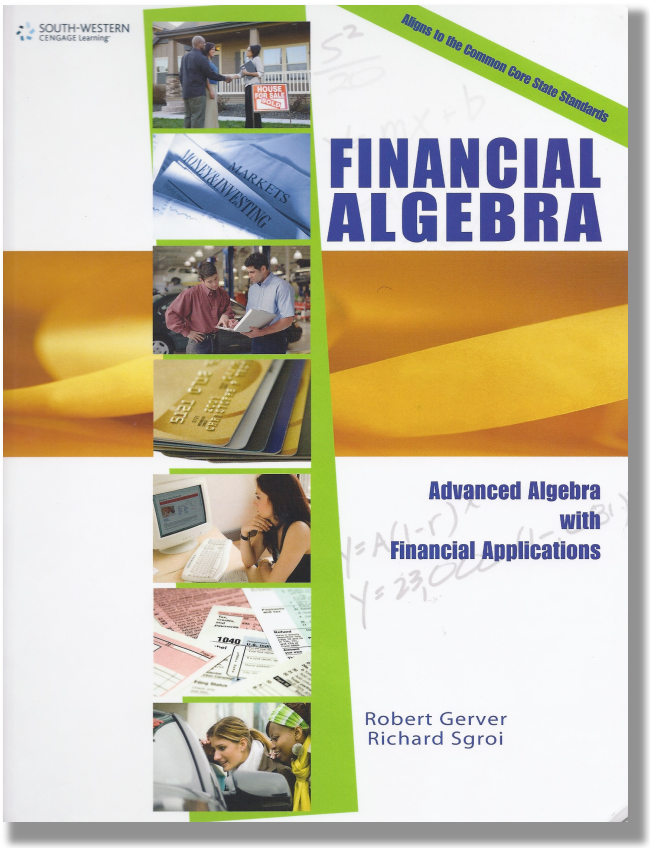


USING TECHNOLOGY

Using a Graphing Calculator

Using a Graphing Calculator Emulator

(http://rentcalculators.org/stheli.html)

Using a Spreadsheet

Using an Online Graphing Website

(http://www.fooplot.com)

SYSTEMS OF LINEAR EQUATIONS

Section 5-5 Linear Automobile Depreciation

- Depreciate
- Appreciate
- Straight line depreciation
- Slope
- Straight line depreciation equation

Example 6, p.249

Celine bought a new car for $33,600. She made a $4000 down payment and pays $560 each month for 5 years to pay off her loan. She knows from her research that the make and model of the car she purchased straight line depreciates to zero over 10 years.

a) Let x represent time in months and y represent dollars. Celine's expense function is the sum of her monthly payments over this time period and her initial payment.
   - What was Celine's initial payment? _____ This amount represents her first investment in the car when x=0 months. This will represent the **y-intercept** of the expense function.

   - How much does Celine pay per month? _____

   - How could the ratio of the change in the total expense per month be expressed as a fraction? _____ This will represent the **slope** of the expense function.

   - Use the information from above to express the expense function: y = _____

b) As stated above, the time x is in months rather than years. Since Celine's car will totally depreciate after 10 years, how many months will it take for the value of this car to reach zero? _____. This amount will represent the **x-intercept** of the expense function.

- What was the purchase price of Celine's car? _____

- Determine the monthly depreciation amount over the total number of months it will take for the car to depreciate. _____.

- To calculate the slope of the depreciation equation, you will use the intercepts (0, 33600) and (120,0). In the context of this problem, what do these intercepts represent?
  _____
  _____
  _____

- What is the slope of the depreciation equation? _____

- Where have you seen that number before?
  _____
  _____

- In the context of this problem, what does the slope represent? Why is it negative?
  _____
  _____
  _____

- Write the depreciation function. y= _____

c) TECHNOLOGY – The Graphing Calculator

- Press **Y=**
- Y1 = _____ (Expense Function)
- Y2 = _____(Depreciation Function)
- **THE VIEWING WINDOW –** Since negative points on the graph have no meaning in the context of this problem, you will use the intercepts to determine the viewing window. Examine the x values of the intercepts.
  What is the minimum value of x? Xmin= _____
  What is the maximum value of x? Xmax = _____
  What is the minimum value of y? Ymin = _____
  What is the maximum value of y? Ymax = _____
- Press **WINDOW** Enter Xmin, Xmax, Ymin, and Ymax.
- Press **GRAPH** Make a sketch of the graph here.

- What is the significance of the point of intersection of the expense and the depreciation functions?
  _____
  _____

- To find the coordinates of that intersection point, press **2nd TRACE 5 .** You will see the prompt "First Curve?". The cursor is now positioned on the first curve, Y1. Use the left or right arrows until the cursor is as close as possible to the intersection point. Press **ENTER.**

- You will now be asked to repeat the process again for the second curve but since the cursor remains at the intersection point, just press **ENTER**

- Press **ENTER** again to skip the "Guess"

- The intersection point will appear on the screen. Round the x and y coordinates of the intersection point to 2 decimal places and write that point here. _____

- Interpret the intersection point in the context of the problem and the numbers you have found.
  _____
  _____

- Interpret the graph on the domain when x < 35.24.
  _____
  _____

- Interpret that graph on the domain when x > 35.24.
  _____
  _____

d) TECHNOLOGY – Spreadsheet

The expense and depreciation functions will now be used to create two columns of values in the spreadsheet.

- The independent variable, x, is time in months. Choose the interval from x = 0 to x = 120 and a workable increment that will yield some points for the chart. I suggest using x values of 0, 20, 40, 60, 80, 100, and 120. Enter those amounts in column A under the heading "Months".

- Enter the label "Expense" in cell B2.

- Now enter the formula that represents the expense function y= 560x + 4000. Since the first x value is in cell A3, enter the following formula in cell B3 **=560*A3+4000**

- You will now use the **fill down** command to have the spreadsheet calculate the expense values in column B for the remaining months. Highlight cells B3 through B9. On the EXCEL toolbar, click on **EDIT,** scroll down to **FILL,** then move over to **DOWN** (OR use the shortcut depending upon whether you are using a PC or a MAC).

