Q28

(a)

P=γ0+γ1Q+γ2DI+γ3PF+vd

P=δ0+δ1Q+δ2PS+vs

(b)

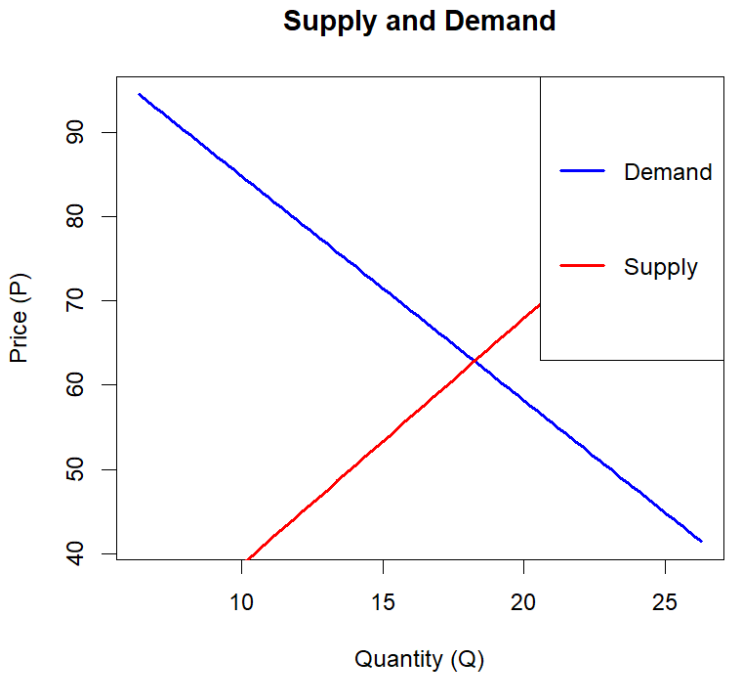
Supply 和 demand 的係數皆符合預期

```
> summary(supply_2sls)

Call:
ivreg(formula = p ~ q + pf | ps + di + pf, data = truffles)

Residuals:
    Min      1Q  Median      3Q     Max
-9.7983 -2.3440 -0.6281  2.4350 11.1600

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -58.7982     5.8592  -10.04 1.32e-10 ***
q             2.9367     0.2158   13.61 1.32e-13 ***
pf            2.9585     0.1560   18.97  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 4.399 on 27 degrees of freedom
Multiple R-Squared: 0.9486,     Adjusted R-squared: 0.9448
Wald test: 232.7 on 2 and 27 DF,  p-value: < 2.2e-16

Call:
ivreg(formula = p ~ q + ps + di | ps + di + pf, data = truffles)

Residuals:
    Min      1Q  Median      3Q     Max
-39.661  -6.781   2.410   8.320  20.251

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  -11.428     13.592  -0.841  0.40810
q             -2.671      1.175  -2.273  0.03154 *
ps             3.461      1.116   3.103  0.00458 **
di            13.390      2.747   4.875 4.68e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 13.17 on 26 degrees of freedom
Multiple R-Squared: 0.5567,     Adjusted R-squared: 0.5056
Wald test: 17.37 on 3 and 26 DF,  p-value: 2.137e-06
```

(c)

```
Price elasticity of demand at means: -1.272464
```

(d)



(e)

```
> cat("Equilibrium Q:", q_eq, "\n")
Equilibrium Q: 18.25021
> cat("Equilibrium P:", p_eq, "\n")
Equilibrium P: 62.84257
```

(f)

```
> summary(demand_ols)

Call:
lm(formula = p ~ q + ps + di, data = truffles)

Residuals:
     Min       1Q   Median       3Q      Max
-25.0753  -2.7742  -0.4097   4.7079  17.4979

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -13.6195     9.0872  -1.499   0.1460
q             0.1512     0.4988   0.303   0.7642
ps            1.3607     0.5940   2.291   0.0303 *
di           12.3582     1.8254   6.770 3.48e-07 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 8.814 on 26 degrees of freedom
Multiple R-squared:  0.8013,    Adjusted R-squared:  0.7784
F-statistic: 34.95 on 3 and 26 DF,  p-value: 2.842e-09

> summary(supply_ols)

Call:
lm(formula = p ~ q + pf, data = truffles)

Residuals:
    Min      1Q  Median      3Q     Max
-8.4721 -3.3287  0.1861  2.0785 10.7513

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -52.8763     5.0238  -10.53 4.68e-11 ***
q             2.6613     0.1712   15.54 5.42e-15 ***
pf            2.9217     0.1482   19.71  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 4.202 on 27 degrees of freedom
Multiple R-squared:  0.9531,    Adjusted R-squared:  0.9496
F-statistic: 274.4 on 2 and 27 DF,  p-value: < 2.2e-16
```

