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Q7. An object is suspended in a wind tunnel and the force measured for various wind velocity is given:-

v	10	20	30	40	50	60	70	80
F	25	70	380	550	610	1220	830	1450

We know that for $v = 0 \Rightarrow F = 0$

∴ Second-order polynomial regression must PASS through ORIGIN.

$$\Rightarrow y = a_1 x + a_2 x^2$$

This can be written as

$$\begin{bmatrix} x_1 & x_1^2 \\ x_2 & x_2^2 \\ | & | \\ | & | \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ | \\ | \end{bmatrix}$$

$$X \quad A \quad = \quad Y$$

Calculate $A = (X^T X)^{-1} X^T Y$

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where $X = \begin{bmatrix} 10 & 100 \\ 20 & 400 \\ 30 & 900 \\ 40 & 1600 \\ 50 & 2500 \\ 60 & 3600 \\ 70 & 4900 \\ 80 & 6400 \end{bmatrix}$ $Y = \begin{bmatrix} 25 \\ 70 \\ 380 \\ 550 \\ 610 \\ 1220 \\ 830 \\ 1450 \end{bmatrix}$

$$(X^T X)^{-1} = 10^{-3} \begin{bmatrix} 0.7984 & -0.0118 \\ -0.0118 & 0.0002 \end{bmatrix}$$

this gives us $\Rightarrow a_1 = 7.7710 \quad a_2 = 0.1191$