計量經濟學_HW5_20250324

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1) Let $K = 2$, show that (b1, b2) in p.29 of slides in CH5 reduces to the formula of (b1, b2) in (2.7)~(2.8)

a)

2) Let $K = 2$, show that COV(b1, b2) in p.30 of slides in CH5 reduces to the formula of in (2.14)~(2.16)

a)

3)

5.3 Consider the following model that relates the percentage of a household's budget spent on alcohol *WALC* to total expenditure *TOTEXP*, age of the household head *AGE*, and the number of children in the household *NK*.

$$WALC = \beta_1 + \beta_2 \ln(TOTEXP) + \beta_3 NK + \beta_4 AGE + e$$

This model was estimated using 1200 observations from London. An incomplete version of this output is provided in Table 5.6.

TABLE 5.6 **Output for Exercise 5.3**

Dependent Variable: *WALC*				
Included observations: 1200				
Variable	**Coefficient**	**Std. Error**	***t*-Statistic**	**Prob.**
C	1.4515	2.2019		0.5099
ln(*TOTEXP*)	2.7648		5.7103	0.0000
NK		0.3695	−3.9376	0.0001
AGE	−0.1503	0.0235	−6.4019	0.0000
R-squared		Mean dependent var		6.19434
S.E. of regression		S.D. dependent var		6.39547
Sum squared resid	46221.62			

a. Fill in the following blank spaces that appear in this table.
   i. The *t*-statistic for b_1.
   ii. The standard error for b_2.
   iii. The estimate b_3.
   iv. R^2.
   v. $\hat{\sigma}$.
b. Interpret each of the estimates b_2, b_3, and b_4.
c. Compute a 95% interval estimate for β_4.What does this interval tell you?
d. Are each of the coefficient estimates significant at a 5% level? Why?
e. Test the hypothesis that the addition of an extra child decreases the mean budget share of alcohol by 2 percentage points against the alternative that the decrease is not equal to 2 percentage points. Use a 5% significance level.

a)

4)

5.23 The file *cocaine* contains 56 observations on variables related to sales of cocaine powder in northeastern California over the period 1984–1991. The data are a subset of those used in the study Caulkins, J. P. and R. Padman (1993), "Quantity Discounts and Quality Premia for Illicit Drugs," *Journal of the American Statistical Association*, 88, 748–757. The variables are

PRICE = price per gram in dollars for a cocaine sale
QUANT = number of grams of cocaine in a given sale
QUAL = quality of the cocaine expressed as percentage purity
TREND = a time variable with 1984 = 1 up to 1991 = 8
Consider the regression model

$$PRICE = \beta_1 + \beta_2 QUANT + \beta_3 QUAL + \beta_4 TREND + e$$

a. What signs would you expect on the coefficients β_2, β_3, and β_4?

b. Use your computer software to estimate the equation. Report the results and interpret the coefficient estimates. Have the signs turned out as you expected?

c. What proportion of variation in cocaine price is explained jointly by variation in quantity, quality, and time?

d. It is claimed that the greater the number of sales, the higher the risk of getting caught. Thus, sellers are willing to accept a lower price if they can make sales in larger quantities. Set up H_0 and H_1 that would be appropriate to test this hypothesis. Carry out the hypothesis test.

e. Test the hypothesis that the quality of cocaine has no influence on expected price against the alternative that a premium is paid for better-quality cocaine.

f. What is the average annual change in the cocaine price? Can you suggest why price might be changing in this direction?

a) β_2:對價格應該是「負面」影響，因為量多使得物品價值減少，故$\beta_2 < 0$

β_3:對價格應該是「正面」影響，因為品質越好，理應價格越高，故$\beta_3 > 0$

β_4:對價格應該是「正面」影響，因為物價隨時間會有通膨問題，故$\beta_4 > 0$

b) Model Summary 如下：

Variable	Estimate	Std. Error	t value	Pr(>|t|)	Significance
Intercept	90.84669	8.58025	10.588	1.39E-14	***
quant	-0.05997	0.01018	-5.892	2.85E-07	***
qual	0.11621	0.20326	0.572	0.57	
trend	-2.35458	1.38612	-1.699	0.0954	.

變數	Estimate	t-value	p-value	結論
quant	-0.06	-5.89	2.85E-07	非常顯著，有影響
qual	+0.12	0.572	0.57	不顯著，不一定有影響
trend	-2.35	-1.699	0.095	稍微顯著，可能有影響

「Trend」跟我原本預期的有些許不同，「Qual」也沒有我預期的那麼有顯著性。

c) 模型的 Multiple R^2 為 0.5097，表示模型可解釋約 51% 的價格變異。但考慮變數個數與樣本數後，Adjusted R^2 為 0.4814，為更保守且真實的解釋力指標，顯示模型仍具有中等程度的預測力。

d) 這題主要是想知道是否「Quant」與「Price」成負向關係，也就是檢測 $\beta_2 < 0$，下面為假設檢定流程：

i) $H_0 : \beta_2 \geq 0$

$H_1 : \beta_2 < 0$

ii) $\widehat{\beta_2} = -0.05997$

$SE = 0.01018$

$DF = 56 - 4 = 52$

iii) $t = \frac{\widehat{\beta_2} - 0}{SE(\widehat{\beta_2})} \approx -5.892$

iv) $pvalue_{左尾} = \frac{2.85 \times 10^{-7}}{2} = 1.425 \times 10^{-7} << 0.01$

v) 拒絕 H_0，數量增加會導致價格下降，支持「量多折扣」、「為了降低風險而大量銷售」的理論

e) 這題主要是想檢驗「Quality」與「Price」的關係，是否無影響，下面為檢定流程：

i) $H_0 : \beta_3 = 0$

$H_1 : \beta_3 > 0$

ii) $\widehat{\beta_3} = 0.11621$

$SE = 0.20326$

$DF = 52$

iii) $t = \frac{\widehat{\beta_3} - 0}{SE(\widehat{\beta_3})} = 0.572$

iv) $Pvalue_{雙尾} = 0.57$ (從 Summary 得知)

故 $Pvalue_{右尾} = 0.285$

v) 因為 $Pvalue_{右尾} = 0.285 \geq 0.05$，故我們無法拒絕 H_0

f) 年平均變化價格是指「Trend」的係數 $\beta_4 = -2.35458$，代表每一年平均價格會減少 2.35458 美元。

可能造成此現象的猜測：

i) 販毒集團擴張版圖，使得原物料以及製造成本降低

ii) 出現新型態的替代型毒品，使原本cocaine供給過剩