hw3

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the document is from R11323019.

5.2 simulate mutiple treatment

```
library ("data.table")
library ('fixest')
```

```
set.seed(2333)

data <- data.table(state = rep (1:10,each = 4000),
                   id = rep (1:1000,each = 40),
                   year = rep (1980:2019,1000),
                   indv_FE = rep( runif (1000, min =0, max =5),each = 40),
                   time_FE = rep (1:40, 1000),
                   group = rep (1:4,each = 10000),
                   treat_year = rep(c (1999,2004,2009,2014),each = 10000),
                   epsilon = rnorm (40000,0,(0.5)^2),
                   hetero=c( rnorm (10000,10,(0.2)^2),rnorm (10000,8,(0.2)^2),
                             rnorm (10000,6,(0.2)^2),rnorm (10000,4,(0.2)^2)))
```

```
data [ ,treat:= ifelse (year >= treat_year ,1,0)]
data [ ,time_til := year - treat_year]

data [ ,treated:=1]
data [ , y := indv_FE + time_FE+treat * hetero *(year - treat_year+1) + epsilon ]
```

```
TWFE <-feols(y~i ( time_til ,treated ,ref=-1)|id+year ,data ,vcov = ~state)
```

```
## The variables 'time_til::16:treated', 'time_til::17:treated' and three others have been removed becau
```

```
summary(TWFE)
```

```
## OLS estimation, Dep. Var.: y
## Observations: 40,000
## Fixed-effects: id: 1,000,  year: 40
## Standard-errors: Clustered (state)
##                          Estimate Std. Error   t value   Pr(>|t|)
## time_til::-34:treated 377.84973   7.414369  50.96182 2.1653e-12 ***
## time_til::-33:treated 363.77514   7.166154  50.76296 2.2426e-12 ***
```

```
## time_til::-32:treated 349.65642   6.945677  50.34159 2.4167e-12 ***
## time_til::-31:treated 335.59390   6.703484  50.06261 2.5403e-12 ***
## time_til::-30:treated 319.61857   6.423740  49.75584 2.6843e-12 ***
## time_til::-29:treated 322.96944   6.744066  47.88943 3.7823e-12 ***
## time_til::-28:treated 308.89261   6.505048  47.48506 4.0811e-12 ***
## time_til::-27:treated 294.74939   6.283316  46.90985 4.5524e-12 ***
## time_til::-26:treated 280.71023   6.039158  46.48168 4.9425e-12 ***
## time_til::-25:treated 264.72310   5.764710  45.92132 5.5103e-12 ***
## time_til::-24:treated 267.16762   5.794877  46.10410 5.3175e-12 ***
## time_til::-23:treated 253.08139   5.547794  45.61838 5.8472e-12 ***
## time_til::-22:treated 238.93510   5.330695  44.82251 6.8464e-12 ***
## time_til::-21:treated 224.88868   5.091684  44.16784 7.8116e-12 ***
## time_til::-20:treated 208.94765   4.818262  43.36577 9.2059e-12 ***
## time_til::-19:treated 210.04237   4.508249  46.59068 4.8398e-12 ***
## time_til::-18:treated 195.96486   4.260347  45.99740 5.4291e-12 ***
## time_til::-17:treated 181.88479   4.040982  45.01005 6.5949e-12 ***
## time_til::-16:treated 167.82256   3.797479  44.19315 7.7716e-12 ***
## time_til::-15:treated 151.81775   3.548773  42.78035 1.0398e-11 ***
## time_til::-14:treated 153.54965   3.397357  45.19679 6.3547e-12 ***
## time_til::-13:treated 139.40457   3.182108  43.80887 8.4043e-12 ***
## time_til::-12:treated 125.22891   2.995379  41.80737 1.2778e-11 ***
## time_til::-11:treated 111.10564   2.794740  39.75527 2.0055e-11 ***
## time_til::-10:treated  95.15720   2.523556  37.70758 3.2196e-11 ***
## time_til::-9:treated   96.75873   2.303655  42.00227 1.2257e-11 ***
## time_til::-8:treated   82.67164   2.081270  39.72172 2.0207e-11 ***
## time_til::-7:treated   68.56898   1.880570  36.46180 4.3485e-11 ***
## time_til::-6:treated   54.46652   1.676604  32.48621 1.2204e-10 ***
## time_til::-5:treated   38.96036   1.331332  29.26420 3.0993e-10 ***
## time_til::-4:treated   41.00824   0.954454  42.96514 1.0004e-11 ***
## time_til::-3:treated   27.35663   0.641980  42.61289 1.0770e-11 ***
## time_til::-2:treated   13.67046   0.333459  40.99597 1.5230e-11 ***
## time_til::0:treated    -7.49196   0.160388 -46.71144 4.7288e-12 ***
## time_til::1:treated     2.83495   0.670128   4.23046 2.2051e-03 **
## time_til::2:treated    -2.83502   0.730447  -3.88121 3.7245e-03 **
## time_til::3:treated    -8.49808   0.824868 -10.30235 2.7910e-06 ***
## time_til::4:treated   -14.15248   0.905132 -15.63582 7.8621e-08 ***
## time_til::5:treated   -20.10520   0.892677 -22.52237 3.1776e-09 ***
## time_til::6:treated    -9.50335   1.197408  -7.93661 2.3586e-05 ***
## time_til::7:treated   -13.58913   1.177261 -11.54300 1.0711e-06 ***
## time_til::8:treated   -17.67966   1.199667 -14.73714 1.3152e-07 ***
## time_til::9:treated   -21.76160   1.183331 -18.39012 1.9008e-08 ***
## time_til::10:treated  -25.81038   1.119835 -23.04837 2.5897e-09 ***
## time_til::11:treated  -10.72307   1.364172  -7.86050 2.5468e-05 ***
## time_til::12:treated  -12.94683   1.206646 -10.72960 1.9853e-06 ***
## time_til::13:treated  -15.12703   1.129560 -13.39196 3.0078e-07 ***
## time_til::14:treated  -17.37629   1.048946 -16.56548 4.7499e-08 ***
## time_til::15:treated  -19.24244   1.030445 -18.67392 1.6614e-08 ***
## ... 5 variables were removed because of collinearity (time_til::16:treated, time_til::17:treated and
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## RMSE: 2.24632     Adj. R2: 0.998272
##                 Within R2: 0.992269
```

