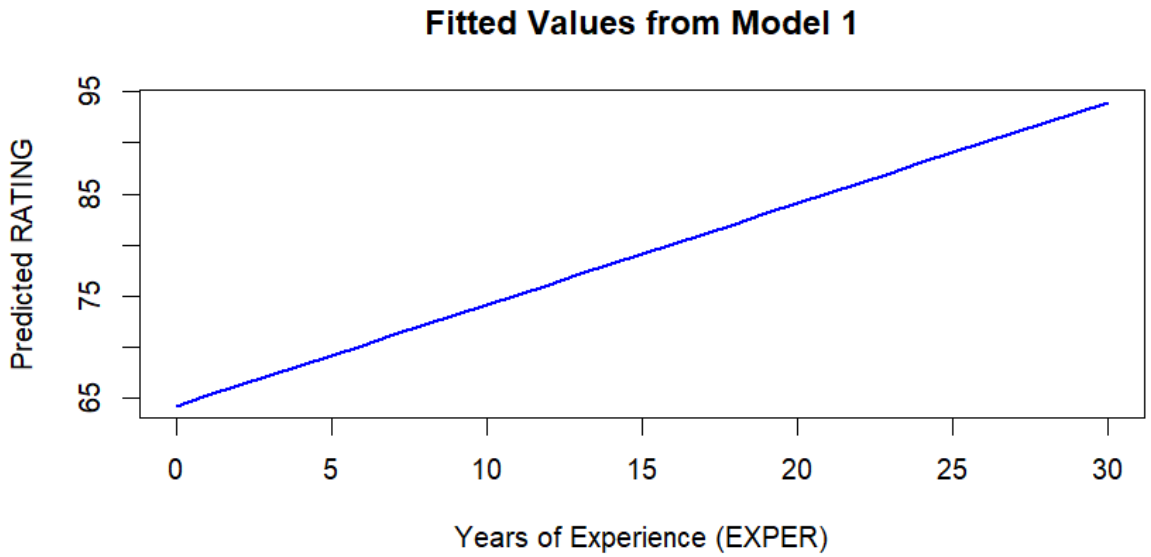
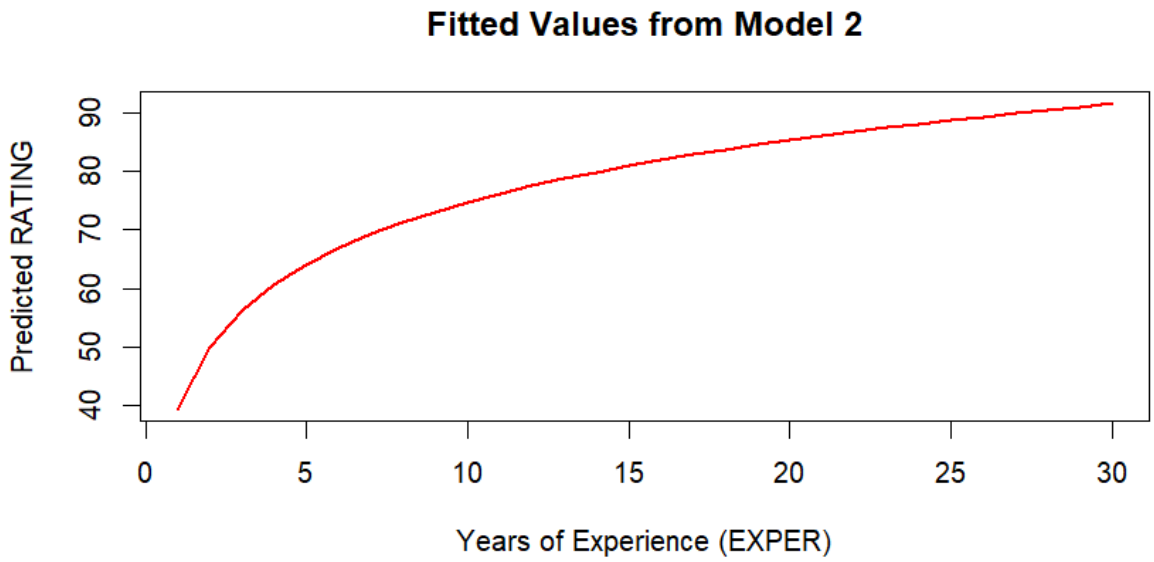
313707040 魯尚軒

CH04Q4

(a)



(b)



因為 Model 2 使用的數據是 ln(EXPER)，當 EXPER=0 時，ln(0)無意義，所以去除 EXPER=0 的樣本。

(c)

因為 Model 1 為線性模型，marginal effect 為固定，所以在

EXPER=10 或 EXPER=20 的情況下都等於 0.99。

(d)

將 Model 2 對 EXPER 微分，得到邊際效果為 15.312/EXPER。

當 EXPER=10，邊際效果為$\frac{15.312}{10}$=1.5312

當 EXPER=20，邊際效果為$\frac{15.312}{20}$=0.7656

(e)

Model 1 R^2=0.3793
Model 1 (without EXPER=0) R^2=0.4858
Model 2 R^2=0.6414

因此 Model 2 最適配資料

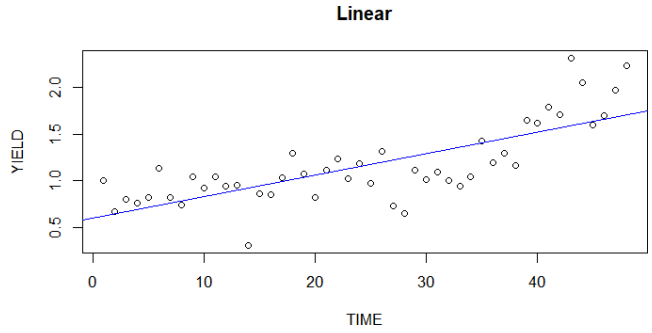
(f)

