Quadratic (Second-Order Polynomial) Regression

Least-squares quadratic y = a + bx + cx² through up to eight points, with the coefficient of determination R², the vertex and the predicted y at a chosen x.

Method: Least-squares polynomial regression

Input parameters

Unit system: SI

Parameter	Value	Unit
Number of points used (3–8)	6.0000	
Point 1: x	1.0000	
Point 1: y	2.1000	
Point 2: x	2.0000	
Point 2: y	3.9000	
Point 3: x	3.0000	
Point 3: y	6.8000	
Point 4: x	4.0000	
Point 4: y	11.200	
Point 5: x	5.0000	
Point 5: y	16.100	
Point 6: x	6.0000	
Point 6: y	22.300	
Point 7: x	0	
Point 7: y	0	
Point 8: x	0	
Point 8: y	0	
x for prediction	7.0000	

Calculated results

Parameter	Value	Unit
Constant term	1.2000	
Linear coefficient	0.30714	
Quadratic coefficient	0.53571	
Coefficient of determination	0.99977	
Vertex x (−b/2c)	-0.28667	
Predicted y at x_0	29.600	

Notes for this case

• The coefficients minimise the sum of squared residuals: the normal equations $[\Sigma 1\ \Sigma x\ \Sigma x^2;\ \Sigma x\ \Sigma x^2\ \Sigma x^3;\ \Sigma x^2\ \Sigma x^3\ \Sigma x^4]\cdot[a\ b\ c]^T = [\Sigma y\ \Sigma xy\ \Sigma x^2 y]^T$, solved here by Gaussian elimination. $R^2 = 1 - SS_{res}/SS_{tot}$. Extrapolating a quadratic beyond the data range is risky; the vertex (maximum or minimum) is meaningful only if it lies within the data. Vertex shows 0 when c = 0.

Formula and method

$$\min \sum (y_i - a - bx_i - cx_i^2)^2, \quad R^2 = 1 - \frac{SS_{res}}{SS_{tot}}$$

Variables

n	Number of points used (3–8)	-
x_1	Point 1: x	-
y_1	Point 1: y	-
x_2	Point 2: x	-
y_2	Point 2: y	-
x_3	Point 3: x	-
y_3	Point 3: y	-
x_4	Point 4: x	-
y_4	Point 4: y	-
x_5	Point 5: x	-
y_5	Point 5: y	-
x_6	Point 6: x	-
y_6	Point 6: y	-
x_7	Point 7: x	-
y_7	Point 7: y	-
x_8	Point 8: x	-
y_8	Point 8: y	-
x_0	x for prediction	-
a	Constant term	-
b	Linear coefficient	-
c	Quadratic coefficient	-
R^2	Coefficient of determination	-
x_v	Vertex x (−b/2c)	-
$\widehat{y}(x_0)$	Predicted y at x_0	-

Method and standards

Quadratic fit.

Assumptions and limits

- Errors in y only; equal weights.

References

Least-squares polynomial regression

Report details

Report reference	FCC-CGYR-7GY2 (the same inputs always give the same reference)
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Calculator	Quadratic (Second-Order Polynomial) Regression
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/general/geometry/quadratic-regression

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.