5.3

```
fixest <-feols(y~ sunab(treat_year ,year)|id+year ,data , subset = ~year <2014,vcov= ~state)
summary(fixest)
```

```
## OLS estimation, Dep. Var.: y
## Observations: 34,000
## Subset: year < 2014
## Fixed-effects: id: 1,000,  year: 34
## Standard-errors: Clustered (state)
##             Estimate Std. Error      t value  Pr(>|t|)
## year::-29  -0.017090   0.007424    -2.302174 0.0468325 *
## year::-28   0.018956   0.026641     0.711556 0.4947686
## year::-27  -0.016980   0.028855    -0.588465 0.5706911
## year::-26   0.001223   0.026675     0.045849 0.9644316
## year::-25   0.001904   0.011581     0.164431 0.8730258
## year::-24   0.007385   0.015796     0.467528 0.6512358
## year::-23   0.003654   0.016401     0.222797 0.8286681
## year::-22  -0.011678   0.010007    -1.167000 0.2731994
## year::-21  -0.011636   0.010140    -1.147536 0.2807486
## year::-20   0.014525   0.016830     0.863048 0.4105197
## year::-19   0.018105   0.014444     1.253450 0.2416243
## year::-18  -0.003161   0.012822    -0.246561 0.8107796
## year::-17   0.025609   0.011045     2.318621 0.0455886 *
## year::-16  -0.014974   0.009552    -1.567587 0.1514211
## year::-15   0.018923   0.013261     1.426962 0.1873492
## year::-14   0.017229   0.009701     1.775962 0.1094719
## year::-13   0.009299   0.010020     0.927969 0.3776387
## year::-12   0.014999   0.011707     1.281198 0.2321492
## year::-11  -0.008619   0.012164    -0.708512 0.4965672
## year::-10   0.017634   0.008773     2.009977 0.0753309 .
## year::-9    0.016018   0.019821     0.808127 0.4398546
## year::-8   -0.001233   0.011192    -0.110200 0.9146689
## year::-7    0.032361   0.007880     4.106864 0.0026494 **
## year::-6   -0.015457   0.008838    -1.748971 0.1142285
## year::-5    0.012122   0.011090     1.093057 0.3027610
## year::-4    0.000375   0.013104     0.028587 0.9778182
## year::-3    0.006979   0.012512     0.557809 0.5905774
## year::-2    0.016181   0.015812     1.023354 0.3328588
## year::0     8.018652   0.011150   719.186523 < 2.2e-16 ***
## year::1    15.998359   0.017199   930.201398 < 2.2e-16 ***
## year::2    23.989110   0.011954  2006.758415 < 2.2e-16 ***
## year::3    32.017224   0.013324  2402.943250 < 2.2e-16 ***
## year::4    40.018390   0.010960  3651.357875 < 2.2e-16 ***
## year::5    53.994336   0.014873  3630.323684 < 2.2e-16 ***
## year::6    63.019936   0.019118  3296.447018 < 2.2e-16 ***
## year::7    72.010237   0.007195 10007.949263 < 2.2e-16 ***
## year::8    81.045019   0.027245  2974.711366 < 2.2e-16 ***
## year::9    90.038691   0.015737  5721.392247 < 2.2e-16 ***
## year::10  110.020675   0.061774  1781.032786 < 2.2e-16 ***
## year::11  120.048418   0.049638  2418.468363 < 2.2e-16 ***
## year::12  129.959120   0.027330  4755.265411 < 2.2e-16 ***
```

```
## year::13  139.989198   0.019790  7073.660406 < 2.2e-16 ***
## year::14  149.965199   0.033925  4420.537871 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## RMSE: 0.284885     Adj. R2: 0.999938
##                  Within R2: 0.999784
```