```
OPEN DATA "C:\Users\chris\Downloads\final_project.xlsx"
CALENDAR(M) 2000:12
DATA(FORMAT=XLSX,ORG=COLUMNS,LEFT=2) 2000:12 2024:01
CONS_CONF<<"consumer_confidence" FED_FUND<<"federal_funds_rate" $
 GOVT_JOBS<<"govt_job_openings" HOUSING_PRICES<<"housing_price_index"
*Preliminary Graph
GRAPH(STYLE=LINE,HEADER="Consumer
Confidence",VLABEL="Index",HLABEL="Year",KEY=BELOW) 1
# CONS_CONF
GRAPH(STYLE=LINE,HEADER="Federal Funds Rate",VLABEL="Interest
Rate",HLABEL="Year",KEY=BELOW) 1
# FED_FUND
GRAPH(STYLE=LINE,HEADER="Government Job Openings",VLABEL="Number of Job
Openings",HLABEL="Year",KEY=BELOW) $
 1
# GOVT_JOBS
GRAPH(STYLE=LINE,HEADER="Housing Prices",VLABEL="Index",HLABEL="Year",KEY=BELOW) 1
# HOUSING_PRICES

@bjident CONS_CONF
@bjident HOUSING_PRICES
@bjident FED FUND
@bjident GOVT JOBS

cmom(corr,print)
#CONS_CONF HOUSING_PRICES FED_FUND GOVT_JOBS

Correlation Matrix
                CONS_CONF   HOUSING_PRICES   FED_FUND    GOVT_JOBS
CONS_CONF       1.000000000   -0.309086671  0.111522668 -0.220913557
HOUSING_PRICES -0.309086671    1.000000000  0.177606998  0.931548691
FED_FUND        0.111522668    0.177606998  1.000000000  0.169682267
GOVT_JOBS      -0.220913557    0.931548691  0.169682267  1.000000000

*Let's declare variables for COVID, HOUSING CRASH AND TIME
*COVID SEEMED TO HAVE ABOUT A 2 YEAR EFFECT
SET COVID * 2024:01 = T>=2020:04.AND.T<=2022:01
SET HCRASH * 2024:01 = T>2008:01.AND.T<=2009:12
SET TIME * 2024:01 = T

*We'll start forecasting CONS_CONF (already stationary)

*First let's try ARMA(3,1) with COVID and HCRASH
BOXJENK(REGRESSORS,CONST,AR=3,MA=1) CONS_CONF
# COVID HCRASH

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in     8 Iterations. Final criterion was  0.0000065 <=  0.0000100

Dependent Variable CONS_CONF
Monthly Data From 2001:03 To 2023:01
Usable Observations                        263
Degrees of Freedom                         256
Centered R^2                         0.9935155
R-Bar^2                              0.9933635
Uncentered R^2                       0.9999987
Mean of Dependent Variable          99.647979658
Std Error of Dependent Variable      1.409185676
Standard Error of Estimate           0.114798546
Sum of Squared Residuals             3.3737487897
Log Likelihood                          199.6502
```

```
Durbin-Watson Statistic                1.9842
Q(36-4)                               26.8986
Significance Level of Q              0.7225698

    Variable                          Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONSTANT                     99.17804637   0.85977680    115.35325  0.00000000
2.  AR{1}                         1.97194423   0.07275676     27.10324  0.00000000
3.  AR{2}                        -1.46521550   0.13225004    -11.07913  0.00000000
4.  AR{3}                         0.48030510   0.06848451      7.01334  0.00000000
5.  MA{1}                         0.46978363   0.07448446      6.30714  0.00000000
6.  COVID                        -0.04798531   0.03702271     -1.29610  0.19610663
7.  HCRASH                       -0.04721108   0.03698447     -1.27651  0.20293174

@regcrits

Information Criteria
AIC          -1.457
SBC          -1.349
Hannan-Quinn -1.414
(log) FPE    -1.457


*hmmm COVID and HOUSING CRASH not significantly different from 0, ARMA(3,1) has
both lower AIC and SBC...
@DFUNIT(LAGS=4) CONS_CONF

Dickey-Fuller Unit Root Test, Series CONS_CONF
Regression Run From 2001:05 to 2024:01
Observations        274
With intercept
Using fixed lags 4
Null is unit root. Reject in left tail.

Sig Level    Crit Value
1%(**)         -3.45578
5%(*)          -2.87220
10%            -2.57241

T-Statistic    -2.00878

*FOUND EVIDENCE OF A UNIT ROOT
BOXJENK(REGRESSORS,CONST,AR=3) CONS_CONF
# COVID HCRASH

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in     5 Iterations. Final criterion was  0.0000031 <=  0.0000100

Dependent Variable CONS CONF
Monthly Data From 2001:03 To 2023:01
Usable Observations                      263
Degrees of Freedom                       257
Centered R^2                          0.9927537
R-Bar^2                               0.9926127
Uncentered R^2                        0.9999986
Mean of Dependent Variable       99.647979658
Std Error of Dependent Variable   1.409185676
Standard Error of Estimate        0.121118523
Sum of Squared Residuals         3.7701120017
Regression F(5,257)                 7041.8717
Significance Level of F             0.0000000
```

```
Log Likelihood                          185.0432
Durbin-Watson Statistic                   1.6133
Q(36-3)                                  44.6456
Significance Level of Q                0.0849021

    Variable                           Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONSTANT                      98.84730719   1.20751212     81.86030  0.00000000
2.  AR{1}                          2.20867578   0.04715583     46.83781  0.00000000
3.  AR{2}                         -1.87004306   0.08687195    -21.52643  0.00000000
4.  AR{3}                          0.65404587   0.04704773     13.90175  0.00000000
5.  COVID                         -0.05610449   0.05037965     -1.11363  0.26647669
6.  HCRASH                        -0.05737295   0.05033916     -1.13973  0.25546074

@REGCRITS

Information Criteria
AIC          -1.354
SBC          -1.259
Hannan-Quinn -1.316
(log) FPE    -1.354

BOXJENK(CONST,AR=3) CONS CONF * 2023:01

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in     4 Iterations. Final criterion was  0.0000000 <=  0.0000100

Dependent Variable CONS_CONF
Monthly Data From 2001:03 To 2023:01
Usable Observations                      263
Degrees of Freedom                       259
Centered R^2                          0.9926820
R-Bar^2                               0.9925973
Uncentered R^2                        0.9999985
Mean of Dependent Variable           99.647979658
Std Error of Dependent Variable       1.409185676
Standard Error of Estimate            0.121244989
Sum of Squared Residuals              3.8073899880
Regression F(3,259)                   11711.1365
Significance Level of F               0.0000000
Log Likelihood                        183.7493
Durbin-Watson Statistic                 1.6163
Q(36-3)                                44.2811
Significance Level of Q               0.0907702

    Variable                           Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONSTANT                      98.84363271   1.19836154     82.48231  0.00000000
2.  AR{1}                          2.20864317   0.04698447     47.00794  0.00000000
3.  AR{2}                         -1.86912105   0.08656066    -21.59319  0.00000000
4.  AR{3}                          0.65312289   0.04687839     13.93228  0.00000000

@REGCRITS

Information Criteria
AIC          -1.359
SBC          -1.291
Hannan-Quinn -1.332
(log) FPE    -1.359

BOXJENK(CONST,AR=3,MA=1) CONS_CONF * 2023:01
```

```
Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in     9 Iterations. Final criterion was  0.0000061 <=  0.0000100

Dependent Variable CONS_CONF
Monthly Data From 2001:03 To 2023:01
Usable Observations                        263
Degrees of Freedom                         258
Centered R^2                         0.9934319
R-Bar^2                              0.9933301
Uncentered R^2                       0.9999987
Mean of Dependent Variable          99.647979658
Std Error of Dependent Variable      1.409185676
Standard Error of Estimate           0.115087341
Sum of Squared Residuals             3.4172347768
Log Likelihood                          197.9661
Durbin-Watson Statistic                   1.9833
Q(36-4)                                  27.1968
Significance Level of Q                0.7084407

    Variable                         Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  CONSTANT                      99.16965175   0.85957702    115.37029  0.00000000
2.  AR{1}                          1.97411024   0.07278773     27.12147  0.00000000
3.  AR{2}                         -1.46815916   0.13228915    -11.09811  0.00000000
4.  AR{3}                          0.48112237   0.06840549      7.03339  0.00000000
5.  MA{1}                          0.46227749   0.07478586      6.18135  0.00000000

@REGCRITS

Information Criteria
AIC          -1.460
SBC          -1.378
Hannan-Quinn -1.427
(log) FPE    -1.460

*FOUND EVIDENCE OF UNIT ROOT IN DF TEST; LET'S TRY DIFFERENCED DATA
BOXJENK(DIFFS=1,CONST,AR=3,MA=1) CONS_CONF * 2023:01

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in    20 Iterations. Final criterion was  0.0000082 <=  0.0000100

Dependent Variable CONS_CONF, differenced 1 times
Monthly Data From 2001:04 To 2023:01
Usable Observations                        262
Degrees of Freedom                         257
Centered R^2                         0.9933459
R-Bar^2                              0.9932423
Uncentered R^2                       0.9999987
Mean of Dependent Variable          99.644511260
Std Error of Dependent Variable      1.410757512
Standard Error of Estimate           0.115971571
Sum of Squared Residuals             3.4564971343
Log Likelihood                          195.2177
Durbin-Watson Statistic                   1.9999
Q(36-4)                                  26.6163
Significance Level of Q                0.7357266

    Variable                         Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  CONSTANT                     -0.013160008  0.020915998     -0.62918  0.52978759
```

```
2.  AR{1}                          1.039521505  0.175151044      5.93500  0.00000001
3.  AR{2}                         -0.561631336  0.224298250     -2.50395  0.01290208
4.  AR{3}                          0.037354797  0.135421537      0.27584  0.78289195
5.  MA{1}                          0.416697309  0.165745686      2.51408  0.01254622

@REGCRITS

Information Criteria
AIC          -1.444
SBC          -1.363
Hannan-Quinn -1.412
(log) FPE    -1.444

BOXJENK(DIFFS=1,CONST,AR=2,MA=1) CONS_CONF * 2023:01

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in     9 Iterations. Final criterion was  0.0000054 <=  0.0000100

Dependent Variable CONS_CONF, differenced 1 times
Monthly Data From 2001:03 To 2023:01
Usable Observations                        263
Degrees of Freedom                         259
Centered R^2                         0.9933582
R-Bar^2                              0.9932813
Uncentered R^2                       0.9999987
Mean of Dependent Variable          99.647979658
Std Error of Dependent Variable      1.409185676
Standard Error of Estimate           0.115507993
Sum of Squared Residuals             3.4556029656
Log Likelihood                          196.4978
Durbin-Watson Statistic                   1.9905
Q(36-3)                                  27.1706
Significance Level of Q                0.7521692

    Variable                          Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  CONSTANT                      -0.013074714  0.020383491     -0.64144  0.52180640
2.  AR{1}                          0.997297729  0.070539020     14.13824  0.00000000
3.  AR{2}                         -0.504871151  0.066061521     -7.64244  0.00000000
4.  MA{1}                          0.454548714  0.074001376      6.14244  0.00000000

@REGCRITS

Information Criteria
AIC          -1.456
SBC          -1.388
Hannan-Quinn -1.429
(log) FPE    -1.456

*If we difference the data, it leads to a lower SBC, but higher AIC; since data is
already stationary and due to difference in MSE, we'll keep the model with the
lower AIC, ARMA(3,1)
BOXJENK(CONST,AR=3,MA=1,DEFINE=CONS_CONF_ARMA) CONS_CONF * 2023:01

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in     9 Iterations. Final criterion was  0.0000061 <=  0.0000100

Dependent Variable CONS_CONF
Monthly Data From 2001:03 To 2023:01
Usable Observations                        263
Degrees of Freedom                         258
```

```
Centered R^2                          0.9934319
R-Bar^2                               0.9933301
Uncentered R^2                        0.9999987
Mean of Dependent Variable           99.647979658
Std Error of Dependent Variable       1.409185676
Standard Error of Estimate            0.115087341
Sum of Squared Residuals              3.4172347768
Log Likelihood                          197.9661
Durbin-Watson Statistic                   1.9833
Q(36-4)                                  27.1968
Significance Level of Q                0.7084407

    Variable                          Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  CONSTANT                       99.16965175   0.85957702    115.37029  0.00000000
2.  AR{1}                           1.97411024   0.07278773     27.12147  0.00000000
3.  AR{2}                          -1.46815916   0.13228915    -11.09811  0.00000000
4.  AR{3}                           0.48112237   0.06840549      7.03339  0.00000000
5.  MA{1}                           0.46227749   0.07478586      6.18135  0.00000000

UFORECAST(FROM=2023:02,TO=2024:01,EQUATION=CONS_CONF_ARMA,STDERRS=CONS_CONF_STDE_A,P
RINT) CONS CONF ARMA F

  Entry    CONS CONF
  2023:02 97.54865886
  2023:03 97.62794816
  2023:04 97.63145420
  2023:05 97.61665051
  2023:06 97.62042685
  2023:07 97.65130275
  2023:08 97.69958853
  2023:09 97.75139613
  2023:10 97.79763392
  2023:11 97.83608199
  2023:12 97.86902406
  2024:01 97.89985350

@uforeerrors CONS_CONF CONS_CONF_ARMA_F 2023:02 2024:01

Forecast Analysis for CONS_CONF
From 2023:02 to 2024:01
Mean Error                  0.00351004
Mean Absolute Error         0.28575015
Root Mean Square Error      0.37586217
Mean Square Error             0.141272
Theil's U                     1.154557

Mean Pct Error                0.000019
Mean Abs Pct Error            0.002917
Root Mean Square Pct Error    0.003821
Theil's Relative U            1.154164

*hmmm I wonder if using our ARIMA(2,1,1) model would yield a lower MSE...
