作業（五）：複迴歸模型、虛擬變數模型之推論

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一、

1. log(D)=β_1+$\beta_2$log(P)+$\beta_3$log(Pop)+$\beta_4$log(Ad)+$\beta_5$log(Cap)+e

2.假設 H_0= $\beta_i = 0, i = 2 \sim 6$； H_1= $\beta_i \neq 0, i = 2 \sim 6$

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+----------------------------------------------------------------------+
| Ordinary     least squares regression     Weighting variable = none  |
| Dep. var. = LOGD      Mean=    4.487246654     , S.D.=    .3710911209E-01 |
| Model size: Observations =       15, Parameters =    5, Deg.Fr.=     10 |
| Residuals:  Sum of squares= .5488573924E-02, Std.Dev.=         .02343 |
| Fit:        R-squared=  .715311, Adjusted R-squared =          .60144 |
| Model test: F[  4,      10] =     6.28,     Prob value =          .00856 |
| Diagnostic: Log-L =      38.0644, Restricted(b=0) Log-L =      28.6418 |
|             LogAmemiyaPrCrt.=   -7.220, Akaike Info. Crt.=     -4.409 |
| Autocorrel: Durbin-Watson Statistic =    2.05216,    Rho =      -.02608 |
+----------------------------------------------------------------------+
+---------+-------------+----------------+--------+---------+----------+
|Variable | Coefficient | Standard Error | t-ratio| P[|T|>t]| Mean of X|
+---------+-------------+----------------+--------+---------+----------+
 Constant   3.296463236       .43430246       7.590    .0000
 LOGP      -.1664541078      .44376648E-01   -3.751    .0038    3.4455470
 LOGPOP     .1557859205      .12789440       1.218    .2512    3.2077444
 LOGAD      .1322063323      .38927429E-01   3.396    .0068    6.0884463
 LOGCAP     .1354379957      .48533773E-01   2.791    .0191    3.3938505
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所以，迴歸模型的估計結果如下（括號內的為 t-ratio）

$\log(\hat{D})$ = 3.296463236-0.1664541078 **log(P)**+ 0.1557859205**log(Pop)**+ 0.1322063323**log(Ad)**

(7.590) **(-3.751)** **(1.218)** **(3.396)**

+0.1354379957**log(Cap)**

(2.791)

$R^{2=}$ **0.715311**

(t)

3. 由上式變數 log(Pop)的係數 t 值（<2）可以看出，無法拒絕虛無假設（$\beta_i = 0$）。因此可以判斷出只有鄉鎮人口數（POP）不會對大同公司新產品的需求量（Y）造成影響；其餘的變數：產品價格（P）、廣告支出（A）的變動以及競爭產品平均價格（CAP），均會對大同公司新產品的需求量（Y）造成影響。

而由迴歸式的係數可知，當價格上升 1%，新產品需求量會下降 16%；而廣告

支出上升 1%，新產品需求量會上升 13%；競爭產品平均價格上升 1%，新產品需求量會上升 13%。

4. H_0：常態分配；H_1：非常態分配

$$JB=\frac{T}{6}\left(S^2+\frac{(k-3)^2}{4}\right)=\frac{15}{6}\left((-0.7176)^2+\frac{(3.1002-3)^2}{4}\right)=1.293649$$

小於卡方值=11.07048257，所以不拒絕 H_0 ，為常態分配。

5. 用 RESET 檢定模型是否設定錯誤，將 $\hat{D}$ 帶入迴歸模型當中，迴歸模型為 $\log(\hat{D})=\beta_1+\beta_2\log(P)+\beta_3\log(Pop)+\beta_4\log(Ad)+\beta_5\log(Cap)+r_1\hat{D}^2+e$。