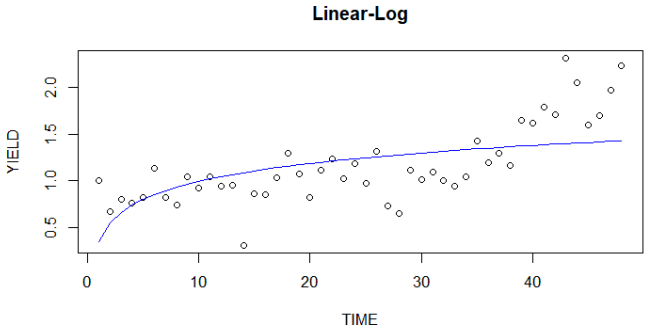
Model 1 假設工作經驗對表現評分的影響是線性的，而 Model 2 假設

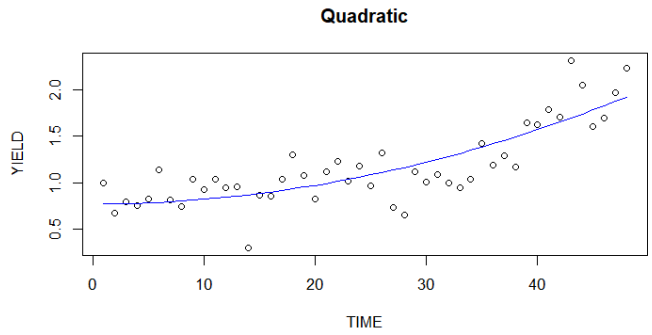
工作經驗對表現評分的影響遞減，符合邊際效益遞減法則，因此

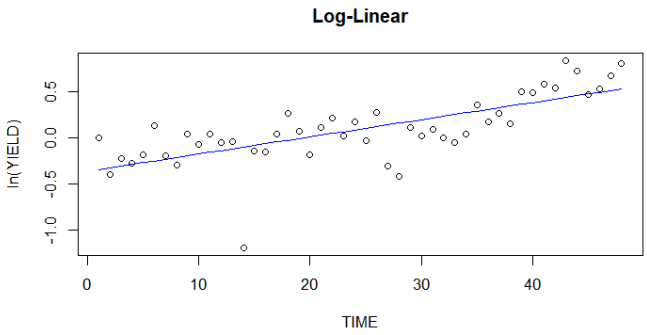
Model 2 更合理。

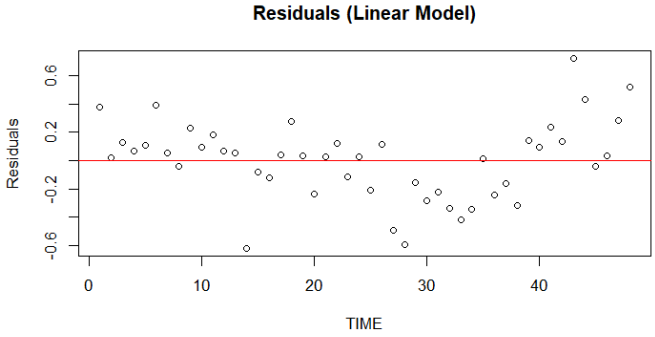
CH04Q28
(a)