BOXJENK(DIFFS=1,CONST,AR=2,MA=1,DEFINE=CONSCONF_ARIMA_F) CONS_CONF * 2023:01

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in     9 Iterations. Final criterion was  0.0000054 <=  0.0000100

Dependent Variable CONS_CONF, differenced 1 times
Monthly Data From 2001:03 To 2023:01
Usable Observations                        263
```

```
Degrees of Freedom                        259
Centered R^2                         0.9933582
R-Bar^2                              0.9932813
Uncentered R^2                       0.9999987
Mean of Dependent Variable          99.647979658
Std Error of Dependent Variable      1.409185676
Standard Error of Estimate           0.115507993
Sum of Squared Residuals             3.4556029656
Log Likelihood                          196.4978
Durbin-Watson Statistic                   1.9905
Q(36-3)                                  27.1706
Significance Level of Q                0.7521692

    Variable                         Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  CONSTANT                     -0.013074714  0.020383491     -0.64144  0.52180640
2.  AR{1}                         0.997297729  0.070539020     14.13824  0.00000000
3.  AR{2}                        -0.504871151  0.066061521     -7.64244  0.00000000
4.  MA{1}                         0.454548714  0.074001376      6.14244  0.00000000

UFORECAST(FROM=2023:02,TO=2024:01,EQUATION=CONSCONF_ARIMA_F,PRINT) CONS_ARIMA_FORE

  Entry    CONS CONF
  2023:02 97.52665549
  2023:03 97.55172121
  2023:04 97.48183362
  2023:05 97.39284354
  2023:06 97.33274180
  2023:07 97.31109460
  2023:08 97.31321317
  2023:09 97.31961868
  2023:10 97.31830089
  2023:11 97.30711634
  2023:12 97.28999094
  2024:01 97.27192220

@uforeerrors CONS_CONF CONS_ARIMA_FORE 2023:02 2024:01

Forecast Analysis for CONS_CONF
From 2023:02 to 2024:01
Mean Error                  0.34792396
Mean Absolute Error         0.44696460
Root Mean Square Error      0.61469111
Mean Square Error             0.377845
Theil's U                     1.888181

Mean Pct Error                0.003538
Mean Abs Pct Error            0.004555
Root Mean Square Pct Error    0.006241
Theil's Relative U            1.886450


*It doesn't, let's keep our ARMA(3,1) model

GRAPH(STYLE=LINE,HEADER="Consumer Confidence Actual versus
Forecast",VLABEL="Index",HLABEL="Month",KEY=BELOW, MAX=100,MIN=95) $
 3
# CONS_CONF_TRUNC
# CONS_CONF_ARMA_F
# CONS_ARIMA_FORE
```

```
*We can now move on to our 2nd variable, housing prices


@bjautofit(pmax=5,qmax=5,crit=SBC) HOUSING_PRICES

BIC analysis of models for series HOUSING_PRICES
   MA
AR    0         1         2          3         4         5
 0 3838.2139 3465.7545 3215.8914  2958.8296 2584.4722 2378.1869
 1 1138.6854  931.3911  847.8495   794.1699  776.2157  767.4900
 2  690.6713 2405.8604  686.7825* 2273.0316  696.2989  701.8675
 3  687.2675  699.5293 2552.1781  1537.9589  698.6159  703.9354
 4  689.3634  690.9006  694.0901  2496.4134  703.9134 1475.4069
 5  693.7328  697.3447  703.9213   706.2561  708.5432  717.2180

*ARMA(2,2) seems to be the choice without a trend... let's try now with a trend

BOXJENK(REGRESSORS,CONST,AR=2,MA=2) HOUSING_PRICES * 2023:01
# TIME HCRASH

Box-Jenkins - Estimation by LS Gauss-Newton
NO CONVERGENCE IN 100 ITERATIONS
LAST CRITERION WAS  0.1355711
TRY INCREASING ITERS OPTION

Dependent Variable HOUSING_PRICES
Monthly Data From 2001:02 To 2023:01
Usable Observations                        264
Degrees of Freedom                         257
Centered R^2                         0.9998212
R-Bar^2                              0.9998170
Uncentered R^2                       0.9999890
Mean of Dependent Variable         223.76700758
Std Error of Dependent Variable     57.36807657
Standard Error of Estimate           0.77610248
Sum of Squared Residuals           154.80010965
Log Likelihood                        -304.1363
Durbin-Watson Statistic                  2.0273
Q(36-4)                                 40.2874
Significance Level of Q                0.1492237

    Variable                         Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  CONSTANT                     -6201.53161  48882.69046     -0.12687  0.89914598
2.  AR{1}                            1.92262      0.03367     57.10419  0.00000000
3.  AR{2}                           -0.92254      0.03381    -27.28757  0.00000000
4.  MA{1}                           -0.23148      0.07404     -3.12630  0.00197361
5.  MA{2}                           -0.11283      0.06971     -1.61866  0.10674785
6.  TIME                            -6.53812     27.81272     -0.23508  0.81433653
7.  HCRASH                          -0.35215      0.45199     -0.77910  0.43664050
*NO CONVERGENCE- LET'S TRY DIFFERENCING
BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=2,MA=1) HOUSING_PRICES * 2023:01
# HCRASH TIME

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in    11 Iterations. Final criterion was  0.0000018 <=  0.0000100

Dependent Variable HOUSING_PRICES, differenced 1 times
Monthly Data From 2001:03 To 2023:01
```

```
Usable Observations                        263
Degrees of Freedom                         257
Centered R^2                          0.9998213
R-Bar^2                               0.9998178
Uncentered R^2                        0.9999891
Mean of Dependent Variable          224.05897338
Std Error of Dependent Variable      57.28060165
Standard Error of Estimate            0.77309573
Sum of Squared Residuals            153.60299099
Log Likelihood                         -302.4624
Durbin-Watson Statistic                   1.9830
Q(36-3)                                  40.1499
Significance Level of Q                0.1829119

    Variable                         Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONSTANT                    -0.166306954  0.980870096     -0.16955  0.86549708
2.  AR{1}                        1.331030814  0.194255956      6.85194  0.00000000
3.  AR{2}                       -0.367841730  0.172000055     -2.13861  0.03340990
4.  MA{1}                       -0.668286478  0.168459245     -3.96705  0.00009443
5.  HCRASH                      -0.590749867  0.515477265     -1.14603  0.25285074
6.  TIME                         0.007580946  0.005783800      1.31072  0.19112222

