

MA125 Assignment 3

Name:

- 1) Two MAPLE worksheets are posted on the website.

The first calculates the difference quotient for the function

$$f(x) = x^2 + 3x + 2$$

at $x = 2$ using the formula

$$\frac{f(x+h) - f(x)}{h}$$

for several values of h . It then computes the limit of the difference quotient as $h \rightarrow 0$,

$$\lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

The second worksheet does the same, but uses the alternative formula

$$\frac{f(x_2) - f(x_1)}{x_2 - x_1}$$

Download and execute both worksheets to verify that both forms of the difference quotient produce the same result.

What is the limit of the difference quotient (either form) for an arbitrary value of x ?

Think of this limit as a new function of x , defined by

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

provided the limit exists. How are the values of this new function at $x = 2$ related to the instantaneous rate of change of the original function at $x = 2$? Do you think this is true at any point in the domains of f and f' ?

- 2) Modify either of the worksheets in problem 1 to investigate the function

$$f(x) = \frac{1}{x}$$

You will need to modify the line starting with " $f := x \mapsto$ " to read

$$f := x \rightarrow 1/x;$$

What is the limit of the difference quotient for an arbitrary value of x for this function?

3) Modify either of the worksheets in problem 1 to investigate the function

$$f(x) = \sin(x)$$

You will need to modify the line starting with " $f := x \rightarrow$ " to read

$$f := x \rightarrow \sin(x);$$

What is the limit of the difference quotient for an arbitrary value of x for this function?

4) Modify either of the worksheets in problem 1 to investigate the function

$$f(x) = e^x$$

You will need to modify the line starting with " $f := x \rightarrow$ " to read

$$f := x \rightarrow \exp(x);$$

What is the limit of the difference quotient for an arbitrary value of x for this function?