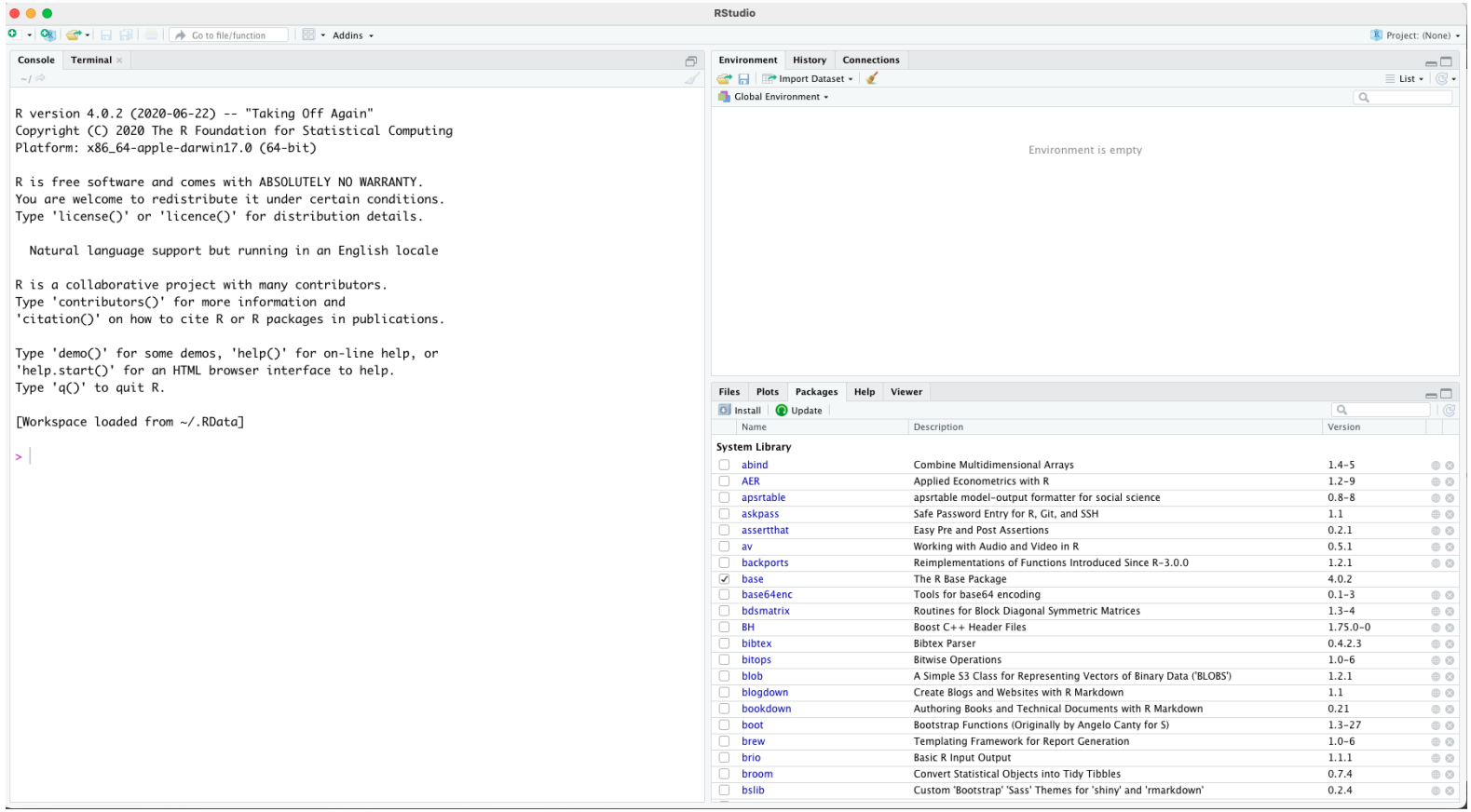
6.5 Practical Econometrics from Chapter 6

