Advanced Topics 1: Time Series Modeling and Forecasting **Problem Set 3--Solution**

1) Information Criterion and Cross Validation

c) Compare model selection using the four criteria. Did they agree in both cases (n=30 and n=300)? For each criterion, are the differences between the "best" model and the next best more or less pronounced with more data?

	N=30				N=300			
Lags	5-Fold* RMSE**	LOOCV RMSE	AIC	BIC	10-Fold RMSE**	LOOCV RMSE	AIC	BIC
1	1.200	1.181	84.905	87.496	0.971	0.973	826.860	834.248
2	1.106	1.161	83.709	86.301	1.030	1.031	860.809	868.196
3	1.179	1.178	83.284	85.876	1.006	1.003	845.514	852.901
1,2	1.208	1.165	83.683	87.571	0.977	0.977	828.387	839.468
1,3	1.102	1.117	81.155	85.043	0.952	0.951	813.588	824.669
2,3	1.007	1.129	81.986	85.874	1.005	1.006	847.514	858.595
1,2,3	0.987	1.002	76.828	82.011	0.948	0.946	811.069	825.844

*I used K=5 because there are only 27 observations, if you leave out the first three to make sure all samples used are based on the same set (30 if you did not).

**To get the K-Fold RMSE, I squared each folds RMSE to get the MSE, averaged them, then took the square root, to get the RMSE as it would be for all out validation set observations if calculated all together. If you just averaged, OK, it will be very close.

Some other things to be aware of:

- You will have different numbers and a different pattern than in my table.
- In both cases, K-fold, LOOCV, and AIC agree on the first choice for my results.
- The BIC selection is "wrong" for n=300. But only slightly.
- Some of you may have gotten more disagreement. Part of the point of this is just to drive home that that can happen and there is no perfect selection criteria.

2) From the table below, we see performance does not differ much across these models by these selection criteria. Model 3 is best if I had to pick one. It is a good bit simpler than 1 or 2, since it drops one variable and has fewer lags than 1.

Model	1	2	3	4
Lags	1/12 0/12	1/12 0/2	1/12 0/2, 12	1/12,24 0/2, 12, 24
FL Bld Permits	Yes	Yes	Yes	No
US EPR	Yes	Yes	No	Yes
10-Fold	0.0039	0.0039	0.0037	0.0039
LOOCV	0.0039	0.0038	0.0038	0.0037
AIC	-2655.729	-2774.178	-2781.418	-2679.016
BIC	-2902.086	-2905.055	-2908.446	-2804.882

Appendix A: Do File

```
*Problem Set 3 Solution

clear
set more off
cd "C:\Users\jdewey\Documents\A S20 Time Series\Problem Sets\"
log using "Problem Set 3 Work", replace


*Question 1a

clear
set obs 30
gen t=[_n]
tsset t
gen r=rnormal()
gen y=r if t<4
replace y=0.5+0.5*l.y-0.1*l2.y+0.25*l3.y+r if t>=4
drop r

*Note, I restrict the sample to t>3 so the same observations
** are compared for each model
crossfold reg y l(1).y if t>3 , k(5)
loocv reg y l(1).y if t>3
reg y l(1).y if t>3
estat ic

crossfold reg y l(2).y if t>3 , k(5)
loocv reg y l(2).y if t>3
reg y l(2).y if t>3
estat ic

crossfold reg y l(3).y if t>3 , k(5)
loocv reg y l(3).y if t>3
reg y l(3).y if t>3
estat ic

crossfold reg y l(1,2).y if t>3 , k(5)
loocv reg y l(1,2).y if t>3
reg y l(1,2).y if t>3
estat ic

crossfold reg y l(1,3).y if t>3 , k(5)
loocv reg y l(1,3).y if t>3
reg y l(1,3).y if t>3
estat ic

crossfold reg y l(2,3).y if t>3 , k(5)
loocv reg y l(2,3).y if t>3
reg y l(2,3).y if t>3
estat ic

crossfold reg y l(1/3).y if t>3 , k(5)
loocv reg y l(1/3).y if t>3
reg y l(1/3).y if t>3
estat ic

*Question 1b

clear
set obs 300
gen t=[_n]
tsset t
```

```
gen r=rnormal()
gen y=r if t<4
replace y=0.5+0.5*l.y-0.1*l2.y+0.25*l3.y+r if t>=4
drop r


crossfold reg y l(1).y if t>3 , k(10)
loocv reg y l(1).y if t>3
reg y l(1).y if t>3
estat ic

crossfold reg y l(2).y if t>3 , k(10)
loocv reg y l(2).y if t>3
reg y l(2).y if t>3
estat ic

crossfold reg y l(3).y if t>3 , k(10)
loocv reg y l(3).y if t>3
reg y l(3).y if t>3
estat ic

crossfold reg y l(1,2).y if t>3 , k(10)
loocv reg y l(1,2).y if t>3
reg y l(1,2).y if t>3
estat ic

crossfold reg y l(1,3).y if t>3 , k(10)
loocv reg y l(1,3).y if t>3
reg y l(1,3).y if t>3
estat ic

crossfold reg y l(2,3).y if t>3 , k(10)
loocv reg y l(2,3).y if t>3
reg y l(2,3).y if t>3
estat ic

crossfold reg y l(1/3).y if t>3 , k(10)
loocv reg y l(1/3).y if t>3
reg y l(1/3).y if t>3
estat ic



*Question 2

clear
set more off
** data prep
import delimited using "us and florida economic time series.txt"
rename observation_date datestring
gen dateday=date(datestring,"YMD")
gen date=mofd(dateday)
format date %tm
tsset date
generate month=month(dateday)
keep if tin(1990m1,2019m12)

rename flbppriv fl_bp
rename fllfn fl_lf
rename flnan fl_nonfarm
rename lnu02300000_20200110 us_epr

gen lnflnonfarm=ln( fl_nonfarm)
```

```
gen lnfllf=ln( fl_lf)
gen lnusepr = ln(us_epr)
gen lnflbp=ln( fl_bp)


*fit and evaluate models
*Note I restrict estimation to year>1989 so the same observations
*Are compared for all models

crossfold reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/12)d.lnfllf ///
      l(0/12)d.lnusepr l(0/12)d.lnflbp i.month date, k(10)
loocv reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/12)d.lnfllf ///
      l(0/12)d.lnusepr l(0/12)d.lnflbp i.month date
reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/12)d.lnfllf ///
      l(0/12)d.lnusepr l(0/12)d.lnflbp i.month date
estat ic

crossfold reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/2)d.lnfllf ///
      l(0/2)d.lnusepr l(0/2)d.lnflbp i.month date, k(10)
loocv reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/2)d.lnfllf ///
      l(0/2)d.lnusepr l(0/2)d.lnflbp i.month date
reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/2)d.lnfllf l(0/2)d.lnusepr ///
      l(0/2)d.lnflbp i.month date
estat ic

crossfold reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/2,12)d.lnfllf ///
      l(0/2,12)d.lnflbp i.month date, k(10)
loocv reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/2,12)d.lnfllf ///
      l(0/2,12)d.lnflbp i.month date
reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/2,12)d.lnfllf ///
      l(0/2,12)d.lnflbp i.month date
estat ic

crossfold reg d.lnflnonfarm l(1/12,24)d.lnflnonfarm l(1/2,12,24)d.lnfllf ///
      l(1/2,12,24)d.lnusepr i.month if tin(1990m1,2019m12), k(10)
loocv reg d.lnflnonfarm l(1/12,24)d.lnflnonfarm l(1/2,12,24)d.lnfllf ///
      l(1/2,12,24)d.lnusepr i.month
reg d.lnflnonfarm l(1/12,24)d.lnflnonfarm l(1/2,12,24)d.lnfllf ///
      l(1/2,12,24)d.lnusepr i.month
estat ic


log close
```

