Transformation.

$\hat{y} = 1 + 0.9x + \hat{e}$

1. $x^* = x - 10$

$x = x^* + 10$

$\hat{y} = 1 + 0.9(x^* + 10) + \hat{e}$

$\hat{y} = 10 + 0.9x^* + \hat{e}$

$\Rightarrow \boxed{\hat{\alpha}^* = 10,\ \hat{\beta}^* = 0.9}$

since $\hat{e}^* = e \Rightarrow \boxed{\hat{\sigma}^* = \hat{\sigma} = 2}$

$r = \sqrt{R^2} = \sqrt{1 - \frac{\sum(y_i - \hat{y}_i)}{\sum(y_i - \bar{y})}},\ \hat{y}_i^* = \hat{y}_i$

$\Rightarrow \boxed{r^* = r = 0.3}$

- $x^* = 10x$

$x = \frac{x^*}{10}$

$\hat{y} = 1 + 0.9 \cdot \frac{x^*}{10} + \hat{e}$

$\Rightarrow \boxed{\hat{\alpha}^* = 1,\ \hat{\beta}^* = \frac{0.9}{10} = 0.09,\ \hat{\sigma}^* = \hat{\sigma} = 2,\ r^* = r = 0.3}$

- $x^* = 10(x - 1)$

$x = \frac{x^*}{10} + 1$

$\hat{y} = 1 + 0.9(\frac{x^*}{10} + 1) + \hat{e}$

$= 10 + 0.09x^* + \hat{e}$

$\Rightarrow \boxed{\hat{\alpha}^* = 10,\ \hat{\beta}^* = 0.09,\ \hat{\sigma}^* = \hat{\sigma} = 2,\ r^* = r = 0.3}$

2. $-y = y^{**} - 10 = 1 + 0.9x + \hat{e}$

$y^{**} = 11 + 0.9x + \hat{e}$

$\Rightarrow \boxed{\hat{\alpha}^{**} = 11,\ \hat{\beta}^{**} = 0.9,\ \hat{\sigma}^{**} = \hat{\sigma} = 2}$

since $\hat{y}_i^{**} = \hat{y}_i + 10,\ \bar{y}^{**} = \bar{y}_i + 10$

we know $\hat{R}^{2**} = \hat{R}^2$, so $\boxed{r^{**} = r = 0.3}$

- $y^{**} = 5y \Rightarrow y = \frac{y^{**}}{5} = 1 + 0.9x + \hat{e}$

$y^{**} = 5 + 4.5x + 5\hat{e}$

$\Rightarrow \boxed{\hat{\alpha}^{**} = 5,\ \hat{\beta}^{**} = 4.5,\ r^{**} = r = 0.3}$, since $\hat{e}^{**} = 5\hat{e}$, so $\boxed{\sigma^{**} = 5\sigma = 10}$

- $y^{**} = 5(y+2)$

$y = \frac{y^{**}}{5} - 2 = 1 + 0.9x + \hat{e}$

$y^{**} = 15 + 4.5\hat{x} + 5\hat{e}$

$\Rightarrow$ $\hat{\alpha}^{**} = 15$, $\hat{\beta}^{**} = 4.5$, $\hat{\sigma}^{**} = 5\sigma = 10$

$r^{**} = r = 0.3$

3. Transformation of X:

- $x+c$: α will change to $\alpha - c\beta$
  β, r and σ will not change
- cx : β will change to $\frac{\beta}{c}$
  α, r and σ will not change

Transformation of y:

- $y+c$: α will change to $\alpha + c$
  β, r, and σ will not change
- cy : α will change to $c\alpha$, β will change to $c\beta$,
  σ will change to $c\sigma$
  r will not change.

4. $\beta^* = \frac{\hat{\beta}}{10} = \frac{0.9}{10} = 0.09$

$SE(\hat{\beta}^*) = \frac{SE(\hat{\beta})}{10} = \frac{0.03}{10} = 0.003$

$t_0^* = \frac{\hat{\beta}^*}{SE(\hat{\beta}^*)} = \frac{0.09}{0.003} = 30$

5. $\hat{\beta}^{**} = 5\hat{\beta} = 5 \cdot 0.9 = 4.5$

$SE(\hat{\beta}^{**}) = 5 \cdot SE(\hat{\beta}) = 5 \cdot 0.03 = 0.15$

$t_0^{**} = \frac{4.5}{0.15} = 30$

b. $[\bar{\beta} - t_{\alpha/2} \cdot SE(\beta), \bar{\beta} + t_{\alpha/2} \cdot SE(\beta)]$

transformation of X:

- $x+c$: will not change CI or hypothesis test.
- cx : $\bar{\beta}^* = \frac{\bar{\beta}}{c}$, CI will change to $[\frac{\bar{\beta}}{c} - t_{\alpha/2} \cdot \frac{SE(\beta)}{c}, \frac{\bar{\beta}}{c} + t_{\alpha/2} \cdot \frac{SE(\beta)}{c}]$
  hypothesis test result will not change.

transformation of y:

- $y+c$: will not change CI or hypothesis test.
- cy : CI will change to $[c\bar{\beta} - t_{\alpha/2} \cdot SE(\beta) \cdot c, c\bar{\beta} + t_{\alpha/2} \cdot SE(\beta) \cdot c]$
  hypothesis test result will not change.