@regcrits

Information Criteria
AIC          2.353
SBC          2.448
Hannan-Quinn 2.392
(log) FPE    2.353

BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=2) HOUSING_PRICES
# TIME HCRASH

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in     7 Iterations. Final criterion was  0.0000021 <=  0.0000100

Dependent Variable HOUSING_PRICES, differenced 1 times
Monthly Data From 2001:03 To 2023:01
Usable Observations                        263
Degrees of Freedom                         258
Centered R^2                          0.9998173
R-Bar^2                               0.9998144
Uncentered R^2                        0.9999888
Mean of Dependent Variable          224.05897338
Std Error of Dependent Variable      57.28060165
Standard Error of Estimate            0.78027930
Sum of Squared Residuals            157.07963129
Regression F(4,258)                  352920.5196
Significance Level of F                0.0000000
Log Likelihood                         -305.4056
Durbin-Watson Statistic                   2.0299
Q(36-2)                                  42.7816
Significance Level of Q                0.1435902

    Variable                         Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONSTANT                    -0.055009776  0.645616304     -0.08521  0.93216445
2.  AR{1}                        0.703129714  0.061698510     11.39622  0.00000000
3.  AR{2}                        0.137733019  0.062371806      2.20826  0.02810603
4.  TIME                         0.007466399  0.003996808      1.86809  0.06288295
```

```
5.  HCRASH                      -0.795067300  0.526886314     -1.50899  0.13252442

@regcrits

Information Criteria
AIC          2.368
SBC          2.450
Hannan-Quinn 2.401
(log) FPE    2.368

BOXJENK(REGRESSORS,CONST,AR=2,MA=1) HOUSING_PRICES * 2023:01
# HCRASH TIME

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in    15 Iterations. Final criterion was  0.0000004 <=  0.0000100

Dependent Variable HOUSING_PRICES
Monthly Data From 2001:02 To 2023:01
Usable Observations                        264
Degrees of Freedom                         258
Centered R^2                         0.9998191
R-Bar^2                              0.9998156
Uncentered R^2                       0.9999889
Mean of Dependent Variable         223.76700758
Std Error of Dependent Variable     57.36807657
Standard Error of Estimate           0.77905800
Sum of Squared Residuals           156.58829404
Log Likelihood                        -305.6523
Durbin-Watson Statistic                  1.9350
Q(36-3)                                 45.3453
Significance Level of Q              0.0745179

    Variable                         Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONSTANT                     -19.7956853  453.4960423     -0.04365  0.96521613
2.  AR{1}                          1.9164468    0.0333563     57.45386  0.00000000
3.  AR{2}                         -0.9172272    0.0338360    -27.10803  0.00000000
4.  MA{1}                         -0.2725871    0.0729542     -3.73642  0.00022983
5.  HCRASH                        -0.1953149    0.4594618     -0.42509  0.67112177
6.  TIME                           1.4230875    1.5342172      0.92757  0.35449972

@regcrits

Information Criteria
AIC          2.369
SBC          2.463
Hannan-Quinn 2.407
(log) FPE    2.369

LINREG HOUSING_PRICES
# Constant TIME HCRASH COVID

Linear Regression - Estimation by Least Squares
Dependent Variable HOUSING_PRICES
Monthly Data From 2000:12 To 2023:01
Usable Observations                        266
Degrees of Freedom                         262
Centered R^2                         0.6927409
R-Bar^2                              0.6892227
Uncentered R^2                       0.9809096
Mean of Dependent Variable         223.17853383
```

```
Std Error of Dependent Variable   57.55122604
Standard Error of Estimate        32.08331442
Sum of Squared Residuals         269686.83489
Regression F(3,262)                 196.9002
Significance Level of F             0.0000000
Log Likelihood                  -1297.9999
Durbin-Watson Statistic             0.0189

    Variable                         Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  Constant                    148.4723775    4.2025393     35.32921  0.00000000
2.  TIME                          0.5348088    0.0285642     18.72307  0.00000000
3.  HCRASH                       -4.1945061    7.0754790     -0.59282  0.55381100
4.  COVID                        44.3962334    7.9160378      5.60839  0.00000005

*LET'S REMOVE THE HOUSING CRASH VARIABLE

LINREG HOUSING_PRICES
# Constant TIME COVID

Linear Regression - Estimation by Least Squares
Dependent Variable HOUSING PRICES
Monthly Data From 2000:12 To 2023:01
Usable Observations                   266
Degrees of Freedom                    263
Centered R^2                        0.6923288
R-Bar^2                             0.6899891
Uncentered R^2                      0.9808840
Mean of Dependent Variable        223.17853383
Std Error of Dependent Variable    57.55122604
Standard Error of Estimate         32.04373110
Sum of Squared Residuals          270048.58480
Regression F(2,263)                  295.9043
Significance Level of F             0.0000000
Log Likelihood                  -1298.1781
Durbin-Watson Statistic             0.0188

    Variable                         Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  Constant                    147.83837823   4.05917026     36.42084  0.00000000
2.  TIME                          0.53673959   0.02834285     18.93739  0.00000000
3.  COVID                        44.56007613   7.90145104      5.63948  0.00000004

@regcrits

Information Criteria
AIC          9.791
SBC          9.845
Hannan-Quinn 9.812
(log) FPE    9.791

BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=2,MA=1) HOUSING_PRICES * 2023:01
# TIME COVID

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in    19 Iterations. Final criterion was  0.0000054 <=  0.0000100

Dependent Variable HOUSING_PRICES, differenced 1 times
Monthly Data From 2001:03 To 2023:01
Usable Observations                   263
Degrees of Freedom                    257
```

```