Appendix B: Log File

```
.
. *Question 1a
.
. clear

. set obs 30
number of observations (_N) was 0, now 30

. gen t=[_n]

. tsset t
        time variable:  t, 1 to 30
                delta:  1 unit

. gen r=rnormal()

. gen y=r if t<4
(27 missing values generated)

. replace y=0.5+0.5*l.y-0.1*l2.y+0.25*l3.y+r if t>=4
(27 real changes made)

. drop r

.
. *Note, I restrict the sample to t>3 so the same observations
. ** are compared for each model
. crossfold reg y l(1).y if t>3 , k(5)

             |      RMSE
-------------+-----------
        est1 |  .4477374
        est2 |  .9144028
        est3 |  .8166789
        est4 |  1.028801
        est5 |  1.644439

. loocv reg y l(1).y if t>3


 Leave-One-Out Cross-Validation Results
----------------------------------------
         Method          |    Value
-------------------------+--------------
Root Mean Squared Errors |   1.0506173
Mean Absolute Errors     |   .71878381
Pseudo-R2                |   .20815721
----------------------------------------

. reg y l(1).y if t>3

      Source |       SS           df       MS      Number of obs   =        27
-------------+----------------------------------   F(1, 25)        =      9.41
       Model |  9.93272065         1  9.93272065   Prob > F        =    0.0051
    Residual |  26.4001087        25  1.05600435   R-squared       =    0.2734
-------------+----------------------------------   Adj R-squared   =    0.2443
       Total |  36.3328294        26  1.39741651   Root MSE        =    1.0276

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
```

```
         L1. |   .6469674   .2109508     3.07   0.005     .2125061    1.081429
             |
       _cons |   .3563493   .2464536     1.45   0.161    -.1512315      .86393
------------------------------------------------------------------------------

. estat ic

Akaike's information criterion and Bayesian information criterion

------------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+----------------------------------------------------------------
           . |         27 -42.31929  -38.00801       2    80.01602    82.6077
------------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

.
. crossfold reg y l(2).y if t>3 , k(5)

             |      RMSE
-------------+-----------
        est1 |   1.03154
        est2 |  1.343264
        est3 |  .9272938
        est4 |  1.330561
        est5 |   1.88108

. loocv reg y l(2).y if t>3


 Leave-One-Out Cross-Validation Results
----------------------------------------
         Method          |    Value
-------------------------+--------------
Root Mean Squared Errors |   1.3147762
Mean Absolute Errors     |   .9761385
Pseudo-R2                |   .4786845
----------------------------------------

. reg y l(2).y if t>3

      Source |       SS           df       MS      Number of obs   =        27
-------------+----------------------------------   F(1, 25)        =      0.05
       Model |  .073995561         1  .073995561   Prob > F        =    0.8231
    Residual |  36.2588338        25  1.45035335   R-squared       =    0.0020
-------------+----------------------------------   Adj R-squared   =   -0.0379
       Total |  36.3328294        26  1.39741651   Root MSE        =    1.2043

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
         L2. |   .0571522    .253027     0.23   0.823    -.4639667    .5782711
             |
       _cons |   .7695221   .2860344     2.69   0.013     .1804233    1.358621
------------------------------------------------------------------------------

. estat ic

Akaike's information criterion and Bayesian information criterion

------------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
```

```
-------------+-------------------------------------------------------------------
           . |         27 -42.31929  -42.29176       2    88.58353    91.1752
-------------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

.
. crossfold reg y l(3).y if t>3 , k(5)

             |      RMSE
-------------+-----------
        est1 |  1.009151
        est2 |  2.343802
        est3 |   1.13863
        est4 |  .5679428
        est5 |  1.529219

. loocv reg y l(3).y if t>3


 Leave-One-Out Cross-Validation Results
----------------------------------------
         Method          |    Value
-------------------------+--------------
Root Mean Squared Errors |   1.4733996
Mean Absolute Errors     |   1.0713477
Pseudo-R2                |   .61797207
----------------------------------------

. reg y l(3).y if t>3

      Source |       SS           df       MS      Number of obs   =        27
-------------+----------------------------------   F(1, 25)        =      0.12
       Model |  .169510545         1  .169510545   Prob > F        =    0.7350
    Residual |  36.1633188        25  1.44653275   R-squared       =    0.0047
-------------+----------------------------------   Adj R-squared   =   -0.0351
       Total |  36.3328294        26  1.39741651   Root MSE        =    1.2027

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
         L3. |   -.088026   .2571441    -0.34   0.735    -.6176241    .4415722
             |
       _cons |   .8671521   .2899284     2.99   0.006     .2700335    1.464271
------------------------------------------------------------------------------

. estat ic

Akaike's information criterion and Bayesian information criterion

-------------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+-----------------------------------------------------------------
           . |         27 -42.31929  -42.25615       2    88.51231   91.10398
-------------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

.
. crossfold reg y l(1,2).y if t>3 , k(5)

             |      RMSE
-------------+-----------
        est1 |  .6746962
```

```
        est2 |  1.563159
        est3 |  .7311557
        est4 |  1.007034
        est5 |  1.523913

. loocv reg y l(1,2).y if t>3


 Leave-One-Out Cross-Validation Results
----------------------------------------
         Method          |    Value
-------------------------+--------------
Root Mean Squared Errors |   1.0986212
Mean Absolute Errors     |   .83345356
Pseudo-R2                |   .19030643
----------------------------------------

. reg y l(1,2).y if t>3

      Source |       SS           df       MS      Number of obs   =        27
-------------+----------------------------------   F(2, 24)        =      6.10
       Model |  12.2396339         2  6.11981694   Prob > F        =    0.0072
    Residual |  24.0931955        24  1.00388315   R-squared       =    0.3369
-------------+----------------------------------   Adj R-squared   =    0.2816
       Total |  36.3328294        26  1.39741651   Root MSE        =    1.0019

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
         L1. |   .8283623   .2379548     3.48   0.002     .3372477    1.319477
         L2. |  -.3691902   .2435433    -1.52   0.143    -.8718389    .1334584
             |
       _cons |   .4744731   .2526132     1.88   0.073    -.0468949     .995841
------------------------------------------------------------------------------

. estat ic

Akaike's information criterion and Bayesian information criterion

------------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+----------------------------------------------------------------
           . |         27 -42.31929  -36.77359       3    79.54718   83.43469
------------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

.
. crossfold reg y l(1,3).y if t>3 , k(5)

             |      RMSE
-------------+-----------
        est1 |  .9226874
        est2 |  1.217376
        est3 |  1.108357
        est4 |  1.757104
        est5 |  .8038165

. loocv reg y l(1,3).y if t>3


 Leave-One-Out Cross-Validation Results
----------------------------------------
```

```
        Method          |    Value
------------------------+---------------
Root Mean Squared Errors |   1.2125174
Mean Absolute Errors     |   .86848364
Pseudo-R2                |   .08552092
----------------------------------------

. reg y l(1,3).y if t>3

      Source |       SS           df       MS      Number of obs   =        27
-------------+----------------------------------   F(2, 24)        =      5.32
       Model |  11.1555742         2   5.5777871   Prob > F        =    0.0123
    Residual |  25.1772552        24   1.0490523   R-squared       =    0.3070
-------------+----------------------------------   Adj R-squared   =    0.2493
       Total |  36.3328294        26  1.39741651   Root MSE        =    1.0242

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
         L1. |   .6962714   .2151573     3.24   0.004     .2522086    1.140334
         L3. |  -.2419406   .2240888    -1.08   0.291    -.7044372    .2205559
             |
       _cons |   .4862484   .2735234     1.78   0.088    -.0782762    1.050773