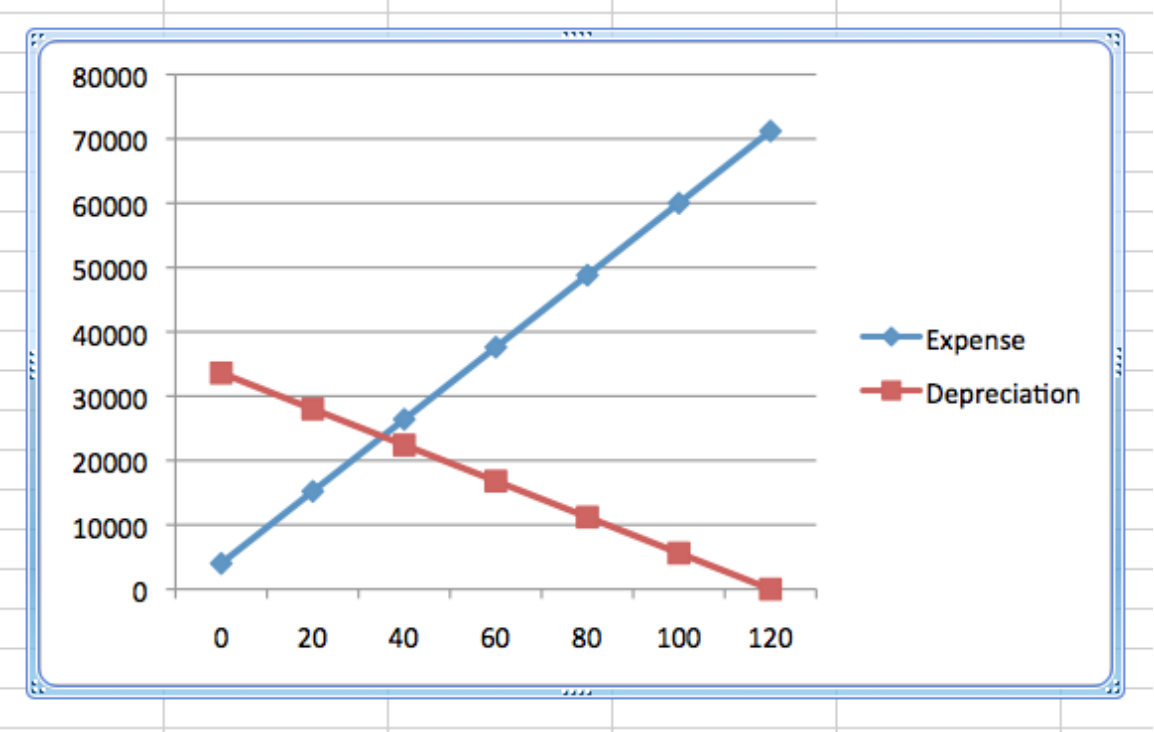
- Now enter the formula that represents the depreciation function y = -280x + 33600 into cell C3 as **=-280*A3 +33600.** Use the fill down feature to get the remaining values in column C. Your spreadsheet should look as follows:

	A	B	C
1	p.248		
2	Months	Expense	Depreciation
3	0	4000	33600
4	20	15200	28000
5	40	26400	22400
6	60	37600	16800
7	80	48800	11200
8	100	60000	5600
9	120	71200	0

- Highlight cells B3 through C9. Click on a line graph in **CHART.**

- Depending on your type of computer and version of EXCEL, identify the lines and enter the x-axis labels.

- Your graphs should look as follows:

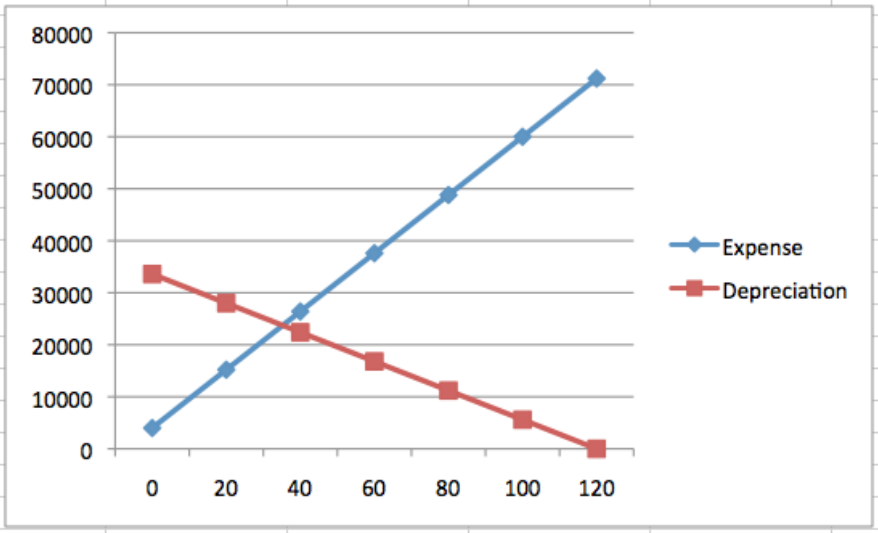


- The best way to find the intersection point using EXCEL is to use what you have learned from Algebra. That is, if you are trying to find the intersection of Y=Ax+B and Y=Cx+D, use substitution, AX+B=CX+D and solve for x. Namely, x = (D-B)/(A-C) where, in this problem, A is the slope of the expense function; B is the y-intercept of that function; C is the slope of the depreciation function; and D is the y-intercept of that function. Set up cells representing those values as shown here:

