

## Flipped IN-CLASS Lesson Plan Template

Topic or concept: Rules of Differentiation with Economics Applications

### Basic objectives for preparatory work:

- Use the Constant Functions rule to differentiate a constant function like  $f(x) = 10$ .
- Use the Power Functions rule to differentiate a power function like  $f(x) = x^{10}$ .
- Use the Sum Rule to differentiate a sum (or difference) of functions (for example,  $f(x) = x^4 + x^2 - 1$ ).
- Use the Product Rule to differentiate a product of two functions (for example,  $f(x) = (x+1)(x^3 - x^2 + 1)$ )
- Use the Quotient Rule to differentiate a function that is a ratio of two functions (for example,  $f(x) = (x - 2)/(x^2 - 1)$ )
- Use the Exponential Functions rule to differentiate an exponential function like  $f(x) = e^x$ .
- Use the Logarithmic Functions rule to differentiate a logarithmic function like  $f(x) = \ln x$ .
- State the mathematical formulas for marginal revenue and marginal cost.

### Advanced objectives for classwork & after class work:

- Use the computation rules of this module to find the derivatives of combinations exponential functions, logarithmic functions, and power/polynomial functions.
- Use the computational rules in this module to find marginal revenue and marginal cost.

	Time planned	Activity and rationale	Resources needed
Beginning of class period	15 mins	Review the pre-class quiz questions and answer questions raised in the discussion forum on Canvas.	Quiz results and discussion posts
Middle of period	30 mins	Lecture on “how to apply rules of differentiation to solve economics problems”	Lecture slides
Middle of period	25 mins	Practice solving problems on their own and discussing solutions with a neighbor  Have students write their answers on the board	Worksheets
End of period	5 mins	Comment on students’ solutions and summarize the key points.	Worksheets

	Time planned	Activity and rationale	Resources needed

## Flipped AFTER CLASS Work Plan Template

Advanced learning objective	Activity and rationale	Instructions to students
<ul style="list-style-type: none"> <li>• Use the computation rules of this module to find the derivatives of combinations exponential functions, logarithmic functions, and power/polynomial functions.</li> <li>• Use the computational rules in this module to find marginal revenue and marginal cost.</li> </ul>	<p>Complete the in-class worksheet</p> <p>Complete weekly problem sets which are similar to problems discussed in class.</p> <p>Post any questions on weekly discussion forum</p>	<ul style="list-style-type: none"> <li>• Go to Canvas → Course Homepage → Assignment → This week's problem set</li> <li>• Either type or handwrite your step-by-step solutions to each problem</li> <li>• You may work in groups but just be sure that YOU can solve problems independently</li> <li>• Problems sets are due at the beginning of next class</li> </ul>

## GUIDED PRACTICE

Class: ECON 104 Mathematical Methods of Economics

Date assigned: Monday morning

Date due: Wednesday before class

Time estimate to complete this assignment: 2 – 3 hours

### Overview/Introduction

What is this lesson about? Why do we care?

In the last two modules we reviewed different types of functions and how derivatives can represent slope and instantaneous rates of change. In this module, we will look at various rules for computing derivatives and apply these rules to calculate marginal cost and marginal revenue. After the module is over, you will be able to find the derivative of a power function, a polynomial function, an exponential function, a logarithmic function and their combinations. In addition, you will be able to calculate marginal cost and marginal revenue, which prepares you to answer the optimization problems in economics where we try to maximize profit or minimize cost.

### Learning Objectives

Basic objectives

List 3-5 learning objectives that you expect students to be able to master on their own before class.

- Use the Constant Functions rule to differentiate a constant function like  $f(x) = 10$ .
- Use the Power Functions rule to differentiate a power function like  $f(x) = x^{10}$ .
- Use the Sum Rule to differentiate a sum (or difference) of functions (for example,  $f(x) = x^4 + x^2 - 1$ ).
- Use the Exponential Functions rule to differentiate an exponential function like  $f(x) = e^x$ .
- Use the Logarithmic Functions rule to differentiate a logarithmic function like  $f(x) = \ln x$ .
- Use the Product Rule to differentiate a product of two functions (for example,  $f(x) = (x+1)(x^3 - x^2 + 1)$ ).
- Use the Quotient Rule to differentiate a function that is a ratio of two functions (for example,  $f(x) = (x - 2)/(x^2 - 1)$ ).
- State the mathematical formulas for marginal revenue and marginal cost.

Advanced objectives

List 3-4 learning objectives that you expect students to need help mastering.