------------------------------------------------------------------------------

. estat ic

Akaike's information criterion and Bayesian information criterion

------------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+----------------------------------------------------------------
           . |         27 -42.31929  -37.36775       3    80.73549     84.623
------------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

.
. crossfold reg y l(2,3).y if t>3 , k(5)

             |      RMSE
-------------+-----------
        est1 |   1.19416
        est2 |  1.132158
        est3 |   .788579
        est4 |  1.710587
        est5 |  2.293407

. loocv reg y l(2,3).y if t>3


 Leave-One-Out Cross-Validation Results
----------------------------------------
        Method          |    Value
------------------------+---------------
Root Mean Squared Errors |   1.5206717
Mean Absolute Errors     |   1.1282346
Pseudo-R2                |   .50131148
----------------------------------------

. reg y l(2,3).y if t>3

      Source |       SS           df       MS      Number of obs   =        27
```

```
-------------+----------------------------------   F(2, 24)        =      0.19
       Model |  .552294111         2  .276147055   Prob > F        =    0.8321
    Residual |  35.7805353        24  1.49085564   R-squared       =    0.0152
-------------+----------------------------------   Adj R-squared   =   -0.0669
       Total |  36.3328294        26  1.39741651   Root MSE        =     1.221

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
         L2. |   .1584684   .3127402     0.51   0.617    -.4869957    .8039325
         L3. |  -.1802594   .3182483    -0.57   0.576    -.8370917    .4765729
             |
       _cons |   .8247929   .3059778     2.70   0.013     .1932857      1.4563
------------------------------------------------------------------------------

. estat ic

Akaike's information criterion and Bayesian information criterion

-----------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+---------------------------------------------------------------
           . |         27 -42.31929   -42.1125       3    90.22499   94.11251
-----------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

.
. crossfold reg y l(1/3).y if t>3 , k(5)

             |      RMSE
-------------+----------
        est1 |  .7544789
        est2 |  1.965404
        est3 |   .564728
        est4 |  1.557515
        est5 |   .977751

. loocv reg y l(1/3).y if t>3


 Leave-One-Out Cross-Validation Results
----------------------------------------
         Method          |    Value
-------------------------+--------------
Root Mean Squared Errors |   1.2397812
Mean Absolute Errors     |   .93246793
Pseudo-R2                |   .08044492
----------------------------------------

. reg y l(1/3).y if t>3

      Source |       SS           df       MS      Number of obs   =        27
-------------+----------------------------------   F(3, 23)        =      3.94
       Model |  12.3437179         3  4.11457264   Prob > F        =    0.0209
    Residual |  23.9891114        23  1.04300485   R-squared       =    0.3397
-------------+----------------------------------   Adj R-squared   =    0.2536
       Total |  36.3328294        26  1.39741651   Root MSE        =    1.0213

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
```

```
         L1. |   .8201704   .2439294     3.36   0.003      .315564    1.324777
         L2. |  -.3174417   .2974217    -1.07   0.297    -.9327052    .2978219
         L3. |  -.0845685   .2677069    -0.32   0.755    -.6383624    .4692255
             |
       _cons |   .5033211   .2732026     1.84   0.078    -.0618415    1.068484
------------------------------------------------------------------------------

. estat ic

Akaike's information criterion and Bayesian information criterion

------------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+----------------------------------------------------------------
           . |         27 -42.31929  -36.71514       4    81.43029   86.61363
------------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

.
.
. *Question 1b
.
. clear

. set obs 300
number of observations (_N) was 0, now 300

. gen t=[_n]

. tsset t
        time variable:  t, 1 to 300
                delta:  1 unit

. gen r=rnormal()

. gen y=r if t<4
(297 missing values generated)

. replace y=0.5+0.5*l.y-0.1*l2.y+0.25*l3.y+r if t>=4
(297 real changes made)

. drop r

.
.
. crossfold reg y l(1).y if t>3 , k(10)

             |      RMSE
-------------+-----------
        est1 |  .9485579
        est2 |  .8905471
        est3 |  .8814989
        est4 |  1.145825
        est5 |  .7819257
        est6 |  1.208638
        est7 |  1.047432
        est8 |  .9934633
        est9 |  1.022898
       est10 |  1.027969

. loocv reg y l(1).y if t>3
```

```
 Leave-One-Out Cross-Validation Results
----------------------------------------
         Method          |    Value
-------------------------+--------------
Root Mean Squared Errors |   .99349549
Mean Absolute Errors     |   .81452099
Pseudo-R2                |   .1658777
----------------------------------------

. reg y l(1).y if t>3

      Source |       SS           df       MS      Number of obs   =       297
-------------+----------------------------------   F(1, 295)       =     61.58
       Model |  60.5416388         1  60.5416388   Prob > F        =    0.0000
    Residual |  290.036048       295  .983173043   R-squared       =    0.1727
-------------+----------------------------------   Adj R-squared   =    0.1699
       Total |  350.577686       296  1.18438408   Root MSE        =    .99155

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
         L1. |   .4140138   .0527597     7.85   0.000     .3101806     .517847
             |
       _cons |   .8642433   .0963091     8.97   0.000     .6747034    1.053783
------------------------------------------------------------------------------

. estat ic

Akaike's information criterion and Bayesian information criterion

------------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+----------------------------------------------------------------
           . |        297 -446.0535  -417.9013       2    839.8026   847.1901
------------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

.
. crossfold reg y l(2).y if t>3 , k(10)

             |      RMSE
-------------+----------
        est1 |  .9484897
        est2 |  1.064733
        est3 |  .9910389
        est4 |  1.091403
        est5 |  1.027012
        est6 |  1.024085
        est7 |  1.062075
        est8 |  1.078493
        est9 |  1.027734
       est10 |  1.422612

. loocv reg y l(2).y if t>3


 Leave-One-Out Cross-Validation Results
----------------------------------------
         Method          |    Value
-------------------------+--------------
Root Mean Squared Errors |   1.0808964
Mean Absolute Errors     |   .88628806
```

```
Pseudo-R2                |   .01702274
-----------------------------------------

. reg y l(2).y if t>3

      Source |       SS           df       MS      Number of obs   =       297
-------------+----------------------------------   F(1, 295)       =      7.88
       Model |  9.12416691         1  9.12416691   Prob > F        =    0.0053
    Residual |   341.45352       295  1.15746956   R-squared       =    0.0260
-------------+----------------------------------   Adj R-squared   =    0.0227
       Total |  350.577686       296  1.18438408   Root MSE        =    1.0759

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
         L2. |   .1603387    .057108     2.81   0.005     .0479481    .2727294
             |
       _cons |   1.235926   .1042415    11.86   0.000     1.030774    1.441077
------------------------------------------------------------------------------

. estat ic

Akaike's information criterion and Bayesian information criterion

------------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+----------------------------------------------------------------
           . |        297 -446.0535  -442.1374       2    888.2749   895.6623
------------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

.
. crossfold reg y l(3).y if t>3 , k(10)

             |      RMSE
-------------+-----------
        est1 |  .9204688
        est2 |  1.229033
        est3 |  1.139943
        est4 |  1.081345
        est5 |  .8443094
        est6 |  .9478467
        est7 |  .9490367
        est8 |  1.187149
        est9 |  1.090669
       est10 |  1.070583

. loocv reg y l(3).y if t>3


 Leave-One-Out Cross-Validation Results
-----------------------------------------
         Method          |    Value
-------------------------+---------------
Root Mean Squared Errors |   1.0596216
Mean Absolute Errors     |   .84556019
