第二章　简单线性回归模型

2.1

（1）　①首先分析人均寿命与人均　GDP的数量关系，用　Eviews 分析：

Dependent Variable: Y

Method: Least Squares

Date: 12/23/15　　Time: 14:37

Sample: 1 22

Included observations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	56.64794	1.960820	28.88992	0.0000
X1	0.128360	0.027242	4.711834	0.0001

R-squared	0.526082	Mean dependent var	62.50000
Adjusted R-squared	0.502386	S.D. dependent var	10.08889
S.E. of regression	7.116881	Akaike info criterion	6.849324
Sum squared resid	1013.000	Schwarz criterion	6.948510
Log likelihood	-73.34257	Hannan-Quinn criter.	6.872689
F-statistic	22.20138	Durbin-Watson stat	0.629074
Prob(F-statistic)	0.000134		

有上可知，关系式为　$y=56.64794+0.128360x_1$

②关于人均寿命与成人识字率的关系，用　Eviews 分析如下：

Dependent Variable: Y

Method: Least Squares

Date: 12/23/15　　Time: 15:01

Sample: 1 22

Included observations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	38.79424	3.532079	10.98340	0.0000
X2	0.331971	0.046656	7.115308	0.0000

R-squared	0.716825	Mean dependent var	62.50000
Adjusted R-squared	0.702666	S.D. dependent var	10.08889
S.E. of regression	5.501306	Akaike info criterion	6.334356
Sum squared resid	605.2873	Schwarz criterion	6.433542
Log likelihood	-67.67792	Hannan-Quinn criter.	6.357721
F-statistic	50.62761	Durbin-Watson stat	1.846406
Prob(F-statistic)	0.000001		

由上可知，关系式为　$y=38.79424+0.331971x_2$

③关于人均寿命与一岁儿童疫苗接种率的关系，用　Eviews 分析如下：

Dependent Variable: Y
Method: Least Squares
Date: 12/23/14 Time: 15:20
Sample: 1 22
Included observations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	31.79956	6.536434	4.864971	0.0001
X3	0.387276	0.080260	4.825285	0.0001

R-squared	0.537929	Mean dependent var	62.50000
Adjusted R-squared	0.514825	S.D. dependent var	10.08889
S.E. of regression	7.027364	Akaike info criterion	6.824009
Sum squared resid	987.6770	Schwarz criterion	6.923194
Log likelihood	-73.06409	Hannan-Quinn criter.	6.847374
F-statistic	23.28338	Durbin-Watson stat	0.952555
Prob(F-statistic)	0.000103		

由上可知，关系式为 $y=31.79956+0.387276x_3$

（2）①关于人均寿命与人均 GDP 模型，由上可知，可决系数为 0.526082，说明所建模型整体上对样本数据拟合较好。

对于回归系数的 t 检验：$t(\beta_1)=4.711834>t_{0.025}(20)=2.086$，对斜率系数的显著性检验表明，人均 GDP 对人均寿命有显著影响。

②关于人均寿命与成人识字率模型，由上可知，可决系数为 0.716825，说明所建模型整体上对样本数据拟合较好。

对于回归系数的 t 检验：$t(\beta_2)=7.115308>t_{0.025}(20)=2.086$，对斜率系数的显著性检验表明，成人识字率对人均寿命有显著影响。

③关于人均寿命与一岁儿童疫苗的模型，由上可知，可决系数为 0.537929，说明所建模型整体上对样本数据拟合较好。

对于回归系数的 t 检验：$t(\beta_3)=4.825285>t_{0.025}(20)=2.086$，对斜率系数的显著性检验表明，一岁儿童疫苗接种率对人均寿命有显著影响。

2.2

（1）

①对于浙江省预算收入与全省生产总值的模型，用 Eviews 分析结果如下：

Dependent Variable: Y

Method: Least Squares

Date: 12/23/15 Time: 17:46

Sample (adjusted): 1 33

Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	0.176124	0.004072	43.25639	0.0000
C	-154.3063	39.08196	-3.948274	0.0004

R-squared	0.983702	Mean dependent var	902.5148
Adjusted R-squared	0.983177	S.D. dependent var	1351.009
S.E. of regression	175.2325	Akaike info criterion	13.22880
Sum squared resid	951899.7	Schwarz criterion	13.31949
Log likelihood	-216.2751	Hannan-Quinn criter.	13.25931
F-statistic	1871.115	Durbin-Watson stat	0.100021
Prob(F-statistic)	0.000000		

②由上可知，模型的参数：斜率系数 0.176124，截距为 —154.3063

③关于浙江省财政预算收入与全省生产总值的模型，检验模型的显著性：

1）可决系数为 0.983702 ，说明所建模型整体上对样本数据拟合较好。

2）对于回归系数的 t 检验：t（β2）=43.25639>$t_{0.025}$(31)=2.0395 ，对斜率系数的显著性检验表明，全省生产总值对财政预算总收入有显著影响。

④用规范形式写出检验结果如下：

Y=0.176124X —154.3063

(0.004072) (39.08196)

t= (43.25639) （-3.948274 ）

R2=0.983702 F=1871.115 n=33

⑤经济意义是：全省生产总值每增加 1 亿元，财政预算总收入增加 0.176124 亿元。

（2）当 x=32000 时，

①进行点预测，由上可知 Y=0.176124X —154.3063 ，代入可得：

Y= Y=0.176124*32000 —154.3063=5481.6617

②进行区间预测：

先由 Eviews 分析：

	X	Y
Mean	6000.441	902.5148
Median	2689.280	209.3900
Maximum	27722.31	4895.410
Minimum	123.7200	25.87000
Std. Dev.	7608.021	1351.009
Skewness	1.432519	1.663108
Kurtosis	4.010515	4.590432
Jarque-Bera	12.69068	18.69063
Probability	0.001755	0.000087
Sum	198014.5	29782.99
Sum Sq. Dev.	1.85E+09	58407195
Observations	33	33

由上表可知,

$\sum x^2 = \sum (X_i - X)^2 = \delta_x^2 (n-1) = 7608.021^2 \times (33-1) = 1852223.473$

$(X_f - X)^2 = (32000 - 6000.441)^2 = 675977068.2$

当 Xf=32000 时，将相关数据代入计算得到：

$5481.6617 - 2.0395 \times 175.2325 \times \sqrt{1/33 + 1852223.473/675977068.2} \leq$

$Y_f \leq 5481.6617 + 2.0395 \times 175.2325 \times \sqrt{1/33 + 1852223.473/675977068.2}$

即 Yf 的置信区间为（ 5481.6617 —64.9649, 5481.6617+64.9649 ）

(3) 对于浙江省预算收入对数与全省生产总值对数的模型，由 Eviews 分析结果如下：

Dependent Variable: LNY

Method: Least Squares

Date: 12/23/15 Time: 18:04

Sample (adjusted): 1 33

Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNX	0.980275	0.034296	28.58268	0.0000
C	-1.918289	0.268213	-7.152121	0.0000

R-squared	0.963442	Mean dependent var	5.573120
Adjusted R-squared	0.962263	S.D. dependent var	1.684189
S.E. of regression	0.327172	Akaike info criterion	0.662028
Sum squared resid	3.318281	Schwarz criterion	0.752726
Log likelihood	-8.923468	Hannan-Quinn criter.	0.692545
F-statistic	816.9699	Durbin-Watson stat	0.096208
Prob(F-statistic)	0.000000		

①模型方程为： lnY=0.980275lnX-1.918289

②由上可知，模型的参数：斜率系数为 0.980275，截距为 -1.918289

③关于浙江省财政预算收入与全省生产总值的模型，检验其显著性：

1）可决系数为 0.963442，说明所建模型整体上对样本数据拟合较好。

2）对于回归系数的 t 检验：$t(\beta_2)=28.58268>t_{0.025}(31)=2.0395$，对斜率系数的显著性检验表明，全省生产总值对财政预算总收入有显著影响。

④经济意义：全省生产总值每增长 1%，财政预算总收入增长 0.980275%

2.4

（1）对建筑面积与建造单位成本模型，用 Eviews 分析结果如下：

Dependent Variable: Y

Method: Least Squares

Date: 12/23/15 Time: 20:11

Sample: 1 12

Included observations: 12

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	-64.18400	4.809828	-13.34434	0.0000
C	1845.475	19.26446	95.79688	0.0000

R-squared	0.946829	Mean dependent var	1619.333
Adjusted R-squared	0.941512	S.D. dependent var	131.2252
S.E. of regression	31.73600	Akaike info criterion	9.903792
Sum squared resid	10071.74	Schwarz criterion	9.984610
Log likelihood	-57.42275	Hannan-Quinn criter.	9.873871
F-statistic	178.0715	Durbin-Watson stat	1.172407
Prob(F-statistic)	0.000000		

由上可得：建筑面积与建造成本的回归方程为：

Y=1845.475--64.18400X

（2）经济意义：建筑面积每增加 1 万平方米，建筑单位成本每平方米减少 64.18400 元。

（3）

①首先进行点预测，由 Y=1845.475--64.18400X 得，当 x=4.5，y=1556.647

②再进行区间估计：

用 Eviews 分析：

	Y	X
Mean	1619.333	3.523333
Median	1630.000	3.715000
Maximum	1860.000	6.230000
Minimum	1419.000	0.600000
Std. Dev.	131.2252	1.989419
Skewness	0.003403	-0.060130
Kurtosis	2.346511	1.664917
Jarque-Bera	0.213547	0.898454
Probability	0.898729	0.638121
Sum	19432.00	42.28000
Sum Sq. Dev.	189420.7	43.53567
Observations	12	12

由上表可知，

$\sum x^2=\sum(X_i—X)^2=\delta^2_x(n—1)=1.989419^2 \times (12—1)=43.5357$

$(X_f—X)^2=(4.5—3.523333)^2=0.95387843$

当 Xf=4.5 时，将相关数据代入计算得到：

$1556.647—2.228x31.73600 \times \sqrt{1/12+43.5357/0.95387843} \le$

$Yf \le 1556.647+2.228x31.73600 \times \sqrt{1/12+43.5357/0.95387843}$

即 Yf 的置信区间为（ 1556.647 —478.1231, 1556.647 +478.1231）

3.1

（1）

①对百户拥有家用汽车量计量经济模型，用 Eviews 分析结果如下：

Dependent Variable: Y

Method: Least Squares

Date: 12/23/15 Time: 20:59

Sample: 1 31

Included observations: 31

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X2	5.996865	1.406058	4.265020	0.0002
X3	-0.524027	0.179280	-2.922950	0.0069
X4	-2.265680	0.518837	-4.366842	0.0002
C	246.8540	51.97500	4.749476	0.0001

R-squared	0.666062	Mean dependent var	16.77355
Adjusted R-squared	0.628957	S.D. dependent var	8.252535
S.E. of regression	5.026889	Akaike info criterion	6.187394
Sum squared resid	682.2795	Schwarz criterion	6.372424
Log likelihood	-91.90460	Hannan-Quinn criter.	6.247709
F-statistic	17.95108	Durbin-Watson stat	1.147253
Prob(F-statistic)	0.000001		

②得到模型得：

$Y=246.8540+5.996865X_2-0.524027X_3-2.265680X_4$

③对模型进行检验：

1） 可决系数是 0.666062，修正的可决系数为 0.628957，说明模型对样本拟合较好

2） F 检验，F=17.95108>F（3,27）=3.65，回归方程显著。

3）t 检验，t 统计量分别为 4.749476，4.265020，-2.922950，-4.366842，均大于 t（27）=2.0518，所以这些系数都是显著的。