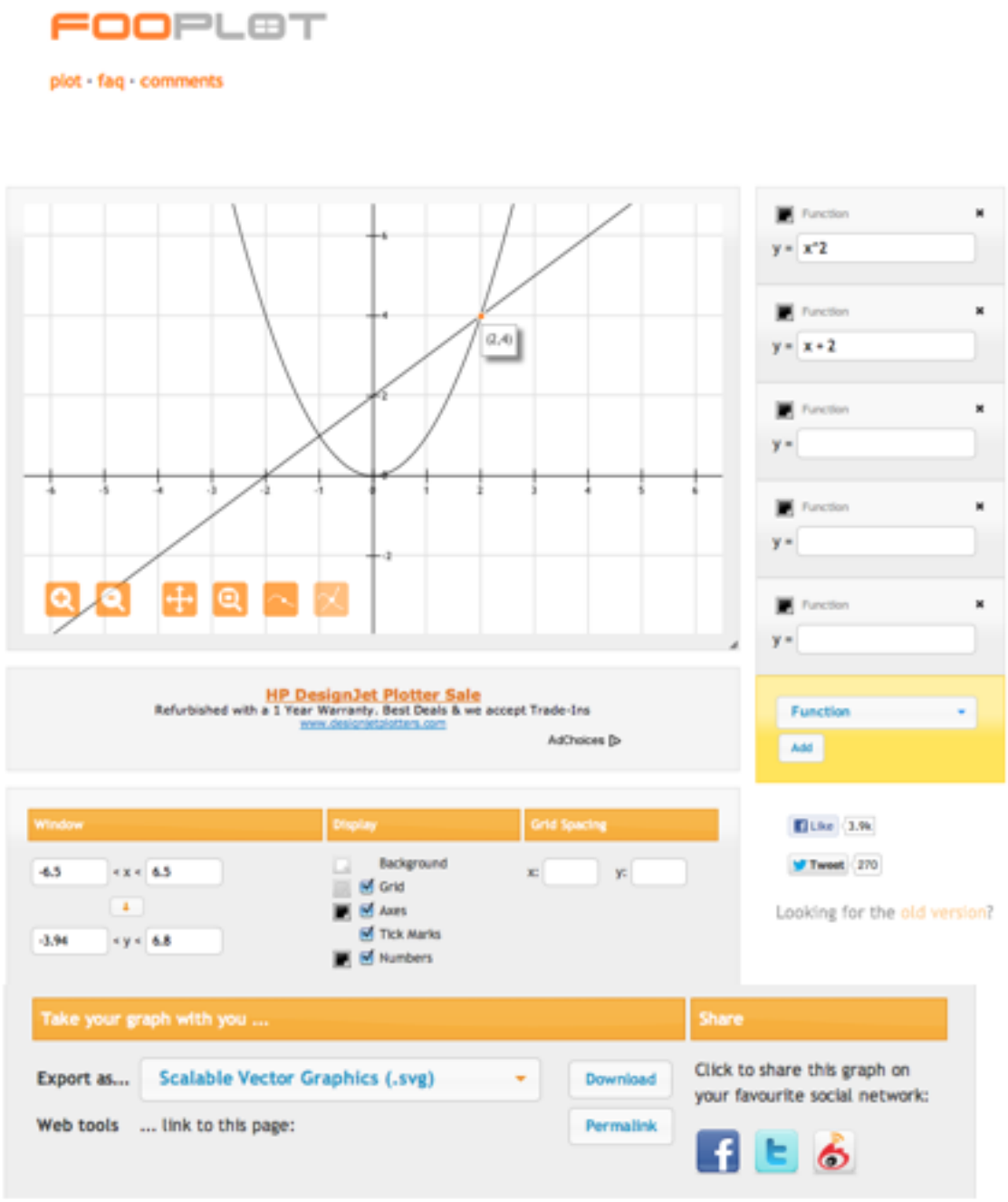
	E	F
1		
2		
3	Expense slope	560
4	Expense y-int	4000
5	Depr. Slope	-280
6	Depr. Y-int	33600
7		
8	X intersection	35.2380952
9		23733.3333
10		

The formula for cell F8 is =(F6-F4)/(F3-F5). Notice this yields the same value of 35.24 months as was attained with the graphing calculator. To determine the value of the car at that time, enter the value in cell F8 into either of the two original functions. That is, **=560*F8+4000 OR =-280*F8+33600. The value of the car when expense is equal to the depreciation value is $23,733.33.**

	A	B	C	D	E	F
1	p.248					
2	Months	Expense	Depreciation			
3	0	4000	33600		Expense slope	560
4	20	15200	28000		Expense y-int	4000
5	40	26400	22400		Depr. Slope	-280
6	60	37600	16800		Depr. Y-int	33600
7	80	48800	11200			
8	100	60000	5600		X intersection	35.2380952
9	120	71200	0			23733.3333



e) TECHNOLOGY - www.fooplot.com



REGRESSION WITH TECHNOLOGY

Problem: Chapter 2 Applications – pp. 112-113

A company is interested in producing and selling a new device called an eyePOD (eyewear personal optical device). The eyePOD is an MP3 and video player built into a pair of sunglasses. The user can listen to music from the small earphones and watch videos projected on the screen behind the glasses.

*The market research department conducted consumer surveys at college campuses and reported its results. In these ordered pairs, the first number represents the price, **p**, and the second number represents the quantity demanded, **q**. The points are listed as **(p, q).***

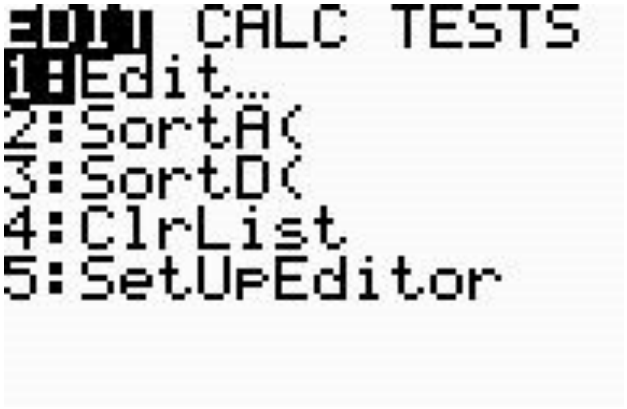
(300, 10000), (325, 8900), (350, 8800), (375, 8650), (400, 6700), (425, 6500), (450, 5000), (475, 4500), (500, 4450), (525, 3000)

- *Make a **scatterplot** of the data.*
- *What is the **correlation coefficient**? Round it to the nearest hundredth. Is this line a good **predictor**? Explain.*
- *Write the **linear regression equation.** Remember that the demanded quantity, **q**, is the **dependent variable.** Round the **slope** and the **y-intercept** to the nearest hundredth.*

GRAPHING CALCULATOR

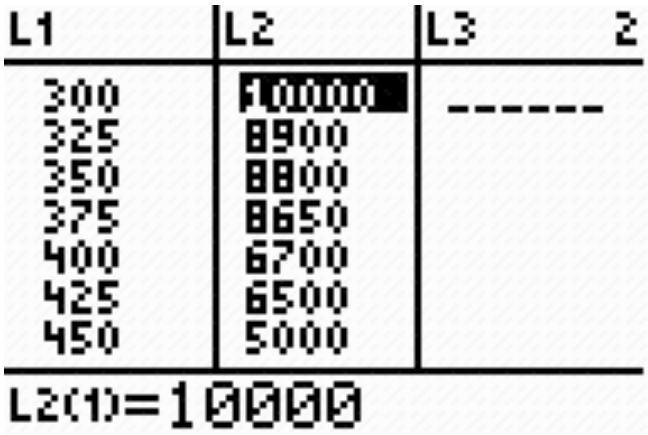
The Statistics Feature

1) Press **STAT**



2) You will see this screen:
3) Press **1** to enter data into lists

4) Enter the price into List 1 and the quantity (demand) into List 2.