Pseudo-R2                |   .05520804
-----------------------------------------

. reg y l(3).y if t>3

      Source |       SS           df       MS      Number of obs   =       297
```

```
-------------+----------------------------------   F(1, 295)       =     21.30
       Model |   23.604574         1   23.604574   Prob > F        =    0.0000
    Residual |  326.973112       295  1.10838343   R-squared       =    0.0673
-------------+----------------------------------   Adj R-squared   =    0.0642
       Total |  350.577686       296  1.18438408   Root MSE        =    1.0528

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
         L3. |   .2577714   .0558575     4.61   0.000     .1478417    .3677011
             |
       _cons |   1.093973   .1018939    10.74   0.000     .8934415    1.294504
------------------------------------------------------------------------------

. estat ic

Akaike's information criterion and Bayesian information criterion

------------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+----------------------------------------------------------------
           . |        297 -446.0535  -435.7024       2    875.4048   882.7923
------------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

.
. crossfold reg y l(1,2).y if t>3 , k(10)

             |      RMSE
-------------+----------
        est1 |  .8753155
        est2 |  1.079413
        est3 |  .9750601
        est4 |  .9606736
        est5 |  .9878336
        est6 |  .9170026
        est7 |  .9686407
        est8 |  .9939085
        est9 |  1.064011
       est10 |  1.142216

. loocv reg y l(1,2).y if t>3


 Leave-One-Out Cross-Validation Results
----------------------------------------
         Method          |    Value
-------------------------+--------------
Root Mean Squared Errors |   .9981137
Mean Absolute Errors     |   .81971413
Pseudo-R2                |   .16107318
----------------------------------------

. reg y l(1,2).y if t>3

      Source |       SS           df       MS      Number of obs   =       297
-------------+----------------------------------   F(2, 294)       =     30.74
       Model |  60.6241574         2  30.3120787   Prob > F        =    0.0000
    Residual |  289.953529       294  .986236494   R-squared       =    0.1729
-------------+----------------------------------   Adj R-squared   =    0.1673
       Total |  350.577686       296  1.18438408   Root MSE        =    .99309
```

```
------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
         L1. |   .4211222   .0582767     7.23   0.000     .3064298    .5358146
         L2. |  -.0168165   .0581365    -0.29   0.773     -.131233    .0976001
             |
       _cons |   .8784199   .1081959     8.12   0.000     .6654833    1.091357
------------------------------------------------------------------------------

. estat ic

Akaike's information criterion and Bayesian information criterion

------------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+----------------------------------------------------------------
           . |        297 -446.0535   -417.859       3    841.7181   852.7993
------------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

.
. crossfold reg y l(1,3).y if t>3 , k(10)

             |      RMSE
-------------+----------
        est1 |  .8379843
        est2 |  1.119864
        est3 |  .9830091
        est4 |  1.027417
        est5 |  .9641554
        est6 |  .8945947
        est7 |  1.130843
        est8 |  .8870858
        est9 |  .9412586
       est10 |  .9789032

. loocv reg y l(1,3).y if t>3


 Leave-One-Out Cross-Validation Results
----------------------------------------
         Method          |    Value
-------------------------+--------------
Root Mean Squared Errors |   .97580523
Mean Absolute Errors     |   .78232156
Pseudo-R2                |   .1985535
----------------------------------------

. reg y l(1,3).y if t>3

      Source |       SS           df       MS      Number of obs   =       297
-------------+----------------------------------   F(2, 294)       =     39.17
       Model |  73.7635366         2  36.8817683   Prob > F        =    0.0000
    Residual |   276.81415       294  .941544728   R-squared       =    0.2104
-------------+----------------------------------   Adj R-squared   =    0.2050
       Total |  350.577686       296  1.18438408   Root MSE        =    .97033

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
         L1. |   .3819759   .0523338     7.30   0.000     .2789795    .4849722
```

```
         L3. |   .1955498   .0521832     3.75   0.000     .0928498    .2982499
             |
       _cons |   .6256466   .1137394     5.50   0.000     .4018001    .8494931
------------------------------------------------------------------------------

. estat ic

Akaike's information criterion and Bayesian information criterion

------------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+----------------------------------------------------------------
           . |        297 -446.0535  -410.9725       3    827.9449   839.0261
------------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

.
. crossfold reg y l(2,3).y if t>3 , k(10)

             |      RMSE
-------------+-----------
        est1 |  .9761117
        est2 |  1.134196
        est3 |  1.220372
        est4 |  1.025265
        est5 |  .9111706
        est6 |   .950201
        est7 |  1.096652
        est8 |  1.072383
        est9 |  1.130017
       est10 |  1.036515

. loocv reg y l(2,3).y if t>3


 Leave-One-Out Cross-Validation Results
----------------------------------------
         Method          |    Value
-------------------------+--------------
Root Mean Squared Errors |   1.0602008
Mean Absolute Errors     |   .8499411
Pseudo-R2                |   .05470602
----------------------------------------

. reg y l(2,3).y if t>3

      Source |       SS           df       MS      Number of obs   =       297
-------------+----------------------------------   F(2, 294)       =     11.16
       Model |  24.7384365         2  12.3692183   Prob > F        =    0.0000
    Residual |   325.83925       294  1.10829677   R-squared       =    0.0706
-------------+----------------------------------   Adj R-squared   =    0.0642
       Total |  350.577686       296  1.18438408   Root MSE        =    1.0528

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
         L2. |   .0623826   .0616753     1.01   0.313    -.0589985    .1837637
         L3. |   .2313871   .0616462     3.75   0.000     .1100633    .3527109
             |
       _cons |   1.041301   .1144258     9.10   0.000     .8161037    1.266499
------------------------------------------------------------------------------
```

```
. estat ic

Akaike's information criterion and Bayesian information criterion

------------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+----------------------------------------------------------------
           . |        297 -446.0535  -435.1865       3    876.3731   887.4543
------------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

.
. crossfold reg y l(1/3).y if t>3 , k(10)

             |      RMSE
-------------+----------
        est1 |  .8134784
        est2 |  .9355836
        est3 |  .9581936
        est4 |  1.063685
        est5 |  .8773045
        est6 |  .8814801
        est7 |  1.296819
        est8 |  1.046323
        est9 |  .9691692
       est10 |  .7505918

. loocv reg y l(1/3).y if t>3


 Leave-One-Out Cross-Validation Results
----------------------------------------
         Method          |    Value
-------------------------+--------------
Root Mean Squared Errors |   .9733126
Mean Absolute Errors     |   .77755733
Pseudo-R2                |   .20282467
----------------------------------------

. reg y l(1/3).y if t>3

      Source |       SS           df       MS      Number of obs   =       297
-------------+----------------------------------   F(3, 293)       =     27.63
       Model |  77.3017268         3  25.7672423   Prob > F        =    0.0000
    Residual |   273.27596       293  .932682456   R-squared       =    0.2205
-------------+----------------------------------   Adj R-squared   =    0.2125
       Total |  350.577686       296  1.18438408   Root MSE        =    .96575

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           y |
         L1. |    .425519   .0566819     7.51   0.000     .3139636    .5370743
         L2. |  -.1199196   .0615696    -1.95   0.052    -.2410943    .0012552
         L3. |   .2391761   .0565612     4.23   0.000     .1278584    .3504937
             |
       _cons |   .6735114   .1158396     5.81   0.000     .4455284    .9014945
------------------------------------------------------------------------------

. estat ic

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

