USING SCIENTIFIC NOTEBOOK AND EXCEL IN A COLLEGE ALGEBRA COURSE

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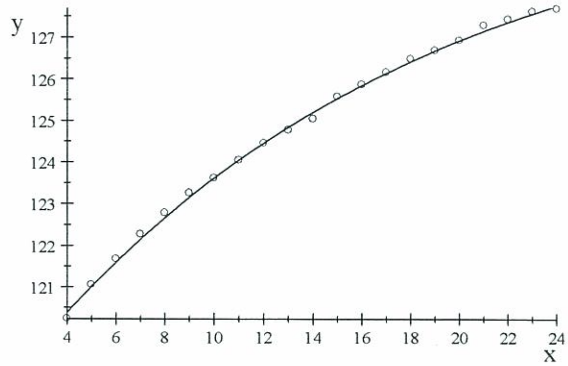
I. USING SCIENTIFIC NOTEBOOK

EXAMPLE 1: Population of Japan
Between 1984 and 2004, the population of Japan increased but at has leveled off in the last decade. The table below gives the population in millions for these years.

Year	Population(millions)	Year	Population (millions)	Year	Population(millions)
1984	120.235	1992	124.452	2000	126.926
1985	121.049	1993	124.764	2001	127.291
1986	121.672	1994	125.134	2002	127.435
1987	122.264	1995	125.570	2003	127.619
1988	122.783	1996	125.864	2004	127.687
1989	123.255	1997	126.166		
1990	123.611	1998	126.486		
1991	124.043	1999	126.686		

Source: **College Algebra in Context**, Harshbarger, R.J. and Yocco, L.S.

A scatterplot of the data and the fact that the population growth is leveling off indicate that a logistic model may be appropriate. The logistic function that models the data is $f(x) = \dfrac{130.439}{1+0.11e^{-.069x}}$ where x is the number of years after 1980.



This function can be defined and graphed using Scientific Notebook, and the population of Japan in 2007 can be estimated. To estimate the population in 2007 , we must evaluate $f(27) = 128.25$ Thus, according to the model, the population of Japan will be 128,250,000 in 2007.

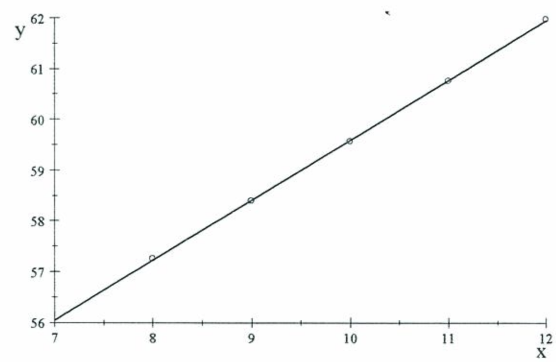
EXAMPLE 2: Peanut Production

Georgia's production of peanuts has increased moderately in the last 10 years, but profit margins have been reduced by lower prices, declining yields, and increasing costs. The table below gives the annual revenue, variable costs, and fixed costs for peanut production in Georgia for the years 1998-2002.

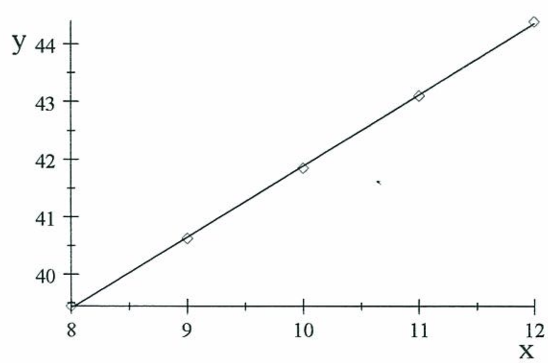
GA Peanut Production	1998	1999	2000	2001	2002
Revenue ($)	57,250	58,395	59,563	60,754	61,969
Variable Costs ($)	28,064	28,905	29,773	30,666	31,586
Fixed Costs ($)	11,382	11,724	12,076	12,438	12,811

Source: **College Algebra in Context**, Harshbarger, R.J. and Yocco, L.S.

