Math 4 Name_____

5-1 Introduction – Average Rate of Change

Date_____

One of the most important topics in beginning Calculus is to understand average and instantaneous rate of change of a function. While these concepts might sound complicated, they are very similar to content you have learned in the past.

To analyze the **average rate of change** (A_{ROC}), for a given time interval of a function $f(x)$, use the following formula:

$$A_{ROC} = \frac{\Delta y}{\Delta x} = \frac{f(x_2) - f(x_1)}{x_2 - x_1} = \frac{y_2 - y_1}{x_2 - x_1}$$

The A_{ROC} is the same as what formula that you are familiar with?

Use the below problems to help you further understand A_{ROC}.

When it comes to American median habits, the growth of blogs, emails, and music downloads has exceeded all expectations – though some old-media favorites have fared surprisingly well (data from *Newsweek* magazine, summer of 2010).

Based on the below data:

1.) Calculate A_{ROC} for each media category. **Label each quantity with the correct units.**
2.) Indicate if the category is increasing, decreasing, or has no change.

iTUNES DOWNLOADS	
2000	2010
0	10 billion

$= \frac{10 \text{ bill} - 0}{2010 - 2000}$

$= \frac{10 \text{ billion}}{10 \text{ yrs.}} =$ 1 billion downloads per year

DAILY GOOGLE SEARCHES	
2000	2010
100 million	2 billion

$= \frac{2 \text{ billion} - 100 \text{ mill}}{2010 - 2000}$

$=$ 1,900,000,000 searches/yr.

DAILY NEWSPAPERS	
2000	2010
1,480	1,302

$= \frac{1302 - 1480}{2010 - 2000}$

$= \frac{-178}{10} =$ -17.8 papers/yr.

DAILY LETTERS MAILED	
2000	2010
207.88 billion	175.67 billion

$= \frac{175.67 - 207.88}{10}$

$= \frac{-32.21}{10} =$ -3.221 billion letters/yr.

REALITY TV SHOWS	
2000	2010
4	320

$= \frac{320 - 4}{10}$

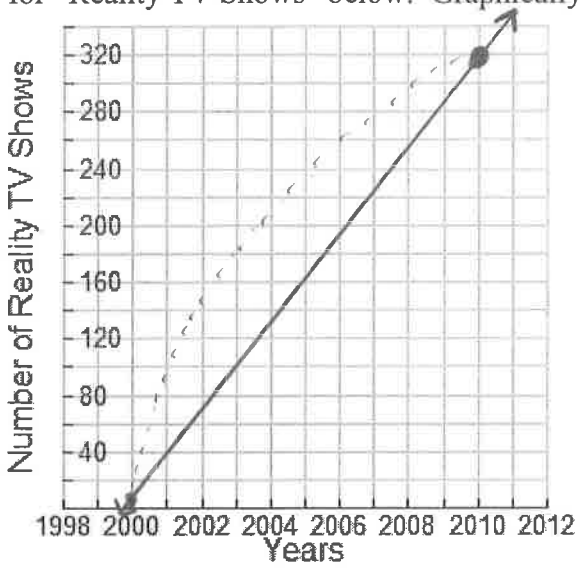
$= \frac{316}{10} =$ 31.6 shows/yr.

CD SALES REVENUE	
2000	2010
$943 million	$427.9 million

$= \frac{427.9 - 943}{10}$

$= \frac{-515.1}{10} =$ -$51.51 million per year

3.) Graph the data for "Reality TV Shows" below. Graphically represent the A_{ROC}.



4.) Do you think this graphical representation of A_{ROC} represents the typical growth of Reality TV Shows?

No. They most likely have not grown at a constant rate the past 10 years.

5.) Explain what the A_{ROC} represents in terms of Reality TV Show growth.

It represents the average yearly growth for those 10 years.

6.) On the grid above, draw a graphical representation that you think represents the actual growth of Reality TV Shows.

✓

Hopefully their growth rate is decreasing...

OVER →

Below is data for the average price of a movie ticket in North America over several years.

Year	1987	1991	1995	1999	2003	2007	2009
Price ($)	3.91	4.21	4.35	5.06	6.03	6.88	7.50

7.) Find the average rate of change from 1995 to 2003. Label your answer with the correct units.

$= \frac{6.03 - 4.35}{2003 - 1995} = \frac{\$1.68}{8 \text{ yrs}} = \boxed{\$0.21/\text{year}}$

8.) Find the average rate of change from 1999 to 2007. Label your answer with the correct units.

$= \frac{6.88 - 5.06}{2007 - 1999} = \frac{\$1.82}{8 \text{ yrs}} = \boxed{\$0.2275/\text{year}}$

9.) Find the average rate of change from 2003 to 2007. Label your answer with the correct units.

$= \frac{6.88 - 6.03}{2007 - 2003} = \frac{\$0.85}{4 \text{ yrs}} = \boxed{\$0.2125/\text{yr}}$

10.) Do you think the function that models this data is linear? Explain

Not perfectly linear, but close. The AROCs were all very similar.

Below is data for the time it takes a batter to run the first 15 feet to first base in a softball game.

Run to First Base	
x Time (seconds)	y Distance (feet)
0.00	0.0
0.68	3.0
0.96	6.0
1.18	9.0
1.36	12.0
1.52	15.0

11.) Find A_{ROC} for the interval of 0.00 to 0.68. Label your answer with the correct units.

$= \frac{3 - 0}{0.68 - 0} = \frac{3 \text{ ft}}{0.68 \text{ sec}} \approx \boxed{4.41 \text{ ft/sec}}$

12.) Find A_{ROC} for the interval of 0.68 to 0.96. Label your answer with the correct units.

$= \frac{6-3}{0.96-0.68} = \frac{3 \text{ ft}}{0.28 \text{ sec}} \approx$ 10.71 ft/sec

13.) Find A_{ROC} for the interval of 1.36 to 1.52. Label your answer with the correct units.

$= \frac{15-12}{1.52-1.36} = \frac{3 \text{ ft}}{0.16 \text{ sec}} =$ 18.75 ft/sec

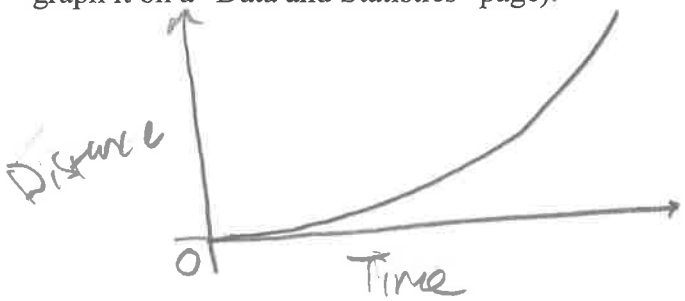
14.) Do you think the function that models this data is linear? Explain.

No. The average rate of change is quite different for each interval.

15.) What is happening with the A_{ROC} as time increases? What does that mean about the rate of increase of the function?

As time increases, the AROC also increases. The function is increasing at an increasing rate.

16.) Sketch what you think the shape of a graph of this data will look like. Check your answer by graphing the data on your calculator (enter the data into a "Lists and Spreadsheet" page and then graph it on a "Data and Statistics" page).



17.) Describe the motion of the runner over time for the first 15 feet of the run towards first base.

They are gaining speed the longer they run.