1. Open R through R-studio. Your console should look like this



2. Install data from the package wooldridge. It loads all the datasets we require in R.

```
> install.packages("wooldridge")
trying URL 'https://cran.rstudio.com/bin/macosx/contrib/4.0/wooldridge_1.3.1.tgz'
Content type 'application/x-gzip' length 5327836 bytes (5.1 MB)
==================================================
downloaded 5.1 MB


The downloaded binary packages are in
        /var/folders/7_/q3lln33j0zx59nf_8s24t8d00000gn/T//Rtmpai01yd/downloaded_packages
```

3. Load the *BWGHT* dataset from the package called wooldridge and then have a look at the data. You should get something like this

bwght

Filter

	faminc	cigtax	cigprice	bwght	fatheduc	motheduc	parity	male	white	cigs	lbwght	bwghtlbs
1	13.5	16.5	122.3	109	12	12	1	1	1	0	4.691348	6.8125
2	7.5	16.5	122.3	133	6	12	2	1	0	0	4.890349	8.3125
3	0.5	16.5	122.3	129	NA	12	2	0	0	0	4.859812	8.0625
4	15.5	16.5	122.3	126	12	12	2	1	0	0	4.836282	7.8750
5	27.5	16.5	122.3	134	14	12	2	1	1	0	4.897840	8.3750
6	7.5	16.5	122.3	118	12	14	6	1	0	0	4.770685	7.3750
7	65.0	16.5	122.3	140	16	14	2	0	1	0	4.941642	8.7500
8	27.5	16.5	122.3	86	12	14	2	0	0	0	4.454347	5.3750
9	27.5	16.5	122.3	121	12	17	2	0	1	0	4.795791	7.5625
10	37.5	16.5	122.3	129	16	18	2	0	1	0	4.859812	8.0625
11	27.5	16.5	122.3	101	12	16	2	1	0	0	4.615120	6.3125
12	27.5	16.5	122.3	133	16	15	1	1	1	0	4.890349	8.3125
13	6.5	16.5	122.3	61	NA	12	3	1	0	0	4.110874	3.8125
14	10.5	16.5	122.3	104	12	12	1	1	1	0	4.644391	6.5000
15	12.5	16.5	122.3	92	7	12	1	1	0	0	4.521789	5.7500
16	17.5	16.5	122.3	122	13	13	1	1	1	0	4.804021	7.6250
17	42.5	16.5	122.3	159	18	16	1	1	1	0	5.068904	9.9375
18	4.5	16.5	122.3	154	NA	11	1	0	0	0	5.036952	9.6250

Showing 1 to 18 of 1,388 entries, 14 total columns

Console Terminal

```
Type 'q()' to quit R.

[Workspace loaded from ~/.RData]

> install.packages("wooldridge")
trying URL 'https://cran.rstudio.com/bin/macosx/contrib/4.0/wooldridge_1.3.1.tgz'
Content type 'application/x-gzip' length 5327836 bytes (5.1 MB)
==================================================
downloaded 5.1 MB


The downloaded binary packages are in
        /var/folders/7_/q3lln33j0zx59nf_8s24t8d00000gn/T//RtmpcQT024/downloaded_packages
> library(wooldridge)
> data('bwght')
> View(bwght)
```

4. Lets try and recreate Table [6.1]

```
> summary(lm(bwght ~ cigs + faminc, bwght))

Call:
lm(formula = bwght ~ cigs + faminc, data = bwght)

Residuals:
    Min      1Q  Median      3Q     Max
-96.061 -11.543   0.638  13.126 150.083

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 116.97413    1.04898 111.512  < 2e-16 ***
cigs         -0.46341    0.09158  -5.060 4.75e-07 ***
faminc        0.09276    0.02919   3.178  0.00151 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 20.06 on 1385 degrees of freedom
Multiple R-squared:  0.0298,    Adjusted R-squared:  0.0284
F-statistic: 21.27 on 2 and 1385 DF,  p-value: 7.942e-10
```

5. Changing the birth weight from ounces to lbs

```
> summary(lm(bwghtlbs ~ cigs + faminc, bwght))

Call:
lm(formula = bwghtlbs ~ cigs + faminc, data = bwght)

Residuals:
    Min      1Q  Median      3Q     Max
-6.0038 -0.7215  0.0399  0.8204  9.3802

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  7.310883   0.065562 111.512  < 2e-16 ***
cigs        -0.028963   0.005724  -5.060 4.75e-07 ***
faminc       0.005798   0.001824   3.178  0.00151 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.254 on 1385 degrees of freedom
Multiple R-squared:  0.0298,    Adjusted R-squared:  0.0284
F-statistic: 21.27 on 2 and 1385 DF,  p-value: 7.942e-10
```

