Q2.2 Part B

Generalizing to weighted setting:

$$J(\theta) = (X\theta - y)^T W (X\theta - y)$$

$$\frac{\partial J}{\partial \theta} = \frac{\partial J}{\partial (X\theta - y)} \cdot \frac{\partial (X\theta - y)}{\partial \theta} = 2X^T W (X\theta - y) = 0$$

$$\Rightarrow \quad X^T W X \theta - X^T W y = 0$$

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

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