④依据：

1） 可决系数越大，说明拟合程度越好

2） F 的值与临界值比较，若大于临界值，则否定原假设，回归方程是显著的；若小于临界值，则接受原假设，回归方程不显著。

3） t 的值与临界值比较，若大于临界值，则否定原假设，系数都是显著的；若小于临界值，则接受原假设，系数不显著。

（2）经济意义：人均ＧＤＰ增加１万元，百户拥有家用汽车增加 5.996865 辆，城镇人口比重增加１个百分点，百户拥有家用汽车减少 0.524027 辆，交通工具消费价格指数每上升１，百户拥有家用汽车减少 2.265680 辆。

（3）用 EViews 分析得：

Dependent Variable: Y

Method: Least Squares

Date: 12/23/15　Time: 21:09

Sample: 1 31

Included observations: 31

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X2	5.135670	1.010270	5.083465	0.0000
LNX3	-22.81005	6.771820	-3.368378	0.0023
LNX4	-230.8481	49.46791	-4.666624	0.0001
C	1148.758	228.2917	5.031974	0.0000

R-squared	0.691952	Mean dependent var	16.77355
Adjusted R-squared	0.657725	S.D. dependent var	8.252535
S.E. of regression	4.828088	Akaike info criterion	6.106692
Sum squared resid	629.3818	Schwarz criterion	6.291723
Log likelihood	-90.65373	Hannan-Quinn criter.	6.167008
F-statistic	20.21624	Durbin-Watson stat	1.150090
Prob(F-statistic)	0.000000		

模型方程为：

$Y=5.135670X_2-22.81005LNX_3-230.8481LNX_4+1148.758$

此分析得出的可决系数为 0.691952>0.666062，拟合程度得到了提高，可这样改进。

3.2

（1）对出口货物总额计量经济模型，用 Eviews 分析结果如下：：

Dependent Variable: Y

Method: Least Squares

Date: 12/24/15 Time: 08:23

Sample: 1994 2011

Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X2	0.135474	0.012799	10.58454	0.0000
X3	18.85348	9.776181	1.928512	0.0729
C	-18231.58	8638.216	-2.110573	0.0520

R-squared	0.985838	Mean dependent var	6619.191
Adjusted R-squared	0.983950	S.D. dependent var	5767.152
S.E. of regression	730.6306	Akaike info criterion	16.17670
Sum squared resid	8007316.	Schwarz criterion	16.32510
Log likelihood	-142.5903	Hannan-Quinn criter.	16.19717
F-statistic	522.0976	Durbin-Watson stat	1.173432
Prob(F-statistic)	0.000000		

①由上可知，模型为：

$Y = 0.135474X_2 + 18.85348X_3 - 18231.58$

②对模型进行检验：

1）可决系数是 0.985838，修正的可决系数为 0.983950，说明模型对样本拟合较好

2）F 检验， F=522.0976>F （2,15）=4.77，回归方程显著

3）t 检验，t 统计量分别为 X2 的系数对应 t 值为 10.58454，大于 t（15）=2.131，系数是显著的，X3 的系数对应 t 值为 1.928512，小于 t（15）=2.131，说明此系数是不显著的。

（2）对于对数模型，用 Eviews 分析结果如下：

Dependent Variable: LNY

Method: Least Squares

Date: 12/24/15   Time: 08:47

Sample: 1994 2011

Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNX2	1.564221	0.088988	17.57789	0.0000
LNX3	1.760695	0.682115	2.581229	0.0209
C	-20.52048	5.432487	-3.777363	0.0018

R-squared	0.986295	Mean dependent var	8.400112
Adjusted R-squared	0.984467	S.D. dependent var	0.941530
S.E. of regression	0.117343	Akaike info criterion	-1.296424
Sum squared resid	0.206540	Schwarz criterion	-1.148029
Log likelihood	14.66782	Hannan-Quinn criter.	-1.275962
F-statistic	539.7364	Durbin-Watson stat	0.686656
Prob(F-statistic)	0.000000		

①由上可知，模型为：

$LNY=-20.52048+1.564221\ LNX_2+1.760695\ LNX_3$

②对模型进行检验：

1）可决系数是 0.986295，修正的可决系数为 0.984467，说明模型对样本拟合较好。

2）F 检验，F=539.7364> F（2,15）=4.77，回归方程显著。

3）t 检验，t 统计量分别为 -3.777363，17.57789，2.581229，均大于 t（15）=2.131，所以这些系数都是显著的。

（3）

①（1）式中的经济意义：工业增加 1 亿元，出口货物总额增加 0.135474 亿元，人民币汇率增加 1，出口货物总额增加 18.85348 亿元。

②（2）式中的经济意义：工业增加额每增加 1%，出口货物总额增加 1.564221%，人民币汇率每增加 1%，出口货物总额增加 1.760695%

3.3

（1）对家庭书刊消费对家庭月平均收入和户主受教育年数计量模型，由 Eviews 分析结果如下：

Dependent Variable: Y

Method: Least Squares

Date: 12/24/15 Time: 09:03

Sample: 1 18

Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	0.086450	0.029363	2.944186	0.0101
T	52.37031	5.202167	10.06702	0.0000
C	-50.01638	49.46026	-1.011244	0.3279

R-squared	0.951235	Mean dependent var	755.1222
Adjusted R-squared	0.944732	S.D. dependent var	258.7206
S.E. of regression	60.82273	Akaike info criterion	11.20482
Sum squared resid	55491.07	Schwarz criterion	11.35321
Log likelihood	-97.84334	Hannan-Quinn criter.	11.22528
F-statistic	146.2974	Durbin-Watson stat	2.605783
Prob(F-statistic)	0.000000		

①模型为： $Y = 0.086450X + 52.37031T - 50.01638$

②对模型进行检验：

1）可决系数是 0.951235 ，修正的可决系数为 0.944732 ，说明模型对样本拟合较好。

2）F 检验， F=539.7364> F （2,15）=4.77，回归方程显著。

3）t 检验， t 统计量分别为 2.944186 ，10.06702 ，均大于 t（15）=2.131，所以这些系数都是显著的。

③经济意义：家庭月平均收入增加 1 元，家庭书刊年消费支出增加 0.086450 元，户主受教育年数增加 1 年，家庭书刊年消费支出增加 52.37031 元。

（2）用 Eviews 分析：

①

Dependent Variable: Y

Method: Least Squares

Date: 12/24/15 Time: 09:18

Sample: 1 18

Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
T	63.01676	4.548581	13.85416	0.0000
C	-11.58171	58.02290	-0.199606	0.8443

R-squared	0.923054	Mean dependent var	755.1222
Adjusted R-squared	0.918245	S.D. dependent var	258.7206
S.E. of regression	73.97565	Akaike info criterion	11.54979
Sum squared resid	87558.36	Schwarz criterion	11.64872
Log likelihood	-101.9481	Hannan-Quinn criter.	11.56343
F-statistic	191.9377	Durbin-Watson stat	2.134043
Prob(F-statistic)	0.000000		

②

Dependent Variable: X

Method: Least Squares

Date: 12/24/15 Time: 09:34

Sample: 1 18

Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
T	123.1516	31.84150	3.867644	0.0014
C	444.5888	406.1786	1.094565	0.2899

R-squared	0.483182	Mean dependent var	1942.933
Adjusted R-squared	0.450881	S.D. dependent var	698.8325
S.E. of regression	517.8529	Akaike info criterion	15.44170
Sum squared resid	4290746.	Schwarz criterion	15.54063
Log likelihood	-136.9753	Hannan-Quinn criter.	15.45534
F-statistic	14.95867	Durbin-Watson stat	1.052251
Prob(F-statistic)	0.001364		

以上分别是 y 与 T, X 与 T 的一元回归

模型分别是：

$Y = 63.01676T - 11.58171$

$X = 123.1516T + 444.5888$

（3）对残差进行模型分析，用　Eviews分析结果如下：

Dependent Variable: E1

Method: Least Squares

Date: 12/24/15　　Time: 09:39

Sample: 1 18

Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
E2	0.086450	0.028431	3.040742	0.0078
C	3.96E-14	13.88083	2.85E-15	1.0000

R-squared	0.366239	Mean dependent var	2.30E-14
Adjusted R-squared	0.326629	S.D. dependent var	71.76693
S.E. of regression	58.89136	Akaike info criterion	11.09370
Sum squared resid	55491.07	Schwarz criterion	11.19264
Log likelihood	-97.84334	Hannan-Quinn criter.	11.10735
F-statistic	9.246111	Durbin-Watson stat	2.605783
Prob(F-statistic)	0.007788		

模型为：

$E_1 = 0.086450E_2 + 3.96e\text{-}14$

参数：斜率系数　α 为 0.086450，截距为　3.96e-14

（3）由上可知，　β 2 与 α 2 的系数是一样的。回归系数与被解释变量的残差系数是一样的，它们的变化规律是一致的。

3.6

（1）预期的符号是 X_1, X_2,X_3,X_4,X_5 的符号为正， X_6 的符号为负

（2）根据 Eviews 分析得到数据如下：

Dependent Variable: Y

Method: Least Squares

Date: 12/24/15 Time: 10:13

Sample: 1994 2011

Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X2	0.001382	0.001102	1.254330	0.2336
X3	0.001942	0.003960	0.490501	0.6326
X4	-3.579090	3.559949	-1.005377	0.3346
X5	0.004791	0.005034	0.951671	0.3600
X6	0.045542	0.095552	0.476621	0.6422
C	-13.77732	15.73366	-0.875659	0.3984

R-squared	0.994869	Mean dependent var	12.76667
Adjusted R-squared	0.992731	S.D. dependent var	9.746631
S.E. of regression	0.830963	Akaike info criterion	2.728738
Sum squared resid	8.285993	Schwarz criterion	3.025529
Log likelihood	-18.55865	Hannan-Quinn criter.	2.769662
F-statistic	465.3617	Durbin-Watson stat	1.553294
Prob(F-statistic)	0.000000		

①与预期不相符。

②评价：

1） 可决系数为 0.994869 ，数据相当大，可以认为拟合程度很好。

2） F 检验， F=465.3617>F （5.12 ）=3,89，回归方程显著

3） T 检验， X_1, X_2,X_3,X_4,X_5, X_6 系数对应的 t 值分别为： 1.254330 ， 0.490501 ， -1.005377 ，

0.951671 ， 0.476621 ，均小于 t（12）=2.179，所以所得系数都是不显著的。

（3）根据 Eviews分析得到数据如下：

Dependent Variable: Y

Method: Least Squares

Date: 12/24/15 Time: 10:20

Sample: 1994 2011

Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X5	0.001032	2.20E-05	46.79946	0.0000
X6	-0.054965	0.031184	-1.762581	0.0983
C	4.205481	3.335602	1.260786	0.2266

R-squared	0.993601	Mean dependent var	12.76667
Adjusted R-squared	0.992748	S.D. dependent var	9.746631
S.E. of regression	0.830018	Akaike info criterion	2.616274
Sum squared resid	10.33396	Schwarz criterion	2.764669
Log likelihood	-20.54646	Hannan-Quinn criter.	2.636736
F-statistic	1164.567	Durbin-Watson stat	1.341880
Prob(F-statistic)	0.000000		