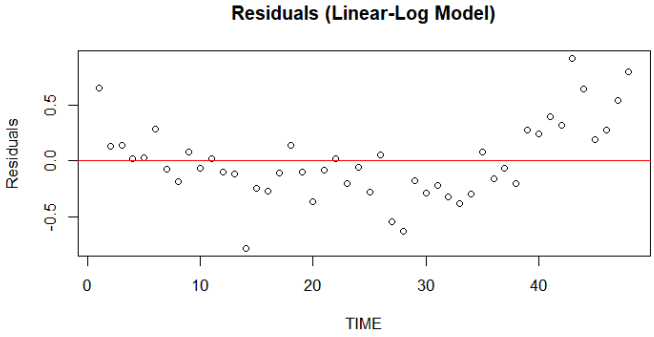

Linear
YIELD
TIME

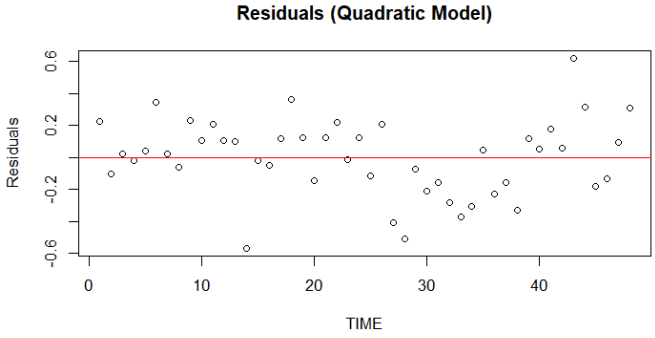

Linear-Log
YIELD
TIME

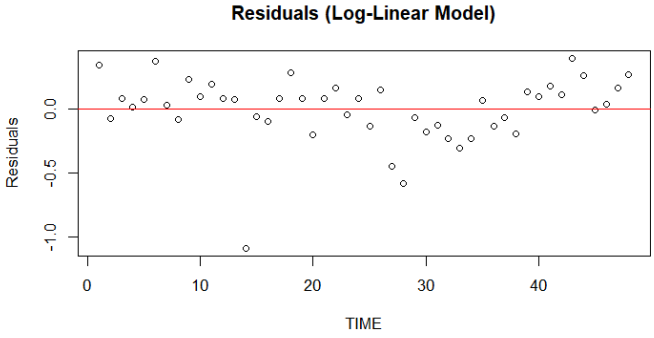

Quadratic
YIELD
TIME


Log-Linear
ln(YIELD)
TIME


Residuals (Linear Model)
Residuals
TIME


Residuals (Linear-Log Model)
Residuals
TIME


Residuals (Quadratic Model)
Residuals
TIME


Residuals (Log-Linear Model)
Residuals
TIME

```
> jarque.bera.test(resid(model1))

        Jarque Bera Test

data:  resid(model1)
X-squared = 0.13257, df = 2, p-value = 0.9359

> jarque.bera.test(resid(model2))

        Jarque Bera Test

data:  resid(model2)
X-squared = 2.7629, df = 2, p-value = 0.2512

> jarque.bera.test(resid(model3))

        Jarque Bera Test

data:  resid(model3)
X-squared = 0.32406, df = 2, p-value = 0.8504

> jarque.bera.test(resid(model4))

        Jarque Bera Test

data:  resid(model4)
X-squared = 83.874, df = 2, p-value < 2.2e-16
```

線性模型R^2=0.5778

Linear-log 模型R^2=0.3886

Quadratic 模型R^2=0.6890

Log-linear 模型R^2=0.5074

我認為 Quadratic model 最適合，因為有最高的 R-squared，對資料的解釋力比較強

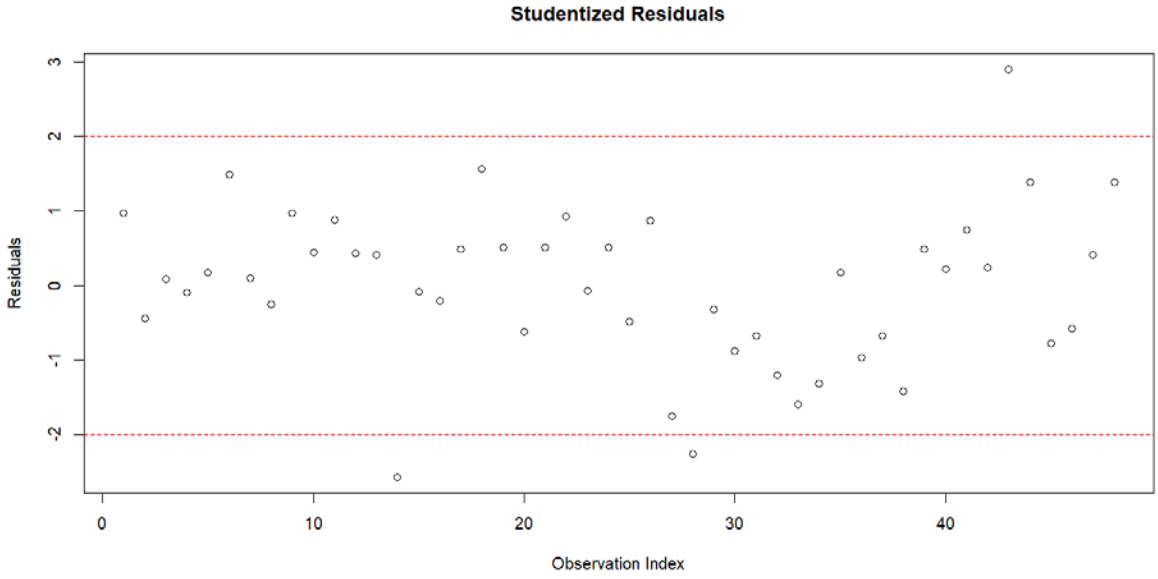
(b)

在 Quadratic model 中，γ_1為正，代表隨著$TIME^2$的增加，YIELD 也會跟著增加，且增加的速率越來越快。

(c)

計算離群值

High leverage points: 45,46,47,48
High DFBetas points: 14,43,44,48
High DFFITS points: 14,43,48
High Studentized Residuals points: 14,28,43



(d)

```
> print(pred_1997)
       fit      lwr      upr
1 1.81766 1.304248 2.331073
```

