2.1

a.

9
4
1
1

x	y	$x-\bar{x}$	$(x-\bar{x})^2$	$y-\bar{y}$	$(x-\bar{x})(y-\bar{y})$
3	4	2	4	2	4
2	2	1	1	0	0
1	3	0	0	1	0
−1	1	−2	4	−1	2
0	0	−1	1	−2	2
$\sum x_i = 5$	$\sum y_i = 10$	$\sum(x_i-\bar{x}) = 0$	$\sum(x_i-\bar{x})^2 = 10$	$\sum(y_i-\bar{y}) = 0$	$\sum(x_i-\bar{x})(y_i-\bar{y}) = 8$

$\bar{x} = \frac{\sum x_i}{n} = \frac{5}{5} = 1 \quad \bar{y} = \frac{\sum y_i}{n} = 2$

b. $b_2 = \frac{\sum(x_i-\bar{x})(y_i-\bar{y})}{\sum(x_i-\bar{x})^2} = \frac{8}{10} = 0.8$

$b_1 = \bar{y} - b_2\bar{x} = 2 - 0.8 \times 1 = 1.2$ ✓

$\hat{y}_i = 1.2 + 0.8x_i$

c. $\sum x_i^2 = 15 \quad \sum x_i y_i = 18$

$\sum(x_i-\bar{x})^2 = \sum(x_i^2 - 2\bar{x}x_i + \bar{x}^2)$

$= \sum x_i^2 - 2\bar{x}\sum x_i + \sum\bar{x}^2$

$= \sum x_i^2 - 2N\bar{x}^2 + N\bar{x}^2$

$= \sum x_i^2 - N\bar{x}^2$

$\sum(x_i-\bar{x})(y_i-\bar{y}) = \sum(x_i y_i - x_i\bar{y} - \bar{x}y_i + \bar{x}\bar{y})$

$= \sum x_i y_i - \bar{y}\sum x_i - \bar{x}\sum y_i + N\bar{x}\bar{y}$

$= \sum x_i y_i - N\bar{x}\bar{y}$

d.

x_i	y_i	$\hat{y}_i$	$\hat{e}_i$	$\hat{e}_i^2$	$x_i\hat{e}_i$
3	4	3.6	0.4	0.16	1.2
2	2	2.8	-0.8	0.64	-1.6
1	3	2	1	1	1
–1	1	0.4	0.6	0.36	-0.6
0	0	1.2	-1.2	1.44	0
$\sum x_i = 5$	$\sum y_i = 10$	$\sum \hat{y}_i = 10$	$\sum \hat{e}_i = 0$	$\sum \hat{e}_i^2 = 3.6$	$\sum x_i\hat{e}_i = 0$

$$S_y^2 = \frac{\Sigma(Y_i-\bar{Y})^2}{N-1} = \frac{10}{5-1} = 2.5$$

$N=5$, $-1,0,1,2,3$

$$S_x^2 = \frac{\Sigma(X_i-\bar{X})^2}{N-1} = \frac{10}{5-1} = 2.5$$

$5 \div 2 = 2.5 \Rightarrow$ 取3

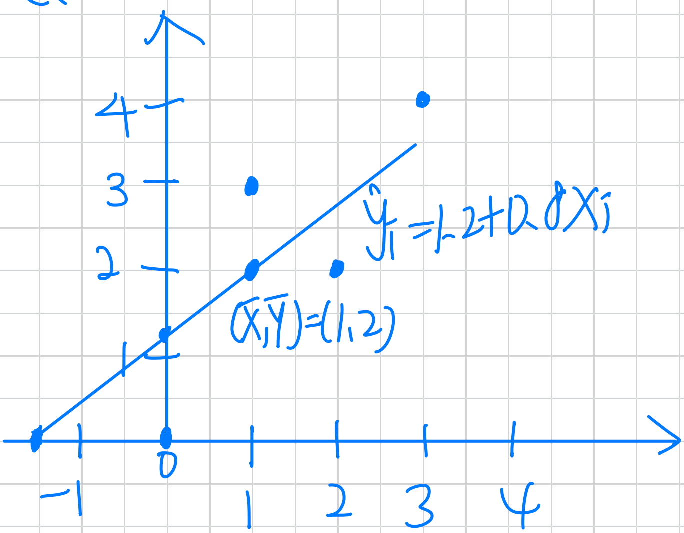
$$S_{xy} = \frac{\Sigma(X_i-\bar{X})(Y_i-\bar{Y})}{N-1} = \frac{8}{5-1} = 2$$

media $= 1$

$$r_{xy} = \frac{S_{xy}}{S_x S_y} = \frac{2}{\sqrt{2.5\times 2.5}} = 0.8$$

$$C.V_x = 100\left(\frac{S_x}{\bar{X}}\right) = 158.11$$

e.



g、 $\hat{y}_i = b_1 + b_2 x_i$

$\sum \hat{Y}_i = n b_1 + b_2 \sum X_i$

$\bar{\hat{Y}} = b_1 + b_2 \bar{X}$

h、 $\bar{\hat{y}} = \frac{1}{n} \sum \hat{y}_i = \frac{1}{n} \sum (b_1 + b_2 x_i)$

$= \frac{1}{n} \times (n b_1 + b_2 n \bar{X})$

$= b_1 + b_2 \bar{X} = \bar{Y}$

得證 $\bar{\hat{y}} = \bar{y}$ #

i、 $\hat{\sigma}^2 = \frac{\sum \hat{e}_i^2}{N-2} = \frac{3.6}{5-2} = 1.2$

j、 $\widehat{var}(b_2|x) = \frac{\hat{\sigma}^2}{SST_x} = \frac{1.2}{10} = 0.12$

$S.E(b_2) = \sqrt{0.12} = 0.3464$

2.14

a、 $\varepsilon = \beta_2 \frac{x}{\beta_1 + \beta_2 x} = 1.8 \frac{13.68}{19.74} = 1.247$

b、 $\bar{x} = 13.68 \quad \bar{y} = 22.89$

$var(\varepsilon) = var(b_2 \frac{\bar{x}}{\bar{y}})$

$= (\frac{\bar{x}}{\bar{y}})^2 var(b_2)$

$S.E(\varepsilon) = \frac{\bar{x}}{\bar{y}} \cdot S.E(b_2) = \frac{13.68}{22.89} \times 0.16 = 0.0956$

c.

urban:

12 years: $\hat{wage} = -10.76 + 2.46 \times 12 = 18.76$

16 years: $\hat{wage} = -10.76 + 2.46 \times 16 = 28.6$

Rural:

12 years: $\hat{wage} = -4.88 + 1.8 \times 12 = 16.72$

16 years: $\hat{wage} = -4.88 + 1.8 \times 16 = 23.92$

2.16

a. A simple linear regression model is any regression equation with just one explanatory variable, a constant and an error term

b.

Firm	Beta	Alpha
1. ge	1.1480	-0.0010
2. ibm	0.9769	0.0061
3 ford	1.6620	0.0038
4 msft	1.2018	0.0032

5. dis 1.0115 0.0010
6. xom 0.4565 0.0053

defensive firm = min Beta = 0.4565 = Exxon-Mobil
aggressive firm : Max Beta = 1.6620 = Ford

d.
According to the code, the difference between "Beta_with_intercept" and "Beta_no_intercept" seem quite small.