Time Series Modeling and Forecasting **Midterm—answers, do file, log file**

In Class Part A: Time Series Basics and Static Models (4 points per question)

1) The first model in the Stata output regresses employment in amusement parks and arcades on nonfarm employment. The second adds month indicators and a linear time trend.

a) What is the purpose of adding the month indicators and the time trend?

The monthly indicators control for predictable seasonal fluctuations. The time trend is to allow for a (more or less constant) growth rate over time.

b) What do you make of the change in the coefficient on nonfarm employment that occurred when month indicators and a time trend were added?

The general upward time trend in employment is present in total non-farm employment and amusement park employment, as likely are various seasonal patterns. The time trend captures that upward trend and the monthly indicators capture predictable seasonal factors. That leaves non-farm employment to provide information for the model on only variability around the predictable trend and seasonal effects in the second model.

2) Nonstationarity

2a) What is a non-stationary process and why do we need to be wary of them?

Speaking loosely, a non-stationary process does not have a constant mean or variance—they change over time. Among the troubles: 1) we need to model a process that we expect to be the same in the future as in the data being used or what is the point, and 2) two non-stationary series that are completely independent are almost certain to show strong statistically significant correlation with one another due only to the non-stationarity.

2b) Why include lagged differences of the dependent variable in a Dickey-Fuller test?

To control for serial correlation likely to interfere with statistical inference.

2c) Interpret the partial autocorrelogram and Dickey-Fuller test results for employment in amusement parks and arcades.

The first order partial autocorrelation coefficient is essentially 1. And the null hypothesis it is one cannot be rejected. Thus the log of amusement park employment is I(1).

3) The third regression model in the output regresses the first difference of amusement park and arcade employment on nonfarm employment, including month indicators and a time trend.

a) The time trend was statistically significant in the second model but not the third. What do you make of that?

Any time trend reflected a constant growth rate. When we take the first difference, this is then captured in the constant in the model.

b) Compare the coefficients on nonfarm employment in the second and third models. What likely explains the difference?

The part of the correlation due to the non-stationarity, particularly strong first order autocorrelation, was removed by differencing.

c) Interpret the Breusch-Godfrey test results that follow estimation of the third model.

Even after differencing and controlling for movements in total non-farm employment, amusement part employment continues to show autocorrelation.

4) The fourth regression model is just like the third, but with Newey-West standard errors.

a) Why use Newey-West standard errors?

To correct the coefficient standard errors for the presence of autocorrelation.

b) What are Newey-West standard errors anyway? How do they work?

They use the pattern of residual correlation in the sample, up to L lags and structured so the size of the correlation decays the further the lag from the present, to correct the coefficient covariance matrix for the presence of autocorrelation.

c) Why can't we use lots and lots of lags for the Newey-West standard errors?

Because it amounts to asking to estimate more parameters than the data available, since the residual covariance matrix has potentially $n(n-1)/2 > n$ elements to estimate.

d) Why were 5 lags used in this case?

Just because the rule of thumb for the bet tradeoff between accounting for autocorrelation and adding complexity to the model, $L=0.75T^{(1/3)}$, suggests the number.

e) Interpret the difference Newey-West standard errors make in the findings on the relationship between employment in amusement parks and arcades and nonfarm employment.

In the third regression, the standard error was 0.22. In the fourth, after allowing for serial correlation, it is 0.196. In this case, the difference is minor, but it is large in some cases.

In Class Part B: One Period Ahead Forecasting (8 points)

The Stata output for Part B contains three models that are potentially appropriate for making a one period ahead forecast of (the difference in the log of) amusement park and arcade employment. Using the output provided, make the case that Model 2 is the best of them.

The out of sample RMSE using leave one out cross validation and the last year that was held out is lower for model 2 than both others—though only slightly lower than in model 3.

Model 1 also contains a number of lags that do not appear to be systematically related to employment (as indicated by the joint F test) and for which there is no good reason to expect effects to persist that long into the future.

Model 3 leaves out the US unemployment rate. However, since amusement park employment depends heavily on visitors from out of state, it stands to reason that national economic conditions may provide important information this model leaves out.

Take home component (3 points additional content, 3 points for quality of the report)

This should be a formal report corresponding in large part to part B, though you may have used different models or independent variables, including the output you generated from estimating your versions of the models. In addition to that, it should include performing the forecast for the preferred model and generating figures with the actuals and the prediction and the forecast interval for evaluation and discussing them (figures for this additional work appear at the end of the log file). The report should have been formatted according to the instructions given. Here are the major points your report should have covered:

1. What is the purpose?
2. Should you difference and why?
3. Model Specification
   3.1. Which variables should you use? Why?
   3.2. How many lags? Why
   3.3. Use of cross validation and complete out of sample testing.
4. Actual Forecast for Selected Model, Charts, Discussion
   4.1. The prediction closely tracks the actual.
   4.2. The predicted difference almost always turns up when the actual difference turns up (which could include simply a smaller decline) and down when the actual difference turns down.
   4.3. The actual is almost always within the approximate 95% forecast interval.

