3-3 Activity

At some point in the activity:

1. Argue why the arithmetic of the formula makes sense: Why change in y contains no “initial amount”. Argue why division is “how many in each group” division. Argue why it means that we are “sharing” the change in y among all the hours.
2. When is the average rate of change = the instantaneous rate of change (linear vs. non-linear). What is slope of the line/curve for various (small, large) intervals). Difference between rate at an instant vs. avg. rate over a period of time.

S-Z: p. 166 #50-53: compute the average rate of change of the given function over the interval [x, x + h]. Here we assume [x, x + h] is in the domain of the function. 50. f(x) = x 3 51. f(x) = 1 x 52. f(x) = x + 4 x − 3 53. f(x) = 3x 2 + 2x – 7

S-Z: p. 166 #55-56 Using data from Bureau of Transportation Statistics, the average fuel economy F in miles per gallon for passenger cars in the US can be modeled by F(t) = −0.0076t 2 + 0.45t + 16, 0 ≤ t ≤ 28, where t is the number of years since 1980. Find and interpret the average rate of change of F over the interval [0, 28].

56. The temperature T in degrees Fahrenheit t hours after 6 AM is given by: T(t) = − 1 2 t 2 + 8t + 32, 0 ≤ t ≤ 12 (a) Find and interpret T(4), T(8) and T(12). (b) Find and interpret the average rate of change of T over the interval [4, 8].

**Active Reading: 1.3.2:** A The interactive (Geogebra) graph below is that of a function D=f(t)D=f(t) where *D* is the number of miles a train is from downtown at tt hours after 8 am.s the time changes along the horizontal axis the result is the changing position of the train measured on the vertical axis. The key word here is “change”

Use the graph to find the change in distance between the 9:00 and 11:00 A.M..f(3)−f(1)≈ miles. What is the change in time between the 9:00 and 11:00 A.M.?The change in time is hour(s). What is the average speed (rate of change) between 9:00 and 11:00 A.M.?The average speed is

?

hours

miles

hours per mile

miles per hour

Use function notation (as in part a) to write an expression that represents the *change in distance* between the 10:00 A.M. and 1:00 P.M. The change in distance can be expressed as

(Note: Perhaps add: Predict the position of the train at some time. What would graph look like if the train moved at the average rate all the time?)

Active Reading: 1.3.9-10: Previously you were given the function f(x)=(x−2)(x+3) and you calculated f(0)=−6 and f(−2)=−4. Use these values to calculate the average rate of change of the function in two different directions.f(0)−f(−2)0−−2= f(−2)−f(0)−2−0= (Does order of subtraction matter)

APC: p. 28 1.3.2: According to the US census, the populations of Kent and Ottawa Counties in Michigan where GVSU is located¹ from 1960 to 2010 measured in 10-year intervals are given in the following tables. 1960 1970 1980 1990 2000 2010 363,187 411,044 444,506 500,631 574,336 602,622 Table 1.3.5: Kent County population data. 1960 1970 1980 1990 2000 2010 98,719 128,181 157,174 187,768 238,313 263,801 Table 1.3.6: Ottawa county population data. Let K(Y) represent the population of Kent County in year Y and W(Y) the population of Ottawa County in year Y.

a. Compute AV[1990,2010] for both K and W.

b. What are the units on each of the quantities you computed in (a.)?

c. Write a careful sentence that explains the meaning of the average rate of change of the Ottawa county population on the time interval[1990, 2010]. Your sentence 28 1.3 The Average Rate of Change of a Function should begin something like “In an average year between 1990 and 2010, the population of Ottawa County was . . .”

d. Which county had a greater average rate of change during the time interval [2000, 2010]? Were there any intervals in which one of the counties had a negative average rate of change?

e. Using the given data, what do you predict will be the population of Ottawa County in 2018? Why?

??(Note: write equation of a secant line?)