①得到模型的方程为：

$Y=0.001032X_5-0.054965X_6+4.205481$

②评价：

1） 可决系数为 0.993601，数据相当大，可以认为拟合程度很好。
2） F检验，F=1164.567>F（5.12）=3,89，回归方程显著
3） T检验，X_5 系数对应的 t 值为 46.79946，大于 t（12）=2.179，所以系数是显著的，即人均 GDP 对年底存款余额有显著影响。X_6 系数对应的 t 值为 -1.762581，小于 t（12）=2.179，所以系数是不显著的。

4.3

（1）根据 Eviews 分析得到数据如下：

Dependent Variable: LNY

Method: Least Squares

Date: 12/24/15 Time: 10:39

Sample: 1985 2011

Included observations: 27

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP	1.338533	0.088610	15.10582	0.0000
LNCPI	-0.421791	0.233295	-1.807975	0.0832
C	-3.111486	0.463010	-6.720126	0.0000

R-squared	0.988051	Mean dependent var	9.484710
Adjusted R-squared	0.987055	S.D. dependent var	1.425517
S.E. of regression	0.162189	Akaike info criterion	-0.695670
Sum squared resid	0.631326	Schwarz criterion	-0.551689
Log likelihood	12.39155	Hannan-Quinn criter.	-0.652857
F-statistic	992.2582	Durbin-Watson stat	0.522613
Prob(F-statistic)	0.000000		

得到的模型方程为：

$LNY=1.338533\ LNGDP_t-0.421791\ LNCPI_t-3.111486$

（2）

① 该模型的可决系数为 0.988051 ，可决系数很高， F 检验值为 992.2582 ，明显显著。但当 $\alpha=0.05$ 时， t（24）=2.064，LNCPI 的系数不显著，可能存在多重共线性。

②得到相关系数矩阵如下：

	LNY	LNGDP	LNCPI
LNY	1.000000	0.993189	0.935116
LNGDP	0.993189	1.000000	0.953740
LNCPI	0.935116	0.953740	1.000000

LNGDP， LNCPI 之间的相关系数很高，证实确实存在多重共线性。

（3）由 Eviews 得：

a）

Dependent Variable: LNY

Method: Least Squares

Date: 12/24/15 Time: 10:41

Sample: 1985 2011

Included observations: 27

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP	1.185739	0.027822	42.61933	0.0000
C	-3.750670	0.312255	-12.01156	0.0000

R-squared	0.986423	Mean dependent var	9.484710
Adjusted R-squared	0.985880	S.D. dependent var	1.425517
S.E. of regression	0.169389	Akaike info criterion	-0.642056
Sum squared resid	0.717312	Schwarz criterion	-0.546068
Log likelihood	10.66776	Hannan-Quinn criter.	-0.613514
F-statistic	1816.407	Durbin-Watson stat	0.471111
Prob(F-statistic)	0.000000		

b)

Dependent Variable: LNY

Method: Least Squares

Date: 12/24/15 Time: 10:55

Sample: 1985 2011

Included observations: 27

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNCPI	2.939295	0.222756	13.19511	0.0000
C	-6.854535	1.242243	-5.517871	0.0000

R-squared	0.874442	Mean dependent var	9.484710
Adjusted R-squared	0.869419	S.D. dependent var	1.425517
S.E. of regression	0.515124	Akaike info criterion	1.582368
Sum squared resid	6.633810	Schwarz criterion	1.678356
Log likelihood	-19.36196	Hannan-Quinn criter.	1.610910
F-statistic	174.1108	Durbin-Watson stat	0.137042
Prob(F-statistic)	0.000000		

c)

Dependent Variable: LNGDP
Method: Least Squares
Date: 12/24/15 Time: 11:07
Sample: 1985 2011
Included observations: 27

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNCPI	2.511022	0.158302	15.86227	0.0000
C	-2.796381	0.882798	-3.167634	0.0040

R-squared	0.909621	Mean dependent var	11.16214
Adjusted R-squared	0.906005	S.D. dependent var	1.194029
S.E. of regression	0.366072	Akaike info criterion	0.899213
Sum squared resid	3.350216	Schwarz criterion	0.995201
Log likelihood	-10.13938	Hannan-Quinn criter.	0.927755
F-statistic	251.6117	Durbin-Watson stat	0.099623
Prob(F-statistic)	0.000000		

①得到的回归方程分别为

1） $LNY=1.185739\ LNGDP_t-3.750670$

2） $LNY=2.939295\ LNCPI_t-6.854535$

3） $LNGDP_t=2.511022\ LNCPI_t-2.796381$

②对多重共线性的认识：

单方程拟合效果都很好，回归系数显著，判定系数较高， GDP和 CPI对进口的显著的单一影响，在这两个变量同时引入模型时影响方向发生了改变， 这只有通过相关系数的分析才能发现。

（4）建议：如果仅仅是作预测，可以不在意这种多重共线性，但如果是进行结构分析，还是应该引起注意的。

4.4

（1）按照设计的理论模型，由 Eviews 分析得：

Dependent Variable: CZSR
Method: Least Squares
Date: 12/24/15 Time: 11:23
Sample: 1985 2011
Included observations: 27

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CZZC	0.090114	0.044367	2.031129	0.0540
GDP	-0.025334	0.005069	-4.998036	0.0000
SSZE	1.176894	0.062162	18.93271	0.0000
C	-221.8540	130.6532	-1.698038	0.1030

R-squared	0.999857	Mean dependent var	22572.56
Adjusted R-squared	0.999838	S.D. dependent var	27739.49
S.E. of regression	353.0540	Akaike info criterion	14.70707
Sum squared resid	2866884.	Schwarz criterion	14.89905
Log likelihood	-194.5455	Hannan-Quinn criter.	14.76416
F-statistic	53493.93	Durbin-Watson stat	1.458128
Prob(F-statistic)	0.000000		

从回归结果可见，可决系数为 0.999857，校正的可决系数为 0.999838，模型拟合的很好。F 的统计量为 53493.93，说明在 $\alpha=0.05$，水平下，回归方程回归方程整体上是显著的。但是 t 检验结果表明，国内生产总值对财政收入的影响显著，但回归系数的符号为负，与实际不符合。由此可得知，该方程可能存在多重共线性。

（2）得到相关系数矩阵如下：

	CZSR	CZZC	GDP	SSZE
CZSR	1.000000	0.998729	0.992838	0.999832
CZZC	0.998729	1.000000	0.992536	0.998575
GDP	0.992838	0.992536	1.000000	0.994370
SSZE	0.999832	0.998575	0.994370	1.000000

由上表可知， CZZC 与 GDP， CZZC 与 SSZE， GDP 与 SSZE 之间的相关系数都非常高，说明确实存在多重共线性。

（3）做辅助回归

被解释变量	可决系数	方差扩大因子
CZZC	0.997168	353
GDP	0.988833	90
SSZE	0.997862	468

方差扩大因子均大于 10，存在严重多重共线性。并且通过以上分析，两两被解释变量之间相关性都很高。

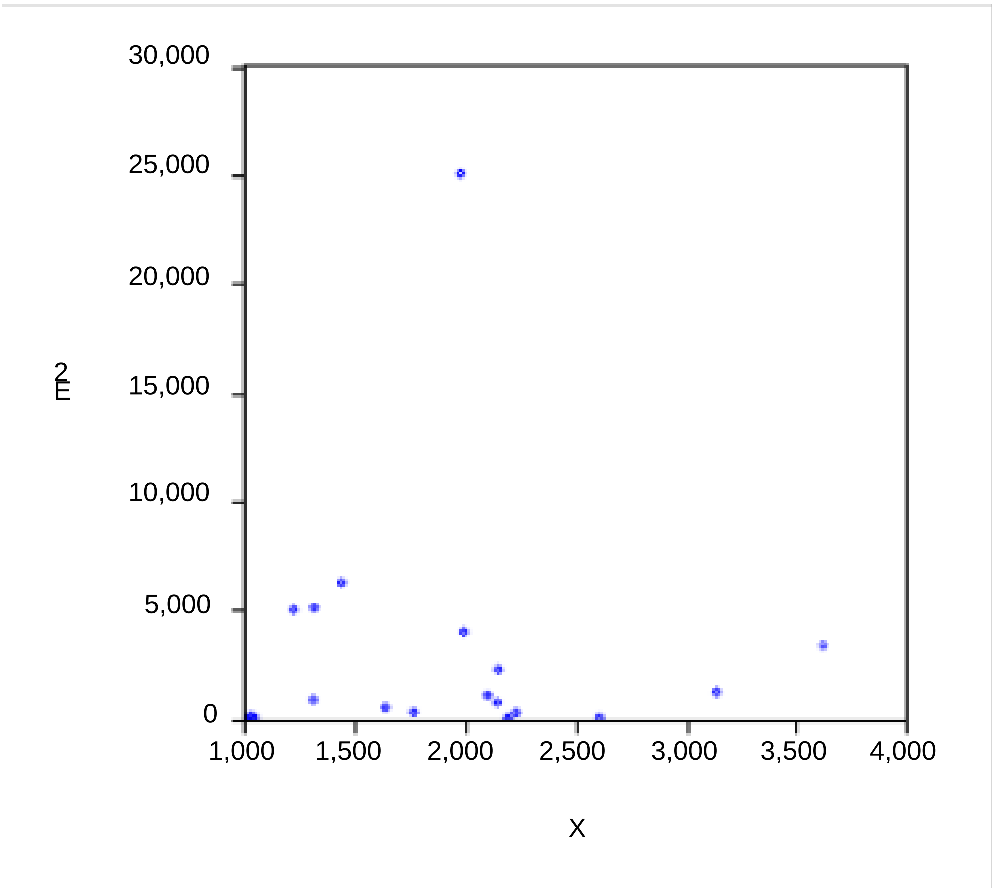
（4）解决方式：分别作出财政收入与财政支出、国内生产总值、税收总额之间的一元回归。

5.2

（1）

①用图形法检验

绘制 e^2 的散点图，用 Eviews 分析如下：



由上图可知，模型可能存在异方差，

② Goldfeld-Quanadt 检验

1）定义区间为 1-7 时，由软件分析得：

Dependent Variable: Y

Method: Least Squares

Date: 12/24/15 Time: 14:52

Sample: 1 7

Included observations: 7

Variable	Coefficient	Std. Error	t-Statistic	Prob.
T	35.20664	4.901492	7.182843	0.0020
X	0.109949	0.061965	1.774380	0.1507
C	77.12588	82.32844	0.936807	0.4019

R-squared	0.943099	Mean dependent var	565.6857
Adjusted R-squared	0.914649	S.D. dependent var	108.2755
S.E. of regression	31.63265	Akaike info criterion	10.04378
Sum squared resid	4002.499	Schwarz criterion	10.02060
Log likelihood	-32.15324	Hannan-Quinn criter.	9.757267
F-statistic	33.14880	Durbin-Watson stat	1.426262
Prob(F-statistic)	0.003238		

得 $\sum e_{1i}^2=4002.499$

2）定义区间为　12-18 时，由软件分析得：

Dependent Variable: Y
Method: Least Squares
Date: 12/24/15　　Time: 14:55
Sample: 12 18
Included observations: 7

Variable	Coefficient	Std. Error	t-Statistic	Prob.
T	52.40588	6.923378	7.569409	0.0016
X	0.068689	0.053763	1.277635	0.2705
C	-8.789265	79.92542	-0.109968	0.9177