Stata do file

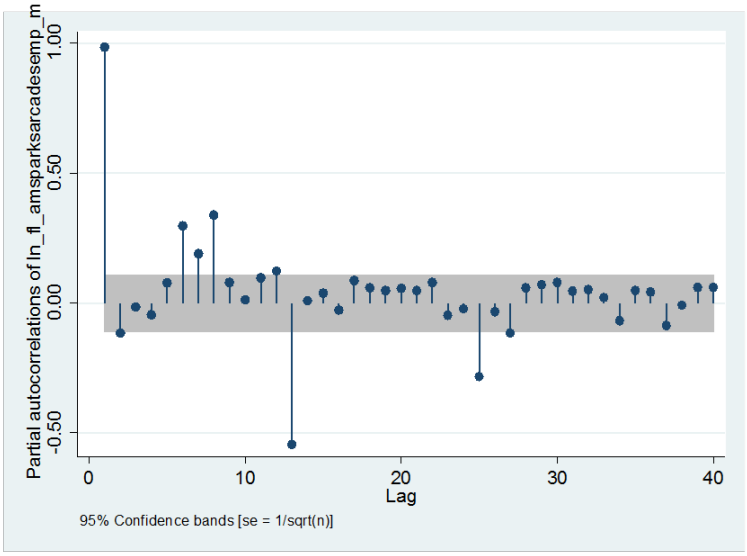
```
*Midterm Work
*March 25, 2018

clear
set more off

cd "C:\Users\jdewey\Documents\A S18 Adv Topics\Midterm\"
log using "Midterm Work", replace
import delimited using "fl and us monthly data.csv"

** data prep
gen date=ym(year,month)
tsset date
format date %tm

gen ln_fl_amsparksarcadesemp_m = ln(fl_amsparksarcadesemp_m)
gen ln_fl_nonfarmemp_m = ln(fl_nonfarmemp_m)
gen ln_fl_laborforce_m = ln(fl_laborforce_m)
gen ln_fl_unemprate_m = ln(fl_unemprate_m)
gen ln_fl_bldpmt_m = ln(fl_bldpmt_m)
gen ln_us_civillianemptopopratio_m = ln(us_civillianemptopopratio_m)
gen ln_us_emptopopratio25to54_m = ln(us_emptopopratio25to54_m)
gen ln_us_bldpmt_m = ln(us_bldpmt_m)
gen ln_us_unemprate_m = ln(us_unemprate_m)


**Part A: Time Series Modeling

reg ln_fl_amsparksarcadesemp_m ln_fl_nonfarmemp_m
reg ln_fl_amsparksarcadesemp_m ln_fl_nonfarmemp_m i.month date
pac ln_fl_amsparksarcadesemp_m
dfuller ln_fl_amsparksarcadesemp_m, trend regress lags(12)
reg d.ln_fl_amsparksarcadesemp_m d.ln_fl_nonfarmemp_m i.month date
estat bgodfrey, lags(12)
newey d.ln_fl_amsparksarcadesemp_m d.ln_fl_nonfarmemp_m i.month date, lag(5)


**Part B: One Period Forecasting
***The last year is held out for a test set

**Model 1: Many lags of Y and X
loocv reg d.ln_fl_amsparksarcadesemp_m ///
          l(1/24)d.ln_fl_amsparksarcadesemp_m ///
          l(1/12)d.ln_us_unemprate_m i.month if tin(1990m1,2016m12)
reg d.ln_fl_amsparksarcadesemp_m ///
    l(1/24)d.ln_fl_amsparksarcadesemp_m ///
    l(1/12)d.ln_us_unemprate_m i.month if tin(1990m1,2016m12)
predict p_model_1
predict res_model_1 , residual
gen ressq_model_1=res_model_1^2
summ ressq_model_1 if tin(2017m1, )
gen rmse_1=r(mean)^0.5
summ rmse_1
pac res_model_1
testparm l(2/12)d.ln_us_un
```

```
testparm l(2/11)d.ln_fl_am

*Model 2: Parsimonious Lag Structure in Y and X
loocv reg d.ln_fl_amsparksarcadesemp_m ///
          l(1,12,24)d.ln_fl_amsparksarcadesemp_m ///
          l(1)d.ln_us_unemprate_m i.month if tin(1990m1,2016m12)
reg d.ln_fl_amsparksarcadesemp_m ///
    l(1,12,24)d.ln_fl_amsparksarcadesemp_m ///
    l(1)d.ln_us_unemprate_m i.month if tin(1990m1,2016m12)
predict p_model_2
predict res_model_2, residual
gen ressq_model_2=res_model_2^2
summ ressq_model_2 if tin(2017m1, )
gen rmse_2=r(mean)^0.5
summ rmse_2
pac res_model_2

*Model 3: Y only
loocv reg d.ln_fl_amsparksarcadesemp_m ///
          l(1,12,24)d.ln_fl_amsparksarcadesemp_m ///
          i.month if tin(1990m1,2016m12)
reg d.ln_fl_amsparksarcadesemp_m ///
    l(1,12,24)d.ln_fl_amsparksarcadesemp_m ///
    i.month if tin(1990m1,2016m12)
predict p_model_3
predict res_model_3 , residual
gen ressq_model_3=res_model_3^2
summ ressq_model_3 if tin(2017m1, )
gen rmse_3=r(mean)^0.5
summ rmse_3
pac res_model_3


*Forecast and graphs for Model 2
reg d.ln_fl_amsparksarcadesemp_m ///
    l(1,12,24)d.ln_fl_amsparksarcadesemp_m ///
    l(1)d.ln_us_unemprate_m i.month if tin(1990m1, )

predict Predicted_DLN
predict stdf2_model2, stdf
gen FIUB=Predicted_DLN+2*stdf2_model2
gen FILB=Predicted_DLN-2*stdf2_model2

tsline d.ln_fl_amsparksarcade Predicted_DLN if tin(2010m1, ) , ///
       title("Employment Amusement Parks and Arcades in Florida") ///
       scheme(s2mono) ytitle("Log Difference from Previous Month") ///
       xtitle("") legend(label(1 "Actual") label(2 "Predicted" ))

tsline d.ln_fl_amsparksarcade FIUB FILB if tin(2010m1, ) , ///
       title("Employment Amusement Parks and Arcades in Florida") ///
       scheme(s2mono) ytitle("Log Difference from Previous Month") ///
       xtitle("") legend(label(1 "Actual") ///
         label(2 "Upper Bound" ) label(3 "Lower Bound"))

log close
```