Centered R^2                          0.9998216
R-Bar^2                               0.9998181
Uncentered R^2                        0.9999891
Mean of Dependent Variable          224.05897338
Std Error of Dependent Variable      57.28060165
Standard Error of Estimate            0.77252298
Sum of Squared Residuals            153.37547896
Log Likelihood                       -302.2675
Durbin-Watson Statistic                 1.9759
Q(36-3)                                39.8739
Significance Level of Q                0.1909347

    Variable                          Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  CONSTANT                      -0.253814593  1.031064881     -0.24617  0.80574912
2.  AR{1}                          1.392696998  0.160356802      8.68499  0.00000000
3.  AR{2}                         -0.420442265  0.143307077     -2.93386  0.00365024
4.  MA{1}                         -0.744692933  0.132200271     -5.63307  0.00000005
5.  TIME                           0.007235520  0.006002637      1.20539  0.22916137
6.  COVID                          0.771935212  0.496125354      1.55593  0.12095583

@regcrits

Information Criteria
AIC          2.352
SBC          2.447
Hannan-Quinn 2.390
(log) FPE    2.352

BOXJENK(CONST,AR=2,MA=2) HOUSING_PRICES * 2023:01

Box-Jenkins - Estimation by LS Gauss-Newton
NO CONVERGENCE IN 35 ITERATIONS. FINAL NORMED GRADIENT  176.43236
SUBITERATIONS LIMIT EXCEEDED.
ESTIMATION POSSIBLY HAS STALLED OR MACHINE ROUNDOFF IS MAKING FURTHER PROGRESS
DIFFICULT
TRY DIFFERENT SETTING FOR EXACTLINE, DERIVES OR ALPHA ON NLPAR
RESTARTING ESTIMATION FROM LAST ESTIMATES OR DIFFERENT INITIAL GUESSES/PMETHOD
OPTION MIGHT ALSO WORK

Dependent Variable HOUSING_PRICES
Monthly Data From 2001:02 To 2023:01
Usable Observations                     264
Degrees of Freedom                      259
Centered R^2                          0.9998205
R-Bar^2                               0.9998177
Uncentered R^2                        0.9999890
Mean of Dependent Variable          223.76700758
Std Error of Dependent Variable      57.36807657
Standard Error of Estimate            0.77460544
Sum of Squared Residuals            155.40351964
Log Likelihood                       -304.6498
Durbin-Watson Statistic                 1.9929
Q(36-4)                                42.3904
Significance Level of Q                0.1035761

    Variable                          Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  CONSTANT                      -1936.37417  51588.07700     -0.03754  0.97008711
2.  AR{1}                             1.95133      0.02790     69.94983  0.00000000
3.  AR{2}                            -0.95130      0.02818    -33.76348  0.00000000
```

```
4.  MA{1}                          -0.28191      0.06874     -4.10106  0.00005510
5.  MA{2}                          -0.14406      0.06776     -2.12608  0.03444307

*NO CONVERGENCE IN BJAUTOFIT RECCOMENDATION

BOXJENK(CONST,AR=2,MA=1) HOUSING_PRICES

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in    16 Iterations. Final criterion was  0.0000000 <=  0.0000100

Dependent Variable HOUSING_PRICES
Monthly Data From 2001:02 To 2024:01
Usable Observations                        276
Degrees of Freedom                         272
Centered R^2                         0.9998664
R-Bar^2                              0.9998650
Uncentered R^2                       0.9999896
Mean of Dependent Variable       231.80416667
Std Error of Dependent Variable   67.65018985
Standard Error of Estimate         0.78614416
Sum of Squared Residuals         168.10215967
Log Likelihood                      -323.2026
Durbin-Watson Statistic                1.9603
Q(36-3)                               44.3859
Significance Level of Q              0.0890500

    Variable                          Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  CONSTANT                       27.4621380  283.0718192      0.09701  0.92278614
2.  AR{1}                           1.9049837    0.0343360     55.48060  0.00000000
3.  AR{2}                          -0.9045374    0.0347239    -26.04938  0.00000000
4.  MA{1}                          -0.2267623    0.0715785     -3.16802  0.00170982

@REGCRITS

Information Criteria
AIC          2.378
SBC          2.444
Hannan-Quinn 2.405
(log) FPE    2.378

BOXJENK(DIFFS=1,CONST,AR=2,MA=1) HOUSING_PRICES

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in     6 Iterations. Final criterion was  0.0000032 <=  0.0000100

Dependent Variable HOUSING PRICES, differenced 1 times
Monthly Data From 2001:03 To 2024:01
Usable Observations                        275
Degrees of Freedom                         271
Centered R^2                         0.9998671
R-Bar^2                              0.9998656
Uncentered R^2                       0.9999896
Mean of Dependent Variable       232.11261818
Std Error of Dependent Variable   67.57881174
Standard Error of Estimate         0.78343998
Sum of Squared Residuals         166.33389326
Log Likelihood                      -321.0767
Durbin-Watson Statistic                1.9977
Q(36-3)                               38.3283
Significance Level of Q              0.2405022
```

```
783
784     Variable                         Coeff      Std Error      T-Stat      Signif
785 ********************************************************************************
786 1.  CONSTANT                      0.956708432  0.567175431      1.68679  0.09279358
787 2.  AR{1}                        1.391369419  0.178222278      7.80693  0.00000000
788 3.  AR{2}                       -0.416462108  0.162686358     -2.55991  0.01101287
789 4.  MA{1}                       -0.700940296  0.151866134     -4.61551  0.00000606
790
791 @REGCRITS
792
793 Information Criteria
794 AIC          2.371
795 SBC          2.437
796 Hannan-Quinn 2.398
797 (log) FPE    2.371
798
799 BOXJENK(DIFFS=1,CONST,AR=2,MA=2) HOUSING_PRICES
800
801 Box-Jenkins - Estimation by LS Gauss-Newton
802 Convergence in     9 Iterations. Final criterion was  0.0000064 <=  0.0000100
803
804 Dependent Variable HOUSING PRICES, differenced 1 times
805 Monthly Data From 2001:03 To 2024:01
806 Usable Observations                      275
807 Degrees of Freedom                     270
