

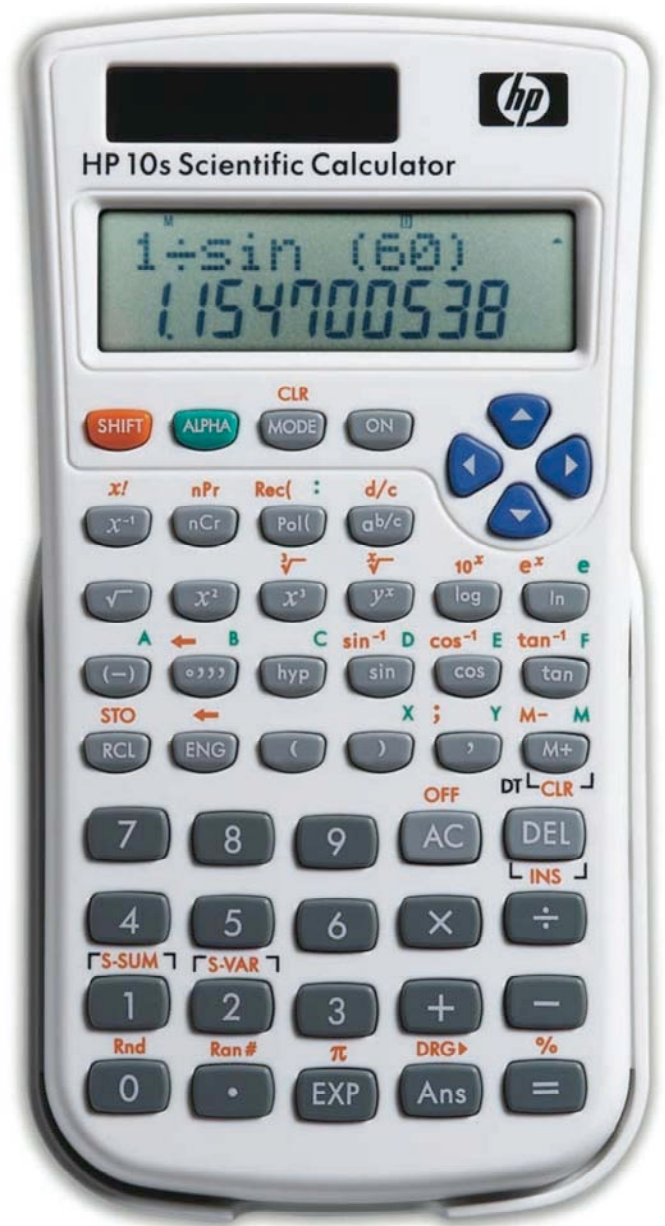


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HP 10s Statistics – Non-Linear regression

Non-Linear regression

Practice fitting a curve to data



Non-Linear regression

The HP10s provides several functions to fit data to different regression models.

Non-Linear regression is a general name for the processing of finding the equation of one of several different curves that “best fits” a set of given x and y coordinates. This is done by minimizing the sum of the squared residuals, or differences between the actual data points and the points on the curve fit to the data points.

On the HP 10s, several non-linear regression modes are available.

MODE	3	2	Logarithmic regression.
MODE	3	3	Exponential regression
MODE	3	1	Power regression.
MODE	3	2	Inverse regression.
MODE	3	3	Quadratic regression.

The resulting equations for each type of regression are shown below. Coefficients a and b are computed by the HP 10s.

Logarithmic regression:	$y = a + b \text{LN}(x)$
Exponential regression:	$y = a e^{bx}$
Power regression:	$y = a x^b$
Inverse regression:	$y = a + b/x$
Quadratic regression:	$y = a + bx + cx^2$

On the HP 10s, the following key sequences can be used to display calculated regression coefficients for non-quadratic regressions.