```
-----------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+---------------------------------------------------------------
           . |        297 -446.0535  -409.0621       4    826.1242   840.8992
-----------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

.
.
.
. *Question 2
.
. clear

. set more off

. ** data prep
. import delimited using "us and florida economic time series.txt"
(5 vars, 972 obs)

. rename observation_date datestring

. gen dateday=date(datestring,"YMD")

. gen date=mofd(dateday)

. format date %tm

. tsset date
        time variable:  date, 1939m1 to 2019m12
                delta:  1 month

. generate month=month(dateday)

. keep if tin(1990m1,2019m12)
(612 observations deleted)

. rename flbppriv fl_bp

. rename fllfn fl_lf

. rename flnan fl_nonfarm

. rename lnu02300000_20200110 us_epr

. gen lnflnonfarm=ln( fl_nonfarm)

. gen lnfllf=ln( fl_lf)

. gen lnusepr = ln(us_epr)

. gen lnflbp=ln( fl_bp)

.
.
. *fit and evaluate models
. *Note I restrict estimation to year>1989 so the same observations
. *Are compared for all models
.
. crossfold reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/12)d.lnfllf ///
>         l(0/12)d.lnusepr l(0/12)d.lnflbp i.month date if tin(1991m1,2019m12) , k(10)

             |      RMSE
```

```
-------------+-----------
        est1 |   .004854
        est2 |  .0028465
        est3 |  .0048683
        est4 |  .0034981
        est5 |  .0030781
        est6 |  .0040035
        est7 |  .0037033
        est8 |  .0036501
        est9 |  .0039859
       est10 |  .0033776

. loocv reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/12)d.lnfllf ///
>         l(0/12)d.lnusepr l(0/12)d.lnflbp i.month date


 Leave-One-Out Cross-Validation Results
----------------------------------------
         Method          |    Value
-------------------------+--------------
Root Mean Squared Errors |   .00389888
Mean Absolute Errors     |   .00288576
Pseudo-R2                |   .8474397
----------------------------------------

. reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/12)d.lnfllf ///
>         l(0/12)d.lnusepr l(0/12)d.lnflbp i.month date

      Source |       SS           df       MS      Number of obs   =       347
-------------+----------------------------------   F(63, 283)      =     42.26
       Model |  .030831254        63  .000489385   Prob > F        =    0.0000
    Residual |  .003277128       283   .00001158   R-squared       =    0.9039
-------------+----------------------------------   Adj R-squared   =    0.8825
       Total |  .034108382       346  .000098579   Root MSE        =     .0034

