Interactive Calculus, Chapter 1 table of contents

Section 1.1

In Interactive Assignment 1.1-1, we

- Review function notation and vocabulary.
- Provide a formal definition of function.
- Explore examples of functions.
- Represent functions algebraically, numerically, and graphically.
- Explore some characteristics of functions graphically.

In Interactive Assignment 1.1-2, we

- Define piecewise functions.
- View common examples of piecewise functions.
- Explore increasing and decreasing functions.
- Explore even and odd functions.

In Interactive Assignment 1.1-3, we explore the following families of functions algebraically and graphically:

- Linear functions.
- Power functions.
- Polynomials.
- Rational functions.

Section 1.2

In Interactive Assignment 1.2-1, we

- Review the process of adding, subtracting, multiplying, and dividing functions.
- See the effects of these operations on the domain and range.
- Visualize combinations of functions graphically.
- Review the definition of a composition of functions.
- Practice generating the formulas and domains of compositions of functions.
- Practice decomposing functions as the composition of other functions.

In Interactive Assignment 1.2-2, we

- Review how addition shifts a graph.
- Review how scaling stretches or compresses a graph.
- Review how to reflect a graph about an axis.

Section 1.3

In Interactive Assignment 1.3-1, we

- Define angles and how they are measured.
- Review the difference and conversion between radians and degrees.
- Define trigonometric function using a right triangle.

- Define trigonometric function using the unit circle.

In Interactive Assignment 1.3-2, we

- Explore the trigonometric functions graphically.
- Identify a trigonometric function's domain, range, and periodicity.
- Learn how to apply our classic function transformations to trigonometric functions.

In Interactive Assignment 1.3-3, we

- Derive and apply trigonometric identities.
- Derive and apply the Law of Cosines.
- Derive and apply some important trigonometric inequalities.

Section 1.4

In Interactive Assignment 1.4-1, we

- Provide basic instructions for using three groups of graphing tools.
- Discuss the pros and cons of each group of graphing tools.
- Identify three things to be careful about when working with graphing tools:
  - Choosing the right viewing window.
  - Understanding the aspect ratio.
  - Considering the mathematical nature of the function.

Section 1.5

In Interactive Assignment 1.5-1, we

- Review an informal definition of the exponential function.
- Review the graphical and numerical representation of exponential functions and look at some applications.
- Extend our definition of exponential functions to include negative, rational, and irrational inputs.

In Interactive Assignment 1.5-2, we

- Review and apply exponent rules.

In Interactive Assignment 1.5-3, we

- Introduce the number "e" and the natural exponential function.
- Explore the natural exponential function graphically.
- Identify key parameters.
- Investigate applications of the natural exponential function.

Section 1.6

In Interactive Assignment 1.6-1, we

- Define and identify one-to-one functions.

- Define inverse functions and explore them graphically, symbolically, and numerically.

In Interactive Assignment 1.6-2, we

- Define the logarithmic function for general and common bases.
- Explore logarithmic functions graphically.
- Explore the algebraic and inverse properties of logarithmic functions.
- Review how to convert logarithms from one base to another.

In Interactive Assignment 1.6-3, we

- Explore the inverse trigonometric functions graphically.
- Explore the relationship between the domain and range of a function and the domain and range of its inverse.
- Define the inverse trigonometric functions algebraically and calculate their values for some common inputs.
- Use inverse trigonometric functions to solve an application problem.
- Show the visual representation of common identities involving inverse trigonometric functions.

Interactive Calculus, Chapter 2 table of contents

Section 2.1

In Interactive Assignment 2.1-1, we

- Calculate average rates of change.
- Investigate the graphical meaning of average rate of change.
- Apply the concept of average velocity to a physical problem.
- Investigate secant lines.
- Find the slope of a curve.
- Understand the relationship between slopes and rates of change.

Section 2.2

In Interactive Assignment 2.2-1, we

- Understand the concept and informal definition of the limit of a function.
- Discuss the Limit Laws.
- Use limit laws to evaluate examples of limits.

In Interactive Assignment 2.2-2, we

- Discuss limits of polynomials and rational functions.
- Learn the technique of rationalizing the numerator or the denominator.
- Use the technique of changing the variable, in the context of rationalizing.

In Interactive Assignment 2.2-3, we

- State and understand the Squeeze Theorem.
- Use the Squeeze Theorem to establish some important limit results.
- Establish the Fundamental Sine Limit.

Section 2.3

In Interactive Assignment 2.3-1, we

- State the precise definition of a limit of a function.
- Connect the informal and precise definitions of the limit.
- Understand the graphical meaning of the precise definition of the limit.
- Prove a limit exists using the precise definition.
- Explore the precise definition of a limit graphically.
- Learn how to approach limit proofs in general.
- Prove the limit results for the identity, constant, rational, and root functions.

In Interactive Assignment 2.3-2, we

- Prove the Sum Rule for Limits.
- Prove the Squeeze Theorem.
- Prove the uniqueness of the limit.

- Prove a limit does not exist.

Section 2.4

In Interactive Assignment 2.4-1, we

- Consider limits as a value is approached from just one side.
- State an important theorem relating the one-sided limits and the corresponding limit.

In Interactive Assignment 2.4-2, we

- State the precise definition of the two one-sided limits.
- Learn how to use the definition to prove some limit results and properties.

