Dependent Variable: *WALC*				
Included observations: 1200				
Variable	**Coefficient**	**Std. Error**	***t*-Statistic**	**Prob.**
C	1.4515	2.2019	0.659	0.5099
ln(*TOTEXP*)	2.7648	0.4842	5.7103	0.0000
NK	-1.4549	0.3695	−3.9376	0.0001
AGE	−0.1503	0.0235	−6.4019	0.0000
R-squared	0.0575	Mean dependent var		6.19434
S.E. of regression	6.2167	S.D. dependent var		6.39547
Sum squared resid	46221.62			

CH5 Q3 a

(i) $t_{b_1} = \dfrac{1.4515}{2.2019} = 0.659$

(ii) $se\, b_2 = \dfrac{2.7648}{5.7103} = 0.4842$

(iii) $b_3 = 0.3695 \times 3.9376 = -1.4549$

(iv) $1199 \times 6.39547^2 \doteq 49041.54$ $R^2 = 1 - \dfrac{46221.62}{49041.54} = 0.0575$

(v) $\hat{\sigma} = \sqrt{\dfrac{46221.62}{1196}} = 6.2167$

Q3 (b)

b_2: 總支出(TOTEXP)增加 e% 時，家庭預算中酒精支出增加 2.76%

b_3: 每增加1個孩子時，家庭預算中酒精支出減少 1.4549

b_4: 每增加1歲，家庭預算中酒精支出減少 0.1503

Q3 (c)

95% $\Rightarrow$ $-0.1503 \pm 1.96 \times 0.0235 = [-0.1964, -0.1042]$

Q3 d

沒有，因為 β_1 的 $p = 0.5099$ $0.5099 > 0.05$ 所以 β_1 不顯著

Q3 e

$H0: \beta_3 = -2$

$H1: \beta_3 \neq -2$

$$t = \frac{-1.4549 + 2}{0.3695} = 1.4752 \quad vs \quad t_{0.05}\ 1196 = 1.993$$

$\because 1.4752 < 1.993$ $\therefore$ 接受 $H0$ $\therefore$ $\beta_3 = -2$

CH5Q23 a

B_2：銷售數量增加，價格下降（有折扣），期望是負數

B_3：品質更好，價格上升，期望是正數

B_4：價格隨時間上升，期望是正數

Q23 b

b_1（數量）：每增加1單位，價格減少 0.05997 單位　　符合預期

b_2（品質）：每增加1單位，價格增加 0.11621 單位　　符合預期

b_3（時間）：每增加1年，價格下降 2.35458 單位，　　不符預期

p-value = 0.0954 > 0.05　　∴ b_3 在 5% 顯著性水準下不顯著

Q23 c

$R^2 = 0.5097$

Q24 d

H0：$B_2 \geq 0$　沒影響

H1：$B_2 < 0$　有影響

$t = \dfrac{-0.05997}{0.01018} = -5.8910$　vs　$-t_{0.05}\ 52 = -1.675$

∴ $-5.8910 < -1.675$　　拒絕H0　　∴ $B_2 < 0$ 有影響

Q23 e

$H_0: B_3 \leq 0$ 沒影響

$H_1: B_3 > 0$ 有影響

$$t = \frac{0.11621}{0.20326} = 0.5717 \quad vs \quad t_{0.05}\ 52 = 1.675$$

$\because 0.5717 < 1.675$ $\therefore$ 接受H0 $\therefore$ 沒影響

Q23 f

年均變化：每克下降 2.35458美元 ($b_4 = -2.35458$)

原因市場上的供給量提升，加上技術的進步造成供過於求，價格下降

Q_1

$$Y = \begin{bmatrix} y_1 \\ \vdots \\ y_n \end{bmatrix} \quad B = \begin{bmatrix} b_1 \\ b_2 \end{bmatrix} \quad X = \begin{bmatrix} 1 & x_1 \\ 1 & x_2 \\ \vdots & \vdots \\ 1 & x_n \end{bmatrix} \quad \varepsilon = \begin{bmatrix} e_1 \\ \vdots \\ e_n \end{bmatrix}$$

$$(X^T X)^{-1} = \begin{bmatrix} 1 & 1 & \cdots & 1 \\ x_1 & x_2 & \cdots & x_n \end{bmatrix} \begin{bmatrix} 1 & x_1 \\ 1 & x_2 \\ \vdots & \vdots \\ 1 & x_n \end{bmatrix} = \begin{bmatrix} n & x_1 + \cdots + x_n \\ x_1 + \cdots + x_n & \Sigma x_i^2 \end{bmatrix}^{-1} = \begin{bmatrix} n & n\bar{x} \\ n\bar{x} & \Sigma x_i^2 \end{bmatrix}^{-1}$$

