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Economic Forecasting (Econ 460)
May 8, 2022
Project Report

Project Description and Historical Data

This project aims to predict point and interval forecasts of the consumer price index for all urban consumers: all items in U.S. city average. Data for this variable is released through the U.S. Bureau of Labor Statistics (BLS) every month. BLS also has historical data on this variable since January 1st, 1947. I accessed the data using Stata's Fred API. The variable code is CPIAUCSL. The variable is seasonally adjusted and has the index 1982-1984 equals 100.

Description of the Forecasting Method

The first thing I did was graph the consumer price index against time. From this graph, I was able to see that there was an increasing trend. At this point, I had to test if the graph was increasing linearly or exponentially. I performed a natural log transformation of the CPI data and then graphed the results. I thought the graph for the natural log of CPI was more linear so I decided to use the natural log of CPI. From this point on I will refer to the natural log of CPI as CPI.

The next thing I did was determine if the data had any cyclical components. In order to determine this, I graphed the autocorrelation function. The results of the graph showed that the current CPI was highly correlated with past lags of itself. This implied that I should add cyclical components to my model.

The next decision I made was determining if I should use an autoregressive, mean-adjusted model, or a combination of both. I chose to use a purely autoregressive model to measure the cyclical components because the data was highly correlated to past lags and the graph did not revolve around a constant value.

At this point, my equation looked like this. $y_t = T_t + C_t + E_t$

In order to find the best autoregressive model, I regressed CPI against time and lags of itself. I ran tests until I included twelve lags. Then I used the AIC algorithm to find the best model. This algorithm compiled the data in a table. I selected the economic model with the lowest AIC value. The model I chose was an AR(10) model because it was the most negative value in the table. I also used AIC instead of BIC because AIC provides the best model.

My final equation was the following. $y_t = \alpha + \beta_0 \, x\,time_t + AR(10) + E_t$

Now that I had a complete model, one that accounted for trends and cyclical components, I was ready to predict point and interval estimates by using the direct method to calculate point and 90% interval forecasts.

In order to predict point and interval forecasts for April, I executed the following code in stata.

```
regress y time L(1/10).y
predict y1
predict sf1,stdf
generate y1L=y1-1.645*sf1
generate y1U=y1+1.645*sf1
```

I ran nearly identical code to predict the next eleven intervals. After running the regressions, I was able to create the data in the following section. Do not forget the values are in natural log form.

Point and Interval Forecasts

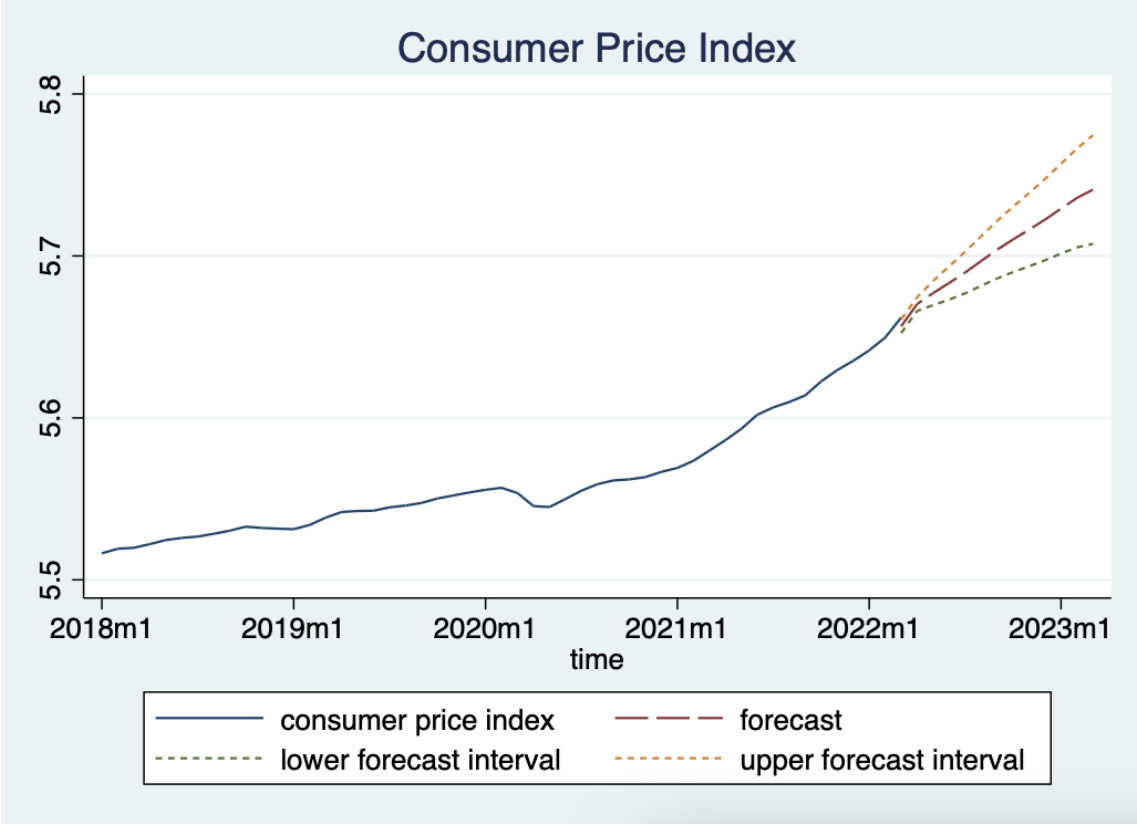
Figure 1

time	pL	p	pU
2022m4	5.666039	5.670297	5.674556
2022m5	5.669603	5.677082	5.68456
2022m6	5.673034	5.6833	5.693565
2022m7	5.676917	5.689733	5.702548
2022m8	5.681571	5.696838	5.712106
2022m9	5.686102	5.703846	5.72159
2022m10	5.690009	5.710173	5.730338
2022m11	5.6936	5.716213	5.738826
2022m12	5.69732	5.722432	5.747544
2023m1	5.701456	5.729199	5.756943
2023m2	5.705278	5.735812	5.766345
2023m3	5.70744	5.740982	5.774524

After converting the estimates out of log form, the estimates are as follows. The point estimate for April is 290.12. There is a ninety percent probability that the real value lies in the following interval [288.89, 291.36].

