Practical 12

Table below gives the hypothetical data on consumption expenditure and income perform the following test of heteroscedasticity and write your conclusion
(a) GQ test
(b) BPG test (c) Whites test
(d) KB test

Use C=4 for GQ test

Y	X
55	80
65	100
70	85
80	110
79	120
84	115
98	130
95	140
90	125
75	90
74	105
110	160
113	150
125	165
108	145
115	180
140	225
120	200
145	240
130	185
152	220
144	210
175	245
180	260
135	190
140	205
178	265
191	270
137	230
189	250

Workout

First of all we have to put our data in R

```r
x<-c(80,100,85,110,120,115,130,140,125,90,105,160,150,165,145,180,225,200,240,185,
     220,210,245,260,190,205,265,270,230,250)
y<-c(55,65,70,80,79,84,98,95,90,75,74,110,113,125,108,115,140,120,145,130,152,144,
     175,180,135,140,178,191,137,189)
n=30
c=4
```

Goldfed Quandt Test

```r
df<-data.frame(y,rep(1,30),x)
df <-df[order(df$x),]
df1<-as.matrix(df[1:13,])
df2<-as.matrix(df[18:30,])
```

Now we need to calculate RSS for both the model , so let us first calculate coefficients then RSS

```r
#For first subset
x1<-df1[,c(2,3)]
y1<-df1[,1]
beta1<-solve(t(x1)%*%x1)%*%t(x1)%*%y1
print(beta1)
```

```
##                  [,1]
## rep.1..30. 3.4094293
## x          0.6967742
```

```r
#for second subset
x2<-df2[,c(2,3)]
y2<-df2[,1]
beta2<-solve(t(x2)%*%x2)%*%t(x2)%*%y2
print(beta2)
```

```
##                    [,1]
## rep.1..30. -28.0271687
## x            0.7941373
```

Now RSS is given by

```r
RSS1<-t(y1-x1%*%beta1)%*%(y1-x1%*%beta1)
RSS2<-t(y2-x2%*%beta2)%*%(y2-x2%*%beta2)
print(RSS1)
```

```
##          [,1]
## [1,] 377.1663
```

```r
print(RSS2)
```

```
##        [,1]
## [1,] 1536.8
```

Now let us calculate F statistic

```r
degree_of_freedom<-length(y1)-length(beta1)
Fcal<-(RSS2/degree_of_freedom)/(RSS1/degree_of_freedom)
print(Fcal)
```

```
##          [,1]
## [1,] 4.074595
```

F tabulated can be calculated by at 5%

```r
Ftab<-qf(0.95,11,11)
print(Ftab)
```

```
## [1] 2.81793
```

THE BREUSCH–PAGAN–GODFREY (BPG) TEST

First of all we need to calculate error terms by gitting linear refression model , and then estimate the σ^2 by MLE

```r
l<-cbind(rep(1,30),x )
beta<-solve(t(l)%*%l)%*%t(l)%*%y
sigma_2<-(t(y-l%*%beta)%*%(y-l%*%beta))/30
u<-(y-l%*%beta)
print(sigma_2)
```

```
##          [,1]
## [1,] 78.70511
```

```r
print(u)
```

```
##               [,1]
##  [1,]  -5.31307205
##  [2,]  -8.06876320
##  [3,]   6.49800516
##  [4,]   0.55339122
##  [5,]  -6.82445435
##  [6,]   1.36446843
##  [7,]   5.79770007
##  [8,]  -3.58014551
##  [9,]   0.98662286
## [10,]   8.30908238
## [11,]  -2.25768599
```

```
## [12,]  -1.33583666
## [13,]   8.04200892
## [14,]  10.47524055
## [15,]   6.23093171
## [16,]  -9.09152781
## [17,] -12.79183290
## [18,] -16.84721896
## [19,] -17.35860127
## [20,]   2.71954940
## [21,]   2.39708989
## [22,]   0.77493546
## [23,]   9.45247594
## [24,]   4.88570758
## [25,]   4.53062661
## [26,]  -0.03614175
## [27,]  -0.30321521
## [28,]   9.50786200
## [29,] -18.98075569
## [30,]  20.26355316
```

Constructing p_i

```
p<-(u^2)/as.numeric(sigma_2)
beta_p<-solve(t(l)%*%l)%*%t(l)%*%p
print(beta_p)
```

```
##          [,1]
##   -0.74261366
## x  0.01006322
```

Now calclating ESS (Explained sum of square)

```
ESS<-t((l%*%beta_p)-mean(p))%*%((l%*%beta_p)-mean(p))
phi<-ESS/2
print(phi)
```

```
##          [,1]
## [1,] 5.214011
```

White's General Heteroscedasticity Test

We have already residual from previous , now we will regress $u_i = \alpha + \alpha_1 x + \alpha_2 x^2$

```
m<-cbind(l,l[,2]^2)
alpha<-solve(t(m)%*%m)%*%t(m)%*%u
print(alpha)
```

```
##            [,1]
##   14.0265375597
## x -0.1807263960
##    0.0005167469
```

```r
SSR<-(t(u-m%*%alpha)%*%(u-m%*%alpha))
SST<-(t(u-mean(u))%*%(u-mean(u)))
R_2<-1-(SSR/SST)
chi_2calc<-30*R_2
print(chi_2calc)
```

```
##           [,1]
## [1,] 0.8443091
```

Koenker–Bassett (KB) test

We have to regree u_i^2 by y^2

```r
u<-u^2
c<-y^2
summary(lm(u~c))
```

```
##
## Call:
## lm(formula = u ~ c)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -141.19  -66.34  -28.20   26.41  269.90
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 16.369395  37.690480   0.434   0.6674
## c            0.003943   0.002034   1.938   0.0628 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 107.6 on 28 degrees of freedom
## Multiple R-squared:  0.1183, Adjusted R-squared:  0.08677
## F-statistic: 3.755 on 1 and 28 DF,  p-value: 0.06279
```

Conclusion

(a)GQ test
We will F calculated is greater than F tabulated so we will reject the hypothesis of homoscedasticity and conclude tha variance of error term are not same
(b)BPG test
from the chi-square table we find that for 1 df the 5 percent critical chi-square value is 3.8414 and the1 percent critical χ^2 value is 6.6349. Thus, the observed chi-square value of 5.2140 is significant at the 5 percent but not the 1 percent level of significance
(c)Whites test
We got 0.8443091 and tabulated value at 1% is given by 0.0201007 hwnce we reject the null hypothesis at 1% significance level
(d)KB test
From the summary of lm we can conlude that we can reject null hypothesis by 0.1 significance