R-squared	0.984688	Mean dependent var	887.6143
Adjusted R-squared	0.977032	S.D. dependent var	274.4148
S.E. of regression	41.58810	Akaike info criterion	10.59103
Sum squared resid	6918.280	Schwarz criterion	10.56785
Log likelihood	-34.06861	Hannan-Quinn criter.	10.30451
F-statistic	128.6166	Durbin-Watson stat	2.390329
Prob(F-statistic)	0.000234		

得 $\sum e_{2i}^2$=6918.280

3）根据 Goldfeld-Quanadt 检验， F 统计量为：

$F=\sum e_{2i}^2 / \sum e_{1i}^2$ =6918.280/4002.499=1.7285

在 α =0.05 水平下，分子分母的自由度均为　4，查分布表得临界值　$F_{0.05}$（4,4）=6.39，因为 $F=1.7285< F_{0.05}$（4,4）=6.39，所以接受原假设，此检验表明模型不存在异方差。

（2）存在异方差，估计参数的方法：

①可以对模型进行变换

②使用加权最小二乘法进行计算，得出模型方程，并对其进行相关检验

③对模型进行对数变换，进行分析

（3）评价：

3.3 所得结论是可以相信的，随机扰动项之间不存在异方差。回归方程是显著的。

5.3

(1)由 Eviews 软件分析得：

Dependent Variable: Y

Method: Least Squares

Date: 12/24/15 Time: 16:00

Sample: 1 31

Included observations: 31

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	1.244281	0.079032	15.74411	0.0000
C	242.4488	291.1940	0.832602	0.4119

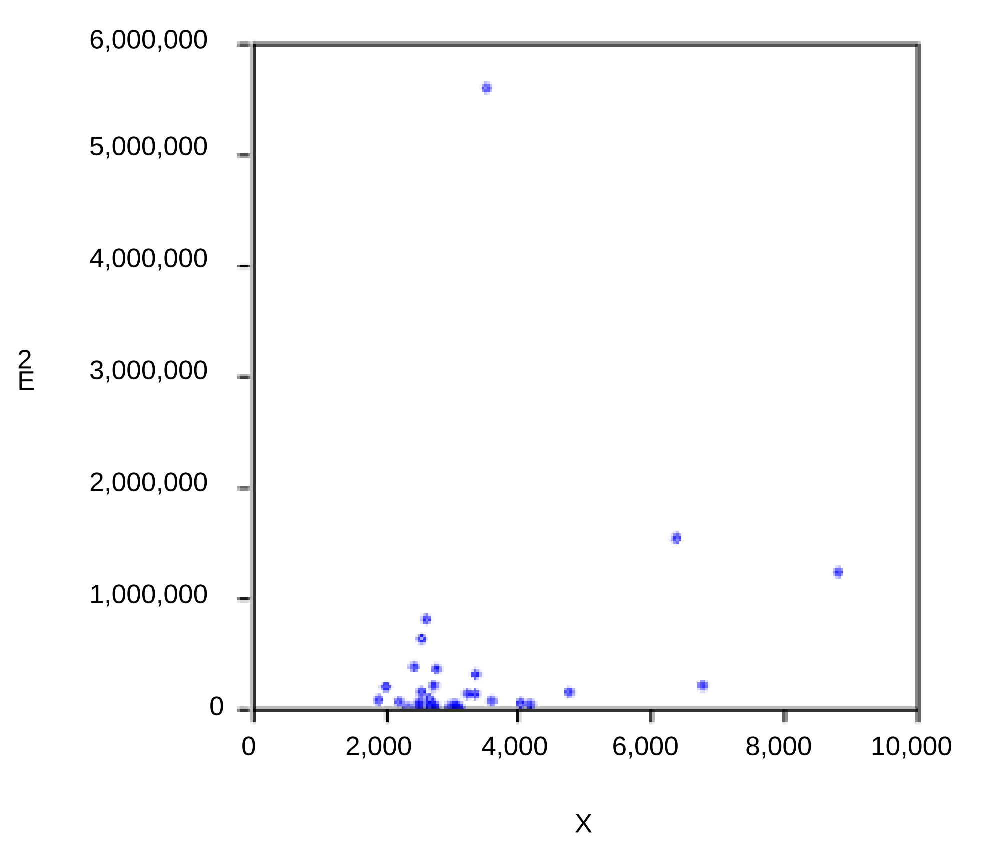
R-squared	0.895260	Mean dependent var	4443.526
Adjusted R-squared	0.891649	S.D. dependent var	1972.072
S.E. of regression	649.1426	Akaike info criterion	15.85152
Sum squared resid	12220196	Schwarz criterion	15.94404
Log likelihood	-243.6986	Hannan-Quinn criter.	15.88168
F-statistic	247.8769	Durbin-Watson stat	1.078581
Prob(F-statistic)	0.000000		

由上表可知，2007 年我国农村居民家庭人均消费支出（ x）对人均纯收入（ y）的模型为：

Y=1.244281X+242.4488

（2）

①由图形法检验



由上图可知，模型可能存在异方差。

②Goldfeld-Quanadt 检验

1）定义区间为 1-12 时，由软件分析得：

Dependent Variable: Y1
Method: Least Squares
Date: 12/24/15 Time: 16:05
Sample: 1 12
Included observations: 12

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1	1.485296	0.500386	2.968297	0.0141
C	-550.5492	1220.063	-0.451247	0.6614

R-squared	0.468390	Mean dependent var	3052.950
Adjusted R-squared	0.415229	S.D. dependent var	550.5148
S.E. of regression	420.9803	Akaike info criterion	15.07406
Sum squared resid	1772245.	Schwarz criterion	15.15488
Log likelihood	-88.44437	Hannan-Quinn criter.	15.04414
F-statistic	8.810789	Durbin-Watson stat	2.354167
Prob(F-statistic)	0.014087		

得 $\sum e_{1i}^2$=1772245.

2）定义区间为 20-31 时，由软件分析得：

Dependent Variable: Y1
Method: Least Squares
Date: 12/24/15 Time: 16:16
Sample: 20 31
Included observations: 12

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1	1.086940	0.148863	7.301623	0.0000
C	1173.307	733.2520	1.600141	0.1407

R-squared	0.842056	Mean dependent var	6188.329
Adjusted R-squared	0.826262	S.D. dependent var	2133.692
S.E. of regression	889.3633	Akaike info criterion	16.56990
Sum squared resid	7909670.	Schwarz criterion	16.65072
Log likelihood	-97.41940	Hannan-Quinn criter.	16.53998
F-statistic	53.31370	Durbin-Watson stat	2.339767
Prob(F-statistic)	0.000026		

得 $\sum e_{2i}^2$=7909670.

3）根据 Goldfeld-Quanadt 检验， F统计量为：

$F=\sum e_{2i}^2 / \sum e_{1i}^2$ =7909670./ 1772245=4.4631

在 α =0.05 水平下，分子分母的自由度均为 10，查分布表得临界值 $F_{0.05}$（10,10）=2.98，因为 F=4.4631> $F_{0.05}$（10,10）=2.98，所以拒绝原假设，此检验表明模型存在异方差。

（3）

1）采用 WLS 法估计过程中，

①用权数 w1=1/X，建立回归得：

Dependent Variable: Y

Method: Least Squares

Date: 12/24/15 Time: 16:29

Sample: 1 31

Included observations: 31

Weighting series: W1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	1.425859	0.119104	11.97157	0.0000
C	-334.8131	344.3523	-0.972298	0.3389

Weighted Statistics

R-squared	0.831707	Mean dependent var	3946.082
Adjusted R-squared	0.825904	S.D. dependent var	536.1907
S.E. of regression	536.6796	Akaike info criterion	15.47102
Sum squared resid	8352726.	Schwarz criterion	15.56354
Log likelihood	-237.8008	Hannan-Quinn criter.	15.50118
F-statistic	143.3184	Durbin-Watson stat	1.369081
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.875855	Mean dependent var	4443.526
Adjusted R-squared	0.871574	S.D. dependent var	1972.072
S.E. of regression	706.7236	Sum squared resid	14484289
Durbin-Watson stat	1.532908		

对此模型进行 White 检验得：

Heteroskedasticity Test: White

F-statistic	0.299395	Prob. F(2,28)	0.7436
Obs*R-squared	0.649065	Prob. Chi-Square(2)	0.7229
Scaled explained SS	1.798067	Prob. Chi-Square(2)	0.4070

Test Equation:

Dependent Variable: WGT_RESID^2

Method: Least Squares

Date: 12/24/15 Time: 16:34

Sample: 1 31

Included observations: 31

Collinear test regressors dropped from specification

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	61927.89	1045682.	0.059222	0.9532
WGT^2	-593927.9	1173622.	-0.506064	0.6168
X*WGT^2	282.4407	747.9780	0.377606	0.7086

R-squared	0.020938	Mean dependent var	269442.8
Adjusted R-squared	-0.048995	S.D. dependent var	689166.5
S.E. of regression	705847.6	Akaike info criterion	29.86395
Sum squared resid	1.40E+13	Schwarz criterion	30.00273
Log likelihood	-459.8913	Hannan-Quinn criter.	29.90919
F-statistic	0.299395	Durbin-Watson stat	1.922336
Prob(F-statistic)	0.743610		

从上可知， nR^2=0.649065 ，比较计算的 χ^2 统计量的临界值，因为 nR^2=0.649065< $\chi^2_{0.05}$（2）=5.9915，所以接受原假设，该模型消除了异方差。

估计结果为：

Y=1.425859X-334.8131

t=（11.97157 ）（ -0.972298 ）

R^2=0.875855 F=143.3184 DW=1.369081

②用权数 $w2=1/x^2$,用回归分析得：

Dependent Variable: Y
Method: Least Squares
Date: 12/24/15 Time: 16:40
Sample: 1 31
Included observations: 31
Weighting series: W2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	1.557040	0.145392	10.70922	0.0000
C	-693.1946	376.4760	-1.841272	0.0758

Weighted Statistics

R-squared	0.798173	Mean dependent var	3635.028
Adjusted R-squared	0.791214	S.D. dependent var	1029.830
S.E. of regression	466.8513	Akaike info criterion	15.19224
Sum squared resid	6320554.	Schwarz criterion	15.28475
Log likelihood	-233.4797	Hannan-Quinn criter.	15.22240
F-statistic	114.6875	Durbin-Watson stat	1.562975
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.834850	Mean dependent var	4443.526
Adjusted R-squared	0.829156	S.D. dependent var	1972.072
S.E. of regression	815.1229	Sum squared resid	19268334
Durbin-Watson stat	1.678365		

对此模型进行 White 检验得：

Heteroskedasticity Test: White

F-statistic	0.299790	Prob. F(3,27)	0.8252
Obs*R-squared	0.999322	Prob. Chi-Square(3)	0.8014
Scaled explained SS	1.789507	Prob. Chi-Square(3)	0.6172

Test Equation:

Dependent Variable: WGT_RESID^2

Method: Least Squares

Date: 12/24/15 Time: 16:45

Sample: 1 31

Included observations: 31

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-111661.8	549855.7	-0.203075	0.8406
WGT^2	426220.2	2240181.	0.190262	0.8505
X^2*WGT^2	0.194888	0.516395	0.377402	0.7088
X*WGT^2	-583.2151	2082.820	-0.280012	0.7816

R-squared	0.032236	Mean dependent var	203888.8
Adjusted R-squared	-0.075293	S.D. dependent var	419282.0
S.E. of regression	434780.1	Akaike info criterion	28.92298
Sum squared resid	5.10E+12	Schwarz criterion	29.10801
Log likelihood	-444.3062	Hannan-Quinn criter.	28.98330
F-statistic	0.299790	Durbin-Watson stat	1.835854
Prob(F-statistic)	0.825233		

