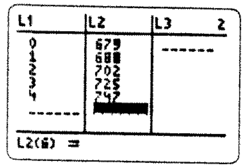
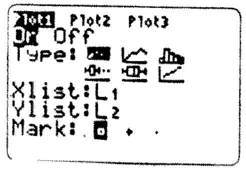
1. **Use a Graphing Calculator**

a) Make a scatter plot of the data. For simplicity, renumber the years from 0 to 4.

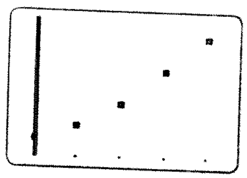
- Press (STAT) and select **1:Edit**.
- Enter the data in lists **L1** and **L2**.



- Press (Y=). Clear any functions in the equation section. Then, turn on **Plot1** only.
- Press (2nd) [STATPLOT] and select **Plot1**.
- Use the settings shown.



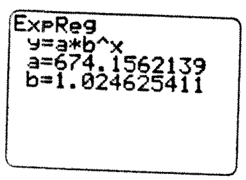
Press (ZOOM) and select **9:ZoomStat**. A scatter plot of the data will appear.



The trend appears to be exponential. Use exponential regression to find a curve of best fit.

- Press (2nd) [QUIT] to return to the home screen.
- Press (STAT). Cursor over to **CALC** and select **0:ExpReg**.
- Press (2nd) [L1] (,) (2nd) [L2] (,), and then press (VARS). Select **Y-VARS**, and then select **1:Function**.
- Select **1:Y1** and press (ENTER).

An exponential equation will appear.

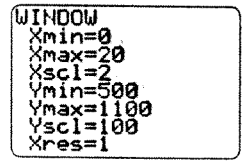


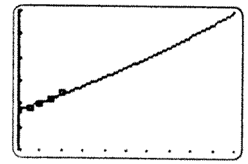
Round the calculated values of a and b and substitute into the equation $y = ab^x$ to obtain the approximate equation of the curve of best fit.

$y = 674 \times 1.025^x$

Replace x and y with variables that make sense for the problem. Let n represent the number of years following 2002 and E represent the average Canadian's weekly earnings in year n.
Then, the equation is $E(n) = 674 \times 1.025^n$.

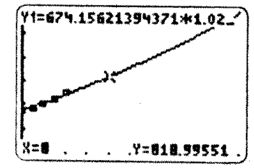
Press (GRAPH) to see the curve of best fit drawn through the scatter plot. Use the window settings shown.





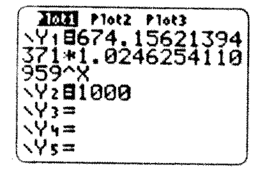
b) To predict the average Canadian's weekly earnings in 2010, find the value of E when $n = 8$.

- Press (2nd) [CALC].
- Select **1:value** and enter 8 when prompted.

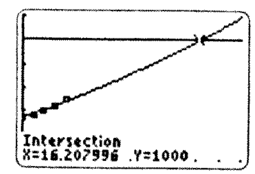


Therefore, assuming that the trend continues, the average Canadian will earn approximately \$819 per week in 2010.

c) To find when the average Canadian might expect to earn \$1000 per week, find the intersection of the graph with the graph of $y = 1000$.



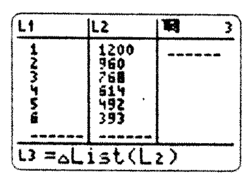
- Press (2nd) [CALC].
- Select **5:intersect**.

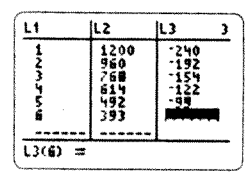


From the graph, you can see that the average Canadian can expect to earn \$1000 per week in approximately 16.2 years after 2002, or in 2018.

2. **a)** Enter the data in **L1** and **L2** using the **Table Editor**. To calculate the first differences:

- Move the cursor to the top of the **L3** column.
- Press (2nd) [LIST]. Cursor over to **OPS**.
- Select **7:ΔList(** and press (2nd) [L2].
- Press ( )) and then press (ENTER).





The first differences are decreasing at a decreasing rate, suggesting that the computer depreciates most quickly in the early years following purchase and less quickly as it ages.

Unit 5 Day 5

pg (2) of (4)

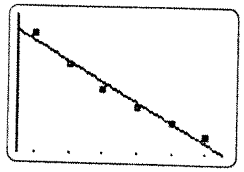
Perform a linear regression and store the equation as **Y1**.

```
LinReg(ax+b) L1,
L2,Y1
```

```
LinReg
 y=ax+b
 a=-159.8
 b=1297.133333
 r²=.97456272
 r=-.9871994327
```

The line of best fit corresponds approximately to the equation $v(n) = -160n + 1297$, where v is the value of the computer, in dollars, n years after purchase.

To view the scatter plot and line of best fit, ensure that **Plot1** and **Y1** are turned on. From the **ZOOM** menu, choose **9:ZoomStat**.



Although the line of best fit passes near most of the data points, it does not reflect the curved nature of the trend, which indicates a decreasing rate of depreciation. This may not be the best model for this situation.

Quadratic Model

Perform a quadratic regression and store the equation as **Y2**.

