1E/1F: Applications

In this activity, we will explore some applications of the *average rate of change* and the *difference quotient.*

- The ***average velocity*** of the projectile is measured by the *rate of change* over a certain interval.
- If we want to find the ***instantaneous velocity*** at time t, we find the value of the *difference quotient* at time t as $h \to 0$.

1. A ball is launched vertically in the air with a velocity of $64\frac{ft}{sec}$. The equation for the height of the ball at t seconds is $v(t) = 64t - 16t^2$
   Find the average rate of change for the given intervals:
   a. [0,1]

   b. [1,2]

   c. [2,3]

   d. [3,4]

   e. Explain what these rates of change tell us about the movement of the ball during the first 4 seconds of its flight.

   f. Find the difference quotient for $v(t) = 64t - 16t^2$.

   g. What is the limit of this quotient as h goes to 0?

   Use this function D(t) to fin the instantaneous velocity at the following times
   h. $t = 0$

   i. $t = 1$

   j. $t = 2$

   k. $t = 3$

   l. $t = 4$

2. A ball is launched off of a 96 foot tall building. The position of the ball can be modeled by the function $s(t) = -16t^2 + 48t + 96$. The average rate of change of a the position function tells us the *vertical speed* of the ball. Find the rate of change on the following intervals:
   a. [0,1]

   b. [1,2]

   c. [2,3]

   d. [3,4]

   e. Describe what is happening to the ball during each of the intervals above.

3. A certain population of protozoan has an initial population of 10. The population growth can be modeled by $g(t) = 10(1.15^t)$ for time in days.

   Find the average rate of change to the nearest hundredth for the given intervals of days.
   a. [0,1]

   b. [1,2]

   c. [2,3]

   d. [3,4]

   e. In reality, can this type of population growth continue this way?