Section 2.5

In Interactive Assignment 2.5-1, we

- State the definition of continuity.
- Learn how to use the definition of continuity.
- Discuss continuity on an interval and continuous functions.
- State properties of continuous functions.

In Interactive Assignment 2.5-2, we

- State the definition of continuity.
- Learn how to use the definition of continuity.
- Discuss continuity on an interval and continuous functions.
- State properties of continuous functions.

In Interactive Assignment 2.5-3, we

- Learn the Intermediate Value Theorem.
- Learn how we can use the Intermediate Value Theorem to approximate roots equations.
- Use the method of bisection to approximate roots.

Section 2.6

In Interactive Assignment 2.6-1, we

- State and apply an informal definition of finite limits at infinity.
- Learn the properties for finite limits at infinity.
- Investigate the graphical meaning of a finite limit at infinity: a horizontal asymptote.
- Find the horizontal asymptotes of the graph of a function.
- Sketch the graph of a function with one or more horizontal asymptotes.

In Interactive Assignment 2.6-2, we

- Learn that rational functions can have an “oblique asymptote.”

- State the Squeeze Theorem for Finite Limits at Infinity.
- Use the Squeeze Theorem.

In Interactive Assignment 2.6-3, we

- State and apply the informal definition of an infinite limit at a point.
- Investigate the graphical meaning of an infinite limit at a point: a vertical asymptote.
- Use asymptotes and other information to sketch the graph of a curve.

In Interactive Assignment 2.6-4, we

- State the precise definitions for infinite limits and finite limits at infinity.
- Use the definitions to prove limit results.

Interactive Calculus, Chapter 3 table of contents

Section 3.1

In Interactive Assignment 3.1-1, we

- Introduce f' notation.
- Use the definition of the derivative to determine the slope of the tangent line to a curve at a point.
- Relate the slope of a tangent line with the derivative of a function at a point.
- Compute the derivative of a function at a point.
- Use the definition of $f'(x_0)$ to find the derivative at a point.
- Find the equation of the tangent line using the derivative at a point.
- Use the derivative to analyze the velocity of a falling object.

Section 3.2

In Interactive Assignment 3.2-1, we

- Introduce *the derivative function*, $f'(x)$.
- Observe that the derivative function f' tells us the derivative of f for *any* point x
- Consider an alternate formula for the derivative function:

$$f'(x) = \lim_{z \to x} \frac{f(z) - f(x)}{z - x}$$

- Understand why this formula is true.
- Use this formula to compute $f'(x)$ when $f(x) = x^3$.
- Use this formula to compute $f'(x)$ when $f(x) = \sqrt{x}$.
- Examine two ways to denote the derivative of a function.

In Interactive Assignment 3.2-2, we

- Relate the graphs of f and f'.
- Given unlabeled graphs, identify which is f and which is f'.
- Sketch the graph of f', given the graph of f.

In Interactive Assignment 3.2-3, we

- Examine the behavior of a function at a single point where its derivative exists.
- Discuss one-sided derivatives.
- Define "differentiability on an interval."
- Discuss reasons why $f'(x_0)$ might not exist.
- Discuss and prove a basic fact relating continuity and differentiability.

Section 3.3

In Interactive Assignment 3.3-1, we

- Learn the rule for differentiating constant functions.
- Learn the rule for differentiating power functions.

- Learn the rule for differentiating functions with a constant multiple.
- Learn the rule for differentiating sums of functions.
- Learn the rule for differentiating exponential functions.
- Justify that $\frac{d}{dx}e^x = e^x$.

In Interactive Assignment 3.3-2, we

- Learn the rule for differentiating a product of functions.
- Learn the rule for differentiating a quotient of functions.
- Present notation for indicating the derivative of a derivative, that is, the second derivative of a function.
- Extend the notation to the third derivative, fourth derivative, fifth derivative, etc.

Section 3.4

In Interactive Assignment 3.4-1, we

- Examine an application of derivatives: motion along a straight line.
- Understand the relationship between position, motion, displacement, and distance traveled.
- Discuss the connection between average and instantaneous velocity.
- Describe an object's speed given its velocity.
- Continue our discussion of motion and the role of the derivative.
- Understand the meaning of "an acceleration of 9.8 m/s per second."
- Analyze the position, velocity, and acceleration of an object in free fall.
- Understand "rate of change," when the independent variable isn't time.

Section 3.5

In Interactive Assignment 3.5-1, we

- Prove: $\frac{d}{dx}\sin x = \cos x$
- Acknowledge: $\frac{d}{dx}\cos x = -\sin x$
- Describe simple harmonic motion.
- Consider the position, velocity, and acceleration of a weight on a spring.
- Compute derivatives for the four remaining basic trigonometric functions: tangent, cotangent, secant, cosecant.

Section 3.6

In Interactive Assignment 3.6-1, we

- Introduce the Chain Rule and notation.
- Compute the derivative of composite functions using the Chain Rule.
- Compute the derivative of composite functions using the Chain Rule more than one time.
- Discuss a proof of one case of the Chain Rule.

Section 3.7

In Interactive Assignment 3.7-1, we

- Apply the Chain Rule to find derivatives of implicitly defined functions.
- Find the tangent and normal lines to a curve at a point.
- Find the second derivative of an implicitly defined function.

