Stata Textbook Examples
Introductory Econometrics: A Modern Approach by Jeffrey M. Wooldridge (1st & 2d eds.)
Chapter 18 - Advanced Time Series Topics

Example 18.1: Housing Investment and Residential Price Inflation

use http://fmwww.bc.edu/ec-p/data/wooldridge/HSEINV

tsset year

```
time variable:  year, 1947 to 1988
```

reg linvpc t

```
      Source |       SS       df       MS              Number of obs =      42
-------------+------------------------------           F(  1,    40) =   20.19
       Model |  .409447014     1  .409447014           Prob > F      =  0.0001
    Residual |   .81117293    40  .020279323           R-squared     =  0.3354
-------------+------------------------------           Adj R-squared =  0.3188
       Total |  1.22061994    41  .029771218           Root MSE      =  .14241

------------------------------------------------------------------------------
      linvpc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           t |   .0081459   .0018129     4.49   0.000     .0044819    .0118098
       _cons |  -.8412918    .044744   -18.80   0.000    -.9317228   -.7508608
------------------------------------------------------------------------------
```

predict elinvpc,r

reg elinvpc gprice L.elinvpc

```
      Source |       SS       df       MS              Number of obs =      41
-------------+------------------------------           F(  2,    38) =   13.02
       Model |  .322534831     2  .161267415           Prob > F      =  0.0000
    Residual |  .470603501    38  .012384303           R-squared     =  0.4067
-------------+------------------------------           Adj R-squared =  0.3754
       Total |  .793138332    40  .019828458           Root MSE      =  .11128

------------------------------------------------------------------------------
elinvpc      |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
gprice       |   3.094828   .9333266     3.32   0.002     1.205407    4.984249
elinvpc      |
         L1  |   .3399015   .1315881     2.58   0.014     .0735154    .6062876
_cons        |  -.0099629    .017916    -0.56   0.581     -.046232    .0263061
------------------------------------------------------------------------------
```

```
scalar lrpGDL = _b[gprice]/(1-_b[L.elinvpc])

display _n "long run propensity : " lrpGDL

long run propensity : 4.6884339

reg elinvpc gprice L.elinvpc L.gprice

      Source |       SS       df       MS              Number of obs =      40
-------------+------------------------------           F(  3,    36) =   14.20
       Model |  .429863193     3  .143287731           Prob > F      =  0.0000
    Residual |    .3632598    36   .01009055           R-squared     =  0.5420
-------------+------------------------------           Adj R-squared =  0.5038
       Total |  .793122992    39  .020336487           Root MSE      =  .10045

------------------------------------------------------------------------------
elinvpc      |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
gprice       |   3.256352   .9703223     3.36   0.002     1.288447    5.224257
elinvpc      |
         L1 |   .5471706   .1516713     3.61   0.001     .2395669    .8547743
gprice       |
         L1 |  -2.936344   .9731857    -3.02   0.005    -4.910056   -.9626315
_cons        |   .0058685   .0169326     0.35   0.731    -.0284725    .0402095
------------------------------------------------------------------------------

scalar lrpRDL = (_b[gprice]+_b[L.gprice])/(1-_b[L.elinvpc])

display _n "long run propensity : " lrpRDL

long run propensity : .70668588
```

Example 18.2: Unit Root Test for Three-Month T-Bill Rates

```
use http://fmwww.bc.edu/ec-p/data/wooldridge/INTQRT

reg cr3 r3_1

      Source |       SS       df       MS              Number of obs =     123
-------------+------------------------------           F(  1,   121) =    6.12
       Model |  9.22556712     1  9.22556712           Prob > F      =  0.0148
    Residual |  182.506041   121  1.50831439           R-squared     =  0.0481
-------------+------------------------------           Adj R-squared =  0.0403
       Total |  191.731608   122  1.57157056           Root MSE      =  1.2281

------------------------------------------------------------------------------
```

```
        cr3 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------+----------------------------------------------------------------
       r3_1 |  -.0907106   .0366782    -2.47   0.015    -.1633247   -.0180965
      _cons |   .6253371   .2608254     2.40   0.018     .1089645     1.14171
------------------------------------------------------------------------------
```

