

Chapter 12 Problems

Problem 12.1

$$C_t = \beta_{1t} + \beta_{2t} Y_t + e_t$$

a) Let $\beta_{jt} = \delta_j + \gamma_j \text{War}_t$ $J=1,2$ $\text{War}_t=1$ for 1941–1946, zero otherwise.

$$C_t = \delta_1 + \gamma_1 \text{War}_t + \delta_2 Y_t + \gamma_2 Y_t * \text{War}_t + e_t$$

b)

SHAZAM OUTPUT

```

*****
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*                                                                      *
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Hello/Bonjour/Aloha/Howdy/G Day/Kia Ora/Konnichiwa/Buenos Dias/Nee Hau/Ciao
Welcome to SHAZAM - Version 10.0 - JUL 2004 SYSTEM=LINUX  PAR= 781
|_ sample 1 42
|_ read C Y
|_ 2 VARIABLES AND          42 OBSERVATIONS STARTING AT OBS      1

|_ genr war = 1
|_ sample 1 12
|_ genr war = 0
|_ sample 19 42
|_ genr war = 0
|_ sample 1 42
|_ genr P = 1-war
|_ genr ywar = Y*war
|_ genr yp = y*p

|_ ols c war y ywar

REQUIRED MEMORY IS PAR=          5 CURRENT PAR=          781
OLS ESTIMATION
      42 OBSERVATIONS      DEPENDENT VARIABLE= C
...NOTE...SAMPLE RANGE SET TO:      1,      42

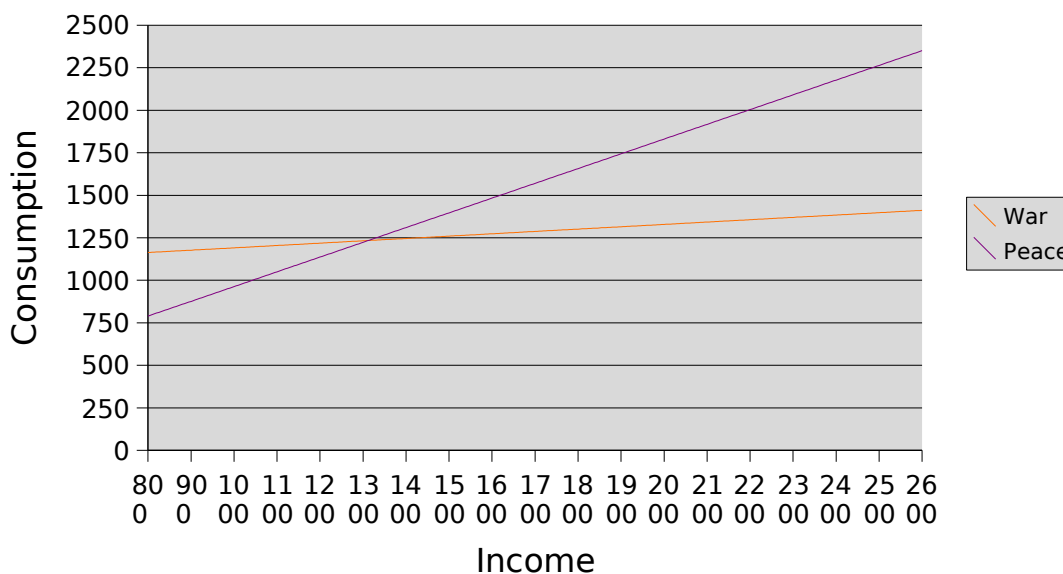
R-SQUARE =      0.9924      R-SQUARE ADJUSTED =      0.9918
VARIANCE OF THE ESTIMATE-SIGMA**2 =      1329.3

```

STANDARD ERROR OF THE ESTIMATE-SIGMA = 36.459
 SUM OF SQUARED ERRORS-SSE= 50512.
 MEAN OF DEPENDENT VARIABLE = 1498.8
 LOG OF THE LIKELIHOOD FUNCTION = -208.534

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO	P-VALUE	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS
WAR	957.14	299.4	3.197	0.003	0.460	0.8403	0.0912
Y	0.86706	0.1263E-01	68.64	0.000	0.996	0.9724	0.9556
YWAR	-0.72928	0.1876	-3.887	0.000	-0.533	-1.0216	-0.1107
CONSTANT	95.863	21.85	4.387	0.000	0.580	0.0000	0.0640

