

Text: “Calculus for Business, Economics, and the Social and Life Sciences (Brief)”, 11th edition, by Hoffmann, Bradley, Sobecki, Price

Coordinator: Mike Price (mprice@uoregon.edu, 6-0991)

Technology: If you require a graphing calculator, use it and recommend a TI-84. If you do not allow the use of a calculator, be prepared to a) not use one yourself (lest ye be accused of hypocrisy) and b) write exams so that the simplification of arithmetically complex problems does not overshadow the actual concept they are being tested on.

Calculators like the TI-89, TI-92 and some Casio calculators (e.g. Casio FX-115ES and FX-991ES) can do differentiation and integration. The Casio calculators are not “graphing calculators”, so simply banning any calculators that graph is insufficient. You may need to be *very specific* about your calculator policy if you want to limit this kind of assistance on exams.

Course Objectives: The course-level objectives for a student completing the class are the following.

- (CO 1): Compute the derivative as a function and at a point for non-trigonometric functions
- (CO 2): Translate bidirectionally between business/economics contexts and mathematics models
- (CO 3): Use rules to extend derivative computations to sums, differences, products, quotients, and compositions of functions
- (CO 4): Apply the derivative to optimization, rates of change, and graphing strategies
- (CO 5): Determine limits of functions algebraically, graphically, and (approximate) numerically

Learning Objectives: A successful student should be able to succeed at an exam which focuses on the essential objectives (indicated by an asterisk), contains a lesser focus on supporting objectives, and may or may not contain content on the additional objectives. Remember that a single task can incorporate multiple learning objectives. (Linked Course Objectives appear in parentheses following each learning objective.)

1. Use supply, demand, revenue, cost, and profit terminology in constructing and evaluating functions (CO 2)
2. Find market equilibrium given representations of supply and demand (CO 2)
3. Determine break-even quantities and prices, given a profit function (CO 2)
4. Make a conjecture about a limit using numerical approximation (CO 5)
5. Identify the limit of a function at a point from a graph (CO 5)
6. *Calculate the limit of a rational (or algebraic) function using properties of these functions (CO 5)
7. Use sum, difference, and scalar multiple rules to calculate limits (CO 5)
8. *Identify limits of functions of the form k/t^p at ∞ or $-\infty$ (CO 5)
9. *Use algebra to determine the value of the one- and two-sided limits of a function of the indeterminate form $\frac{\infty}{\infty}$ or $\frac{0}{0}$ (CO 5)
10. *Determine intervals of continuity of a function from a graph of the function (CO 5)

11. Determine continuity of a function at a point using the limit definition of continuity (CO 5)
12. Use the definition to find the derivative of a function as a formula or at a point (CO 1)
13. *Interpret the derivative as the instantaneous rate of change in a function (CO 4)
14. *Interpret the rate of change of a function in context, including units (CO 4)
15. *Compute derivatives using the power rule (CO 1)
16. *Compute derivatives using sum, difference, and constant multiple rules (CO 1)
17. Write the equation of a tangent line using the derivative (CO 4)
18. Compute relative and percentage rates of change in a function at a point (CO 4)
19. *Compute derivatives from formulas, graphs, tables, and words using the product rule (CO 1, 3)
20. *Compute derivatives from formulas, graphs, tables, and words using the quotient rule (CO 1, 3)
21. *Compute second and higher-order derivatives of a function (CO 4)
22. *Interpret the second derivative as a rate of change in rate of change (CO 4)
23. From the graph of a function, estimate relative steepness and concavity of the function, including a positive or negative value (CO 4)
24. *Compute derivatives of formulas using the chain rule and power rule (CO 1, 3)
25. Compute derivatives from functions defined by table or graph using the chain rule (CO 1, 3)
26. *Compute derivatives using the alternative formulation of the chain rule (CO 1, 3)
27. Find marginal functions (e.g. marginal cost, revenue, and profit) (CO 1, 4)
28. *Use approximation by increments (linear approximation) to estimate the change in a function (CO 4)
29. Use the second derivative to determine if a linear approximation calculation is most likely to overestimate or underestimate the true value (CO 4)
30. *Identify the critical points of a function from a formula, graph, or table (CO 4)
31. *Use the first derivative test to classify a critical point as a relative maximum or relative minimum (CO 4)
32. *Find exact intervals of increase and decrease for a function using methods of calculus (CO 4)
33. Approximate the concavity and location of inflection points from the graph of a function (CO 4)
34. Use the second derivative test to classify a critical point as a relative maximum or relative minimum (CO 4)
35. *Find inflections points using the second derivative (CO 4)
36. *Find exact intervals of positive and negative concavity for a function, as well as its inflection points, using methods of calculus (CO 4)
37. *Find horizontal and vertical asymptotes of a function using limits (CO 4)
38. Interpret extrema, inflection points, and asymptotes of functions in applied contexts (CO 2)
39. *Find the absolute extrema of a function on a closed interval using the Extreme Value Theorem (CO 4)