808 Centered R^2                        0.9998671
809 R-Bar^2                             0.9998651
810 Uncentered R^2                      0.9999896
811 Mean of Dependent Variable       232.11261818
812 Std Error of Dependent Variable   67.57881174
813 Standard Error of Estimate         0.78485158
814 Sum of Squared Residuals         166.31783879
815 Log Likelihood                     -321.0634
816 Durbin-Watson Statistic               1.9920
817 Q(36-4)                              38.2612
818 Significance Level of Q             0.2064169
819
820     Variable                         Coeff      Std Error      T-Stat      Signif
821 ********************************************************************************
822 1.  CONSTANT                      0.957824133  0.574617902      1.66689  0.09669604
823 2.  AR{1}                        1.444983260  0.374751843      3.85584  0.00014424
824 3.  AR{2}                       -0.467053735  0.351624017     -1.32828  0.18520861
825 4.  MA{1}                       -0.757397573  0.380537386     -1.99034  0.04756206
826 5.  MA{2}                        0.023167032  0.146579769      0.15805  0.87453501
827
828 @REGCRITS
829
830 Information Criteria
831 AIC          2.379
832 SBC          2.458
833 Hannan-Quinn 2.410
834 (log) FPE    2.379
835
836
837 BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=2,MA=1) HOUSING_PRICES
838 # COVID TIME
839
840 Box-Jenkins - Estimation by LS Gauss-Newton
841 Convergence in    19 Iterations. Final criterion was  0.0000054 <=  0.0000100
842
843 Dependent Variable HOUSING_PRICES, differenced 1 times
```

```
Monthly Data From 2001:03 To 2023:01
Usable Observations                        263
Degrees of Freedom                         257
Centered R^2                          0.9998216
R-Bar^2                               0.9998181
Uncentered R^2                        0.9999891
Mean of Dependent Variable          224.05897338
Std Error of Dependent Variable      57.28060165
Standard Error of Estimate            0.77252298
Sum of Squared Residuals            153.37547896
Log Likelihood                        -302.2675
Durbin-Watson Statistic                  1.9759
Q(36-3)                                 39.8739
Significance Level of Q                0.1909347

    Variable                         Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  CONSTANT                     -0.253814597  1.031064878     -0.24617  0.80574912
2.  AR{1}                         1.392696999  0.160356803      8.68499  0.00000000
3.  AR{2}                        -0.420442267  0.143307077     -2.93386  0.00365024
4.  MA{1}                        -0.744692935  0.132200271     -5.63307  0.00000005
5.  COVID                         0.771935213  0.496125353      1.55593  0.12095583
6.  TIME                          0.007235520  0.006002637      1.20539  0.22916136

@REGCRITS

Information Criteria
AIC          2.352
SBC          2.447
Hannan-Quinn 2.390
(log) FPE    2.352


BOXJENK(CONST,AR=2,MA=1) HOUSING_PRICES

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in    16 Iterations. Final criterion was  0.0000000 <=  0.0000100

Dependent Variable HOUSING_PRICES
Monthly Data From 2001:02 To 2024:01
Usable Observations                        276
Degrees of Freedom                         272
Centered R^2                          0.9998664
R-Bar^2                               0.9998650
Uncentered R^2                        0.9999896
Mean of Dependent Variable          231.80416667
Std Error of Dependent Variable      67.65018985
Standard Error of Estimate            0.78614416
Sum of Squared Residuals            168.10215967
Log Likelihood                        -323.2026
Durbin-Watson Statistic                  1.9603
Q(36-3)                                 44.3859
Significance Level of Q                0.0890500

    Variable                         Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  CONSTANT                      27.4621380  283.0718192      0.09701  0.92278614
2.  AR{1}                          1.9049837    0.0343360     55.48060  0.00000000
3.  AR{2}                         -0.9045374    0.0347239    -26.04938  0.00000000
4.  MA{1}                         -0.2267623    0.0715785     -3.16802  0.00170982
```

```
@REGCRITS

Information Criteria
AIC          2.378
SBC          2.444
Hannan-Quinn 2.405
(log) FPE    2.378


BOXJENK(DIFFS=2,REGRESSORS,CONST,AR=2,MA=1) HOUSING_PRICES
# COVID

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in    13 Iterations. Final criterion was  0.0000099 <=  0.0000100

Dependent Variable HOUSING_PRICES, differenced 2 times
Monthly Data From 2001:04 To 2023:01
Usable Observations                        262
Degrees of Freedom                         257
Centered R^2                         0.9998091
R-Bar^2                              0.9998061
Uncentered R^2                       0.9999884
Mean of Dependent Variable         224.35022901
Std Error of Dependent Variable     57.19477893
Standard Error of Estimate           0.79636450
Sum of Squared Residuals           162.98847859
Log Likelihood                        -309.5808
Durbin-Watson Statistic                  2.0779
Q(36-3)                                 51.0398
Significance Level of Q              0.0233458

    Variable                         Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  CONSTANT                    -0.027079711  0.040144785     -0.67455  0.50056731
2.  AR{1}                       -1.192477557  0.065954010    -18.08044  0.00000000
3.  AR{2}                       -0.264222436  0.060501797     -4.36718  0.00001826
4.  MA{1}                        0.970196793  0.030943347     31.35397  0.00000000
5.  COVID                        0.249893417  0.143174614      1.74538  0.08211472

@regcrits

Information Criteria
AIC          2.409
SBC          2.491
Hannan-Quinn 2.442
(log) FPE    2.409

BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=2,MA=1,DEFINE=HOUSE ARIMA) HOUSING PRICES *
2023:01
# COVID

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in    19 Iterations. Final criterion was  0.0000024 <=  0.0000100

Dependent Variable HOUSING_PRICES, differenced 1 times
Monthly Data From 2001:03 To 2023:01