display "rho=" 1+_b[r3_1]

```
rho=.90928937
```

Example 18.3: Unit Root Test for Annual U.S. Inflation

use http://fmwww.bc.edu/ec-p/data/wooldridge/PHILLIPS

reg cinf inf_1 cinf_1

```
      Source |       SS       df       MS              Number of obs =      47
-------------+------------------------------           F(  2,    44) =    4.57
       Model |  38.4043268     2  19.2021634            Prob > F      =  0.0158
    Residual |  184.960355    44  4.20364442            R-squared     =  0.1719
-------------+------------------------------           Adj R-squared =  0.1343
       Total |  223.364681    46  4.85575395            Root MSE      =  2.0503

------------------------------------------------------------------------------
        cinf |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       inf_1 |  -.3103252   .1027077    -3.02   0.004     -.517319   -.1033315
      cinf_1 |   .1383615   .1264025     1.09   0.280    -.1163861    .3931091
       _cons |   1.360791   .5167103     2.63   0.012     .3194297    2.402152
------------------------------------------------------------------------------
```

display "rho=" 1+_b[inf_1]

```
rho=.68967477
```

Example 18.4: Unit Root in the Log of U.S. Real Gross Domestic Product

use http://fmwww.bc.edu/ec-p/data/wooldridge/INVEN

tsset year

```
        time variable:  year, 1959 to 1995
```

gen lgdp=log(gdp)

reg D.lgdp year L.lgdp L.D.lgdp

```
      Source |       SS       df       MS              Number of obs =      35
-------------+------------------------------           F(  3,    31) =    3.78
       Model |  .004591884     3  .001530628           Prob > F      =  0.0201
    Residual |  .012541804    31  .000404574           R-squared     =  0.2680
-------------+------------------------------           Adj R-squared =  0.1972
       Total |  .017133688    34  .000503932           Root MSE      =  .02011

------------------------------------------------------------------------------
D.lgdp       |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
year         |   .0058696    .002696     2.18   0.037     .0003711    .0113681
lgdp         |
         L1  |  -.2096203   .0865941    -2.42   0.022    -.3862301   -.0330104
         LD  |   .2637479   .1647397     1.60   0.120    -.0722409    .5997367
_cons        |  -9.841804   4.620125    -2.13   0.041    -19.26461   -.4189969
------------------------------------------------------------------------------
```

display "rho=" 1+_b[L.lgdp]

```
rho=.79037972
```

reg D.lgdp L.lgdp L.D.lgdp

```
      Source |       SS       df       MS              Number of obs =      35
-------------+------------------------------           F(  2,    32) =    2.96
       Model |  .002674165     2  .001337083           Prob > F      =  0.0662
    Residual |  .014459523    32   .00045186           R-squared     =  0.1561
-------------+------------------------------           Adj R-squared =  0.1033
       Total |  .017133688    34  .000503932           Root MSE      =  .02126

------------------------------------------------------------------------------
D.lgdp       |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lgdp         |
         L1  |  -.0226876   .0118894    -1.91   0.065    -.0469056    .0015304
         LD  |   .1671587    .167669     1.00   0.326    -.1743718    .5086892
_cons        |   .2148862    .100468     2.14   0.040     .0102395    .4195328
------------------------------------------------------------------------------
```

display "rho=" 1+_b[L.lgdp]

```
rho=.9773124
```

Example 18.5: Cointegration Between Fertility and Personal Exemption

use http://fmwww.bc.edu/ec-p/data/wooldridge/FERTIL3

tsset year

```
time variable:  year, 1913 to 1984
```

reg gfr pe year

```
      Source |       SS       df       MS              Number of obs =      72
-------------+------------------------------           F(  2,    69) =   34.53
       Model |  13929.0853     2  6964.54264           Prob > F      =  0.0000
    Residual |  13918.8101    69  201.721886           R-squared     =  0.5002
-------------+------------------------------           Adj R-squared =  0.4857
       Total |  27847.8954    71  392.223879           Root MSE      =  14.203

------------------------------------------------------------------------------
         gfr |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          pe |    .186662   .0346265     5.39   0.000     .1175841    .2557399
        year |  -.9051881   .1089923    -8.31   0.000    -1.122622   -.6877543
       _cons |    1840.65   210.0516     8.76   0.000     1421.608    2259.691
------------------------------------------------------------------------------
```

predict uh, res

reg D.gfr D.pe year

```
      Source |       SS       df       MS              Number of obs =      71
-------------+------------------------------           F(  2,    68) =    1.16
       Model |  42.0144941     2  21.0072471           Prob > F      =  0.3185
    Residual |  1227.56788    68  18.0524688           R-squared     =  0.0331
-------------+------------------------------           Adj R-squared =  0.0047
       Total |  1269.58238    70  18.1368911           Root MSE      =  4.2488

------------------------------------------------------------------------------
D.gfr        |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
pe           |
         D1  |  -.0441285   .0289463    -1.52   0.132    -.1018899    .0136329
year         |   -.007633   .0249413    -0.31   0.761    -.0574026    .0421367
_cons        |   14.09361   48.61889     0.29   0.773    -82.92387    111.1111
------------------------------------------------------------------------------
```

