2.1

a.

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

$\bar{x}=1,\ \bar{y}=2$ #

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

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

c. $\sum x_i^2 = 3^2+2^2+1^2+(-1)^2+0^2 = 15$

$\sum x_i y_i = 12+4+3-1+0 = 18$

$\begin{cases} \sum(x_i-\bar{x})^2 = 10 \\ \sum x_i^2 - N\bar{x}^2 = 15-5\times 1^2 = 10 \end{cases}$ $=$

$\begin{cases} \sum(x_i-\bar{x})(y_i-\bar{y}) = 8 \\ \sum x_i y_i - N\bar{x}\bar{y} = 18-5\times1\times2 = 8 \end{cases}$ $=$

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

$s_y^2 = \dfrac{\sum(y_i-\bar{y})^2}{N-1} = \dfrac{4+0+1+1+4}{4} = 2.5$

$s_x^2 = \dfrac{\sum(x_i-\bar{x})^2}{N-1} = \dfrac{10}{4} = 2.5$

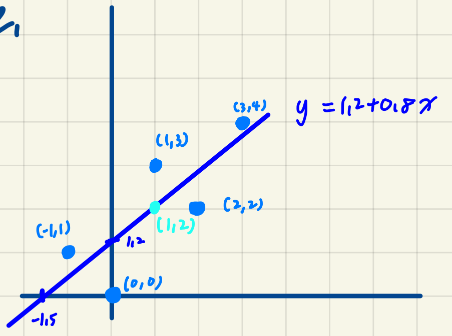
$$s_{xy} = \frac{\Sigma(x_i-\bar{x})(y_i-\bar{y})}{N-1} = \frac{8}{4} = 2$$

$$r_{xy} = \frac{2}{\sqrt{2.5}\cdot\sqrt{2.5}} = 0.8$$

$$CV_x = 100 \times \frac{\sqrt{2.5}}{1} = 158.1139$$

$$x_{0.5} = 1$$

e.



f. $(\bar{x},\bar{y}) = (1,2)$, the fitted line pass through the point.

g. $b_1 + b_2\bar{x} = 1.2 + 0.8 \times 1 = 2 = \bar{y}$

h. $\bar{\hat{y}} = \frac{\Sigma \hat{y}_i}{N} = \frac{10}{5} = 2 = \bar{y}$

i. $\hat{\sigma}^2 = var(e_i) = \frac{3.6}{5-2} = 1.2$

j. $\hat{var}(b_2|X) = \frac{\hat{\sigma}^2}{\Sigma(x_i-\bar{x})^2} = \frac{1.2}{10} = 0.12$

$s.e.(b_2) = \sqrt{0.12} \doteq 0.3464$

2.14

a. $\bar{y}_2 = 19.74$

$\bar{x}_2 = (19.74+4.88)/1.8$

$$\varepsilon = b_2 \times \frac{\bar{x}_2}{\bar{y}_2} = \frac{19.74+4.88}{19.74} = 1.2472$$

b. $\bar{x}_1 = 13.68$

$\bar{y}_1 = 13.68 \times 2.46 - 10.76$

$$s.e(\varepsilon) = \sqrt{Var(\varepsilon)} = \sqrt{Var(b_2 \times \frac{\bar{x}_1}{\bar{y}_1})} = \frac{\bar{x}_1}{\bar{y}_1} \cdot se(b_2) = 0.0956$$

c. Urban : 12y : $-10.76 + 2.46 \times 12 = 18.76$

16y : $-10.76 + 2.46 \times 16 = 28.6$

Rural : 12 y : $-4.88 + 1.8 \times 12 = 16.72$

16 y : $-4.88 + 1.8 \times 16 = 23.92$

2.16

a. $r_j - r_f = \alpha_j + \beta_j (r_m - r_f) + e_j$

$r_j - r_f$ can be seen as dependent variable y

$r_m - r_f$ can be seen as independent variable x

$\Rightarrow y = \alpha + \beta x + e$

$\therefore$ CAPM is a simple regression

b.

```
Company: ge
Intercept: -0.0009586682
Slope: 1.147952

Call:
lm(formula = y ~ x)

Residuals:
      Min        1Q    Median        3Q       Max
-0.173801 -0.033907 -0.003789  0.038858  0.202748

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.0009587  0.0044244  -0.217    0.829
x            1.1479521  0.0895394  12.821   <2e-16 ***
---
```

$r_{ge} - r_f = -0.0010 + 1.1480(r_m - r_f)$

```
Company: ibm
Intercept: 0.00605255
Slope: 0.9768898

Call:
lm(formula = y ~ x)

Residuals:
      Min        1Q    Median        3Q       Max
-0.254880 -0.035266 -0.005322  0.031490  0.274520

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.006053   0.004834   1.252    0.212
x           0.976890   0.097839   9.985   <2e-16 ***
```

$r_{ibm} - r_f = 0.0060 + 0.9769(r_m - r_f)$

```
Company: ford
Intercept: 0.003778911
Slope: 1.662031

Call:
lm(formula = y ~ x)

Residuals:
     Min       1Q   Median       3Q      Max
-0.27315 -0.07875 -0.01198  0.04720  1.08874

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.003779   0.010225   0.370    0.712
x           1.662031   0.206937   8.032 1.27e-13 ***
```

$r_{Ford} - r_f = 0.0038 + 1.6620(r_m - r_f)$

```
Company: msft
Intercept: 0.003249601
Slope: 1.20184

Call:
lm(formula = y ~ x)

Residuals:
     Min       1Q   Median       3Q      Max
-0.27424 -0.04744 -0.00820  0.03869  0.35801

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.003250   0.006036   0.538    0.591
x           1.201840   0.122152   9.839   <2e-16 ***
```

$r_{msft} - r_f = 0.0032 + 1.2018(r_m - r_f)$

```
Company: dis
Intercept: 0.001046924
Slope: 1.011521

Call:
lm(formula = y ~ x)

Residuals:
      Min        1Q    Median        3Q       Max
-0.176233 -0.030021 -0.004232  0.029179  0.280528

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.001047   0.004676   0.224    0.823
x           1.011521   0.094638  10.688   <2e-16 ***
---
```

$r_{dis} - r_f = 0.0010 + 1.0115(r_m - r_f)$

```
Company: xom
Intercept: 0.005283533
Slope: 0.4565208

Call:
lm(formula = y ~ x)

Residuals:
      Min        1Q    Median        3Q       Max
-0.114474 -0.030596 -0.001884  0.026849  0.215396

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.005284   0.003535   1.494    0.137
x           0.456521   0.071550   6.380 1.48e-09 ***
```

$r_{xom} - r_f = 0.0053 + 0.4565(r_m - r_f)$

Ford is the most aggressive
Exxon-Mobile is the most defensive

c. Yes, all of these firm's intercept parameter show α_j is not significant (not to reject $\alpha_j = 0$)

d. Do not change much

有 intercept　　no intercept

$1.1480 \rightarrow$
```
Company: ge
Slope: 1.146763
-------------------------
```
$0.9769 \rightarrow$
```
Company: ibm
Slope: 0.9843954
-------------------------
```
$1.6620 \rightarrow$
```
Company: ford
Slope: 1.666717
-------------------------
```
$1.2018 \rightarrow$
```
Company: msft
Slope: 1.205869
-------------------------
```
$1.0115 \rightarrow$
```
Company: dis
Slope: 1.012819
-------------------------
```
$0.4565 \rightarrow$
```
Company: xom
Slope: 0.4630727
-------------------------
```