預測區間為[1.3042, 2.3311]，實際值為 1.9691，有落在這個區間內

CH04Q29

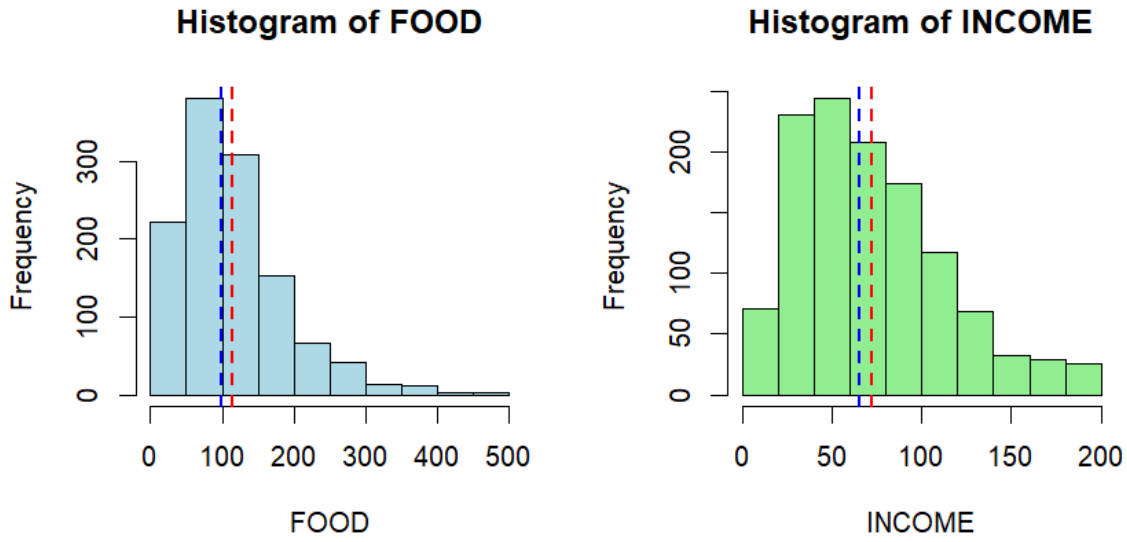
(a)

```
FOOD Summary:
> print(summary_food)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
   9.63   57.78   99.80  114.44  145.00  476.67
```

```
FOOD Standard Deviation: 72.6575
```

```
INCOME Summary:
> print(summary_income)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  10.00   40.00   65.29   72.14   96.79  200.00
```

```
INCOME Standard Deviation: 41.65228
```



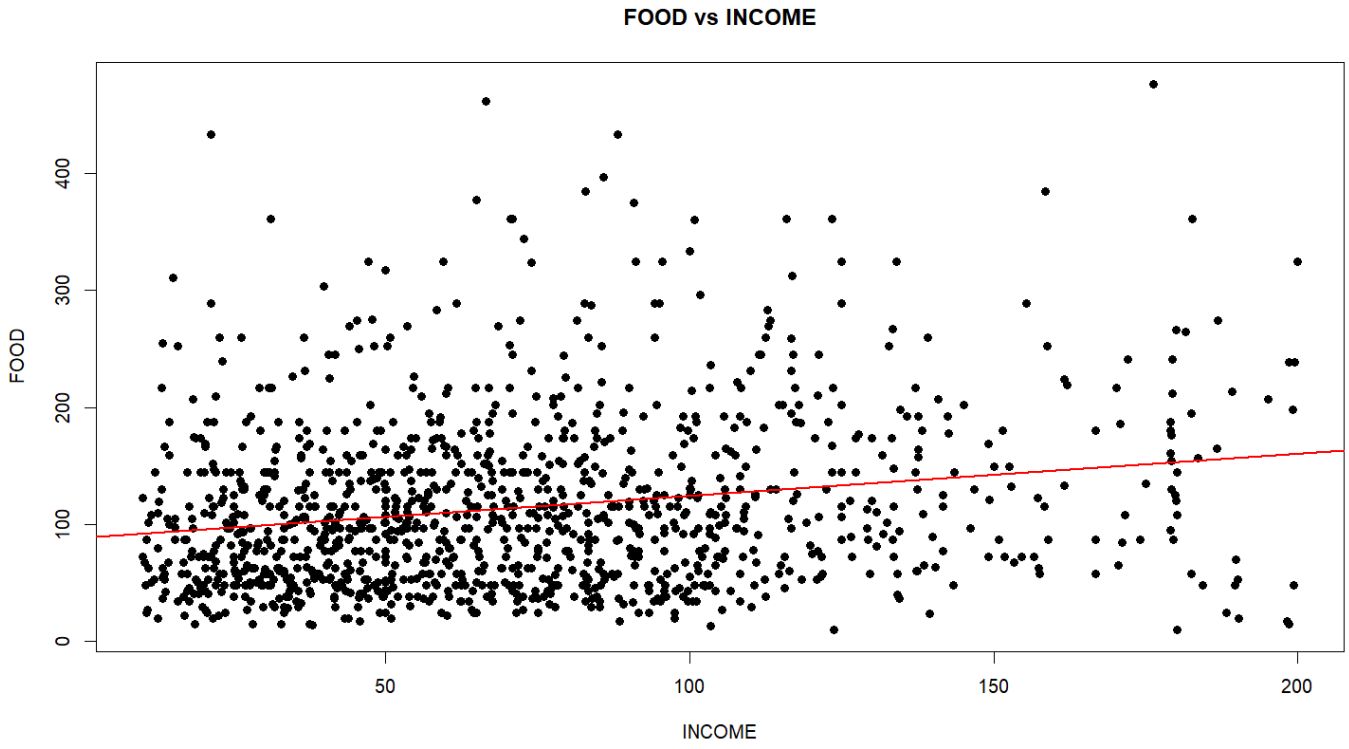
FOOD 跟 INCOME 並非對稱的鐘形分配，兩者皆平均數大於中位數，為右偏分配。

```
        Jarque-Bera Normality Test

data:  cex5_small$food
JB = 648.65, p-value < 2.2e-16
alternative hypothesis: greater
```

```
        Jarque-Bera Normality Test

data:  cex5_small$income
JB = 148.21, p-value < 2.2e-16
alternative hypothesis: greater
```

兩者皆非常態分配。

(b)

