Chapter 11 - Further Issues in Using OLS with Time Series Data

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Exercise 11.1

Upload packages

```
library(tseries)
library(lmreg)
library(wooldridge)
```

Upload database

```
data<-wooldridge::hseinv

attach(data)
```

Use the data in HSEINV.RAW for this exercise.

(i) Find the first order autocorrelation in log(invpc). Now, find the autocorrelation after linearly detrending log(invpc). Do the same for log(price). Which of the two series may have a unit root?

```
linvpc.ts<-ts(linvpc, start=1947, end=1988, frequency = 1)

acf(linvpc.ts, pl=FALSE)
```

```
##
## Autocorrelations of series 'linvpc.ts', by lag
##
##      0      1      2      3      4      5      6      7      8      9     10
##  1.000  0.594  0.186 -0.099 -0.026  0.103  0.161  0.228  0.170  0.131  0.056
##     11     12     13     14     15     16
##  0.011  0.048  0.136  0.182  0.143  0.027
```

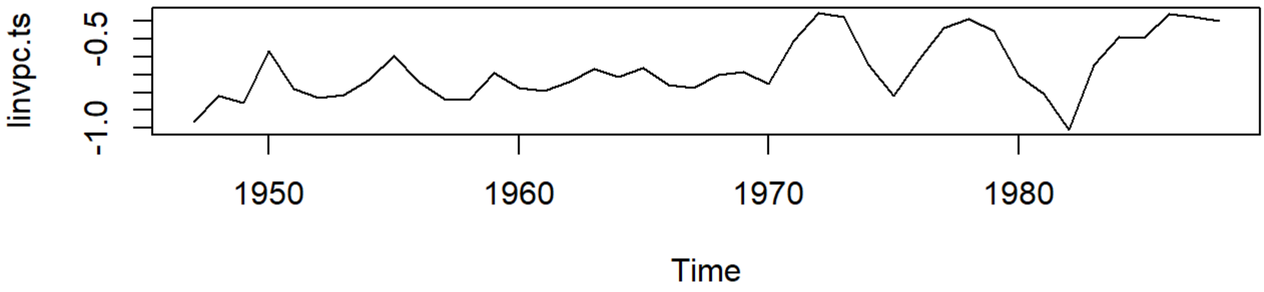
The first-order autocorrelation on `log(invpc)` is equal to 0.594.

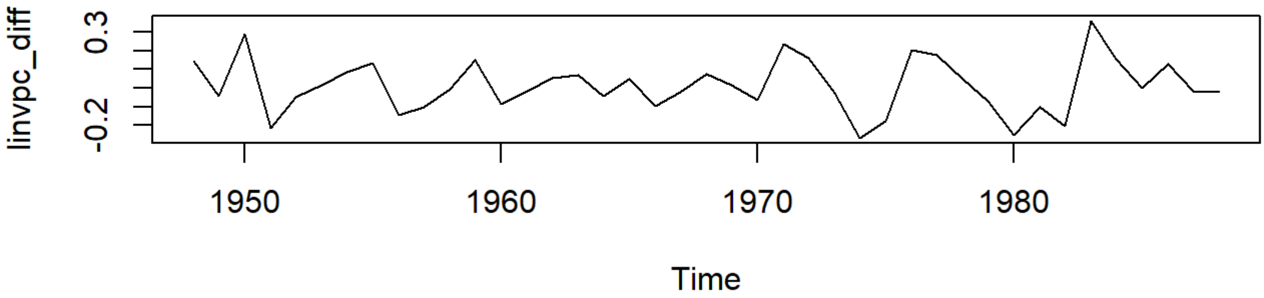
```
linvpc_diff<-diff(linvpc.ts) #Applying first-difference

acf(linvpc_diff, pl=FALSE)
```

```
##
## Autocorrelations of series 'linvpc_diff', by lag
##
##      0      1      2      3      4      5      6      7      8      9     10
##  1.000  0.042 -0.211 -0.385 -0.167  0.135  0.113  0.150 -0.014 -0.086 -0.115
##     11     12     13     14     15     16
## -0.116  0.033  0.096  0.057  0.037 -0.084
```

Now, the first order autocorrelations reduces from 0.594 to 0.042.

```
par(mfrow=c(2,1))

plot.ts(linvpc.ts)
plot.ts(linvpc_diff)
```






```
lprice.ts<-ts(lprice, start=1947, end=1988, frequency = 1)
```

ACF

```
acf(lprice.ts, pl=FALSE)
```

```
##
## Autocorrelations of series 'lprice.ts', by lag
##
##      0      1      2      3      4      5      6      7      8      9     10
##  1.000  0.896  0.810  0.708  0.635  0.568  0.494  0.428  0.339  0.260  0.191
##     11     12     13     14     15     16
##  0.132  0.071  0.026 -0.024 -0.088 -0.136
```

The first order autocorrelation on variable `log(price)` is equal to 0.896.

