SEM

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Simultaneous Equation Model (SEM) using IV

we have 2 methods

①explicitly using IV

②コマンドのsystemfit

```
load("~/計量経済学演習/R data sets for 5e/mroz.RData")
mroz<-data
library(AER)
```

```
## Loading required package: car
```

```
## Loading required package: carData
```

```
## Loading required package: lmtest
```

```
## Loading required package: zoo
```

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

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

```
## Loading required package: sandwich
```

```
## Loading required package: survival
```

```
sampleset <- subset(mroz,!is.na(wage))
```

①

```
summary( ivreg(hours~log(wage)+educ+age+kidslt6+nwifeinc
        leduc+age+kidslt6+nwifeinc+exper+I(exper^2), data=sampleset))
```

```
##
## Call:
## ivreg(formula = hours ~ log(wage) + educ + age + kidslt6 + nwifeinc |
##     educ + age + kidslt6 + nwifeinc + exper + I(exper^2), data = sampleset)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4570.13  -654.08   -36.94   569.86  8372.91
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 2225.662    574.564   3.874 0.000124 ***
## log(wage)   1639.556    470.576   3.484 0.000545 ***
## educ        -183.751     59.100  -3.109 0.002003 **
## age           -7.806      9.378  -0.832 0.405664
## kidslt6     -198.154    182.929  -1.083 0.279325
## nwifeinc     -10.170      6.615  -1.537 0.124942
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1354 on 422 degrees of freedom
## Multiple R-Squared: -2.008,  Adjusted R-squared: -2.043
## Wald test: 3.441 on 5 and 422 DF,  p-value: 0.004648
```

```
summary( ivreg(log(wage)~hours+educ+exper+I(exper^2)
        |educ+age+kidslt6+nwifeinc+exper+I(exper^2), data=sampleset))
```

```
##
## Call:
## ivreg(formula = log(wage) ~ hours + educ + exper + I(exper^2) |
##     educ + age + kidslt6 + nwifeinc + exper + I(exper^2), data = sampleset)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.49800 -0.29307  0.03208  0.36486  2.45912
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -0.6557254  0.3377883  -1.941   0.0529 .
## hours        0.0001259  0.0002546   0.494   0.6212
## educ         0.1103300  0.0155244   7.107 5.08e-12 ***
## exper        0.0345824  0.0194916   1.774   0.0767 .
## I(exper^2)  -0.0007058  0.0004541  -1.554   0.1209
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.6794 on 423 degrees of freedom
## Multiple R-Squared: 0.1257,  Adjusted R-squared: 0.1174
## Wald test: 19.03 on 4 and 423 DF,  p-value: 2.108e-14
```

②

Define system of equations and instruments

```
#式2本登録してIVとして使う変数も登録
eq.hrs   <- hours    ~ log(wage)+educ+age+kidslt6+nwifeinc
eq.wage  <- log(wage)~ hours    +educ+exper+I(exper^2)
eq.system<- list(eq.hrs, eq.wage)
instrum  <- ~educ+age+kidslt6+nwifeinc+exper+I(exper^2)
```

```
library(systemfit)
```

```
## Loading required package: Matrix
```

```
##
## Please cite the 'systemfit' package as:
## Arne Henningsen and Jeff D. Hamann (2007). systemfit: A Package for Estimating Systems of Simultane
ous Equations in R. Journal of Statistical Software 23(4), 1-40. http://www.jstatsoft.org/v23/i04/.
##
## If you have questions, suggestions, or comments regarding the 'systemfit' package, please use a forum
or 'tracker' at systemfit's R-Forge site:
## https://r-forge.r-project.org/projects/systemfit/
```

```
summary(systemfit(eq.system,inst=instrum,data=sampleset,method="2SLS"))
```

```
##
## systemfit results
## method: 2SLS
##
##         N  DF       SSR detRCov   OLS-R2 McElroy-R2
## system 856 845 773893309  155089 -2.00762   0.748802
##
##      N  DF        SSR        MSE       RMSE       R2    Adj R2
## eq1 428 422 7.73893e+08 1.83387e+06 1354.204541 -2.007617 -2.043253
## eq2 428 423 1.95266e+02 4.61621e-01    0.679427  0.125654  0.117385
##
## The covariance matrix of the residuals
##            eq1         eq2
## eq1 1833869.938 -831.542690
## eq2    -831.543    0.461621
##
## The correlations of the residuals
##          eq1       eq2
## eq1  1.000000 -0.903769
## eq2 -0.903769  1.000000
##
##
## 2SLS estimates for 'eq1' (equation 1)
## Model Formula: hours ~ log(wage) + educ + age + kidslt6 + nwifeinc
## Instruments: ~educ + age + kidslt6 + nwifeinc + exper + I(exper^2)
##
##               Estimate Std. Error  t value   Pr(>|t|)
## (Intercept) 2225.66182  574.56412  3.87365 0.00012424 ***
## log(wage)   1639.55561  470.57568  3.48415 0.00054535 ***
## educ        -183.75128   59.09981 -3.10917 0.00200323 **
## age           -7.80609    9.37801 -0.83238 0.40566404
## kidslt6     -198.15429  182.92914 -1.08323 0.27932497
## nwifeinc     -10.16959    6.61474 -1.53741 0.12494167
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1354.204541 on 422 degrees of freedom
## Number of observations: 428 Degrees of Freedom: 422
## SSR: 773893113.843842 MSE: 1833869.938019 Root MSE: 1354.204541
## Multiple R-Squared: -2.007617 Adjusted R-Squared: -2.043253
##
##
## 2SLS estimates for 'eq2' (equation 2)
## Model Formula: log(wage) ~ hours + educ + exper + I(exper^2)
## Instruments: ~educ + age + kidslt6 + nwifeinc + exper + I(exper^2)
##
##                Estimate   Std. Error  t value   Pr(>|t|)
## (Intercept) -0.655725440  0.337788292 -1.94123   0.052894 .
## hours        0.000125900  0.000254611  0.49448   0.621223
## educ         0.110330004  0.015524358  7.10690 5.0768e-12 ***
## exper        0.034582356  0.019491555  1.77422   0.076746 .
## I(exper^2)  -0.000705769  0.000454080 -1.55428   0.120865
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.679427 on 423 degrees of freedom
## Number of observations: 428 Degrees of Freedom: 423
```

```
## SSR: 195.26556 MSE: 0.461621 Root MSE: 0.679427
## Multiple R-Squared: 0.125654 Adjusted R-Squared: 0.117385
```

①の方法と全く同じ**estimates**が出ている。