Consumption Function War vs NonWar Years



This graph shows a flatter consumption function for the war years. It is like the drawing in Figure 12.3 (b). The mouth type drawing definitely appears for the income levels that represent the war and post-war years.

c)

```
|_ ols c p war yp ywar / noconstant
```

```
REQUIRED MEMORY IS PAR= 5 CURRENT PAR= 781
```

```
OLS ESTIMATION
```

```
42 OBSERVATIONS DEPENDENT VARIABLE= C
```

```
...NOTE...SAMPLE RANGE SET TO: 1, 42
```

```
R-SQUARE = 0.9924 R-SQUARE ADJUSTED = 0.9918
```

```
VARIANCE OF THE ESTIMATE-SIGMA**2 = 1329.3
```

```
STANDARD ERROR OF THE ESTIMATE-SIGMA = 36.459
```

```
SUM OF SQUARED ERRORS-SSE= 50512.
```

```
MEAN OF DEPENDENT VARIABLE = 1498.8
```

```
LOG OF THE LIKELIHOOD FUNCTION = -208.534
```

RAW MOMENT R-SQUARE = 0.9995

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO	PARTIAL CORR. COEFFICIENT	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS
P	95.863	21.85	4.387	0.000	0.580	0.0548
WAR	1053.0	298.6	3.527	0.001	0.497	0.1004
YP	0.86706	0.1263E-01	68.64	0.000	0.996	0.8239
YWAR	0.13777	0.1872	0.7361	0.466	0.119	0.0209

The coefficient of P is the intercept of our previous model for the non-war years. The coefficient of War is the sum of intercept of the previous model and the war coefficient of the previous model. The coefficient of YP is the slope coefficient of Y in the previous model and the YWAR coefficient is the sum of the coefficient of Y and YWAR in the previous model.

D)

|_ sample 1 12 19 42

|_ ols c y

REQUIRED MEMORY IS PAR= 4 CURRENT PAR= 781

OLS ESTIMATION

36 OBSERVATIONS DEPENDENT VARIABLE= C

...NOTE...SAMPLE RANGE SET TO: 1, 42

R-SQUARE = 0.9983 R-SQUARE ADJUSTED = 0.9982

VARIANCE OF THE ESTIMATE-SIGMA**2 = 316.55

STANDARD ERROR OF THE ESTIMATE-SIGMA = 17.792

SUM OF SQUARED ERRORS-SSE= 10763.

MEAN OF DEPENDENT VARIABLE = 1536.5

LOG OF THE LIKELIHOOD FUNCTION = -153.688

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO	PARTIAL CORR. COEFFICIENT	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS
Y	0.86706	0.6165E-02	140.7	0.000	0.999	0.9376
CONSTANT	95.863	10.66	8.990	0.000	0.839	0.0624

|_ sample 13 18

|_ ols c y

REQUIRED MEMORY IS PAR= 3 CURRENT PAR= 781

OLS ESTIMATION

6 OBSERVATIONS DEPENDENT VARIABLE= C

...NOTE...SAMPLE RANGE SET TO: 13, 18

R-SQUARE = 0.0178 R-SQUARE ADJUSTED = -0.2278

VARIANCE OF THE ESTIMATE-SIGMA**2 = 9937.3

STANDARD ERROR OF THE ESTIMATE-SIGMA = 99.686

SUM OF SQUARED ERRORS-SSE= 39749.

MEAN OF DEPENDENT VARIABLE = 1272.5

LOG OF THE LIKELIHOOD FUNCTION = -34.9094

VARIABLE	ESTIMATED	STANDARD	T-RATIO	PARTIAL	STANDARDIZED	ELASTICITY
----------	-----------	----------	---------	---------	--------------	------------

NAME	COEFFICIENT	ERROR	4 DF	P-VALUE	CORR.	COEFFICIENT	AT MEANS
Y	0.13777	0.5118	0.2692	0.801	0.133	0.1334	0.1725
CONSTANT	1053.0	816.3	1.290	0.267	0.542	0.0000	0.8275
_ end							
_ end							
_ STOP							

The coefficients for the first regression correspond exactly for the values of the coefficients for the non-war years from the two previous models. The coefficients of the second model correspond exactly to the calculated coefficients for the war years model in the (b) and (c).