Section 3.8

In Interactive Assignment 3.8-1, we

- Learn the Derivative Rule for Inverses.
- Apply the Derivative Rule for Inverses to the natural logarithm function.
- Learn the general form for the derivative of a general exponential function.
- Apply the general form for the derivative of a general exponential function.
- Learn the general form for the derivative of a general logarithm function.
- Apply the general form for the derivative of a general logarithm function.

In Interactive Assignment 3.8-2, we

- Use the process of logarithmic differentiation.
- Use logarithmic differentiation.

Section 3.9

In Interactive Assignment 3.9-1, we

- Define the inverse sine function.
- Evaluate the inverse sine function.
- Compute the derivative of the inverse sine function.
- Define the inverse tangent function.
- Evaluate the inverse tangent function.
- Compute the derivative of the inverse tangent function.
- Define the inverse secant function.
- Evaluate the inverse secant function.
- Compute the derivative of the inverse secant function.
- Define the inverse cosine, cotangent, and cosecant functions.
- Compute the derivatives of the inverse trigonometric functions.

Section 3.10

In Interactive Assignment 3.10-1, we

- Learn a related rates problem-solving strategy.
- Solve a related rates problem.
- Apply a related rates problem-solving strategy to solve an application.

Section 3.11

In Interactive Assignment 3.11-1, we

- Define linearization.
- Find the linearization of a function.
- Use a linear approximation to estimate a value.
- Review the standard linearization approximation.
- Use linearization to estimate a value.
- Define differentials.
- Find values of differentials.
- Consider an additional example using differentials.

In Interactive Assignment 3.11-2, we

- Solve applications using differentials.
- Describe absolute change.
- Describe relative change.
- Describe percentage change.
- Prove the Chain Rule.

Interactive Calculus, Chapter 4 table of contents

Section 4.1

In Interactive Assignment 4.1-1, we

- Define absolute extrema: absolute minimum and absolute maximum.
- Find absolute extrema graphically.
- Explore how the given domain affects absolute extrema.
- Define local extrema: local minimum and local maximum.
- Find all extrema graphically.

In Interactive Assignment 4.1-2, we

- Determine the critical points of a polynomial.
- Determine the critical points of a function involving trigonometry.
- Determine the critical points of function involving a root.
- Determine the critical points of a rational function.
- Determine the critical points of an exponential function.

In Interactive Assignment 4.1-3, we

- Outline the steps to find the absolute extrema of a function on a closed interval.
- Find the absolute maximum and minimum of a polynomial function.
- Find the absolute maximum and minimum of a root function.
- Find the absolute maximum and minimum of a rational function.
- Find the absolute maximum and minimum of a function involving trigonometry.
- Find the absolute maximum and minimum of a logarithmic function.

Section 4.2

In Interactive Assignment 4.2-1, we

- Explore Rolle's Theorem graphically.
- State Rolle's Theorem.
- Understand the necessary criteria for Rolle's Theorem.
- Determine if Rolle's Theorem can be applied to a certain function on a given interval.
- Find all values *c* that satisfy Rolle's Theorem, if Rolle's Theorem can be applied.
- Apply Rolle's Theorem to find the zeros of a function on a closed interval.

In Interactive Assignment 4.2-2, we

- Explore the Mean Value Theorem graphically.
- State the Mean Value Theorem.
- Develop a connection between Rolle's Theorem and the Mean Value Theorem.
- Determine if the Mean Value Theorem can be applied to a certain function on a given interval.
- Find all values *c* that satisfy the Mean Value Theorem, if the MVT can be applied.
- Apply the Mean Value Theorem to a velocity problem.
- Prove the Mean Value Theorem.

In Interactive Assignment 4.2-3, we

- Explore two corollaries of the Mean Value Theorem.
- Apply the Mean Value Theorem corollaries to various problems.
- Prove a logarithm law.
- Prove an exponential law.

Section 4.3

In Interactive Assignment 4.3-1, we

- Define intervals of increase and decrease for a function.
- Explore the First Derivative Test for Local Extrema.
- Find extrema and intervals of increase and decrease for a polynomial.
- Find extrema and intervals of increase and decrease for a function with rational exponents.
- Find extrema and intervals of increase and decrease for a square root function.
- Find extrema and intervals of increase and decrease for a function involving trigonometry.
- Find extrema and intervals of increase and decrease for a function involving exponentials.
- Prove the statement connecting increasing and decreasing intervals of a function and the derivative.
- Prove the first part of First Derivative Test for Local Extrema.

In Interactive Assignment 4.3-2, we

- Graph a function given information about its derivative.
- Explore the behavior of a function based on the graph of its derivative.
- Explore an interactive figure to correctly identify the graphs of f and f'.
- Explore an interactive figure to reconstruct the graph of f from the graph of f'.

Section 4.4

In Interactive Assignment 4.4-1, we

- Define concavity and inflection points.
- Draw connections between the derivative and concavity.
- Explore concavity and inflection points graphically.
- Define the Second Derivative Test for Concavity.
- Find intervals of concavity and any inflections points for a polynomial.
- Find intervals of concavity and any inflections points for a function involving trigonometry.
- Find intervals of concavity and inflection points for a root function.
- Find intervals of concavity and inflection points for a function involving the natural logarithm.
- Create a connection between the second derivative and local extrema.
- Define the Second Derivative Test for Local Extrema.
- Apply to the Second Derivative Test for Local Extrema to a polynomial.