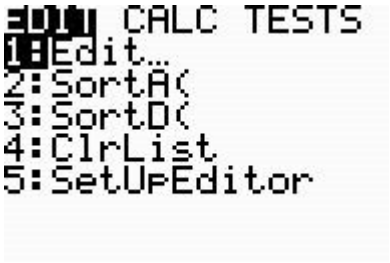


5) To display the scatterplot: Press **2nd Y=**

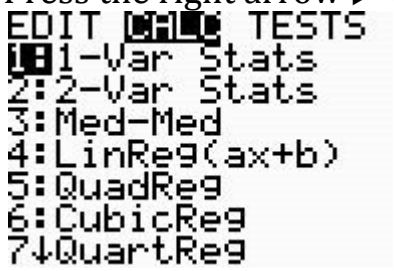
6) Press **1** to get to the Plot 1 menu. If the plot is off, turn it on by moving the cursor over the word ON and pressing enter.

7) Press **ZOOM 9.** This will display the scatterplot in a window that will fit all of the points in the list.

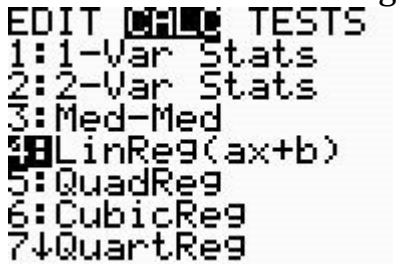
8) Now follow these steps to determine the LINE OF BEST FIT (the Regression Line)
Press **STAT**



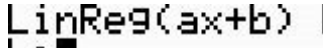
9) Press the right arrow ▶ to highlight **CALC**



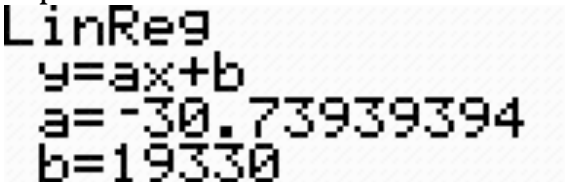
10) Press **4** for the linear regression equation



11) The **LinReg(ax+b)** prompt will appear. You must now instruct the calculator as to where the data is stored. It is common to store data in Lists 1 and 2. If this is the case, then no further typing on this line is needed. Press **ENTER.**

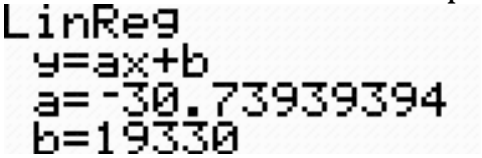


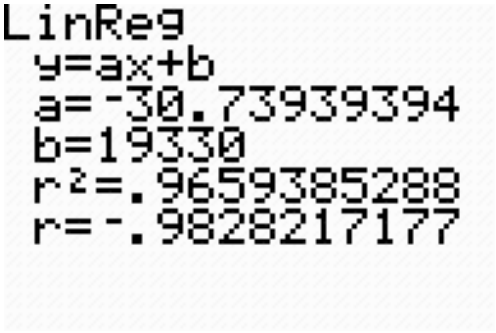
12) The constants for the regression equation will appear. Round as stipulated.



13) ***The Correlation Coefficient r***

When you do the linear regression analysis, your calculator will show either of these two displays:





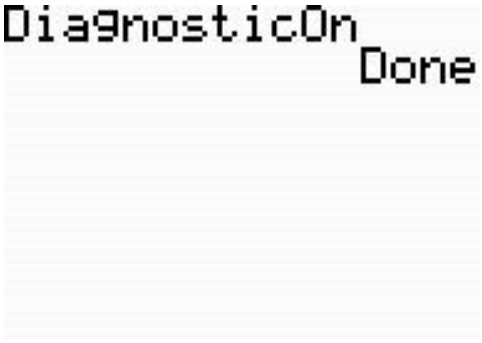
Notice that the correlation coefficient analysis is missing from the first display. Some calculators are programmed not to display that analysis until the "diagnostic feature" of the calculator is manually turned on. If this is the case, follow these steps then repeat the regression steps.

Press 2nd 0

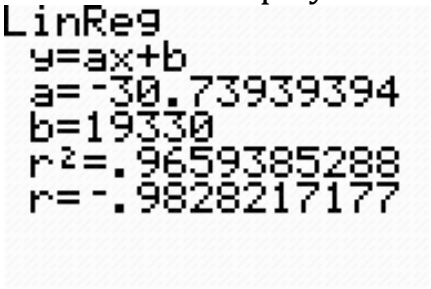
You will see the CATALOG screen as shown here:

Scroll down using the down arrow (or hit the letter D) until you reach **DiagnosticOn.**

Then press **ENTER** twice. You will see this screen:



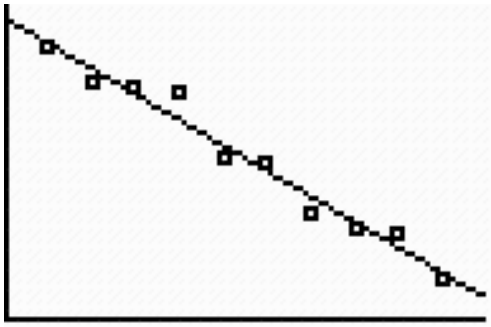
Now, repeat the regression analysis keystrokes. Your screen will show the full display:



Rounded to two decimal places, The regression line is
y = -30.74x - 19330 with a correlation coefficient of -.98.

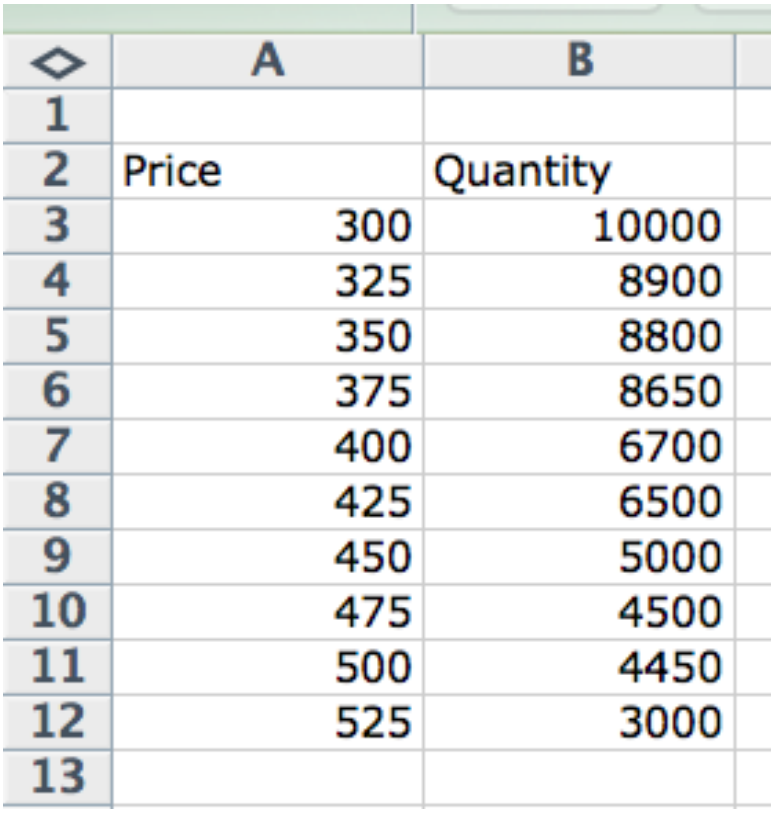
14) If you want to see what the regression line looks like superimposed over the scatterplot, press