6. Changing the birth weight back to ounces, but now we change independent variable to packs of cigs

```
> summary(lm(bwght ~ packs + faminc, bwght))

Call:
lm(formula = bwght ~ packs + faminc, data = bwght)

Residuals:
    Min      1Q  Median      3Q     Max
-96.061 -11.543   0.638  13.126 150.083

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 116.97413    1.04898 111.512  < 2e-16 ***
packs        -9.26815    1.83154  -5.060 4.75e-07 ***
faminc        0.09276    0.02919   3.178  0.00151 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 20.06 on 1385 degrees of freedom
Multiple R-squared:  0.0298,    Adjusted R-squared:  0.0284
F-statistic: 21.27 on 2 and 1385 DF,  p-value: 7.942e-10
```

7. Obtaining SST, SSE and SSR from the regressions

```
> fit = lm(bwght ~ cigs + faminc, bwght)
> SST = sum(( bwght$bwght - mean(bwght$bwght))^2 )
> SST
[1] 574611.7
> SSE = sum(fitted(fit) - mean(bwght$bwght))^2 )
Error: unexpected ')' in "SSE = sum(fitted(fit) - mean(bwght$bwght))^2 )"
> SSE = sum((fitted(fit) - mean(bwght$bwght))^2 )
> SSE
[1] 17126.21
> SSR = sum((bwght$bwght - fitted(fit))^2 )
> SSR
[1] 557485.5
> SSE + SSR
[1] 574611.7
```

8. Lets try and recreate example [6.19]

```
> mod = lm(stndfnl ~ atndrte + I(ACT*ACT)+ACT + I(priGPA*priGPA) + priGPA * atndrte, attend)
> summary(mod)

Call:
lm(formula = stndfnl ~ atndrte + I(ACT * ACT) + ACT + I(priGPA *
    priGPA) + priGPA * atndrte, data = attend)

Residuals:
    Min      1Q  Median      3Q     Max
-3.1698 -0.5316 -0.0177  0.5737  2.3344

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)         2.050293   1.360319   1.507 0.132225
atndrte            -0.006713   0.010232  -0.656 0.512005
I(ACT * ACT)        0.004533   0.002176   2.083 0.037634 *
ACT                -0.128039   0.098492  -1.300 0.194047
I(priGPA * priGPA)  0.295905   0.101049   2.928 0.003523 **
priGPA             -1.628540   0.481003  -3.386 0.000751 ***
atndrte:priGPA      0.005586   0.004317   1.294 0.196173
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.8729 on 673 degrees of freedom
Multiple R-squared:  0.2287,    Adjusted R-squared:  0.2218
F-statistic: 33.25 on 6 and 673 DF,  p-value: < 2.2e-16
```

9. Calculating APE for priGPA using two manual methods.

Note: You should try and do these manual methods in excel or R in order to get clarity about what is being done. One representative example might be done in class.

```
> #Long Method
> APE = -1.63  + 2 * (0.296) * attend$priGPA + 0.0056 * attend$atndrte
> mean(APE)
[1] 0.3589443
> #Short method
> APE = -1.63  + 2 * (0.296) * mean(attend$priGPA) + 0.0056 * mean(attend$atndrte)
> APE
[1] 0.3589443
```