Problem 12.3

	Constant	Y	War	1-War	
	1	1236	0	0	1
	1	1128	0	0	1
	1	1077	0	0	1
	1	921	0	0	1
	1	893	0	0	1
	1	952	0	0	1
	1	1035	0	0	1
	1	1158	0	0	1
	1	1187	0	0	1
	1	1105	0	0	1
	1	1190	0	0	1
	1	1259	1	1	0
	1	1427	1	1	0
	1	1582	1	1	0
	1	1629	1	1	0
	1	1673	1	1	0
	1	1642	1	1	0
	1	1606	0	0	1
	1	1513	0	0	1
	1	1567	0	0	1
	1	1547	0	0	1
	1	1646	0	0	1
	1	1657	0	0	1
	1	1678	0	0	1
	1	1726	0	0	1
	1	1714	0	0	1
	1	1795	0	0	1
	1	1839	0	0	1
	1	1844	0	0	1
	1	1831	0	0	1
	1	1881	0	0	1
	1	1883	0	0	1
	1	1909	0	0	1
	1	1968	0	0	1
	1	2013	0	0	1
	1	2123	0	0	1
	1	2235	0	0	1
	1	2331	0	0	1
	1	2398	0	0	1
	1	2480	0	0	1
	1	2517	0	0	1
	1	2579	0	0	1

X=

The sum of columns 3 and 4 equals column 1. This is the linear dependence.

Problem 12.9

a) $Male: E[BE] = \delta_1 + \theta_1 Y_i$
 $Female: E[BE] = (\delta_1 + \delta_2) + (\theta_1 + \theta_2) Y_i$

b)

```
|_ sample 1 40
|_ read BE S E1 E2 E3 Y Age
7 VARIABLES AND 40 OBSERVATIONS STARTING AT OBS 1
```

```
|_ genr YS = Y*S
```

```
|_ ols BE S Y YS
```

REQUIRED MEMORY IS PAR= 5 CURRENT PAR= 781

OLS ESTIMATION

40 OBSERVATIONS DEPENDENT VARIABLE= BE

...NOTE...SAMPLE RANGE SET TO: 1, 40

R-SQUARE = 0.5055 R-SQUARE ADJUSTED = 0.4643
 VARIANCE OF THE ESTIMATE-SIGMA**2 = 13016.
 STANDARD ERROR OF THE ESTIMATE-SIGMA = 114.09
 SUM OF SQUARED ERRORS-SSE= 0.46857E+06
 MEAN OF DEPENDENT VARIABLE = 191.55
 LOG OF THE LIKELIHOOD FUNCTION = -244.129

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO	PARTIAL P-VALUE	STANDARD CORR. COEFFICIENT	ELASTICITY AT MEANS
S	-126.00	57.01	-2.210	0.034	-0.346	-0.4088
Y	0.23266E-02	0.8569E-03	2.715	0.010	0.412	0.5875
YS	-0.12915E-02	0.1019E-02	-1.267	0.213	-0.207	-0.3262
CONSTANT	186.47	45.67	4.083	0.000	0.563	0.9735

```
|_ end
```

c)

```
|_ ols BE Y
```

REQUIRED MEMORY IS PAR= 5 CURRENT PAR= 781

OLS ESTIMATION

40 OBSERVATIONS DEPENDENT VARIABLE= BE

...NOTE...SAMPLE RANGE SET TO: 1, 40

R-SQUARE = 0.1355 R-SQUARE ADJUSTED = 0.1127
 VARIANCE OF THE ESTIMATE-SIGMA**2 = 21560.
 STANDARD ERROR OF THE ESTIMATE-SIGMA = 146.83
 SUM OF SQUARED ERRORS-SSE= 0.81929E+06
 MEAN OF DEPENDENT VARIABLE = 191.55
 LOG OF THE LIKELIHOOD FUNCTION = -255.304