Stata Log File – Graphs Added

```
      name:  <unnamed>
       log:  C:\Users\jdewey\Documents\A S18 Adv Topics\Midterm\Midterm Work.smcl
  log type:  smcl
 opened on:  25 Mar 2018, 13:51:46

. import delimited using "fl and us monthly data.csv"
(11 vars, 338 obs)
.
. ** data prep
. gen date=ym(year,month)

. tsset date
        time variable:  date, 360 to 697
                delta:  1 unit

. format date %tm
.
. gen ln_fl_amsparksarcadesemp_m = ln(fl_amsparksarcadesemp_m)
(2 missing values generated)

. gen ln_fl_nonfarmemp_m = ln(fl_nonfarmemp_m)
(2 missing values generated)

. gen ln_fl_laborforce_m = ln(fl_laborforce_m)
(2 missing values generated)

. gen ln_fl_unemprate_m = ln(fl_unemprate_m)
(2 missing values generated)

. gen ln_fl_bldpmt_m = ln(fl_bldpmt_m)
(1 missing value generated)

. gen ln_us_civillianemptopopratio_m = ln(us_civillianemptopopratio_m)

. gen ln_us_emptopopratio25to54_m = ln(us_emptopopratio25to54_m)

. gen ln_us_bldpmt_m = ln(us_bldpmt_m)
(1 missing value generated)

. gen ln_us_unemprate_m = ln(us_unemprate_m)

.
. **Part A: Time Series Modeling
.
. reg ln_fl_amsparksarcadesemp_m ln_fl_nonfarmemp_m

      Source |       SS           df       MS      Number of obs   =       336
-------------+----------------------------------   F(1, 334)       =   1301.37
       Model |  10.6494338         1  10.6494338   Prob > F        =    0.0000
    Residual |  2.73319729       334  .008183225   R-squared       =    0.7958
-------------+----------------------------------   Adj R-squared   =    0.7952
       Total |  13.3826311       335  .039948152   Root MSE        =    .09046

------------------------------------------------------------------------------
ln_fl_amsparksar~m |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------+----------------------------------------------------------------
ln_fl_nonfarmemp_m |    1.26385   .0350344    36.07   0.000     1.194934    1.332766
             _cons |  -7.192252   .3099447   -23.20   0.000    -7.801942   -6.582563
------------------------------------------------------------------------------
```

```
. reg ln_fl_amsparksarcadesemp_m ln_fl_nonfarmemp_m i.month date

      Source |       SS           df       MS      Number of obs   =       336
-------------+----------------------------------   F(13, 322)      =    233.13
       Model |  12.0973567        13  .930565899   Prob > F        =    0.0000
    Residual |  1.28527439       322  .003991535   R-squared       =    0.9040
-------------+----------------------------------   Adj R-squared   =    0.9001
       Total |  13.3826311       335  .039948152   Root MSE        =    .06318

------------------------------------------------------------------------------
ln_fl_amsparksar~m |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------+----------------------------------------------------------------
ln_fl_nonfarmemp_m |   .4405917   .0588552     7.49   0.000     .3248024     .556381
                   |
             month |
                2  |   .0189225   .0168911     1.12   0.263    -.0143083    .0521533
                3  |   .0423161   .0169062     2.50   0.013     .0090556    .0755766
                4  |   .0554543   .0168992     3.28   0.001     .0222074    .0887011
                5  |    .061782   .0168978     3.66   0.000      .028538    .0950261
                6  |   .1065679   .0168863     6.31   0.000     .0733466    .1397893
                7  |   .1083098      .0169     6.41   0.000     .0750615    .1415581
                8  |   .0797846   .0168885     4.72   0.000     .0465589    .1130104
                9  |    .055445   .0168877     3.28   0.001     .0222209    .0886691
               10  |   .0381391   .0168912     2.26   0.025      .004908    .0713702
               11  |   .0171462   .0169105     1.01   0.311    -.0161227    .0504152
               12  |   .0232929   .0169307     1.38   0.170    -.0100159    .0566016
                   |
             date  |   .0013297   .0000853    15.59   0.000     .0011618    .0014975
            _cons  |  -.6619079   .4798783    -1.38   0.169    -1.606001    .2821848
------------------------------------------------------------------------------

. pac ln_fl_amsparksarcadesemp_m
```