10. Another method using the margins package.

```
> library("margins")
Error in library("margins") : there is no package called ‘margins’
> install.packages("margins")
also installing the dependency ‘prediction’

trying URL 'https://cran.rstudio.com/bin/macosx/contrib/4.0/prediction_0.3.14.tgz'
Content type 'application/x-gzip' length 234608 bytes (229 KB)
==================================================
downloaded 229 KB

trying URL 'https://cran.rstudio.com/bin/macosx/contrib/4.0/margins_0.3.26.tgz'
Content type 'application/x-gzip' length 1642088 bytes (1.6 MB)
==================================================
downloaded 1.6 MB


The downloaded binary packages are in
        /var/folders/7_/q3lln33j0zx59nf_8s24t8d00000gn/T//RtmpcQT024/downloaded_packages
> library("margins")
> marg1 <- margins(mod)
> summary(marg1)
  factor    AME     SE      z      p  lower  upper
     ACT 0.0761 0.0112 6.7914 0.0000 0.0541 0.0980
 atndrte 0.0077 0.0026 2.9384 0.0033 0.0026 0.0129
  priGPA 0.3588 0.0778 4.6121 0.0000 0.2063 0.5112
```

11. C5 Chapter 4 using data on MLB1

(a) Use the model estimated in equation (4.31) and drop the variable rbisyr. What happens to the statistical significance of hrunsyr? What about the size of the coefficient on hrunsyr? Recall the model:

$$\begin{aligned} log(salary) =& \beta_0 + \beta_1 years + \beta_2 gamesyr + \beta_3 bavg \\ &+ \beta_4 hrunsyr + \beta_5 rbisyr \end{aligned}$$

```
> mymodel = lm(lsalary ~ years + gamesyr + bavg + hrunsyr + rbisyr, mlb1)
> summary(mymodel)

Call:
lm(formula = lsalary ~ years + gamesyr + bavg + hrunsyr + rbisyr,
    data = mlb1)

Residuals:
     Min       1Q   Median       3Q      Max
-3.02508 -0.45034 -0.04013  0.47014  2.68924

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 1.119e+01  2.888e-01  38.752  < 2e-16 ***
years       6.886e-02  1.211e-02   5.684 2.79e-08 ***
gamesyr     1.255e-02  2.647e-03   4.742 3.09e-06 ***
bavg        9.786e-04  1.104e-03   0.887    0.376
hrunsyr     1.443e-02  1.606e-02   0.899    0.369
rbisyr      1.077e-02  7.175e-03   1.500    0.134
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7266 on 347 degrees of freedom
Multiple R-squared:  0.6278,    Adjusted R-squared:  0.6224
F-statistic: 117.1 on 5 and 347 DF,  p-value: < 2.2e-16
```

```
> mymodelc4 = lm(lsalary ~ years + gamesyr + bavg + hrunsyr, mlb1)
> summary(mymodelc4)

Call:
lm(formula = lsalary ~ years + gamesyr + bavg + hrunsyr, data = mlb1)

Residuals:
    Min      1Q  Median      3Q     Max
-3.0642 -0.4614 -0.0271  0.4654  2.7216

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 11.020912   0.265719  41.476  < 2e-16 ***
years        0.067732   0.012113   5.592 4.55e-08 ***
gamesyr      0.015759   0.001564  10.079  < 2e-16 ***
bavg         0.001419   0.001066   1.331    0.184
hrunsyr      0.035943   0.007241   4.964 1.08e-06 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7279 on 348 degrees of freedom
Multiple R-squared:  0.6254,    Adjusted R-squared:  0.6211
F-statistic: 145.2 on 4 and 348 DF,  p-value: < 2.2e-16
```

(b) Add the variables *runsyr* (runs per year), *fldperc* (fielding percentage), and *sbasesyr* (stolen bases per year) to the model from part (a). Which of these factors are individually significant?

(c) In the model from part (b), test the joint significance of bavg, fldperc, and sbasesyr

```
> mymodelc4b = lm(lsalary ~ years + gamesyr + bavg + hrunsyr + runsyr + fldperc + sbasesyr, mlb1)
> summary(mymodelc4b)

Call:
lm(formula = lsalary ~ years + gamesyr + bavg + hrunsyr + runsyr +
    fldperc + sbasesyr, data = mlb1)

Residuals:
     Min       1Q   Median       3Q      Max
-2.11554 -0.44557 -0.08808  0.48731  2.57872

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 10.4082680  2.0032546   5.196 3.50e-07 ***
years        0.0699848  0.0119756   5.844 1.18e-08 ***
gamesyr      0.0078995  0.0026775   2.950 0.003391 **
bavg         0.0005296  0.0011038   0.480 0.631656
hrunsyr      0.0232106  0.0086392   2.687 0.007566 **
runsyr       0.0173922  0.0050641   3.434 0.000666 ***
fldperc      0.0010351  0.0020046   0.516 0.605936
sbasesyr    -0.0064191  0.0051842  -1.238 0.216479
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7176 on 345 degrees of freedom
Multiple R-squared:  0.639,     Adjusted R-squared:  0.6317
F-statistic: 87.25 on 7 and 345 DF,  p-value: < 2.2e-16
```