In Interactive Assignment 4.4-2, we

- Sketch a function based on the sign patterns of its first and second derivatives.
- Create a chart of equivalent statements for f, f', and f''.
- Explore the behavior of a function based on the graph of its derivative.
- Identify f, f', and f'' from a group of given graphs.
- Sketch a function based on the graphs of its first and second derivatives.
- Use the graph of f'' to reconstruct the graph of f.

In Interactive Assignment 4.4-3, we

- Outline the steps for curve sketching.
- Use the curve sketching steps to graph a polynomial.
- Use the steps for curve sketching to graph a rational function.
- Use the steps for curve sketching to graph a function involving trigonometry.
- Use the steps for curve sketching to graph an exponential function.
- Use the steps for curve sketching to graph a function with rational powers.

Section 4.5

In Interactive Assignment 4.5-1, we

- Define the term "indeterminate form."
- Use l'Hôpital's Rule to evaluate an indeterminate form.
- Apply l'Hôpital's Rule more than once to a limit.
- Prove l'Hôpital's Rule for the $\frac{0}{0}$ case.

In Interactive Assignment 4.5-2, we

- Understand why $0 \cdot \infty$ is an indeterminate product.
- Evaluate limits involving an indeterminate product.
- Understand why $\infty - \infty$ is an indeterminate difference.
- Evaluate limits involving an indeterminate difference.

In Interactive Assignment 4.5-3, we

- Understand why 1^{∞}, 0^0, and ∞^0 are indeterminate powers.
- Evaluate limits involving an indeterminate power.
- Evaluate additional limits involving indeterminate powers.

Section 4.6

In Interactive Assignment 4.6-1, we

- Define what an optimization problem is.
- Use an example and interactive figure to grasp the idea of optimization.
- Outline the steps for solving an optimization problem.
- Use calculus to solve an open-top box problem.
- Determine the minimum amount of material needed to construct a cylindrical can.

In Interactive Assignment 4.6-2, we

- Determine the minimum distance from a point to a curve.
- Determine the largest area of a rectangle inscribed in a semicircle.
- Apply optimization techniques to a physics application.

In Interactive Assignment 4.6-3, we

- Define revenue, cost, and profit.
- Understand how these three business concepts interact with one another.
- Maximize revenue from number of products sold.

Section 4.7

In Interactive Assignment 4.7-1, we

- Develop a basic understanding of Newton's Method.
- Understand how Newton's Method works graphically.
- Outline the steps required for Newton's Method.
- Apply these steps to some examples.
- Apply Newton's Method to find an intersection point of two curves.

In Interactive Assignment 4.7-2, we

- Determine what can go wrong with Newton's Method.
- Investigate problematic initial approximations graphically.
- Develop pseudocode for Newton's Method.

Section 4.8

In Interactive Assignment 4.8-1, we

- Define what an antiderivative is.
- Explore antiderivative rules.
- Use antiderivative rules to find general antiderivatives.
- List the general antiderivative rules that involve the six trigonometric functions.
- Apply these rules to various examples.
- List the antidifferentiation rules that result in a logarithmic, exponential, or inverse trigonometric function.
- Apply these rules to various examples.

In Interactive Assignment 4.8-2, we

- Define what an indefinite integral is.
- Form a connection between an indefinite integral and a general antiderivative.
- Evaluate indefinite integrals involving trigonometric and other transcendental functions.

In Interactive Assignment 4.8-3, we

- Solve for a specific antiderivative that satisfies a given condition.
- Define vocabulary associated with differential equations.
- Solve an initial value problem.

- Solve an initial value problem involving a second derivative.
- Understand the relationship between position, velocity, and acceleration in terms of calculus.
- Apply these relationships to an initial value problem.

Interactive Calculus, Chapter 5 table of contents

Section 5.1

In Interactive Assignment 5.1-1, we

- Introduce integration.
- Develop a simple method to approximate areas under the graph of a function and above the x-axis.
- See three standard methods of approximation: right endpoint approximation, left endpoint approximation, and midpoint approximation.

In Interactive Assignment 5.1-2, we

- See the connection between area under the graph of a function and the distance that an object travels.
- Consider the difference between approximating *distance* and approximating *displacement*.
- Learn how to approximate the average value of a function.

Section 5.2

In Interactive Assignment 5.2-1, we

- Learn about Sigma notation, a concise way to express sums.
- Given a sum in Sigma notation, write it out fully.
- Given a sum, express it using Sigma notation.

In Interactive Assignment 5.2-2, we

- Learn identities for $\sum_{k=1}^{n} k$, $\sum_{k=1}^{n} k^2$, and $\sum_{k=1}^{n} k^3$
- Simplify sums in Σ-notation by employing algebraic rules.
- Take the limit of certain sums as $n \to \infty$.

In Interactive Assignment 5.2-3, we

- Create a Riemann sum.
- Compute the limit of a Riemann sum as $n \to \infty$.