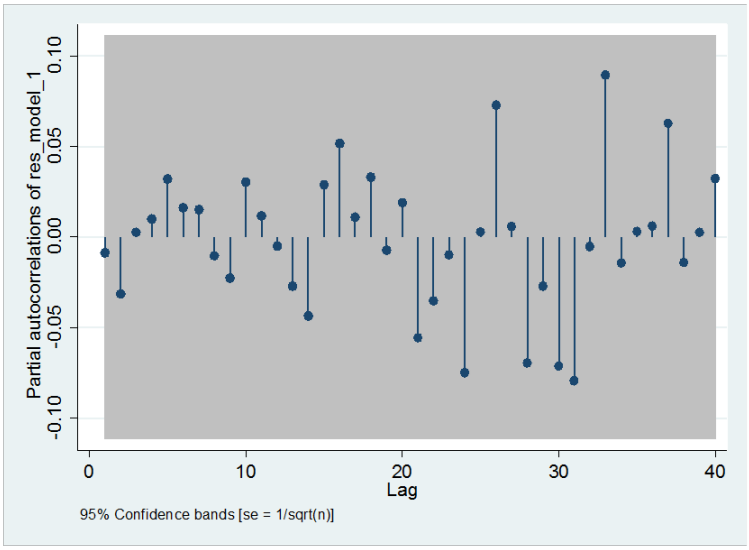


```
. dfuller ln_fl_amsparksarcadesemp_m, trend regress lags(12)

Augmented Dickey-Fuller test for unit root         Number of obs   =       323
                              ---------- Interpolated Dickey-Fuller ---------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -2.212           -3.987            -3.427           -3.130
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.4831
------------------------------------------------------------------------------
D.ln_fl_am~m |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
ln_fl_amsp~m |
         L1. |  -.0383278    .017327    -2.21   0.028    -.0724221   -.0042336
         LD. |   -.028895    .048609    -0.59   0.553    -.1245428    .0667528
        L2D. |  -.0374161   .0482057    -0.78   0.438    -.1322704    .0574382
        L3D. |   .0288771   .0476649     0.61   0.545    -.0649128    .1226671
        L4D. |  -.0203811   .0475925    -0.43   0.669    -.1140287    .0732665
        L5D. |  -.1157919   .0473818    -2.44   0.015    -.2090249    -.022559
        L6D. |  -.0904795   .0466345    -1.94   0.053    -.1822421    .0012831
        L7D. |  -.1399554   .0464133    -3.02   0.003    -.2312827   -.0486282
        L8D. |  -.0297848   .0447821    -0.67   0.506    -.1179022    .0583327
        L9D. |  -.0042856    .044565    -0.10   0.923     -.091976    .0834048
       L10D. |  -.0313607   .0443949    -0.71   0.480    -.1187164    .0559949
       L11D. |  -.0648674   .0443373    -1.46   0.144    -.1521097    .0223749
       L12D. |    .551247    .044504    12.39   0.000     .4636766    .6388173
      _trend |   .0000768   .0000347     2.21   0.028     8.54e-06     .000145
       _cons |   .1417888   .0634466     2.23   0.026     .0169451    .2666325
------------------------------------------------------------------------------


. reg d.ln_fl_amsparksarcadesemp_m d.ln_fl_nonfarmemp_m i.month date
      Source |       SS           df       MS      Number of obs   =       335
-------------+----------------------------------   F(13, 321)      =     29.85
       Model |  .152043278        13  .011695637   Prob > F        =    0.0000
    Residual |   .12578679       321  .000391859   R-squared       =    0.5473
-------------+----------------------------------   Adj R-squared   =    0.5289
       Total |  .277830068       334  .000831827   Root MSE        =     .0198
------------------------------------------------------------------------------
D.                 |
ln_fl_amsparksar~m |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------+----------------------------------------------------------------
ln_fl_nonfarmemp_m |
               D1. |   .2963923   .2204301     1.34   0.180    -.1372778    .7300625
                   |
             month |
                2  |   .0405913   .0078251     5.19   0.000     .0251963    .0559863
                3  |   .0449418    .007687     5.85   0.000     .0298184    .0600651
                4  |   .0333373   .0063634     5.24   0.000     .0208181    .0458564
                5  |   .0268119   .0066069     4.06   0.000     .0138137    .0398101
                6  |   .0639918   .0056779    11.27   0.000     .0528212    .0751624
                7  |   .0205223   .0054894     3.74   0.000     .0097225    .0313221
                8  |  -.0068206   .0078386    -0.87   0.385    -.0222422     .008601
                9  |  -.0030493   .0073834    -0.41   0.680    -.0175753    .0114768
               10  |   .0039528    .007346     0.54   0.591    -.0104997    .0184052
               11  |   .0009348   .0080783     0.12   0.908    -.0149582    .0168278
               12  |   .0275626   .0075048     3.67   0.000     .0127977    .0423274
                   |
             date  |  -4.23e-06   .0000112    -0.38   0.706    -.0000263    .0000178
            _cons  |  -.0168444   .0078631    -2.14   0.033    -.0323141   -.0013748
------------------------------------------------------------------------------
```

```
. estat bgodfrey, lags(12)

Breusch-Godfrey LM test for autocorrelation
----------------------------------------------------------------------------
    lags(p)  |          chi2               df                 Prob > chi2
-------------+--------------------------------------------------------------
      12     |         37.976              12                   0.0002
----------------------------------------------------------------------------
                       H0: no serial correlation


. newey d.ln_fl_amsparksarcadesemp_m d.ln_fl_nonfarmemp_m i.month date, lag(5)
Regression with Newey-West standard errors      Number of obs     =        335
maximum lag: 5                                  F( 13,       321) =      38.65
                                                Prob > F          =     0.0000
------------------------------------------------------------------------------
D.                  |             Newey-West
ln_fl_amsparksar~m |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------+----------------------------------------------------------------
ln_fl_nonfarmemp_m |
               D1. |   .2963923   .1957429     1.51   0.131    -.0887088    .6814934
                   |
             month |
                2  |   .0405913   .0087143     4.66   0.000      .023447    .0577356
                3  |   .0449418   .0078255     5.74   0.000     .0295461    .0603374
                4  |   .0333373    .007943     4.20   0.000     .0177104    .0489642
                5  |   .0268119   .0068342     3.92   0.000     .0133665    .0402573
                6  |   .0639918   .0066808     9.58   0.000     .0508482    .0771354
                7  |   .0205223   .0061924     3.31   0.001     .0083395    .0327051
                8  |  -.0068206   .0074224    -0.92   0.359    -.0214233    .0077822
                9  |  -.0030493   .0078552    -0.39   0.698    -.0185034    .0124049
               10  |   .0039528   .0092023     0.43   0.668    -.0141517    .0220572
               11  |   .0009348   .0075343     0.12   0.901     -.013888    .0157577
               12  |   .0275626   .0069349     3.97   0.000     .0139189    .0412062
                   |
             date  |  -4.23e-06   .0000105    -0.40   0.687    -.0000249    .0000164
            _cons  |  -.0168444   .0085823    -1.96   0.051    -.0337292    .0000403
------------------------------------------------------------------------------


. **Part B: One Period Forecasting

. ***The last year is held out for a test set
.
. **Model 1: Many lags of Y and X

. loocv reg d.ln_fl_amsparksarcadesemp_m ///
>           l(1/24)d.ln_fl_amsparksarcadesemp_m ///
>           l(1/12)d.ln_us_unemprate_m i.month if tin(1990m1,2016m12)

 Leave-One-Out Cross-Validation Results
----------------------------------------
         Method          |    Value
-------------------------+--------------
Root Mean Squared Errors |   .01930523
Mean Absolute Errors     |   .01485857
Pseudo-R2                |   .48661599
----------------------------------------

. reg d.ln_fl_amsparksarcadesemp_m ///
>     l(1/24)d.ln_fl_amsparksarcadesemp_m ///
>     l(1/12)d.ln_us_unemprate_m i.month if tin(1990m1,2016m12)
```

```
      Source |       SS           df       MS      Number of obs   =       299
-------------+----------------------------------   F(47, 251)      =      9.64
       Model |  .140385958        47  .002986935   Prob > F        =    0.0000
    Residual |  .077790102       251  .000309921   R-squared       =    0.6435
-------------+----------------------------------   Adj R-squared   =    0.5767
       Total |   .21817606       298  .000732134   Root MSE        =     .0176
------------------------------------------------------------------------------
D.                      |
ln_fl_amsparksarca~m |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------------
ln_fl_amsparksarca~m |
                 LD. |  -.1052156   .0619833    -1.70   0.091    -.2272892     .016858
                L2D. |  -.0650859   .0626638    -1.04   0.300    -.1884998    .0583279
                L3D. |   .0113327   .0623814     0.18   0.856    -.1115249    .1341904
                L4D. |  -.0356583   .0622978    -0.57   0.568    -.1583513    .0870346
                L5D. |  -.0721342   .0614085    -1.17   0.241    -.1930758    .0488074
                L6D. |  -.0029064   .0618638    -0.05   0.963    -.1247446    .1189319
                L7D. |  -.0610742   .0619485    -0.99   0.325    -.1830793    .0609308
                L8D. |  -.0283865   .0615896    -0.46   0.645    -.1496848    .0929117
                L9D. |  -.0280401   .0614581    -0.46   0.649    -.1490793    .0929992
               L10D. |  -.0227261   .0601375    -0.38   0.706    -.1411645    .0957123
               L11D. |  -.1101929   .0601762    -1.83   0.068    -.2287075    .0083217
               L12D. |   .1887552   .0606101     3.11   0.002      .069386    .3081245
               L13D. |   .0108801   .0618843     0.18   0.861    -.1109986    .1327589
               L14D. |  -.0250538   .0615785    -0.41   0.684    -.1463302    .0962227
               L15D. |   .0530571   .0614662     0.86   0.389    -.0679981    .1741124
               L16D. |   -.100063   .0607259    -1.65   0.101    -.2196602    .0195343
               L17D. |   .0656976   .0601151     1.09   0.276    -.0526967    .1840919
               L18D. |   -.012924   .0599232    -0.22   0.829    -.1309404    .1050923
               L19D. |   .0350884   .0591959     0.59   0.554    -.0814955    .1516723
               L20D. |  -.0445701   .0575794    -0.77   0.440    -.1579704    .0688301
               L21D. |  -.0407449   .0575943    -0.71   0.480    -.1541745    .0726847
               L22D. |   .0684074   .0563874     1.21   0.226    -.0426453    .1794601
               L23D. |   .0352428   .0562758     0.63   0.532    -.0755901    .1460756
               L24D. |   .1597019   .0560503     2.85   0.005     .0493131    .2700906
   ln_us_unemprate_m |
                 LD. |  -.0705341   .0383489    -1.84   0.067    -.1460607    .0049926
                L2D. |  -.0427314   .0394213    -1.08   0.279    -.1203702    .0349073
                L3D. |   .0117992   .0396611     0.30   0.766    -.0663117      .08991
                L4D. |   .0075577   .0395101     0.19   0.848    -.0702558    .0853713
                L5D. |   -.092576   .0391791    -2.36   0.019    -.1697376   -.0154143
                L6D. |  -.0775704   .0403716    -1.92   0.056    -.1570807    .0019399
                L7D. |   .0439132   .0406744     1.08   0.281    -.0361935    .1240198
                L8D. |  -.0125625    .039968    -0.31   0.754    -.0912779     .066153
                L9D. |  -.0174837   .0399305    -0.44   0.662    -.0961252    .0611578
               L10D. |   .0155879   .0391649     0.40   0.691    -.0615459    .0927217
               L11D. |   .0167915   .0389829     0.43   0.667    -.0599838    .0935668
               L12D. |   .0188713   .0386769     0.49   0.626    -.0573014     .095044
               month |
                   2 |   .0471029    .013005     3.62   0.000     .0214902    .0727157
                   3 |   .0448213   .0155651     2.88   0.004     .0141664    .0754762
                   4 |   .0329593   .0162935     2.02   0.044       .00087    .0650487
                   5 |   .0186156   .0143094     1.30   0.194    -.0095662    .0467974
                   6 |   .0570619   .0146967     3.88   0.000     .0281174    .0860065
                   7 |   .0435412   .0148522     2.93   0.004     .0142904    .0727921
                   8 |   .0083409   .0149277     0.56   0.577    -.0210585    .0377403
                   9 |   .0003456   .0143571     0.02   0.981      -.02793    .0286213
                  10 |   .0096207   .0164138     0.59   0.558    -.0227055     .041947
                  11 |   .0213091   .0153637     1.39   0.167     -.008949    .0515672
                  12 |    .029197   .0126879     2.30   0.022     .0042088    .0541852
                     |
               _cons |  -.0239654   .0100705    -2.38   0.018    -.0437988    -.004132
------------------------------------------------------------------------------
```