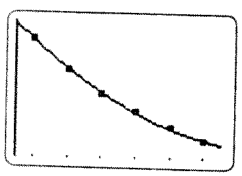
```
QuadReg L1,L2,Y2
```

```
QuadReg
 y=ax²+bx+c
 a=17.58928571
 b=-282.925
 c=1461.3
 R²=.9997517457
```

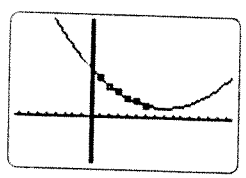
The quadratic curve of best fit corresponds approximately to the equation $v(n) = 17.6n^2 - 283n + 1461$, where v is the value of the computer, in dollars, n years after purchase.

To view the scatter plot and quadratic curve of best fit, turn **Y1** off and ensure that **Plot1** and **Y2** are turned on. From the (ZOOM) menu, select **9:ZoomStat**.

```
Plot1 Plot2 Plot3
\Y1=-159.8X+1297
.1333333333
\Y2■17.589285714
289X^2+-282.9250
0000002X+1461.3
\Y3=
\Y4=
```



The quadratic curve of best fit models the data trend well for the domain shown. However, this quadratic function does not indicate continuing depreciation. This can be observed by extrapolating beyond the data set. Press (ZOOM), select **3:Zoom Out**, and press (ENTER).



According to the graph, the value function will reach a minimum and then begin to increase, which makes no sense in this situation. Therefore, the quadratic model is not effective for extrapolating beyond the given set of data for this scenario.

Exponential Model

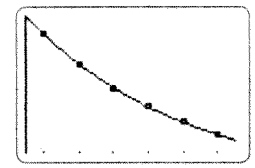
Perform an exponential regression and store the equation as **Y3**.

```
ExpReg L1,L2,Y3
```

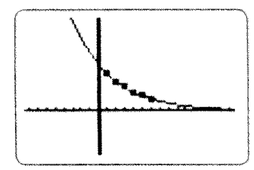
```
ExpReg
 y=a*b^x
 a=1500.014391
 b=.7999892496
 r²=.9999980869
 r=-.9999990435
```

The exponential curve of best fit corresponds approximately to the equation $v(n) = 1500 \times 0.8^n$, where v is the value of the computer, in dollars, n years after purchase.

To view the scatter plot and exponential curve of best fit, turn **Y1** and **Y2** off and ensure that **Plot1** and **Y3** are turned on. From the (ZOOM) menu, select **9:ZoomStat**.



The exponential curve of best fit models the data trend well for the domain shown, and beyond. This can be illustrated by extrapolating beyond the data set. Press (ZOOM), select **3:Zoom Out**, and press (ENTER).

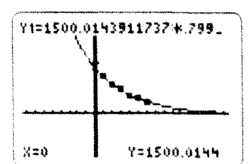


The exponential model correctly reflects the continuous depreciation of the computer. It is the best model for this scenario.

c) Apply the exponential model to determine the purchase price of the computer by evaluating the function when $n = 0$.

Method 1: Use the Graph

Press (2nd) [CALC] and select **1:value**. When prompted, enter 0 and press (ENTER). The corresponding function value will be given.



Method 2: Use the Equation

$v(n) = 1500 \times 0.8^n$

$v(0) = 1500 \times 0.8^0$

$= 1500 \times 1$

$= 1500$

Both the graph and the equation indicate that the purchase price of the computer was $1500.

3a) If you say no...
Justification:
First differences are increasing only slightly

If you say yes...
Justification:
First differences are increasing

b) y-int is 100 ~~so~~ $a = 100$. Goes through (1,110)

$$y = ab^x$$
$$110 = 100(b^1)$$
$$\frac{110}{100} = b$$
$$b = 1.1$$
$$\therefore \; y = 100(1.1^x)$$

c) Difficult as we need to estimate the y-values from the graph when $x = 2, 3$.

I used:
(0, 100)
(1, 110)
(2, 122)
(3, 133)

$a = 100.0973843$
$b = 1.100657524$
$r^2 = 0.99885898$ ← 99.89% of the time this model fits the data.
$r = 0.9994$ ← very good model very strong correlation.

So, $y = 100(1.1)^x$

d) $x = 10$ $\quad y = 100(1.1^{10})$
$= \$259.37$

using $\boxed{2^{nd}}\boxed{Calc}\boxed{Value}$ \$261.18
$\therefore$ after 10 years she will have \$261.18.

e) $x = ?$ when $y = 200$.

using $\boxed{2^{nd}}\boxed{Calc}$ $\boxed{\text{intersection}}$
$x = 7.217$
$\therefore$ it will take 7.2 years for \$ to double

$200 = 100(1.1)^x$
$2 = 1.1^x$
trial and error
$1.1^7 = 1.95$
$1.1^8 = 2.14$

NOTE: $100(1.1)^x$

initial investment of \$100

after one year $100 \times 1.10 \Rightarrow$ she received 10% interest.

after two years $100 \times 1.10 \times 1.10 \Rightarrow$

she left the original \$100 invested and the interest has been added to the investment so the interest is also gaining interest.

This is called "compound interest".

Accountants use something called the "rule of 72"

72 ÷ interest rate = approximate number of years for money to double

$72 \div 10 = 7.2 \Rightarrow$ Money takes about 7.2 years to double.

Interest rate 5% (Compound Interest).

$72 \div 5 = 14.4 \Rightarrow$ Money takes about 14.4 years to double

Using $y = 100(1.05^x)$ and $y = 100$ on TI-83 to check this we get 14.2 years.

Interest rate 7%

$72 \div 7 \doteq 10.29 \Rightarrow$ Money doubles in about 10.3 years

Using TI-83 $y = 100(1.07^x)$, $y = 200$ we get 10.2 years