Section 5.3

In Interactive Assignment 5.3-1, we

- Investigate the limit of general Riemann sums.
- Examine left-endpoint and right-endpoint Riemann sums.
- Define the definite integral.
- Learn the notation that describes definite integrals.

In Interactive Assignment 5.3-2, we

- Learn the properties of definite integrals.
- Visualize properties of definite integrals.

In Interactive Assignment 5.3-3, we

- Evaluate definite integrals using known area formulas.
- Use a definite integral to find the average value of a function.

Section 5.4

In Interactive Assignment 5.4-1, we

- Define the "distance so far" function.
- Discover the Fundamental Theorem of Calculus, Part 1.
- Demonstrate how the derivative of the "distance so far" function and a Riemann sum of the velocity function relate to each other.

In Interactive Assignment 5.4-2, we

- Discover the Fundamental Theorem of Calculus, Part 2.
- Use the Fundamental Theorem of Calculus, Part 2 to evaluate definite integrals exactly.

In Interactive Assignment 5.4-3, we

- Use the Fundamental Theorem of Calculus, Part 1 to sketch functions.
- Combine the Fundamental Theorem of Calculus, Part 1with the Chain Rule to find derivatives.

Section 5.5

In Interactive Assignment 5.5-1, we

- Review the definition of the definite and indefinite integrals.
- Look at the "big picture" progression of finding anti-derivatives.
- Develop a method for finding anti-derivatives by reversing the chain rule.

In Interactive Assignment 5.5.2, we

- Practice identifying integrals that are best suited for the Substitution Method of Integration.
- Practice identifying the associated best substitution.
- Learn some common algebraic or trigonometric simplifications that prepare an integral for substitution.
- Look at some integrals that while they don't fit the "classic" form for substitution, substitution can still be used creatively.

Section 5.6

In Interactive Assignment 5.6-1, we

- Evaluate integrals using the Substitution Formula.
- Complete examples showing the use of substitution in definite integrals involving trigonometry and natural logarithms.

In Interactive Assignment 5.6-2, we

- Find areas of regions enclosed by lines and curves.
- Find bounds when they are not given.
- Find area using more than one integral.
- Integrate with respect to y rather than x.

In Interactive Assignment 5.6-3, we

- Review the definitions for even and odd functions.
- Learn how to integrate specific even and odd functions.

Interactive Calculus, Chapter 6 table of contents

Section 6.1

In Interactive Assignment 6.1-1, we

- Calculate the volume of a solid, given the areas of its cross sections.
- Justify the volume formula.
- Solve three problems involving finding volume by integrating cross sections.
- Understand Cavalieri's principle.

In Interactive Assignment 6.1-2, we

- Use the disk method to find the volume of a solid generated by rotating a planar region, which is bounded by the x-axis, about the x-axis.
- Use the disk method to find the volume of a solid generated by rotating a planar region about an axis, which also bounds the region.
- Use the washer method to find the volume of a solid generated by revolving a planar region, which is not bounded by the x-axis, about the x-axis.
- Use the washer method to find the volume of a solid generated by revolving a planar region, which is not bounded by the axis of rotation, about an axis.

Section 6.2

In Interactive Assignment 6.2-1, we

- Understand how the volume of a solid can be computed by considering cylindrical "shells" that make up the solid.
- Gain greater familiarity with the method of cylindrical shells for computing volume.
- Prove: $V = \int_a^b 2\pi|x - L|f(x)\,dx$
- Learn some simple rules that will help you decide whether to use the method of disks, washers, or shells when computing a volume.

Section 6.3

In Interactive Assignment 6.3-1, we

- Introduce and use the arc length formula to compute the length of a curve generated by a function.
- Justify that the definition of arc length is reasonable.
- Gain greater familiarity with the arc length formula by going through two more examples.
- Understand the parametrization
$$s(x) = \int_a^x \sqrt{1 + [f'(t)]^2}\,dt$$
as a function that provides the length of the curve $y = f(t)$ from a to any value x.
- Examine the roles of dy, dx, and ds as they relate to the arc length function $s(x)$.

Section 6.4

In Interactive Assignment 6.4-1, we

- Calculate the area of a surface of revolution.
- Justify that the definition of surface area for a solid of revolution is reasonable.

Section 6.5

In Interactive Assignment 6.5-1, we

- Introduce the idea of "work."
- Use integration to calculate the work done by a variable force over a given distance.
- Appreciate Hooke's Law as a natural application for computing work.
- Calculate the work required to pump liquid from a container.

In Interactive Assignment 6.5-2, we

- Address the basics of hydrostatic pressure.
- Calculate the force that a fluid exerts on a submerged horizontal surface.
- Calculate the force against a vertical surface submerged in fluid.

Section 6.6

In Interactive Assignment 6.6-1, we

- Calculate the center of mass of a system of discrete objects distributed in a line.
- Put the discussion of center of mass into context.
- Make physical sense of the moment of a system.
- Find the total mass and center of mass of a thin, straight rod of variable density.

In Interactive Assignment 6.6-2, we

- Calculate the center of mass of a system of a set of discrete objects distributed over a plane.
- Calculate the center of mass of a region in the plane representing a thin, flat plate of variable density.
- Calculate the centroid of a region in the xy-plane.
- Use integrals to compute the centroid of the curve $y = f(x)$ between $x = a$ and $x = b$.

