Questions from last day's homework?

Read and understand p. 75 "**Need to Know**".
Complete: pp. 76-78 #2, 6, 7, 10, 12, 13

p. 77

7. Shelly has a cell phone plan that costs \$39 per month and allows her 250 free anytime minutes. Any minutes she uses over the 250 free minutes cost \$0.10 per minute. The function

$$C(m) = \begin{cases} 39, \text{ if } 0 \leq m \leq 250 \\ 0.10(m - 250) + 39, \text{ if } m > 250 \end{cases}$$

can be used to determine her monthly cell phone bill, where $C(m)$ is her monthly cost in dollars and m is the number of minutes she talks. Discuss how the average rate of change in her monthly cost changes as the minutes she talks increases.

$200 \leq m \leq 249$

$$\text{aroc} = m_{secant} = \frac{\Delta C}{\Delta t} = \frac{C(249) - C(200)}{249 - 200} = \frac{39 - 39}{49} = 0$$

$\therefore$ on average, the rate of change in price is 0 from 0 to 250 minutes

$255 \leq m \leq 265$

$$\frac{\Delta C}{\Delta t} = \frac{C(265) - C(255)}{265 - 255}$$

$$= \frac{0.1(265-250)+39-(0.1(255-250)+39)}{10}$$

$$= \frac{0.1(15)+39-(0.1(5)+39)}{10}$$

$$= 1.5+39-(0.5+39)$$

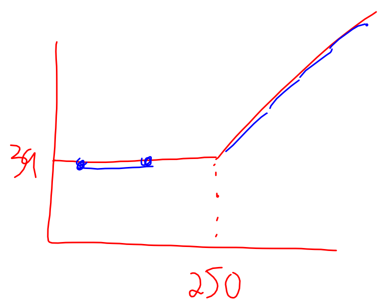
$$= \frac{40.50 - 39.50}{10}$$

$$= \frac{1}{10}$$

$$= 0.1$$

$300 \leq m \leq 320$

$$\text{aroc} = \frac{C(320) - C(300)}{320 - 300} = \frac{46 - 44}{20} = \frac{2}{20} = 0.10$$



p. 77 **10.** A company that sells sweatshirts finds that the profit can be modelled by $P(s) = -0.30s^2 + 3.5s + 11.15$, where $P(s)$ is the profit, in thousands of dollars, and s is the number of sweatshirts sold (expressed in thousands).

a) Calculate the average rate of change in profit for the following intervals.

i) $1 \le s \le 2$ **ii)** $2 \le s \le 3$ **iii)** $3 \le s \le 4$ **iv)** $4 \le s \le 5$

b) As the number of sweatshirts sold increases, what do you notice about the average rate of change in profit on each sweatshirt? What does this mean?

c) Predict if the rate of change in profit will stay positive. Explain what this means.

$$\frac{\Delta P}{\Delta n} = \frac{P(\quad) - P(\quad)}{\quad - \quad}$$

$-0.30s^2 + 3.5s + 11.15$

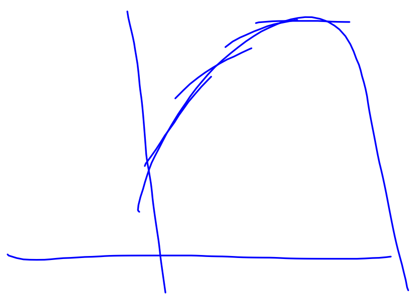
$$\frac{\Delta P}{\Delta n} = \frac{P(2) - P(1)}{2 - 1}$$

$$= \frac{-0.3(2)^2 + 3.5(2) + 11.15 - \left(-0.3(1)^2 + 3.5(1) + 11.15\right)}{1}$$

$$= \frac{16.95 - 14.35}{1}$$

$$= 2.60 \ \frac{\text{thousand}}{\text{thousand}} \rightarrow \frac{\$2600}{1000}$$

$= \$2.60/\text{shirt}$



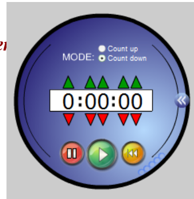
2.2 Estimating Instantaneous Rates of Change from Tables of Values and Equations (Part 1)

Math Learning Target:

"I understand what average rate of change and instantaneous rate of change are, and the difference between the them.
Also, I can determine a reasonable estimate for the instantaneous rate of change using the methods presented, and interpret the result."