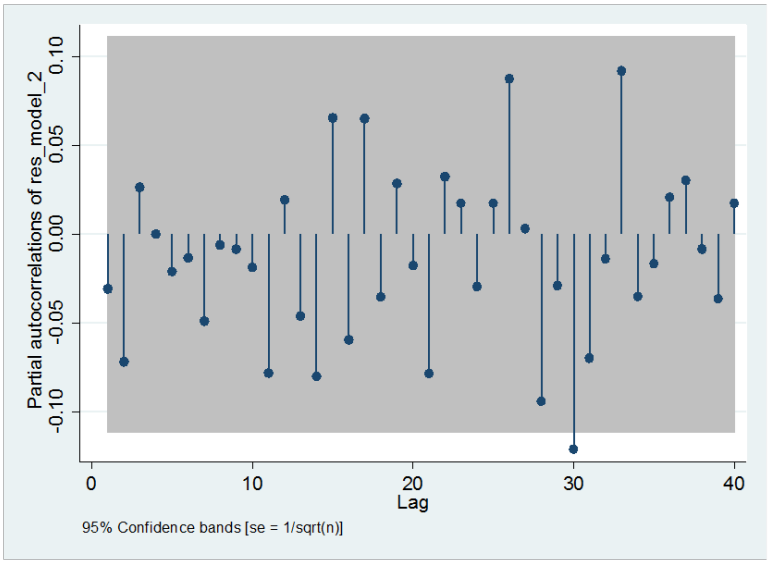
```
. predict p_model_1
(option xb assumed; fitted values)
(26 missing values generated)

. predict res_model_1 , residual
(27 missing values generated)

. gen ressq_model_1=res_model_1^2
(27 missing values generated)

. summ ressq_model_1 if tin(2017m1, )

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
ressq_mode~1 |         12    .0000333    .0000277   1.00e-06    .000073

. gen rmse_1=r(mean)^0.5

. summ rmse_1

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
      rmse_1 |        338    .0057736           0   .0057736   .0057736

. pac res_model_1
```




```
. testparm l(2/12)d.ln_us_un
 ( 1)  L2D.ln_us_unemprate_m = 0
 ( 2)  L3D.ln_us_unemprate_m = 0
 ( 3)  L4D.ln_us_unemprate_m = 0
 ( 4)  L5D.ln_us_unemprate_m = 0
 ( 5)  L6D.ln_us_unemprate_m = 0
 ( 6)  L7D.ln_us_unemprate_m = 0
 ( 7)  L8D.ln_us_unemprate_m = 0
 ( 8)  L9D.ln_us_unemprate_m = 0
 ( 9)  L10D.ln_us_unemprate_m = 0
 (10)  L11D.ln_us_unemprate_m = 0
 (11)  L12D.ln_us_unemprate_m = 0

       F( 11,   251) =    1.10
            Prob > F =    0.3656
```

