333 prob stat $S(\alpha, \beta) = \sum_i (y_i - (\alpha + \beta x_i))^2 = \sum_i (y_i - \alpha - \beta x_i)^2$

$\frac{\partial S}{\partial \alpha} = -2\sum_i (y_i - \alpha - \beta x_i) = 0$; $\sum_i (y_i - \alpha - \beta x_i) = 0$ ①

$\frac{\partial S}{\partial \beta} = -x_i \sum_i (y_i - \alpha - \beta x_i) = 0$; $\sum_i (y_i - \alpha - \beta x_i) x_i = 0$ ②

① $\sum_i y_i = n\alpha + \beta \sum_i x_i$

② $\sum_i x_i y_i = \alpha \sum_i x_i + \beta \sum_i x_i^2$

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① $\alpha = \frac{\sum_i y_i - \beta \sum_i x_i}{n} = \bar{y} - \beta \bar{x}$

Substitute α into ②

② $\sum_i (x_i y_i - \alpha x_i - \beta x_i^2) = 0$; $\sum_i (x_i y_i - (\bar{y} - \beta \bar{x}) x_i - \beta x_i^2) = 0$

$\sum_i (x_i y_i - x_i \bar{y} + \beta x_i \bar{x} - \beta x_i^2) = 0$; $\sum_i (x_i y_i - x_i \bar{y}) - \beta \sum_i (x_i^2 - x_i \bar{x}) = 0$

$$\beta = \frac{\sum_i (x_i y_i - x_i \bar{y})}{\sum_i (x_i^2 - x_i \bar{x})} = \frac{\sum_i (x_i y_i) - n\bar{x}\bar{y}}{\sum_i (x_i^2) - n\bar{x}^2}$$