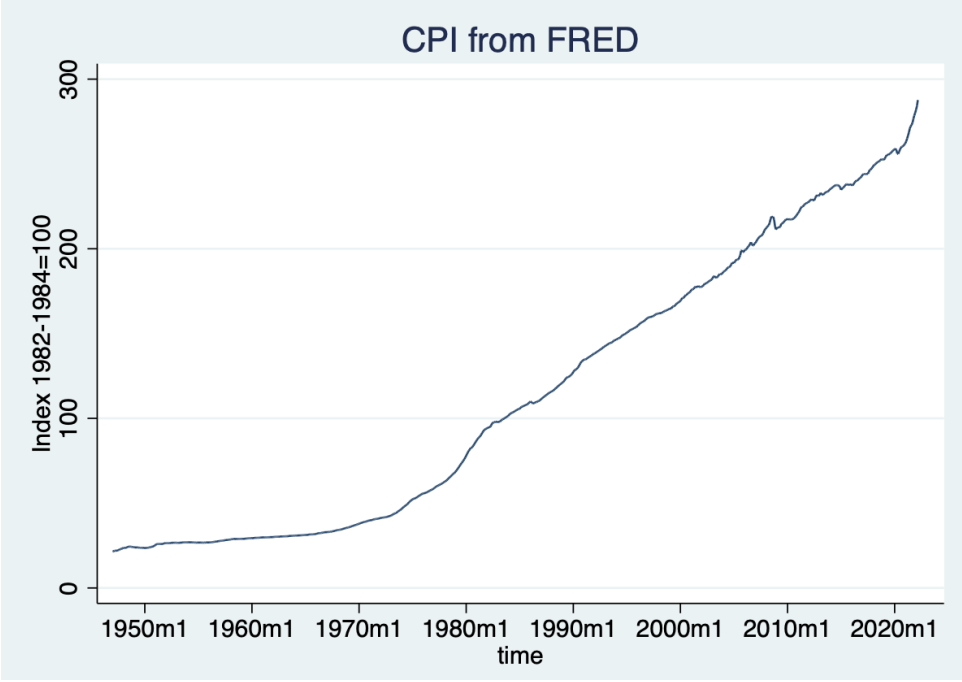
[1] Figure 1 is a table containing point and 90% interval estimates for the CPI in the next twelve intervals. The column pL contains estimates for the lower bound. The column p contains point estimates for the true value of CPI. The column pU contains estimates for the upper bound.

Figure 2



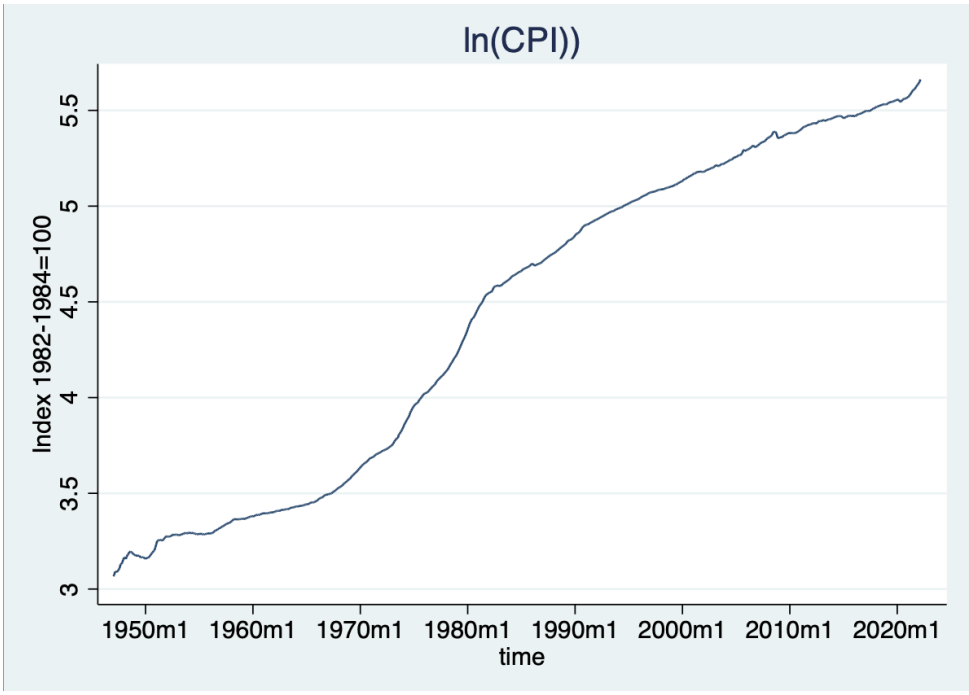
[2]

Appendix 1: Graph of CPI

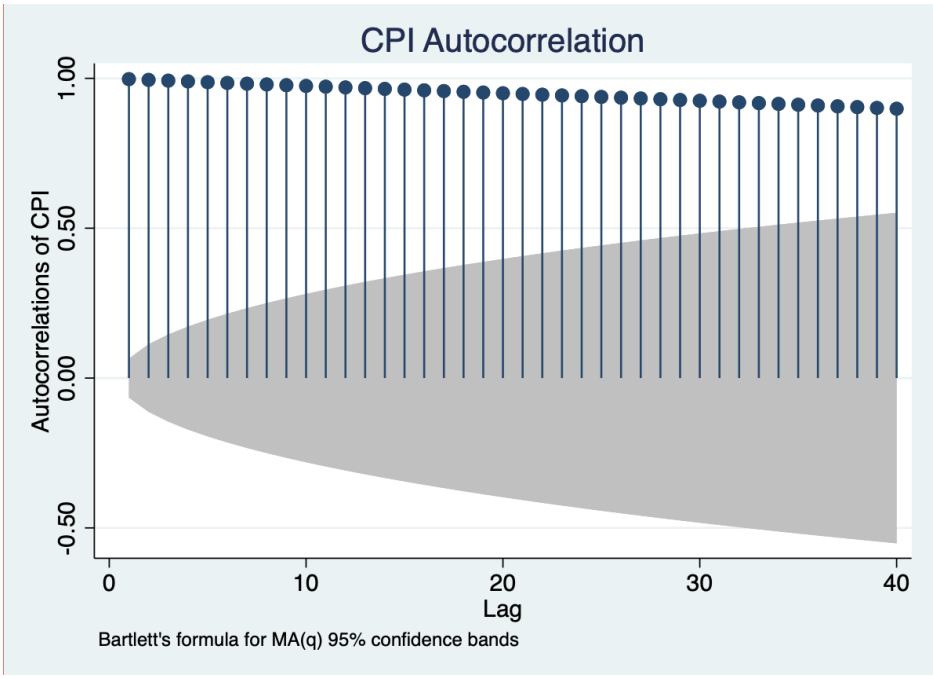


[2] Figure 2 is a graphical representation of the data in Figure 1.

