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

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Exercise 11.8

Upload packages

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

Upload database

```
data<-wooldridge::phillips

attach(data)
```

Use the data in PHILLIPS.RAW for this exercise.

(i) Estimate an AR(1) model for the unemployment rate. Use this equation to predict the unemployment rate for 2004. Compare this with the actual unemployment rate for 2004. (You can find this information in a recent Economic Report of the President.)

Transforming `unem` into ts object.

```
unem.ts<-ts(unem, start=1948, end=2003, frequency=1)
```

```
ndiffs(unem.ts)
```

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

```
summary(ar_1<-forecast::Arima(unem, order=c(1,1,0)))
```

```
## Series: unem
## ARIMA(1,1,0)
##
## Coefficients:
##          ar1
##       0.0294
## s.e.  0.1386
##
## sigma^2 = 1.133:  log likelihood = -80.97
## AIC=165.95   AICc=166.18   BIC=169.96
##
## Training set error measures:
##                       ME      RMSE      MAE       MPE     MAPE      MASE
## Training set 0.03828886 1.045305 0.77726 -0.8994061 13.53364 0.9804885
##                      ACF1
## Training set 0.004478139
```

Forecast 1-year ahead

```
forecast(ar_1, h=1)
```

```
##    Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 57       6.005872 4.641677 7.370067 3.919516 8.092228
```

The effective unemployment rate of USA in the year 2004 was equal to 5.53%. The forecast model predicts a rate equal to 6.00%. An error of forecast equal to 6.00-5.53=0.47%

(ii) Add a lag of inflation to the AR(1) model from part (i). Is `inf_t-1` statistically significant?

```
ar_2<-Arima(unem.ts, order=c(1,1,0), xreg = inf_1)
```

(iii) Use the equation from part (ii) to predict the unemployment rate for 2004. Is the result better or worse than in the model from part (i)?

```
for_inf_2004<-forecast(ar_2, xreg = inf)

for_inf_2004
```

```
##      Point Forecast        Lo 80      Hi 80        Lo 95       Hi 95
## 2004       6.685497   5.38782169   7.983172    4.70087390    8.670120
## 2005       5.726314   3.84919069   7.603438    2.85550141    8.597127
## 2006       5.984367   3.66694924   8.301785    2.44018241    9.528552
## 2007       6.665548   3.97899226   9.352104    2.55681555   10.774281
## 2008       6.046294   3.03552086   9.057067    1.44171394   10.650874
## 2009       5.932764   2.62944339   9.236084    0.88077116   10.984757
## 2010       5.922443   2.35045490   9.494431    0.45955865   11.385327
## 2011       5.808913   1.98709784   9.630728   -0.03604889   11.653875
## 2012       6.005010   1.94872574  10.061295   -0.19854154   12.208562
## 2013       6.190786   1.91286454  10.468708   -0.35173053   12.733303
## 2014       6.139182   1.65055315  10.627811   -0.72558341   13.003947
## 2015       5.922443   1.23256438  10.612322   -1.25010736   13.094993
## 2016       6.025652   1.14281129  10.908493   -1.44200845   13.493312
## 2017       5.953406   0.88494378  11.021868   -1.79813787   13.704949
## 2018       5.953406   0.70588450  11.200927   -2.07198541   13.978797
## 2019       5.984368   0.56369952  11.405037   -2.30582924   14.274566
## 2020       5.984368   0.39591391  11.572823   -2.56243519   14.531172
## 2021       6.015331   0.26398379  11.766678   -2.78059556   14.811258
## 2022       6.149503   0.23975090  12.059255   -2.88868282   15.187689
## 2023       6.170145   0.10612447  12.234165   -3.10397390   15.444263
## 2024       6.283675   0.06921458  12.498135   -3.22052183   15.787871
## 2025       6.417846   0.05650330  12.779189   -3.31098830   16.146681
## 2026       6.438488  -0.06642215  12.943398   -3.50991366   16.386890
## 2027       6.304316  -0.34106020  12.949693   -3.85891010   16.467543
## 2028       6.180466  -0.60246913  12.963400   -4.19313786   16.554069
## 2029       6.490093  -0.42766530  13.407851   -4.08970517   17.069891
## 2030       6.985496  -0.06450727  14.035500   -3.79655364   17.767546
## 2031       6.789399  -0.39041442  13.969212   -4.19117805   17.769976
## 2032       6.448809  -0.85850866  13.756127   -4.72676902   17.624387
## 2033       6.521055  -0.91157974  13.953691   -4.84617912   17.888290
## 2034       6.634585  -0.92128904  14.190460   -4.92112733   18.190298
## 2035       7.016459  -0.66067669  14.693594   -4.72470677   18.757625
## 2036       7.243519  -0.55299219  15.040030   -4.68021578   19.167253
## 2037       6.913250  -1.00083606  14.827336   -5.19030006   19.016800
## 2038       6.490093  -1.53984678  14.520032   -5.79063996   18.770825
## 2039       6.180466  -1.96367958  14.324611   -6.27492960   18.635861
## 2040       6.293996  -1.96277579  14.550767   -6.33364651   18.921638
## 2041       6.221749  -2.14613259  14.589631   -6.57582162   19.019320
## 2042       6.046294  -2.43124226  14.523830   -6.91897877   19.011566
## 2043       6.221749  -2.36404084  14.807539   -6.90908353   19.352582
## 2044       6.273354  -2.41934224  14.966050   -7.02097750   19.567685
## 2045       6.345600  -2.45270291  15.143903   -7.11024316   19.801443
## 2046       6.407525  -2.49513185  15.310183   -7.20791397   20.022965
## 2047       6.283675  -2.72212798  15.289477   -7.48951189   20.056861
## 2048       6.159824  -2.94795602  15.267604   -7.76932340   20.088971
## 2049       6.159824  -3.04880399  15.368452   -7.92355706   20.243205
## 2050       6.118540  -3.18984305  15.426923   -8.11740346   20.354484
## 2051       6.139182  -3.26789890  15.546263   -8.24770669   20.526071
## 2052       6.159824  -3.34492992  15.664577   -8.37644258   20.696090
## 2053       6.087577  -3.51385554  15.689010   -8.59654713   20.771702
## 2054       6.015331  -3.68181732  15.712480   -8.81517761   20.845840
## 2055       6.077257  -3.71467178  15.869185   -8.89820550   21.052719
## 2056       6.201107  -3.68469214  16.086907   -8.91791830   21.320133
## 2057       6.139182  -3.83960580  16.117970   -9.12205694   21.400421
```

```
## 2058          6.015331 -4.05558631 16.086248 -9.38680794 21.417470
## 2059          6.087577 -4.07463443 16.249789 -9.45418443 21.629339
```

```
plot(for_inf_2004)
```