------------------------------------------------------------------------------
D.           |
 lnflnonfarm |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lnflnonfarm |
         LD. |  -.1574149   .0580953    -2.71   0.007    -.2717687   -.0430611
        L2D. |  -.1574789   .0594298    -2.65   0.009    -.2744594   -.0404983
        L3D. |   .1395365   .0599708     2.33   0.021      .021491    .2575819
        L4D. |   .1302252   .0601073     2.17   0.031     .0119111    .2485394
        L5D. |    .036204   .0614863     0.59   0.556    -.0848245    .1572325
        L6D. |   .0953011   .0634205     1.50   0.134    -.0295346    .2201369
        L7D. |   .0117236   .0621461     0.19   0.851    -.1106038    .1340509
        L8D. |  -.0508451   .0615834    -0.83   0.410    -.1720649    .0703746
        L9D. |   .0859865   .0595028     1.45   0.150    -.0311377    .2031106
       L10D. |   -.207794   .0584651    -3.55   0.000    -.3228756   -.0927124
       L11D. |  -.0434531   .0578108    -0.75   0.453    -.1572468    .0703406
       L12D. |   .3097061    .056476     5.48   0.000     .1985398    .4208723
             |
      lnfllf |
          D1. |   .1062022   .1000859     1.06   0.290     -.090805    .3032094
          LD. |  -.1178716   .1004531    -1.17   0.242    -.3156017    .0798584
         L2D. |  -.1274227   .1028799    -1.24   0.217    -.3299297    .0750842
         L3D. |  -.1037616   .1043474    -0.99   0.321    -.3091571    .1016339
         L4D. |  -.0764095   .1050053    -0.73   0.467       -.2831    .1302811
         L5D. |  -.0037077   .1037939    -0.04   0.972    -.2080138    .2005984
         L6D. |    -.05965   .1041819    -0.57   0.567    -.2647198    .1454198
         L7D. |  -.0006012   .1042636    -0.01   0.995    -.2058318    .2046294
         L8D. |   .0146311   .1043507     0.14   0.889    -.1907709    .2200331
```

```
        L9D. |   .1777699   .1037189     1.71   0.088    -.0263885    .3819283
       L10D. |   .2173552   .1068988     2.03   0.043     .0069375    .4277728
       L11D. |   .0190543   .1069936     0.18   0.859    -.1915499    .2296585
       L12D. |  -.1648009   .1057575    -1.56   0.120     -.372972    .0433703
             |
     lnusepr |
         D1. |   -.203726   .1354639    -1.50   0.134    -.4703707    .0629187
          LD. |   .2001192   .1371366     1.46   0.146     -.069818    .4700563
         L2D. |   .0790793   .1387443     0.57   0.569    -.1940226    .3521811
         L3D. |   .1610994   .1376737     1.17   0.243     -.109895    .4320939
         L4D. |   .2234233   .1391924     1.61   0.110    -.0505605     .497407
         L5D. |    -.02279   .1364623    -0.17   0.867       -.2914      .24582
         L6D. |   .2954135   .1352384     2.18   0.030     .0292126    .5616144
         L7D. |   .1286871   .1367504     0.94   0.347    -.1404899    .3978641
         L8D. |  -.0747586   .1381187    -0.54   0.589     -.346629    .1971119
         L9D. |  -.1316723   .1391333    -0.95   0.345    -.4055396    .1421951
        L10D. |  -.2945532   .1419814    -2.07   0.039    -.5740268   -.0150796
        L11D. |   .1266267   .1410913     0.90   0.370    -.1510948    .4043483
        L12D. |    .224092   .1373989     1.63   0.104    -.0463615    .4945455
             |
      lnflbp |
         D1. |   .0044437   .0016422     2.71   0.007     .0012112    .0076761
          LD. |   .0039814   .0019214     2.07   0.039     .0001994    .0077635
         L2D. |   .0064503   .0020021     3.22   0.001     .0025094    .0103913
         L3D. |   .0068853   .0020155     3.42   0.001      .002918    .0108525
         L4D. |   .0051008   .0020277     2.52   0.012     .0011094    .0090921
         L5D. |   .0046621   .0020346     2.29   0.023     .0006572     .008667
         L6D. |    .004366   .0020655     2.11   0.035     .0003003    .0084316
         L7D. |   .0038368   .0020881     1.84   0.067    -.0002733    .0079469
         L8D. |    .003177   .0021186     1.50   0.135    -.0009933    .0073473
         L9D. |   .0028721   .0021085     1.36   0.174    -.0012782    .0070224
        L10D. |   .0033299   .0020848     1.60   0.111    -.0007738    .0074337
        L11D. |   .0035077   .0019783     1.77   0.077    -.0003864    .0074019
        L12D. |   .0031535   .0016353     1.93   0.055    -.0000653    .0063723
             |
       month |
           2 |   .0112254   .0039079     2.87   0.004     .0035332    .0189175
           3 |    .009569   .0040687     2.35   0.019     .0015602    .0175777
           4 |   .0103909   .0044854     2.32   0.021      .001562    .0192198
           5 |   .0053637   .0034821     1.54   0.125    -.0014904    .0122179
           6 |  -.0019222   .0041834    -0.46   0.646    -.0101568    .0063124
           7 |   .0044899   .0040453     1.11   0.268    -.0034728    .0124526
           8 |    .013014   .0040663     3.20   0.002     .0050099     .021018
           9 |   .0109015   .0034322     3.18   0.002     .0041457    .0176574
          10 |   .0179031    .004553     3.93   0.000     .0089411    .0268652
          11 |   .0109558   .0040924     2.68   0.008     .0029005    .0190112
          12 |   .0157008   .0037763     4.16   0.000     .0082677    .0231339
             |
        date |  -3.71e-06   2.01e-06    -1.85   0.066    -7.67e-06    2.43e-07
       _cons |  -.0054646    .003224    -1.69   0.091    -.0118107    .0008814
------------------------------------------------------------------------------

. estat ic

Akaike's information criterion and Bayesian information criterion

-----------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+---------------------------------------------------------------
           . |        347  1108.606   1515.043      64   -2902.086  -2655.729
-----------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.
```

```
.
. crossfold reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/2)d.lnfllf ///
>         l(0/2)d.lnusepr l(0/2)d.lnflbp i.month date , k(10)

             |      RMSE
-------------+----------
        est1 |  .0033667
        est2 |  .0040457
        est3 |  .0053336
        est4 |  .0033043
        est5 |  .0034043
        est6 |  .0032772
        est7 |  .0033094
        est8 |  .0035109
        est9 |  .0048244
       est10 |  .0029423

. loocv reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/2)d.lnfllf ///
>         l(0/2)d.lnusepr l(0/2)d.lnflbp i.month date


 Leave-One-Out Cross-Validation Results
-----------------------------------------
         Method          |    Value
-------------------------+---------------
Root Mean Squared Errors |   .00381283
Mean Absolute Errors     |   .00277029
Pseudo-R2                |   .85334667
-----------------------------------------

. reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/2)d.lnfllf l(0/2)d.lnusepr ///
>         l(0/2)d.lnflbp i.month date

      Source |       SS           df       MS      Number of obs   =       347
-------------+----------------------------------   F(33, 313)      =     74.27
       Model |  .030245856        33  .000916541   Prob > F        =    0.0000
    Residual |  .003862526       313   .00001234   R-squared       =    0.8868
-------------+----------------------------------   Adj R-squared   =    0.8748
       Total |  .034108382       346  .000098579   Root MSE        =    .00351