Usable Observations                        263
Degrees of Freedom                         258
Centered R^2                         0.9998207
R-Bar^2                              0.9998180
Uncentered R^2                       0.9999890
```

```
Mean of Dependent Variable       224.05897338
Std Error of Dependent Variable   57.28060165
Standard Error of Estimate         0.77282404
Sum of Squared Residuals         154.09230621
Log Likelihood                     -302.8806
Durbin-Watson Statistic               1.9731
Q(36-3)                              40.1143
Significance Level of Q               0.1839328

    Variable                         Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  CONSTANT                      0.860711867  0.553748095      1.55434  0.12132954
2.  AR{1}                         1.401242800  0.151119694      9.27240  0.00000000
3.  AR{2}                        -0.423020353  0.137880964     -3.06801  0.00238445
4.  MA{1}                        -0.750037294  0.122047641     -6.14545  0.00000000
5.  COVID                         0.778099025  0.494047154      1.57495  0.11649365

UFORECAST(FROM=2023:02,TO=2024:01,EQUATION=HOUSE_ARIMA,PRINT) HOUSE_ARIMA_FORE

    Entry      HOUSING_PRICES
       2023:02    393.4268487
       2023:03    394.2824485
       2023:04    395.1376312
       2023:05    395.9927580
       2023:06    396.8479827
       2023:07    397.7033684
       2023:08    398.5589381
       2023:09    399.4146977
       2023:10    400.2706454
       2023:11    401.1267765
       2023:12    401.9830849
       2024:01    402.8395642

@uforeerrors HOUSING_PRICES HOUSE_ARIMA_FORE 2023:02 2024:01

Forecast Analysis for HOUSING_PRICES
From 2023:02 to 2024:01
Mean Error                  10.4896046
Mean Absolute Error         10.4896046
Root Mean Square Error      11.6764138
Mean Square Error           136.338640
Theil's U                     4.978334

Mean Pct Error                0.025435
Mean Abs Pct Error            0.025435
Root Mean Square Pct Error    0.028190
Theil's Relative U            4.867271

FILTER HOUSING PRICES 2023:02 2024:01 HOUSE TRUNC
GRAPH(STYLE=LINE,HEADER="Housing Prices Actual versus
Forecast",VLABEL="Index",HLABEL="Month",KEY=BELOW, MAX=450, MIN=350) 2
# HOUSE_TRUNC
# HOUSE_ARIMA_FORE

@DFUNIT(LAGS=3) HOUSING_PRICES

Dickey-Fuller Unit Root Test, Series HOUSING_PRICES
Regression Run From 2001:04 to 2024:01
Observations        275
With intercept
Using fixed lags 3
```

```
Null is unit root. Reject in left tail.

Sig Level    Crit Value
1%(**)         -3.45570
5%(*)          -2.87217
10%            -2.57239

T-Statistic     0.63118
*EVIDENCE OF A UNIT ROOT


*Let's move on to our next variable, the FED_FUND
LINREG FED_FUND * 2023:01
# TIME COVID HCRASH

Linear Regression - Estimation by Least Squares
Dependent Variable FED_FUND
Monthly Data From 2000:12 To 2023:01
Usable Observations                        266
Degrees of Freedom                         263
Centered R^2                         -0.4099369
R-Bar^2                              -0.4206588
Uncentered R^2                        0.2070731
Mean of Dependent Variable       1.4719548872
Std Error of Dependent Variable  1.6717944076
Standard Error of Estimate       1.9926350454
Sum of Squared Residuals         1044.2663335
Log Likelihood                      -559.3249
Durbin-Watson Statistic                0.0165

    Variable                         Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  TIME                          0.007231950  0.000911048      7.93806  0.00000000
2.  COVID                        -1.684616250  0.479264685     -3.51500  0.00051766
3.  HCRASH                        0.277790614  0.424977578      0.65366  0.51390231

@REGCRITS

Information Criteria
AIC          4.236
SBC          4.289
Hannan-Quinn 4.257
(log) FPE    4.236

BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=1) FED_FUND
# TIME COVID

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in     8 Iterations. Final criterion was  0.0000027 <=  0.0000100

Dependent Variable FED_FUND, differenced 1 times
Monthly Data From 2001:02 To 2024:01
Usable Observations                        276
Degrees of Freedom                         272
Centered R^2                          0.9835792
R-Bar^2                               0.9833980
Uncentered R^2                        0.9910060
Mean of Dependent Variable       1.5950724638
Std Error of Dependent Variable  1.7584944992
Standard Error of Estimate       0.2265795130
```

```
Sum of Squared Residuals         13.964010997
Regression F(3,272)                 5430.7712
Significance Level of F             0.0000000
Log Likelihood                        20.1536
Durbin-Watson Statistic                1.9948
Q(36-1)                              122.9632
Significance Level of Q             0.0000000

    Variable                         Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONSTANT                    -0.098977354  0.033093063     -2.99088  0.00303669
2.  AR{1}                        0.146731514  0.057648073      2.54530  0.01147097
3.  TIME                         0.000807086  0.000216665      3.72503  0.00023745
4.  COVID                       -0.176958219  0.063068126     -2.80583  0.00538119

@REGCRITS

Information Criteria
AIC          -0.110
SBC          -0.044
Hannan-Quinn -0.083
(log) FPE    -0.110

BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=1,MA=1) FED FUND * 2023:01
# TIME COVID

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in    49 Iterations. Final criterion was  0.0000099 <=  0.0000100

Dependent Variable FED_FUND, differenced 1 times
Monthly Data From 2001:02 To 2023:01
Usable Observations                      264
Degrees of Freedom                       259
Centered R^2                        0.9803319
R-Bar^2                             0.9800281
Uncentered R^2                      0.9889573
Mean of Dependent Variable       1.4376136364
Std Error of Dependent Variable  1.6297276319
Standard Error of Estimate       0.2303163252
Sum of Squared Residuals         13.738812896
Log Likelihood                        15.5558
Durbin-Watson Statistic                2.0255
Q(36-2)                              101.5052
Significance Level of Q             0.0000000

