This course supports the Calculus I objective exam. It covers 3 competencies.

Introduction

Overview

Calculus I is the study of rates of change in relation to the slope of a curve and covers the knowledge and skills necessary to apply differential calculus of one variable and to use appropriate technology to model and solve real-life problems. Topics include:

- functions,
- limits, continuity, differentiability, visual, analytical, and conceptual approaches to the definition of the derivative;
- the power, chain, sum, product, and quotient rules applied to polynomial, trigonometric, exponential, and logarithmic functions;
- implicit differentiation, position, velocity, and acceleration, optimization, related rates, curve sketching; and
- L'Hopital's Rule.

Pre-Calculus is a pre-requisite for this course.

Getting Started

Welcome to Calculus I! In this course you will read the textbook, watch videos, and then take diagnostics to make sure you learned what you needed from the book and videos. If you don't score well, you can review what you missed in the interactive textbook and see other examples and extended solutions to help you learn more before you take the diagnostic again. Repeat this cycle until you are successful, and then move on to the next set of readings, videos, and diagnostics. When the topics are all mastered, take the objective exam to demonstrate your competence in the Calculus topics.

Teaching Dispositions Statement

Please review the Statement of Teaching Dispositions.

Course Instructor Assistance

As you prepare to demonstrate competency in this subject, remember that course instructors stand ready to help you reach your educational goals. As subject matter experts, mentors enjoy and take pride in helping students become reflective learners, problem solvers, and critical thinkers. Course instructors are excited to hear from you and eager to work with you. Successful students report that working with a course instructor is the key to their success. Course instructors are able to share tips on approaches, tools, and skills that can help you apply the content you're studying. They also provide guidance in assessment preparation strategies and troubleshoot areas of deficiency. Even if things don't work out on your first try, course instructors act as a support system to help you prepare for another attempt. You should expect
to work with course instructors for the duration of your coursework, and you are encouraged to contact them as soon as you begin. Course instructors are fully committed to your success!

Preparing for Success

The information in this section is provided to detail the resources available for you to use as you complete this course.

Learning Resources

The learning resources listed in this section are required to complete the activities in this course. For many resources, WGU has provided automatic access through the course. However, you may need to enroll manually or acquire other resources independently. Read the full instructions provided to ensure that you have access to all of your resources in a timely manner.

Automatically Enrolled Resources

You can access the learning resources listed in this section by clicking on the links provided throughout the course. You may be prompted to log in to the WGU student portal to access the resources.

VitalSource E-Texts

The following textbooks are available to you as e-texts within this course. You will be directly linked to the specific readings required within the activities that follow.


*Note: These e-texts are available to you as part of your program tuition and fees, but you may purchase hard copies at your own expense through a retailer of your choice. If you choose to do so, please use the ISBN listed to ensure that you receive the correct edition.*

Thinkwell

You will access the materials in the following Thinkwell course at the activity level within this course. This web-based resource includes multimedia video lectures, review notes, interactive animations, and sample exercises.

- Thinkwell Calculus, ONLINE, CRN 03U

Other Resources

You will use the following learning resources for this course.

Pearson Study Plan

Follow the link to access Pearson’s Study Plan:

- Study Plan

Additional Preparations
Graphing Calculator
Acquire a graphing calculator and familiarize yourself with how to use it. Refer to the WGU Calculator and Scratch Paper Guidelines document for calculators permitted on WGU exams. If you are in a secondary mathematics program, refer to the “WGU Calculator Recommendations for Secondary Math and Science Programs” document for calculator suggestions for your degree program.

Guide for Successful Learning

This courses utilizes content from several different sources to guide your learning. Typically, you will begin a topic by reading in the textbook, and then watching a Thinkwell video. While there are other resources within the Thinkwell learning environment, we want you to focus on the video lectures within this resource. To access the videos, click "Course Home" in the upper left, navigate to find the correct section and then click "Watch Lecture".

After reading from the text book and watching the video, take the corresponding Diagnostic and try to succeed without using any notes or readings. Regardless of the score, use Review Results (click the word "Review" for in-depth help). The Review Results section of the textbook provides many features useful for self-guided learning. Select,

- "View an Example" to see the solution to a similar problem done step-by-step,
- "Help Me Solve This" to go through the solution interactively,
- "Video" to see a relevant presentation,
- "Animation" to view an interactive and/or animated illustration, or
- "Textbook" for a direct link to the relevant section of the textbook.

