The Normal Equation

Data Science | CCDATSCL

We know the Linear Regression model is a **parameterized model** which means that the model's behavior and predictions are determined by a set of **parameters or coefficients in the model**.

Normal Equation is an approach to Linear Regression with the Least Square Cost Function.

We can use the normal equation to directly compute the parameters of a model that **minimizes the sum of the squared difference between the actual term and the predicted term**.

$$X^T X\theta = X^T y$$

Price of Fuel (X)	Jeepney Fare (Y)
1	1
2	3
3	2

$$X^T X\theta = X^T y$$

$$\begin{pmatrix}1&1&1\\1&2&3\end{pmatrix}\begin{pmatrix}1&1\\1&2\\1&3\end{pmatrix}\begin{pmatrix}b\\m\end{pmatrix}=\begin{pmatrix}1&1&1\\1&2&3\end{pmatrix}\begin{pmatrix}1\\3\\2\end{pmatrix}$$

$$\begin{pmatrix}1\\3\\2\end{pmatrix}=\begin{pmatrix}1&1\\1&2\\1&3\end{pmatrix}\begin{pmatrix}b\\m\end{pmatrix}$$

$$\begin{pmatrix}1&1&1\\1&2&3\end{pmatrix}\begin{pmatrix}1&1\\1&2\\1&3\end{pmatrix}\begin{pmatrix}b\\m\end{pmatrix}=\begin{pmatrix}1&1&1\\1&2&3\end{pmatrix}\begin{pmatrix}1\\3\\2\end{pmatrix}$$

$$\begin{pmatrix}3&6\\6&14\end{pmatrix}\begin{pmatrix}b\\m\end{pmatrix}=\begin{pmatrix}6\\13\end{pmatrix}$$

$$\theta = (X^T X)^{-1}(X^T y)$$

$$\begin{pmatrix}b\\m\end{pmatrix}=\begin{pmatrix}3&6\\6&14\end{pmatrix}^{-1}\begin{pmatrix}6\\13\end{pmatrix}$$

$$b = 1,\ m = 0.5$$

$$y = 1 + \frac{1}{2}X$$