从上可知， nR^2=0.999322 ，比较计算的 χ^2 统计量的临界值，因为 nR^2=0.999322< $\chi^2_{0.05}(2)$ =5.9915 ，所以接受原假设，该模型消除了异方差。

估计结果为：

Y=1.557040X-693.1946

t= （ 10.70922 ） （ -1.841272 ）

R^2=0.798173 F=114.6875 DW=1.562975

③用权数　w3=1/sqr　（x）,用回归分析得：

Dependent Variable: Y
Method: Least Squares
Date: 12/24/15　　Time: 16:49
Sample: 1 31
Included observations: 31
Weighting series: W3

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	1.330130	0.098345	13.52507	0.0000
C	-47.40242	313.1154	-0.151390	0.8807

Weighted Statistics

R-squared	0.863161	Mean dependent var	4164.118
Adjusted R-squared	0.858442	S.D. dependent var	991.2079
S.E. of regression	586.9555	Akaike info criterion	15.65012
Sum squared resid	9990985.	Schwarz criterion	15.74263
Log likelihood	-240.5768	Hannan-Quinn criter.	15.68027
F-statistic	182.9276	Durbin-Watson stat	1.237664
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.890999	Mean dependent var	4443.526
Adjusted R-squared	0.887240	S.D. dependent var	1972.072
S.E. of regression	662.2171	Sum squared resid	12717412
Durbin-Watson stat	1.314859		

对此模型进行 White 检验得：

Heteroskedasticity Test: White

F-statistic	0.423886	Prob. F(2,28)	0.6586
Obs*R-squared	0.911022	Prob. Chi-Square(2)	0.6341
Scaled explained SS	2.768332	Prob. Chi-Square(2)	0.2505

Test Equation:

Dependent Variable: WGT_RESID^2

Method: Least Squares

Date: 12/24/15 Time: 16:57

Sample: 1 31

Included observations: 31

Collinear test regressors dropped from specification

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1212308.	2141958.	0.565981	0.5759
WGT^2	-715673.0	1301839.	-0.549740	0.5869
X^2*WGT^2	-0.015194	0.082276	-0.184677	0.8548

R-squared	0.029388	Mean dependent var	322289.8
Adjusted R-squared	-0.039942	S.D. dependent var	863356.7
S.E. of regression	880429.8	Akaike info criterion	30.30597
Sum squared resid	2.17E+13	Schwarz criterion	30.44475
Log likelihood	-466.7426	Hannan-Quinn criter.	30.35121
F-statistic	0.423886	Durbin-Watson stat	1.887426
Prob(F-statistic)	0.658628		

从上可知， nR^2=0.911022 ，比较计算的 χ^2统计量的临界值，因为 nR^2=0.911022< $\chi^2_{0.05}(2)$ =5.9915 ，所以接受原假设，该模型消除了异方差。

估计结果为：

Y=1.330130X-47.40242

t=（13.52507 ）（ -0.151390 ）

R^2=0.863161 F=182.9276 DW=1.237664

经过检验发现，用权数 w1 的效果最好，所以综上可知，即修改后的结果为：

Y=1.425859X-334.8131

t=（11.97157 ）（ -0.972298 ）

R^2=0.875855 F=143.3184 DW=1.369081

5.6

(1)

a)用 Eviews 模型分析得：

Dependent Variable: Y

Method: Least Squares

Date: 12/24/15 Time: 19:16

Sample: 1978 2011

Included observations: 34

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	0.746241	0.019120	39.03027	0.0000
C	92.55422	42.80529	2.162215	0.0382

R-squared	0.979426	Mean dependent var	1295.802
Adjusted R-squared	0.978783	S.D. dependent var	1188.791
S.E. of regression	173.1597	Akaike info criterion	13.20333
Sum squared resid	959497.2	Schwarz criterion	13.29311
Log likelihood	-222.4566	Hannan-Quinn criter.	13.23395
F-statistic	1523.362	Durbin-Watson stat	1.534491
Prob(F-statistic)	0.000000		

得回归模型为：

Y=0.746241 X+92.55422

b)检验是否存在异方差：

①用 Goldfeld-Quanadt 检验如下：

1）当定义区间为 1-13 时，由软件分析得：

Dependent Variable: Y

Method: Least Squares

Date: 12/24/15 Time: 19:27

Sample: 1 13

Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	0.967839	0.026879	36.00771	0.0000
C	-18.86861	8.963780	-2.104984	0.0591

R-squared	0.991587	Mean dependent var	280.1377
Adjusted R-squared	0.990823	S.D. dependent var	127.0409
S.E. of regression	12.17039	Akaike info criterion	7.976527
Sum squared resid	1629.301	Schwarz criterion	8.063442
Log likelihood	-49.84742	Hannan-Quinn criter.	7.958662
F-statistic	1296.555	Durbin-Watson stat	1.071505
Prob(F-statistic)	0.000000		

得$\sum e_{1i}^2$=1629.301

2）当定义区间为 1-13 时，由软件分析得：

Dependent Variable: Y
Method: Least Squares
Date: 12/24/15 Time: 19:34
Sample: 22 34
Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	0.719567	0.058312	12.33998	0.0000
C	179.3950	202.8764	0.884258	0.3955

R-squared	0.932629	Mean dependent var	2496.127
Adjusted R-squared	0.926504	S.D. dependent var	1022.591
S.E. of regression	277.2250	Akaike info criterion	14.22817
Sum squared resid	845390.4	Schwarz criterion	14.31509
Log likelihood	-90.48313	Hannan-Quinn criter.	14.21031
F-statistic	152.2752	Durbin-Watson stat	1.658418
Prob(F-statistic)	0.000000		

得$\sum e_{2i}^2$=845390.4

3）根据 Goldfeld-Quanadt 检验，F统计量为：

$F=\sum e_{2i}^2 / \sum e_{1i}^2$=845390.4/ 1629.301=518.8669

在 α =0.05 水平下，分子分母的自由度均为 11，查分布表得临界值 $F_{0.05}$（11,11）=4.47，因为 F=518.8669> $F_{0.05}$（11,11）=4.47，所以拒绝原假设，此检验表明模型存在异方差。

②White 检验

用 EViews 软件分析得：

Heteroskedasticity Test: White

F-statistic	10.36759	Prob. F(2,31)	0.0004
Obs*R-squared	13.62701	Prob. Chi-Square(2)	0.0011
Scaled explained SS	76.13635	Prob. Chi-Square(2)	0.0000

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 12/24/15 Time: 19:56

Sample: 1 34

Included observations: 34

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11581.11	26117.11	0.443430	0.6605
X	-27.69901	27.86540	-0.994029	0.3279
X^2	0.012230	0.005156	2.371861	0.0241

R-squared	0.400795	Mean dependent var	28220.51
Adjusted R-squared	0.362136	S.D. dependent var	101738.9
S.E. of regression	81255.15	Akaike info criterion	25.53267
Sum squared resid	2.05E+11	Schwarz criterion	25.66735
Log likelihood	-431.0554	Hannan-Quinn criter.	25.57860
F-statistic	10.36759	Durbin-Watson stat	3.021651
Prob(F-statistic)	0.000357		

从上图中可以看出，nR^2=13.62701 ，比较计算的 χ^2 统计量的临界值，因为 nR^2=13.62701> $\chi^2_{0.05}(2)$=5.9915，所以拒绝原假设，不拒绝备择假设，表明模型存在异方差。

用以上两种方法，可以检验模型是存在异方差的。

c)修正模型

1）用加权二乘法修正异方差现象步骤如下：

①当权数 w1=1/x 时，用软件分析得：

Dependent Variable: Y

Method: Least Squares

Date: 12/24/15 Time: 20:22

Sample: 1 34

Included observations: 34

Weighting series: W1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	0.821013	0.016866	48.67993	0.0000
C	17.69318	6.283256	2.815926	0.0083

Weighted Statistics

R-squared	0.986676	Mean dependent var	457.8505
Adjusted R-squared	0.986260	S.D. dependent var	41.70384
S.E. of regression	37.91285	Akaike info criterion	10.16548
Sum squared resid	45996.29	Schwarz criterion	10.25527
Log likelihood	-170.8132	Hannan-Quinn criter.	10.19610
F-statistic	2369.735	Durbin-Watson stat	0.605852
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.968070	Mean dependent var	1295.802
Adjusted R-squared	0.967072	S.D. dependent var	1188.791
S.E. of regression	215.7175	Sum squared resid	1489089.
Durbin-Watson stat	1.079107		

得方程模型为：

Y=0.821013X-17.69318

t=（48.67993）（2.815926）

R^2=0.986676 F=2369.735 DW=0.605852

对此模型进行 White 检验如下：

Heteroskedasticity Test: White

F-statistic	1.348072	Prob. F(2,31)	0.2745
Obs*R-squared	2.720457	Prob. Chi-Square(2)	0.2566
Scaled explained SS	1.221901	Prob. Chi-Square(2)	0.5428

Test Equation:

Dependent Variable: WGT_RESID^2

Method: Least Squares

Date: 12/24/15 Time: 20:29

Sample: 1 34

Included observations: 34

Collinear test regressors dropped from specification

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1678.870	416.5417	4.030498	0.0003
WGT^2	-32.13071	187.6175	-0.171257	0.8651
X*WGT^2	-0.484040	1.279449	-0.378319	0.7078

R-squared	0.080013	Mean dependent var	1352.832
Adjusted R-squared	0.020659	S.D. dependent var	1382.825
S.E. of regression	1368.467	Akaike info criterion	17.36487
Sum squared resid	58053732	Schwarz criterion	17.49955
Log likelihood	-292.2027	Hannan-Quinn criter.	17.41080
F-statistic	1.348072	Durbin-Watson stat	1.199640
Prob(F-statistic)	0.274545		

从上图中可以看出， nR^2=2.720457 ，比较计算的 χ^2统计量的临界值，

因为 nR^2=2.720457< $\chi^2$0.05 （2） =5.9915，所以接受原假设，即该模型消除了异方差的影响。

②当权数 w2=1/x ^{2}时，用软件分析得：

Dependent Variable: Y
Method: Least Squares
Date: 12/24/15   Time: 20:41
Sample: 1 34
Included observations: 34
Weighting series: W2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	0.852193	0.020150	42.29335	0.0000
C	8.890886	3.604301	2.466744	0.0192

Weighted Statistics

R-squared	0.982425	Mean dependent var	230.2433
Adjusted R-squared	0.981875	S.D. dependent var	247.1718
S.E. of regression	16.20273	Akaike info criterion	8.465259
Sum squared resid	8400.912	Schwarz criterion	8.555045
Log likelihood	-141.9094	Hannan-Quinn criter.	8.495879
F-statistic	1788.728	Durbin-Watson stat	0.604647
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.954142	Mean dependent var	1295.802
Adjusted R-squared	0.952709	S.D. dependent var	1188.791
S.E. of regression	258.5207	Sum squared resid	2138654.
Durbin-Watson stat	0.781788		

得方程模型为：

Y=0.852193X+8.890886

t=（42.29335 ）（ 2.466744 ）

R^2=0.982425 F=1788.728   DW=0.604647

用 White 检验模型得：

Heteroskedasticity Test: White

F-statistic	7.462185	Prob. F(3,30)	0.0007
Obs*R-squared	14.52935	Prob. Chi-Square(3)	0.0023
Scaled explained SS	19.40139	Prob. Chi-Square(3)	0.0002

