# Examples 5-4 & 5-5

September 12, 2020

[ ]:
```r
# install the following package and libraries
install.packages("plm")

library("plm")
library("lmtest")
library("sandwich")

# import the data, create the following formula, and run the pooled OLS model
data("Produc", package = "plm")
fm <- log(gsp) ~ log(pcap) + log(pc) + log(emp) + unemp
plmmod <- plm(fm, Produc, model = "pooling")
```

[2]:
```r
##---------------------------------Block 1---------------------------------

#### Example 5-4 ####

## ------------------------------------------------------------------------

# functions that calculate different covariance estimators
Vw <- function(x) vcovHC(x, method = "white1")
Vcx <- function(x) vcovHC(x, cluster = "group", method = "arellano")
Vct <- function(x) vcovHC(x, cluster = "time", method = "arellano")
Vcxt <- function(x) Vcx(x) + Vct(x) - Vw(x)
Vct.L <- function(x) vcovSCC(x, wj = function(j, maxlag) 1)
Vnw.L <- function(x) vcovNW(x)
Vscc.L <- function(x) vcovSCC(x)
Vcxt.L<- function(x) Vct.L(x) + Vcx(x) - vcovNW(x, wj = function(j, maxlag) 1)

## ------------------------------------------------------------------------
# put these different covariance estimates in a vector
vcovs <- c(vcov, Vw, Vcx, Vct, Vcxt, Vct.L, Vnw.L, Vscc.L, Vcxt.L)
names(vcovs) <- c("OLS", "Vw", "Vcx", "Vct", "Vcxt", "Vct.L", "Vnw.L",
                  "Vscc.L", "Vcxt.L")

## ------------------------------------------------------------------------

# create a table of all these estimates
```

```
cfrtab <- function(mod, vcovs, ...) {
    cfrtab <- matrix(nrow = length(coef(mod)), ncol = 1 + length(vcovs))
    dimnames(cfrtab) <- list(names(coef(mod)),
                             c("Coefficient", paste("s.e.", names(vcovs))))
    cfrtab[,1] <- coef(mod)
    for(i in 1:length(vcovs)) {
        myvcov = vcovs[[i]]
        cfrtab[ , 1 + i] <- sqrt(diag(myvcov(mod)))
        }
    return(t(round(cfrtab, 4)))
}

## ------------------------------------------------------------------------
cfrtab(plmmod, vcovs)
```

| | (Intercept) | log(pcap) | log(pc) | log(emp) | unemp |
|---|---|---|---|---|---|
| Coefficient | 1.6433 | 0.1550 | 0.3092 | 0.5939 | -0.0067 |
| s.e. OLS | 0.0576 | 0.0172 | 0.0103 | 0.0137 | 0.0014 |
| s.e. Vw | 0.0708 | 0.0185 | 0.0125 | 0.0195 | 0.0013 |
| s.e. Vcx | 0.2442 | 0.0601 | 0.0462 | 0.0686 | 0.0031 |
| s.e. Vct | 0.0944 | 0.0232 | 0.0063 | 0.0246 | 0.0018 |
| s.e. Vcxt | 0.2520 | 0.0617 | 0.0450 | 0.0702 | 0.0033 |
| s.e. Vct.L | 0.1875 | 0.0461 | 0.0079 | 0.0480 | 0.0031 |
| s.e. Vnw.L | 0.1144 | 0.0299 | 0.0206 | 0.0316 | 0.0020 |
| s.e. Vscc.L | 0.1503 | 0.0370 | 0.0076 | 0.0387 | 0.0025 |
| s.e. Vcxt.L | 0.2722 | 0.0657 | 0.0389 | 0.0736 | 0.0036 |

[3]:
```
##---------------------------------Block 2---------------------------------

#### Example 5-5 ####

# replication of the previous table now using random effects as the␣
 ↪specification

## ------------------------------------------------------------------------
replmmod <- plm(fm, Produc)
cfrtab(replmmod, vcovs)
```

| | log(pcap) | log(pc) | log(emp) | unemp |
|---|---|---|---|---|
| Coefficient | -0.0261 | 0.2920 | 0.7682 | -0.0053 |
| s.e. OLS | 0.0290 | 0.0251 | 0.0301 | 0.0010 |
| s.e. Vw | 0.0312 | 0.0305 | 0.0398 | 0.0011 |
| s.e. Vcx | 0.0603 | 0.0617 | 0.0817 | 0.0025 |
| s.e. Vct | 0.0454 | 0.0480 | 0.0627 | 0.0015 |
| s.e. Vcxt | 0.0688 | 0.0720 | 0.0949 | 0.0027 |
| s.e. Vct.L | 0.0640 | 0.0644 | 0.0941 | 0.0015 |
| s.e. Vnw.L | 0.0434 | 0.0417 | 0.0562 | 0.0015 |
| s.e. Vscc.L | 0.0575 | 0.0588 | 0.0828 | 0.0015 |
| s.e. Vcxt.L | 0.0717 | 0.0747 | 0.1054 | 0.0023 |