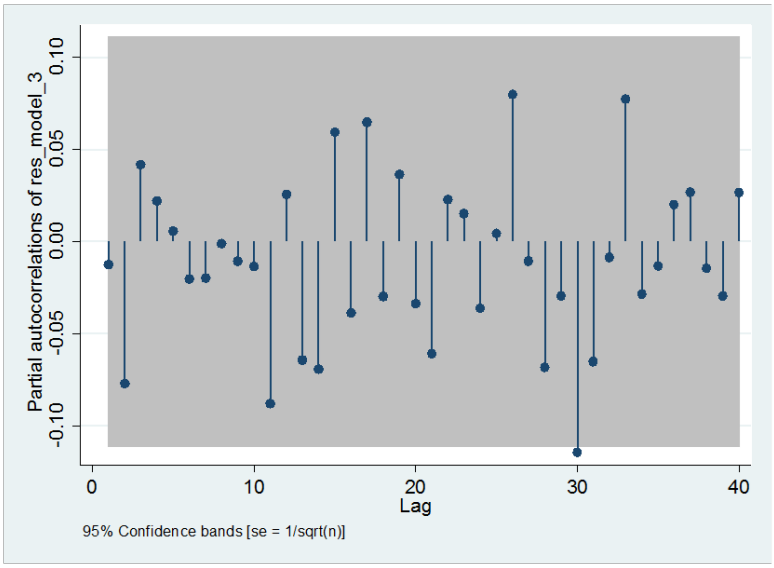
```
. testparm l(2/11)d.ln_fl_am
 ( 1)  L2D.ln_fl_amsparksarcadesemp_m = 0
 ( 2)  L3D.ln_fl_amsparksarcadesemp_m = 0
 ( 3)  L4D.ln_fl_amsparksarcadesemp_m = 0
 ( 4)  L5D.ln_fl_amsparksarcadesemp_m = 0
 ( 5)  L6D.ln_fl_amsparksarcadesemp_m = 0
 ( 6)  L7D.ln_fl_amsparksarcadesemp_m = 0
 ( 7)  L8D.ln_fl_amsparksarcadesemp_m = 0
 ( 8)  L9D.ln_fl_amsparksarcadesemp_m = 0
 ( 9)  L10D.ln_fl_amsparksarcadesemp_m = 0
 (10)  L11D.ln_fl_amsparksarcadesemp_m = 0

       F( 10,   251) =    0.67
            Prob > F =    0.7518


. *Model 2: Parsimonious Lag Structure in Y and X

. loocv reg d.ln_fl_amsparksarcadesemp_m ///
>           l(1,12,24)d.ln_fl_amsparksarcadesemp_m ///
>           l(1)d.ln_us_unemprate_m i.month if tin(1990m1,2016m12)
 Leave-One-Out Cross-Validation Results
----------------------------------------
         Method          |    Value
-------------------------+--------------
Root Mean Squared Errors |   .01757819
Mean Absolute Errors     |   .01357635
Pseudo-R2                |   .56252575
----------------------------------------

. reg d.ln_fl_amsparksarcadesemp_m ///
>     l(1,12,24)d.ln_fl_amsparksarcadesemp_m ///
>     l(1)d.ln_us_unemprate_m i.month if tin(1990m1,2016m12)
      Source |       SS           df       MS      Number of obs   =       299
-------------+----------------------------------   F(15, 283)      =     28.48
       Model |  .131246055        15  .008749737   Prob > F        =    0.0000
    Residual |  .086930005       283  .000307173   R-squared       =    0.6016
-------------+----------------------------------   Adj R-squared   =    0.5804
       Total |   .21817606       298  .000732134   Root MSE        =    .01753
------------------------------------------------------------------------------
D.                   |
ln_fl_amsparksarca~m |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------------
ln_fl_amsparksarca~m |
                LD. |  -.0953068    .055729    -1.71   0.088    -.2050026    .0143891
              L12D. |    .227269   .0564004     4.03   0.000     .1162515    .3382864
              L24D. |   .1414653   .0531426     2.66   0.008     .0368603    .2460703
   ln_us_unemprate_m |
                LD. |   -.070526   .0331445    -2.13   0.034     -.135767   -.0052849
              month |
                 2  |   .0354322   .0076361     4.64   0.000     .0204015    .0504628
                 3  |   .0303924   .0060431     5.03   0.000     .0184973    .0422876
                 4  |   .0238767   .0057076     4.18   0.000      .012642    .0351114
                 5  |   .0136104    .005978     2.28   0.024     .0018434    .0253774
                 6  |   .0375956   .0064853     5.80   0.000     .0248302    .0503611
                 7  |    .021344   .0060842     3.51   0.001     .0093679    .0333201
                 8  |  -.0003765   .0050557    -0.07   0.941    -.0103281    .0095751
                 9  |  -.0002258   .0055171    -0.04   0.967    -.0110854    .0106339
                10  |   .0016958    .005397     0.31   0.754    -.0089276    .0123191
                11  |  -.0007945   .0052529    -0.15   0.880    -.0111343    .0095453
                12  |   .0186375   .0055823     3.34   0.001     .0076494    .0296256
              _cons |   -.013696   .0038649    -3.54   0.000    -.0213036   -.0060884
------------------------------------------------------------------------------
```

```
. predict p_model_2
(option xb assumed; fitted values)
(26 missing values generated)

. predict res_model_2, residual
(27 missing values generated)

. gen ressq_model_2=res_model_2^2
(27 missing values generated)

. summ ressq_model_2 if tin(2017m1, )

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
ressq_mode~2 |         12    .0000255    .0000173   1.54e-07   .0000512

. pac res_model_2
```




```
. *Model 3: Y only
. loocv reg d.ln_fl_amsparksarcadesemp_m ///
>           l(1,12,24)d.ln_fl_amsparksarcadesemp_m ///
>           i.month if tin(1990m1,2016m12)
 Leave-One-Out Cross-Validation Results
-----------------------------------------
         Method          |    Value
-------------------------+---------------
Root Mean Squared Errors |   .01764286
Mean Absolute Errors     |   .01360036
Pseudo-R2                |   .55920894
-----------------------------------------

. reg d.ln_fl_amsparksarcadesemp_m ///
>     l(1,12,24)d.ln_fl_amsparksarcadesemp_m ///
>     i.month if tin(1990m1,2016m12)
      Source |       SS           df       MS      Number of obs   =       299
-------------+----------------------------------   F(14, 284)      =     29.83
       Model |  .129855275        14  .009275377   Prob > F        =    0.0000
    Residual |  .088320785       284  .000310989   R-squared       =    0.5952
-------------+----------------------------------   Adj R-squared   =    0.5752
       Total |   .21817606       298  .000732134   Root MSE        =    .01763
```