Appendix 2: Graph of ln(CPI)



Appendix 3: CPI Autocorrelation Function



Appendix 4: Stata .do file and Output

```
-------------------------------------------------------------------------------
> -------------------
      name:  <unnamed>
       log:  /Users/andrewpeterson/Desktop/Stata-Workspace/econ460/project2.lo
> g
  log type:  text
 opened on:   6 May 2022, 18:53:06

.
. freduse CPIAUCSL
(903 observations read)

. rename CPIAUCSL cpi

.
. tsmktim time, start(1947m1)

Time variable: time, 1947m1 to 2022m3
        Delta: 1 month

. tsset time

Time variable: time, 1947m1 to 2022m3
        Delta: 1 month

.
. describe

Contains data
 Observations:           903
    Variables:             4
-------------------------------------------------------------------------------
> -------------------
Variable      Storage   Display    Value
    name         type    format    label      Variable label
-------------------------------------------------------------------------------
> -------------------
date            str10   %10s                  fed string date
cpi             double  %10.0g                Consumer Price Index for All Urb
> an Consumers: All
                                                Items in U.S. City Average
daten           float   %td                   numeric (daily) date
time            float   %tm
-------------------------------------------------------------------------------
> -------------------
Sorted by: time
     Note: Dataset has changed since last saved.
```

```
. // browse
. // summarize
.
. tsappend, add(12)

.
. generate x = cpi
(12 missing values generated)

.
. generate y = ln(cpi)
(12 missing values generated)

.
. tsline x, title("CPI from FRED")

. graph rename cpi

.
. tsline y, title("ln(CPI))")

. graph rename ln_cpi

.
. ac y, title("CPI Autocorrelation")

. graph rename cpi_autocorrelation

.
.
. // test aic and bic to find the best model
. regress y if time>=tm(1947m1), r

Linear regression                               Number of obs     =        903
                                                F(0, 902)         =       0.00
                                                Prob > F          =          .
                                                R-squared         =     0.0000
                                                Root MSE          =     .85378

------------------------------------------------------------------------------
             |               Robust
           y | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
       _cons |   4.422797   .0284122   155.67   0.000     4.367035    4.478558
------------------------------------------------------------------------------
```

```
. estimates store ar0

.
. regress y time L.y if time>=tm(1947m1), r

Linear regression                               Number of obs     =        902
                                                F(2, 899)         >   99999.00
                                                Prob > F          =     0.0000
                                                R-squared         =     1.0000
                                                Root MSE          =     .00343

------------------------------------------------------------------------------
             |               Robust
           y | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |  -2.63e-06   2.19e-06    -1.20   0.229    -6.93e-06    1.66e-06
             |
           y |
         L1. |   1.000551   .0006152  1626.51   0.000     .9993437    1.001758
             |
       _cons |   .0012185   .0020815     0.59   0.558    -.0028666    .0053036
------------------------------------------------------------------------------

. estimates store ar1

.
. regress y time L(1/2).y if time>=tm(1947m1), r

Linear regression                               Number of obs     =        901
                                                F(3, 897)         >   99999.00
                                                Prob > F          =     0.0000
                                                R-squared         =     1.0000
                                                Root MSE          =      .0028

------------------------------------------------------------------------------
             |               Robust
           y | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   5.30e-08   1.83e-06     0.03   0.977    -3.53e-06    3.64e-06
             |
           y |
         L1. |   1.582806   .0473105    33.46   0.000     1.489954    1.675658
         L2. |  -.5829132   .0473185   -12.32   0.000     -.675781   -.4900454
             |
       _cons |    .001661   .0017461     0.95   0.342    -.0017659    .0050879
------------------------------------------------------------------------------
```

```
. estimates store ar2

.
. regress y time L(1/3).y if time>=tm(1947m1), r

Linear regression                               Number of obs     =        900
                                                F(4, 895)         >   99999.00
                                                Prob > F          =     0.0000
                                                R-squared         =     1.0000
                                                Root MSE          =     .00275

------------------------------------------------------------------------------
             |               Robust
           y | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   6.55e-07   1.80e-06     0.36   0.716    -2.88e-06    4.19e-06
             |
           y |
         L1. |   1.511166   .0575492    26.26   0.000     1.398218    1.624113
         L2. |  -.3936845   .0951505    -4.14   0.000    -.5804285   -.2069405
         L3. |  -.1177317   .0488717    -2.41   0.016    -.2136482   -.0218152
             |
       _cons |   .0019705   .0017219     1.14   0.253    -.0014089      .00535
------------------------------------------------------------------------------

. estimates store ar3

.
. regress y time L(1/4).y if time>=tm(1947m1), r

Linear regression                               Number of obs     =        899
                                                F(5, 893)         >   99999.00
                                                Prob > F          =     0.0000
                                                R-squared         =     1.0000
                                                Root MSE          =      .0027

------------------------------------------------------------------------------
             |               Robust
           y | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   8.92e-07   1.74e-06     0.51   0.609    -2.53e-06    4.31e-06
             |
           y |
         L1. |   1.513002   .0566027    26.73   0.000     1.401912    1.624092
         L2. |   -.479042   .0941492    -5.09   0.000    -.6638214   -.2942625
         L3. |   .1144011   .0853891     1.34   0.181    -.0531856    .2819878
         L4. |  -.1486882   .0473101    -3.14   0.002    -.2415402   -.0558363
             |
       _cons |   .0020581   .0017014     1.21   0.227    -.0012812    .0053974
```

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

. estimates store ar4

.
. regress y time L(1/5).y if time>=tm(1947m1), r

Linear regression                               Number of obs     =        898
                                                F(6, 891)         >   99999.00
                                                Prob > F          =     0.0000
                                                R-squared         =     1.0000
                                                Root MSE          =     .00268

------------------------------------------------------------------------------
             |               Robust
           y | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   1.14e-06   1.76e-06     0.65   0.519    -2.32e-06    4.59e-06
             |
           y |
         L1. |   1.488532   .0598443    24.87   0.000      1.37108    1.605984
         L2. |  -.4458292   .0960157    -4.64   0.000    -.6342726   -.2573859
         L3. |    .050001   .0871346     0.57   0.566     -.121012     .221014
         L4. |   .0147856   .0878471     0.17   0.866    -.1576258    .1871971
         L5. |  -.1078893   .0522904    -2.06   0.039    -.2105161   -.0052625
             |
       _cons |   .0022086   .0016985     1.30   0.194     -.001125    .0055422
------------------------------------------------------------------------------

. estimates store ar5

.
. regress y time L(1/6).y if time>=tm(1947m1),r

Linear regression                               Number of obs     =        897
                                                F(7, 889)         >   99999.00
                                                Prob > F          =     0.0000
                                                R-squared         =     1.0000
                                                Root MSE          =     .00267
```

```
------------------------------------------------------------------------------
             |               Robust
           y | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   1.55e-06   1.77e-06     0.88   0.381    -1.92e-06    5.02e-06
             |
           y |
         L1. |   1.480202   .0612142    24.18   0.000     1.360061    1.600343
         L2. |  -.4425083   .0957369    -4.62   0.000    -.6304049   -.2546116
         L3. |   .0410465   .0885411     0.46   0.643    -.1327276    .2148205
         L4. |  -.0184738   .0872152    -0.21   0.832    -.1896455    .1526978
         L5. |   .0423117   .0782278     0.54   0.589     -.111221    .1958445
         L6. |  -.1030847    .046761    -2.20   0.028    -.1948596   -.0113098
             |
       _cons |   .0024731   .0016953     1.46   0.145    -.0008542    .0058003
------------------------------------------------------------------------------

. estimates store ar6

.
. regress y time L(1/7).y if time>=tm(1947m1),r

Linear regression                               Number of obs     =        896
                                                F(8, 887)         >   99999.00
                                                Prob > F          =     0.0000
                                                R-squared         =     1.0000
                                                Root MSE          =     .00266