In Interactive Assignment 6.6-3, we

- Compute the force against a submerged flat vertical plate using the centroid of the plate.
- Compute a volume of rotation using the centroid of a plane region.
- Compute the area of a surface of revolution using the centroid of a planar curve.

Interactive Calculus, Chapter 7 table of contents

Section 7.1

In Interactive Assignment 7.1-1, we
- Define the natural logarithm function as an integral.
- Define the number e in terms of the natural logarithm function.
- State the derivative of the natural logarithm function.
- Revisit the graph of the natural logarithm function.

In Interactive Assignment 7.1-2, we
- Evaluate integrals involving logarithmic functions.

In Interactive Assignment 7.1-3, we
- Define the natural exponential function, e^x, for all x.
- Derive the derivative and integral of e^x.

In Interactive Assignment 7.1-4, we
- State the algebraic properties of the natural logarithm and discuss proofs.
- State the laws of the exponent for e^x and discuss proofs.
- Define the general exponential function a^x where $a > 0$.
- Define the logarithm function with base a where $a > 0$.
- Evaluate derivatives and integrals involving logarithms with base a.

Section 7.2

In Interactive Assignment 7.2-1, we
- Introduce a solution method for separable differential equations.
- Solve a differential equation that is separable.

In Interactive Assignment 7.2-2, we
- Consider an example involving exponential change.
- Introduce a differential equation modeling exponential change.

In Interactive Assignment 7.2-3, we
- Consider an example involving exponential change.

Section 7.3

In Interactive Assignment 7.3-1, we
- Define the six basic hyperbolic functions.
- Introduce the identities for hyperbolic functions.
- Introduce the derivatives and integrals of hyperbolic functions.
- Evaluate derivatives and integrals of hyperbolic functions.

In Interactive Assignment 7.3-2, we

- Introduce inverse hyperbolic functions.
- Introduce the derivatives of inverse hyperbolic functions.
- Introduce integrals leading to inverse hyperbolic functions.
- Evaluate derivatives and integrals leading to inverse hyperbolic functions.

Section 7.4

In Interactive Assignment 7.4-1, we

- Define growth comparisons of functions.
- Compare the growth rates of functions.
- Order functions based on growth rates.

In Interactive Assignment 7.4-2, we

- Define oh-notation.
- Consider examples using oh-notation.

In Interactive Assignment 7.4-3, we

- Introduce sequential and binary search algorithms.
- Consider an example comparing the search algorithms.

Interactive Calculus, Chapter 8 table of contents

Section 8.1

In Interactive Assignment 8.1-1, we
- Review the substitution method for integration.
- Evaluate various integrals that require substitution.

In Interactive Assignment 8.1-2, we
- Use various algebra techniques to evaluate integrals.
- Use trigonometric techniques to evaluate integrals.

Section 8.2

In Interactive Assignment 8.2-1, we
- Establish the integration by parts method.
- Evaluate an integral using integration by parts.

In Interactive Assignment 8.2-2, we
- Use integration by parts twice to solve for the original integral.
- Evaluate integrals using substitution then integration by parts.
- Establish a reduction formula for $\int \cos^n x \ dx$.

Section 8.3

In Interactive Assignment 8.3-1, we
- Evaluate integrals of the form $\int \sin^m x \cos^n x \ dx$.
- Evaluate integrals that contain square roots with sine or cosine in the radicand.

In Interactive Assignment 8.3-2, we
- Evaluate integrals of the form $\int \tan^m x \sec^n x \ dx$.
- Evaluate integrals of the form $\int \cot^m x \csc^n x \ dx$.

Section 8.4

In Interactive Assignment 8.4-1, we
- Establish a procedure for using trigonometric substitution in integration.
- Evaluate integrals using trigonometric substitution.

In Interactive Assignment 8.4-2, we
- Evaluate integrals using trig substitution where the coefficient on x^2 isn't one.
- Evaluate integrals using trig substitution where a substitution must be made first.

Section 8.5

In Interactive Assignment 8.5-1, we

- Establish the steps for the algebraic method of partial fractions.

In Interactive Assignment 8.5-2, we
- Evaluate integrals using the method of partial fractions.

Section 8.6

In Interactive Assignment 8.6-1, we
- Discuss the use of integral tables as a reference for evaluating integrals.
- Discuss the use of computational software as a tool for evaluating integrals.

Section 8.7

In Interactive Assignment 8.7-1, we
- Approximate a definite integral using the Trapezoid Rule.
- Approximate a definite integral using Simpson's Rule
- Discuss error bounds for such approximations.

Section 8.8

In Interactive Assignment 8.8-1, we
- Learn and understand the two types of improper integrals.

In Interactive Assignment 8.8-2, we
- Learn two Comparison Tests for improper integrals.

Section 8.9

In Interactive Assignment 8.9-1, we
- Learn that integrals can be used to calculate probabilities.
- Define and understand probability density functions, mean, median, variance, and standard deviation.

Interactive Calculus, Chapter 9 table of contents

Section 9.1

In Interactive Assignment 9.1-1, we

- Define the general first order differential equation.
- Determine if a function is a solution to a differential equation.
- Use an initial condition to identify one particular solution from a family of solutions.
- Solve differential equations of the form $\frac{dy}{dx} = f(x)$.

