



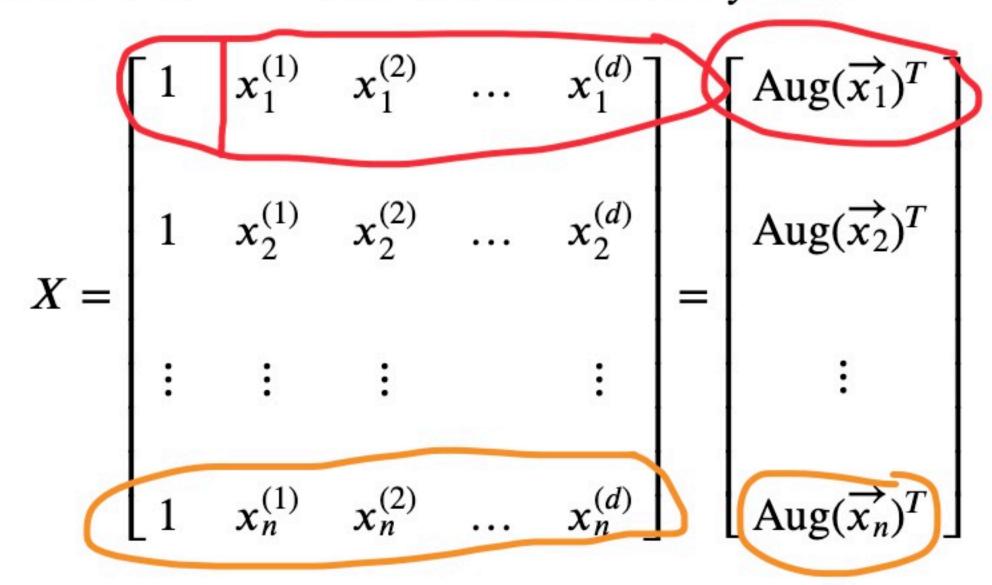
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## The general solution

• Define the design matrix  $X \in \mathbb{R}^{n \times (d+1)}$  and observation vector  $\vec{y} \in \mathbb{R}^n$ :



$$\vec{y} = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix}$$









## Finding the optimal parameters

• To find the optimal parameter vector,  $\vec{w}^*$  , we can use the **design matrix**  $X \in \mathbb{R}^{n \times 3}$  and **observation vector**  $\vec{y} \in \mathbb{R}^n$ :

$$X = \begin{bmatrix} 1 & \text{departure hour}_1 & \text{day}_1 \\ 1 & \text{departure hour}_2 & \text{day}_2 \\ \dots & \dots & \dots \\ 1 & \text{departure hour}_n & \text{day}_n \end{bmatrix} \qquad \vec{y} = \begin{bmatrix} \text{commute time}_1 \\ \text{commute time}_2 \\ \vdots \\ \text{commute time}_n \end{bmatrix}$$

$$\vec{y} = \begin{bmatrix} \text{commute time}_1 \\ \text{commute time}_2 \\ \vdots \\ \text{commute time}_n \end{bmatrix}$$

Then, all we need to do is solve the normal equations once again:

$$X^T X \vec{w}^* = X^T \vec{y}$$

the w that satisfies this minimizes MSE!!!!

 $X^T X \vec{w}^* = X^T \vec{y}$  If  $X^T X$  is invertible, we know the solution is:

$$\vec{w}^* = (X^T X)^{-1} X^T \vec{y}$$

