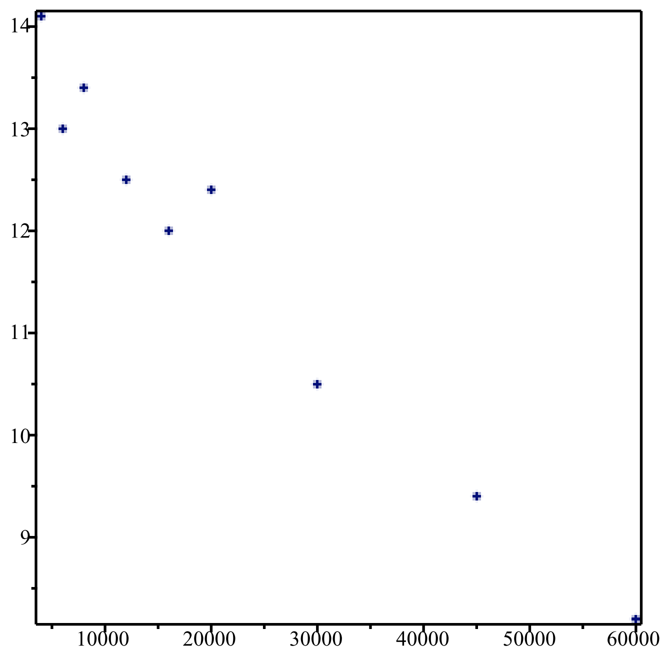
Heduin R B de Morais
BrockU ID: 6967483
Campus ID: hr19ut
Math 1P01 - Lab #04
Assingment #01 - Maple

Question 15:
a) The table shows (lifetime) peptic ulcer rates (per 100 population) for various family incomes as reported by the National Health Interview Survey. A table is given as Income vs Ulcer rate (per 100 population).

```
> with(Statistics):
> Income:=<4000,6000,8000,12000,16000,20000,30000,45000,60000>:
> Cases:=<14.1,13.0,13.4,12.5,12.0,12.4,10.5,9.4,8.2>:
> ScPlot:=ScatterPlot(Income,Cases);
```




b) Find a linear model using the first and last data points. (Round your values to six decimal places.)
For a linear model, we have:
y = m*x + b, where m=(y1-y0)/(x1-x0)
Considering the first and last points, we have:

```
> m:= (8.2-14.1)/(60000-4000);
```

$$m := -0.0001053571429 \quad (1)$$

Using any data point, let's do both (first and last), we have b= y - m.x :

```
> b:= 14.1-m*4000;
```

$$b := 14.52142857 \quad (2)$$

```
> b:= 8.2-m*60000;
```

$$b := 14.52142857 \quad (3)$$

Now that values of "m" and "b" are known, the linear model (M) is presented as follows :

```
> FLast:= m*x+b;
```

$$FLast := -0.0001053571429\, x + 14.52142857 \quad (4)$$

This linear model intercepts x-axis for y=0, or for x=-b/m:

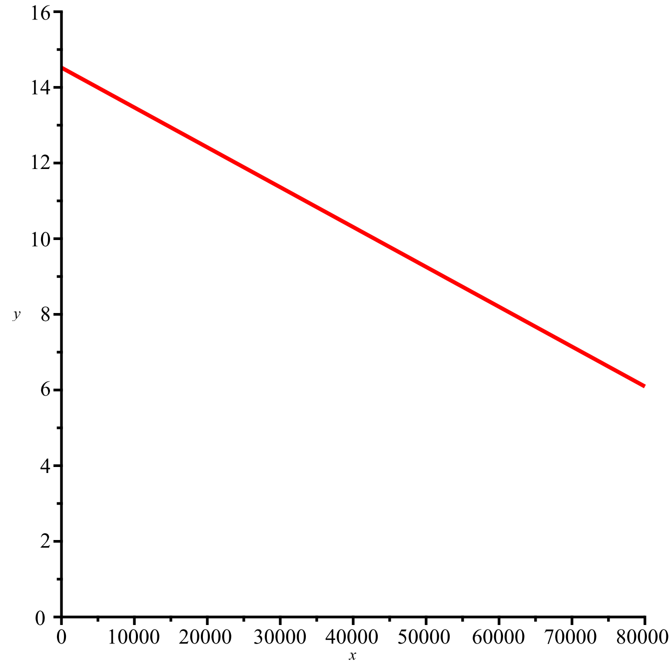
This is a notable point, since the number of cases becomes negative after x_0, losing its meaning for our model.
The same applies for x < 0, where an negative income has no practical meaning.

```
> x_0:= (-b/m); #where y=0
```

$$x\_0 := 137830.5084 \tag{5}$$

Although, x_0 is barely 140,000, let's cap it at 80,000 for better zoom purposes:

```
> FirstLast:= plot(FLast(x), x=0..80000,y=0..16, color=red);
```