STAT ▶ 4 VARS ▶ 1 1 ENTER GRAPH



SPREADSHEETS

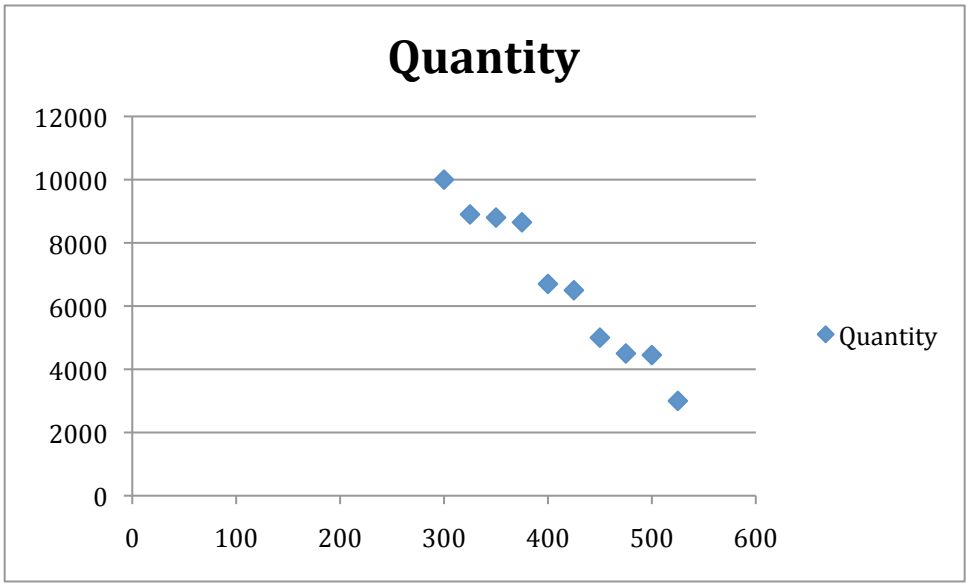
1) Enter the data in two columns



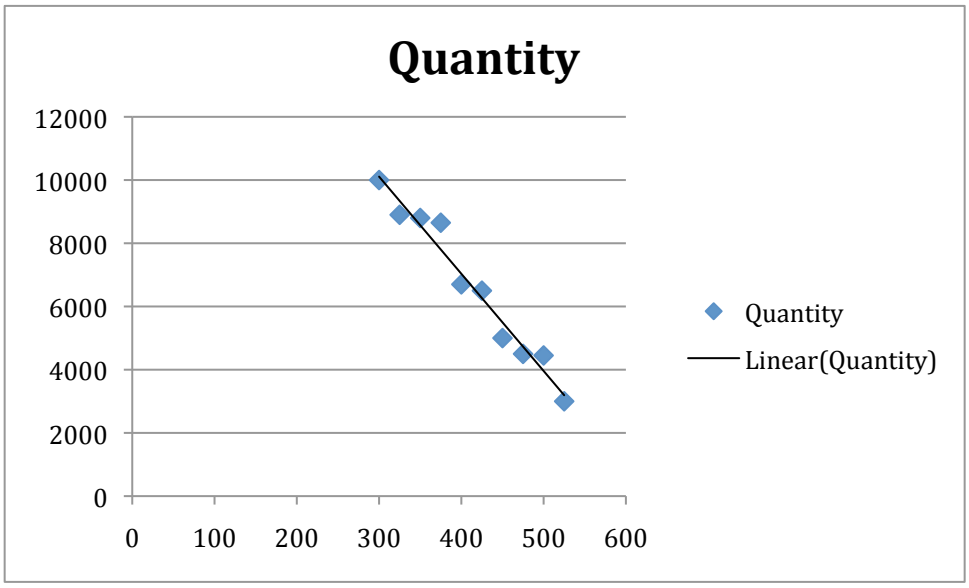
	A	B
1		
2	Price	Quantity
3	300	10000
4	325	8900
5	350	8800
6	375	8650
7	400	6700
8	425	6500
9	450	5000
10	475	4500
11	500	4450
12	525	3000
13		

2) Highlight both columns. Now, the remainder of the tasks depend on the version of EXCEL you are using. But, with a little poking around, you should find the commands since they haven't changed much from version to version.

Click on the **XY Scatter** chart.

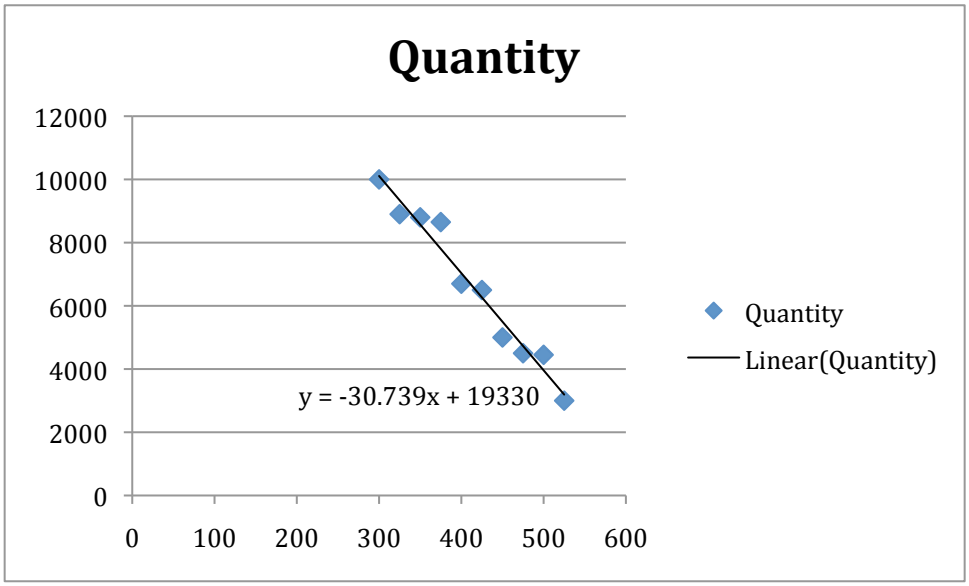


3) Click on any of the data points. All will be selected. Under CHART click on ADD TRENDLINE.



