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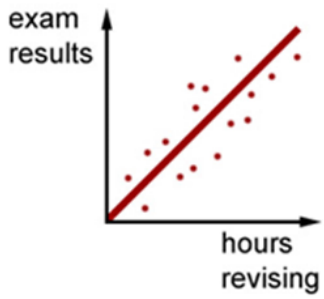
Algebra 2 Common Core – Notes and examples on Regressions

Regression analysis is used to study the relationship between pairs of variables of the form (x,y). The x-variable is the independent variable controlled by the researcher. The y-variable is the dependent variable and is the effect observed by the researcher. When this data is graphed, forming a scatter plot, an attempt is made to find an equation/model that "fits" the data. We know that this equation may, or may not, be linear (a straight line).

An important term in discussing regressions…

Correlation

Correlation tests relationships between two variables. You need to identify an independent variable (x variable) which is often considered the causative agent, and a dependent variable (y variable) which is thought to be affected by the x variable. If a graph is made, the x variable plotted on the x (horizontal) axis and the y variable is plotted on the y (vertical) axis.
A simple equation results in a value known as "r" or the correlation coefficient. "r" takes values from -1 to +1.



POSITIVE CORRELATION
- people who do more revision get higher exam results.

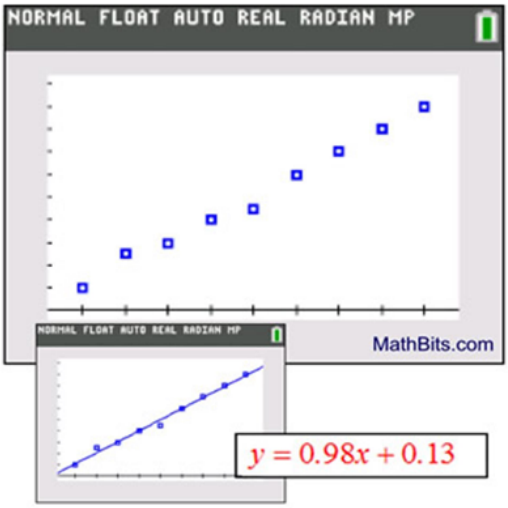
NEGATIVE CORRELATION
- when more jabs are given the number of people with flu falls.

* r-value close to +1 or −1 shows strong correlation/relationship.

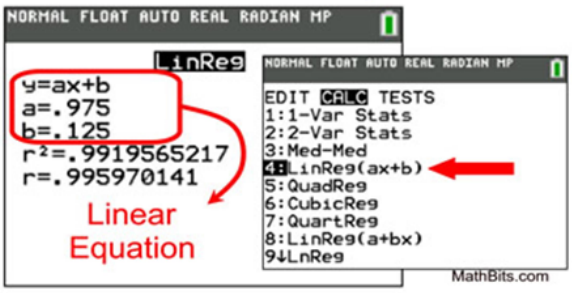
* r-value close to 0 shows weak correlation.

Algebra 2 Common Core – Notes and examples on Regressions

Linear Regression (LinReg)



Calculator help with Linear Regressions



Characteristics:

- The scatter plot appears to be nearly a straight line with a positive slope (for this example) or negative slope.
- The residual plot would show a random pattern.
- Form: $y = ax + b$ where a is the slope
- The linear regression equation will be used to predict y-values that lie within the plotted values (from $x = 0$ to $x = 9$) (*interpolate*).
- The linear regression equation will be used to predict y-values that lie outside the plotted values (ex*trapolate*). (less reliable)

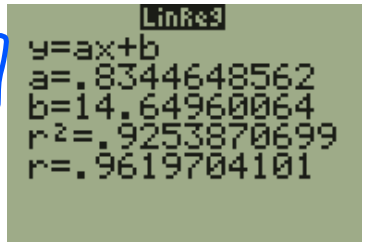
You Try:

1. In a mathematics class of ten students, the teacher wanted to determine how a homework grade influenced a student's performance on the subsequent test. The homework grade and subsequent test grade for each student are given in the accompanying table.

Homework Grade (x)	Test Grade (y)
94	98
95	94
92	95
87	89
82	85
80	78
75	73
65	67
50	45
20	40

a) Give the equation of the ~~linear regression~~ line for this set of data. Round the coefficients to the *nearest thousandth*.

$y = .834x + 14.650$



b) A new student comes to the class and earns a homework grade of 78. Based on the equation in part *a*, what grade would the teacher predict the student would receive on the subsequent test, to the *nearest integer*.

$x = 78$

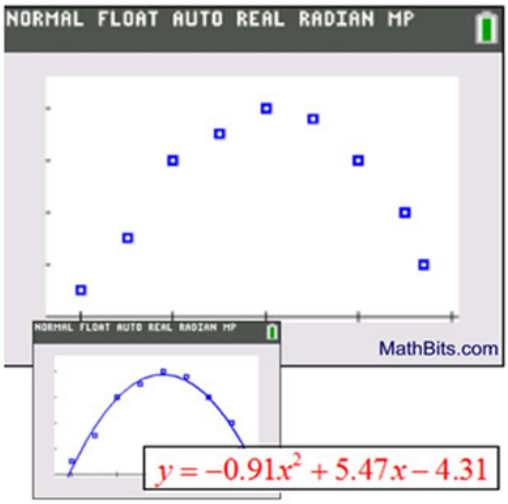
$y = .834(78) + 14.650$

$y \approx \boxed{80}$

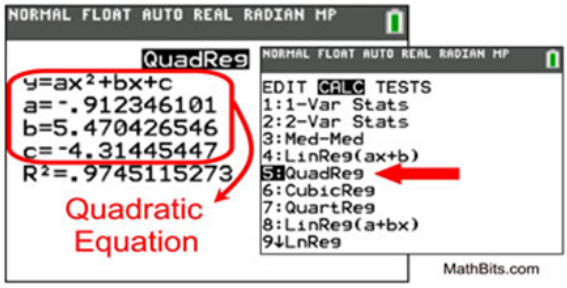
Algebra 2 Common Core – Notes and examples on Regressions