To create the model for revenue with x = the number of years after 1990 and y = revenue in thousands of dollars, we create a 5 x 2 matrix and create the scatterplot to see that a linear function is appropriate. The best fit linear function is $R(x) = 1.1797x + 47.789$.
The model and the data points are graphed at right.



To create the model for total cost with x = the number of years after 1990 and y = total cost in thousands of dollars, we create a 5 x 2 matrix and create the scatterplot to see that a linear function is appropriate. The best fit linear function is $C(x) = 1.2377x + 29.508$.
The model and the data points are graphed at right.

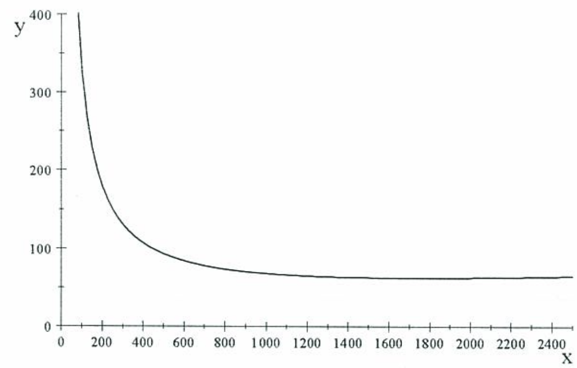


To create the profit function we must compute R(x)-C(x). To find the sum, leave the insertion point in the expression and click the Evaluate button on the Compute toolbar, or choose Evaluate.
R(x)-C(x)= 18. 281-0.058x and define this function as P(x). P(x)=18. 281-0.058x
o estimate the profit for the year 2008, we evaluate the function at x=18:
P(18)= 17. 237
This means that in 2008, the profit is estimated to be $17,237.

EXAMPLE 3: Average Cost
Suppose that the monthly cost for producing x units of a product is given by
$C(x) = .01x^2 + 28x + 30{,}000$.

The average cost is $\overline{C}(x) = \dfrac{.01x^2 + 28x + 30000}{x}$

We can graph this function, noting that only positive x-values make sense for the application.



The average cost function reaches a minimum although the graph may not indicate so. For functions with a finite number of extrema, the command Find Extrema on the Calculus submenu is useful.
Candidate(s) for extrema: $\{-6.641, 62.641\}$ at $\{[x = -1732.1], [x = 1732.1]\}$.
Because we are only interested in positive values, we conclude that the minimum average cost, 62.64, occurs when 1732 units are produced.

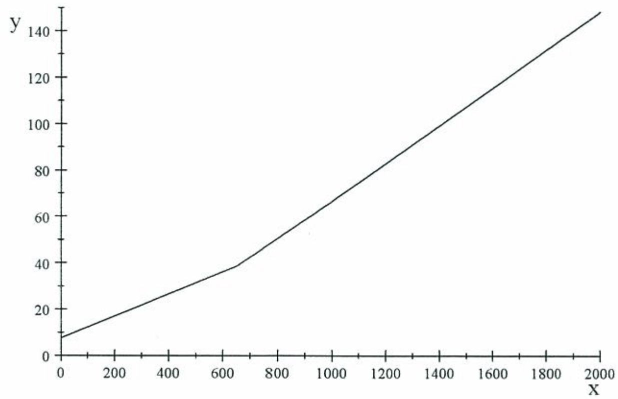
EXAMPLE 4: Georgia Power Company charges
Excluding fuel adjustment costs and taxes, Georgia Power Company charges its residential customers for electricity during the months of June through September according to the table.

Monthly Kilowatt-Hours (kWh)	Monthly Charge
0 to 650	$7.50 plus $0.04783 per kWh
More than 650, up to 1000	$38.59 plus $0.07948 per kWh above 650
More than 2000	$66.41 plus $0.08184 per kWh above 1000

Source: **College Algebra in Context**, Harshbarger, R.J. and Yocco, L.S.

