

## MATH 104: Week 2 Learning Goals

### Learning Goals

The material in Week 2 includes studying the notion of continuity, and developing the notion of derivative. We will expand on ideas introduced in Week 1 to deepen our conceptual understanding of studying the rate of change of a function. We will work with **the derivative** and further our understanding by **interpreting the derivative** as the slope of a tangent line, and as an instantaneous rate of change. We introduce some of the basic rules of differentiation and consider the derivatives of the elementary functions (polynomials, logarithms, exponentials, trigonometric functions). NOTE: It will suffice for you to learn to *use* the derivatives of these elementary functions and the rules of differentiation, and we will not ask you to derive these formulas.

*We do not stress proofs in this course, but we encourage you to tackle the parts of the notes presenting proofs as you build confidence about your basic understanding of the concepts.*

The specific learning goals for this week are that by the end of the week and review homework, you should be able to:

1. calculate limits using the limit laws.
2. explain what it means for a function to be continuous at a point. you should be able to correctly analyze whether a given function is continuous at a given point.
3. identify points of discontinuity for a given function.
4. know the way continuous functions behave under basic algebraic operations, and use these results to correctly identify whether or not a given function is continuous at a point.
5. know the way continuous functions behave when they are composed.
6. identify whether or not a given function is continuous on a given interval. This includes identifying when a function is left- or right-continuous at the endpoints of a closed interval.
7. state the Intermediate Value Theorem and to apply it to simple situations such as determining whether or not a function has a zero in some interval.
8. compute the average rate of change of a function on an interval (started in Week 1) .
9. explain the notion of instantaneous rate of change at a given point and its role as the slope of the tangent line at that point (started in Week 1).
10. state the definition of the derivative and use it to compute the derivative of a given function in simple cases (such as those given in the exercises).
11. sketch the graph of  $f'$  given the graph of  $f$ .
12. explain using sketches of appropriate functions the relationship between continuity and differentiability.
13. interpret the derivative as the slope of a tangent line, and as an instantaneous rate of change.
14. use the power, sum, and constant multiple rules to differentiate, for example, polynomials.
15. use the derivative of an exponential function.

16. know the definition of “ $e$ ” as the base of the exponential function with the property that

$$\frac{d}{dx}(e^x) = e^x.$$

17. use the derivatives of the trigonometric functions, especially  $\sin x$ ,  $\cos x$ , and  $\tan x$ .

18. correctly state and use the product rule.

19. correctly state and use the quotient rule.

20. differentiate given functions using appropriate combinations of the rules of differentiation.

21. find equations of tangent lines to given functions at given points.

## Readings, Problems, and Assignments

**Readings:** In the CLP Notes: Chapter 1.6, 2.1 to 2.8; Section 2.5 is optional.

**Problems:** There are problems in the Problem Book for Chapter 1.6, 2.1 to 2.8. You should attempt as many as possible, including some of the harder ones.