MATH 133 – Calculus with Fundamentals 1
Rates of Change, Slopes of Tangents
September 26, 2017

Background

We are now ready to move into Chapter 2 of our text and consider average rates of change, and eventually limits and tangent lines. *This is really the start of the subject of calculus itself.* Everything we have done up until now has been review of precalculus topics to prepare!

Questions

1) A ball dropped from a height of 40 meters and from a state of rest at time $t = 0$ has height $s(t) = 40 - 4.9t^2$ meters at time t seconds.

   (a) How far does the ball travel between $t = 1$ and $t = 1.5$? What is the ball's average velocity over that interval? (Note: Your answer should be negative. That just means the ball is moving downward.)

   (b) Complete the following table by following the same steps you did in part (a) for each of the given intervals. Use at least 5 decimal places in all calculations for these.

interval	$[1, 1.1]$	$[1, 1.01]$	$[1, 1.001]$	$[1, 1.0001]$
ave.vel.				

   (c) Using this information, estimate the velocity of the ball *right at the instant* $t = 1$. This is called the *instantaneous velocity* of the ball at that time.

   (d) Now repeat part (b) for these intervals *ending at* $t = 1$:

interval	$[0.9, 1]$	$[0.99, 1]$	$[0.999, 1]$	$[0.9999, 1]$
ave.vel.				

   Are these results consistent with what you did before in part (b)? (They should be!)

2) The fungus *Fusarium exosporium* infects a field of flax plants through the roots and causes the plants to wilt. Eventually the entire field is infected. The percentage $f(t)$ of infected plants as a function of time t (in days) is given in Table 1 (on the back of the page).

   (a) Plot the points $(t, f(t))$ given in the table and connect to make a smooth curve.

   (b) Use your graph to say which is largest, and which is smallest of
   - the average infection rate over the time interval $[0, 10]$,
   - the average infection rate over the time interval $[20, 30]$,
   - the average infection rate over the time interval $[40, 50]$

   (c) Using the table, compute the actual values of the average infection rates (in units of percent per day) over the intervals given in part (b).

   (d) Draw a line tangent to your graph at $t = 40$. Estimate its slope from the information you have.

$t =$ time in days	0	10	20	30	40	50	60
$f(t) =$ percent infected	0	18	56	82	91	96	98

Table 1: Percent of flax plants infected as function of time in days