- Use the computation rules of this module to find the derivatives of combinations exponential functions, logarithmic functions, and power/polynomial functions.
- Use the computational rules in this module to find marginal revenue and marginal cost

## Preparatory Activities and Resources:

1. Give detailed, action-oriented instructions for completing the Guided Practice assignment. Keep in mind that the activities should be minimal, simple, engaging, productive, and failure tolerant (see Talbert, 2017, pg. 135)
  - **Read** Chapter 4 of *Essential Mathematics for Economic Analysis*. As you read, jot down any questions that you have and post them on weekly discussion forum.
  - **Watch** the videos (links provided below in the playlist). After you watch each video, try to solve the problems from the video on your own.
2. Give a “playlist” of resources such as readings, videos, audio, or other content delivery methods that provide students the content to work with.
  - Reading: From *Essential Mathematics for Economic Analysis*, read Chapter 4
  - Video: Watch the following videos on Canvas:
    - Derivatives of Power Function <https://www.khanacademy.org/math/calculus-all-old/taking-derivatives-calc/power-rule-calc/v/power-rule> (3:53)
    - Derivative of Exponential Function <https://www.khanacademy.org/math/calculus-all-old/taking-derivatives-calc/exponential-functions-differentiation-calc/v/exponential-functions-differentiation-intro?modal=1> (5:24)
    - Derivative of Logarithmic Function <https://www.youtube.com/watch?v=R2JsJyr0ck> (6:00)
    - Sum Rule <https://www.youtube.com/watch?v=hZAS9iIEbEE> (10:00)
    - Product Rule <https://www.khanacademy.org/math/calculus-all-old/taking-derivatives-calc/product-rule-calc/v/applying-the-product-rule-for-derivatives> (2:39)
    - Quotient Rule <https://www.khanacademy.org/math/calculus-all-old/taking-derivatives-calc/quotient-rule-calc/v/quotient-rule-example?modal=1> (5:25)

Exercises: Please complete by Wednesday.

An open-book pre-class quiz will be due on Wednesday before class.

Sample quiz questions: Find the derivative of the following functions.

1.  $f(x) = 6x^3 - 9x + 4$
2.  $g(z) = 4z^7 - 3z^{-7} + 9z$
3.  $z = x(3x^2 - 9)$
4.  $h(x) = (4x^3 - 7x + 8)/x$
5.  $g(x) = e^x$
6.  $f(x) = \log_2 x$

## Questions?

Give a way for students to get help.

- Email: [rui.liu@sjsu.edu](mailto:rui.liu@sjsu.edu). (Response time is within 24 hours.)
- Office hours: MW 9-10am at DMH 143
- Canvas discussion forum: You may post any questions about course materials on weekly discussion forum. I will reply to these questions in the forum within 24 hours and go over selected questions in class.

## ADVANCED PRACTICE

This is given for students to complete after the class meeting in which they work together.

Class: ECON 104

Date assigned: Wednesday

Date due: Monday

Time estimate to complete this assignment: 3-4 hr

## Learning Objectives

### Advanced objectives

List 3-4 learning objectives that you expect students to need help mastering in class and after class.

- Use the computation rules of this module to find the derivatives of combinations exponential functions, logarithmic functions, and power/polynomial functions.
- Use the computational rules in this module to find marginal revenue and marginal cost.

## Activities & deliverables

1. Give detailed, action-oriented instructions for completing the assignment. Make sure to also include a reflective component.
2. Describe what students should turn in, by when.
  - Complete the in-class worksheet
  - Complete weekly problem set with step-by-step solutions
  - All students must post a “muddy point” question in the weekly discussion forum.
  - All assignments are due Monday before class

## Resources:

3. Give a “playlist” of resources to help students complete the assignment.  
Class notes; book chapter, videos, discussion posts
  - Reading:
    - From *Essential Mathematics for Economic Analysis*, read Chapter 4
    - Lecture slides posted on Canvas
    - Weekly discussion posts on Canvas
  - Video: Watch the following videos on Canvas:
    - Derivatives of Power Function <https://www.khanacademy.org/math/calculus-all-older/taking-derivatives-calc/power-rule-calc/v/power-rule> (3:53)
    - Derivative of Exponential Function <https://www.khanacademy.org/math/calculus-all-older/taking-derivatives-calc/exponential-functions-differentiation-calc/v/exponential-functions-differentiation-intro?modal=1> (5:24)
    - Derivative of Logarithmic Function <https://www.youtube.com/watch?v=R2JsJyr0ck> (6:00)
    - Sum Rule <https://www.youtube.com/watch?v=hZAS9iEbEE> (10:00)
    - Product Rule <https://www.khanacademy.org/math/calculus-all-older/taking-derivatives-calc/product-rule-calc/v/applying-the-product-rule-for-derivatives> (2:39)
    - Quotient Rule <https://www.khanacademy.org/math/calculus-all-older/taking-derivatives-calc/quotient-rule-calc/v/quotient-rule-example?modal=1> (5:25)
    - **Marginal Cost and Marginal Revenue** <https://www.youtube.com/watch?v=3x0tnqNWodI> (5:19)

## Questions?

Give a way for students to get help.

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- Canvas discussion forum: You may post any questions on weekly discussion forum. I will reply to these questions in the forum within 24 hours and go over selected questions in class.