The piecewise-defined function that gives the monthly charge for residential customers is placed in a 3x3 matrix

$$g(x) = \begin{cases} 7.50 + 0.04783x & if \;\; 0 \le x \le 650 \\ 38.59 + 0.07948(x-650) & if \;\; 650 < x \le 1000 \\ 66.52 + 0.08184(x-1000) & if \;\; x > 1000 \end{cases}$$



To graph the function, place the insertion point in the matrix and select Plot 2D
To find the amount of the bill for certain numbers of kWhs used, we evaluate the function at by placing the insertion point in the matrix and selecting 'New Definition" to define the function, then type g(c) and select Evaluate.

For 400 kWhs used: g(400)= 26. 632
For 650 kWhs used: g(650)= 38. 590
For 800 kWhs used: g(800)= 50. 512
For 1200 kWhs used: g(1200)= 82. 788

II. USING EXCEL

EXAMPLE 5: Levels of Aleve in the Bloodstream
The anti-inflammatory drug Aleve has a half-life of 12 hours, and the recommended dosage is 550 mg taken every 12 hours. The drug will have 50% removed through the kidneys and liver and 50% remaining in the system 12 hours it was taken.
a. Find the amount of the drug in the system 5 days after the person begins to take the drug.
b. An alternate way to take this medication is to take 550 mg followed by 275 mg every 6 hours. The kidneys and liver will remove 25% of the drug every 6 hours, so 75% will still be in the system when the next dosage is taken. Does the alternate plan provide the same maximum amount of drug as the original plan?
Source: *Physician's Desk Reference*

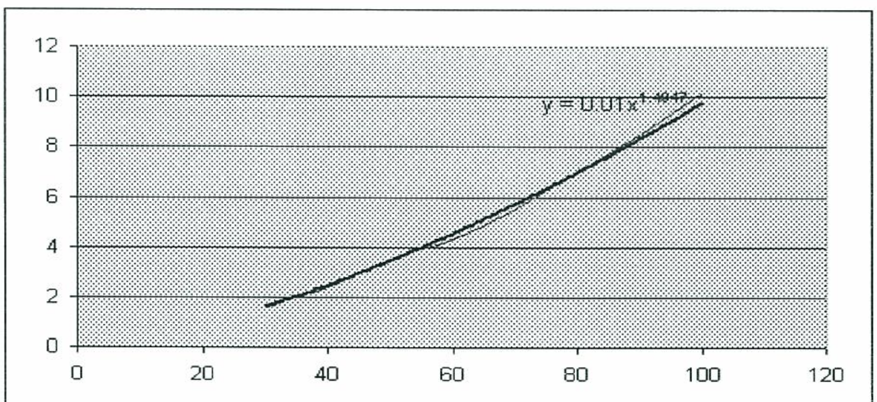
Levels of Aleve	in the Bloodstream
Normal Dose	Alternate Dose
550	550
825	687.5
962.5	790.625
1031.25	867.9688
1065.625	925.9766
1082.813	969.4824
1091.406	1002.112
1095.703	1026.584
1097.852	1044.938
1098.926	1058.703
1099.463	1069.028
	1076.771
	1082.578

1086.934
1090.2
1092.65
1094.488
1095.866
1096.899
1097.674
1098.256

EXAMPLE 6: **Corvette Acceleration**

The following table shows the times that it takes a 2005 Corvette to reach speeds from 0 to 100 mph, in increments of 10 mph after 30 mph.
a. Use a power function to model the time it takes to reach a given speed and discuss the fit of the model to the data.
b. How long does the model indicate it will take to reach a speed of 120 mph?
c. What does the model indicate that the speed will be 5 seconds after the car starts to move?
Source: **College Algebra in Context**, Harshbarger, R. J., and Yocco, L. S.

Corvette	**Acceleration**			
Time (sec)	Speed (mph)		Speed (mph)	Time (sec)
1.7	30		30	1.7
2.4	40		40	2.4
3.5	50		50	3.5
4.3	60		60	4.3
5.5	70		70	5.5
7	80		80	7
8.5	90		90	8.5
10.2	100		100	10.2



120	12.81599
65	5.125799
64.5	5.066977
64	5.008379
63.9	4.996687