

HW8.1

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

x	10	20	30	40	50	60	70	80
y	25	70	180	550	1100	1920	3080	4600

$$S_m = \sum_{i=1}^n (y_i - (a_1 x_i + a_2 x_i^2))^2$$

$$\frac{\partial S_m}{\partial a_1} = 0 \quad \frac{\partial S_m}{\partial a_2} = 0$$

$$\frac{\partial S_m}{\partial a_1} = \frac{\partial}{\partial a_1} \sum (y_i - (a_1 x_i + a_2 x_i^2))^2$$

$$= \sum 2 (y_i - a_1 x_i - a_2 x_i^2) (-x_i)$$

$$\frac{\partial S_m}{\partial a_2} = \frac{\partial}{\partial a_2} \sum (y_i - (a_1 x_i + a_2 x_i^2))^2$$

$$= \sum 2 (y_i - a_1 x_i - a_2 x_i^2) (-2x_i)$$

$$\frac{\partial S_m}{\partial a_1} = 0 \quad \frac{\partial S_m}{\partial a_2} = 0$$

$$\sum x_i y_i - \sum a_1 x_i^2 - \sum a_2 x_i^3 = 0$$

$$\sum y_i x_i^2 - \sum a_1 x_i^3 - \sum a_2 x_i^4 = 0$$

$$\begin{pmatrix} \sum x_i^2 & \sum x_i^3 \\ \sum x_i^3 & \sum x_i^4 \end{pmatrix} \begin{pmatrix} a_1 \\ a_2 \end{pmatrix} = \begin{pmatrix} \sum y_i x_i \\ \sum y_i x_i^2 \end{pmatrix}$$

$$\sum x_i^2 = (10^2 + 20^2 + 30^2 + 40^2 + 50^2 + 60^2 + 70^2 + 80^2) = 20400$$

$$\sum x_i^3 = (10^3 + 20^3 + 30^3 + 40^3 + 50^3 + 60^3 + 70^3 + 80^3) = 129600$$

$$\sum x_i^4 = (10^4 + 20^4 + 30^4 + 40^4 + 50^4 + 60^4 + 70^4 + 80^4) = 87720000$$

$$\sum x_i y_i = (10 \times 25) + (20 \times 70) + (30 \times 380) + (40 \times 550) + (50 \times 610) + (60 \times 1220) + (70 \times 830) + (80 \times 1450) = 312850$$

$$\sum y_i x_i^2 = (10^2 \times 25) + (20^2 \times 70) + (30^2 \times 380) + (40^2 \times 550) + (50^2 \times 610) + (60^2 \times 1220) + (70^2 \times 830) + (80^2 \times 1450) = 20516500$$

$$\begin{bmatrix} 20400 & 129600 \\ 129600 & 87720000 \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} 312850 \\ 20516500 \end{bmatrix}$$

$$D = \begin{bmatrix} 20400 & 129600 \\ 129600 & 87720000 \end{bmatrix} \Rightarrow \text{Det}[D] = 109872000000$$

$$D_x = \begin{bmatrix} 312850 & 129600 \\ 20516500 & 87720000 \end{bmatrix} \Rightarrow \text{Det}(D_x) = 853818000000$$

$$D_y = \begin{bmatrix} 20400 & 312850 \\ 129600 & 20516500 \end{bmatrix}, \text{Det}(D_y) = 1308300000$$

$$w_1 = \frac{Dx}{D} = 7.7710245$$

$$w_2 = \frac{Dy}{D} = 0.1196749233$$

$$(0.8 + 0.05 + 0.02 + 0.03 + 0.04 + 0.08 + 0.05 + 0.01) = 0.31$$

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