APC: 1.3.3: Let’s consider two different functions and see how different computations of their average rate of change tells us about their respective behavior. Plots of q and h are shown in Figures 1.3.8 and 1.3.9.

a. Consider the function q(x) 4 − (x − 2) 2 . Compute AV[0,1] , AV[1,2] , AV[2,3] , and AV[3,4] . What do your last two computations tell you about the behavior of the function q on [2, 4]?

b. Consider the function h(t) 3 − 2(0.5) t . Compute AV[−1,1] , AV[1,3] , and AV[3,5] . What do your computations tell you about the behavior of the function h on [−1, 5]? c. On the graphs in Figures 1.3.8 and 1.3.9, plot the line segments whose respective slopes are the average rates of change you computed in (a) and (b). 2 4 2 4 x y q(x) = 4 − (x − 2)2 Figure 1.3.8: Plot of q from part (a). 2 4 2 4 t y h(t) = 3−2(0.5) t Figure 1.3.9: Plot of h from part (b).

d. True or false: Since AV[0,3] 1, the function q is increasing on the interval (0, 3). Justify your decision. e. Give an example of a function that has the same average rate of change no matter what interval you choose. You can provide your example through a table, a graph, or a formula; regardless of your choice, write a sentence to explain.

APC: 1.3.4: Activity 1.3.4. Sketch at least two different possible graphs that satisfy the criteria for the function stated in each part. Make your graphs as significantly different as you can. If it is impossible for a graph to satisfy the criteria, explain why. a. f is a function defined on [−1, 7] such that f (1) 4 and AV[1,3] −2.. b. 1 is a function defined on [−1, 7] such that 1(4) 3, AV[0,4] 0.5, and 1 is not always increasing on (0, 4). c. h is a function defined on [−1, 7] such that h(2) 5, h(4) 3 and AV[2,4] −2.

APC p. 33: HW #3: Find the average rate of change of f (x) 3x 2 + 7 between each of the pairs of points below. (a) Between (3, 34) and (5, 82) (b) Between (c, k) and (q, t) (c) Between (x, f (x)) and (x + h, f (x + h))

APC 1.3 HW #6: After finding AV: Which of the statements below CORRECTLY explains the significance of your answer to part (b)? Select ALL that apply (more than one may apply). □ It is the average velocity of the car over the first two hours. □ It is the total distance the car travels in five hours. □ It is how far the car will travel in a half-hour. □ It represents the car’s velocity. □ It is the acceleration of the car over the five hour time interval. □ It is the slope of the line. □ None of the above

APC 1.3 HW #7: b. Based on the graph sketched below, match each of your answers in (i) - (iii) with one of the lines labeled A - F. Type the corresponding letter of the line segment next to the appropriate formula. Clearly not all letters will be used. D. Which of the statements below correctly explains the significance of your answer to part (c: Finding several AV’s) )? Select all that apply (more than one may apply). □ On average, the temperature is changing at a rate of 0.0072 degrees Celsius per minute over the interval 75 ≤ d ≤ 200 . □ 0.0072 is the slope of the graph of at d 75. □ The temperature changes by a total of 0.0072 degrees Celsius when moving from a depth 75 meters to 200 meters. □ Over the interval from 75 meters to 200 meters, the temperature changes on average at a rate of 0.0072 degrees Celsius per meter. □ The temperature is changing at a rate of 0.0072 degrees Celsius per minute when the depth is 75 meters. □ None of the above

APC !.3 HW #9: What can you observe about when the soda’s temperature appears to be changing most rapidly? d. Estimate the soda’s temperature when t 37 minutes. Write at least one sentence to explain your thinking.

MFG (1.4): 1.99:   
Which grow faster, Hybrid A wheat seedlings, which grow 11.2 centimeters in 14 days, or Hybrid B seedlings, which grow 13.5 centimeters in 18 days?

MFG 1.02: Which is steeper, Stony Point trail, which climbs 400 feet over a horizontal distance of 2500 feet, or Lone Pine trail, which climbs 360 feet over a horizontal distance of 1800 feet?

MFG 1.06: What is wrong with the following reasoning? The point (10,7) lies on the graph of a line, so the slope of the line is 7/10.

The slope is 10/7.7 is not an intercept.We need two points to compute the slope.The line is decreasing.

(Note: A slope is 1 or 2 numbers?)

MFG: 1.120: Comment on the following calculation: The intercepts of a line are (0,3) and (5,0), so the slope of the line is 5/3.It is true because we used two points.It is false because Δx and Δy have opposite signs.It is true because the values are increasing.  
 It is false because the slope is 3/5.

MFg 1.4: HW #19: Residential staircases are usually built with a slope of 70%,70%, or 710.710. If the vertical distance between stories is 1010 feet, how much horizontal space does the staircase require?

ORCCA: I-177 #50: A biologist has been observing a tree’s height. Fourteen months into the observation, the tree was 20.24 feet tall. Twenty months into the observation, the tree was 20.9 feet tall. What is the rate at which the tree is growing? In other words, what is the slope if you plotted height versus time? (Or price per minute on phone: #45).