40. Compute price elasticity of demand, given a demand function, and interpret the elasticity in context (CO 2, 4)
41. Identify demand as elastic, inelastic, or of unitary elasticity at a particular price, and use that fact to make a statement about revenue (CO 2, 4)
42. Construct, and then optimize, a function from a written description including, but not limited to, average cost, inventory control cost, profit, travel time, and fuel cost (CO 2, 4)
43. Compute the future value or present value of an invested quantity (CO 2)
44. Find the effective annual interest rate of an investment (CO 2)
45. *Compute the derivative of functions containing exponential terms (CO 1)
46. Compute the derivative of functions containing logarithmic terms (CO 1)
47. Construct models of exponential and logistic functions from given data points (CO 2)

Prerequisite Objectives – Prerequisite skills to be incorporated into the course learning objectives are as follows.

1. Solve linear and quadratic equations
2. From two points or a point and a slope, construct the equation of the unique line with those characteristics
3. Identify whether or not a relationship between two variables defines a function
4. Interpret the input and output of a function within an applied context
5. Evaluate functions at numeric and symbolic inputs
6. Identify the domain of a function mathematically and, if in an applied context, within that context
7. Find the domain and image of a function defined by table or graph
8. Compute the composition of two functions at a point given formulas, table, and/or graphs of the functions
9. Write a simplified composition of two functions defined by formula
10. Sketch graphs of functions by plotting points
11. Compute or identify from a graph the locations of a graph's horizontal and vertical axis intercepts
12. Find the minimum or maximum value of a quadratic function using the $-\frac{b}{2a}$ formula
13. Compute and interpret the slope of a line in an applied context
14. Model a linear function which is fit to two data points
15. Write formulas for relationships defined by proportionality and inverse proportionality
16. Identify increasing and decreasing behavior in a function
17. Compute the average rate of change for a given function over a specified interval
18. Use properties of exponents to simplify expressions
19. Find the formula for an exponential function given two data points (two points or a point and a percentage growth rate)
20. Rewrite an exponential equation as an equivalent logarithmic equation, and vice versa
21. Solve an exponential equation using logarithms
22. Use properties of logarithms to solve equations

