**Math 1151**

**The Derivative of the Sine Function**

**Instructor Cover Sheet**

**Learning Outcomes:**

* This will reinforce the concepts of slope of a graph at a point and the derivative as a function.
* Discover the rule through exploration.

The purpose of this activity is to allow students to discover the derivative of the sine function by exploring the slope of its graph at any point on the interval . First, students enter an -value and click “Submit”. The graphing window on the left will display the tangent line to the graph of and two points. is the point of tangency, and is a second point on the line. Students are asked to enter the slope. They can either compute it by hand or enter the slope formula into the textbox. To proceed, they click “Next Pair”. The -value – slope pair is plotted as a point in the second graphing window, and the pair is recorded in the table in the Feedback section. Students should repeat this process until they are ready to enter a guess for a rule for the derivative of the sine function. If they make a mistake, the “Delete Pair” button will remove the last row in the table, and its associated point.

After entering five points, a “Guess” button will appear. When clicked, it will allow students to enter their guess for . After clicking “Submit Derivative”, the student’s guess will be graphed in graphing window with their points. If they are correct, the page will tell them and give them next steps. If they are incorrect, there will be a notification in the Feedback section above the table, and the page will prompt them to enter another -value – slope pair.

When entering their guess, students should only enter the rule for the function. It should not be preceded by y= or f’(x) =, etc. This is hinted at in the prompt, but if it is not followed, an error will be generated. Students can enter multiple guesses in a row by clicking the Guess button. Each time the second graph will be updated and students will be given feedback on their guesses.

The graphing windows are powered by Geogebra. Any entry into a textbox should use its entry syntax. The page that follows summarizes the major issues.

**Geogebra Syntax:**

* + for addition
* - for subtraction
* \* for multiplication
* / for division
* ^ for exponents
* sqrt() for square roots (the radicand must be in parentheses)
* parentheses for all grouping symbols
* pi for
* e for
* Geogebra only recognizes as an independent variable
* The transcendental functions are entered as usual, but they must be entered using lower case, and the arguments must always be in parentheses. For example, sin(x) is correct, but sin x, sin(X), Sin(x), etc will not be recognized. The same holds for all trig functions, inverse trig, and log functions.
* Multiplication can be shown by juxtaposition between a number and the independent variable or any expression in parentheses, but it will not work for a number and a named constant. For example, 2x will work as expected, but 2pi will generate an error. Either enter 2\*pi or 2(pi).

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**Directions:** This activity uses “The Derivative of the Sine Function” web page, which can be found in Blackboard. To start, enter an -value on the interval and click the Submit button. Next, use the points and on the tangent line tot compute the slope of the curve at this -value, enter this in the field and click “Next Pair”. Repeat this for several -value – slope pairs. The table in the Feedback section will keep track of your entries, and each pair will be plotted as a point on the graph of in the second window. Once you have a guess at a rule for , click the guess button to enter your hypothesis. If your hypothesis is wrong, you will be notified in the section between the Feedback heading and the table. If you can’t read the labels on the points, you can click and drag them to move them into a position you can see them.

1. Record your -value – slope pairs in the table below. Also, record any guesses you make for . If your guesses are incorrect, explain your reasoning that led to the guess, and find an -value – slope pair that proves your guess was not correct.

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**Next Steps**

1. Explain why the steps taken above do not constitute a proof of our conjecture about the derivative of the sine function. What would we need to do to prove our conjecture? Start this process and see how far you can get. You may need to look up some trigonometric identities to progress. Identify challenges that we encounter in attempting to prove this rule. What might we need to overcome these challenges?