Exercise 12

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Exercise 12.1

In this exercise you will work with the `Guns` dataset, which contains observations on criminal and demographic variables for all US states in the years 1977-1999. You will need to load the package `AER`.

```
library(AER, quietly = T)
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
data("Guns")
```

a) Verify that Guns is a balanced panel: extract the number of years and states from the dataset and assign them to the predefined variables years and states, respectively. Afterwards use these variables for a logical comparison: check that the panel is balanced.

```
head(Guns)
```

```
##   year violent murder robbery prisoners     afam     cauc     male population
## 1 1977   414.4   14.2    96.8        83 8.384873 55.12291 18.17441   3.780403
## 2 1978   419.1   13.3    99.1        94 8.352101 55.14367 17.99408   3.831838
## 3 1979   413.3   13.2   109.5       144 8.329575 55.13586 17.83934   3.866248
## 4 1980   448.5   13.2   132.1       141 8.408386 54.91259 17.73420   3.900368
## 5 1981   470.5   11.9   126.5       149 8.483435 54.92513 17.67372   3.918531
## 6 1982   447.7   10.6   112.0       183 8.514000 54.89621 17.51052   3.925229
##     income   density   state law
## 1 9563.148 0.0745524 Alabama  no
## 2 9932.000 0.0755667 Alabama  no
## 3 9877.028 0.0762453 Alabama  no
## 4 9541.428 0.0768288 Alabama  no
## 5 9548.351 0.0771866 Alabama  no
## 6 9478.919 0.0773185 Alabama  no
```

```
summary(Guns)
```

```
##       year        violent           murder          robbery
##  1977   : 51   Min.   :  47.0   Min.   : 0.200   Min.   :   6.4
##  1978   : 51   1st Qu.: 283.1   1st Qu.: 3.700   1st Qu.:  71.1
##  1979   : 51   Median : 443.0   Median : 6.400   Median : 124.1
##  1980   : 51   Mean   : 503.1   Mean   : 7.665   Mean   : 161.8
##  1981   : 51   3rd Qu.: 650.9   3rd Qu.: 9.800   3rd Qu.: 192.7
##  1982   : 51   Max.   :2921.8   Max.   :80.600   Max.   :1635.1
##  (Other):867
```

```
##    prisoners           afam              cauc            male
##  Min.   :  19.0   Min.   : 0.2482   Min.   :21.78   Min.   :12.21
##  1st Qu.: 114.0   1st Qu.: 2.2022   1st Qu.:59.94   1st Qu.:14.65
##  Median : 187.0   Median : 4.0262   Median :65.06   Median :15.90
##  Mean   : 226.6   Mean   : 5.3362   Mean   :62.95   Mean   :16.08
##  3rd Qu.: 291.0   3rd Qu.: 6.8507   3rd Qu.:69.20   3rd Qu.:17.53
##  Max.   :1913.0   Max.   :26.9796   Max.   :76.53   Max.   :22.35
##
##    population          income         density                 state
##  Min.   : 0.4027   Min.   : 8555   Min.   : 0.000707   Alabama   :  23
##  1st Qu.: 1.1877   1st Qu.:11935   1st Qu.: 0.031911   Alaska    :  23
##  Median : 3.2713   Median :13402   Median : 0.081569   Arizona   :  23
##  Mean   : 4.8163   Mean   :13725   Mean   : 0.352038   Arkansas  :  23
##  3rd Qu.: 5.6856   3rd Qu.:15271   3rd Qu.: 0.177718   California:  23
##  Max.   :33.1451   Max.   :23647   Max.   :11.102120   Colorado  :  23
##                                                        (Other)   :1035
##   law
##  no :888
##  yes:285
##
##
##
##
##
```

```
years <- length(levels(Guns$year))
states <- length(levels(Guns$state))
years * states == nrow(Guns)
```

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

The data set is indeed balanced.

b) There is a controversial debate whether and if to what extent the right to carry a gun influences crime. Proponents of so-called "Carrying a Concealed Weapon" (CCW) laws argue that the deterrent effect of guns prevents crime, whereas opponents argue that the public availability of guns increases their usage and thus makes it easier to commit crimes. In the following exercises you will empirically investigate this topic. To begin with consider the following estimated model

$$log(\hat{v}_i) = 6.135 - 0.443 \cdot l_i \quad \text{with } i = 1, ..., 51$$

where v (violent feature) is the violent crime rate (incidents per 100'000 residents) and l (law feature) is a binary variable indicating the implementation of a CCW law (1 = yes, 0 = no), respectively.

i) Extend and estimate the model by including state fixed effects using the function `plm()` and assign the model object to the predefined variable `model.se`. Can you think of an unobserved variable that is captured by this model specification?

```
library(plm, quietly = T)
model.se <- plm(log(violent) ~ law, data = Guns, index = c('state', 'year'), model = 'within')
```

ii) Print a summary of the model which reports cluster robust standard errors.

```
coeftest(model.se, vcov. = vcovHC, type = 'HC1')
```

```
##
## t test of coefficients:
##
```

```
##        Estimate Std. Error t value Pr(>|t|)
## lawyes  0.11366        NaN     NaN      NaN
```

According to this model, having a law in effect increases the violent crime rate by 11.36%. However, we get NaN values for the standard error and p-value. Therefore, the interpretation of this value might not be very reliable.

iii) Test whether the fixed state effects are jointly significant from zero. To do so use the function `pFtest()`. Use `?pFtest` for additional information.

```
model = plm(log(violent) ~ law, data = Guns, index = c('state', 'year'), model = 'pooling')

# model.se -> fixed effects
# model -> no fixed effects
pFtest(model.se, model)
```

```
##
##  F test for individual effects
##
## data:  log(violent) ~ law
## F = 260.5, df1 = 50, df2 = 1121, p-value < 2.2e-16
## alternative hypothesis: significant effects
```

The p-value is below the significance level. Therefore, we reject the null hypothesis that there are no significant effects. The state fixed effects are significantly different from 0.