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO	PARTIAL P-VALUE	STANDARD CORR. COEFFICIENT	ELASTICITY AT MEANS
Y	0.14577E-02	0.5974E-03	2.440	0.019	0.368	0.3680
CONSTANT	128.98	34.59	3.729	0.001	0.518	0.6734

The adjusted coefficient of determination for the first model is substantially higher. The sex dummy was significant in the first regression suggesting a difference in the intercept between the sexes. The sex-income interaction was not significant suggesting no change in the propensity to consume beer as income rises between the sexes.

$$\text{Female: } E[BE] = \alpha_2 + \gamma_2 Y_i$$

$$\text{Male: } E[BE] = \alpha_1 + \gamma_1 Y_i$$

d)

For males $\alpha_1 = \delta_1$ part a $\gamma_1 = \theta_1$ part a.

For females $\alpha_2 = (\delta_1 + \delta_2)$ part a $\gamma_2 = (\theta_1 + \theta_2)$ part a

e)

```
|_ genr H = 1-S
|_ genr YH = Y*H
```

```
|_ ols BE H S YH YS / noconstant
```

```
REQUIRED MEMORY IS PAR=          6 CURRENT PAR=          781
OLS ESTIMATION
  40 OBSERVATIONS      DEPENDENT VARIABLE= BE
...NOTE...SAMPLE RANGE SET TO:      1,      40
```

```
R-SQUARE =      0.5055      R-SQUARE ADJUSTED =      0.4643
VARIANCE OF THE ESTIMATE-SIGMA**2 =      13016.
STANDARD ERROR OF THE ESTIMATE-SIGMA =      114.09
SUM OF SQUARED ERRORS-SSE=      0.46857E+06
MEAN OF DEPENDENT VARIABLE =      191.55
LOG OF THE LIKELIHOOD FUNCTION = -244.129
RAW MOMENT R-SQUARE =      0.8060
```

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO	P-VALUE	CORR. COEFFICIENT	PARTIAL STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS
H	186.47	45.67	4.083	0.000	0.563	0.6050	0.4624
S	60.469	34.12	1.772	0.085	0.283	0.1962	0.1657
YH	0.23266E-02	0.8569E-03	2.715	0.010	0.412	0.4583	0.2520
YS	0.10351E-02	0.5523E-03	1.874	0.069	0.298	0.2615	0.1198

Both models (b) and (d) give exactly the same intercept and slope coefficients for males versus females. Females have lower intercepts and lower propensities to consume beer as income rises. Models (b) and (d) have the same adjusted coefficient of determination which is substantially higher than that for model c that does not allow sex variations in the model.

Problem 12.11

a)

```
|_ *Westinghouse Regression
|_ sample 1 20
```

```
|_ ols i v k
```

```
REQUIRED MEMORY IS PAR=      2 CURRENT PAR=      781
OLS ESTIMATION
      20 OBSERVATIONS      DEPENDENT VARIABLE= I
...NOTE..SAMPLE RANGE SET TO:      1,      20
```

```
R-SQUARE =      0.7444      R-SQUARE ADJUSTED =      0.7144
VARIANCE OF THE ESTIMATE-SIGMA**2 =      104.31
STANDARD ERROR OF THE ESTIMATE-SIGMA =      10.213
SUM OF SQUARED ERRORS-SSE=      1773.2
MEAN OF DEPENDENT VARIABLE =      42.892
LOG OF THE LIKELIHOOD FUNCTION = -73.2271
```

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO	17 DF	P-VALUE	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS
V	0.52894E-01	0.1571E-01	3.368		0.004	0.633	0.6155	0.8274
K	0.92406E-01	0.5610E-01	1.647		0.118	0.371	0.3011	0.1845
CONSTANT	-0.50939	8.015	-0.6355E-01		0.950	-0.015	0.0000	-0.0119

```
|_ *GE Regression
|_ sample 21 40
```

```
|_ ols i v k
```

```
REQUIRED MEMORY IS PAR=      2 CURRENT PAR=      781
OLS ESTIMATION
      20 OBSERVATIONS      DEPENDENT VARIABLE= I
...NOTE..SAMPLE RANGE SET TO:      21,      40
```

```
R-SQUARE =      0.7053      R-SQUARE ADJUSTED =      0.6706
VARIANCE OF THE ESTIMATE-SIGMA**2 =      777.45
STANDARD ERROR OF THE ESTIMATE-SIGMA =      27.883
SUM OF SQUARED ERRORS-SSE=      13217.
MEAN OF DEPENDENT VARIABLE =      102.29
LOG OF THE LIKELIHOOD FUNCTION = -93.3137
```