A Quadratic Regression produces a quadratic model, following the shape of a parabola, to represent the relationship of the data. The data shown below is obviously not linear.

Quadratic Regression (QuadReg)



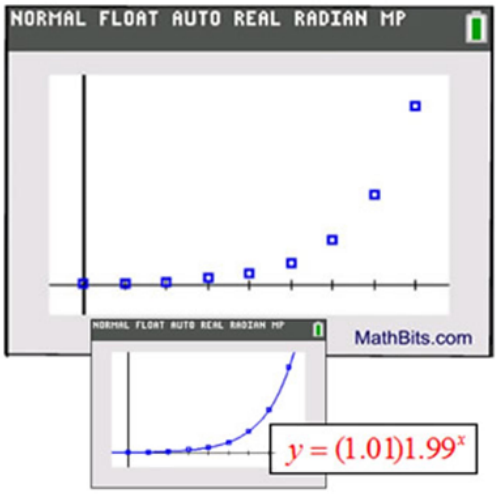
Calculator help with Quadratic Regressions



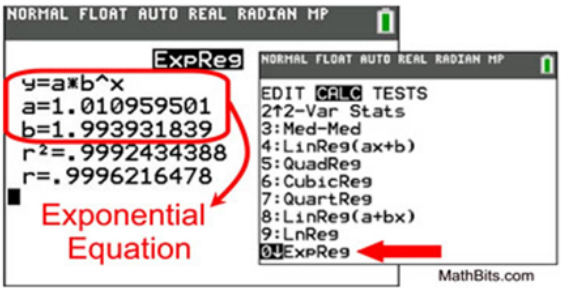
Characteristics:

- The scatter plot appears to resemble a parabola opening downward (for this example) or opening downward.
- The residual plot would show a pattern.
- Form: $y = ax^2 + bx + c$ (where a is not 0)
- The quadratic regression equation will be used to predict y-values that lie within the plotted values (from $x = 0$ to $x = 5$) (*interpolate*).
- The quadratic regression equation will be used to predict y-values that lie outside the plotted values (*extrapolate*). (less reliable)

Exponential Regression (ExpReg)



Calculator help with Exponential Regressions



Characteristics:

- The scatter plot appears to resemble a rate of growth for this example (opening upward) or rate of decay (opening downward).
- The residual plot would show a pattern.
- Form: $y = ab^x$ (where a is not 0)
- The exponential regression equation will be used to predict y-values that lie within the plotted values (from $x = 0$ to $x = 8$) (*interpolate*).
- The exponential regression equation will be used to predict y-values that lie outside the plotted values (*extrapolate*). (less reliable)

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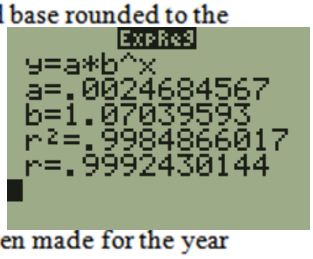
More Practice:

2. The table below, created in 1996, shows a history of transit fares from 1955 to 1995.

	Year	55	60	65	70	75	80	85	90	95
x										
y	Fare ($)	0.10	0.15	0.20	0.30	0.40	0.60	0.80	1.15	1.50

State the exponential regression equation with the coefficient and base rounded to the *nearest thousandth.*

$$\boxed{y = .002(1.070)^x}$$



Using this equation, determine the prediction that should have been made for the year 1998, to the *nearest cent.*

$x = 98$

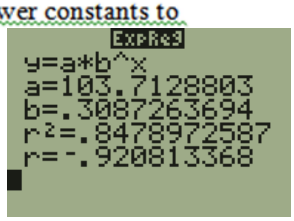
$$y = .002(1.070)^{98}$$
$$\approx \boxed{\$1.52}$$

3. The volume of a particular gas was determined at various pressures. *P* is the pressure (in atmospheres) and is the independent variable on the horizontal axis, and *V* is the volume (in liters) and is the dependent variable on the vertical axis.

x	y
P	V
0.1	225
0.3	74.999
0.5	45
0.7	32.139
0.9	25
1.1	20.45
1.5	15
1.7	13.24
1.9	11.84
2.1	10.71
2.3	9.78

Find the equation of the curve of best fit. (Round answer constants to *nearest tenth*).

$$\boxed{V = 103.7(.3)^P}$$



Using the regression equation found, estimate *V* if *P* = 2.5.

$$V = 103.7(.3)^{2.5}$$
$$\boxed{V \approx 5.1 \text{ liters}}$$