Calculus—Math 251, 2022 Fall

Instructor: Weiyong He

- office: University Hall 211M, 541-3464720.
- email: whe#uoregon.edu (replace # by @ when you really email me)
- office hours: Tuesday, Wed: 9:00 am–10:00 am or by appointment.

Lecture: **MTWF** 1:00pm - 1:50pm at Straub 251.
Textbook: *OpenSTAX Calculus, Volume I*, an electronic version is free at
https://openstax.org/details/books/calculus-volume-1

Prerequisite: Math 112, or satisfactory placement exam score..
Grading: total 100%, based on

- Homework: 25%. Homework is probably the most important activity in the course in terms of helping you internalize the material. Homework will be assigned through WEBWORK. The best way to do the WEBWORK homework is to print out the homework, do the problems, and then enter the numeric and symbolic answers. Each student's problems will be similar but individualized. So the same technique will work to solve your homework as your friend's but the answers will be different. You are encouraged to work together on homework, as long as you understand it.
- Midterm: 45%. There will be two in-class midterm on Tuesday Week 5 (Oct 25th) and Friday Week 8 (Nov 18th).
- Final: 30%. 14:45 Tuesday, December 6, Straub 251.
- Bring your UO student ID to all your exams. You can bring a simple calculator to the exams. You are also allowed to use an 3×5 inch note card for exams. No Wifi device is allowed in any exam.
- We have no make-up exams for midterm. If you miss one midterm exam for example, the 20% grade will be distributed to homework 25%, midterm 35% and final 40%.
- Your course grade will be assigned based on total score of homework and exams. Letter grades will be assigned according to the Math Department's Undergraduate Grading Standards, which can be found here:
  Math department: letter grading standards
- Incomplete can only be given when two criteria are **BOTH** satisfied: first, a student must have a passing grade at the time the Incomplete is assigned; secondly, some work could not be completed due to extenuating circumstances (illness, accident, etc.). Under no circumstances should an Incomplete be given as a substitute for a W, D or F/N.

Workload: There will be homework due every week, as well as reading and class attendance. An average well-prepared student should expect to spend about 12 hours per week on this course (including time in class), but there will be a lot of variation depending on background and ability.

Broad Course Learning Goals:

The students in Math 251 are mostly science majors of some kind. They need to understand how to model problems that can be solved with calculus and then use calculus to solve those problems.

A successful student in this course should be able to model and solve a wide class of optimization problems that are accessible to differential calculus. Much of the other material covered in this course is necessary for that objective. So subgoals include:

(1) Learning how to differentiate - this is necessary if you wish to use calculus to solve optimization problems.

(2) Learning how to sketch graphs of functions - this is necessary to help identify where to search for local/global extrema when trying to optimize.

(3) Understanding some basic facts about limits — this is needed for two reasons: to incorporate an understanding of the geometric interpretation of the derivative as the slope of the tangent line of a graph. It is not important for students to understand the definition of limits.

(4) Students should be able to solve related rates problems. These are less central than optimization, but can be introduced early as a source for problems that require students to practice modeling.

(5) Students should be able to find the linear approximation to a function at a specific value of the variable, graph the linear approximation and the function on the same pair of axes, and use the linear approximation to find approximations to values of the function near the point at which the approximation is taken.

More Detailed Learning Goals:

(1) Evaluate limits using the algebraic limit laws

(2)Identify limits of rational functions at infinity

(3) Identify limits of rational functions involving cancellation of linear factors from numerator and denominator

(4) Compute left and right limits for a function (or decide they do not exist), given an expression for the function.

(5) Identify the points where common functions are continuous and/or differentiable, and the same for functions given graphically.

(6) Identify limits, as well as left and right limits, for functions given graphically.

(7) State and use the product rule, quotient rule, chain rule, and linearity rules for derivatives.

(8) State the definition of the derivative in terms of a limit of difference quotients.

(9) Interpret, including units, the derivative as an instantaneous rate of change of a quantity defined in an applied context.

(10) Recognize the derivative as the slope of the tangent line.