------------------------------------------------------------------------------
D.           |
 lnflnonfarm |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lnflnonfarm |
         LD. |  -.0926596   .0539475    -1.72   0.087    -.1988052    .0134861
        L2D. |  -.1013494   .0545464    -1.86   0.064    -.2086733    .0059745
        L3D. |   .2257017   .0538977     4.19   0.000     .1196541    .3317493
        L4D. |   .1584207   .0515924     3.07   0.002     .0569089    .2599325
        L5D. |   .1456743   .0524817     2.78   0.006     .0424128    .2489358
        L6D. |    .140864   .0550022     2.56   0.011     .0326431    .2490849
        L7D. |   .0853223   .0547739     1.56   0.120    -.0224494    .1930939
        L8D. |   .0145033   .0536544     0.27   0.787    -.0910657    .1200722
        L9D. |   .1028963   .0513696     2.00   0.046     .0018229    .2039698
       L10D. |  -.1763997   .0503805    -3.50   0.001    -.2755269   -.0772724
       L11D. |  -.0750815   .0518778    -1.45   0.149    -.1771547    .0269918
       L12D. |   .3597356   .0514983     6.99   0.000     .2584091    .4610622
             |
      lnfllf |
          D1. |   .0215757   .0964236     0.22   0.823    -.1681446    .2112961
          LD. |  -.1651507    .096038    -1.72   0.086    -.3541123     .023811
         L2D. |   -.141473   .0978523    -1.45   0.149    -.3340044    .0510585
             |
```

```
     lnusepr |
         D1. |  -.1612876   .1291331    -1.25   0.213    -.4153664    .0927912
         LD. |   .1960407   .1287356     1.52   0.129    -.0572559    .4493373
        L2D. |   .0613202   .1305917     0.47   0.639    -.1956284    .3182687
             |
      lnflbp |
         D1. |     .00441   .0015488     2.85   0.005     .0013625    .0074574
         LD. |   .0029326   .0017603     1.67   0.097     -.000531    .0063961
        L2D. |   .0034816   .0015737     2.21   0.028     .0003853    .0065779
             |
       month |
          2  |   .0125423   .0028953     4.33   0.000     .0068455     .018239
          3  |   .0092578   .0031904     2.90   0.004     .0029805     .015535
          4  |   .0110159   .0032953     3.34   0.001     .0045322    .0174996
          5  |   .0044171   .0029959     1.47   0.141    -.0014776    .0103118
          6  |   .0027434    .003072     0.89   0.373    -.0033008    .0087877
          7  |   .0039961   .0027956     1.43   0.154    -.0015045    .0094967
          8  |   .0134171    .002811     4.77   0.000     .0078862    .0189479
          9  |    .016115   .0027803     5.80   0.000     .0106446    .0215854
         10  |   .0235632   .0032462     7.26   0.000      .017176    .0299504
         11  |   .0153235   .0029086     5.27   0.000     .0096006    .0210463
         12  |   .0142819   .0023467     6.09   0.000     .0096647    .0188992
             |
        date |  -1.94e-06   1.93e-06    -1.01   0.315    -5.74e-06    1.85e-06
       _cons |  -.0087229   .0025667    -3.40   0.001    -.0137731   -.0036728
------------------------------------------------------------------------------

. estat ic

Akaike's information criterion and Bayesian information criterion

-----------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+---------------------------------------------------------------
           . |        347  1108.606   1486.527      34   -2905.055  -2774.178
-----------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

.
. crossfold reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/2,12)d.lnfllf ///
>         l(0/2,12)d.lnflbp i.month date , k(10)

             |      RMSE
-------------+----------
        est1 |   .002985
        est2 |   .002963
        est3 |  .0028823
        est4 |   .003077
        est5 |  .0046443
        est6 |  .0056406
        est7 |  .0035519
        est8 |  .0027221
        est9 |  .0033546
       est10 |  .0048672

. loocv reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/2,12)d.lnfllf ///
>         l(0/2,12)d.lnflbp i.month date


 Leave-One-Out Cross-Validation Results
----------------------------------------
         Method          |    Value
-------------------------+--------------
```

```
Root Mean Squared Errors |   .00379585
Mean Absolute Errors     |   .00271345
Pseudo-R2                |   .85464439
-----------------------------------------

. reg d.lnflnonfarm l(1/12)d.lnflnonfarm l(0/2,12)d.lnfllf ///
>         l(0/2,12)d.lnflbp i.month date

      Source |       SS           df       MS      Number of obs   =       347
-------------+----------------------------------   F(32, 314)      =     77.19
       Model |  .030261308        32  .000945666   Prob > F        =    0.0000
    Residual |  .003847073       314  .000012252   R-squared       =    0.8872
-------------+----------------------------------   Adj R-squared   =    0.8757
       Total |  .034108382       346  .000098579   Root MSE        =     .0035

------------------------------------------------------------------------------
D.           |
 lnflnonfarm |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lnflnonfarm |
         LD. |  -.1056193   .0518028    -2.04   0.042    -.2075438   -.0036948
        L2D. |  -.0921418    .052223    -1.76   0.079    -.1948931    .0106095
        L3D. |   .2294649   .0513697     4.47   0.000     .1283925    .3305372
        L4D. |   .1576544   .0512838     3.07   0.002     .0567511    .2585577
        L5D. |   .1465611   .0519056     2.82   0.005     .0444345    .2486878
        L6D. |   .1448653   .0541136     2.68   0.008     .0383941    .2513364
        L7D. |   .0950336   .0533402     1.78   0.076    -.0099158    .1999831
        L8D. |   .0395854     .05266     0.75   0.453    -.0640258    .1431965
        L9D. |   .1072418   .0508503     2.11   0.036     .0071915    .2072922
       L10D. |  -.1768537   .0498853    -3.55   0.000    -.2750055   -.0787019
       L11D. |  -.0876855   .0512101    -1.71   0.088    -.1884439    .0130729
       L12D. |   .3534041   .0511326     6.91   0.000     .2527984    .4540099
             |
      lnfllf |
         D1. |   -.056149   .0556547    -1.01   0.314    -.1656523    .0533543
         LD. |  -.0363912   .0539611    -0.67   0.501    -.1425623      .06978
        L2D. |  -.1069649   .0537053    -1.99   0.047    -.2126327   -.0012972
       L12D. |  -.1056342   .0539506    -1.96   0.051    -.2117847    .0005162
             |
      lnflbp |
         D1. |   .0040897   .0015363     2.66   0.008     .0010669    .0071125
         LD. |    .003202   .0017507     1.83   0.068    -.0002426    .0066466
        L2D. |   .0032357   .0015535     2.08   0.038      .000179    .0062923
       L12D. |   .0014876   .0013168     1.13   0.259    -.0011032    .0040784
             |
       month |
          2  |   .0098277   .0021732     4.52   0.000     .0055519    .0141036
          3  |   .0085637   .0025121     3.41   0.001      .003621    .0135064
          4  |   .0096017   .0028128     3.41   0.001     .0040674     .015136
          5  |    .004879   .0027898     1.75   0.081    -.0006101     .010368
          6  |   .0009795   .0025176     0.39   0.697     -.003974    .0059329
          7  |   .0038837   .0022606     1.72   0.087    -.0005642    .0083316
          8  |   .0127237    .002469     5.15   0.000     .0078659    .0175815
          9  |   .0160257   .0026769     5.99   0.000     .0107587    .0212926
         10  |   .0209295   .0026518     7.89   0.000      .015712    .0261471
         11  |   .0147903   .0024106     6.14   0.000     .0100473    .0195333
         12  |   .0137729   .0019983     6.89   0.000     .0098412    .0177046
             |
        date |  -1.98e-06   1.89e-06    -1.05   0.295    -5.71e-06    1.74e-06
       _cons |  -.0078223   .0019928    -3.93   0.000    -.0117433   -.0039013
------------------------------------------------------------------------------