------------------------------------------------------------------------------
             |               Robust
           y | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   1.89e-06   1.74e-06     1.09   0.278    -1.53e-06    5.31e-06
             |
           y |
         L1. |   1.469883   .0621121    23.67   0.000     1.347979    1.591787
         L2. |  -.4355676   .0960885    -4.53   0.000    -.6241549   -.2469804
         L3. |    .038369   .0875908     0.44   0.661    -.1335404    .2102783
         L4. |  -.0188853   .0875836    -0.22   0.829    -.1907806      .15301
         L5. |    .008419   .0822318     0.10   0.918    -.1529726    .1698107
         L6. |   .0261994    .096067     0.27   0.785    -.1623456    .2147445
         L7. |  -.0890175   .0548467    -1.62   0.105    -.1966619    .0186269
             |
       _cons |   .0027142   .0016779     1.62   0.106    -.0005789    .0060073
------------------------------------------------------------------------------
```

```
. estimates store ar7

.
. regress y time L(1/8).y if time>=tm(1947m1),r

Linear regression                               Number of obs     =        895
                                                F(9, 885)         >   99999.00
                                                Prob > F          =     0.0000
                                                R-squared         =     1.0000
                                                Root MSE          =     .00265

------------------------------------------------------------------------------
             |               Robust
           y | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   2.27e-06   1.73e-06     1.31   0.190    -1.13e-06    5.67e-06
             |
           y |
         L1. |   1.460417   .0623541    23.42   0.000     1.338037    1.582796
         L2. |   -.432822   .0961771    -4.50   0.000    -.6215837   -.2440602
         L3. |   .0423785   .0881895     0.48   0.631    -.1307065    .2154635
         L4. |  -.0211976   .0868168    -0.24   0.807    -.1915884    .1491932
         L5. |   .0059474   .0840951     0.07   0.944    -.1591016    .1709964
         L6. |  -.0077954   .1004028    -0.08   0.938    -.2048508      .18926
         L7. |   .0462792   .1009597     0.46   0.647    -.1518692    .2444275
         L8. |  -.0939078   .0569317    -1.65   0.099    -.2056447    .0178291
             |
       _cons |    .002988    .001671     1.79   0.074    -.0002916    .0062676
------------------------------------------------------------------------------

. estimates store ar8

.
. regress y time L(1/9).y if time>=tm(1947m1),r

Linear regression                               Number of obs     =        894
                                                F(10, 883)        >   99999.00
                                                Prob > F          =     0.0000
                                                R-squared         =     1.0000
                                                Root MSE          =      .0026
```

```
------------------------------------------------------------------------------
             |               Robust
           y | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   2.81e-06   1.72e-06     1.63   0.103    -5.68e-07    6.20e-06
             |
           y |
         L1. |   1.448421   .0620725    23.33   0.000     1.326594    1.570248
         L2. |  -.4256651   .0957317    -4.45   0.000    -.6135532   -.2377769
         L3. |   .0364757   .0889797     0.41   0.682    -.1381607    .2111121
         L4. |   .0015135   .0860848     0.02   0.986    -.1674412    .1704681
         L5. |   .0067462   .0842967     0.08   0.936    -.1586992    .1721915
         L6. |  -.0574047   .0892548    -0.64   0.520    -.2325809    .1177716
         L7. |   .0594525   .0953075     0.62   0.533    -.1276033    .2465082
         L8. |   .0005011   .0831061     0.01   0.995    -.1626076    .1636097
         L9. |  -.0708726   .0388677    -1.82   0.069    -.1471565    .0054114
             |
       _cons |   .0033672   .0016667     2.02   0.044     .0000961    .0066384
------------------------------------------------------------------------------

. estimates store ar9

.
. regress y time L(1/10).y if time>=tm(1947m1),r

Linear regression                               Number of obs     =        893
                                                F(11, 881)        >   99999.00
                                                Prob > F          =     0.0000
                                                R-squared         =     1.0000
                                                Root MSE          =     .00256

------------------------------------------------------------------------------
             |               Robust
           y | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   3.08e-06   1.71e-06     1.80   0.072    -2.74e-07    6.44e-06
             |
           y |
         L1. |    1.45889   .0604415    24.14   0.000     1.340264    1.577516
         L2. |  -.4504831     .09426    -4.78   0.000    -.6354836   -.2654827
         L3. |   .0451048   .0862481     0.52   0.601    -.1241709    .2143805
         L4. |   .0034788   .0831631     0.04   0.967    -.1597422    .1666997
         L5. |  -.0057763   .0810915    -0.07   0.943    -.1649315    .1533788
         L6. |  -.0635437   .0880846    -0.72   0.471    -.2364238    .1093365
         L7. |   .1024191   .0904915     1.13   0.258     -.075185    .2800231
         L8. |  -.0834838   .0808066    -1.03   0.302    -.2420797     .075112
         L9. |   .1215453   .0649197     1.87   0.062      -.00587    .2489606
        L10. |  -.1290718   .0388334    -3.32   0.001    -.2052885    -.052855
             |
```

```
       _cons |   .0035903   .0016517     2.17   0.030     .0003485    .0068321
------------------------------------------------------------------------------

. estimates store ar10

.
. regress y time L(1/11).y if time>=tm(1947m1),r

Linear regression                               Number of obs     =        892
                                                F(12, 879)        >   99999.00
                                                Prob > F          =     0.0000
                                                R-squared         =     1.0000
                                                Root MSE          =     .00255

------------------------------------------------------------------------------
             |               Robust
           y | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   3.57e-06   1.73e-06     2.07   0.039     1.79e-07    6.96e-06
             |
           y |
         L1. |   1.449651   .0614513    23.59   0.000     1.329043     1.57026
         L2. |  -.4502919   .0961906    -4.68   0.000    -.6390819   -.2615018
         L3. |   .0498737   .0888662     0.56   0.575     -.124541    .2242884
         L4. |   .0036028   .0813187     0.04   0.965    -.1559986    .1632042
         L5. |  -.0069576   .0782414    -0.09   0.929    -.1605195    .1466042
         L6. |  -.0582275   .0851387    -0.68   0.494    -.2253263    .1088713
         L7. |   .0990836   .0904994     1.09   0.274    -.0785367    .2767038
         L8. |  -.0874038   .0843609    -1.04   0.300    -.2529762    .0781686
         L9. |   .0888051   .0674843     1.32   0.189    -.0436441    .2212544
        L10. |   .0085365    .065488     0.13   0.896    -.1199945    .1370676
        L11. |  -.0977262    .038526    -2.54   0.011    -.1733399   -.0221126
             |
       _cons |   .0039853   .0016628     2.40   0.017     .0007217    .0072489
------------------------------------------------------------------------------

. estimates store ar11
```

```
.
. regress y time L(1/12).y if time>=tm(1947m1),r

Linear regression                               Number of obs     =        891
                                                F(13, 877)        >   99999.00
                                                Prob > F          =     0.0000
                                                R-squared         =     1.0000
                                                Root MSE          =     .00254

