ECN 3972 **Lab Report #10**

Download the data file "abortion.xls" from D2L. Import it into R.

Use R to answer the following questions. You will need to turn in a printout of your work in R, your plots, and answers for each of the questions listed below. For any hypothesis test, you should provide the hypotheses, critical and calculated values, the decision rule, and the decision.

1. We're going to estimate the following model:

$$Abort_i = \beta_0 + \beta_1 P_i + \beta_2 Y_i + \beta_3 Picket_i + \varepsilon_i$$

where:

$Abort_i$ =	Number of abortions per 1,000 women ages 15-44 in state *i*
P_i =	Average price charged in non-hospital facilities for an abortion at 10 weeks with local anesthesia in state *i*
Y_i =	Disposable personal income in state *i*
$Picket_i$ =	Percentage of respondents in state *i* who reported experiencing picketing with physical contact or blocking of patients

```
Call:
lm(formula = Abort ~ P + Y + Picket, data = abortion)

Residuals:
   Min     1Q Median     3Q    Max
-9.706 -5.913 -0.082  4.387 17.869

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -5.8591609  8.8613429  -0.661  0.51178
P           -0.0451828  0.0216740  -2.085  0.04268 *
Y            0.0023900  0.0003801   6.288 1.07e-07 ***
Picket      -0.1089301  0.0387032  -2.814  0.00717 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 7.047 on 46 degrees of freedom
Multiple R-squared:  0.5392,  Adjusted R-squared:  0.5091
F-statistic: 17.94 on 3 and 46 DF,  p-value: 7.506e-08
```

2. We would expect β_2 to be positive and β_1 and β_3 to be negative. Test these hypotheses at the 5% level.

H_0: $\beta_1 \geq 0$ Reject H_0 if $|t_{calc}| > t_{crit}$ and $\beta_1 < 0$
H_1: $\beta_1 < 0$
df = N-K-1 = 50-3-1=46 $t_{calc} = -2.085$
$t_{crit} \approx 1.684$ Reject H_0

H_0: $\beta_2 \leq 0$ Reject H_0 if $|t_{calc}| > t_{crit}$ and $\beta_2 > 0$
H_1: $\beta_2 > 0$
df = N-K-1 = 50-3-1=46 $t_{calc} = 6.288$
$t_{crit} \approx 1.684$ Reject H_0

H_0: $\beta_3 \geq 0$ Reject H_0 if $|t_{calc}| > t_{crit}$ and $\beta_3 < 0$
H_1: $\beta_3 < 0$
df = N-K-1 = 50-3-1=46 $t_{calc} = -2.814$
$t_{crit} \approx 1.684$ Reject H_0

3. Perform the Breusch-Pagan test for heteroskedasticity (using a 5% level).

```
Call:
lm(formula = res2 ~ P + Y + Picket, data = abortion)

Residuals:
   Min     1Q Median     3Q    Max 
-69.58 -32.28 -15.37  12.84 183.65 

Coefficients:
              Estimate Std. Error t value Pr(>|t|)  
(Intercept) -1.393e+02  7.488e+01  -1.860   0.0693 .
P            3.353e-01  1.832e-01   1.831   0.0736 .
Y            6.085e-03  3.212e-03   1.895   0.0645 .
Picket      -6.544e-01  3.271e-01  -2.001   0.0513 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 59.55 on 46 degrees of freedom
Multiple R-squared:  0.2585,  Adjusted R-squared:  0.2101 
F-statistic: 5.345 on 3 and 46 DF,  p-value: 0.003043
```

H_0: $\alpha_1 = \alpha_2 = \alpha_3 = 0$ (homoskedasticity)
H_1: H_0 is false (heteroskedasticity)

$\chi^2_{crit} = 7.81$ Reject H_0 if $\chi^2_{calc} > \chi^2_{crit}$
$\chi^2_{calc} = N \times R^2 = (50)(0.2585) = 12.925$ Reject H_0 and conclude we have heteroskedasticity

4. Perform the White test for heteroskedasticity (using a 5% level).

```
Call:
lm(formula = res2 ~ P + Y + Picket + p2 + y2 + picket2 + P *
    Y + P * Picket + Y * Picket, data = abortion)

Residuals:
    Min      1Q  Median      3Q     Max
-77.285 -27.654  -9.529  15.874 177.052

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -2.944e+02  5.866e+02  -0.502   0.6185
P            1.470e+00  2.599e+00   0.565   0.5749
Y           -1.145e-02  3.282e-02  -0.349   0.7290
Picket       4.710e+00  3.677e+00   1.281   0.2076
p2          -6.549e-03  3.964e-03  -1.652   0.1064
y2          -3.782e-07  1.102e-06  -0.343   0.7332
picket2      7.192e-03  1.119e-02   0.643   0.5242
P:Y          1.581e-04  1.103e-04   1.433   0.1596
P:Picket    -2.203e-03  6.643e-03  -0.332   0.7420
Y:Picket    -2.916e-04  1.672e-04  -1.744   0.0888 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 58.24 on 40 degrees of freedom
Multiple R-squared:  0.3833,  Adjusted R-squared:  0.2446
F-statistic: 2.763 on 9 and 40 DF,  p-value: 0.01298
```

H_0: $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = \alpha_7 = \alpha_8 = \alpha_9 = 0$ (homoskedasticity)
H_1: H_0 is false (heteroskedasticity)

$\chi^2_{crit} = 16.92$ Reject H_0 if $\chi^2_{calc} > \chi^2_{crit}$

$\chi^2_{calc} = N \times R^2 = (50)(0.3833) = 19.165$ Reject H_0 and conclude we have heteroskedasticity

5. If you find heteroskedasticity, get White-corrected standard errors and t-statistics for the coefficients in the model.

```
t test of coefficients:

               Estimate  Std. Error t value  Pr(>|t|)
(Intercept) -5.85916086 10.08465730 -0.5810   0.56408
P           -0.04518284  0.02622471 -1.7229   0.09162 .
```

```
Y          0.00238998  0.00041293  5.7878 6.016e-07 ***
Picket    -0.10893011  0.04300072 -2.5332   0.01478 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

6. Redo the hypothesis tests you performed in (2) with the White-corrected standard errors.

H_0: $\beta_1 \geq 0$ Reject H_0 if $|t_{calc}| > t_{crit}$ and $\beta_1 < 0$
H_1: $\beta_1 < 0$
df = N-K-1 = 50-3-1=46 $t_{calc} = -1.7229$
$t_{crit} \approx 1.684$ Reject H_0

H_0: $\beta_2 \leq 0$ Reject H_0 if $|t_{calc}| > t_{crit}$ and $\beta_2 > 0$
H_1: $\beta_2 > 0$
df = N-K-1 = 50-3-1=46 $t_{calc} = 5.7878$
$t_{crit} \approx 1.684$ Reject H_0

H_0: $\beta_3 \geq 0$ Reject H_0 if $|t_{calc}| > t_{crit}$ and $\beta_3 < 0$
H_1: $\beta_3 < 0$
df = N-K-1 = 50-3-1=46 $t_{calc} = -2.5332$
$t_{crit} \approx 1.684$ Reject H_0

7. Any changes in your conclusions?

Not this time, but the t-statistics did get smaller.