Consider yourself competent when you regularly score above 80% on all Diagnostics. You may also choose to use the Pearson Study Plan to work on objectives that you've missed; however, prior to using this study plan, you must “train” Pearson’s program by taking a lot of Diagnostics that cover most of the course content. A quick way to do this is to immediately attempt the “Diagnostic on the WGU Calculus I Course.”

For additional practice with the problems that generated the diagnostics, work on the customized homework problems for each section of the textbook.

Occasionally, you'll work through "Did I Get This?" problems, which have been carefully designed to resemble the exam but are often deeper or more conceptual than the Diagnostics (make sure you master the Diagnostic first).

At specific spots in the course, you will be invited to try a larger competency-level or whole-course Diagnostic in order to determine what needs further study. These are timed experiences that cover several sections and will give you good training for the preassessment and objective exam for the course.

Supplemental Activities

There might be times when you feel like you need more information or practice than what has
been provided in the course. In addition to consulting with your course instructor when you need help, you can access optional and supplemental activities by using the word "supplemental" in the Course Search box. These activities can be enriching, but they are not essential for becoming competent.

**Pacing Guide**

The pacing guide suggests a weekly structure to pace your completion of learning activities. It is provided as a suggestion and does not represent a mandatory schedule. Follow the pacing guide carefully to complete the course in the suggested time frame.

Week 1
- Self-Evaluation, Limits and Continuity

Week 2
- The Meaning of the Derivative

Week 3
- The Chain Rule and Advanced Differentiation

Week 4
- Rates of Change, Optimization and Curve Sketching

Week 5
- L’Hopital’s Rule, Prepare for Preassessment

Week 6
- Preassessment, Objective Exam

*Note: This pacing guide does not replace the course. Please continue to refer to the course for a comprehensive list of the resources and activities.*

**Calculus I**

Work through the topics and their activities in this course to earn competence in calculous.

**Limits and Continuity**

This topic will explore limits and continuity.

This topic addresses the following competency:

- **Competency 2004.1.1: Limits and Continuity**
  The graduate demonstrates a conceptual understanding of limits and continuity and
solves problems involving limits and continuity.

This topic highlights the following objectives:

- Determine where a function is continuous and not continuous through various methods (e.g., doing computations, inspecting graphs).
- Determine limits or that the limit does not exist through various methods (e.g., tables, graphs, or algebraic and numeric computations).

**Self-Evaluation and Technology Check**

If you are not familiar with Calculus, you should still do this self-evaluation. Feel free to submit immediately and get a score of zero. This will help train the Pearson Study Plan on which topics you need to learn.

- Complete the self-evaluation.
- Skim "Things to know and memorize" to get an idea of the scope of the course.
- Take the Diagnostic on WGU Calculus I Course.

If you score above 70% on the Diagnostic, you may choose to skip ahead to the final topic, “Prepare for Preassessment,” and fill in your gaps instead of going through the course linearly. Use your appropriate calculator to see how much of the needed skills you already know. It would also be a good idea to take the Diagnostic under exam-like conditions: whiteboard, marker, calculator, and a visible timer in a quiet room. You may also choose to set up your WGU camera to record yourself taking the test to simulate how it will feel with the proctor observing when you take the real assessment at the end of the course.

Follow the instructions below and become familiar with the links. Report any questions or issues to your course instructor.

- Make sure you can access the textbook.
- Find a long list of Calculus Diagnostics.
- Look at Review Results to see scores for everything you’ve taken.
- Make sure you can access the optional Pearson Study Plan.
- See if you can find the homework problems we think are useful.
- Open the "Did I Get This?" problem set.

**Self-Evaluation, Competency in Limits and Continuity**

Take the timed Diagnostic for Competence in Limits and Continuity. If you score above 80%, skip to the next topic.

**Rate of Change**

Read 2.1: Rates of Change and Tangents to Curves (pages 59-64)

Watch Thinkwell video lectures:

- 2.1.1: Finding Rate of Change over an Interval
• 3.1.1: Rates of Change, Secants, and Tangents
• 3.1.2: Finding Instantaneous Velocity

Complete the Diagnostic for 2.1, then Review Results.

