3.1 Derivative Practice

Instructions: You can use a calculator for computing with numbers but don’t use one to find derivatives or to graph the functions. We are working on skills to reason and calculate without those tools. Sketching a graph for your own reasoning would be good.

1. I took some data from my car and found a formula that tells me how far I have gone when I slow down by taking my foot of the gas, but not pressing on the break. At a certain speed, at a certain position past a stoplight, the function for my position, s, in feet, at time (t) in seconds is given by: s(t)= -.75t2 + 45t + 100. The stoplight is at position s=0. Remember to put on the appropriate units for each answer.
   1. How far past the stoplight was I when I took my foot off the gas?
   2. How long did it take to come to a complete stop?
   3. How far did the car travel during the slowdown?
   4. What was my initial speed when I took my foot off the gas?
   5. How fast was the car going 10 seconds after I started slowing down?
   6. How fast was the car going 20 seconds after I started slowing down?
   7. How fast was the car going at the halfway-time into the slowdown (at the time that was halfway between taking my foot off the gas and stopping)?
   8. How fast was the car going at the halfway-position into the slowdown (at the time when the car was exactly the same distance from the point when it started to slow down, and the point where it stopped)?
2. One of the things that Newton is famous for is deriving the formula for the gravitational force on two objects: F=GMm/(d2), where M and m are the masses of the two objects, d is the distance between their centers of gravity, and G is a gravitational constant that scales everything and makes all the units work out. I did some work to create a simple formula based on this one where you can use your weight in lbs (when on the surface of the earth), and the distance is measured in miles.

for d≥3950 miles.

* 1. Put in your weight in lbs (or a weight of your friend). You can use my weight of 200 lbs if you would like. Verify that you get your weight (or my weight) when on the surface of the earth (the earth has a radius of about 3950 miles).
  2. What is your weight when you are flying in an airplane about 6 miles above the surface of the earth?
  3. Use your calculations form b. to find the average rate of change in your weight with respect to the distance from earth (from the center of the earth actually).
  4. Find P’(3950) (or at d=3950) and explain the meaning of this value.
  5. Use the value in d. to explain why they don’t calibrate bathroom scales differently for cities at sea level and high cities like Denver or Salt Lake City.
  6. How did your values compare from c. and d.? Why do you think that is?

1. When a skydiver jumps out of a plane, his/her velocity, in miles/hour, t-seconds after jumping is given by This assumes that they are spread-eagle, not feet first. We are also considering velocity to be positive when the person is falling. The derivative of an exponential function is . (This isn’t something the book has taught yet, it has only taught that = , but there are not many applications that fit exactly Usually, we modify it to but we don’t know how to handle that situation yet either.)
   1. How fast is the skydiver falling when he/she first jumps out of the plane?
   2. What is the velocity of the skydiver after 1 second?
   3. How fast is the skydiver’s velocity changing at time=0? At t=1? At t=2?
   4. What are the units for your values in c.?
   5. How fast is the skydiver’s velocity changing at 10 seconds after jumping? (U1se appropriate units).
   6. Compare the result of e. to the results in c. Why do these values make sense in this situation?
   7. What is the terminal velocity of a skydiver? (The terminal velocity is the maximum velocity the skydiver reaches).