Exponential and Power-Law Curve Fit

Least-squares fit of y = a·e^(bx) or y = a·x^b to up to eight points by linearising with logarithms, with R^2, doubling or halving x and a prediction.

Method: Least squares on logarithms of the model

Input parameters

Unit system: SI

Parameter	Value	Unit
Model	Exponential y = a·e^(bx)	
Number of points used (2–8)	6.0000	
Point 1: x	0	
Point 1: y	3.1000	
Point 2: x	1.0000	
Point 2: y	4.4000	
Point 3: x	2.0000	
Point 3: y	6.3000	
Point 4: x	3.0000	
Point 4: y	8.9000	
Point 5: x	4.0000	
Point 5: y	12.800	
Point 6: x	5.0000	
Point 6: y	18.100	
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
Coefficient a	3.0971	
Exponent or rate b	0.35347	
R^2 of the log-linear fit	0.99997	
Predicted y at x_0	36.774	
Change in x (or factor in x) that doubles y	1.9610	

Notes for this case

• Taking logarithms turns y = a·e^(bx) into ln y = ln a + bx, and y = a·x^b into ln y = ln a + b ln x; an ordinary least-squares line then gives ln a and b. This minimises errors in ln y (relative errors), not in y, so large values carry less weight than in a nonlinear fit; R^2 refers to the log-linear fit. The doubling output is Δx = ln 2/b for the exponential and the factor 2^(1/b) on x for the power law (negative b gives halving).

Formula and method

$$\ln y = \ln a + bx \text{ or } \ln y = \ln a + b \ln x, \quad b = \frac{n\sum uw - \sum u \sum w}{n\sum u^2 - (\sum u)^2}$$

Variables

model	Model	-
n	Number of points used (2–8)	-
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	Coefficient a	-
b	Exponent or rate b	-
R^2	R² of the log-linear fit	-
$\widehat{y}(x_0)$	Predicted y at x_0	-

Method and standards

Log-linear fit.

Assumptions and limits

- Errors multiplicative (constant relative scatter); up to eight points.

References

Least squares on logarithms of the model

Report details

Report reference	FCC-4SPK-R9GY (the same inputs always give the same reference)
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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/exponential-power-law-fit

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.