Limit of a Function and Limit Laws

Read 2.2: Limit of a Function and Limit Laws (pages 66-77)

Watch Thinkwell video lectures:

• 2.1.2: Finding Limits Graphically
• 2.1.4: The Limit Laws, Part I
• 2.1.5: The Limit Laws, Part II

Complete the Diagnostic for 2.2, then Review Results.

The Precise Definition of a Limit

Read 2.3: The Precise Definition of a Limit (pages 77-86)

Watch Thinkwell video lecture:

• 2.1.3: The Formal Definition of a Limit

One-Sided Limits

Read 2.4: One-Sided Limits (pages 86-91)

Watch Thinkwell video lecture:

• 2.1.6: One-Sided Limits

Complete the Diagnostic for 2.4, then Review Results.

Complete Did I Get This?: Limits. (After Section 2.4)

Continuity

Read 2.5: Continuity (pages 93-102)

Watch Thinkwell video lecture:

• 2.1.8: Continuity and Discontinuity

Complete the Diagnostic for 2.5, then Review Results.

Complete Did I Get This?: Continuity. (After Section 2.5)

Limits Involving Infinity & Asymptotes
Read 2.6: Limits Involving Infinity; Asymptotes of Graphs (pages 104-115)

Watch the following videos:

- Calculus - Infinite Limits
- Limits at Infinity - Basic Idea and Shortcuts!
- Limits at Infinity – Basic Example and Shortcuts

Complete the Diagnostic for 2.6, then Review Results.

**Competency: Limits and Continuity**

Take the timed Diagnostic for Competence in Limits and Continuity. If you score above 80%, move on; otherwise, Review Results and retake the Diagnostic. If you haven't reached 80% in several cycles, contact your course instructor.

**The Meaning of the Derivative**

This topic will explore the meaning of the derivative.

This topic addresses the following competency:

- **Competency 2004.1.2: The Derivative**
  The graduate demonstrates a conceptual understanding of the derivative and finds the derivative of functions.

This topic highlights the following objectives:

- Identify the derivatives of basic algebraic, logarithmic, exponential, and trigonometric functions.
- Apply the sum, product, and quotient rules to find derivatives.
- Analyze the relationship among rates of change, tangent lines, secant lines, and derivatives at a point.
- Analyze the relationship between a function and its derivative (e.g., differentiability, higher order derivatives, relation of graphs).

**Tangents and the Derivative at a Point**

Read 3.1: Tangents and the Derivative at a Point (pages 123-126)

Watch Thinkwell video lectures:

- 3.2.2: Instantaneous Rate
- 3.2.3: The Equation of a Tangent Line
- 3.2.4: More on Instantaneous Rate

Complete the Diagnostic for 3.1, then Review Results.

**The Derivative and Differentiability**
Read 3.2: The Derivative as a Function (pages 128-133)

Watch Thinkwell video lectures:

- 3.1.3: The Derivative
- 3.1.4: Differentiability

Complete the Diagnostic for 3.2, then Review Results.

Derivatives of Reciprocals and Square Roots

Read 3.3: Differentiation Rules (pages 136-144)

Watch Thinkwell video lectures:

- 3.3.1: The Derivative of the Reciprocal Function
- 3.3.2: The Derivative of the Square Root Function

Complete the Diagnostic for 3.3a, then Review Results.

Power Rule

Review 3.3 Differentiation Rules (pages 136-144)

Watch Thinkwell video lectures:

- 4.1.1: A Shortcut for Finding Derivatives
- 4.1.3: Uses of the Power Rule

Complete the Diagnostic for 3.3b, then Review Results.

Product and Quotient Rule

Reread 3.3 Differentiation Rules (pages 136-144)

Watch Thinkwell video lectures:

- 4.2.1: The Product Rule
- 4.2.2: The Quotient Rule

Complete the Diagnostic for 3.3c, then Review Results.

Derivatives of Exponentials

Reread 3.3 Differentiation Rules (pages 136-144)

Watch Thinkwell video lectures:

- 5.2.1: Graphing Exponential Functions
- 5.2.2: Derivatives of Exponential Functions
Complete the Diagnostic titled 3.3 abcd, then Review Results.

**Ballistics**

Read 3.4: The Derivative as a Rate of Change (pages 146-152)

Watch Thinkwell video lectures:

- 7.1.1: Acceleration and the Derivative
- 7.1.2: Solving Word Problems Involving Distance and Velocity

Complete the Diagnostic for 3.4, then Review Results.