Forecasts from Regression with ARIMA(1,1,0) errors
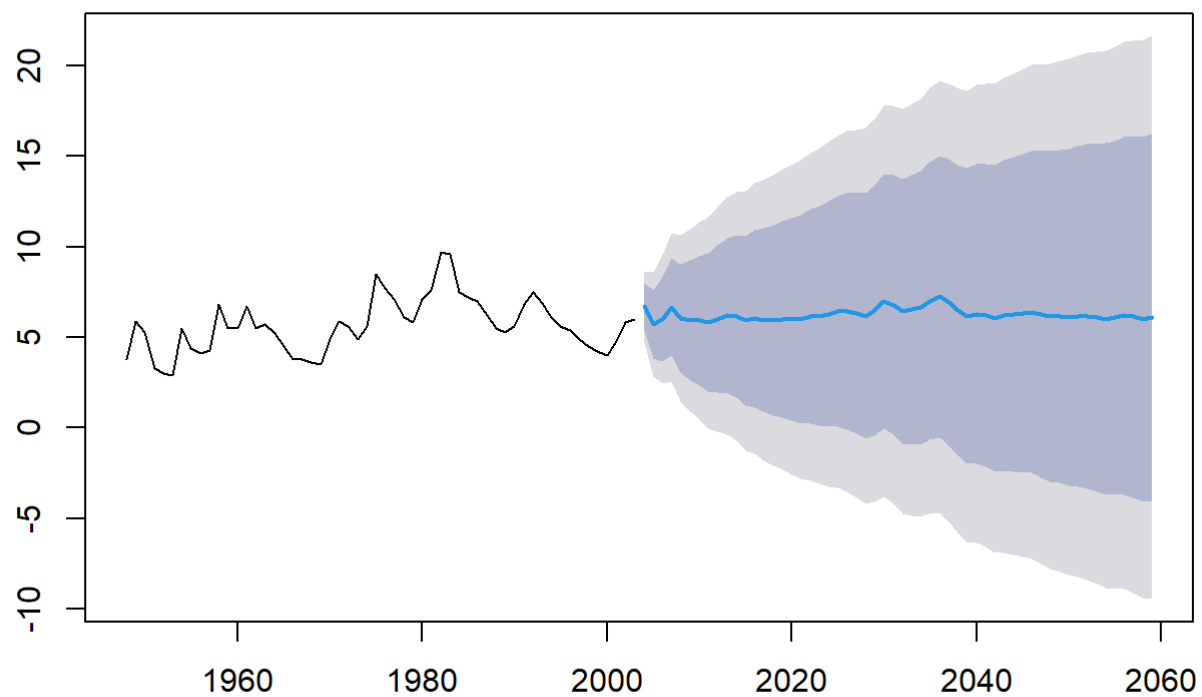
The unemployment forecasted is 6.68%, which means a larger value than before.