Math 151.01, Applied Calculus, Fall 2016
Section 1.1

8 a The statement $f(40) = 370$ means that $C = 370$ when $t = 40$. In other words, in the year 2000, the concentration of carbon dioxide in the atmosphere was $370ppm$

b The expression $f(50)$ represents the concentration of carbon dioxide in the year 2010.

11 Substituting $x = 5$ into $f(x) = 10x - x^2$ gives

$$f(5) = 10(5) - (5)2 = 50 - 25 = 25.$$

13 Looking at the graph, we see that the point on the graph with an x-coordinate of 5 has a y-coordinate of 2. Thus

$$f(5) = 2$$

15 (a) We are asked for the value of y when x is zero. That is, we are asked for $f(0)$. Plugging in we get

$$f(0) = (0)2 + 2 = 0 + 2 = 2.$$

(b) Substituting we get

$$f(3) = (3)2 + 2 = 9 + 2 = 11$$

(c) Asking what values of x give a y-value of 11 is the same as solving

$$y = 11 = x^2 + 2x^2 = 9 \longrightarrow x = \pm\sqrt{9}$$

(d) No. No matter what, x^2 is greater than or equal to 0, so $y = x^2 + 2$ is greater than or equal to 2.

25 (a) The original deposit is the balance, B, when $t = 0$, which is the vertical intercept. The original deposit was \$1000.

(b) It appears that $f(10) \approx 2200$. The balance in the account after 10 years is about \$2200.

(c) When $B = 5000$, it appears that $t \approx 20$. It takes about 20 years for the balance in the account to reach \$5000.

30 a Your plot should be a line with positive slope, increasing return comes with increasing risk.

b Pick any point that represents low risk and high return above your line (top left corner)

33 (a) i. I The incidence of cancer increase with age, but the rate of increase slows down slightly. The graph is nearly linear. This type of cancer is closely related to the aging process

ii. II In this case a peak is reached at about age 55, after which the incidence decreases.

iii. III This type of cancer has an increased incidence until the age of about 48, then a slight decrease, followed by a gradual increase

iv. IV In this case the incidence rises steeply until the age of 30, after which it levels out completely.

v. V This type of cancer is relatively frequent in young children, and its incidence increases gradually from about the age of 20.

vi. VI This type of cancer is not age-related all age-groups are equally vulnerable, although the overall incidence is low (assuming each graph has the same vertical scale).

(b) Graph (V) shows a relatively high incidence rate for children. Leukemia behaves in this way.

(c) Graph (III) could represent cancer in women with menopause as a significant factor. Breast cancer is a possibility here

(d) Graph (I) shows a cancer which might be caused by toxins building up in the body. Lung cancer is a good example of this.

34 a Since 2008 corresponds to $t = 0$, the average annual sea level in Aberdeen in 2008 was 7.094 meters.

b Looking at the table, we see that the average annual sea level was 7.019 fifty years before 2008, or in the year 1958. Similar reasoning shows that the average sea level was 6.957 meters 125 years before 2008, or in 1883.

c Because 125 years before 2008 the year was 1883, we see that the sea level value corresponding to the year 1883 is 6.957 (this is the sea level value corresponding to $t = 125$). Similar reasoning yields the table:

x	1883	1908	1933	1958	1983	2008
S	6.957	6.938	6.965	6.992	7.019	7.094

Section 1.2

7 Rewrite the equation of the line as $y = 2x - \frac{2}{3}$. The slope is 2 and intercept is $-\frac{2}{3}$.

11 a The slope is constant at 850 people per year so this is a linear function. The vertical intercept (at $t = 0$) is 30,700. We have

$$P = 30,700 + 850t.$$

b The population when $t = 10$ is predicted to be

$$P = 30,700 + 850(10) = 39,200.$$

c We use $P = 45,000$ and solve for t:

$$P = 30,700 + 850t 45,000 = 30,700 + 850t 14,300 = 850t t = 16.82.$$

12 a The fist company $C_1(m) = 40 + 0.15m$ and the competitor's price is $C_2(m) = 50 + 0.1m$.

b Use the slope intercept form to plot.

c To find which one is cheaper, we need to determine where the two lines intersect. Set $C_1 = C_2$ and solve. You should obtain $m = 200$. This means that if you want to travel less than 200, the first car is cheaper.

14 (a) and (b) have constant rates of change, therefore they are linear. (c) is not.

16 This is a linear function with vertical intercept 25 and slope 0.05. The formula for the monthly charge is $C = 25 + 0.05m$.