reg D.gfr L.gfr L.D.gfr year

```
      Source |       SS       df       MS              Number of obs =      70
```

```
-------------+------------------------------           F(  3,    66) =    2.77
       Model |  141.284323     3  47.0947745           Prob > F      =  0.0482
    Residual |  1120.70979    66  16.9804513           R-squared     =  0.1120
-------------+------------------------------           Adj R-squared =  0.0716
       Total |  1261.99411    69  18.2897697           Root MSE      =  4.1207

------------------------------------------------------------------------------
D.gfr        |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
gfr          |
         L1 |  -.0438938   .0297773    -1.47   0.145    -.1033461    .0155585
         LD |   .3092968   .1166811     2.65   0.010     .0763355    .5422581
year         |  -.0185421   .0282515    -0.66   0.514     -.074948    .0378638
_cons        |   39.73213    56.5777     0.70   0.485    -73.22889    152.6931
------------------------------------------------------------------------------
```

reg D.pe L.pe L.D.pe year

```
      Source |       SS       df       MS              Number of obs =      70
-------------+------------------------------           F(  3,    66) =    2.49
       Model |  2254.87222     3  751.624073           Prob > F      =  0.0675
    Residual |   19882.889    66  301.255894           R-squared     =  0.1019
-------------+------------------------------           Adj R-squared =  0.0610
       Total |  22137.7612    69  320.837119           Root MSE      =  17.357

------------------------------------------------------------------------------
D.pe         |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
pe           |
         L1 |  -.0661281   .0449466    -1.47   0.146    -.1558668    .0236106
         LD |   .2567035   .1220926     2.10   0.039     .0129377    .5004694
year         |   .0316731   .1463908     0.22   0.829    -.2606056    .3239517
_cons        |  -54.13747   282.2287    -0.19   0.848    -617.6253    509.3503
------------------------------------------------------------------------------
```

reg D.uh L.uh L.D.uh year

```
      Source |       SS       df       MS              Number of obs =      70
-------------+------------------------------           F(  3,    66) =    3.07
       Model |  291.902357     3  97.3007857           Prob > F      =  0.0338
    Residual |  2092.94085    66   31.711225           R-squared     =  0.1224
-------------+------------------------------           Adj R-squared =  0.0825
       Total |  2384.84321    69   34.562945           Root MSE      =  5.6313

------------------------------------------------------------------------------
D.uh         |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
uh           |
         L1 |  -.1188282   .0490884    -2.42   0.018    -.2168364   -.0208201
```

```
          LD |   .2378983   .1176739     2.02   0.047     .0029547    .4728418
year         |   .0257499   .0334197     0.77   0.444    -.0409748    .0924746
_cons        |  -50.38379   65.15702    -0.77   0.442     -180.474     79.7064
------------------------------------------------------------------------------
```

Example 18.6: Cointegrated Parameter for Interest Rates

```
use http://fmwww.bc.edu/ec-p/data/wooldridge/INTQRT

gen cr3_2 = cr3[_n-2]

gen cr3_1p = cr3[_n+1]

gen cr3_2p = cr3[_n+2]

reg r6 r3 cr3 cr3_1 cr3_2 cr3_1p cr3_2p

      Source |       SS       df       MS              Number of obs =     119
-------------+------------------------------           F(  6,   112) = 3176.06
       Model |  1148.95762     6  191.492937            Prob > F      =  0.0000
    Residual |  6.75277085   112  .060292597            R-squared     =  0.9942
-------------+------------------------------           Adj R-squared =  0.9938
       Total |  1155.71039   118  9.79415587            Root MSE      =  .24555

------------------------------------------------------------------------------
          r6 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          r3 |   1.038171   .0080773   128.53   0.000     1.022167    1.054175
         cr3 |  -.0531227   .0194406    -2.73   0.007    -.0916418   -.0146036
       cr3_1 |  -.0611365   .0190433    -3.21   0.002    -.0988684   -.0234046
       cr3_2 |  -.0437775   .0189032    -2.32   0.022    -.0812318   -.0063233
      cr3_1p |  -.0035722   .0191223    -0.19   0.852    -.0414606    .0343163
      cr3_2p |   .0123662   .0189704     0.65   0.516    -.0252213    .0499536
       _cons |   .0651458   .0569524     1.14   0.255     -.047698    .1779895
------------------------------------------------------------------------------

test r3

 ( 1)  r3 = 0.0

       F(  1,   112) =16519.67
            Prob > F =    0.0000

reg r6 r3

      Source |       SS       df       MS              Number of obs =     124
```

```
-------------+------------------------------           F(  1,   122) =17710.54
       Model |  1182.09126     1  1182.09126           Prob > F      =  0.0000
    Residual |  8.14289673   122  .066745055           R-squared     =  0.9932
-------------+------------------------------           Adj R-squared =  0.9931
       Total |  1190.23416   123   9.6767005           Root MSE      =  .25835

------------------------------------------------------------------------------
          r6 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          r3 |   1.025899   .0077088   133.08   0.000     1.010639     1.04116
       _cons |   .1353736   .0548673     2.47   0.015     .0267584    .2439889
------------------------------------------------------------------------------
```