. estat ic
```

Akaike's information criterion and Bayesian information criterion

```
-----------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+---------------------------------------------------------------
           . |        347  1108.606   1487.223      33   -2908.446  -2781.418
-----------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.
```

```
.
. crossfold reg d.lnflnonfarm l(1/12,24)d.lnflnonfarm l(1/2,12,24)d.lnfllf ///
>         l(1/2,12,24)d.lnusepr i.month , k(10)

             |      RMSE
-------------+----------
        est1 |  .0050724
        est2 |  .0042645
        est3 |  .0033856
        est4 |  .0030582
        est5 |  .0019545
        est6 |  .0035341
        est7 |  .0053942
        est8 |  .0037919
        est9 |  .0033725
       est10 |  .0028878

. loocv reg d.lnflnonfarm l(1/12,24)d.lnflnonfarm l(1/2,12,24)d.lnfllf ///
>         l(1/2,12,24)d.lnusepr i.month


 Leave-One-Out Cross-Validation Results
----------------------------------------
         Method          |    Value
-------------------------+--------------
Root Mean Squared Errors |   .00370499
Mean Absolute Errors     |   .00265047
Pseudo-R2                |   .86035869
----------------------------------------

. reg d.lnflnonfarm l(1/12,24)d.lnflnonfarm l(1/2,12,24)d.lnfllf ///
>         l(1/2,12,24)d.lnusepr i.month

      Source |       SS           df       MS      Number of obs   =       335
-------------+----------------------------------   F(32, 302)      =     74.38
       Model |  .029334712        32   .00091671   Prob > F        =    0.0000
    Residual |  .003721818       302  .000012324   R-squared       =    0.8874
-------------+----------------------------------   Adj R-squared   =    0.8755
       Total |  .033056529       334  .000098972   Root MSE        =    .00351

------------------------------------------------------------------------------
D.           |
 lnflnonfarm |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 lnflnonfarm |
         LD. |  -.0893296   .0527122    -1.69   0.091    -.1930593       .0144
        L2D. |  -.0665814   .0558162    -1.19   0.234    -.1764194    .0432566
        L3D. |   .2241205   .0541419     4.14   0.000     .1175775    .3306636
        L4D. |   .1514706   .0521838     2.90   0.004     .0487806    .2541605
        L5D. |   .1580576   .0532447     2.97   0.003     .0532801    .2628351
        L6D. |   .1598189    .055306     2.89   0.004      .050985    .2686528
        L7D. |   .0713947   .0554199     1.29   0.199    -.0376635    .1804528
        L8D. |   .0199339   .0547887     0.36   0.716    -.0878821      .12775
```

```
        L9D. |    .076253   .0525006     1.45   0.147    -.0270605    .1795664
       L10D. |  -.1636484   .0515785    -3.17   0.002    -.2651471   -.0621497
       L11D. |  -.0908334   .0531678    -1.71   0.089    -.1954596    .0137928
       L12D. |   .3044588   .0598043     5.09   0.000     .1867729    .4221446
       L24D. |   .1201683     .05152     2.33   0.020     .0187846    .2215519
             |
      lnfllf |
         LD. |  -.1225263   .0962344    -1.27   0.204    -.3119012    .0668486
        L2D. |  -.1611748   .0968689    -1.66   0.097    -.3517982    .0294486
       L12D. |  -.1592969   .1014979    -1.57   0.118    -.3590296    .0404358
       L24D. |   .1558841   .0998312     1.56   0.119    -.0405688     .352337
             |
     lnusepr |
         LD. |    .159602   .1313701     1.21   0.225    -.0989147    .4181187
        L2D. |   .0849591   .1315279     0.65   0.519    -.1738682    .3437864
       L12D. |   .1076075   .1327893     0.81   0.418    -.1537019     .368917
       L24D. |   -.330308   .1254379    -2.63   0.009     -.577151   -.0834651
             |
       month |
          2  |    .012446   .0031029     4.01   0.000       .00634     .018552
          3  |   .0108327   .0033014     3.28   0.001      .004336    .0173294
          4  |   .0111764   .0035758     3.13   0.002     .0041397     .018213
          5  |   .0053687   .0030705     1.75   0.081    -.0006736    .0114109
          6  |   .0041449   .0033227     1.25   0.213    -.0023936    .0106835
          7  |    .006134   .0027733     2.21   0.028     .0006765    .0115915
          8  |   .0129795   .0027654     4.69   0.000     .0075375    .0184214
          9  |   .0159311   .0027644     5.76   0.000     .0104912    .0213709
         10  |   .0227959   .0035244     6.47   0.000     .0158605    .0297313
         11  |   .0145436    .003114     4.67   0.000     .0084157    .0206715
         12  |   .0140586    .002605     5.40   0.000     .0089323     .019185
             |
       _cons |  -.0102486    .002402    -4.27   0.000    -.0149754   -.0055219
------------------------------------------------------------------------------

. estat ic

Akaike's information criterion and Bayesian information criterion

-----------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+---------------------------------------------------------------
           . |        335   1069.62   1435.441      33   -2804.882  -2679.016
-----------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

. log close
      name:  <unnamed>
       log:  C:\Users\jdewey\Documents\A S20 Time Series\Problem Sets\Problem Set 3
Work.smcl
  log type:  smcl
 closed on:  17 Feb 2020, 10:09:33
-------------------------------------------------------------------------------------------
```