Homework:

1. 請填寫上方 **random intercept and random slope model** 之 **variance-covariance structure of** y **for the** i **th cluster**，並以任何一個軟體計算之 **(**或手算**+**按計算機**)**。

$$V = ZGZ' + R$$

$$\begin{bmatrix} 1 & 8 \\ 1 & 10 \\ 1 & 12 \\ 1 & 14 \end{bmatrix} \begin{bmatrix} 7.8233 & -0.48500 \\ -0.48500 & 0.05127 \end{bmatrix} \begin{bmatrix} 1 & 1 & 1 & 1 \\ 8 & 10 & 12 & 14 \end{bmatrix} + \begin{bmatrix} 1.7162 & 0 & 0 & 0 \\ 0 & 1.7162 & 0 & 0 \\ 0 & 0 & 1.7162 & 0 \\ 0 & 0 & 0 & 1.7162 \end{bmatrix}$$

$$= \begin{bmatrix} 5.06078 & 3.1949 & 3.04522 & 2.89554 \\ 3.19490 & 4.9665 & 3.30570 & 3.36110 \\ 3.04522 & 3.3057 & 5.28238 & 3.82666 \\ 2.89554 & 3.3611 & 3.82666 & 6.00842 \end{bmatrix}$$

```
Z <- matrix(c(rep(1,4), c(8,10,12,14)), ncol = 2)
G <- matrix(c(7.8233, -0.4850, -0.4850, 0.05127), ncol = 2)
R <- diag(1.7162, 4)

V <- Z %*% G %*% t(Z) + R
```

```
> V
        [,1]   [,2]    [,3]    [,4]
[1,] 5.06078 3.1949 3.04522 2.89554
[2,] 3.19490 4.9665 3.30570 3.36110
[3,] 3.04522 3.3057 5.28238 3.82666
[4,] 2.89554 3.3611 3.82666 6.00842
```

2. 請以任何一個軟體計算 **(**或手算**+**按計算機**) the correlation matrix of** y **for the** i **th cluster**，你的結果是否與 **SAS** 的 **output** 相同？

A: 是

```
> cov2cor(V)
          [,1]      [,2]      [,3]      [,4]
[1,] 1.0000000 0.6372698 0.5889726 0.5250984
[2,] 0.6372698 1.0000000 0.6453917 0.6152846
[3,] 0.5889726 0.6453917 1.0000000 0.6792426
[4,] 0.5250984 0.6152846 0.6792426 1.0000000
```