2.11.1

(a)

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

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

(b)

$b_2=\frac{8}{10}=0.8$

$b_1=2-0.8\times 1=1.2$

$\Rightarrow$ fitted regression line

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

0.8 is the slope, 1.2 is the interprot.

(c)

$\sum_{i=1}^{5} x_i^2=9+4+1+1+0=15$

$\sum_{i=1}^{5} x_i y_i=12+4+3-1+0=18$

$\sum_{i=1}^{5}(x_i-\bar{x})^2=\sum_{i=1}^{5}x_i^2-N\bar{x}^2=15-5\cdot 1^2=10$

$\sum_{i=1}^{5}x_iy_i-N\bar{x}\bar{y}=18-5\times 1\times 2=8=\sum_{i=1}^{5}(x_i-\bar{x})(y_i-\bar{y})$

(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
$\sum x_i=5$	$\sum y_i=10$	$\sum \hat{y}_i=10$	$\sum \hat{e}_i=0$	$\sum \hat{e}_i^2=3.6$	$\sum x_i\hat{e}_i=0$

$s_y^2=\frac{2^2+0^2+1^2+(-1)^2+(-2)^2}{5-1}=2.5$

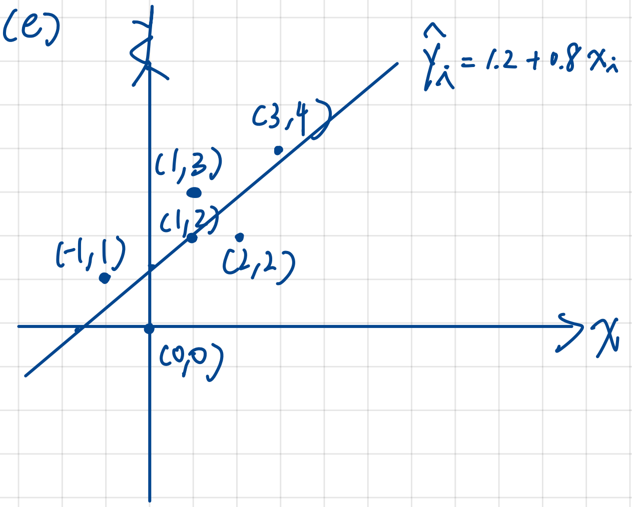
$s_x^2=\frac{2^2+1^2+0^2+(-2)^2+(-1)^2}{5-1}=2.5$

$s_{xy}=\frac{2\times 2+0\times 1+1\times 0+(-1)(-2)+(-2)(-1)}{5-1}=2$

$r_{xy}=\frac{2}{\sqrt{2.5}\cdot\sqrt{2.5}}=0.8$, $CV_x=100\cdot\frac{\sqrt{2.5}}{1}=100\sqrt{2.5}$

Median $x=1$, 50^{th} $x=1$

(e)



(f) Yes, it goes through $(1,2) = (\bar{x}, \bar{y})$

(g) $\bar{x}=1 \quad \bar{y}=2$, $\bar{\hat{y}} = 1.2+0.8\cdot(1) = 2$

(h) $\bar{\hat{y}} = \frac{\sum \hat{y}_i}{N} = 2 = \bar{y}$

(i) $\hat{\sigma}^2 = \frac{\sum \hat{e}_i^2}{N} = \frac{3.6}{5} = 0.72$

(j) $\widehat{\mathrm{var}}(b_2 | x) = \frac{\hat{\sigma}^2}{\sum(x_i-\bar{x})^2} = \frac{0.72}{10} = 0.072$, $se(b_2) = \sqrt{0.072} = 0.2683$

2.1.14

(a) $\widehat{WAGE} = -4.88 + 1.8\, EDUC$

$\overline{WAGE} = 19.74$

$\Rightarrow \varepsilon = 1.8 \times \frac{(19.74+4.88)+1.8}{19.74} = 1.2472$

(b) $b_2 = 2.46$, $\overline{EDUC} = 13.68$, $\overline{WAGE} = 19.74$, $se(b_2) = 0.16$

$\Rightarrow se(\varepsilon) = 0.16 \times \frac{13.68}{19.74} = 0.11$

(c) ① $EDUC = 12$ $\begin{cases} Urban = -10.76 + 2.46 \times 12 = 18.76 \\ Rural = -4.88 + 1.8 \times 12 = 16.72 \end{cases}$

② $EDUC = 16$ $\begin{cases} Urban = -10.76 + 2.46 \times 16 = 28.6 \\ Rural = -4.88 + 1.8 \times 16 = 23.92 \end{cases}$

2.1.16

(a) The econometric model is a simple liner regression because it follows $Y = \alpha + \beta X + e$, the dependent variable is $(r_j - r_f)$, independent variable is $(r_m - r_f)$

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

(b)

```
cam: ge
 beta= 1.147952
cam: ibm
 beta= 0.976890
cam: ford
 beta= 1.662031
cam: msft
 beta= 1.201840
cam: dis
 beta= 1.011521
cam: xom
 beta= 0.456521
```

most aggressive: Ford (最高Beta)

most defensive: xom (最低Beta)

(c)

```
> summary(capm_model)

Call:
lm(formula = rj_c ~ rm_c)

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    
rm_c        1.201840   0.122152   9.839   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.08083 on 178 degrees of freedom
Multiple R-squared:  0.3523,	Adjusted R-squared:  0.3486 
F-statistic:  96.8 on 1 and 178 DF,  p-value: < 2.2e-16
```

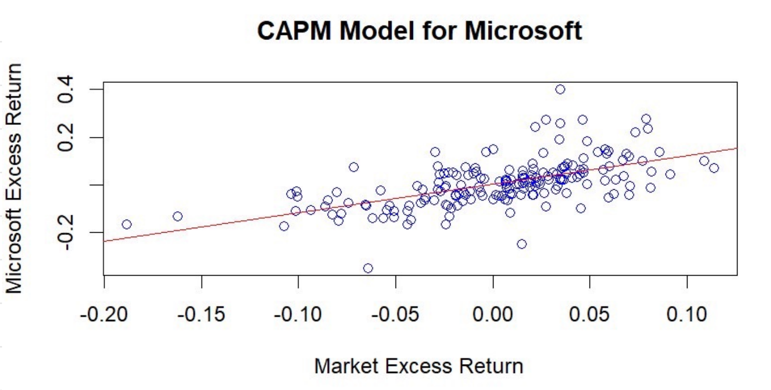
$p = 0.591 > 0.05$

$\Rightarrow$ don't reject H_0

α不显著, β显著 > 1

CAPM 适用于 Msft

Msft 股票比市场更有 risk 和波动



(d)

```
com ge
Slpoe 1.146763
com ibm
Slpoe 0.9843954
com ford
Slpoe 1.666717
com msft
Slpoe 1.205869
com dis
Slpoe 1.012819
com xom
Slpoe 0.4630727
>
```

$\alpha=0$: $\beta \approx 1.2059$

$1.2018 \to 1.2059 \Rightarrow \beta$ 值變化小

$\therefore \alpha$ 幾乎沒有影響

所以CAPM在msft合理