------------------------------------------------------------------------------
             |               Robust
           y | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   3.65e-06   1.74e-06     2.09   0.036     2.30e-07    7.07e-06
             |
           y |
         L1. |   1.448317   .0610664    23.72   0.000     1.328464     1.56817
         L2. |  -.4316041   .0947499    -4.56   0.000    -.6175672    -.245641
         L3. |   .0068347   .0822067     0.08   0.934    -.1545101    .1681795
         L4. |   .0366986   .0768994     0.48   0.633    -.1142296    .1876269
         L5. |    -.01439   .0767257    -0.19   0.851    -.1649775    .1361975
         L6. |    -.06074   .0846034    -0.72   0.473    -.2267888    .1053088
         L7. |   .1124253    .089442     1.26   0.209    -.0631201    .2879707
         L8. |   -.083409   .0839433    -0.99   0.321    -.2481621    .0813442
         L9. |   .0509965   .0611875     0.83   0.405    -.0690945    .1710876
        L10. |   .0489537      .0647     0.76   0.449    -.0780312    .1759385
        L11. |   -.141336   .0784219    -1.80   0.072    -.2952525    .0125805
        L12. |   .0261893   .0471709     0.56   0.579    -.0663918    .1187704
             |
       _cons |   .0040258   .0016712     2.41   0.016     .0007459    .0073058
------------------------------------------------------------------------------

. estimates store ar12

.
. estimates stats ar0 ar1 ar2 ar3 ar4 ar5 ar6 ar7 ar8 ar9 ar10 ar11 ar12

Akaike's information criterion and Bayesian information criterion
```

```
-----------------------------------------------------------------------------
       Model |          N   ll(null)  ll(model)      df        AIC        BIC
-------------+---------------------------------------------------------------
         ar0 |        903  -1138.058  -1138.058       1   2278.117   2282.922
         ar1 |        902  -1136.034   3839.704       3  -7673.409  -7658.995
         ar2 |        901  -1134.018   4020.062       4  -8032.124   -8012.91
         ar3 |        900   -1132.03   4031.329       5  -8052.658  -8028.646
         ar4 |        899  -1130.038   4044.684       6  -8077.368   -8048.56
         ar5 |        898  -1128.037   4046.753       7  -8079.505  -8045.904
         ar6 |        897  -1126.044   4047.826       8  -8079.653   -8041.26
         ar7 |        896  -1124.059     4046.7       9  -8075.399  -8032.218
         ar8 |        895  -1122.085   4046.134      10  -8072.268    -8024.3
         ar9 |        894  -1120.142   4057.652      11  -8093.304  -8040.551
        ar10 |        893  -1118.201   4066.661      12  -8109.322  -8051.787
        ar11 |        892  -1116.269   4066.799      13  -8107.598  -8045.283
        ar12 |        891   -1114.36   4068.081      14  -8108.163   -8041.07
-----------------------------------------------------------------------------
Note: BIC uses N = number of observations. See [R] BIC note.

.
. // use an AR(10) model because AIC is lowest for AR(10)
.
. regress y time L(1/10).y

      Source |       SS           df       MS      Number of obs   =       893
-------------+----------------------------------   F(11, 881)      >  99999.00
       Model |  639.745822        11  58.1587111   Prob > F        =    0.0000
    Residual |  .005792715       881  6.5752e-06   R-squared       =    1.0000
-------------+----------------------------------   Adj R-squared   =    1.0000
       Total |  639.751615       892   .71721033   Root MSE        =    .00256