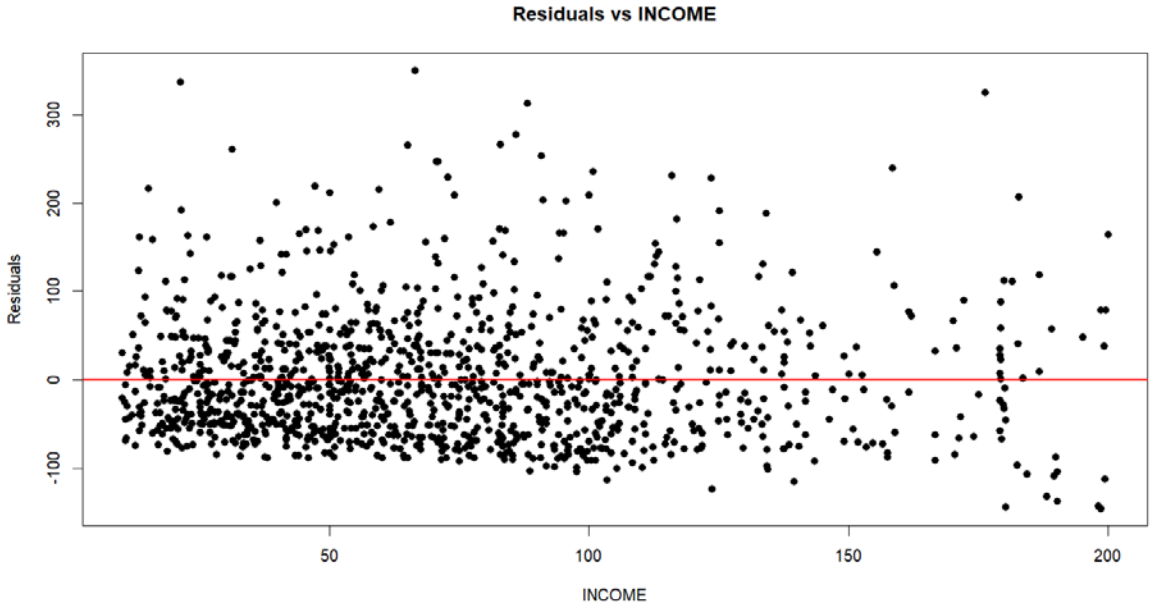



```
95% Confidence Interval for β₂:
> print(confint_beta2)
              2.5 %    97.5 %
income 0.2619215 0.455452
```

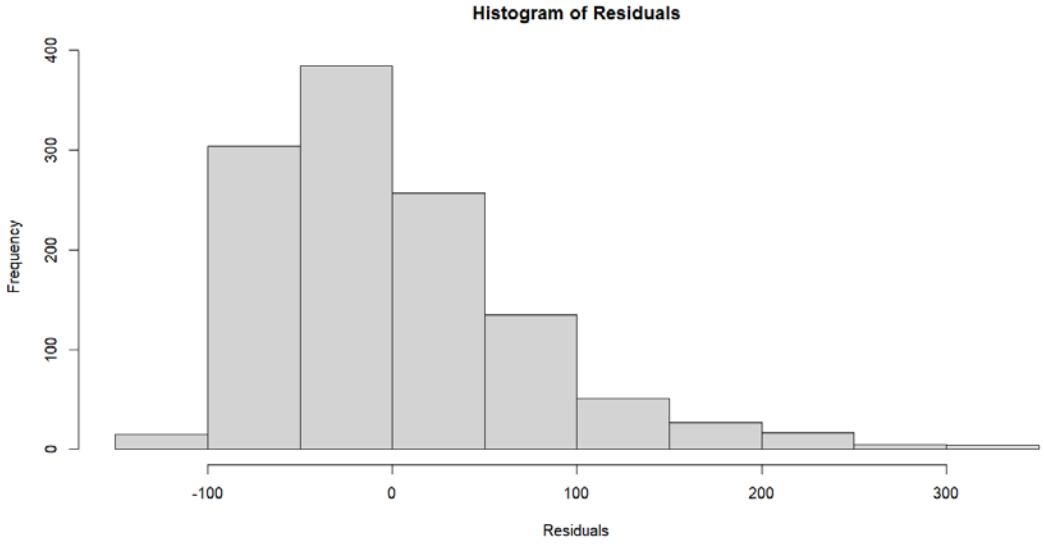
```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 88.56650    4.10819  21.559  < 2e-16 ***
income       0.35869    0.04932   7.272 6.36e-13 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 71.13 on 1198 degrees of freedom
Multiple R-squared:  0.04228,   Adjusted R-squared:  0.04148
F-statistic: 52.89 on 1 and 1198 DF,  p-value: 6.357e-13
```

迴歸線為正斜率，代表食物支出隨所得增加而增加，大致準確。

(c)



殘差疑似為右偏分配，較集中在下半部分，且在高所得區域較為分散




```
Jarque-Bera Test for Residuals:
> print(jb_residuals)

        Jarque-Bera Normality Test

data:  residuals_linear
JB = 624.19, p-value < 2.2e-16
alternative hypothesis: greater
```

通過 Jarque-Bera test 得知殘差非常態分配。殘差為常態分配比 FOOD 跟 INCOME 為常態分配更重要，因為殘差常態分配為 LSE 的假設之一。

(d)