Week	Sections to Cover	Notes
1	1.1, 1.2, 1.3, 1.4,	1.1 - 1.4 (3 hrs): These should be review, except they will probably need help with modeling and proportionality
2	1.5, 1.6	1.5, 1.6 (3 hrs): These are likely new, so dedicate more time than to the rest of the chapter
3	2.1, 2.2	2.1 (1.5 hrs): A more complete discussion of increasing/decreasing behavior takes place in Chapter 3, for the time being, noting that $f' > 0$ implies increasing and $f' < 0$ implies decreasing should be sufficient 2.2 (1.5 hrs): As much as possible, approach the rules using differentiation examples; make sure they get exposure to (and explanation of) the f' as well as $\frac{dy}{dx}$ notations. Holiday (Winter): Martin Luther King Jr. Day Monday
4	2.3, 2.4	2.3 (1.5 hrs): Try to develop practice with modeling products (e.g. given $p(t_0)$, $p'(t_0)$, $q(t_0)$ and $q'(t_0)$, find $R'(t_0)$); remember that without knowing chain rule, there is limited motivation for product rule, stress that you will return to this topic after section 2.4 2.4 (2 hrs): Chain rule is often very difficult for them to process in part because they never really learned what composition was
5	2.5, 2.6*	2.5 (1.5 hrs): This is one of the best chances to relate calculus to 200-level economics classes, take the opportunity to make the connections 2.6* (0 – 1.5 hrs): Related rates are a notoriously difficult subject, but there are some very interesting applications to explore; implicit differentiation is their least favorite topic of the entire quarter * If running behind, minimize or omit section 2.6
6	3.1, 3.2	3.1 (1.5 hrs) This chapter is the point at which the decision around graphing calculators becomes particularly important: how much can they work through on their calculators and use on homework and exams? Also, <i>relative</i> extrema are defined here, but <i>absolute</i> extrema not until 3.4 3.2 (1.5 hrs)
7	3.3, 3.4	3.3 (2 hrs) Asking for intercepts, asymptotes, increase/decrease, concave up/down, extrema, and inflections points makes these examples each take a very long time to do thoroughly 3.4 (2 hrs) Elasticity is an interesting application, and another tie-in with economics
8	3.4, 3.5*	3.5* (0 – 1 hr) * If you are behind at this point, spending little to no time on this section is okay;
9	4.1, 4.2, 4.3	4.1, 4.2 (1.5 hrs) These sections should be review, but many students will not have good facility with logarithms 4.3 (1.5 hrs) Holiday (Fall): Thanksgiving holiday Thursday/Friday

10	4.4 Review, Catch Up	4.4 (3 hrs)	The section includes exponential models with and without differentiation, which provides a good test of whether a student is simply blindly taking the derivative of everything and ignoring the question (spoiler: they are)
11	Final Exam	http://registrar.uoregon.edu/calendars/examinations?schedule=2021-2022	

Additional Notes:

- The typical consumer of this course is a pre-business major satisfying their mathematics requirement. They will need 241 and 243 completed for a grade in order to apply to the business school. More than any other math class, these students can be resentful of the need to take the course. There are also a sizable number of economics students who take this class instead of 251.
- Common areas of difficulty: Basic algebra (factoring, simplifying and operations on fractions), chain rule, implicit differentiation, logarithms, applications of any sort, modeling mathematically in particular. Be conscious of these facts when you approach each topic so that you can be ready for the confused looks, frustrated sighs, and eye rolling. Combat them with detailed examples and ample opportunities for practice. Basic algebra review is most effective when integrated into new concepts, so do it on an as-needed basis. Students complain about the abstract problems because they aren't relatable. Students complain about word problems because they're hard. It's a difficult situation to win, but a responsible math class for predominantly non-majors involves both abstract mathematics and applications.
- Word problems should be a key feature of the course. Consider introducing new topics in a non-mathematical context (there is lots of evidence that this helps students learn the material to begin with, but also to retain it longer). E.g. A function from the perspective of a machine like a wood-chipper or microwave oven; exponential functions from the notion of the thickness of paper after n foldings, and so on.
- Mike has lecture guides, worksheets, quizzes, exams, practice packets, and links to screen capture lecture videos available (they are located on YouTube under "mikesmathchannel").
- Research in instruction is clear: small, regular assessments that count (a very small amount) toward the course grade encourage students to more accurately determine their standing in the course prior to a large assessment like a midterm. Even if you plan to primarily lecture in class, please consider including 1 – 5 minutes of regular student work time to answer quick computational or conceptual questions during class (e.g. iClicker questions: 20 minutes total per week, participation points for engaging, bonus points for accuracy, grading done by iClicker system). Top Hat also provides instant response systems on a subscription model (at cost to students) that works for engagement in remote classes.