In Interactive Assignment 9.1-2, we

- Define slope fields and see how they are generated.
- Use slope fields to approximate solution to initial value problems.
- Explore how characteristics of a differential equation are related to features of a slope field.
- Use slope fields to describe the overall behavior of the family of solutions to a differential equation.

In Interactive Assignment 9.1-3, we

- View the graphical representation of Euler's method.
- Generate formulas to implement the method.
- Complete a practice calculation.
- Explore the error in our approximation.

Section 9.2

In Interactive Assignment 9.2-1, we

- Identify first order linear differential equations.
- Write first order linear differential equations in standard form.
- Develop a step-by-step solution method for this family of differential equations.

In Interactive Assignment 9.2-2, we

- Work through a practice problem using the first order linear method.
- Develop a shortened version of our step-by-step solution method.
- Derive the formula for the integrating factor $v = e^{\int P(x)dx}$.

In Interactive Assignment 9.2-3, we

- Introduce RL circuits and their associated differential equations.
- Work through an example problem.
- Solve the general differential equation for RL circuits.
- Explore how the values of the components of the circuit affect the solution.

Section 9.3

In Interactive Assignment 9.3-1, we

- Generate and then solve their associated differential equations.
- See what the solutions tell us about the physical applications.
- Work through an example problem.

In Interactive Assignment 9.3-2, we

- Review how to determine if two lines are perpendicular.
- Define what it means for two curves to be perpendicular at a point.
- Define orthogonal trajectories.
- Calculate formulas for orthogonal trajectories.

In Interactive Assignment 9.3-3, we

- Introduce a basic mixing problem.
- Identify the key principles.
- Form the related initial value problem.
- Review the process for solving the IVP.
- Learn how to analyze our solution.

Section 9.4

In Interactive Assignment 9.4-1, we

- Define autonomous differential equations and equilibrium points.
- Explore the graphical features of autonomous differential equations.
- Define and learn how to sketch phase lines.
- Analyze solutions.
- Classify equilibrium.

In Interactive Assignment 9.4-2, we

- Generate the appropriate autonomous differential equation from the application.
- Generate the associated phase line.
- Explore how the features of the phase line are related to the application.

Section 9.5

In Interactive Assignment 9.5-1, we

- Introduce the basic definition and notation for systems of differential equations.
- Define autonomous systems of differential equation.
- Explore the graphical representation of these solutions.
- Introduce a process for sketching a phase portrait for a system of differential equations.

In Interactive Assignment 9.5-2, we

- Model an application problem using a first order system of differential equations.
- Generate the phase portrait of the system.

- Analyze the results.
- Explore the limitations of phase plane analysis.

Interactive Calculus, Chapter 10 table of contents

Section 10.1

In Interactive Assignment 10.1-1, we
- Introduce sequences and sequence notation.
- State an informal definition for the limit of a sequence.
- Learn how to evaluate the limit of a sequence.

In Interactive Assignment 10.1-2, we
- Learn some commonly occurring limit results.
- Manipulate given limits in order to use these known results.

In Interactive Assignment 10.1-3, we
- Learn a theorem for special sequences that are bounded and monotonic.
- Learn that a sequence can be defined in terms of a "recursion formula."

In Interactive Assignment 10.1-4, we
- Learn and use the precise definition of limit of a sequence.
- Learn the precise definition of divergence to infinity.

Section 10.2

In Interactive Assignment 10.2-1, we
- Learn about infinite series.
- Consider two special types of infinite series.
- Learn how to reindex and combine infinite series.

In Interactive Assignment 10.2-2, we
- Learn a useful test for divergence of infinite series.
- Consider examples using our current knowledge of infinite series.

Section 10.3

In Interactive Assignment 10.3-1, we
- Learn and use the Integral Test.

In Interactive Assignment 10.3-2, we
- Bound the error of a partial approximation.

Section 10.4

In Interactive Assignment 10.4-1, we
- Learn and use the Comparison Test.

Section 10.5

In Interactive Assignment 10.5-1, we

- Define absolute convergence.
- State and apply the Absolute Convergence Test.
- Provide a proof supporting the Absolute Convergence Test.

In Interactive Assignment 10.5-2, we

- State and apply the Ratio Test.
- Provide a proof supporting the Ratio Test.

In Interactive Assignment 10.5-3, we

- State and apply the Root Test.
- Provide a proof supporting the Root Test.

Section 10.6

In Interactive Assignment 10.6-1, we

- Define alternating series and provide some examples.
- State and apply the Alternating Series Test.
- Provide a proof supporting the Alternating Series Test.

In Interactive Assignment 10.6-2, we

- Define conditional convergence and show some examples.
- State and apply the Rearrangement Theorem for Absolutely Convergent Series.

In Interactive Assignment 10.6-3, we

- Review the various tests we have used and create a process for approaching new series.

Section 10.7

In Interactive Assignment 10.7-1, we

- Define power series.
- Explore how power series can be used to approximate functions.

In Interactive Assignment 10.7-2, we

- State and prove the Convergence Theorem for Power Series.
- State and prove a corollary that outlines the three cases of convergence for power series.
- Outline and demonstrate a process for determining the convergence for a particular power series.