Example 18.7: Error Correction Model for Holding Yields

```
use http://fmwww.bc.edu/ec-p/data/wooldridge/INTQRT

gen del = hy6_1 - hy3[_n-2]

reg chy6 chy3_1 del
```

```
      Source |       SS       df       MS              Number of obs =     122
-------------+------------------------------           F(  2,   119) =  223.79
       Model |  51.8888367     2  25.9444184           Prob > F      =  0.0000
    Residual |  13.7959796   119  .115932602           R-squared     =  0.7900
-------------+------------------------------           Adj R-squared =  0.7864
       Total |  65.6848163   121  .542849722           Root MSE      =  .34049

------------------------------------------------------------------------------
        chy6 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      chy3_1 |   1.218363   .2636012     4.62   0.000     .6964068     1.74032
         del |  -.8400495   .2441269    -3.44   0.001    -1.323445   -.3566539
       _cons |   .0898484    .042688     2.10   0.037     .0053219     .174375
------------------------------------------------------------------------------
```

Example 18.8: Forecasting the U.S. Unemployment Rate

```
use http://fmwww.bc.edu/ec-p/data/wooldridge/PHILLIPS

reg unem unem_1
```

```
      Source |       SS       df       MS              Number of obs =      48
-------------+------------------------------           F(  1,    46) =   57.13
```

```
      Model |  62.8162728     1  62.8162728           Prob > F      =  0.0000
   Residual |  50.5768515    46  1.09949677           R-squared     =  0.5540
-------------+------------------------------           Adj R-squared =  0.5443
      Total |  113.393124    47  2.41261967           Root MSE      =  1.0486

------------------------------------------------------------------------------
        unem |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      unem_1 |   .7323538   .0968906     7.56   0.000     .5373231    .9273845
       _cons |   1.571741   .5771181     2.72   0.009     .4100629     2.73342
------------------------------------------------------------------------------
```

display "Forecast for 1997: " _b[_cons] +_b[unem_1]*5.4

Forecasts for 1997: 5.5264519

reg unem unem_1 inf_1

```
      Source |       SS       df       MS              Number of obs =      48
-------------+------------------------------           F(  2,    45) =   50.22
      Model |  78.3083336     2  39.1541668           Prob > F      =  0.0000
   Residual |  35.0847907    45  .779662015           R-squared     =  0.6906
-------------+------------------------------           Adj R-squared =  0.6768
      Total |  113.393124    47  2.41261967           Root MSE      =  .88298

------------------------------------------------------------------------------
        unem |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      unem_1 |   .6470261   .0838056     7.72   0.000     .4782329    .8158192
       inf_1 |   .1835766   .0411828     4.46   0.000     .1006302    .2665231
       _cons |   1.303797   .4896861     2.66   0.011     .3175188    2.290076
------------------------------------------------------------------------------
```

display "Forecast for 1997: " _b[_cons] +_b[unem_1]*5.4 +_b[inf_1]*3

Forecasts for 1997: 5.3484678

gen un1 = unem_1-5.4

gen inf1 = inf_1-3

reg unem un1 inf1

```
      Source |       SS       df       MS              Number of obs =      48
-------------+------------------------------           F(  2,    45) =   50.22
      Model |  78.3083334     2  39.1541667           Prob > F      =  0.0000
   Residual |  35.0847909    45  .779662019           R-squared     =  0.6906
-------------+------------------------------           Adj R-squared =  0.6768
```

```
       Total |  113.393124    47  2.41261967           Root MSE      =  .88298

------------------------------------------------------------------------------
        unem |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         un1 |   .6470261   .0838056     7.72   0.000     .4782329    .8158192
        inf1 |   .1835766   .0411828     4.46   0.000     .1006302    .2665231
       _cons |   5.348468   .1365394    39.17   0.000     5.073463    5.623472
------------------------------------------------------------------------------
```

```
scalar down = _b[ _cons]-1.96*sqrt(_se[_cons]^2+e(rmse)^2)

scalar up= _b[_cons]+1.96*sqrt(_se[_cons]^2+e(rmse)^2)

display "95% forecast interval: [" down ","up "]"

95% forecast interval: [3.5972486,7.099687]
```

