1. (*Exercise 3 in section 2.1.*) The point $P(2, -1)$ lies on the curve $y = 1/(1 - x)$.

a) Pick a point on the curve $(x, 1/(1 - x))$, not too far from P, and call it Q. Sketch the curve, the points P and Q, and the secant line PQ.

b) Use your calculator to find the slope of the secant line PQ correct to six decimal places, for Q determined by the following values of x:

(a) 1.5 2

(b) 1.9 1.111111

(c) 1.99 1.010101

(d) 2.5 .666667

(e) 2.1 .909091

(f) 2.01 .990099

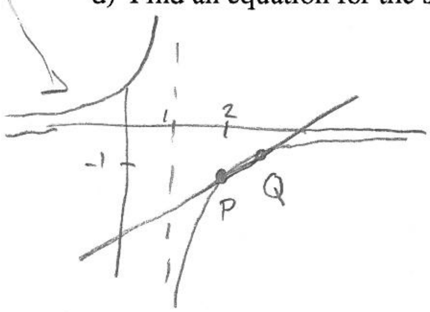
c) Using the results of part b), guess the value of the slope of the tangent line to the curve at $P(2, -1)$. 1

d) Find an equation for the same tangent line as in c).

$y - (-1) = 1(x-2)$

or $y = -1 + (x-2)$

or $y = x - 3$



2. (*Exercise 2 in section 2.1.*) A cardiac monitor is used to measure the heart rate of a patient after surgery. It compiles the number of heartbeats after t minutes, as in the table below. When the data are graphed, the slope of the tangent line represents the heart rate in beats per minute.

t (min)	36	38	40	42	44
heartbeats	2530	2661	2806	2948	3080

The monitor estimates the heart rate using secant line slopes. Use the data to estimate the patient's heart rate at 42 minutes using the secant line between the points

a) $t = 36$ and $t = 42$ $69.7 \frac{\text{beats}}{\text{min}}$

b) $t = 38$ and $t = 42$ 71.8 b/m

c) $t = 40$ and $t = 42$ 71.0 b/m

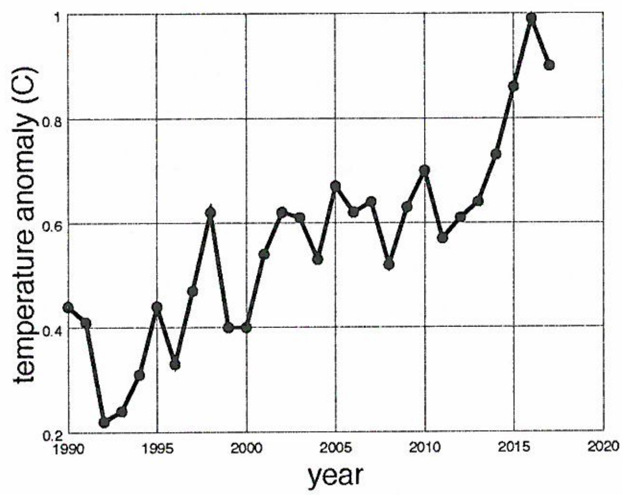
d) $t = 42$ and $t = 44$ 66.0 b/m

Give an (estimated) conclusion about the patient's heartbeat at 42 minutes.

An answer between 66 and 71 is reasonable, so we use the average of those: $\frac{66+71}{2} = 68.5 \frac{b}{m}$

3. Here is a table of the temperature data, for recent years, from NASA. (The full data set covers 1880–2017.) The first column is the year. The second column is the difference of the globally-averaged temperature for that year minus the average of the 1951–1980 period, in Celsius. In other words, it shows the global temperature relative to a baseline temperature from the past. The plot below shows this data.

1990	0.44
1991	0.41
1992	0.22
1993	0.24
1994	0.31
1995	0.44
1996	0.33
1997	0.47
1998	0.62
1999	0.4
2000	0.4
2001	0.54
2002	0.62
2003	0.61
2004	0.53
2005	0.67
2006	0.62
2007	0.64
2008	0.52
2009	0.63
2010	0.7
2011	0.57
2012	0.61
2013	0.64
2014	0.73
2015	0.86
2016	0.99
2017	0.9



Compute from the data:

a) the average rate of change of temperature (i.e. slope of the secant line) in the period 1990–2017

$\frac{.9-.44}{27} = +.017$ °C/year

b) the highest average rate of change you can compute for a ten-year period

1992-2002 $+.04$ °C/year

c) the lowest rate of change you can compute for a ten-year period

1998-2008 $-.01$ °C/year

d) your estimate of the rate of change in the year 2010

2009-2010 gives $+.07$
2010-2011 gives $-.13$
average is $\frac{.07-.13}{2} = -.03$ °C/year

This example shows that slopes can always be computed, but *that noisy data does not really have a slope when you look at a small period. Math 251 Calculus I will focus on well-behaved functions.*