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

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30/03/2022

Exercise 11.2

Upload packages

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

Upload database

```
data<-wooldridge::earns

attach(data)
```

In Example 11.7, define the growth in hourly wage and output per hour as the change in the natural log: $ghrwage = \Delta log(hrwage)$ **and** $goutphr = \Delta log(outphr)$**. Consider a simple extension of the model estimated in (11.29):**

$$ghrwage_t = \beta_0 + \beta_1 goutphr_t + \beta_2 goutphr_{t-1} + u_t$$

This allows an increase in productivity growth to have both a current and lagged effect on wage growth

(i) Estimate the equation using the data in EARNS.RAW and report the results in standard form. Is the lagged value of `goutphr` statistically significant?

```
summary(lm1<-lm(ghrwage~goutphr+goutph_1))
```

```
##
## Call:
## lm(formula = ghrwage ~ goutphr + goutph_1)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.034130 -0.012160 -0.000451  0.007516  0.034636
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) -0.010425   0.004544  -2.294 0.027713 *
## goutphr      0.728364   0.167222   4.356 0.000105 ***
## goutph_1     0.457635   0.165613   2.763 0.008959 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.01554 on 36 degrees of freedom
##   (2 observations deleted due to missingness)
## Multiple R-squared:  0.4931, Adjusted R-squared:  0.465
## F-statistic: 17.51 on 2 and 36 DF,  p-value: 4.878e-06
```

The estimated equation is expressed as follows

$$\widehat{ghrwage}_t = -0.01 + 0.728 goutphr_t + 0.457 goutphr_{t-1}$$

The estimated coefficient associated to the lagged variable $goutphr_{t-1}$ is equal to 0.457 and have statistical significance at the 1% level.

(ii) If $\beta_1 + \beta_2 = 1$, a permanent increase in productivity growth is fully passed on in higher wage growth after one year. Test $H_0 : \beta_1 + \beta_2 = 1$ against the two-sided alternative. Remember, one way to do this is to write the equation so that $\theta = \beta_1 + \beta_2$ appears directly in the model, as in Example 10.4 from Chapter 10.

```
linearHypothesis(lm1, c("goutphr+goutph_1=1"))
```

```
## Linear hypothesis test
##
## Hypothesis:
## goutphr  + goutph_1 = 1
##
## Model 1: restricted model
## Model 2: ghrwage ~ goutphr + goutph_1
##
##   Res.Df       RSS Df  Sum of Sq      F Pr(>F)
## 1     37 0.0088950
## 2     36 0.0086926  1 0.00020243 0.8383  0.366
```

It's not possible to reject the null hypothesis that $\beta_1 + \beta_2 = 1$ because the p-value associated to the F-Test is equal to 0.366>0.050.

(iii) Does $goutphr_{t-2}$ need to be in the model? Explain.

```
summary(lm2<-lm(ghrwage~goutphr+goutph_1+goutph_2))
```

```
##
## Call:
## lm(formula = ghrwage ~ goutphr + goutph_1 + goutph_2)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.029659 -0.011734  0.001379  0.006884  0.034995
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) -0.011284   0.004841  -2.331   0.0258 *
## goutphr      0.746427   0.161504   4.622 5.28e-05 ***
## goutph_1     0.374046   0.166531   2.246   0.0313 *
## goutph_2     0.065349   0.159707   0.409   0.6850
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.01493 on 34 degrees of freedom
##   (3 observations deleted due to missingness)
## Multiple R-squared:  0.5151, Adjusted R-squared:  0.4724
## F-statistic: 12.04 on 3 and 34 DF,  p-value: 1.583e-05
```

In terms of statistical significance, its not necessary to include the variable `goutphr_{t-2}` to the model.