Example 18.9: Out-of -Sample Comparison of Unemployment Forecasts

```
use http://fmwww.bc.edu/ec-p/data/wooldridge/PHILLIPS

reg unem unem_1

      Source |       SS       df       MS              Number of obs =      48
-------------+------------------------------           F(  1,    46) =   57.13
       Model |  62.8162728     1  62.8162728           Prob > F      =  0.0000
    Residual |  50.5768515    46  1.09949677           R-squared     =  0.5540
-------------+------------------------------           Adj R-squared =  0.5443
       Total |  113.393124    47  2.41261967           Root MSE      =  1.0486

------------------------------------------------------------------------------
        unem |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      unem_1 |   .7323538   .0968906     7.56   0.000     .5373231    .9273845
       _cons |   1.571741   .5771181     2.72   0.009     .4100629     2.73342
------------------------------------------------------------------------------

display _n "RMSE : " %9.3f e(rmse)

RMSE :     1.049

qui {

predict eps1 if e(sample), r
```

```
replace eps1 = abs(eps)

summ eps1,meanonly

}

display _n "MAE : " %9.3f `r(mean)'

MAE :     0.813

reg unem unem_1 inf_1

      Source |       SS       df       MS              Number of obs =      48
-------------+------------------------------           F(  2,    45) =   50.22
       Model |  78.3083336     2  39.1541668           Prob > F      =  0.0000
    Residual |  35.0847907    45  .779662015           R-squared     =  0.6906
-------------+------------------------------           Adj R-squared =  0.6768
       Total |  113.393124    47  2.41261967           Root MSE      =  .88298

------------------------------------------------------------------------------
        unem |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      unem_1 |   .6470261   .0838056     7.72   0.000     .4782329    .8158192
       inf_1 |   .1835766   .0411828     4.46   0.000     .1006302    .2665231
       _cons |   1.303797   .4896861     2.66   0.011     .3175188    2.290076
------------------------------------------------------------------------------

display _n "RMSE : " %9.3f e(rmse)

RMSE :     0.883

qui {

predict eps if e(sample), r

replace eps = abs(eps)

summ eps,meanonly

}

display _n "MAE : " %9.3f `r(mean)'

MAE :     0.649
```

Example 18.10: Two-Year-Ahead Forecast for the Unemployment Rate

```
use http://fmwww.bc.edu/ec-p/data/wooldridge/PHILLIPS

reg inf inf_1

      Source |       SS       df       MS              Number of obs =      48
-------------+------------------------------           F(  1,    46) =   38.67
       Model |  214.647351     1  214.647351           Prob > F      =  0.0000
    Residual |  255.342659    46  5.55092736           R-squared     =  0.4567
-------------+------------------------------           Adj R-squared =  0.4449
       Total |   469.99001    47  9.99978744           Root MSE      =   2.356

------------------------------------------------------------------------------
         inf |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       inf_1 |   .6652586   .1069819     6.22   0.000     .4499151    .8806021
       _cons |    1.27665   .5576568     2.29   0.027     .1541456    2.399155
------------------------------------------------------------------------------

scalar inf1997 = _b[_cons]+_b[inf_1]*3

display "Forecast for inflation in 1997: " inf1997

Forecast for inflation in 1997: 3.2724262

reg unem unem_1 inf_1

      Source |       SS       df       MS              Number of obs =      48
-------------+------------------------------           F(  2,    45) =   50.22
       Model |  78.3083336     2  39.1541668           Prob > F      =  0.0000
    Residual |  35.0847907    45  .779662015           R-squared     =  0.6906
-------------+------------------------------           Adj R-squared =  0.6768
       Total |  113.393124    47  2.41261967           Root MSE      =  .88298

------------------------------------------------------------------------------
        unem |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      unem_1 |   .6470261   .0838056     7.72   0.000     .4782329    .8158192
       inf_1 |   .1835766   .0411828     4.46   0.000     .1006302    .2665231
       _cons |   1.303797   .4896861     2.66   0.011     .3175188    2.290076
------------------------------------------------------------------------------

display "Forecast for unemployment in 1998:  " _b[_cons]+_b[unem]*5.35+_b[inf_1]
*inf1997

Forecast for unemployment in 1998:  5.3661276
```

This page prepared by Oleksandr Talavera (revised 9 Nov 2002)

Send your questions/comments/suggestions to Kit Baum at **baum@bc.edu**
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