彈性

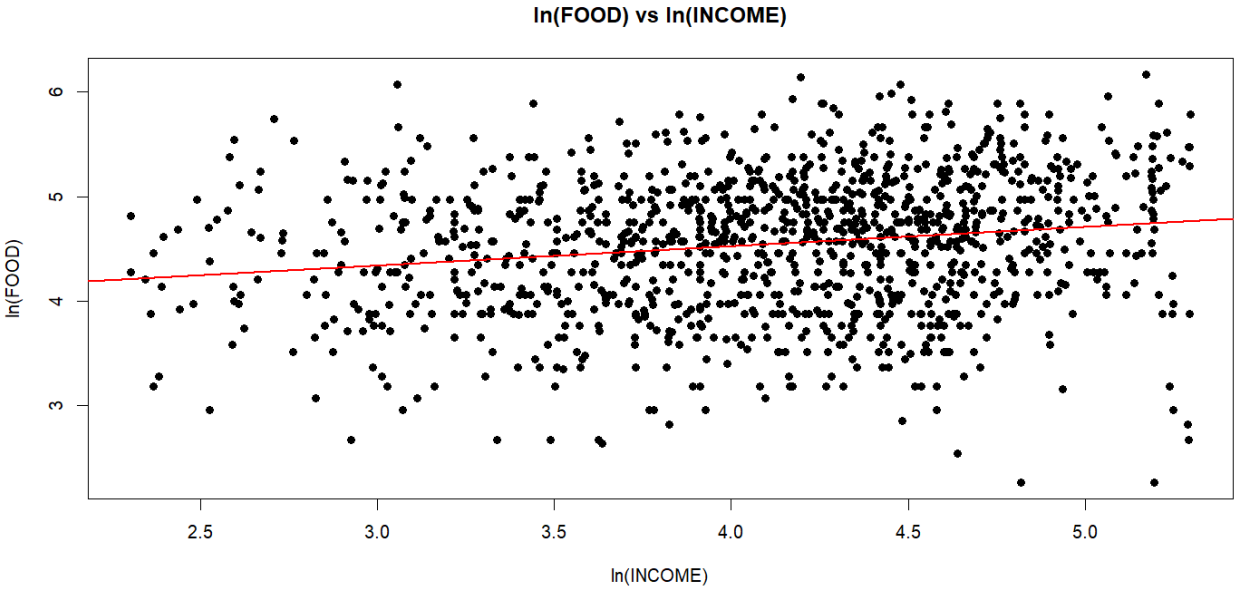
```
Elasticity at INCOME = 19, 65, 160:
> print(elasticity_point)
         1          2          3
0.07145038 0.20838756 0.39319883
```

```
Approximate 95% CI for Elasticity:
> print(elasticity_ci)
          2.5%      97.5%
19  0.05217475 0.09072601
65  0.15216951 0.26460562
160 0.28712305 0.49927462
```

彈性的信賴區間並未重疊，隨著所得增加，食物的所得彈性也增加，符合所得替代彈性。

(e)