In Interactive Assignment 10.7-3, we

- Explore the multiplication of power series.
- Learn differentiation of power series.

- Learn integration of power series.

Section 10.8

In Interactive Assignment 10.8-1, we
- State the formulas for Taylor and Maclaurin series.
- Use the formulas to generate series for infinitely differentiable functions.
- Derive the formulas for Taylor and Maclaurin series.

In Interactive Assignment 10.8-2, we
- State the definition of a Taylor polynomial of order "n".
- Calculate Taylor polynomials and use them to approximate functions on intervals.

Section 10.9

In Interactive Assignment 10.9-1, we
- State Taylor's Theorem and the associated formula.
- Use the theorem to show that certain series converge to a function.
- Use the theorem to bound the error in polynomial approximations.
- Provide a proof of Taylor's Theorem.

Section 10.10

In Interactive Assignment 10.10-1, we
- Define and apply the binomial series.
- Explore classic numerical and STEM applications.
- Derive and apply Euler's Identity.

In Interactive Assignment 10.10-2, we
- Express and then approximate nonelementary integrals using Taylor's series.
- Evaluate limits with indeterminant forms.

Interactive Calculus, Chapter 11 table of contents

Section 11.1

In Interactive Assignment 11.1-1, we

- Introduce curves in the plane defined by a parameter.
- Define parametric equations and parametric curves.
- Use parametric equations to graph a line segment and a circle.
- Examine the natural parametrization of the graph of a function.
- Parametrize a circle with a given starting point, direction, and number of turns.
- Parametrize circles at different locations in the plane.
- Parametrize ellipses.
- Convert between parametric and cartesian equations.

In Interactive Assignment 11.1-2, we

- Use parametric equations to describe the path of a point on a rolling wheel.
- Use parametric equations to describe the path that a point takes when it is attached to one wheel that is revolving around a fixed wheel.

Section 11.2

In Interactive Assignment 11.2-1, we

- Compute the slope $\frac{dy}{dx}$ at a point on a parametric curve.
- Compute $\frac{d^2y}{dx^2}$ at a point on a parametric curve.
- Derive the formula for area under a parametric curve.
- Work through two examples: an ellipse and a Lissajous curve.
- Justify (informally) the formula for the length of a parametric curve.
- Rigorously derive the formula for the length of a parametric curve.
- Make a connection between the length of $y = f(x)$ and the length of a parametric curve.

In Interactive Assignment 11.2-2, we

- Introduce the formula to calculate the centroid of a parametric curve.
- Justify the formula informally.
- Introduce the formula for surface area.
- Discuss the problem of computing the perimeter of an ellipse.
- Introduce the complete elliptic integral of the second kind and derive a series approximation for the integral.

Section 11.3

In Interactive Assignment 11.3-1, we

- Gain familiarity with the polar coordinate system.
- Graph simple curves in the plane using polar equations.
- Describe regions of the plane using polar inequalities.

- Convert between polar and Cartesian coordinates.
- Convert between polar and Cartesian equations.

Section 11.4

In Interactive Assignment 11.4-1, we

- Sketch the graph of $r = f(\theta)$ in the θr-plane.
- Use that graph to help sketch the graph of $r = f(\theta)$ in the xy-plane.
- Graph circles, lines, parabolas, and spirals using polar coordinates.
- Demonstrate how to graph $r = \sqrt{f(\theta)}$, given the graph of $r = f(\theta)$.
- Graph equations of the form $r^2 = f(\theta)$.
- Write the polar equation $r = f(\theta)$ as parametric equations in θ for x and y.
- Use the parametric equations to calculate $\frac{dy}{dx}$ at a point on the polar graph.

Section 11.5

In Interactive Assignment 11.5-1, we

- Introduce the formula for area bounded by a polar curve.
- Use ideas from calculus to derive the formula for the area bounded by a polar curve.
- Examine dA, the area differential.
- Introduce the formula for the area bounded by two polar curves.

In Interactive Assignment 11.5-2, we

- Introduce and justify the formula for the length of a polar curve.
- Use the formula to calculate the length of a cardioid.
- Compute length along $r = e^{\theta/10}$.
- Compute length along $r = \sin^3 \frac{\theta}{3}$.
- Note the difficulty of length problems in general.

Section 11.6

In Interactive Assignment 11.6-1, we

- Describe conic sections geometrically.
- Define the parabola geometrically.
- Derive Cartesian equations of a parabola in standard form.
- Define the ellipse geometrically.
- Derive Cartesian equations of an ellipse in standard form.
- Define the hyperbola geometrically.
- Derive the Cartesian equation of a hyperbola in standard form.
- Find equations for conic sections that are not centered at the origin.
- Examine the connection between polynomial equations and conic sections.
- Identify the conic section and its location from an equation in x^2, y^2, x, and y.

Section 11.7

In Interactive Assignment 11.7-1, we

- Define the eccentricity of a conic section.
- Define the directrices for ellipses and hyperbolas.
- Introduce the "focus-directrix" equation $PF = e \cdot PD$ that is common to all conics.
- Use the focus-directrix equation.
  $PF = e \cdot PD$ to derive a polar equation of a conic section with a given eccentricity.

In Interactive Assignment 11.7-2, we

- Use polar equations to describe lines in the plane.
- Use polar equations to describe circles in the plane.