17 a The slope is 1.8 billion dollars per year. McDonalds revenue is increasing at a rate of 1.8 billion dollars per year.

b The vertical intercept is 19.1 billion dollars. In 2005, McDonalds revenue was 19.1 billion dollars.

c Substituting $t = 10$, we have $R = 19.1 + 1.8 * 10 = 37.1$ billion dollars.

d Substitute $R = 35$ and solve for t. You should obtain $t = 8.83$ years.

20 a A linear function has the form

$$P = b + mt$$

where t is in years since 2000. The slope is

$$Slope = \frac{\Delta P}{\Delta t} = 0.4$$

The function takes the value 11.3 in the year 2000 (when $t = 0$). Thus, the formula is

$$P = 11.3 + 0.4t.$$

b In 2006, we have $t = 6$. We predict $P = 11.3 + 0.4(6) = 13.7$, that is, there are 13.7% below the poverty level in 2006

i. The difference is 13.712.3 = 1.4%; the prediction is too high.

26 a This could be a linear function because w increases by 5 as h increases by 1.

b We find the slope m and the intercept b in the linear equation $w = b + mh$. We first find the slope m using the first two points in the table. Since we want w to be a function of h, we take

$$m = \frac{\Delta w}{\Delta h} = \frac{171166}{69 - 68} = 5.$$

Substituting the first point and the slope $m = 5$ into the linear equation $w = b + mh$, we have $166 = b + (5)(68)$, so $b = -174$. The linear function is $w = 5h174$.

c We find the slope and intercept in the linear function $h = b + mw$ using $m = \frac{\Delta h}{\Delta w}$ to obtain the linear function $h = 0.2w + 34.8$. Alternatively, we could solve the linear equation found in part (b) for h. The slope, $m = 0.2$, has units inches per pound.

Section 1.3

7 The function is increasing and concave up between D and E, and between H and I. It is increasing and concave down between A and B, and between E and F. It is decreasing and concave up between C and D, and between G and H. Finally, it is decreasing and concave down between B and C, and between F and G.

8 Average rate of change is $\dfrac{f(3) - f(1)}{3 - 1} = \dfrac{18 - 2}{2} = 8$

10 When $t = 0$, we have $B = 1000(1.08)^0 = 1000$. When $t = 5$, we have $B = 1000(1.08)^5 = 1469.33$. We have an average rate of change of $= \dfrac{\Delta B}{\Delta t} = \dfrac{1469.33 - 1000}{5 - 0} = 9.87 dollars/year.$

11 (a) Between 2008 and 2010, change in net sales = −134 million dollars.

(b) Average rate of change = −497 million dollars per year

(c) The average rate of change is positive from 2009 to 2010.

13 a The average rate of change is the change in attendance divided by the change in time. Between 2003 and 2007, Average rate of change $= \frac{22.26-21.64}{2007-2003} = 0.155$ million people per year.

b For each of the years from 20032007, the annual increase in the number of games was:

$$2003 \text{ to } 2004 : 21.71 - 21.64 = 0.072004 \text{ to } 2005 : 0.082005 \text{ to } 2006 : 0.412006 \text{ to } 2007 : 0.06.$$

c Average your four figures from part(b), your answer should be the same as in part(a).

17 a 0.077 billion people per year
0.980 million cars per year
207.7 million subscribers per year

b i The number of people is increasing faster since the population is increasing at 77 million per year and car production is increasing at less than 1 million per year.

ii The number of cell phone subscribers is increasing faster since the population is increasing at 77 million per year and the number of cell phone subscribers is increasing at about 208 million per year.

33 (a) $f(1985) = 13,\ f(1990) = 99$.

(b) The average yearly increase is the rate of change $\dfrac{f(1990) - f(1985)}{1990 - 1985} = \dfrac{99 - 13}{5} = 17.2$ billionaires per year

(c) Since the rate of change is constant, we can use a linear function of the form

$$f(t) = b + 17.2t$$

where $f(1985) = 13$ so that

$$13 = b + 17.2(1985)$$

solving for b gives $f(t) = 17.2t - 34,129$.

49 Relative change $= \dfrac{4645}{45} = 0.022$.

55 (a) Relative change in price of candy $= \dfrac{1.25 - 1.00}{1.00} = 0.25$ or 24%.

(b) Relative change in quantity sold $= \dfrac{2440 - 2765}{2765} = -0.1175$ or 11.75%.

(c) Ratio of relative changes $= \dfrac{0.1175}{0.25} = 0.47$ The number of candies sold decreases by 0.47% when the price increases by 1%.