GVPT 722
Examples of Time Series Regression Analysis in Stata

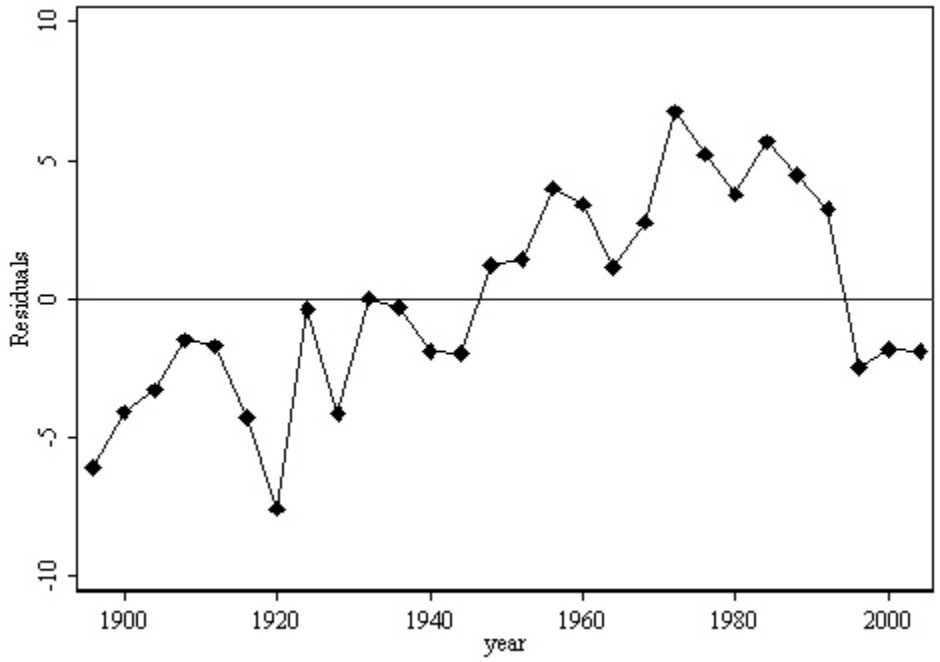
I. Regression of the Democratic percentage of the national congressional vote (in presidential election years) on the Democratic percentage of the presidential vote, 1896-2004

(1) OLS model

```
. reg congvote presvote

      Source |       SS       df       MS              Number of obs =      28
-------------+------------------------------           F(  1,    26) =   24.10
       Model |  344.700304     1  344.700304           Prob > F      =  0.0000
    Residual |  371.908699    26  14.3041807           R-squared     =  0.4810
-------------+------------------------------           Adj R-squared =  0.4611
       Total |  716.609004    27  26.5410742           Root MSE      =  3.7821

------------------------------------------------------------------------------
    congvote |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    presvote |   .4785132   .0974775     4.91   0.000     .2781452    .6788811
       _cons |   27.00044    4.53614     5.95   0.000     17.67627    36.32461
------------------------------------------------------------------------------
```

(2) Predicting and plotting residuals

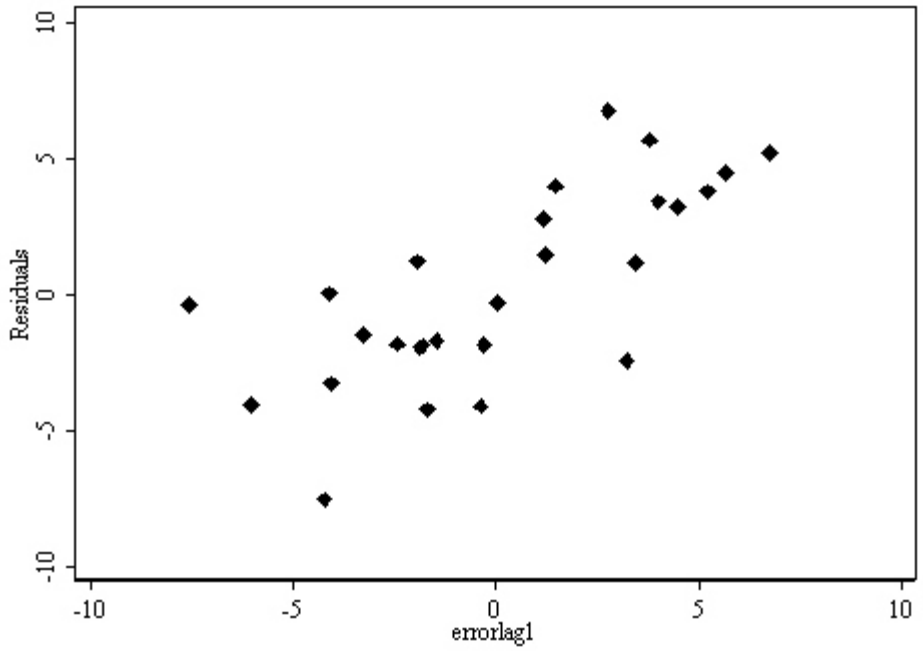
```
. predict error, residuals

. twoway (connected error year, sort msymbol(diamond) mcolor(black) clcolor(black)),
yline(0)
```