Complete Did I Get This?: Ballistics. (After Section 3.4)

**Derivatives of Trigonometric Functions**

Read 3.5: Derivatives of Trigonometric Functions (pages 156-160)

Watch Thinkwell video lectures:

- 5.1.1: A Review of Trigonometry
- 5.1.2: Graphing Trigonometric Functions
- 5.1.3: The Derivatives of Trigonometric Functions

Complete the Diagnostic for 3.5, then Review Results.

**The Chain Rule and Advanced Differentiation**

This topic will explore the chain rule and advanced differentiation.

This topic addresses the following competencies:

- **Competency 2004.1.2: The Derivative**
  The graduate demonstrates a conceptual understanding of the derivative and finds the derivative of functions.

This topic highlights the following objectives:

- Apply the chain rule to find derivatives.
- Find the derivative of implicitly defined functions.

**The Chain Rule**

Read 3.6: The Chain Rule (pages 163-168)

Watch Thinkwell video lectures:

- 4.3.1: An Introduction to the Chain Rule
- 4.3.2: Using the Chain Rule
- **4.3.3: Combining Computational Techniques**

Complete the Diagnostic for 3.6, then Review Results.

Complete Did I Get This?: Chain Rule (After Section 3.6)

**Implicit Differentiation**

Read 3.7: Implicit Differentiation (pages 171-174)

Watch Thinkwell video lectures:

- 6.1.1: An Introduction to Implicit Differentiation
- 6.1.2: Finding the Derivative Implicitly
- 6.2.1: Using Implicit Differentiation
- 6.2.2: Applying Implicit Differentiation

Complete the Diagnostic for 3.7, then Review Results.

**Derivatives of Logarithms**

Read 3.8: Derivatives of Inverse Functions and Logarithms (pages 177-184)

Watch Thinkwell video lectures:

- 5.3.1: Evaluating Logarithmic Functions
- 5.3.2: The Derivative of the Natural Log Function

Complete the Diagnostic for 3.8, then Review Results.

**COMPETENCY: The Derivative**

Take the timed Diagnostic for Competence in Derivatives. If you score above 80%, move on; otherwise, Review Results and retake the Diagnostic. If you haven't reached 80% in several cycles, contact your Course Instructor and get on the Help Line.

**Rates of Change**

This topic will explore rate of change.

This topic addresses the following competencies:

- **Competency 2004.1.3: Applications of Derivatives**
  The graduate applies concepts and techniques of differentiation to solve application problems.

This topic highlights the following objectives:

- Solve problems about position, velocity, and acceleration.
- Solve problems involving related rates.
Related Rates

Read 3.10: Related Rates (pages 193-198)

Watch Thinkwell videos:

- 7.4.1: The Pebble Problem
- 7.4.2: The Ladder Problem
- 7.4.3: The Baseball Problem
- 7.4.4: The Blimp Problem

Complete the Diagnostic for 3.10, then Review Results.

Complete Did I Get This?: Related Rates. (After Section 3.10)

Curve Sketching

Read 4.1: Extreme Values of Functions (pages 223-228)

Watch Thinkwell video lecture:

- 8.1.1: An Introduction to Curve Sketching

Complete the Diagnostic for 4.1, then Review Results.

Calculus Theorems

Read 4.2: The Mean Value Theorem (pages 231-237)

Watch Thinkwell video lecture:

- 8.1.2: Three Big Theorems

Complete the Diagnostic for 4.2, then Review Results.

Complete Did I Get This?: Mean Value Theorem (After Section 4.2)

If you’re feeling a bit overwhelmed by Calculus at this point, watch Thinkwell 8.1.3: Morale Moment, for morale booster.

Optimization and Curve Sketching

This topic will explore optimization and curve sketching.

This topic addresses the following competency:

- Competency 2004.1.3: Applications of Derivatives
  The graduate applies concepts and techniques of differentiation to solve application problems.
This topic highlights the following objectives:

- Analyze the behavior of a function using limits and derivatives.
- Solve applied optimization problems.

**Critical Points**

Read 4.3: Monotonic Functions and the First Derivative Test (pages 238-242)

Watch Thinkwell video lectures:

- 8.2.1: Critical Points
- 8.2.2: Maximum and Minimum
- 8.2.3: Regions Where a Function Increases or Decreases
- 8.2.4: The First Derivative Test

Complete the Diagnostic for 4.3, then Review Results.