***INVESTIGATE** the Math (Page 79, A - G)*

10 min. timer



Time, t (s)	6.0	6.2	6.4	6.6	6.8	7.0
Distance, $d(t)$ (cm)	208.39	221.76	235.41	249.31	263.46	277.84

A. Calculate the average rate of change in the distance that thepebble fell during each of the following time intervals.

1) $6.0 \le t \le 6.4$ **2)** $6.2 \le t \le 6.4$ **3)** $6.4 \le t \le 7.0$

preceding interval

following interval

$$aroc = \frac{\Delta d}{\Delta t}$$

$$= \frac{235.41 - 208.39}{6.4 - 6.0}$$

$$= \frac{27.02}{0.4}$$

$$= 67.55 \text{ cm/s}$$

$= 68.25$

$= 70.716$

$\doteq 70.72$

4) $6.4 \le t \le 6.8$ **5)** $6.4 \le t \le 6.6$

$= 70.125$

$\doteq 70.13$

$= 69.5$

B The ***instantaneous rate of change*** in the distance at t = 6.4 s is about 69 cm/s.
Look at smallest intervals using 6.4 as an endpoint.

C $6.2 \le t \le 6.6$

$= 68.875$ cm/s

centred interval

D It is the place where we want to know the instantaneous rate of change.

E By seeing the rate of change on both sides of 6.4, it will be easier to guess the rate of change at 6.4 because it will need to be somewhere in between those calculations. The best estimates come from the smallest intervals on either side of 6.4 s.

F 6.4 s is the midpoint of this interval. It balances the estimation error that results when only a single interval is used on either side of the value (above or below) for which the instantaneous rate of change is to be determined.

G No. I am able to guess what it might be but there are no values to the right of t = 7.0 to verify that the rate of change chosen might be correct.

2.2_1 Estimating Instantaneous R of C from T of V and Equations-f18e-post Sept.19/18

We now understand the concept of the average rate of change.

The ***instantaneous rate of change*** is the rate of change at one specific value ***x = a*** for a function ***y =f(x)***.
We begin by learning how to *approximate* it.

preceding interval
an interval of the independent variable of the form $a - h \leq x \leq a$, where h is a small positive value; used to determine an average rate of change

following interval
an interval of the independent variable of the form $a \leq x \leq a + h$, where h is a small positive value; used to determine an average rate of change

HW pp. 85-88 #1, 2a, 3, 8, 14

Ex.1:
A bacteria culture is growing exponentially and the population, *P*, is given by $P(n) = 200(1.2)^n$, where *n* is the number of hours.
Estimate, to the nearest tenth, the instantaneous rate of change at 5 hours, by using:

a) at least three preceding intervals
b) at least three following intervals

$$\frac{\Delta P}{\Delta n} = \frac{P(\quad) - P(\quad)}{\quad - \quad}$$

$$\frac{\Delta P}{\Delta n} =$$

a) preceeding intervals

$4.9 \leq n \leq 5$

$$iroc = \frac{\Delta P}{\Delta n}$$

$$\frac{\Delta P}{\Delta n} = \frac{P(5) - P(4.9)}{5 - 4.9}$$

$$\frac{\Delta P}{\Delta n} = \frac{200(1.2)^{5} - 200(1.2)^{4.9}}{5 - 4.9}$$

$$\doteq \frac{497.7 - 488.7}{0.1}$$

$$\doteq \frac{8.99}{0.1}$$

$$\doteq 89.91$$

$$\doteq 89.9$$

$4.99 \leq n \leq 5$

$$\frac{\Delta P}{\Delta n} = \frac{200(1.2)^{5} - 200(1.2)^{4.99}}{5 - 4.99}$$

$$\doteq 90.65$$

$$\doteq 90.7$$

$4.999 \leq n \leq 5$

$$\frac{\Delta P}{\Delta n} = \frac{200(1.2)^{5} - 200(1.2)^{4.999}}{5 - 4.999}$$

$$\doteq 90.72$$

$$\doteq 90.7$$

b) following intervals

$5 \leq n \leq 5.1$

$$\frac{\Delta P}{\Delta n} = \frac{200(1.2)^{5.1} - 200(1.2)^{5}}{5.1 - 5}$$

$$\doteq 91.57$$

$$\doteq 91.6$$

$5 \leq n \leq 5.01$

$$\frac{\Delta P}{\Delta n} = \frac{200(1.2)^{5.01} - 200(1.2)^{5}}{5.01 - 5}$$

$$\doteq 90.82$$

$$\doteq 90.8$$

$5 \leq n \leq 5.001$

$$\frac{\Delta P}{\Delta n} = \frac{200(1.2)^{5.001} - 200(1.2)^{5}}{5.001 - 5}$$

$$\doteq 90.74$$

$$\doteq 90.7$$

$$\text{Estimate} = \frac{90.72 + 90.74}{2}$$

$$\doteq 90.73$$

$$\doteq 90.7$$

it appears the populaton is growing
at exactly 5 hours by about 90.7 bacteria per hour.