------------------------------------------------------------------------------
           y | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   3.08e-06   1.79e-06     1.72   0.086    -4.37e-07    6.60e-06
             |
           y |
         L1. |    1.45889   .0332628    43.86   0.000     1.393606    1.524173
         L2. |  -.4504831   .0581463    -7.75   0.000    -.5646045   -.3363617
         L3. |   .0451048   .0593502     0.76   0.447    -.0713794     .161589
         L4. |   .0034788    .059332     0.06   0.953    -.1129698    .1199274
         L5. |  -.0057763   .0593284    -0.10   0.922    -.1222178    .1106651
         L6. |  -.0635437   .0592094    -1.07   0.283    -.1797516    .0526643
         L7. |   .1024191   .0592723     1.73   0.084    -.0139123    .2187505
         L8. |  -.0834838   .0583922    -1.43   0.153     -.198088    .0311203
         L9. |   .1215453   .0561556     2.16   0.031      .011331    .2317597
        L10. |  -.1290718   .0320957    -4.02   0.000    -.1920647   -.0660788
             |
       _cons |   .0035903   .0018799     1.91   0.056    -.0000994      .00728
```

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

. predict y1
(option xb assumed; fitted values)
(21 missing values generated)

. predict sf1,stdf
(21 missing values generated)

. generate y1L=y1-1.645*sf1
(21 missing values generated)

. generate y1U=y1+1.645*sf1
(21 missing values generated)

.
. regress y time L(2/11).y

      Source |       SS           df       MS      Number of obs   =       892
-------------+----------------------------------   F(11, 880)      >  99999.00
       Model |   638.04309        11  58.0039172   Prob > F        =    0.0000
    Residual |  .017837883       880   .00002027   R-squared       =    1.0000
-------------+----------------------------------   Adj R-squared   =    1.0000
       Total |  638.060927       891  .716117764   Root MSE        =     .0045

------------------------------------------------------------------------------
           y | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   7.67e-06   3.15e-06     2.43   0.015     1.48e-06    .0000139
             |
           y |
         L2. |   1.661922   .0584233    28.45   0.000     1.547257    1.776587
         L3. |  -.6004638   .1021056    -5.88   0.000    -.8008628   -.4000648
         L4. |   .0696008   .1042081     0.67   0.504    -.1349247    .2741263
         L5. |  -.0031081    .104178    -0.03   0.976    -.2075743    .2013582
         L6. |  -.0709581   .1041995    -0.68   0.496    -.2754666    .1335504
         L7. |   .0145226   .1040514     0.14   0.889    -.1896952    .2187404
         L8. |   .0599704   .1040727     0.58   0.565    -.1442893    .2642302
         L9. |  -.0318404   .1025258    -0.31   0.756    -.2330641    .1693833
        L10. |   .1776195   .0986836     1.80   0.072    -.0160631    .3713022
        L11. |  -.2795629   .0564356    -4.95   0.000     -.390327   -.1687987
             |
       _cons |    .008901   .0033018     2.70   0.007     .0024206    .0153814
------------------------------------------------------------------------------
```

```
. predict y2
(option xb assumed; fitted values)
(21 missing values generated)

. predict sf2,stdf
(21 missing values generated)

. generate y2L=y2-1.645*sf2
(21 missing values generated)

. generate y2U=y2+1.645*sf2
(21 missing values generated)

.
. regress y time L(3/12).y

      Source |       SS           df       MS      Number of obs   =       891
-------------+----------------------------------   F(11, 879)      >  99999.00
       Model |  636.371885        11  57.8519896   Prob > F        =    0.0000
    Residual |  .033572205       879  .000038194   R-squared       =    0.9999
-------------+----------------------------------   Adj R-squared   =    0.9999
       Total |  636.405458       890  .715062312   Root MSE        =    .00618

------------------------------------------------------------------------------
           y | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |    .000013   4.34e-06     3.00   0.003     4.51e-06    .0000215
             |
           y |
         L3. |   1.783432   .0802004    22.24   0.000     1.626025    1.940838
         L4. |  -.6368718   .1401641    -4.54   0.000    -.9119671   -.3617765
         L5. |   .0649271   .1430469     0.45   0.650    -.2158262    .3456804
         L6. |  -.0724314   .1430431    -0.51   0.613    -.3531773    .2083145
         L7. |   .0239252   .1431558     0.17   0.867    -.2570419    .3048923
         L8. |  -.0384648   .1428297    -0.27   0.788    -.3187918    .2418623
         L9. |   .0940868   .1428572     0.66   0.510    -.1862943    .3744678
        L10. |   .0296856   .1408288     0.21   0.833    -.2467143    .3060855
        L11. |   .0706972   .1354912     0.52   0.602    -.1952268    .3366211
        L12. |  -.3228762   .0774733    -4.17   0.000    -.4749305   -.1708219
             |
       _cons |   .0150327   .0045342     3.32   0.001     .0061336    .0239318
------------------------------------------------------------------------------
```

```
. predict y3
(option xb assumed; fitted values)
(21 missing values generated)

. predict sf3,stdf
(21 missing values generated)

. generate y3L=y3-1.645*sf3
(21 missing values generated)

. generate y3U=y3+1.645*sf3
(21 missing values generated)

.
. regress y time L(4/13).y

      Source |       SS           df       MS      Number of obs   =       890
-------------+----------------------------------   F(11, 878)      >  99999.00
       Model |  634.723438        11  57.7021308   Prob > F        =    0.0000
    Residual |  .052257392       878  .000059519   R-squared       =    0.9999
-------------+----------------------------------   Adj R-squared   =    0.9999
       Total |  634.775696       889  .714033403   Root MSE        =    .00771

------------------------------------------------------------------------------
           y | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   .0000181   5.43e-06     3.34   0.001     7.46e-06    .0000288
             |
           y |
         L4. |   1.924334   .1001171    19.22   0.000     1.727837    2.120831
         L5. |  -.6825371   .1749729    -3.90   0.000    -1.025951   -.3391231
         L6. |  -.0060952    .178625    -0.03   0.973    -.3566771    .3444867
         L7. |   .0230004   .1787206     0.13   0.898    -.3277691      .37377
         L8. |  -.0239283   .1787082    -0.13   0.894    -.3746735    .3268169
         L9. |  -.0045311   .1782994    -0.03   0.980    -.3544738    .3454117
        L10. |   .1367909   .1784669     0.77   0.444    -.2134805    .4870624
        L11. |  -.0017856   .1758588    -0.01   0.992    -.3469382    .3433671
        L12. |  -.1943267   .1691403    -1.15   0.251    -.5262933    .1376399
        L13. |  -.1763351   .0967231    -1.82   0.069    -.3661706    .0135004
             |
       _cons |   .0210863   .0056629     3.72   0.000     .0099719    .0322006
------------------------------------------------------------------------------
```

```
. predict y4
(option xb assumed; fitted values)
(21 missing values generated)

. predict sf4,stdf
(21 missing values generated)

. generate y4L=y4-1.645*sf4
(21 missing values generated)

. generate y4U=y4+1.645*sf4
(21 missing values generated)

.
. regress y time L(5/14).y

      Source |       SS           df       MS      Number of obs   =       889
-------------+----------------------------------   F(11, 877)      >  99999.00
       Model |  633.067109        11  57.5515554   Prob > F        =    0.0000
    Residual |  .074077489       877  .000084467   R-squared       =    0.9999
-------------+----------------------------------   Adj R-squared   =    0.9999
       Total |  633.141187       888  .712996832   Root MSE        =    .00919

------------------------------------------------------------------------------
           y | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   .0000233   6.49e-06     3.59   0.000     .0000106     .000036
             |
           y |
         L5. |    2.10068    .119269    17.61   0.000     1.866594    2.334766
         L6. |  -.8343481   .2085121    -4.00   0.000    -1.243589   -.4251072
         L7. |    .098777   .2129776     0.46   0.643    -.3192283    .5167823
