Chapter 10 - Basic Regression Analysis with Time Series Data

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Exercise 10.2

Upload packages

```
library(lmreg)
library(wooldridge)
library(car)
library(forecast)
library(seastests)
```

Upload database

```
data1<-wooldridge::barium
```

Use the data in BARIUM.RAW for this exercise.

(i) Add a linear time trend to equation (10.22). Are any variables, other than the trend, statistically significant?

```
lm1<-lm(lchnimp~lchempi+lgas+lrtwex+
          befile6+affile6+afdec6+t, data1)

summary(lm1)
```

```
##
## Call:
## lm(formula = lchnimp ~ lchempi + lgas + lrtwex + befile6 + affile6 +
##     afdec6 + t, data = data1)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.94317 -0.31168  0.03172  0.36366  1.21218
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) -2.367526  20.782165  -0.114  0.90949
## lchempi     -0.686236   1.239711  -0.554  0.58089
## lgas         0.465679   0.876178   0.531  0.59604
## lrtwex       0.078224   0.472440   0.166  0.86876
## befile6      0.090470   0.251289   0.360  0.71945
## affile6      0.097006   0.257313   0.377  0.70683
## afdec6      -0.351502   0.282542  -1.244  0.21584
## t            0.012706   0.003844   3.305  0.00124 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.5748 on 123 degrees of freedom
## Multiple R-squared:  0.3616, Adjusted R-squared:  0.3252
## F-statistic: 9.951 on 7 and 123 DF,  p-value: 8.358e-10
```

In this case, the only variable statisticaly significant is the time trend, `t` , at the 1% level.

(ii) In the equation estimated in part (i), test for joint significance of all variables except the time trend. What do you conclude?

```
# Vector of restriction to test if all coefficients but t are equal to zero

rest<-c("lchempi=0","lgas=0","lrtwex=0","befile6=0","affile6=0","afdec6=0" )

car::linearHypothesis(lm1, rest)
```

```
## Linear hypothesis test
##
## Hypothesis:
## lchempi = 0
## lgas = 0
## lrtwex = 0
## befile6 = 0
## affile6 = 0
## afdec6 = 0
##
## Model 1: restricted model
## Model 2: lchnimp ~ lchempi + lgas + lrtwex + befile6 + affile6 + afdec6 +
##     t
##
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1    129 41.709
## 2    123 40.638  6     1.071 0.5402 0.7767
```

```
summary(lm1)$fstatistic
```

```
##      value      numdf      dendf
##   9.951138   7.000000 123.000000
```

It´s not possible to reject the null hypothesis that coefficients are equal to 0 because the p-value=0.77>0.05.

(iii) Add monthly dummy variables to this equation and test for seasonality. Does including the monthly dummies change any other estimates or their standard errors in important ways?

```
# Creating month dummies

data1[paste0("M", 1:12)] <- as.data.frame(t(sapply(data1$Month, tabulate, 12)))

lm2<-lm(lchnimp~lchempi+lgas+lrtwex+
          befile6+affile6+afdec6+feb+mar+apr+may+jun+jul+aug+
          sep+oct+nov+dec, data1)

summary(lm2)
```

```
##
## Call:
## lm(formula = lchnimp ~ lchempi + lgas + lrtwex + befile6 + affile6 +
##     afdec6 + feb + mar + apr + may + jun + jul + aug + sep +
##     oct + nov + dec, data = data1)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.98535 -0.36207  0.07366  0.41786  1.37734
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 16.778769  32.428650   0.517   0.6059
## lchempi      3.265060   0.492930   6.624 1.24e-09 ***
## lgas        -1.278121   1.389008  -0.920   0.3594
## lrtwex       0.663050   0.471304   1.407   0.1622
## befile6      0.139702   0.266808   0.524   0.6016
## affile6      0.012632   0.278687   0.045   0.9639
## afdec6      -0.521301   0.301950  -1.726   0.0870 .
## feb         -0.417709   0.304444  -1.372   0.1728
## mar          0.059053   0.264731   0.223   0.8239
## apr         -0.451483   0.268387  -1.682   0.0953 .
## may          0.033309   0.269242   0.124   0.9018
## jun         -0.206332   0.269252  -0.766   0.4451
## jul          0.003835   0.278767   0.014   0.9890
## aug         -0.157065   0.277993  -0.565   0.5732
## sep         -0.134161   0.267656  -0.501   0.6172
## oct          0.051692   0.266851   0.194   0.8467
## nov         -0.246260   0.262827  -0.937   0.3508
## dec          0.132837   0.271423   0.489   0.6255
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.6012 on 113 degrees of freedom
## Multiple R-squared:  0.3583, Adjusted R-squared:  0.2618
## F-statistic: 3.712 on 17 and 113 DF,  p-value: 1.282e-05
```

Implementation of seasonality test

```
fried(data1$chnimp , freq = 12, diff = T, residuals = F, autoarima = T)
```

```
## Test used:  Friedman rank
##
## Test statistic:  18.82
## P-value:  0.06448899
```

```
isSeasonal(data1$chnimp,freq=12, test="combined")
```

```
## [1] FALSE
```

According to above tests, the variable chinese imports (`chnimp`) do not show seasonality.