Q30

(a)

```
Call:
lm(formula = i ~ p + plag + klag, data = klein)

Residuals:
     Min       1Q   Median       3Q      Max
-2.56562 -0.63169  0.03687  0.41542  1.49226

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 10.12579    5.46555   1.853 0.081374 .
p            0.47964    0.09711   4.939 0.000125 ***
plag         0.33304    0.10086   3.302 0.004212 **
klag        -0.11179    0.02673  -4.183 0.000624 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.009 on 17 degrees of freedom
  (因為不存在，1 個觀察量被刪除了)
Multiple R-squared:  0.9313,    Adjusted R-squared:  0.9192
F-statistic: 76.88 on 3 and 17 DF,  p-value: 4.299e-10
```

(b)

```
Call:
lm(formula = p ~ w1 + w2 + plag + klag + g + tx + elag + e, data = klein)

Residuals:
       Min         1Q     Median         3Q        Max
-1.191e-14 -3.731e-15  1.103e-15  3.464e-15  7.486e-15

Coefficients:
              Estimate Std. Error    t value Pr(>|t|)
(Intercept) -4.962e-14  5.098e-14 -9.730e-01    0.350
w1          -1.000e+00  3.148e-15 -3.177e+14   <2e-16 ***
w2           2.642e-15  2.777e-15  9.510e-01    0.360
plag         2.658e-16  1.846e-15  1.440e-01    0.888
klag         1.769e-16  3.141e-16  5.630e-01    0.584
g           -1.382e-15  1.628e-15 -8.480e-01    0.413
tx          -1.000e+00  1.837e-15 -5.444e+14   <2e-16 ***
elag        -4.891e-17  8.476e-16 -5.800e-02    0.955
e            1.000e+00  1.501e-15  6.661e+14   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 6.717e-15 on 12 degrees of freedom
Multiple R-squared:      1,     Adjusted R-squared:      1
F-statistic: 9.868e+29 on 8 and 12 DF,  p-value: < 2.2e-16
```

(c)

```
Call:
lm(formula = i ~ p + plag + klag + vt, data = klein)

Residuals:
     Min       1Q   Median       3Q      Max
-2.55474 -0.58214  0.06521  0.52031  1.57563

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  1.013e+01  5.616e+00   1.803 0.090272 .
p            4.796e-01  9.980e-02   4.806 0.000194 ***
plag         3.330e-01  1.036e-01   3.213 0.005424 **
klag        -1.118e-01  2.747e-02  -4.070 0.000890 ***
vt          -1.401e+13  4.458e+13  -0.314 0.757347
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.037 on 16 degrees of freedom
Multiple R-squared:  0.9318,    Adjusted R-squared:  0.9147
F-statistic: 54.62 on 4 and 16 DF,  p-value: 3.971e-09
```

(d)

```
Call:
ivreg(formula = i ~ p + plag + klag | w1 + w2 + g + tx + elag +
    e + plag + klag, data = klein)

Residuals:
     Min       1Q   Median       3Q      Max
-2.56562 -0.63169  0.03687  0.41542  1.49226

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 10.12579    5.46555   1.853 0.081374 .
p            0.47964    0.09711   4.939 0.000125 ***
plag         0.33304    0.10086   3.302 0.004212 **
klag        -0.11179    0.02673  -4.183 0.000624 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.009 on 17 degrees of freedom
Multiple R-Squared: 0.9313,     Adjusted R-squared: 0.9192
Wald test: 76.88 on 3 and 17 DF,  p-value: 4.299e-10
```

(e)

```
Call:
lm(formula = i ~ p_hat + plag + klag, data = klein)

Residuals:
     Min       1Q   Median       3Q      Max
-2.56562 -0.63169  0.03687  0.41542  1.49226

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 10.12579    5.46555   1.853 0.081374 .
p_hat        0.47964    0.09711   4.939 0.000125 ***
plag         0.33304    0.10086   3.302 0.004212 **
klag        -0.11179    0.02673  -4.183 0.000624 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.009 on 17 degrees of freedom
Multiple R-squared:  0.9313,    Adjusted R-squared:  0.9192
F-statistic: 76.88 on 3 and 17 DF,  p-value: 4.299e-10
```

(f)

```
> cat("Sargan test statistic (T * R-square):", sargan_stat, "\n")
Sargan test statistic (T * R-square): 19.29977
> cat("Chi-square critical value (df = 5, 95% level):", crit_val, "\n")
Chi-square critical value (df = 5, 95% level): 11.0705

> if (sargan_stat < crit_val) {
+   cat("Can not reject H0, IV is useful")
+ } else {
+   cat("Reject H0, IV is not valid")
+ }
Reject H0, IV is not valid
```