Test Equation:

Dependent Variable: WGT_RESID^2

Method: Least Squares

Date: 12/24/15 Time: 20:55

Sample: 1 34

Included observations: 34

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7.684700	85.76169	-0.089605	0.9292
WGT^2	64.20016	96.11160	0.667975	0.5093
X^2*WGT^2	0.006306	0.003431	1.838317	0.0759
X*WGT^2	-1.247222	1.163558	-1.071903	0.2923

R-squared	0.427334	Mean dependent var	247.0857
Adjusted R-squared	0.370067	S.D. dependent var	435.4791
S.E. of regression	345.6323	Akaike info criterion	14.63876
Sum squared resid	3583851.	Schwarz criterion	14.81833
Log likelihood	-244.8589	Hannan-Quinn criter.	14.70000
F-statistic	7.462185	Durbin-Watson stat	1.586012
Prob(F-statistic)	0.000712		

从上图中可以看出，nR^2=14.52935，比较计算的 χ^2 统计量的临界值，因为 nR^2=14.52935> $\chi^2_{0.05}(2)$=5.9915，所以拒绝原假设，不拒绝备择假设，表明模型存在异方差。此模型并未消除异方差。

③当权数 w3=1/sqr(x) 时，用软件分析得：

Dependent Variable: Y
Method: Least Squares
Date: 12/24/15 Time: 21:06
Sample: 1 34
Included observations: 34
Weighting series: W3

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	0.778551	0.015677	49.66347	0.0000
C	40.45770	14.57528	2.775775	0.0091

Weighted Statistics

R-squared	0.987192	Mean dependent var	776.3266
Adjusted R-squared	0.986792	S.D. dependent var	367.3152
S.E. of regression	79.19828	Akaike info criterion	11.63881
Sum squared resid	200715.8	Schwarz criterion	11.72859
Log likelihood	-195.8597	Hannan-Quinn criter.	11.66943
F-statistic	2466.460	Durbin-Watson stat	1.178340
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.977590	Mean dependent var	1295.802
Adjusted R-squared	0.976890	S.D. dependent var	1188.791
S.E. of regression	180.7210	Sum squared resid	1045123.
Durbin-Watson stat	1.460832		

得方程模型为：

Y=0.778551X+40.45770

t=（49.66347 ）（2.775775 ）

R^2=0.986792 F=2466.460 DW=1.178340

对所得模型进行 White 检验：

Heteroskedasticity Test: White

F-statistic	8.158958	Prob. F(2,31)	0.0014
Obs*R-squared	11.72514	Prob. Chi-Square(2)	0.0028
Scaled explained SS	28.08353	Prob. Chi-Square(2)	0.0000

Test Equation:

Dependent Variable: WGT_RESID^2

Method: Least Squares

Date: 12/24/15 Time: 21:23

Sample: 1 34

Included observations: 34

Collinear test regressors dropped from specification

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7585.186	5311.263	-1.428132	0.1633
WGT^2	2468.369	1996.041	1.236632	0.2255
X^2*WGT^2	0.009139	0.002481	3.684177	0.0009

R-squared	0.344857	Mean dependent var	5903.405
Adjusted R-squared	0.302590	S.D. dependent var	13934.64
S.E. of regression	11636.97	Akaike info criterion	21.64586
Sum squared resid	4.20E+09	Schwarz criterion	21.78054
Log likelihood	-364.9796	Hannan-Quinn criter.	21.69179
F-statistic	8.158958	Durbin-Watson stat	2.344068
Prob(F-statistic)	0.001423		

从上图中可以看出，nR^2=11.72514，比较计算的 χ^2 统计量的临界值，因为 nR^2=11.72514> $\chi^2$0.05（2）=5.9915，所以拒绝原假设，不拒绝备择假设，表明模型存在异方差。此模型并未消除异方差。

综上所述，用加权二乘法 w1 的效果最好，所以模型为：

得方程模型为：

Y=0.821013X-17.69318

t=（48.67993）（2.815926）

R^2=0.986676 F=2369.735 DW=0.605852

2）用对数模型法

用软件分析得：

Dependent Variable: LNY
Method: Least Squares
Date: 12/24/15 Time: 21:37
Sample: 1 34
Included observations: 34

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNX	0.946887	0.011228	84.33549	0.0000
C	0.201861	0.077905	2.591100	0.0143

R-squared	0.995521	Mean dependent var	6.687779
Adjusted R-squared	0.995381	S.D. dependent var	1.067124
S.E. of regression	0.072525	Akaike info criterion	-2.352753
Sum squared resid	0.168315	Schwarz criterion	-2.262967
Log likelihood	41.99680	Hannan-Quinn criter.	-2.322134
F-statistic	7112.475	Durbin-Watson stat	0.812150
Prob(F-statistic)	0.000000		

得到模型为：

LnY=0.946887 LNX+0.201861

对此模型进行 White 检验得：

Heteroskedasticity Test: White

F-statistic	1.003964	Prob. F(2,31)	0.3780
Obs*R-squared	2.068278	Prob. Chi-Square(2)	0.3555
Scaled explained SS	1.469638	Prob. Chi-Square(2)	0.4796

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 12/24/15 Time: 21:45

Sample: 1 34

Included observations: 34

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.039547	0.046759	0.845753	0.4042
LNX	-0.011601	0.014012	-0.827969	0.4140
LNX^2	0.000932	0.001028	0.906774	0.3715

R-squared	0.060832	Mean dependent var	0.004950
Adjusted R-squared	0.000240	S.D. dependent var	0.006365
S.E. of regression	0.006364	Akaike info criterion	-7.192271
Sum squared resid	0.001255	Schwarz criterion	-7.057592
Log likelihood	125.2686	Hannan-Quinn criter.	-7.146342
F-statistic	1.003964	Durbin-Watson stat	2.022904
Prob(F-statistic)	0.378027		

从上图中可以看出，$nR^2=2.068278$，比较计算的 χ^2 统计量的临界值，因为 $nR^2=2.068278<\chi^2_{0.05}(2)=5.9915$，所以接受原假设，此模型消除了异方差。

综合两种方法，改进后的模型最好为：

$$LnY=0.946887\ LNX+0.201861$$

(2)

1）考虑价格因素，首先用软件三者关系进行分析如下：

Dependent Variable: Y

Method: Least Squares

Date: 12/24/15   Time: 21:51

Sample: 1 34

Included observations: 34

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	0.741684	0.019905	37.26095	0.0000
P	0.235025	0.271701	0.865012	0.3937
C	43.41715	71.22946	0.609539	0.5466

R-squared	0.979911	Mean dependent var	1295.802
Adjusted R-squared	0.978615	S.D. dependent var	1188.791
S.E. of regression	173.8449	Akaike info criterion	13.23830
Sum squared resid	936883.7	Schwarz criterion	13.37298
Log likelihood	-222.0511	Hannan-Quinn criter.	13.28423
F-statistic	756.0627	Durbin-Watson stat	1.681521
Prob(F-statistic)	0.000000		

1）用 Goldfeld-Quanadt 检验如下：

①当样本为 1-13 时，进行回归分析：

Dependent Variable: P

Method: Least Squares

Date: 12/24/15   Time: 21:59

Sample: 1 13

Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	-0.170484	0.203868	-0.836247	0.4225
Y	0.458660	0.209755	2.186646	0.0536
C	59.50496	7.385841	8.056627	0.0000

R-squared	0.956255	Mean dependent var	135.3231
Adjusted R-squared	0.947506	S.D. dependent var	36.95380
S.E. of regression	8.466678	Akaike info criterion	7.309328
Sum squared resid	716.8464	Schwarz criterion	7.439701
Log likelihood	-44.51063	Hannan-Quinn criter.	7.282530
F-statistic	109.2993	Durbin-Watson stat	0.637181
Prob(F-statistic)	0.000000		

得$\sum e_{1i}^2$=716.8464

②当样本为 22-34 时，做回归分析得：

Dependent Variable: Y

Method: Least Squares

Date: 12/24/15 Time:22:07

Sample: 22 34

Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	0.641197	0.092678	6.918569	0.0000
P	-1.206222	1.114278	-1.082514	0.3044
C	795.6887	603.8605	1.317670	0.2170

R-squared	0.939696	Mean dependent var	2496.127
Adjusted R-squared	0.927635	S.D. dependent var	1022.591
S.E. of regression	275.0847	Akaike info criterion	14.27121
Sum squared resid	756715.7	Schwarz criterion	14.40158
Log likelihood	-89.76286	Hannan-Quinn criter.	14.24441
F-statistic	77.91291	Durbin-Watson stat	1.128778
Prob(F-statistic)	0.000001		

得$\sum e_{2i}^2$=756715.7

③根据 Goldfeld-Quanadt 检验， F统计量为：

F=$\sum e_{2i}^2 / \sum e_{1i}^2$ =756715.7/ 716.8464=1055.6176

在 α =0.05 水平下，分子分母的自由度均为 11，查分布表得临界值 $F_{0.05}$（10,10 ）=2.98，

因为 F=1055.6176> $F_{0.05}$（10,10 ）=2.98，所以拒绝原假设，此检验表明模型存在异方差。

2）用 White 检验，软件分析结果为：

Heteroskedasticity Test: White

F-statistic	7.312529	Prob. F(5,28)	0.0002
Obs*R-squared	19.25463	Prob. Chi-Square(5)	0.0017
Scaled explained SS	119.3072	Prob. Chi-Square(5)	0.0000

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 12/24/15 Time: 22:18

Sample: 1 34

Included observations: 34

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	79541.08	112647.3	0.706107	0.4860
X	209.4964	63.90400	3.278298	0.0028
X^2	-0.024133	0.010712	-2.252841	0.0323
X*P	-0.235137	0.106647	-2.204822	0.0358
P	-1175.326	1156.253	-1.016495	0.3181
P^2	1.637366	2.600020	0.629751	0.5340

R-squared	0.566313	Mean dependent var	27555.40
Adjusted R-squared	0.488869	S.D. dependent var	107990.9
S.E. of regression	77206.44	Akaike info criterion	25.50514
Sum squared resid	1.67E+11	Schwarz criterion	25.77450
Log likelihood	-427.5874	Hannan-Quinn criter.	25.59700
F-statistic	7.312529	Durbin-Watson stat	2.787044
Prob(F-statistic)	0.000171		

从上图中可以看出，nR^2=19.25463 ，比较计算的 χ^2 统计量的临界值，因为 nR^2=19.25463> $\chi^2$0.05（5）=11.0705 ，所以拒绝原假设，不拒绝备择假设，表明模型存在异方差。

2）修正

①建立对数模型，用软件分析如下：

Dependent Variable: LNY

Method: Least Squares

Date: 12/24/15 Time: 22:24

Sample: 1 34

Included observations: 34

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNX	0.939605	0.013645	68.86088	0.0000
LNP	0.026821	0.028454	0.942609	0.3532
C	0.108230	0.126322	0.856784	0.3981

R-squared	0.995646	Mean dependent var	6.687779
Adjusted R-squared	0.995365	S.D. dependent var	1.067124
S.E. of regression	0.072652	Akaike info criterion	-2.322188
Sum squared resid	0.163625	Schwarz criterion	-2.187509
Log likelihood	42.47720	Hannan-Quinn criter.	-2.276259
F-statistic	3544.292	Durbin-Watson stat	0.930109
Prob(F-statistic)	0.000000		