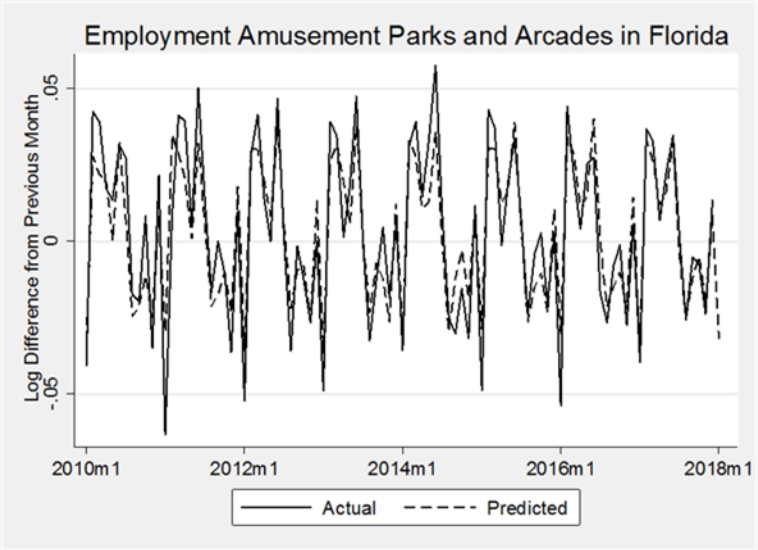
```
------------------------------------------------------------------------------
D.                      |
ln_fl_amsparksarca~m |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------
ln_fl_amsparksarca~m |
                 LD. |  -.0906301   .0560304    -1.62   0.107    -.2009177    .0196574
               L12D. |   .2327216    .056691     4.11   0.000     .1211338    .3443093
               L24D. |   .1452058   .0534424     2.72   0.007     .0400123    .2503992
               month |
                  2  |   .0252489   .0059871     4.22   0.000     .0134641    .0370337
                  3  |   .0314385   .0060604     5.19   0.000     .0195096    .0433675
                  4  |    .025831   .0056681     4.56   0.000     .0146742    .0369878
                  5  |   .0193461   .0053688     3.60   0.000     .0087784    .0299138
                  6  |   .0369461   .0065182     5.67   0.000     .0241161    .0497762
                  7  |   .0156275   .0054928     2.85   0.005     .0048158    .0264392
                  8  |  -.0005625   .0050863    -0.11   0.912    -.0105741     .009449
                  9  |   .0028453   .0053579     0.53   0.596     -.007701    .0133915
                 10  |   .0045235   .0052632     0.86   0.391    -.0058364    .0148833
                 11  |   .0010961   .0052093     0.21   0.833    -.0091576    .0113498
                 12  |   .0180395   .0056098     3.22   0.001     .0069975    .0290814
               _cons |  -.0135536   .0038883    -3.49   0.001    -.0212071   -.0059001
------------------------------------------------------------------------------

. predict p_model_3
(option xb assumed; fitted values)
(26 missing values generated)

. predict res_model_3 , residual
(27 missing values generated)

. gen ressq_model_3=res_model_3^2
(27 missing values generated)

. summ ressq_model_3 if tin(2017m1, )

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
ressq_mode~3 |         12    .0000261    .0000238   4.07e-07   .0000733

. pac res_model_3
```