(11) Use calculus to approximate the value of a function near a point p, given information about the function and/or its derivatives at p.

(12) Compute derivatives of functions involving polynomials, exponentials, logarithms, and trig functions, using a combination of theorems, differentiation rules, and definitions.

(13) Find the equation for the tangent line of a curve at a given point.

(14) Calculate derivatives via implicit differentiation

(15) Use the methods of calculus to

find asymptotes, local minima/maxima, intervals of concavity, intervals where the function is increasing/decreasing, and inflection points. Relate these properties to the graph of the function.

(16) Find extrema of a function on open and closed intervals.

(17) Solve optimization problems, including word problems.

(18) Solve related rates problems, including word problems.

(19) Use LH́opital's rule to evaluate indeterminate forms of limits, including cases requiring multiple applications.

(20) Use the Intermediate Value Theorem to prove that roots of a function exist in a given closed interval.

(21) State the Mean Value Theorem.

Learning Environment: The University of Oregon strives for inclusive learning environments. Please notify me if the instruction or design of this course results in disability-related barriers to your participation. You are also encouraged to contact the Accessible Education Center in 360 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu.

Academic conduct: The code of student conduct and community standards is at conduct.uoregon.edu. In this course, it is appropriate to help each other on homework as long as the work you are submitting is your own and you understand it. It is not appropriate to help each other on exams, to look at other students' exams, or to bring unauthorized material to exams.

Expected Classroom Behavior: Students are expected to behave respectfully towards each other and toward the instructor during class time. This includes refraining from using cellphones during lecture.

Attendance policy: Attendance is not required, except for the exams.

Tentative Schedule:

Week 1 2.1-2.4 Limits
Week 2 3.1-3.3 Introduction to derivatives, power rule, exponential rule
Week 3 3.4, 4.7, 3.3 Linear Approximation, Optimization, Product Rule
Week 4 3.3, 3.5, 4.7 Higher derivatives, trig derivatives, more optimization
Week 5 3.6, 3.8, 3.7 Chain rule, implicit differentiation, inverse functions
Week 6 4.7, 4.1 More optimization, related rates
Week 7 4.3, 4.5, 4.6 Maxima/minima, shapes of graphs, limits at infinity
Week 8 4.6, 4.8, 4.4 More limits at infinity, LH́opital's Rule, MVT and IVT
Week 9 4.8, 4.10, 6.8 Rates of growth, Quick look at antiderivatives, exponential growth
Week 10 4.5, 4.9, 4.2 Second derivative test, Newton's method, differentials

1. Homework via WebWork: things to know

When working on your assignment you should have scratch paper available and neatly write out your thought process in solving the problem. WhileWebWork does not grade you on this process, writing it out carefully will train you in the skills you need. It will help you track down mistakes, and it will help us track down mistakes when you ask for our help. If you ask us a question about a homework problem in office hours, the

first thing we will probably do is ask you to show us your work. Also, remember that on quizzes and exams showing your work will sometimes be required. It is important to practice this each week while doing your home- work assignments.

Log in WebWork: first go to the main login page at http://webwork.uoregon.edu/webwork2. Select "Math251-15870". Your login ID is your DuckID and your password is the same as your UO email password. For example, if your UO email address is abcuoregon.edu, then your DuckID is abc.

Getting help: If you have a question about a homework problem, one excellent resource is the *Email instructor* button at the bottom of the WebWork screen. Clicking on that and typing a short message about what you've tried on the problem will help me diagnose the issue you're having.

What you should NOT do: Do not send an email simply saying *What am I doing wrong on this problem* or *I can't seem to get the right answer on this one.* On most homework problems it is impossible to figure out what you are doing wrong if I only see your answer (which is all WebWork shows me).

What you SHOULD do: If WebWork tells you your answer is wrong, first go back over your work and see if you can find the mistakes yourself. If you can't, feel free to email me: but include a description of how you solved the problem as well as any work you did for intermediate steps. The more information you give, the more likely it is you will get a prompt and helpful reply.

Also note that you can find useful tips for using WebWork at
https://math.uoregon.edu/undergraduate/webwork