Time Series Analysis

Ex)

day	Stock price
1	5
2	6
3	8
4	9
5	10

Autoregressive method (Order 1)

$y \to$ current stock price
$x \to$ previous stock price

y
5
6
8
9
10

x
5
6
8
9

$\to$

y
6
8
9
10

x
5
6
8
9

Prediction of Stock price for 6th data

$$y = \beta_0 + \beta_1 x$$

$$\beta = \begin{bmatrix} \bar{\beta_0} \\ \beta_1 \end{bmatrix} \qquad y = \begin{bmatrix} 6 \\ 8 \\ 9 \\ 10 \end{bmatrix} \qquad x = \begin{bmatrix} 5 & 5 \\ 5 & 6 \\ 1 & 8 \\ 1 & 9 \end{bmatrix}$$

$$x^T x = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 5 & 6 & 8 & 9 \end{bmatrix} \begin{bmatrix} 1 & 5 \\ 1 & 6 \\ 1 & 8 \\ 1 & 9 \end{bmatrix} = \begin{bmatrix} 4 & 28 \\ 28 & 206 \end{bmatrix}$$

$$x^T y = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 5 & 6 & 8 & 9 \end{bmatrix} \begin{bmatrix} 6 \\ 8 \\ 9 \\ 10 \end{bmatrix} = \begin{bmatrix} 33 \\ 240 \end{bmatrix}$$

$$\beta = (x^T x)^{-1} (x^T y) = \begin{bmatrix} 5.15 & -0.7 \\ -0.7 & 0.1 \end{bmatrix} \begin{bmatrix} 33 \\ 240 \end{bmatrix} = \begin{bmatrix} 1.95 \\ 0.9 \end{bmatrix}$$

$$\beta = \begin{bmatrix} 1.95 \\ 0.9 \end{bmatrix}$$

$$y = 1.95 + 0.9x$$

$$x_6 = 10$$

$$y_6 = 1.95 + 0.9 \times 10 = \cancel{2.85} \ \underline{\underline{10.95}}$$