In-Class Lab 10

ECON 4223

September 28, 2023

The purpose of this in-class lab is to use R to practice estimating time series regression models with standard errors corrected for heteroskedasticity and serial correlation (HAC). To get credit, upload your .R script to the appropriate place on Canvas.

For starters

First, install the `pdfetch`, `tsibble`, and `sandwich` packages. `pdfetch` stands for "Public Data Fetch" and is a slick way of downloading statistics on stock prices, GDP, inflation, unemployment, etc. `tsibble` is a package useful for working with time series data. It is the "tibble" for time series data.

Open up a new R script (named `ICL10_XYZ.R`, where `XYZ` are your initials) and add the usual "preamble" to the top:

```
# Add names of group members HERE
library(tidyverse)
library(wooldridge)
library(broom)
library(car)
library(pdfetch)
library(magrittr)
library(lmtest)
library(sandwich)
library(tsibble)
```

Load the data

We're going to use data on US macroeconomic indicators. The `wooldridge` data set is called `intdef`.

```
df.ts <- as_tsibble(intdef, key=NULL, index=year)
```

Now it will be easy to include lags of various variables into our regression models.

Plot time series data

Let's have a look at the inflation rate for the US over the period 1948–2003:

```
ggplot(df.ts, aes(year, inf)) + geom_line()
```

Determinants of the interest rate

Now let's estimate the following regression model:

$$i3_t = \beta_0 + \beta_1 inf_t + \beta_2 inf_{t-1} + \beta_3 inf_{t-2} + \beta_4 def_t + u_t$$

where $i3$ is the 3-month Treasury Bill interest rate, inf is the inflation rate (as measured by the CPI), and def is the budget deficit as a percentage of GDP.

```
est <- lm(i3 ~ inf + lag(inf,1) + lag(inf,2) + def, data=df.ts)
```

1. Are any of these variables significant determinants of the interest rate? If so, which ones?

Correcting for Serial Correlation

Now let's compute HAC (Heteroskedasticity and Autocorrelation Consistent) standard errors. To do so, we'll use the `NeweyWest` option in the `coeftest()` function of the `lmtest` package.[1]

```
coeftest(est) # re-display baseline results
coeftest(est, vcov=NeweyWest)
```

2. How does your interpretation of the interest rate model change, using the Newey-West standard errors?

Another way to correct for serial correlation

Another way to get rid of serial correlation is to *difference* the data. In this case, we will estimate the following regression:

$$\Delta i3_t = \beta_0 + \beta_1 \Delta inf_t + \beta_2 \Delta inf_{t-1} + \beta_4 \Delta def_t + u_t$$

where $\Delta x_t = x_t - x_{t-1}$ for any variable x_t. Aside from addressing serial correlation, the differenced model also accounts for people's interest rate expectations.

```
est <- lm(difference(i3) ~ difference(inf) + lag(difference(inf),1)
          + lag(difference(inf),2) + difference(def), data=df.ts)
```

3. Compute the Newey-West SEs on the difference model. Are they much different from the baseline model?

4. What do you conclude about the effect of inflation on the *change in* the interest rate?

[1] `NeweyWest` comes from the `sandwich` package.