檢定 H_0：$r_1=0$；H_1：$r_1\neq0$。

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+----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = LOGD     Mean=   4.487246654    , S.D.=   .3710911209E-01 |
| Model size: Observations =      15, Parameters =   6, Deg.Fr.=      9 |
| Residuals:  Sum of squares= .5064480637E-02, Std.Dev.=         .02372 |
| Fit:        R-squared=  .737309, Adjusted R-squared =          .59137 |
| Model test: F[  5,      9] =    5.05,    Prob value =          .01758 |
| Diagnostic: Log-L =     38.6676, Restricted(b=0) Log-L =      28.6418 |
|             LogAmemiyaPrCrt.=   -7.146, Akaike Info. Crt.=     -4.356 |
| Autocorrel: Durbin-Watson Statistic =   2.30415,   Rho =      -.15207 |
+----------------------------------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient | Standard Error |t-ratio |P[|T|>t] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
 Constant  77.80686026      85.829796         .907   .3883
 LOGP     -11.96928288      13.595775        -.880   .4016     3.4455470
 LOGPOP    11.23909398      12.767541         .880   .4016     3.2077444
 LOGAD     9.473664301      10.760516         .880   .4015     6.0884463
 LOGCAP    9.685533496      11.000883         .880   .4015     3.3938505
 DHAT2    -7.880403107      9.0774515        -.868   .4079    20.136302
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$$\log(\hat{D})=\underset{(.907)}{77.80686026}-\underset{(-.880)}{11.96928288}\log(P)+\underset{(.880)}{11.23909398}\log(Pop)+\underset{(.880)}{9.473664301}\log(Ad)+\underset{(.880)}{9.685533496}\log(Cap)-\underset{(-.868)}{7.880403107}\hat{D}^2 \qquad \underset{(t)}{R^2=0.737309}$$

DHAT2 的 P-value＝0.4079>0.05，不拒絕 H_0 。所以通過 RESET 檢定，表示沒有設定錯誤。

6.

Correlation Matrix for Listed Variables

	LOGP	LOGPOP	LOGAD	LOGCAP
LOGP	1.00000	.54349	.35947	.11952
LOGPOP	.54349	1.00000	-.13970	.44664
LOGAD	.35947	-.13970	1.00000	-.22678
LOGCAP	.11952	.44664	-.22678	1.00000

由上表可之兩兩之間的相關係數皆<0.8，所以沒有共線性。

使用輔助迴歸的方式

$\log(p)=\beta_1+\beta_2\log(Pop)+\beta_3\log(Ad)+\beta_4\log(Cap)+e$

得出 R-squared=0.337635 <0.8 代表無線性重合。

二、

1. 迴歸模型為 $Y=\beta_1+\beta_2X+\beta_3D1+e$

2. $H_0=\beta_2=\beta_3=0$ ；$H_1=\beta_2\neq\beta_3\neq 0$

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+----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = Y        Mean=   1515.000000    , S.D.=   202.3986596     |
| Model size: Observations =      24, Parameters =   3, Deg.Fr.=     21 |
| Residuals:  Sum of squares= 24843.88489    , Std.Dev.=       34.39538 |
| Fit:        R-squared=  .973632, Adjusted R-squared =         .97112 |
| Model test: F[  2,     21] =  387.71,    Prob value =         .00000 |
| Diagnostic: Log-L =   -117.3623, Restricted(b=0) Log-L =    -160.9896 |
|             LogAmemiyaPrCrt.=    7.194, Akaike Info. Crt.=     10.030 |
| Autocorrel: Durbin-Watson Statistic =   2.86079,   Rho =      -.43040 |
+----------------------------------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient | Standard Error |t-ratio |P[|T|>t] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
 Constant -3625.827338      184.88061      -19.612   .0000
 X         18.16546763      .65234556       27.846   .0000    278.00000
 D1        181.6546763      15.483190       11.732   .0000    .50000000
```

所以，迴歸模型的估計結果如下

$\hat{y}$ = -3625.827338+18.16546763X+181.6546763 D1　　$R^{2=}$ **0.973632**

(-19.612)　(27.846)　(11.732)　(t)

3. 由上式變數 X 及 D1 的係數 t 值(>2)可以看出,拒絕虛無假設($\beta_i = 0,\ i=2,3$)。因此可以判斷出考生人數（X）、便當的口味（D1），會對便當消費造成影響。

4.利用 Chow 檢定，南北考區應該分開估計，或是混合估計，原本迴歸式為
$Y=\beta_1+\beta_2X+\beta_3D1+e$，加入考區變數之後，則式子變為
$Y=\beta_1+\beta_2X+\beta_3D1+\beta_4XD2+\beta_5D1D2+\beta_6D2+e$。

若北區(D2=1)，則 $Y=\beta_1+\beta_2X+\beta_3D1+\beta_4X+\beta_5D1+\beta_6$

$Y=(\beta_1+\beta_6)+(\beta_2+\beta_4)X+(\beta_3+\beta_5)D1$

若南區(D2=0)，則 $Y=\beta_1+\beta_2X+\beta_3D_1$

虛無假設 H_0：$\beta_6=\beta_4=\beta_5=0$；$H_1$：Otherwise

得出 F[3, 18] for the restrictions =0 .0000 ； Prob = 1.0000

由機率值 Prob = 1.0000 看出，不拒絕 H_0