

MATHCAD Example - Power Regression

Problem 3.8 - Graph Resistance, R, vs. Area, A, for a conductor on a log-log graph and determine an equation representing the data.

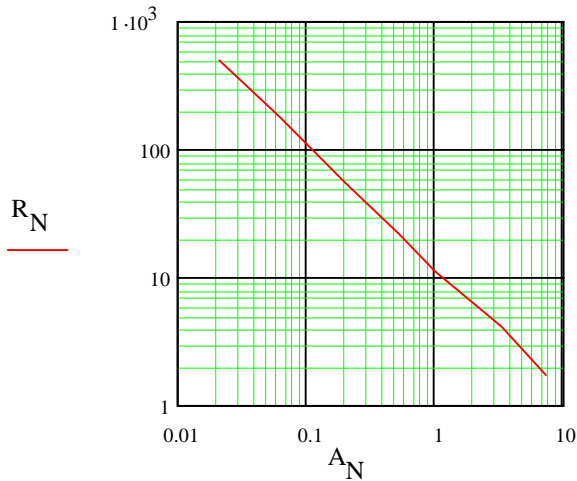
ORIGIN := 1

N := 1..7

Note: There are 7 data points.

Area, A (mm) ²	Resistance R (mW/m)
$A := \begin{bmatrix} 0.021 \\ 0.062 \\ 0.202 \\ 0.523 \\ 1.008 \\ 3.320 \\ 7.290 \end{bmatrix}$	$R := \begin{bmatrix} 505. \\ 182. \\ 55.3 \\ 22.2 \\ 11.3 \\ 4.17 \\ 1.75 \end{bmatrix}$

Electrical Conductor
Resistance vs Area



Note: To determine the power equation representing the data we recall that the power formula can be expressed as

$$y = bx^m \quad \text{or} \quad \log(y) = m\log(x) + \log(b)$$

so the slope $m = \frac{\text{change in } \log(y)}{\text{change in } \log(x)}$ and the intercept $b = \log(b)$

so we need to generate two new functions, $\log(y)$ and

$\log(x)$, for finding the slope.

Note: Two new functions have been generated for regression analysis:

$$\text{LOGR}_N := \log(R_N) \quad \text{LOGA}_N := \log(A_N)$$

$$\text{LOGR} = \begin{bmatrix} 2.703 \\ 2.26 \\ 1.743 \\ 1.346 \\ 1.053 \\ 0.62 \\ 0.243 \end{bmatrix} \quad \text{LOGA} = \begin{bmatrix} -1.678 \\ -1.208 \\ -0.695 \\ -0.281 \\ 3.461 \cdot 10^{-3} \\ 0.521 \\ 0.863 \end{bmatrix}$$

$m := \text{slope}(\text{LOGA}, \text{LOGR}) \quad m = -0.963$ Note: form is slope(x,y)

$\text{logb} := \text{intercept}(\text{LOGA}, \text{LOGR}) \quad \text{logb} = 1.084$ Note: Intercept = log(b), not b

so $b := 10^{\text{logb}}$ $b = 12.122$

Result: $y = bx^m$ or $R = 12.122A^{-0.963}$

Note: If we want to graph the results using the empirical formula just determined to generate a straight line, we should do the following:

1. Graph the original data showing points only
2. Form a new set of values, RNEW, using the empirical form
3. Graph the new set of values showing only the line

$$\text{RNEW}_N := b \cdot (A_N)^m \quad \text{RNEW} = \begin{bmatrix} 501.161 \\ 176.605 \\ 56.599 \\ 22.635 \\ 12.029 \\ 3.815 \\ 1.788 \end{bmatrix}$$

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