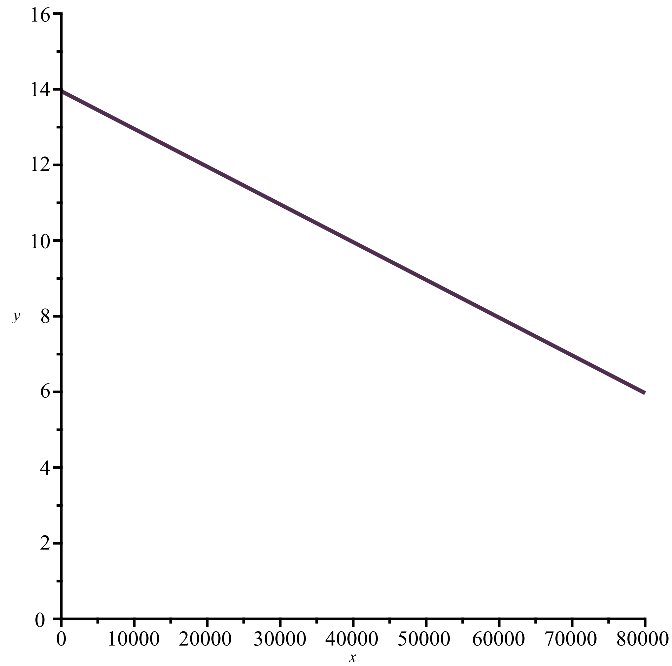



c) Using Maple LinearFit function for the best fit linear model:

```
> LFit:= LinearFit([1,x],Income,Cases,x,summarize=true);
Summary:
----------------
Model: -.99785456e-4*x+13.950764
----------------
Coefficients:
              Estimate   Std. Error   t-value   P(>|t|)
Parameter 1    13.9508     0.2138      65.2621    0.0000
Parameter 2   -0.0001      0.0000     -13.4222    0.0000
----------------
R-squared: 0.9626, Adjusted R-squared: 0.9573
```

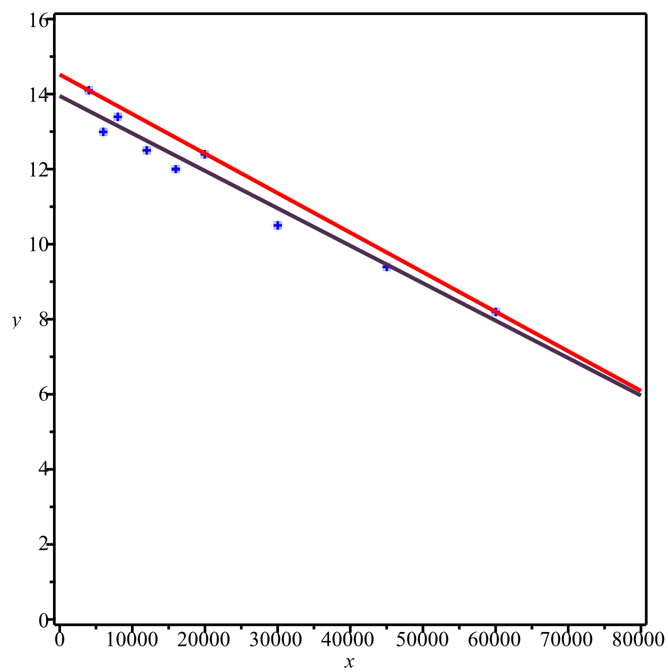
$$LFit := 13.9507640770852 - 0.0000997854561878952\, x \tag{6}$$

```
> BestFit:= plot(LFit(x),x=0..80000,y=0..16, color=violet);
```




Let's plot all of them together, ScatterPlot in Blue, First and Last in Red, and Maple's Best Linerar Fit in Violet.

```
> plots[display]([ScPlot, FirstLast, BestFit], color=[blue, red,
  violet]);
```




d) Use the best fit linear model the Cases for people with an income of $40,000.

```
> subs(x=40000, LFit); #without rounding
```

$$9.95934582956940 \tag{7}$$

```
> evalf(-0.000100*40000+13.950764); #with rounding
```

$$9.950764 \tag{8}$$

e) The same for $90,000.

```
> subs(x=90000, LFit); #withouth rounding
```

$$4.97007302017465 \tag{9}$$

```
> evalf(-0.000100*90000+13.950764); #with rounding
```

$$4.950764 \tag{10}$$

f) Since x_0 <140,000, someone with an income of 200,000 > x_0 would face a negative number of cases, which there's no meaning on this model.

```
> solve(LFit=0); #testing maximum meaningful value of x, which is
  x_0 (y=0)
```

$$139807.5893 \tag{11}$$

```
> subs(x=200000,LFit);
```

$$-6.00632716049385 \tag{12}$$