This trendline is the linear regression line.

4) You now want the equation of that line. Again, finding the command varies from version to version. In the Trendline window, look for OPTIONS then click on the box to "display equation in window".



The linear regression equation, rounded to two decimal places is y=-30.74x +19330 which matches the regression equation found using the calculator.

4) To determine the correlation coefficient, select any empty cell in the chart and type in the command
=CORREL(array1, array2)
Array 1 is the list of the cell names in the first column, A3:A12.
Array 2 is the list of cell names in the second column, B3:B12.
So, the actual cell entry should be **=CORREL(A3:A12, B3:B12).** Hit enter, and the correlation coefficient rounded to two decimal places is displayed as -0.98, which also matches the graphing calculator results.

PIECEWISE FUNCTIONS - GRAPHING CALCULATOR

Section 5-1 Example3 p. 220

Jason works for the Geln Oaks News and is writing a computer program to compute ad costs. He needs to enter an algebraic representation of the costs of an ad. His company charges $42.50 for up to five lines for a classified ad. Each additional line costs $7. Express the cost of an ad with x lines of print as a function of x algebraically.

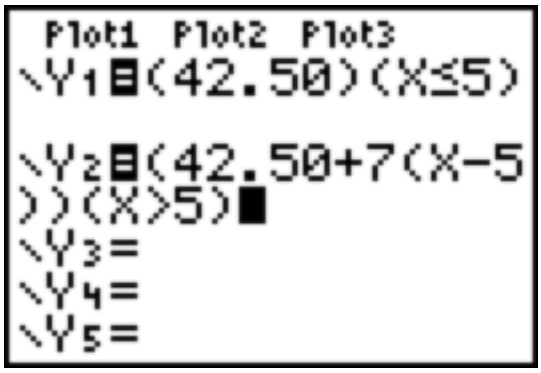
The piecewise function representing this situation is as follows:

$$c(x) = \begin{cases} 42.50 & x \le 5 \\ 42.50 + 7(x-5) & x > 5 \end{cases}$$

Plotting a piecewise function using a graphing calculator requires some extra effort.

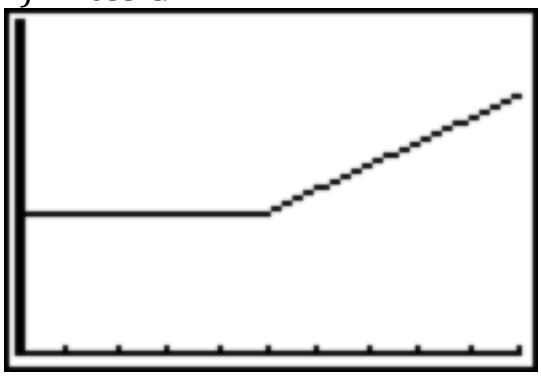
1. In order to get a clean graph, you need to change to DOT mode. This can be found by pressing the MODE key and highlighting DOT as shown here.

2. You want to alert the calculator only to graph the parts of the function on the particular stated domain. In this piecewise function, there are two distince equations on two distinct domains. Notice in the screenshot below, the equations are encased in parentheses followed by the domains in parentheses as well. The inequality symbols can be found by pressing **2nd MATH.**



3) Set the window as shown here:

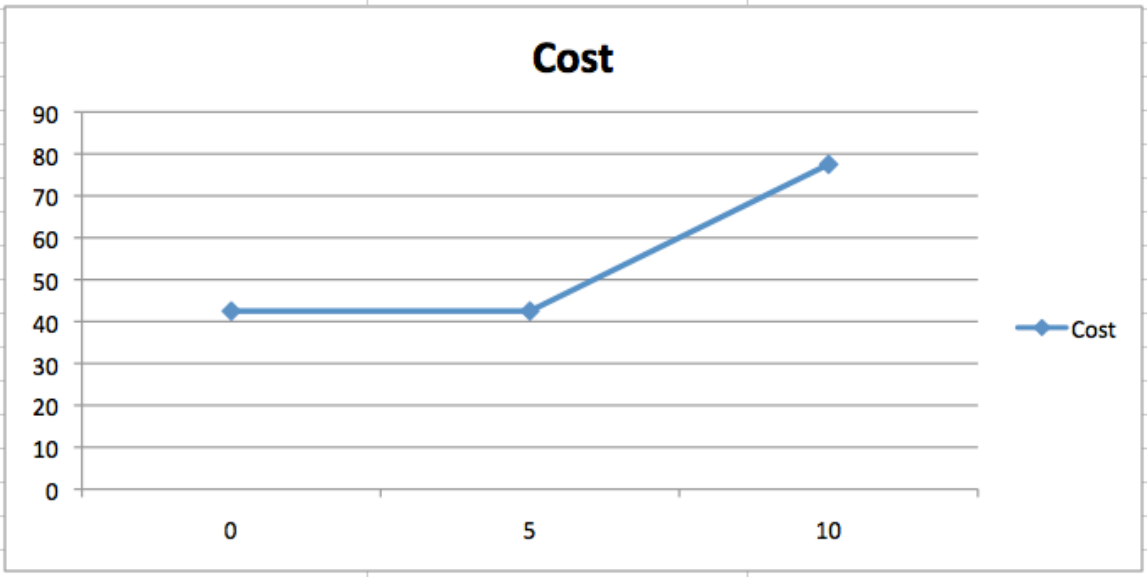
4) Press **GRAPH**



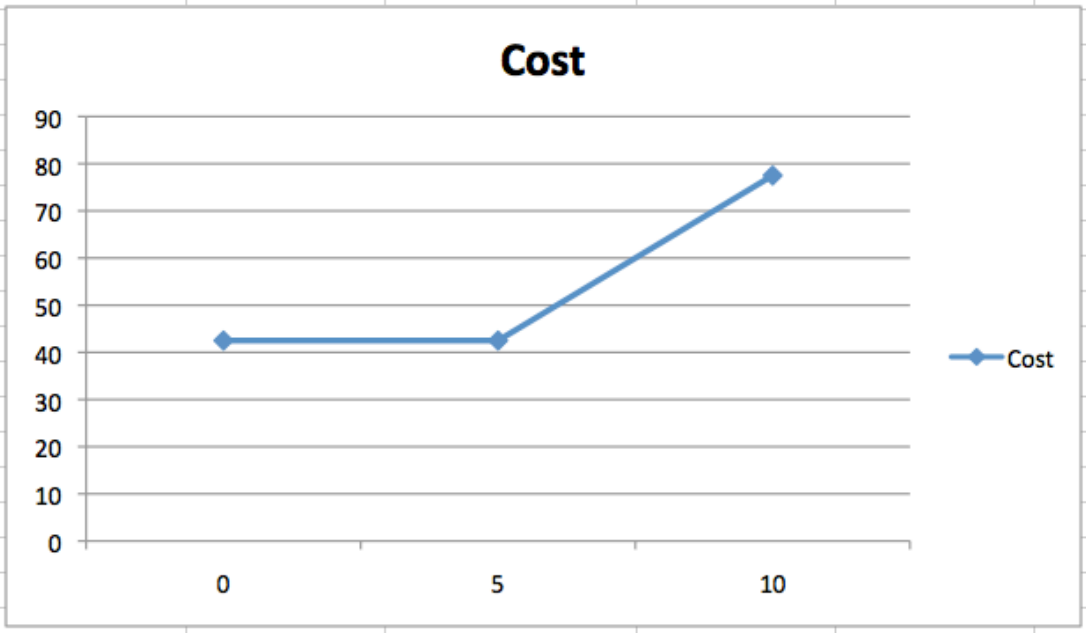
PIECEWISE FUNCTIONS – SPREADSHEETS

a) **Section 5-1 Examples 4 and 5 p. 221**

x	C(x)	DOMAIN
0	=42.5	x<5
5	=42.5	x=5
10	=42.5+7*(A5-5)	x>5



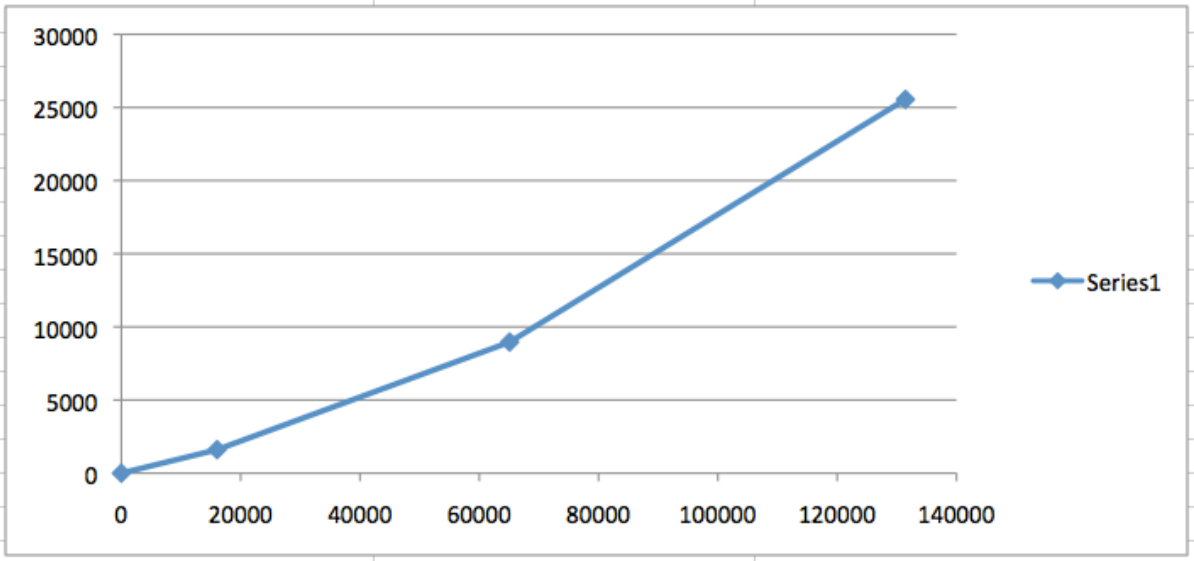
x	C(x)	DOMAIN
0	42.5	x<5
5	42.5	x=5
10	77.5	x>5



b) Section 7-2 Example 4 p. 229

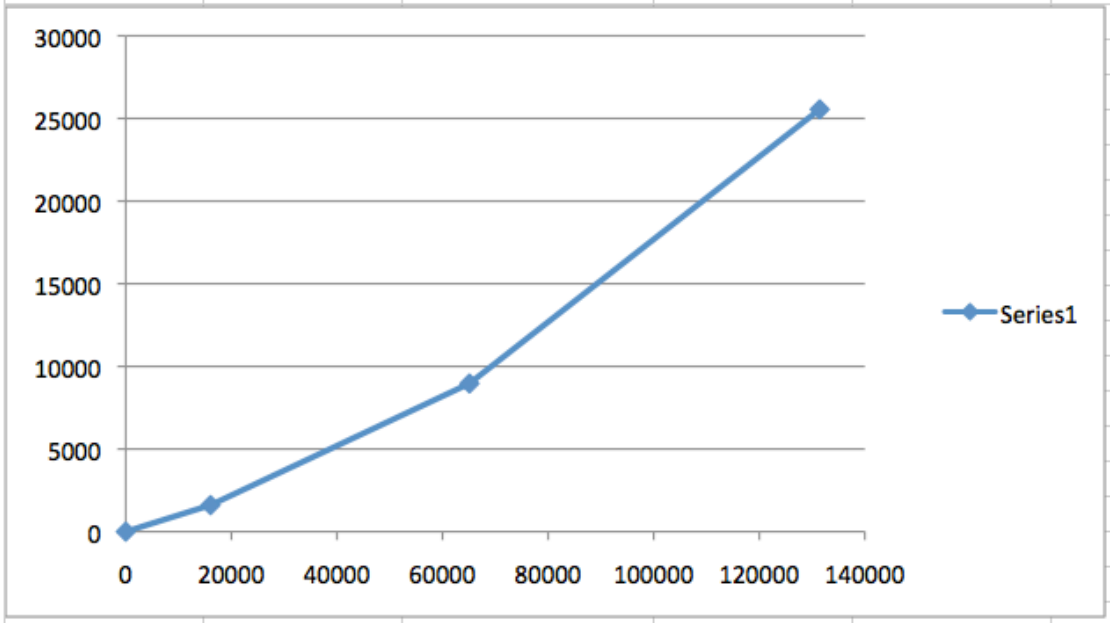
Ex. 4 p. 339

x	f(X)	DOMAIN
0	=0.1*A30	X ≤ 16050
16050	=0.1*A31	X ≤ 16050
65100	=0.15*A32-802.5	16050<X≤65100
131450	=0.25*A33-7312.5	65100<X≤131450