12. Prediction Intervals:

```
> mymodel = lm(colgpa ~ hsize + I(hsize * hsize) + hsperc + sat + female + athlete, gpa2)
> summary(mymodel)

Call:
lm(formula = colgpa ~ hsize + I(hsize * hsize) + hsperc + sat +
    female + athlete, data = gpa2)

Residuals:
     Min       1Q   Median       3Q      Max
-2.69216 -0.34954  0.03416  0.38806  1.90159

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)       1.241e+00  7.949e-02  15.616  < 2e-16 ***
hsize            -5.685e-02  1.635e-02  -3.477 0.000512 ***
I(hsize * hsize)  4.675e-03  2.249e-03   2.079 0.037722 *
hsperc           -1.321e-02  5.728e-04 -23.068  < 2e-16 ***
sat               1.646e-03  6.682e-05  24.640  < 2e-16 ***
female            1.549e-01  1.800e-02   8.602  < 2e-16 ***
athlete           1.693e-01  4.235e-02   3.998  6.5e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.5544 on 4130 degrees of freedom
Multiple R-squared:  0.2925,    Adjusted R-squared:  0.2915
F-statistic: 284.6 on 6 and 4130 DF,  p-value: < 2.2e-16
```

13. The Model in example 6.5

```
> mymodel = lm(colgpa ~ hsize + I(hsize * hsize) + hsperc + sat , gpa2)
> summary(mymodel)

Call:
lm(formula = colgpa ~ hsize + I(hsize * hsize) + hsperc + sat,
    data = gpa2)

Residuals:
     Min       1Q   Median       3Q      Max
-2.57543 -0.35081  0.03342  0.39945  1.81683

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)       1.493e+00  7.534e-02  19.812  < 2e-16 ***
hsize            -6.088e-02  1.650e-02  -3.690 0.000228 ***
I(hsize * hsize)  5.460e-03  2.270e-03   2.406 0.016191 *
hsperc           -1.386e-02  5.610e-04 -24.698  < 2e-16 ***
sat               1.492e-03  6.521e-05  22.886  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.5599 on 4132 degrees of freedom
Multiple R-squared:  0.2781,    Adjusted R-squared:  0.2774
F-statistic:   398 on 4 and 4132 DF,  p-value: < 2.2e-16
```

14. Prediction interval method 1:

```
> gpa2$sat0 = gpa2$sat - 1200
> View(gpa2)
> View(gpa2)
> gpa2$hsperc0 = gpa2$hsperc - 30
> gpa2$hsize0 = gpa2$hsize - 5
> gpa2$hsizesq0 = I(gpa2$hsize*gpa2$hsize) - 25
> mymodel = lm(colgpa ~ hsize0 + hsizesq0 + hsperc0 + sat0, gpa2)
> summary(mymodel)

Call:
lm(formula = colgpa ~ hsize0 + hsizesq0 + hsperc0 + sat0, data = gpa2)

Residuals:
     Min       1Q   Median       3Q      Max
-2.57543 -0.35081  0.03342  0.39945  1.81683

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.700e+00  1.988e-02 135.833  < 2e-16 ***
hsize0      -6.088e-02  1.650e-02  -3.690 0.000228 ***
hsizesq0     5.460e-03  2.270e-03   2.406 0.016191 *
hsperc0     -1.386e-02  5.610e-04 -24.698  < 2e-16 ***
sat0         1.492e-03  6.521e-05  22.886  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.5599 on 4132 degrees of freedom
Multiple R-squared:  0.2781,    Adjusted R-squared:  0.2774
F-statistic:   398 on 4 and 4132 DF,  p-value: < 2.2e-16
```