         L8. |  -.0226085   .2129098    -0.11   0.915    -.4404809    .3952638
         L9. |  -.0006862    .212893    -0.00   0.997    -.4185256    .4171531
        L10. |   .0304672   .2125628     0.14   0.886    -.3867239    .4476582
        L11. |   .1399795   .2126711     0.66   0.511    -.2774242    .5573832
        L12. |  -.2789834   .2094986    -1.33   0.183    -.6901606    .1321939
        L13. |  -.0914518    .201496    -0.45   0.650    -.4869225    .3040189
        L14. |  -.1487976    .115237    -1.29   0.197    -.3749701    .0773749
             |
       _cons |   .0273509   .0067495     4.05   0.000     .0141037     .040598
------------------------------------------------------------------------------
```

```
. predict y5
(option xb assumed; fitted values)
(21 missing values generated)

. predict sf5,stdf
(21 missing values generated)

. generate y5L=y5-1.645*sf5
(21 missing values generated)

. generate y5U=y5+1.645*sf5
(21 missing values generated)

.
. regress y time L(6/15).y

      Source |       SS           df       MS      Number of obs   =       888
-------------+----------------------------------   F(11, 876)      >  99999.00
       Model |  631.384563        11  57.3985967   Prob > F        =    0.0000
    Residual |  .099918765       876  .000114063   R-squared       =    0.9998
-------------+----------------------------------   Adj R-squared   =    0.9998
       Total |  631.484482       887    .7119329   Root MSE        =    .01068

------------------------------------------------------------------------------
           y | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   .0000285   7.55e-06     3.78   0.000     .0000137    .0000434
             |
           y |
         L6. |   2.227759    .138778    16.05   0.000     1.955383    2.500136
         L7. |  -.8341028   .2425337    -3.44   0.001    -1.310118   -.3580879
         L8. |   .0667579    .247495     0.27   0.787    -.4189946    .5525104
         L9. |   .0036936   .2474139     0.01   0.988    -.4818996    .4892869
        L10. |   .0184948   .2475742     0.07   0.940     -.467413    .5044027
        L11. |   .0228434   .2470865     0.09   0.926    -.4621073     .507794
        L12. |  -.0866995   .2471366    -0.35   0.726    -.5717487    .3983496
        L13. |  -.2056596   .2434529    -0.84   0.398    -.6834787    .2721595
        L14. |  -.0844847   .2341796    -0.36   0.718    -.5441032    .3751339
        L15. |   -.137182   .1339178    -1.02   0.306    -.4000193    .1256552
             |
       _cons |   .0338874   .0078472     4.32   0.000      .018486    .0492888
------------------------------------------------------------------------------
```

```
. predict y6
(option xb assumed; fitted values)
(21 missing values generated)

. predict sf6,stdf
(21 missing values generated)

. generate y6L=y6-1.645*sf6
(21 missing values generated)

. generate y6U=y6+1.645*sf6
(21 missing values generated)

.
. regress y time L(7/16).y

      Source |       SS           df       MS      Number of obs   =       887
-------------+----------------------------------   F(11, 875)      >  99999.00
       Model |  629.729857        11  57.2481688   Prob > F        =    0.0000
    Residual |  .128878636       875   .00014729   R-squared       =    0.9998
-------------+----------------------------------   Adj R-squared   =    0.9998
       Total |  629.858735       886  .710901507   Root MSE        =    .01214

------------------------------------------------------------------------------
           y | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   .0000342   8.60e-06     3.98   0.000     .0000173    .0000511
             |
           y |
         L7. |   2.387637   .1577016    15.14   0.000     2.078119    2.697154
         L8. |  -.8953414    .275613    -3.25   0.001    -1.436281   -.3544016
         L9. |   .0939886   .2812428     0.33   0.738    -.4580007     .645978
        L10. |   .0122549   .2813551     0.04   0.965    -.5399547    .5644645
        L11. |   .0293067   .2814179     0.10   0.917    -.5230263    .5816397
        L12. |  -.2121946   .2807786    -0.76   0.450    -.7632729    .3388836
        L13. |  -.0304454   .2808402    -0.11   0.914    -.5816446    .5207538
        L14. |  -.2148541   .2766647    -0.78   0.438    -.7578579    .3281498
        L15. |    .059004   .2661346     0.22   0.825    -.4633328    .5813407
        L16. |  -.2396783   .1522083    -1.57   0.116    -.5384143    .0590577
             |
       _cons |    .040907   .0089222     4.58   0.000     .0233955    .0584185
------------------------------------------------------------------------------
```

```
. predict y7
(option xb assumed; fitted values)
(21 missing values generated)

. predict sf7,stdf
(21 missing values generated)

. generate y7L=y7-1.645*sf7
(21 missing values generated)

. generate y7U=y7+1.645*sf7
(21 missing values generated)

.
. regress y time L(8/17).y

      Source |       SS           df       MS      Number of obs   =       886
-------------+----------------------------------   F(11, 874)      >  99999.00
       Model |  628.087673        11  57.0988794   Prob > F        =    0.0000
    Residual |   .16187688       874  .000185214   R-squared       =    0.9997
-------------+----------------------------------   Adj R-squared   =    0.9997
       Total |   628.24955       885  .709886497   Root MSE        =    .01361

------------------------------------------------------------------------------
           y | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   .0000407   9.67e-06     4.21   0.000     .0000217    .0000597
             |
           y |
         L8. |   2.549556   .1768663    14.42   0.000     2.202424    2.896689
         L9. |  -.9331907   .3090652    -3.02   0.003    -1.539788   -.3265939
        L10. |   .1096883   .3156044     0.35   0.728    -.5097427    .7291194
        L11. |   .0217538   .3156002     0.07   0.945    -.5976691    .6411767
        L12. |  -.2027355   .3155748    -0.64   0.521    -.8221084    .4166374
        L13. |  -.1672518   .3148631    -0.53   0.595     -.785228    .4507244
        L14. |  -.0266918    .314948    -0.08   0.932    -.6448345    .5914509
        L15. |  -.1093604    .310265    -0.35   0.725    -.7183119    .4995912
        L16. |   .0787541   .2984542     0.26   0.792    -.5070166    .6645247
        L17. |  -.3328085   .1706823    -1.95   0.052    -.6678037    .0021866
             |
       _cons |   .0486964   .0100109     4.86   0.000     .0290482    .0683445
------------------------------------------------------------------------------
```

```
. predict y8
(option xb assumed; fitted values)
(21 missing values generated)

. predict sf8,stdf
(21 missing values generated)

. generate y8L=y8-1.645*sf8
(21 missing values generated)

. generate y8U=y8+1.645*sf8
(21 missing values generated)

.
. regress y time L(9/18).y

      Source |       SS           df       MS      Number of obs   =       885
-------------+----------------------------------   F(11, 873)      >  99999.00
       Model |  626.452087        11  56.9501897   Prob > F        =    0.0000
    Residual |  .199382457       873  .000228388   R-squared       =    0.9997
-------------+----------------------------------   Adj R-squared   =    0.9997
       Total |   626.65147       884  .708881753   Root MSE        =    .01511

------------------------------------------------------------------------------
           y | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   .0000477   .0000108     4.43   0.000     .0000266    .0000688
             |
           y |
         L9. |    2.74927   .1964475    13.99   0.000     2.363705    3.134834
        L10. |  -.9920734   .3435312    -2.89   0.004    -1.666317   -.3178299
        L11. |   .1264704   .3505782     0.36   0.718    -.5616043     .814545
        L12. |   -.210121    .350459    -0.60   0.549    -.8979616    .4777196
        L13. |  -.1605136   .3504375    -0.46   0.647     -.848312    .5272848
        L14. |  -.1744144   .3496596    -0.50   0.618     -.860686    .5118572
        L15. |   .1015672   .3497717     0.29   0.772    -.5849244    .7880589
        L16. |  -.1144246   .3445939    -0.33   0.740     -.790754    .5619048
        L17. |   .0290145   .3315051     0.09   0.930    -.6216256    .6796546
        L18. |   -.369188   .1896103    -1.95   0.052    -.7413332    .0029573