Ex. 4 p. 339

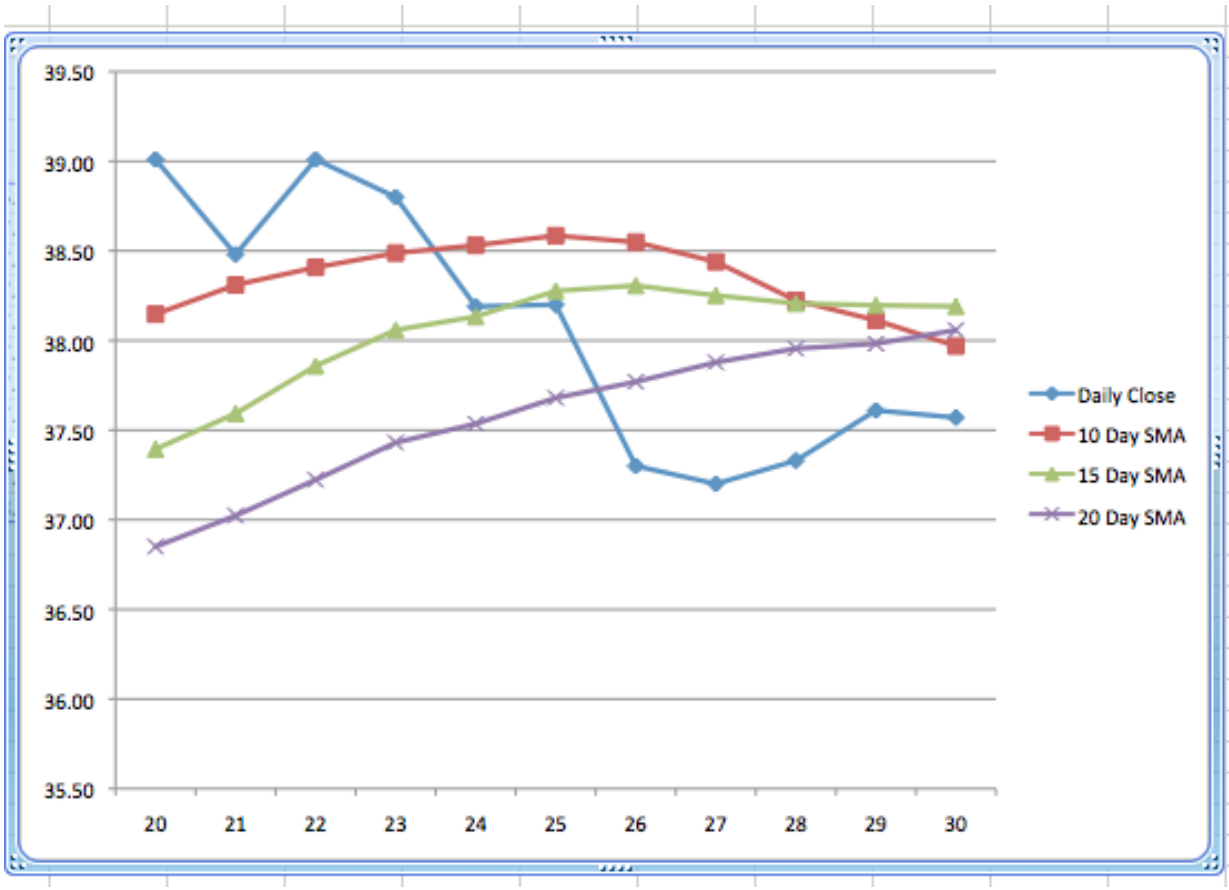
x	f(X)	DOMAIN
0	0	$X \leq 16050$
16050	1605	$X \leq 16050$
65100	8962.5	$16050 < X \leq 65100$
131450	25550	$65100 < X \leq 131450$



Simple Moving Averages
Section 1-4 p. 25

	A	B	C
1	Day	Closing Price	10-Day Moving Average
2	1	35.02	
3	2	35.01	
4	3	34.65	
5	4	36.09	
6	5	35.32	
7	6	35.50	
8	7	35.03	
9	8	35.79	
10	9	37.07	
11	10	36.05	35.55
12	11	36.85	35.74
13	12	38.03	36.04
14	13	38.00	36.37
15	14	37.76	36.54
16	15	37.66	36.77
17	16	37.66	36.99
18	17	38.30	37.32
19	18	39.48	37.69
20	19	38.72	37.85
21	20	39.01	38.15
22	21	38.48	38.31
23	22	39.01	38.41
24	23	38.80	38.49
25	24	38.19	38.53
26	25	38.20	38.59
27	26	37.30	38.55
28	27	37.20	38.44
29	28	37.33	38.22
30	29	37.61	38.11
31	30	37.57	37.97
32			

	A	B	C	D	E
1	Day	Closing Price	10-Day Moving Average	15 day	20 day
2	1	35.02			
3	2	35.01			
4	3	34.65			
5	4	36.09			
6	5	35.32			
7	6	35.50			
8	7	35.03			
9	8	35.79			
10	9	37.07			
11	10	36.05	35.55		
12	11	36.85	35.74		
13	12	38.03	36.04		
14	13	38.00	36.37		
15	14	37.76	36.54		
16	15	37.66	36.77	36.26	
17	16	37.66	36.99	36.43	
18	17	38.30	37.32	36.65	
19	18	39.48	37.69	36.97	
20	19	38.72	37.85	37.15	
21	20	39.01	38.15	37.39	36.85
22	21	38.48	38.31	37.59	37.02
23	22	39.01	38.41	37.86	37.22
24	23	38.80	38.49	38.06	37.43
25	24	38.19	38.53	38.13	37.54
26	25	38.20	38.59	38.28	37.68
27	26	37.30	38.55	38.31	37.77
28	27	37.20	38.44	38.25	37.88
29	28	37.33	38.22	38.21	37.96
30	29	37.61	38.11	38.20	37.98
31	30	37.57	37.97	38.19	38.06
32					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Daily Close
10 Day SMA
15 Day SMA
20 Day SMA