(a).

since

$$y_i = \beta_0 + \beta_1 x_i + \varepsilon_i$$

$$\hat{x}_i = b_0 + b_1 y_i + \varepsilon_i^*$$

$$RSS = \sum_i (\hat{y}_i - y_i)^2.$$

$$RSS = \sum_i (x_i - b_0 - b_1 y_i)^2$$

$$\min_{b_0, b_1} RSS = \min \sum_i (x_i - b_0 - b_1 y_i)^2$$

$$\left.\begin{aligned} \frac{\partial RSS}{\partial b_0} &= 0 \\ \frac{\partial RSS}{\partial b_1} &= 0 \end{aligned}\right\} \quad \begin{aligned} &\cancel{-2}\sum_{i=1}^{n} (x_i - b_0 - b_1 y_i) = 0 \\ &\cancel{-2}\sum_{i=1}^{n} (x_i - b_0 - b_1 y_i) = 0. \end{aligned}$$

$$\sum_{i=1}^{n} x_i - b_0 \sum_{i=1}^{n} 1 - b_1 \sum_{i=1}^{n} y_i = 0$$

$$\sum_{i=1}^{n} x_i y_i - b_0 \sum_{i=1}^{n} y_i - b_1 \sum_{i=1}^{n} y_i^2 = 0.$$

$$\begin{cases} \text{observe } \frac{1}{n} \sum_{i=1}^{n} y_i = \bar{y} \quad \sum_{i=1}^{n} y_i = n \cdot \bar{y} \\ \frac{1}{n} \sum_{i=1}^{n} x_i = \bar{x} \quad \sum_{i=1}^{n} x_i = n\bar{x} \end{cases}$$

$$n\bar{x} - b_0 n - b_1 n \bar{y} = 0$$

$$\sum_{i=1}^{n} x_i y_i - n b_0 \bar{y} - b_1 \sum_{i=1}^{n} y_i^2 = 0$$

$$b_0 = \bar{x} - b_1 \bar{y}$$

$$\sum x_i y_i - n\bar{y}(\bar{x} - b_1 \bar{y}) - b_1 \sum y_i^2 = 0$$

$\Sigma x_i y_i - n\bar{x}\bar{y} + n\bar{y}^2 b_1 - b_1 \Sigma y_i^2 = 0.$

$$b_1 = \frac{\sum_{i=1}^{n} x_i y_i - n\bar{x}\bar{y}}{\sum_{i=1}^{n} y_i^2 - n\bar{y}^2}$$

$$\hat{b}_0 = \bar{x} - b_1 \bar{y}$$

$$\hat{b}_1 = \frac{\sum_{i=1}^{n} x_i y_i - n\bar{x}\bar{y}}{\sum_{i=1}^{n} y_i^2 - n\bar{y}^2}$$

(b).

$$R_I^2 = \frac{\Sigma_i (\hat{y} - \bar{y})^2}{\Sigma_i (y_i - \bar{y})^2}.$$

$$= \frac{\sum_i (\hat{\beta}_1 x_i - \beta_1 \bar{x})^2}{\sum_i (y_i - \bar{y})^2} = \hat{\beta}_1^2 \cdot \frac{\Sigma_i (x_i - \bar{x})^2}{\Sigma_i (y_i - \bar{y})^2}$$

$$= \hat{\beta}_1^2 \cdot \frac{S_{xx}}{S_{yy}}$$

since $\hat{\beta}_1 = \frac{S_{xy}}{S_{xx}} = r_{xy}\sqrt{\frac{S_{yy}}{S_{xx}}}$

$$R_I^2 = \frac{S_{xy}^2}{S_{xx}^2} \cdot \frac{S_{xx}}{S_{yy}} = \frac{S_{xy}^2}{S_{xx} S_{yy}}$$

since $r_{xy} = \frac{S_{xy}}{\sqrt{S_{xx} S_{yy}}}$

$$R_I^2 = r_{xy}^2$$

For R_{II}^2

$$R_{II}^2 = \hat{b_1}^2 \cdot \frac{S_{yy}}{S_{xx}}.$$

since $\hat{b_1} = \frac{S_{xy}}{S_{yy}}.$

$$R_{I}^2 = \frac{S^2_{xy}}{S^2_{yy}} \cdot \frac{S_{yy}}{S_{xx}}$$

$$= \frac{S^2_{xy}}{S_{xx} S_{yy}} = r_{xy}$$

since $r_{xy} = r_{xy}$

thus R_I^2 and R_{II} are same.