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO	17 DF	P-VALUE	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS
V	0.26551E-01	0.1557E-01	1.706		0.106	0.382	0.2262	0.5039
K	0.15169	0.2570E-01	5.902		0.000	0.820	0.7825	0.5934
CONSTANT	-9.9563	31.37	-0.3173		0.755	-0.077	0.0000	-0.0973

b)

```
|_ ols i GE v k
```

```
REQUIRED MEMORY IS PAR=      4 CURRENT PAR=      781
OLS ESTIMATION
      40 OBSERVATIONS      DEPENDENT VARIABLE= I
```


...NOTE..SAMPLE RANGE SET TO: 1, 40

R-SQUARE = 0.8249 R-SQUARE ADJUSTED = 0.8103
VARIANCE OF THE ESTIMATE-SIGMA**2 = 423.60
STANDARD ERROR OF THE ESTIMATE-SIGMA = 20.582
SUM OF SQUARED ERRORS-SSE= 15250.
MEAN OF DEPENDENT VARIABLE = 72.591
LOG OF THE LIKELIHOOD FUNCTION = -175.626

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO	PARTIAL P-VALUE	STANDARD CORR. COEFFICIENT	ELASTICITY AT MEANS
GE	-25.951	14.74	-1.761	0.087	-0.282	-0.1787
V	0.29743E-01	0.1023E-01	2.908	0.006	0.436	0.5352
K	0.15123	0.1861E-01	8.127	0.000	0.804	0.5060
CONSTANT	9.9855	8.170	1.222	0.230	0.200	0.0000

|_ end

The dummy for GE is not significantly different from zero at the 5% level, therefore the conjecture appears to be wrong, at least the data does not support it.

c)

|_ genr GEv = GE*v
|_ genr GEk = GE*k

|_ ols i GE v GEv k GEk

REQUIRED MEMORY IS PAR= 5 CURRENT PAR= 781
OLS ESTIMATION
40 OBSERVATIONS DEPENDENT VARIABLE= I
...NOTE..SAMPLE RANGE SET TO: 1, 40

R-SQUARE = 0.8278 R-SQUARE ADJUSTED = 0.8025
VARIANCE OF THE ESTIMATE-SIGMA**2 = 440.88
STANDARD ERROR OF THE ESTIMATE-SIGMA = 20.997
SUM OF SQUARED ERRORS-SSE= 14990.
MEAN OF DEPENDENT VARIABLE = 72.591
LOG OF THE LIKELIHOOD FUNCTION = -175.282

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO	PARTIAL P-VALUE	STANDARD CORR. COEFFICIENT	ELASTICITY AT MEANS
GE	-9.4469	28.81	-0.3280	0.745	-0.056	-0.0651
V	0.52894E-01	0.3229E-01	1.638	0.111	0.270	0.9517
GEV	-0.26343E-01	0.3435E-01	-0.7668	0.448	-0.130	-0.3523
K	0.92406E-01	0.1153	0.8012	0.429	0.136	0.3092
GEK	0.59287E-01	0.1169	0.5070	0.615	0.087	0.1634
CONSTANT	-0.50939	16.48	-0.3091E-01	0.976	-0.005	-0.0070

|_ test
|_ test GE = 0
|_ test GEv = 0
|_ test GEk = 0
|_ end

F STATISTIC = 1.1894333 WITH 3 AND 34 D.F. P-VALUE= 0.32835
WALD CHI-SQUARE STATISTIC = 3.5682998 WITH 3 D.F. P-VALUE= 0.31201
UPPER BOUND ON P-VALUE BY CHEBYCHEV INEQUALITY = 0.840

We can not reject the null hypothesis that the two regressions are equal (GE and Westinghouse have the same coefficients). The F is not significant at the 5% level or any meaningful level.