$$\det = n \Sigma x_i^2 - (n\bar{x})^2 \quad \Rightarrow \quad \frac{1}{n\Sigma x_i^2 - (n\bar{x})^2} \begin{bmatrix} \Sigma x_i^2 & -n\bar{x} \\ -n\bar{x} & n \end{bmatrix}$$

$$b = \frac{1}{n\Sigma x_i^2 - (n\bar{x})^2} \begin{bmatrix} \Sigma x_i^2 & -n\bar{x} \\ -n\bar{x} & n \end{bmatrix} \begin{bmatrix} n\bar{y} \\ \Sigma xy \end{bmatrix} = \frac{1}{n\Sigma x_i^2 - (n\bar{x})^2} \begin{bmatrix} n\bar{y}\Sigma x_i^2 - n\bar{x}\Sigma xy \\ -n^2\bar{x}\bar{y} + n\Sigma xy \end{bmatrix}$$

$$b_2 = \frac{-n^2\bar{x}\bar{y} + n\Sigma xy}{n\Sigma x_i^2 - (n\bar{x})^2} = \frac{\Sigma xy - n\bar{x}\bar{y}}{\Sigma x_i^2 - n\bar{x}^2} \;\#$$

$$\Sigma x\bar{y} = \Sigma x$$

$$b_2 = \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\Sigma(x_i - \bar{x})^2} = \frac{\Sigma xy - \bar{x}y - x\bar{y} + \bar{x}\bar{y}}{\Sigma x_i^2 - 2x_i\bar{x} + \bar{x}^2} = \frac{\Sigma xy - \Sigma\bar{x}y - \Sigma x\bar{y} + \Sigma\bar{x}\bar{y}}{\Sigma x_i^2 - 2\Sigma x_i\bar{x} + \Sigma\bar{x}^2}$$

$$= \frac{\Sigma xy - n\bar{x}\bar{y}}{\Sigma x_i^2 - n\bar{x}^2}$$

$$b_1 = \frac{(\Sigma x_i^2)(n\bar{y}) - n\bar{x}(\Sigma xy)}{n\Sigma x_i^2 - (n\bar{x})^2} = \frac{\bar{y}\Sigma x_i^2 - \bar{x}\Sigma xy}{\Sigma x_i^2 - n\bar{x}^2}$$

$$b_1 = \bar{y} - b_2\bar{x} = \frac{\bar{y}\Sigma x_i^2 - \cancel{\bar{y}n\bar{x}^2} - \bar{x}\Sigma xy + \cancel{n\bar{x}^2\bar{y}}}{\Sigma x_i^2 - n\bar{x}^2} = \frac{\bar{y}\Sigma x_i^2 - \bar{x}\Sigma xy}{\Sigma x_i^2 - n\bar{x}^2}$$

Q2

$$Var(b) = \sigma^2 (X^T X)^{-1} = \sigma^2 \frac{1}{n\sum x_i^2 - n\bar{x}^2} \begin{bmatrix} \sum x_i^2 & -n\bar{x} \\ -n\bar{x} & n \end{bmatrix}$$

$$var(b_1) = \sigma^2 \times \frac{\sum x_i^2}{n\sum x_i^2 - (n\bar{x})^2} \quad vs \quad var(b_1) = \frac{\sigma^2 \sum x_i^2}{n\sum (x_i - \bar{x})^2} = \frac{\sigma^2 \sum x_i^2}{n\sum x_i^2 - (n\bar{x})^2}$$

$$var(b_2) = \sigma^2 \times \frac{1}{\sum x_i^2 - \frac{(n\bar{x})^2}{n}} = \frac{\sigma^2}{\sum x_i^2 - n\bar{x}^2} \quad vs \quad Var(b_2) = \frac{\sigma^2}{\sum (x_i - \bar{x})^2} = \frac{\sigma^2}{\sum x_i^2 - n\bar{x}^2}$$

$$Cov(b_1, b_2) = \sigma^2 \frac{-\sum x_i}{n\sum x_i^2 - (n\bar{x})^2} \Rightarrow \frac{-\sigma^2 (n\bar{x})}{n\sum x_i^2 - (n\bar{x})^2} \Rightarrow \frac{-\sigma^2 \bar{x}}{\sum x_i^2 - n\bar{x}^2}$$

$$Cov(b_1, b_2) = \frac{-\sigma^2 \bar{x}}{\sum (x_i - \bar{x})^2} \Rightarrow \frac{-\sigma^2 \bar{x}}{\sum x_i^2 - 2\underbrace{\sum x_i}_{n\bar{x}}\bar{x} + \sum \bar{x}^2} \Rightarrow \frac{-\sigma^2 \bar{x}}{\sum x_i^2 - n\bar{x}^2}$$