You might also want to look at the Diagnostic for 2.6.

**Concavity, Graphing, and Asymptotes**

Read 4.4: Concavity and Curve Sketching (pages 244-253)

Watch Thinkwell video lectures:

- 8.3.1: Concavity and Inflection Points
- 8.3.2: Using the Second Derivative to Examine Concavity
- 8.4.1: Graphs of Polynomial Functions
- 8.4.2: Cusp Points and the Derivative
- 8.4.3: Domain-Restricted Functions and the Derivative
- 8.4.4: The Second Derivative Test
- 8.5.1: Vertical Asymptotes
- 8.5.2: Horizontal Asymptotes and Infinite Limits
- 8.5.3: Graphing Functions with Asymptotes
- 8.5.4: Functions with Asymptotes and Holes
- 8.5.5: Functions with Asymptotes and Critical Points

Complete the Diagnostic for 4.4, then Review Results.

Complete Did I Get This?: Derivative Tests. (After Section 4.4)

**Optimization**

Read 4.6: Applied Optimization (pages 264-270)

Watch Thinkwell video lectures:

- 7.3.1: The Connection Between Slope and Optimization
- 7.3.2: The Fence Problem
- 7.3.3: The Box Problem
- 7.3.4: The Can Problem
- 7.3.5: The Wire-Cutting Problem

Complete the Diagnostic for 4.6, then Review Results.

Complete Did I Get This?: Optimization. (After Section 4.6)

**L' Hopital's Rule**
This topic will explore L' Hopital’s Rule.

This topic addresses the following competency:

- **Competency 2004.1.3: Applications of Derivatives**
  The graduate applies concepts and techniques of differentiation to solve application problems.

This topic highlights the following objective:

- Apply L' Hopital's rule to find limits.

**L' Hopital's Rule**

Read 4.5: Indeterminate Forms and L' Hopital's Rule (pages 255-262)

Watch Thinkwell video lectures:

- 14.1.1: Indeterminate Forms
- 14.1.2: An Introduction to L' Hopital's Rule
- 14.1.3: Basic Uses of L' Hopital's Rule
- 14.1.4: More Exotic Examples of Indeterminate Forms

Complete the Diagnostic for 4.5, then Review Results.

Complete Did I Get This?: L' Hopital. (After Section 4.5)

**Prepare for Preassessment**
Take the timed Diagnostic for Competence in Applications of Derivatives. If you score above 80%, move on; otherwise, Review Results and retake the Diagnostic. If you haven’t reached 80% in several cycles, contact your Course Instructor and get on the Help Line.

**Prepare for Preassessment**

Prepare for the Preassessment by completing these activities.

Watch the following Thinkwell video:

- 13.1.2: Review: Calculus I in 20 Minutes
Review "Things to know and memorize" to make sure you've got them all:

- Things to know and memorize

Redo all the items in "Did I Get This?" without notes or the book:

- Did I Get This?

Use the Pearson Study Plan to focus on your remaining trouble spots (recall that this only works after you've taken multiple Diagnostics):

- Pearson Study Plan

**Preassessment**

You will now prepare to take the preassessment and the objective exam. **Take the Preassessment**

It is recommended that you complete the Preassessment under exam-like conditions: whiteboard, marker, calculator, and a visible timer in a quiet room, your WGU camera set up to watch you, just like the proctor will be doing when you take the real thing.

IMPORTANT NOTE: This exam does NOT let you go backwards; you must do your very best before moving on to the next item. The exam is designed so that multiple-step items are presented one step at a time, so if you get a step wrong, the next item starts you with the correct answer and asks you to do the next step.

In the Assessment tab above, the coaching report will show you which material(s) you ought to re-examine. Each line of the report is an exact match for one of the topics above. The highly-weighted topics are deep and require mastery of the earlier material, so sometimes you need to review more than what the coaching report shows. For example, it is impossible to solve a *rates of change* problem without already understanding the *meaning of the derivative* and being able to compute derivatives with the *chain rule* and other *advanced differentiation rules*.

**Take the Objective Exam**

If you do not pass, contact your course instructor.

**Final Steps**

Congratulations on completing the activities in this course! This course has prepared you to complete the assessments associated with this course. If you have not already been directed to complete the assessments, schedule and complete your assessments now.