(3) Taking the lag of the residuals, regressing residuals on their lag, and graphing:

```
. gen errorlag1=error[_n-1]
(1 missing value generated)

. list year error errorlag1

     +-----------------------------+
     | year       error   errorlag1 |
     |-----------------------------|
  1. | 1896   -6.047006          . |
  2. | 1900   -4.072789   -6.047006 |
  3. | 1904   -3.292534   -4.072789 |
  4. | 1908   -1.476508   -3.292534 |
  5. | 1912   -1.702291   -1.476508 |
     |-----------------------------|
  6. | 1916   -4.243289   -1.702291 |
  7. | 1920   -7.565591   -4.243289 |
  8. | 1924   -.3816172   -7.565591 |
  9. | 1928   -4.123775   -.3816172 |
 10. | 1932    .0329031   -4.123775 |
     |-----------------------------|
 11. | 1936   -.2940414    .0329031 |
 12. | 1940   -1.875112   -.2940414 |
 13. | 1944   -1.953046   -1.875112 |
 14. | 1948     1.21316   -1.953046 |
 15. | 1952    1.453575     1.21316 |
     |-----------------------------|
 16. | 1956    4.002006    1.453575 |
 17. | 1960    3.417456    4.002006 |
 18. | 1964    1.162407    3.417456 |
 19. | 1968    2.767048    1.162407 |
 20. | 1972    6.755317    2.767048 |
     |-----------------------------|
 21. | 1976    5.226052    6.755317 |
 22. | 1980    3.780522    5.226052 |
 23. | 1984    5.671925    3.780522 |
 24. | 1988     4.47936    5.671925 |
 25. | 1992    3.223493     4.47936 |
     |-----------------------------|
 26. | 1996   -2.443718    3.223493 |
 27. | 2000   -1.817841   -2.443718 |
 28. | 2004   -1.896064   -1.817841 |
     +-----------------------------+

. reg error errorlag1, beta

      Source |       SS       df       MS              Number of obs =      27
-------------+------------------------------           F(  1,    25) =   27.58
       Model |  175.193254     1  175.193254           Prob > F      =  0.0000
    Residual |  158.794863    25  6.35179453           R-squared     =  0.5245
-------------+------------------------------           Adj R-squared =  0.5055
       Total |  333.988117    26  12.8456968           Root MSE      =  2.5203

------------------------------------------------------------------------------
       error |      Coef.   Std. Err.      t    P>|t|                     Beta
-------------+----------------------------------------------------------------
   errorlag1 |   .6898081   .1313463     5.25   0.000                 .7242578
       _cons |   .1755217   .4851152     0.36   0.721                        .
------------------------------------------------------------------------------
```

```
. twoway (scatter error errorlag1, sort msymbol(diamond) mcolor(black))
```



(4) Computing the Durbin-Watson "d" statistic (*Note*: To compute time-series regression statistics, you must first tell Stata that you have time series data and specify what the time point is. You need to create a time variable in which there are no gaps (e.g. "time" = 1-28 rather than 1896-2004))

```
. tsset time
        time variable:  time, 1 to 28

. reg congvote presvote

      Source |       SS       df       MS              Number of obs =      28
-------------+------------------------------           F(  1,    26) =   24.10
       Model |  344.700304     1  344.700304            Prob > F      =  0.0000
    Residual |  371.908699    26  14.3041807            R-squared     =  0.4810
-------------+------------------------------           Adj R-squared =  0.4611
       Total |  716.609004    27  26.5410742            Root MSE      =  3.7821

------------------------------------------------------------------------------
    congvote |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    presvote |   .4785132   .0974775     4.91   0.000     .2781452    .6788811
       _cons |   27.00044    4.53614     5.95   0.000     17.67627    36.32461
------------------------------------------------------------------------------

. dwstat

Durbin-Watson d-statistic(  2,    28) =  .5239431
```