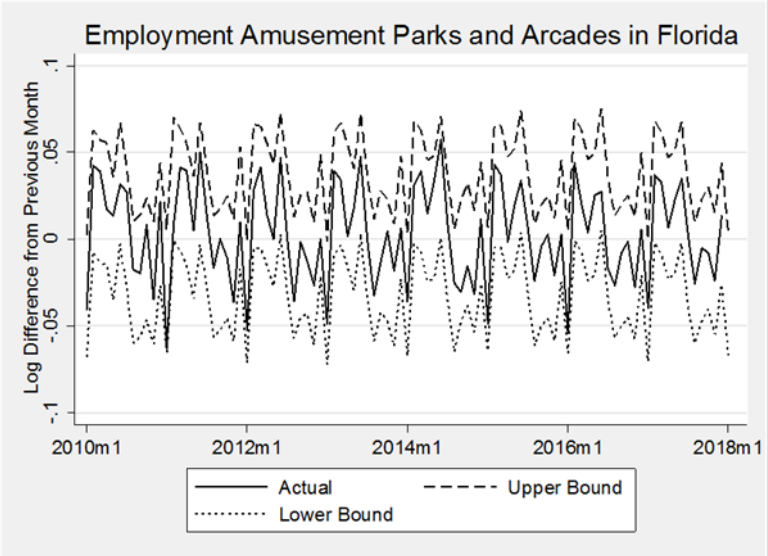
***Forecast and graphs for Model 2**

```
. reg d.ln_fl_amsparksarcadesemp_m ///
>     l(1,12,24)d.ln_fl_amsparksarcadesemp_m ///
>     l(1)d.ln_us_unemprate_m i.month if tin(1990m1, )

      Source |       SS           df       MS      Number of obs   =       311
-------------+----------------------------------   F(15, 295)      =     31.13
       Model |  .138074151        15  .009204943   Prob > F        =    0.0000
    Residual |  .087221187       295  .000295665   R-squared       =    0.6129
-------------+----------------------------------   Adj R-squared   =    0.5932
       Total |  .225295338       310  .000726759   Root MSE        =    .01719
------------------------------------------------------------------------------
D.           |
ln_fl_amspar~m |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------+--------------------------------------------------------------
ln_fl_amspar~m |
          LD. |  -.0961684   .0544288    -1.77   0.078    -.2032864    .0109497
         L12D. |   .2287114   .0548868     4.17   0.000      .120692    .3367307
         L24D. |   .1454639   .0517991     2.81   0.005     .0435212    .2474066
ln_us_unempr~m |
          LD. |  -.0698555   .0321401    -2.17   0.031    -.1331084   -.0066026
        month |
            2 |   .0354068    .007407     4.78   0.000     .0208296     .049984
            3 |   .0305979   .0058712     5.21   0.000     .0190431    .0421526
            4 |    .023691   .0055281     4.29   0.000     .0128115    .0345705
            5 |   .0139549   .0058158     2.40   0.017     .0025091    .0254006
            6 |   .0375024   .0062791     5.97   0.000      .025145    .0498599
            7 |   .0216364   .0058919     3.67   0.000     .0100409    .0332319
            8 |  -.0002146   .0048596    -0.04   0.965    -.0097785    .0093493
            9 |    .000227    .005316     0.04   0.966    -.0102351    .0106891
           10 |   .0017266   .0052204     0.33   0.741    -.0085473    .0120006
           11 |  -.0008245   .0050656    -0.16   0.871    -.0107937    .0091447
           12 |   .0187906   .0053953     3.48   0.001     .0081724    .0294088
              |
        _cons |   -.013753   .0037432    -3.67   0.000    -.0211197   -.0063863
------------------------------------------------------------------------------

.
. predict Predicted_DLN
(option xb assumed; fitted values)
(26 missing values generated)

. predict stdf2_model2, stdf
(26 missing values generated)

. gen FIUB=Predicted_DLN+2*stdf2_model2
(26 missing values generated)

. gen FILB=Predicted_DLN-2*stdf2_model2
(26 missing values generated)
```

```
. tsline d.ln_fl_amsparksarcade Predicted_DLN if tin(2010m1, ) , ///
>        title("Employment Amusement Parks and Arcades in Florida") ///
>        scheme(s2mono) ytitle("Log Difference from Previous Month") ///
>        xtitle("") legend(label(1 "Actual") label(2 "Predicted" ))
```




```
. tsline d.ln_fl_amsparksarcade FIUB FILB if tin(2010m1, ) , ///
>        title("Employment Amusement Parks and Arcades in Florida") ///
>        scheme(s2mono) ytitle("Log Difference from Previous Month") ///
>        xtitle("") legend(label(1 "Actual") ///
>            label(2 "Upper Bound" ) label(3 "Lower Bound"))
```




```
. log close
      name:  <unnamed>
       log:  C:\Users\jdewey\Documents\A S18 Adv Topics\Midterm\Midterm Work.smcl
  log type:  smcl
 closed on:  25 Mar 2018, 13:52:01
```