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  3.77893    0.12035  31.400   <2e-16 ***
ln_INCOME    0.18631    0.02903   6.417    2e-10 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.6418 on 1198 degrees of freedom
Multiple R-squared:  0.03323,   Adjusted R-squared:  0.03242
F-statistic: 41.18 on 1 and 1198 DF,  p-value: 1.999e-10
```



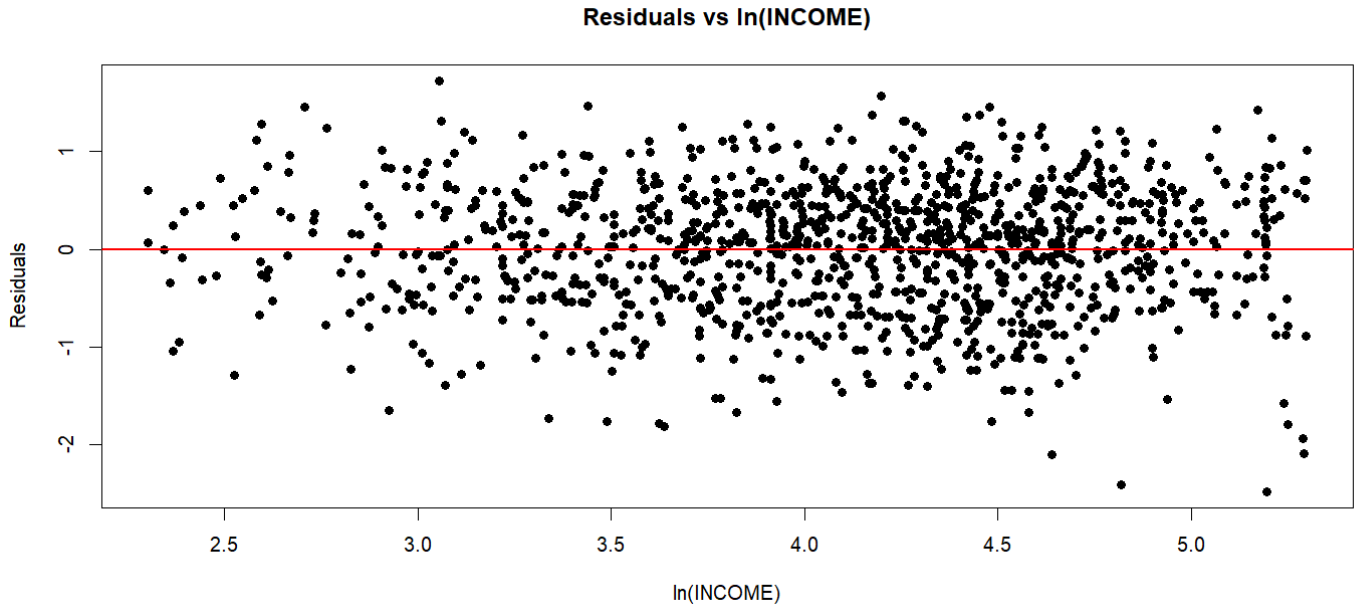
Log-log model 雖然 R-square 較低，但看起來更適合資料。

(f)

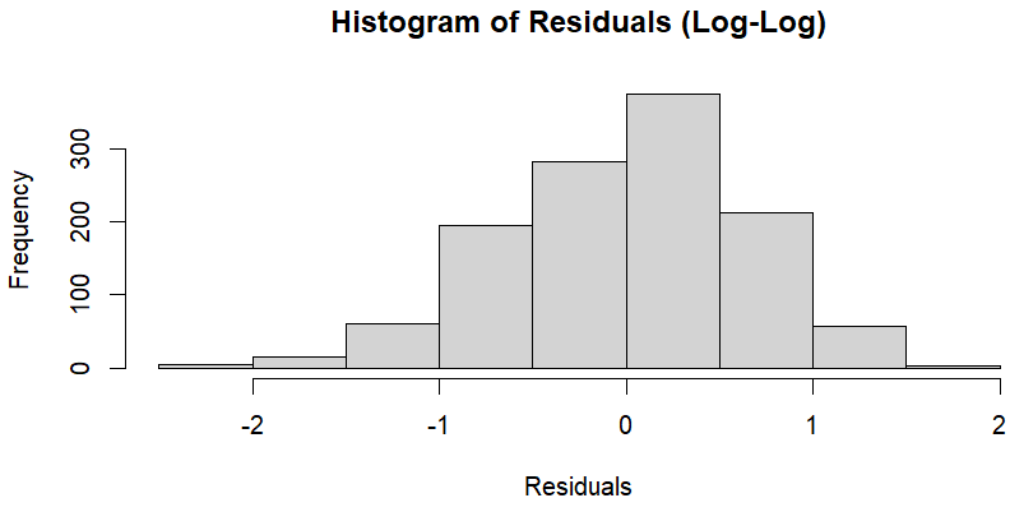
```
Elasticity (γ₂): 0.1863054
> cat("95% CI for Elasticity:\n")
95% CI for Elasticity:
> print(ci_gamma2)
               2.5 %    97.5 %
ln_INCOME 0.1293432 0.2432675
```

與(d)小題不同，log-log model 的彈性為固定，不會隨著 x, y 變動而改變。

(g)



殘差看起來在所得低的時候較分散，為左偏分配

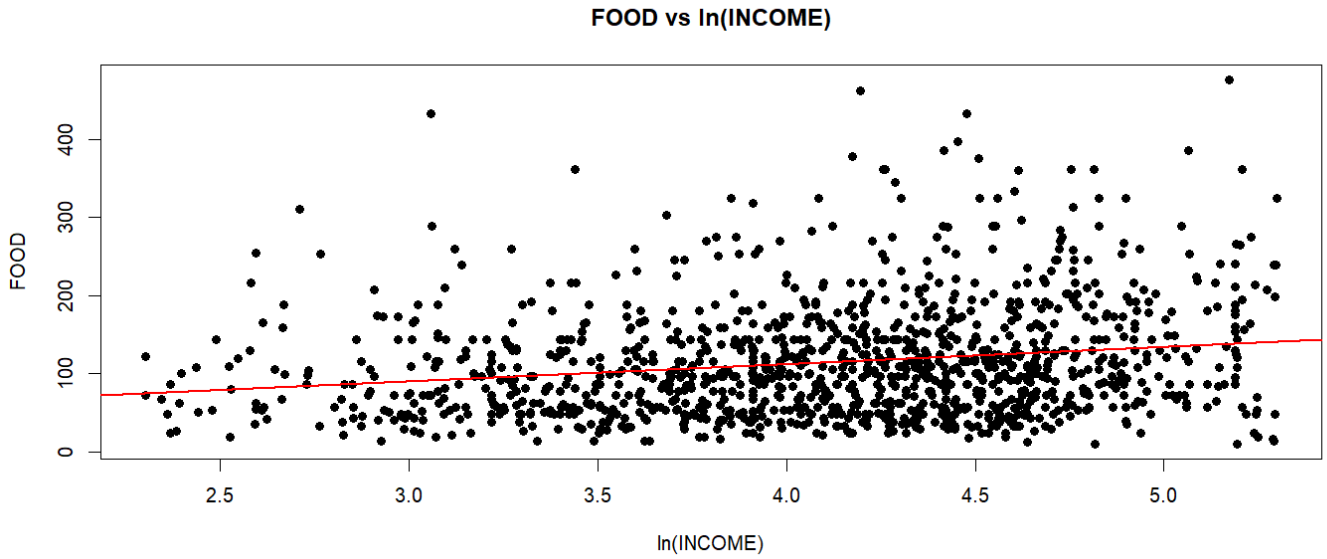


```
        Jarque-Bera Normality Test

data:  residuals_loglog
JB = 25.85, p-value = 2.436e-06
alternative hypothesis: greater
```

根據 Jarque-Bera test 的結果，殘差並非常態分配

(h)

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)    23.568     13.370   1.763   0.0782 .
ln_INCOME      22.187      3.225   6.879 9.68e-12 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 71.29 on 1198 degrees of freedom
Multiple R-squared:  0.038,     Adjusted R-squared:  0.0372
F-statistic: 47.32 on 1 and 1198 DF,  p-value: 9.681e-12
```