对此模型进行 White 检验：

Heteroskedasticity Test: White

F-statistic	3.523832	Prob. F(5,28)	0.0135
Obs*R-squared	13.13158	Prob. Chi-Square(5)	0.0222
Scaled explained SS	12.14373	Prob. Chi-Square(5)	0.0329

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 12/24/15 Time: 22:34

Sample: 1 34

Included observations: 34

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.422872	0.273746	1.544759	0.1336
LNX	0.080712	0.031833	2.535502	0.0171
LNX^2	-0.003917	0.003037	-1.289564	0.2078
LNX*LNP	-0.004955	0.005136	-0.964765	0.3429
LNP	-0.254992	0.129858	-1.963631	0.0596
LNP^2	0.026470	0.012675	2.088390	0.0460

R-squared	0.386223	Mean dependent var	0.004813
Adjusted R-squared	0.276620	S.D. dependent var	0.007286
S.E. of regression	0.006197	Akaike info criterion	-7.170690
Sum squared resid	0.001075	Schwarz criterion	-6.901332
Log likelihood	127.9017	Hannan-Quinn criter.	-7.078831
F-statistic	3.523832	Durbin-Watson stat	2.264261
Prob(F-statistic)	0.013502		

从上图中可以看出，nR^2=13.13158，比较计算的 χ^2 统计量的临界值，因为 nR^2=13.13158> $\chi^2_{0.05}(5)$=11.0705，所以拒绝原假设，不拒绝备择假设，表明模型存在异方差，所以此模型没有消除异方差。

②当 w1=1/x 时，用软件分析如下：

Dependent Variable: Y
Method: Least Squares
Date: 12/24/15 Time: 22:49
Sample: 1 34
Included observations: 34
Weighting series: W1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	0.723218	0.022965	31.49212	0.0000
P	0.719506	0.141085	5.099795	0.0000
C	-44.72084	13.11268	-3.410502	0.0018

Weighted Statistics

R-squared	0.992755	Mean dependent var	457.8505
Adjusted R-squared	0.992287	S.D. dependent var	41.70384
S.E. of regression	28.40494	Akaike info criterion	9.615100
Sum squared resid	25012.05	Schwarz criterion	9.749779
Log likelihood	-160.4567	Hannan-Quinn criter.	9.661030
F-statistic	2123.843	Durbin-Watson stat	1.298389
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.977704	Mean dependent var	1295.802
Adjusted R-squared	0.976266	S.D. dependent var	1188.791
S.E. of regression	183.1446	Sum squared resid	1039800.
Durbin-Watson stat	1.740795		

所得模型为：

Y=0.723218X+0.719506p-44.72084

对此模型进行 White 检验得：

Heteroskedasticity Test: White

F-statistic	2.088840	Prob. F(5,28)	0.0966
Obs*R-squared	9.236835	Prob. Chi-Square(5)	0.1000
Scaled explained SS	25.50696	Prob. Chi-Square(5)	0.0001

Test Equation:

Dependent Variable: WGT_RESID^2

Method: Least Squares

Date: 12/24/15 Time: 22:50

Sample: 1 34

Included observations: 34

Collinear test regressors dropped from specification

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3861.793	1068.806	3.613183	0.0012
WGT^2	3260.199	4309.988	0.756429	0.4557
X*WGT^2	13.72241	8.453473	1.623287	0.1157
X*P*WGT^2	-0.151725	0.061588	-2.463567	0.0202
P^2*WGT^2	0.431162	0.278315	1.549186	0.1326
P*WGT^2	-76.13221	73.40636	-1.037134	0.3085

R-squared	0.271672	Mean dependent var	735.6486
Adjusted R-squared	0.141613	S.D. dependent var	1924.655
S.E. of regression	1783.177	Akaike info criterion	17.96897
Sum squared resid	89032169	Schwarz criterion	18.23832
Log likelihood	-299.4724	Hannan-Quinn criter.	18.06082
F-statistic	2.088840	Durbin-Watson stat	2.336495
Prob(F-statistic)	0.096616		

因为 nR^2=9.236835< $\chi^2$0.05 （5） =11.0705 ， 所以接受原假设。该模型不存在异方差，所以此模型消除了异方差。

③当 $w2=1/x^2$，用软件分析得：

Dependent Variable: Y
Method: Least Squares
Date: 12/24/15 Time: 23:00
Sample: 1 34
Included observations: 34
Weighting series: W2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	0.639012	0.039216	16.29477	0.0000
P	1.200751	0.206023	5.828234	0.0000
C	-81.85973	15.77499	-5.189209	0.0000

Weighted Statistics

R-squared	0.991614	Mean dependent var	230.2433
Adjusted R-squared	0.991073	S.D. dependent var	247.1718
S.E. of regression	11.37136	Akaike info criterion	7.784170
Sum squared resid	4008.543	Schwarz criterion	7.918849
Log likelihood	-129.3309	Hannan-Quinn criter.	7.830100
F-statistic	1832.775	Durbin-Watson stat	1.167961
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.956816	Mean dependent var	1295.802
Adjusted R-squared	0.954030	S.D. dependent var	1188.791
S.E. of regression	254.8849	Sum squared resid	2013955.
Durbin-Watson stat	1.002870		

所得模型为：

Y=0.639012X+1.200751p-81.85973

对该模型进行 White 检验得：

Heteroskedasticity Test: White

F-statistic	43.19853	Prob. F(6,27)	0.0000
Obs*R-squared	30.79235	Prob. Chi-Square(6)	0.0000
Scaled explained SS	47.42430	Prob. Chi-Square(6)	0.0000

Test Equation:

Dependent Variable: WGT_RESID^2

Method: Least Squares

Date: 12/26/15 Time: 07:20

Sample: 1 34

Included observations: 34

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	27.51002	20.12556	1.366919	0.1829
WGT^2	-1245.193	837.2352	-1.487268	0.1485
X^2*WGT^2	0.007732	0.005450	1.418649	0.1674
X*WGT^2	7.948582	4.884597	1.627275	0.1153
X*P*WGT^2	-0.111755	0.064061	-1.744525	0.0924
P^2*WGT^2	0.184342	0.164562	1.120199	0.2725
P*WGT^2	-3.127017	23.56724	-0.132685	0.8954

R-squared	0.905657	Mean dependent var	117.8983
Adjusted R-squared	0.884692	S.D. dependent var	230.3570
S.E. of regression	78.22224	Akaike info criterion	11.73823
Sum squared resid	165205.4	Schwarz criterion	12.05248
Log likelihood	-192.5498	Hannan-Quinn criter.	11.84539
F-statistic	43.19853	Durbin-Watson stat	1.794799
Prob(F-statistic)	0.000000		

因为 nR^2=30.79235> $\chi^2$0.05（5）=11.0705，所以拒绝原假设，不拒绝备择假设，表明模型存在异方差，所以此模型没有消除异方差。

④当 w3=1/sqr(x) 时，用软件分析得：

Dependent Variable: Y
Method: Least Squares
Date: 12/26/15 Time: 07:34
Sample: 1 34
Included observations: 34
Weighting series: W3

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	0.744661	0.019825	37.56252	0.0000
P	0.451861	0.179971	2.510739	0.0175
C	-13.49643	25.37768	-0.531823	0.5986

Weighted Statistics

R-squared	0.989356	Mean dependent var	776.3266
Adjusted R-squared	0.988670	S.D. dependent var	367.3152
S.E. of regression	73.35237	Akaike info criterion	11.51252
Sum squared resid	166797.7	Schwarz criterion	11.64720
Log likelihood	-192.7129	Hannan-Quinn criter.	11.55845
F-statistic	1440.783	Durbin-Watson stat	1.599590
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.979407	Mean dependent var	1295.802
Adjusted R-squared	0.978079	S.D. dependent var	1188.791
S.E. of regression	176.0098	Sum squared resid	960362.6
Durbin-Watson stat	1.761225		

所得模型为：

Y=0.744661X+0.451861p-13.49643

对所得模型进行 White 检验得：

Heteroskedasticity Test: White

F-statistic	4.459272	Prob. F(5,28)	0.0041
Obs*R-squared	15.07219	Prob. Chi-Square(5)	0.0101
Scaled explained SS	72.39077	Prob. Chi-Square(5)	0.0000

Test Equation:

Dependent Variable: WGT_RESID^2

Method: Least Squares

Date: 12/26/15 Time: 07:43

Sample: 1 34

Included observations: 34

Collinear test regressors dropped from specification

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	61163.22	27531.93	2.221538	0.0346
WGT^2	28251.98	17350.39	1.628320	0.1147
X^2*WGT^2	-0.001093	0.006624	-0.164950	0.8702
X*P*WGT^2	-0.235836	0.077110	-3.058447	0.0049
P^2*WGT^2	1.236884	0.644872	1.918030	0.0654
P*WGT^2	-503.3080	262.5884	-1.916718	0.0655

R-squared	0.443300	Mean dependent var	4905.814
Adjusted R-squared	0.343889	S.D. dependent var	16926.97
S.E. of regression	13710.96	Akaike info criterion	22.04856
Sum squared resid	5.26E+09	Schwarz criterion	22.31792
Log likelihood	-368.8256	Hannan-Quinn criter.	22.14042
F-statistic	4.459272	Durbin-Watson stat	2.450171
Prob(F-statistic)	0.004103		

因为 nR^2=15.07219> $\chi^2$0.05 （5）=11.0705 ，所以拒绝原假设，不拒绝备择假设，表明模型存在异方差，所以此模型没有消除异方差。

综上所述，修改后的模型为：

Y= Y=0.723218X+0.719506p-44.72084

t=(31.49212) (5.099705) (-3.410502)

R^2=0.992755 F=2123.843 DW=1.298389

(3) 体会：对于不同的模型，可采取对数模型法或者加权二乘法对具有异方差性的模型进行改进，从而消除异方差。但对于不同的模型，自由度的不同，可能导致改进的方法不同，所

以要对改进的模型进行进一步的检验才行。

6.1

(1) 建立居民收入 -消费模型，用 Eviews 分析结果如下：

Dependent Variable: Y

Method: Least Squares

Date: 12/26/15 Time: 08:22

Sample: 1 19

Included observations: 19

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	0.690488	0.012877	53.62068	0.0000
C	79.93004	12.39919	6.446390	0.0000

R-squared	0.994122	Mean dependent var	700.2747
Adjusted R-squared	0.993776	S.D. dependent var	246.4491
S.E. of regression	19.44245	Akaike info criterion	8.872095
Sum squared resid	6426.149	Schwarz criterion	8.971510
Log likelihood	-82.28490	Hannan-Quinn criter.	8.888920
F-statistic	2875.178	Durbin-Watson stat	0.574663
Prob(F-statistic)	0.000000		

