Average & Instantaneous Rate of Change

w-up: Graph $y = \frac{1}{4}x^2$

Average Rate of Change VS. Instantaneous Rate of Change

How do we find the average for a set of data?

Average Rate of Change: Average change over an INTERVAL which is the slope of the *secant* line.

EX 1) Find the average ROC for $f(x) = \frac{1}{4}x^2$ for the given intervals.

A) [1, 4] B) [1, 2] C) [1, 1.01]

Instantaneous Rate of Change: the change at any moment which is the slope of the tangent line AT a point

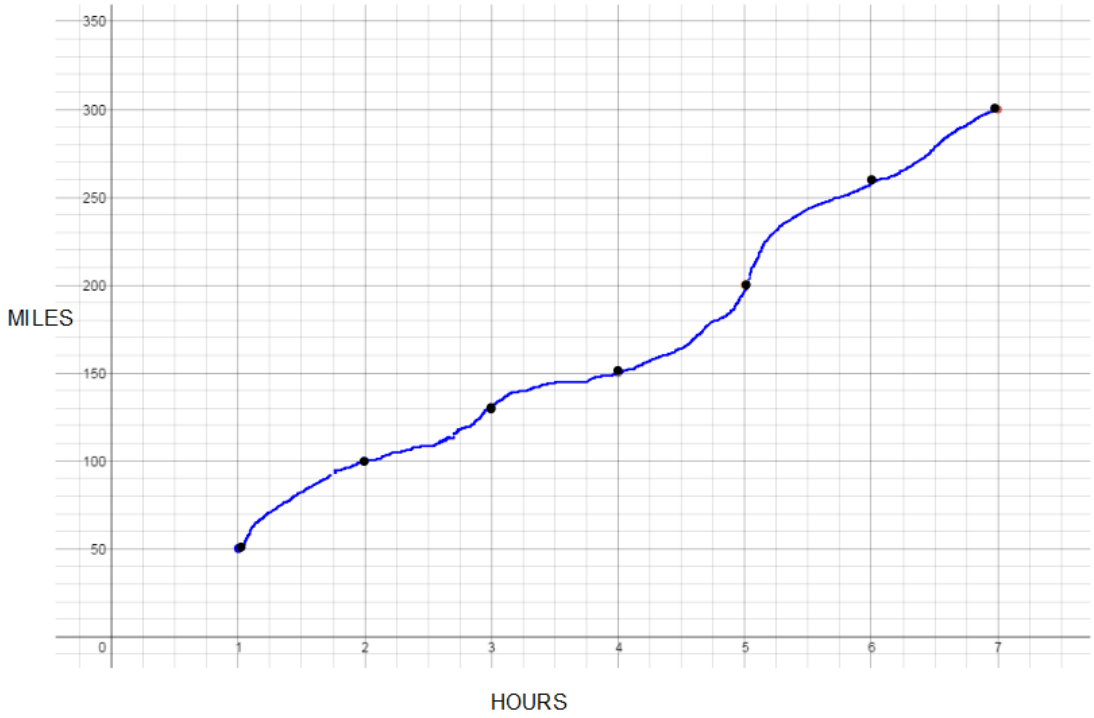
EX 2) Find the instantaneous ROC for $f(x) = \frac{1}{4}x^2$ at x = 1.

Notice when using an interval where Δx is extremely small("C" from example #1) the average rate of change is close to the _____

Linear Approximation: Using the average ROC over a very small interval to approximate the instantaneous ROC

AP Application of Linear Approximation

The following graph represents the distance a car has traveled after a certain time(in hours)



Find the average ROC **from** hour 3 to hour 4. Label your answer. What have you found?

Estimate the instantaneous ROC **at** hour 4. Label your answer. What have you found?

Note: Finding slope(derivative) on a distance vs. time graph yields **velocity**(speed in this case)

Rectilinear Motion

Rectilinear Motion: motion of an object moving in a straight line.

The ***derivative*** of any POSITION function is instantaneous velocity.

The ***derivative*** of any VELOCITY function is instantaneous acceleration.

NOTE: Because slope can be negative, both velocity and acceleration can be a negative value. This simply implies DIRECTION of the movement.

Positive velocity/acceleration means movement RIGHT or UPWARD

Negative velocity/acceleration means movement LEFT or DOWNWARD

SPEED: the magnitude(quantity) of velocity so Speed = |Velocity|

Higher Order Derivatives are derivatives of derivatives and can be noted with extra "prime tick marks"

$f(x)$ function
$f'(x)$ first derivative of the function
$f''(x)$ second derivative of the function
$f^n(x)$ nth derivative of the function

Projectile Formula

$$H(t) = -16t^2 + V_o t + h_o$$

represents the Height(in feet) of an object *H(t)* after time *t*(in seconds) when thrown straight into the air where V_o represents original velocity and h_o represents original height.

So, the distance(height) over time function for an object thrown straight into the air with velocity of 88 ft/sec from 25 feet is $H(t) = -16t^2 + 88t + 25$. This can now find the height of this object after time *t*.

EX) What is the height when t = 2?

EX) When is the object at 50 feet?

EX) What is the velocity at t = 2 seconds?

EX) What is the acceleration at t = 2 seconds?