看起來更符合資料

```
R² Linear: 0.0422812
R² Log-Log: 0.03322915
R² Linear-Log: 0.03799984
```

若以 R squared 比較，linear model 最適配這個資料

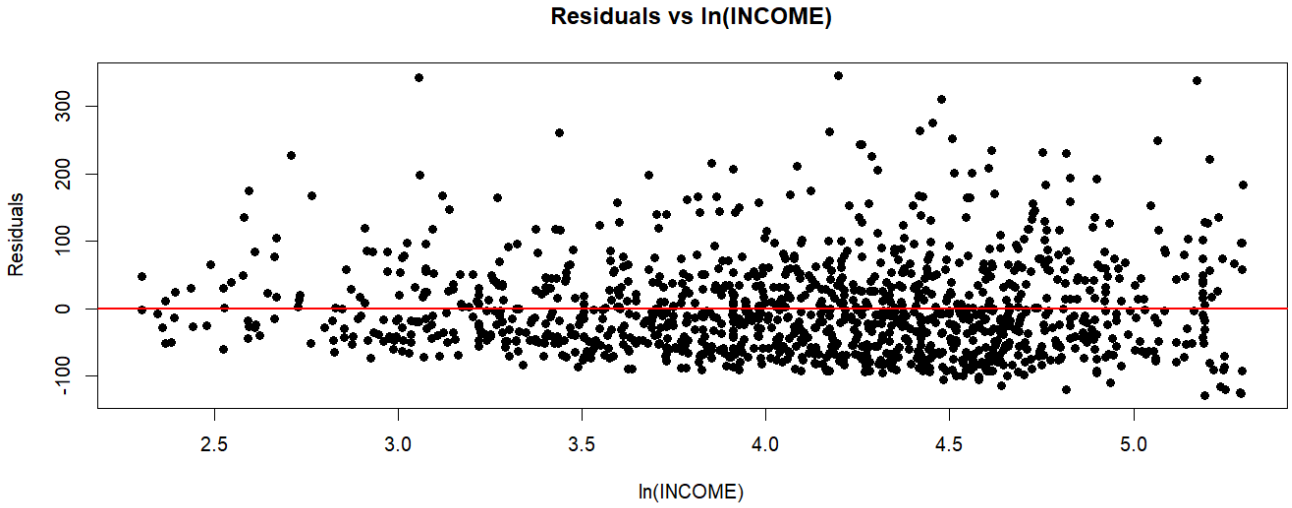
(i)

```
Elasticity at INCOME = 19, 65, 160:
> print(elasticity_linearlog)
        1         2         3
0.2495828 0.1909624 0.1629349
```

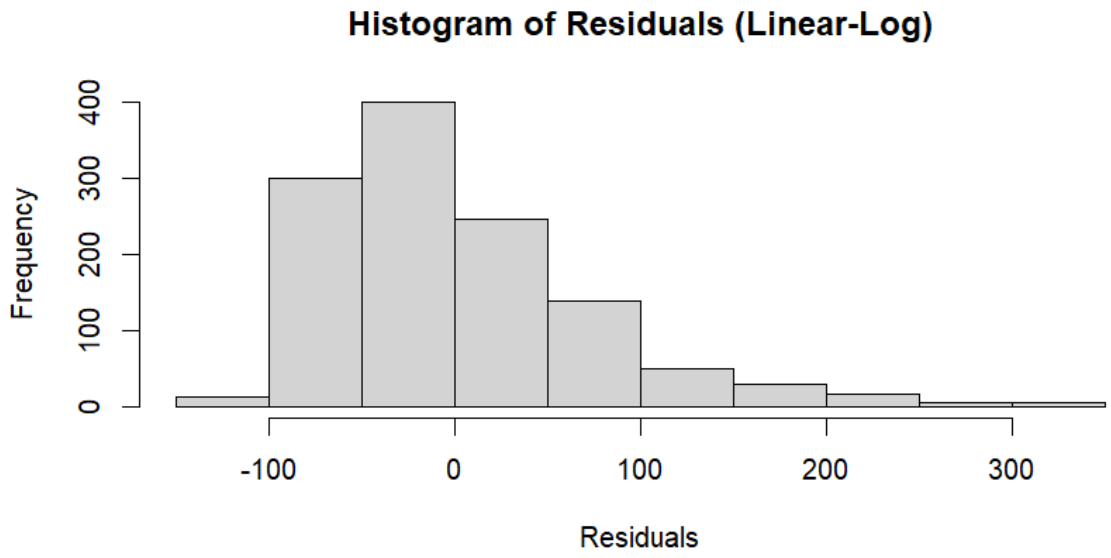
```
Approximate 95% CI for Elasticity
> print(elasticity_ci_alpha2)
         2.5%     97.5%
19  0.1784009 0.3207648
65  0.1364992 0.2454256
160 0.1164652 0.2094046
```

與 linear model 的結果類似，都是隨所得改變的彈性，但彈性越來越小。

(j)



殘差看起來在左邊較少，且似乎在 ln(INCOME)變大時分散程度增加



```
        Jarque-Bera Normality Test

data:  residuals_linearlog
JB = 628.07, p-value < 2.2e-16
alternative hypothesis: greater
```

根據 Jarque-Bera test，linear-log model 的殘差並非常態分配，而是右偏分配

(k)

根據以上的結果，我覺得 log-log model 似乎更適合，因為 log-log model 的斜率為經濟上的彈性，代表 INCOME 增加 1%時，食物支出會增加的百分比，相較其他模型更直覺。