Detrending

```
lprice_diff<-diff(lprice.ts)
```

ACF

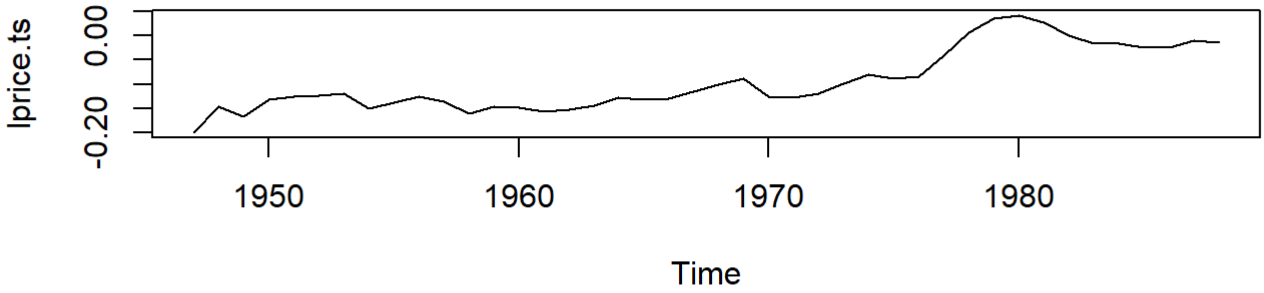
```
acf(lprice_diff, pl=FALSE)
```

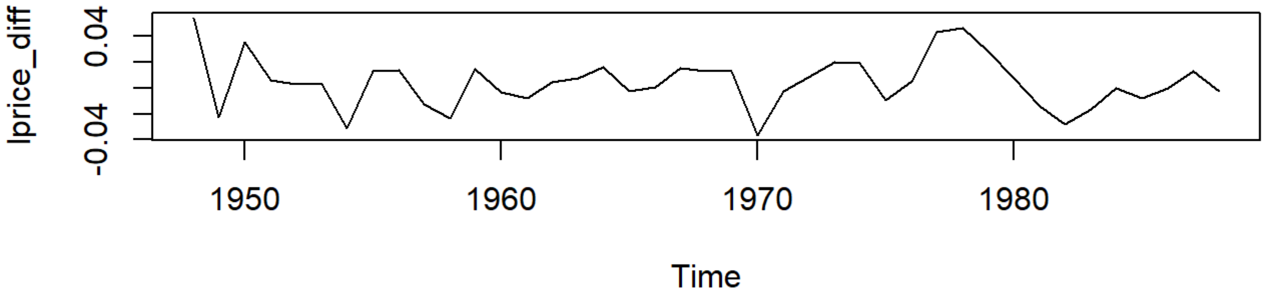
```
##
## Autocorrelations of series 'lprice_diff', by lag
##
##      0      1      2      3      4      5      6      7      8      9     10
##  1.000  0.122  0.033 -0.087 -0.101  0.057 -0.192 -0.166 -0.153 -0.035 -0.087
##     11     12     13     14     15     16
##  0.046  0.108  0.036 -0.005 -0.067  0.054
```

The first order autocorrelation reduces from 0.896 to 0.122.

Based on ACF analysis, both series seems to be integrated of order 1, hence, with presence of unit roots.

```
par(mfrow=c(2,1))

plot.ts(lprice.ts)
plot.ts(lprice_diff)
```





(ii) Based on your findings in part (i), estimate the equation

$$log(invpc)_t = \beta_0 + \beta_1 \Delta log(price)_t + \beta_2 t + u_t$$

and report the results in standard form. Interpret the coefficient $\hat{\beta}_1$ and determine whether it is statistically significant.

```
tt<-t[1:41]

summary(lm1<-lm(linvpc_diff~lprice_diff+tt))
```

```
##
## Call:
## lm(formula = linvpc_diff ~ lprice_diff + tt)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.30442 -0.08426 -0.01110  0.10516  0.38073
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 5.968e-03  4.626e-02   0.129    0.898
## lprice_diff 1.567e+00  1.139e+00   1.375    0.177
## tt          3.698e-05  1.897e-03   0.019    0.985
##
## Residual standard error: 0.1435 on 38 degrees of freedom
## Multiple R-squared:  0.04749,    Adjusted R-squared:  -0.002643
## F-statistic: 0.9473 on 2 and 38 DF,  p-value: 0.3968
```

The estimated model as a whole, its not significant, because the p-value of F-Statistic is equal to 0.396.