2.1 $Q = \sum_{i=1}^{n} (y_i - \beta x_i)^2$

F.O.C: $\frac{\partial Q}{\partial \beta} = -2 \sum_{i=1}^{n} x_i (y_i - \hat{\beta} x_i) = 0$

$\Rightarrow \sum_{i=1}^{n} (x_i y_i - \hat{\beta} x_i^2) = 0$

$\Rightarrow \sum_{i=1}^{n} x_i y_i = \hat{\beta} \sum_{i=1}^{n} x_i^2$

$\Rightarrow \hat{\beta} = \frac{\sum x_i y_i}{\sum x_i^2}$

2.3 $Q = \sum_{i=1}^{n} w_i (y_i - \beta x_i)^2$

F.O.C: $\frac{\partial Q}{\partial \beta} = -2 \sum_{i=1}^{n} w_i x_i (y_i - \hat{\beta} x_i) = 0$

$\Rightarrow \sum_{i=1}^{n} (w_i x_i y_i - \hat{\beta} w_i x_i^2) = 0$

$\Rightarrow \sum_{i=1}^{n} w_i x_i y_i = \sum_{i=1}^{n} \hat{\beta} w_i x_i^2$

$\Rightarrow \hat{\beta} = \frac{\sum w_i x_i y_i}{\sum w_i x_i^2}$

2.8 $y - 69 = r(x - 68)$

When $r = 0.25$: $y_{tall} - 69 = 0.25 \cdot 4 = 1 \Rightarrow y_{tall} = 70$

$y_{short} - 69 = 0.25 \cdot (-4) = -1 \Rightarrow y_{short} = 68$

When $r = 0.75$: $y_{tall} - 69 = 0.75 \cdot 4 = 3 \Rightarrow y_{tall} = 72$

$y_{short} - 69 = 0.75 \cdot (-4) = -3 \Rightarrow y_{short} = 66$

Thus, as r increases, y for the same level of x moves further away from $\bar{y}$