             |
       _cons |   .0570948   .0111216     5.13   0.000     .0352666    .0789231
------------------------------------------------------------------------------
```

```
. predict y9
(option xb assumed; fitted values)
(21 missing values generated)

. predict sf9,stdf
(21 missing values generated)

. generate y9L=y9-1.645*sf9
(21 missing values generated)

. generate y9U=y9+1.645*sf9
(21 missing values generated)

.
. regress y time L(10/19).y

      Source |       SS           df       MS      Number of obs   =       884
-------------+----------------------------------   F(11, 872)      >  99999.00
       Model |  624.832712        11  56.8029738   Prob > F        =    0.0000
    Residual |   .24303835       872  .000278714   R-squared       =    0.9996
-------------+----------------------------------   Adj R-squared   =    0.9996
       Total |   625.07575       883  .707900057   Root MSE        =    .01669

------------------------------------------------------------------------------
           y | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   .0000555   .0000119     4.66   0.000     .0000321    .0000789
             |
           y |
         L10. |   2.974485   .2172741    13.69   0.000     2.548044    3.400927
         L11. |  -1.054734   .3795916    -2.78   0.006    -1.799754   -.3097138
         L12. |   -.099288   .3872824    -0.26   0.798    -.8594026    .6608267
         L13. |  -.1687557    .387159    -0.44   0.663     -.928628    .5911167
         L14. |  -.1635436   .3871519    -0.42   0.673    -.9234021     .596315
         L15. |  -.0582244    .386303    -0.15   0.880    -.8164166    .6999679
         L16. |   .1028883   .3864561     0.27   0.790    -.6556046    .8613812
         L17. |  -.1710897   .3807247    -0.45   0.653    -.9183337    .5761543
         L18. |   .0184805   .3662184     0.05   0.960    -.7002921     .737253
         L19. |  -.3969865   .2095449    -1.89   0.058    -.8082578    .0142848
             |
       _cons |   .0663402   .0122898     5.40   0.000     .0422192    .0904612
------------------------------------------------------------------------------
```

```
. predict y10
(option xb assumed; fitted values)
(21 missing values generated)

. predict sf10,stdf
(21 missing values generated)

. generate y10L=y10-1.645*sf10
(21 missing values generated)

. generate y10U=y10+1.645*sf10
(21 missing values generated)

.
. regress y time L(11/20).y

      Source |       SS           df       MS      Number of obs   =       883
-------------+----------------------------------   F(11, 871)      >  99999.00
       Model |  623.205567        11  56.6550515   Prob > F        =    0.0000
    Residual |  .293983617       871  .000337524   R-squared       =    0.9995
-------------+----------------------------------   Adj R-squared   =    0.9995
       Total |  623.499551       882   .70691559   Root MSE        =    .01837

------------------------------------------------------------------------------
           y | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   .0000632   .0000131     4.81   0.000     .0000374     .000089
             |
           y |
         L11. |   3.244455   .2392235    13.56   0.000     2.774933    3.713977
         L12. |  -1.389035    .417752    -3.33   0.001    -2.208953    -.569117
         L13. |  -.0475338   .4262003    -0.11   0.911    -.8840334    .7889657
         L14. |   -.168014   .4260798    -0.39   0.693    -1.004277    .6682492
         L15. |  -.0508016   .4260828    -0.12   0.905    -.8870707    .7854675
         L16. |  -.0749539   .4251699    -0.18   0.860    -.9094313    .7595234
         L17. |   .0862453   .4253227     0.20   0.839    -.7485318    .9210224
         L18. |  -.2060742   .4189797    -0.49   0.623    -1.028402    .6162537
         L19. |   .0004979   .4030565     0.00   0.999    -.7905775    .7915733
         L20. |  -.4139226   .2305956    -1.80   0.073    -.8665106    .0386654
             |
       _cons |   .0757665   .0135302     5.60   0.000     .0492109    .1023222
------------------------------------------------------------------------------
```

```
. predict y11
(option xb assumed; fitted values)
(21 missing values generated)

. predict sf11,stdf
(21 missing values generated)

. generate y11L=y11-1.645*sf11
(21 missing values generated)

. generate y11U=y11+1.645*sf11
(21 missing values generated)

.
. regress y time L(12/21).y

      Source |       SS           df       MS      Number of obs   =       882
-------------+----------------------------------   F(11, 870)      >  99999.00
       Model |   621.55824        11  56.5052945   Prob > F        =    0.0000
    Residual |  .354311136       870  .000407254   R-squared       =    0.9994
-------------+----------------------------------   Adj R-squared   =    0.9994
       Total |  621.912551       881   .70591663   Root MSE        =    .02018

------------------------------------------------------------------------------
           y | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        time |   .0000712   .0000145     4.92   0.000     .0000428    .0000996
             |
           y |
         L12. |   3.311054    .262855    12.60   0.000      2.79515    3.826958
         L13. |  -1.471639   .4588797    -3.21   0.001     -2.37228   -.5709983
         L14. |  -.0296985   .4681862    -0.06   0.949     -.948605    .8892081
         L15. |   -.051703   .4680704    -0.11   0.912    -.9703821    .8669762
         L16. |  -.0788038   .4680991    -0.17   0.866    -.9975393    .8399317
         L17. |  -.1065286   .4670852    -0.23   0.820    -1.023274    .8102169
         L18. |   .0987374    .467201     0.21   0.833    -.8182355     1.01571
         L19. |  -.2667252   .4602564    -0.58   0.562    -1.170068    .6366174
         L20. |   .0265587   .4427697     0.06   0.952    -.8424629    .8955803
         L21. |  -.4528509   .2533367    -1.79   0.074    -.9500733    .0443715
             |
       _cons |   .0856399   .0148707     5.76   0.000     .0564533    .1148265
------------------------------------------------------------------------------
```

```
. predict y12
(option xb assumed; fitted values)
(21 missing values generated)

. predict sf12,stdf
(21 missing values generated)

. generate y12L=y12-1.645*sf12
(21 missing values generated)

. generate y12U=y12+1.645*sf12
(21 missing values generated)

.
.
. egen p=rowfirst(y1 y2 y3 y4 y5 y6 y7 y8 y9 y10 y11 y12) if time>=tm(2022m3)
(902 missing values generated)

. egen pL=rowfirst(y1L y2L y3L y4L y5L y6L y7L y8L y9L y10L y11L y12L) if time
> >=tm(2022m3)
(902 missing values generated)

. egen pU=rowfirst(y1U y2U y3U y4U y5U y6U y7U y8U y9U y10U y11U y12U) if time
> >=tm(2022m3)
(902 missing values generated)

.
. label variable y "consumer price index"

. label variable p "forecast"

. label variable pL "lower forecast interval"

. label variable pU "upper forecast interval"

.
. tsline y p pL pU if time>=tm(2018m1), title(Consumer Price Index) lpattern (
> solid longdash shor
> tdash shortdash)
```

```
. graph rename cpi_prediction

.
. list time pL p pU if time>=tm(2022m4)

     +-----------------------------------------+
     |    time         pL          p         pU |
     |-----------------------------------------|
904. |  2022m4   5.666039   5.670297   5.674556 |
905. |  2022m5   5.669603   5.677082    5.68456 |
906. |  2022m6   5.673034     5.6833   5.693565 |
907. |  2022m7   5.676917   5.689733   5.702548 |
908. |  2022m8   5.681571   5.696838   5.712106 |
     |-----------------------------------------|
909. |  2022m9   5.686102   5.703846    5.72159 |
910. | 2022m10   5.690009   5.710173   5.730338 |
911. | 2022m11     5.6936   5.716213   5.738826 |
912. | 2022m12    5.69732   5.722432   5.747544 |
913. |  2023m1   5.701456   5.729199   5.756943 |
     |-----------------------------------------|
914. |  2023m2   5.705278   5.735812   5.766345 |
915. |  2023m3    5.70744   5.740982   5.774524 |
     +-----------------------------------------+

.
. log close
      name:  <unnamed>
       log:  /Users/andrewpeterson/Desktop/Stata-Workspace/econ460/project2.lo
> g
  log type:  text
 closed on:   6 May 2022, 18:53:11
-------------------------------------------------------------------------------
> -------------------
```