9, **Hand in:** 8, 16, 20, 22, 28, 34
- § 2.8: Self-Check: 1-21, **Hand in:** 8, 10, 14, 20, 27, 34

Week 06, 02/18 - 02/22: § 2.9 Linearization and Differentials; § 3.1 Extrema

- § 2.9: Self-Check: 1-23, **Hand in:** 6, 10, 14, 18, 20, 28, 32, 34, 38
- § 3.1: Self-Check: 1-35, **Hand in:** 28, 32, 38, 40, 48, 54, 55, 64, 56
- § 6.2: Self-Check: 1-21, **Hand in:** 67, 68

Week 07, 02/25 - 03/01: § 3.3 Derivatives and the Shape of a Graph; § 3.4 Infinite Limits; § 3.5 Summary of Curve Sketching

- § 3.3: Self-Check: 1-21, 27, 31, 33, **Hand in:** 18, 20, 32, 38, 40, 42
- § 3.4: Self-Check: 1-29, **Hand in:** 2, 6, 10, 14, 16, 22, 34, 62
- § 3.5: Self-Check: 1-29, **Hand in:** 12, 16, 26, 30, 43, 44
- § 6.2: Self-Check: 1-21, **Hand in:** 69, 70

Week 08, 03/04 - 03/08: § 3.5 Summary of Curve Sketching; Review for Exam 2; Exam 2 (Friday)

Week 09, 03/11 - 03/15: SPRING BREAK

Week 10, 03/18 - 03/22: § 3.7 Optimization; § 3.9 Antiderivatives and Applications

- § 3.7: Self-Check: 1-11, **Hand in:** 10, 12, 16, 20, 21, 22, 48
- § 3.9: Self-Check: 1-39, **Hand in:** 24, 36, 42, 54, 58, 66, 70* (challenge problem!)

Week 11, 03/25 - 03/29: § 4.1 Approximating Area; § 4.2 Definite Integrals; § 4.3 Fundamental Theorem Parts 1 and 2

- § 4.1: Self-Check: 1-7, **Hand in:** 4, 14, 16
- § 4.2: Self-Check: 1-11, **Hand in:** 2, 10, 20, 22, 34, 42, 48, 50, 52
- § 4.3: Self-Check: 1-11, **Hand in:** 2, 10, 12, 18, 52, 54
- § 4.3: Self-Check: 19-37, **Hand in:** 24, 26, 30, 32, 38, 40

Week 12, 04/01 - 04/05: § 4.4 Indefinite Integrals and the Net Change Theorem; § 4.5 Substitution

- § 4.4: Self-Check: 1-27, **Hand in:** 6, 14, 16, 24, 34, 50, 52, 56
- § 4.5: Self-Check: 1-21, 35, 37, **Hand in:** 4, 8, 14, 16, 18, 26, 38, 42, 50, 58, 68, 70, 72, 82

Week 13, 04/08 - 04/12: § 5.1 Area Between Curves; Review for Exam 3; Exam 3 (Friday); Friday is the last day to drop without Dean's permission.

- § 5.1: Self-Check: 1-13, **Hand in:** 10, 15, 16, 24, 26, 32, 44, 56

Week 14, 04/15 - 04/19: § 5.2 Solids of Revolution; § 5.4 Work

- § 5.2: Self-Check: 1-7, **Hand in:** 4, 10, 12, 14, 16, 20, 48, 49
- § 5.4: Self-Check: 1-5, **Hand in:** 4, 6, 10, 12, 19, 20

Week 15, 04/22 - 04/26: § 8.1 Arc Length; § 5.5 Average Value

- § 8.1: Self-Check: 1-9, **Hand in:** 7, 8, 9, 10, 11
- § 5.5: Self-Check: 1-11, **Hand in:** 6, 8, 14, 18