所得模型为：

$Y=0.690488X+79.93004$

$Se=(0.012877)(12.39919)$

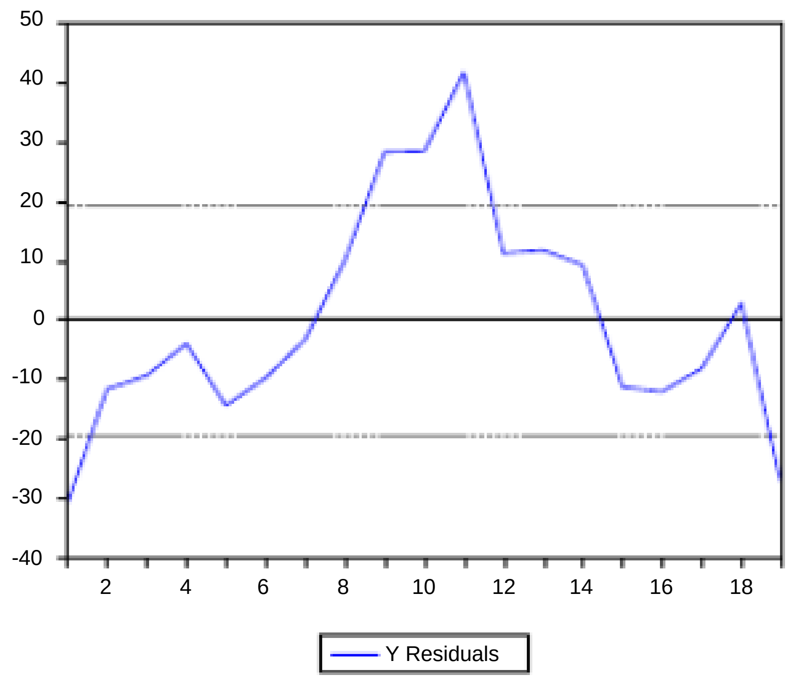
$t=(53.62068)(6.446390)$

$R^2=0.994122$ $F=2875.178$ $DW=0.574663$

（2）

1）检验模型中存在的问题

①做出残差图如下：



残差的变动有系统模式，连续为正和连续为负，表明残差项存在一阶自相关。

②该回归方程可决系数较高，回归系数均显著。对样本量为 19，一个解释变量的模型，5% 的显著水平，查 DW 统计表可知，d_L=1.180，d_U=1.401，模型中 DW=0.574663,< d_L,显然模型中有自相关。

③对模型进行 BG 检验，用 Eviews 分析结果如下：

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	4.811108	Prob. F(2,15)	0.0243
Obs*R-squared	7.425088	Prob. Chi-Square(2)	0.0244

Test Equation:

Dependent Variable: RESID

Method: Least Squares

Date: 12/26/15 Time: 08:27

Sample: 1 19

Included observations: 19

Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X	-0.003275	0.010787	-0.303586	0.7656
C	1.929546	10.35593	0.186323	0.8547
RESID(-1)	0.608886	0.292707	2.080189	0.0551
RESID(-2)	0.089988	0.291120	0.309110	0.7615

R-squared	0.390794	Mean dependent var	-1.65E-13
Adjusted R-squared	0.268953	S.D. dependent var	18.89466
S.E. of regression	16.15518	Akaike info criterion	8.587023
Sum squared resid	3914.848	Schwarz criterion	8.785852
Log likelihood	-77.57671	Hannan-Quinn criter.	8.620672
F-statistic	3.207406	Durbin-Watson stat	1.570723
Prob(F-statistic)	0.053468		

如上表显示，LM=TR2=7.425088，其 p 值为 0.0244，表明存在自相关。

2）对模型进行处理：

①采取广义差分法

a)为估计自相关系数 ρ。对 e_t进行滞后一期的自回归，用 EViews 分析结果如下：

Dependent Variable: E

Method: Least Squares

Date: 12/26/15 Time: 08:34

Sample (adjusted): 2 19

Included observations: 18 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
E(-1)	0.657352	0.177626	3.700759	0.0018

R-squared	0.440747	Mean dependent var	1.717433
Adjusted R-squared	0.440747	S.D. dependent var	17.85134
S.E. of regression	13.34980	Akaike info criterion	8.074833
Sum squared resid	3029.692	Schwarz criterion	8.124298
Log likelihood	-71.67349	Hannan-Quinn criter.	8.081653
Durbin-Watson stat	1.634573		

由上可知， ρ =0.657352

b)对原模型进行广义差分回归，用 Eviews 进行分析所得结果如下：

Dependent Variable: Y-0.657352*Y(-1)

Method: Least Squares

Date: 12/26/15 Time: 08:41

Sample (adjusted): 2 19

Included observations: 18 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	35.97761	8.103546	4.439737	0.0004
X-0.657352*X(-1)	0.668695	0.020642	32.39512	0.0000

R-squared	0.984983	Mean dependent var	278.1002
Adjusted R-squared	0.984044	S.D. dependent var	105.1781
S.E. of regression	13.28570	Akaike info criterion	8.115693
Sum squared resid	2824.158	Schwarz criterion	8.214623
Log likelihood	-71.04124	Hannan-Quinn criter.	8.129334
F-statistic	1049.444	Durbin-Watson stat	1.830746
Prob(F-statistic)	0.000000		

由上图可知回归方程为：

$Y_t^*=35.97761+0.668695X_t^*$

Se=(8.103546)(0.020642)

t=(4.439737)(32.39512)

R^2=0.984983 F=1049.444 DW=1.830746

式中，$Y_t^*=Y_t-0.657352Y_{t-1}$, $X_t^*=X_t-0.657352X_{t-1}$

由于使用了广义差分数据，样本容量减少了 1 个，为 18 个。查 5% 显著水平的 DW 统计表可知，d_L=1.158,d_U=1.391 模型中 DW=1,830746 ，d_u<DW<4- d_U, 说明在 5% 的显著水平下广义差分模型中已无自相关。可决系数 R2，t，F 统计量也均达到理想水平。

由差分方程，β_1=35.97761/(1-0.657352)=104.9987

由此最终的消费模型为：

$Y_t=104.9987+0.668695X_t$

②用科克伦 - 奥克特迭代法，用 EVIews 分析结果如下：

Dependent Variable: Y

Method: Least Squares

Date: 12/26/15 Time: 09:45

Sample (adjusted): 2 19

Included observations: 18 after adjustments

Convergence achieved after 5 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	104.0449	23.87618	4.357687	0.0006
X	0.669262	0.020831	32.12757	0.0000
AR(1)	0.630015	0.164218	3.836462	0.0016

R-squared	0.997097	Mean dependent var	719.1867
Adjusted R-squared	0.996710	S.D. dependent var	238.9866
S.E. of regression	13.70843	Akaike info criterion	8.224910
Sum squared resid	2818.814	Schwarz criterion	8.373306
Log likelihood	-71.02419	Hannan-Quinn criter.	8.245372
F-statistic	2575.896	Durbin-Watson stat	1.787878
Prob(F-statistic)	0.000000		

Inverted AR Roots	.63

所得方程为：

$Y_t=104.0449+0.669262X_t$

（3）经济意义：人均实际收入每增加 1 元，平均说来人均时间消费支出将增加 0.669262 元。

6.4

（1）

1）针对对数模型，用 Eviews 分析结果如下：

Dependent Variable: LNY

Method: Least Squares

Date: 12/26/15 Time: 10:03

Sample: 1980 2000

Included observations: 21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNX	0.951090	0.038897	24.45123	0.0000
C	2.171041	0.241025	9.007529	0.0000

R-squared	0.969199	Mean dependent var	8.039307
Adjusted R-squared	0.967578	S.D. dependent var	0.565486
S.E. of regression	0.101822	Akaike info criterion	-1.640785
Sum squared resid	0.196987	Schwarz criterion	-1.541307
Log likelihood	19.22825	Hannan-Quinn criter.	-1.619196
F-statistic	597.8626	Durbin-Watson stat	1.159788
Prob(F-statistic)	0.000000		

所得模型为：

lnY=0,951090lnX+2.171041

se=(0.038897) (0.241025)

t=(24.45123) (9.007529)

R^2=0.969199 F=597.8626 DW=1.159788

2）检验模型的自相关性

该回归方程可决系数较高，回归系数均显著。对样本量为 21，一个解释变量的模型， 5%的显著水平，查 DW 统计表可知， d_L=1.221， d_U=1.420，模型中 DW=1.159788< d_L,显然模型中有自相关。

(2) 用广义差分法处理模型：

1）为估计自相关系数 ρ。对 e_t 进行滞后一期的自回归，用 EViews 分析结果如下：

Dependent Variable: E
Method: Least Squares
Date: 12/26/15 Time: 10:18
Sample (adjusted): 1982 2000
Included observations: 19 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
E(-1)	-0.012872	0.280581	-0.045878	0.9639

R-squared	0.000073	Mean dependent var	-2.556737
Adjusted R-squared	0.000073	S.D. dependent var	397.7924
S.E. of regression	397.7778	Akaike info criterion	14.86086
Sum squared resid	2848090.	Schwarz criterion	14.91057
Log likelihood	-140.1782	Hannan-Quinn criter.	14.86927
Durbin-Watson stat	1.700254		

由上可知， ρ =-0.012872

2）对原模型进行广义差分回归，用 Eviews 进行分析所得结果如下：

Dependent Variable: Y+0.012872*Y(-1)
Method: Least Squares
Date: 12/26/15 Time: 10:25
Sample (adjusted): 1981 2000
Included observations: 20 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-104.9645	197.7928	-0.530679	0.6021
X+0.012872*X(-1)	6.653757	0.304157	21.87605	0.0000

R-squared	0.963751	Mean dependent var	3753.934
Adjusted R-squared	0.961737	S.D. dependent var	2045.606
S.E. of regression	400.1404	Akaike info criterion	14.91615
Sum squared resid	2882022.	Schwarz criterion	15.01572
Log likelihood	-147.1615	Hannan-Quinn criter.	14.93559
F-statistic	478.5614	Durbin-Watson stat	1.822259
Prob(F-statistic)	0.000000		

由上图可知回归方程为：

$Y_t^*=-104.9645+6.653757X_t^*$

Se=(197.7928)(0.304157)

t=(-0.530679)(21.87605)

R^2=0.963751 F=478.5614DW=1.8222596

式中， $Y_t^*=Y_t+0.012872Y_{t-1}$, $X_t^*=X_t+0.012872X_{t-1}$

由于使用了广义差分数据，样本容量减少了 1 个，为 20 个。查 5% 显著水平的 DW 统计表可知，$d_L=1.201, d_U=1.411$ 模型中 DW=1.8222596，$d_u<DW<4-d_U$，说明在 5% 的显著水平下广义差分模型中已无自相关。可决系数 R2，t，F 统计量也均达到理想水平。

由差分方程，$\beta_1=-104.9645/(1+0.012872)=-103.6306$

由此最终的模型为：

$Y_t=-103.6306+6.653757X_t$

（3）对于此模型，用 Eviews 分析结果如下：

Dependent Variable: LNY1

Method: Least Squares

Date: 12/26/15 Time: 10:32

Sample (adjusted): 1981 2000

Included observations: 20 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNX1	0.442224	0.066024	6.697901	0.0000
C	0.054047	0.013322	4.056896	0.0007

R-squared	0.713658	Mean dependent var	0.091592
Adjusted R-squared	0.697750	S.D. dependent var	0.098311
S.E. of regression	0.054049	Akaike info criterion	-2.903219
Sum squared resid	0.052583	Schwarz criterion	-2.803646
Log likelihood	31.03219	Hannan-Quinn criter.	-2.883781
F-statistic	44.86188	Durbin-Watson stat	1.590363
Prob(F-statistic)	0.000003		

由题目可知，此模型样本容量为 20，查 5% 显著水平的 DW 统计表可知，$d_L=1.201, d_U=1.411$ 模型中 DW=1.590363，$d_u<DW<4-d_U$，说明在 5% 的显著水平此模型中无自相关。可决系数 R2，t，F 统计量也均达到理想水平