(5) Breusch-Godfrey general test of autocorrelation:

```
. bgodfrey, lags(1 2 3 4)

Breusch-Godfrey LM test for autocorrelation
------------------------------------------------------------------------------
    lags(p) |          chi2               df                 Prob > chi2
------------+-----------------------------------------------------------------
       1    |         13.857               1                   0.0002
       2    |         14.264               2                   0.0008
       3    |         14.305               3                   0.0025
       4    |         14.331               4                   0.0063
------------------------------------------------------------------------------
                       H0: no serial correlation
```

(6) Regressing first-differences on first-differences

```
. gen conglag=congvote[_n-1]
(1 missing value generated)

. gen preslag=presvote[_n-1]
(1 missing value generated)

. gen congdiff=congvote-conglag
(1 missing value generated)

. gen presdiff=presvote-preslag
(1 missing value generated)

. reg congdiff presdiff, nocons

      Source |       SS       df       MS              Number of obs =      27
-------------+------------------------------           F(  1,    26) =   42.21
       Model |  303.550869     1  303.550869           Prob > F      =  0.0000
    Residual |  186.965711    26  7.19098888           R-squared     =  0.6188
-------------+------------------------------           Adj R-squared =  0.6042
       Total |  490.516579    27  18.1672807           Root MSE      =  2.6816

------------------------------------------------------------------------------
    congdiff |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    presdiff |   .4120656   .0634227     6.50   0.000     .2816983    .5424329
------------------------------------------------------------------------------
```

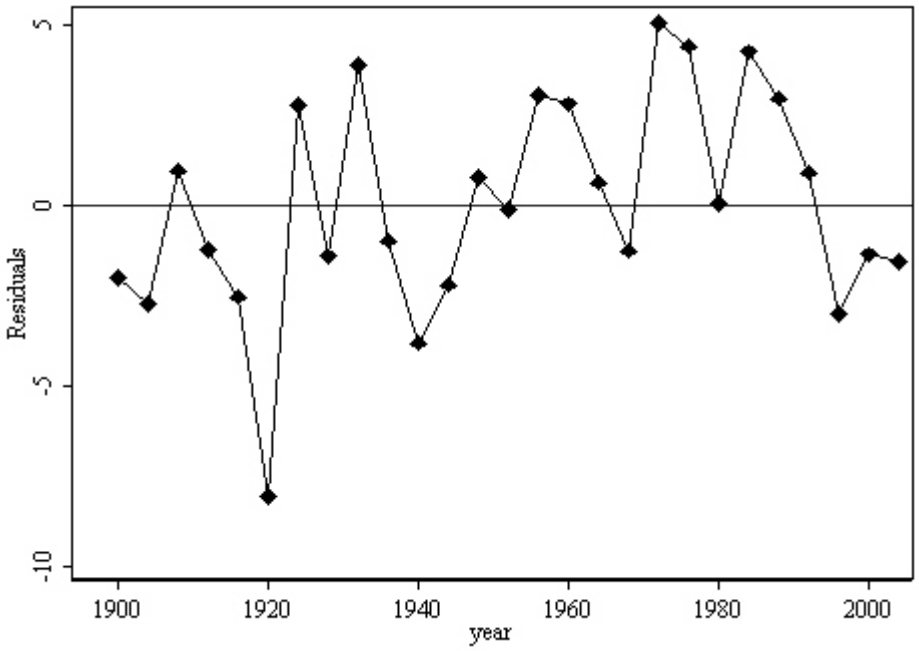
II. Model of the congressional vote (in presidential election years) as a function of its value in the previous presidential election year and the current presidential vote

(1) The model:

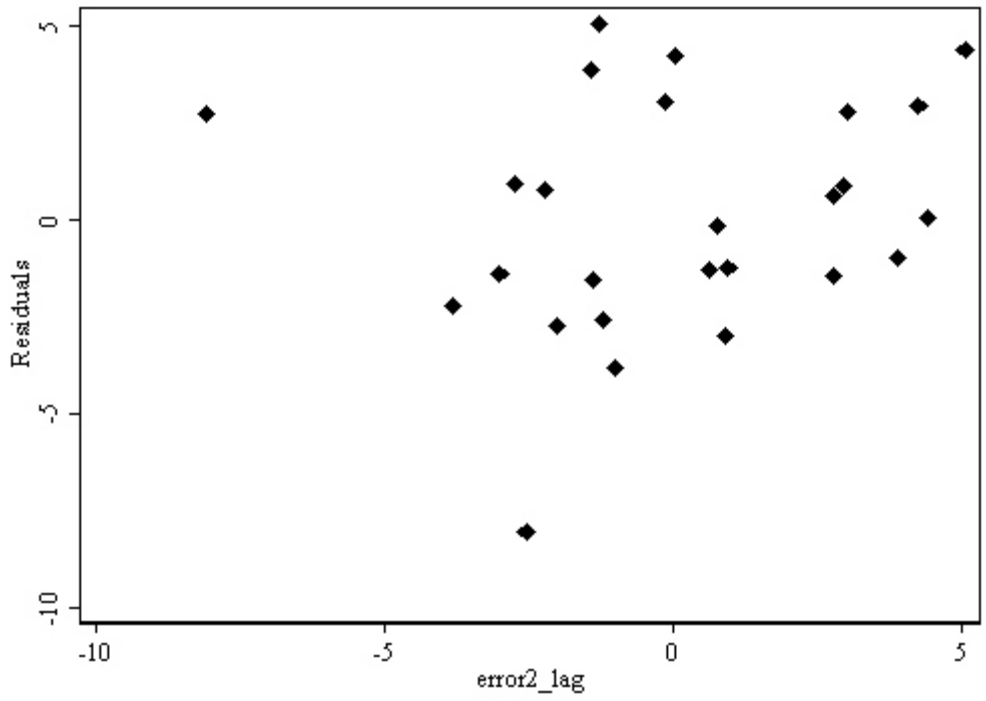
```
. reg congvote conglag presvote

      Source |       SS       df       MS              Number of obs =      27
-------------+------------------------------           F(  2,    24) =   22.67
       Model |  446.642373     2  223.321187           Prob > F      =  0.0000
    Residual |  236.391406    24  9.84964193           R-squared     =  0.6539
-------------+------------------------------           Adj R-squared =  0.6251
       Total |  683.033779    26    26.27053           Root MSE      =  3.1384

------------------------------------------------------------------------------
    congvote |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     conglag |   .4095591   .1301193     3.15   0.004     .1410062    .6781121
    presvote |   .3593574   .0897453     4.00   0.001     .1741322    .5445827
       _cons |   12.61959   5.939815     2.12   0.044     .3604136    24.87876
------------------------------------------------------------------------------
```

(2) Predicting, graphing, and regressing residuals:

```
. twoway (connected error2 year, sort msymbol(diamond) mcolor(black) clcolor(black)),
yline(0)
```




```
. twoway (scatter error2 error2_lag, sort msymbol(diamond) mcolor(black))
```



```
. reg error2 error2_lag

      Source |       SS       df       MS              Number of obs =      26
-------------+------------------------------           F(  1,    24) =    0.89
       Model |  8.27254854     1  8.27254854           Prob > F      =  0.3558
    Residual |  223.947286    24   9.3311369           R-squared     =  0.0356
-------------+------------------------------           Adj R-squared = -0.0046
       Total |  232.219834    25  9.28879337           Root MSE      =  3.0547

------------------------------------------------------------------------------
      error2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  error2_lag |   .1880736   .1997448     0.94   0.356    -.2241793    .6003265
       _cons |   .0658267   .5991935     0.11   0.913    -1.170848    1.302501
------------------------------------------------------------------------------
```

(3) Breusch-Godfrey test:

```
. reg congvote conglag presvote

      Source |       SS       df       MS              Number of obs =      27
-------------+------------------------------           F(  2,    24) =   22.67
       Model |  446.642373     2  223.321187           Prob > F      =  0.0000
    Residual |  236.391406    24  9.84964193           R-squared     =  0.6539
-------------+------------------------------           Adj R-squared =  0.6251
       Total |  683.033779    26    26.27053           Root MSE      =  3.1384

------------------------------------------------------------------------------
    congvote |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     conglag |   .4095591   .1301193     3.15   0.004     .1410062    .6781121
    presvote |   .3593574   .0897453     4.00   0.001     .1741322    .5445827
       _cons |   12.61959   5.939815     2.12   0.044     .3604136    24.87876
------------------------------------------------------------------------------
```

```
. bgodfrey, lags(1 2 3 4)

Breusch-Godfrey LM test for autocorrelation
------------------------------------------------------------------------------
    lags(p)  |          chi2               df                 Prob > chi2
-------------+----------------------------------------------------------------
       1     |          1.448               1                   0.2288
       2     |          2.232               2                   0.3276
       3     |          2.233               3                   0.5255
       4     |          3.278               4                   0.5124
------------------------------------------------------------------------------
                       H0: no serial correlation
```