SHIFT S-VAR 1 =	Displays the average of the x values.
SHIFT S-VAR 2 =	Displays the population standard deviation of the x values.
SHIFT S-VAR 3 =	Displays the sample standard deviation of the x values.
SHIFT S-VAR 1	Displays the average of the y values.
SHIFT S-VAR 2	Displays the population standard deviation of the y values.
SHIFT S-VAR 3	Displays the sample standard deviation of the y values.
SHIFT S-VAR 1	Displays the a regression coefficient (y-intercept).
SHIFT S-VAR 2	Displays the b regression coefficient (slope).
SHIFT S-VAR 3	Displays the r coefficient (correlation).
SHIFT S-VAR 1	Computes predicted x-values given a y-value.
SHIFT S-VAR 2	Computes predicted y-values given an x-value.
SHIFT S-SUM 1 =	Displays the sum of the x^2 values.
SHIFT S-SUM 2 =	Displays the sum of the x values.
SHIFT S-SUM 3 =	Displays the number of data points.
SHIFT S-SUM 1	Displays the sum of the y^2 values.
SHIFT S-SUM 2	Displays the sum of the y values.
SHIFT S-SUM 3	Displays the sum of the x times y values.

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For quadratic regressions, the following key sequences can be used to display calculated regression coefficients.

	Displays the sum of the x^3 values.
	Displays the sum of the x^2y values.
	Displays the sum of the x^4 values.
	Displays the regression coefficient C.
	Computes predicted x1-values.
	Computes predicted x2-values.
	Computes predicted y-values.

Practice fitting a curve to data

Example 1: Johnson’s Chair Company has experienced the following costs for the first 6 months of the year:

# Chairs Made	Total Costs
5,000	\$120,000
5,500	\$122,100
4,800	\$118,540
5,300	\$122,400
4,950	\$119,100
5,150	\$124,200

What is the equation to relate the number of chairs made to the cost, using a logarithmic regression? How good is the fit of the regression curve generated (What is the correlation)?

Solution: First of all, let’s enter regression mode by pressing (the 2 is for logarithmic regression). Every time we select another mode, the statistics data is cleared so that we can be confident that no data remains from previous calculations. Now enter the data. Note that the key is the same thing as the key.

5	0	0	0	,	1	2	0	0	0	0	M+
5	5	0	0	,	1	2	2	1	0	0	M+
4	8	0	0	,	1	1	8	5	4	0	M+
5	3	0	0	,	1	2	2	4	0	0	M+
4	9	5	0	,	1	1	9	1	0	0	M+
5	1	5	0	,	1	2	4	2	0	0	M+

In this situation, the fixed cost will be the y-intercept and the variable cost will be the slope.

	Displays the a regression coefficient.
	Displays the b regression coefficient.
	Displays the r coefficient (correlation).

Answer: The regression equation generated is of the form: $Y = 133755 - 1557 \ln(X)$. The correlation value of -0.66 is not as close to -1 as might be hoped, but still indicates a moderate fit.

Example 2: John’s store has had sales for the last 5 months of \$150, \$165, \$180, \$195, and \$220. Use a power regression to predict sales for months 6 and 7 and also predict when estimated sales would reach \$400. What is the correlation for the regression?

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Solution: The X values will be the months of 1 through 5. The Y values will be the existing sales numbers. First of all, let's enter regression mode and select a power curve fit by pressing MODE $\boxed{3}$ D $\boxed{1}$.

1	'	1	5	0	M+
2	'	1	6	5	M+
3	'	1	8	0	M+
4	'	1	9	5	M+
5	'	2	2	0	M+

SHIFT r S-VAR T	D	D	$\boxed{1}$	=	Displays the a regression coefficient.
SHIFT r S-VAR T	D	D	$\boxed{2}$	=	Displays the b regression coefficient.
SHIFT r S-VAR T	D	D	$\boxed{3}$	=	Displays the r coefficient (correlation).

$\boxed{6}$ SHIFT r S-VAR T	D	D	D	$\boxed{2}$	=	Computes predicted y-values given an x-value.
$\boxed{7}$ SHIFT r S-VAR T	D	D	D	$\boxed{2}$	=	Computes predicted y-values given an x-value.

Answer: Sales in month 6 are predicted to be \$217 and in month 7 \$225. The correlation is 0.96, which indicates a fairly strong relationship and predictive ability. The resulting regression equation is $y = 145.51 x^{0.2245}$