    Variable                         Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONSTANT                    -0.103083422  0.037347552     -2.76011  0.00619090
2.  AR{1}                        0.302277509  0.169376391      1.78465  0.07548856
3.  MA{1}                       -0.131430047  0.182643769     -0.71960  0.47242151
4.  TIME                         0.000868559  0.000257494      3.37312  0.00085692
5.  COVID                       -0.191922894  0.069328643     -2.76831  0.00604178

@REGCRITS

Information Criteria
AIC          -0.072
SBC           0.009
Hannan-Quinn -0.040
(log) FPE    -0.072
```

```
BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=2) FED_FUND * 2023:01
# COVID TIME

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in     9 Iterations. Final criterion was  0.0000070 <=  0.0000100

Dependent Variable FED_FUND, differenced 1 times
Monthly Data From 2001:03 To 2023:01
Usable Observations                         263
Degrees of Freedom                          258
Centered R^2                          0.9813105
R-Bar^2                               0.9810207
Uncentered R^2                        0.9895024
Mean of Dependent Variable       1.4219011407
Std Error of Dependent Variable  1.6126759913
Standard Error of Estimate       0.2221707808
Sum of Squared Residuals         12.734842808
Regression F(4,258)                  3386.6327
Significance Level of F              0.0000000
Log Likelihood                         24.9765
Durbin-Watson Statistic                 2.0806
Q(36-2)                                61.7598
Significance Level of Q              0.0024862

    Variable                         Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONSTANT                    -0.116811644  0.047642152     -2.45185  0.01487561
2.  AR{1}                        0.156569123  0.060036999      2.60788  0.00964151
3.  AR{2}                        0.238009695  0.058461753      4.07120  0.00006224
4.  COVID                       -0.228906884  0.082673022     -2.76882  0.00603410
5.  TIME                         0.000992227  0.000324892      3.05402  0.00249434

@REGCRITS

Information Criteria
AIC          -0.144
SBC          -0.063
Hannan-Quinn -0.112
(log) FPE    -0.144

*BEST ONE SO FAR
BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=3) FED_FUND * 2023:01
# COVID TIME

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in     9 Iterations. Final criterion was  0.0000082 <=  0.0000100

Dependent Variable FED FUND, differenced 1 times
Monthly Data From 2001:04 To 2023:01
Usable Observations                         262
Degrees of Freedom                          256
Centered R^2                          0.9814365
R-Bar^2                               0.9810739
Uncentered R^2                        0.9895715
Mean of Dependent Variable       1.4059923664
Std Error of Dependent Variable  1.5949516765
Standard Error of Estimate       0.2194207717
Sum of Squared Residuals         12.325241611
Regression F(5,256)                  2706.9005
Significance Level of F              0.0000000
Log Likelihood                         28.6652
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Durbin-Watson Statistic                2.0260
Q(36-3)                               55.1460
Significance Level of Q             0.0091626

    Variable                          Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONSTANT                     -0.128866515  0.058090656     -2.21837  0.02740739
2.  AR{1}                         0.109453056  0.061695374      1.77409  0.07723709
3.  AR{2}                         0.252210180  0.060807113      4.14771  0.00004572
4.  AR{3}                         0.143043090  0.059722236      2.39514  0.01733326
5.  COVID                        -0.248241226  0.089970720     -2.75913  0.00621385
6.  TIME                          0.001089182  0.000388961      2.80024  0.00549586

@REGCRITS

Information Criteria
AIC          -0.165
SBC          -0.070
Hannan-Quinn -0.127
(log) FPE    -0.165

BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=4) FED FUND * 2023:01
# TIME COVID

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in     9 Iterations. Final criterion was  0.0000075 <=  0.0000100

Dependent Variable FED_FUND, differenced 1 times
Monthly Data From 2001:05 To 2023:01
Usable Observations                      261
Degrees of Freedom                       254
Centered R^2                        0.9813478
R-Bar^2                             0.9809072
Uncentered R^2                      0.9895123
Mean of Dependent Variable       1.3911111111
Std Error of Dependent Variable  1.5796871377
Standard Error of Estimate       0.2182757644
Sum of Squared Residuals        12.101654573
Regression F(6,254)                 2227.2871
Significance Level of F             0.0000000
Log Likelihood                        30.4458
Durbin-Watson Statistic                2.0342
Q(36-4)                               56.3287
Significance Level of Q             0.0049993

    Variable                          Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONSTANT                     -0.124657036  0.067197037     -1.85510  0.06474098
2.  AR{1}                         0.094708458  0.062332138      1.51942  0.12990154
3.  AR{2}                         0.227848919  0.062273219      3.65886  0.00030804
4.  AR{3}                         0.120530231  0.062780344      1.91987  0.05599409
5.  AR{4}                         0.126819382  0.060506202      2.09597  0.03707437
6.  TIME                          0.001081854  0.000442001      2.44763  0.01505774
7.  COVID                        -0.245961302  0.092706488     -2.65312  0.00847785

@REGCRITS

Information Criteria
AIC          -0.172
SBC          -0.063
Hannan-Quinn -0.128
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```
(log) FPE    -0.172

*SBC STARTS GOING DOWN FROM HERE ARIMA(3,1,0) THUS FAR
*Let's try it with housing crash

BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=3) FED_FUND * 2023:01
# TIME COVID HCRASH

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in    10 Iterations. Final criterion was  0.0000052 <=  0.0000100

Dependent Variable FED_FUND, differenced 1 times
Monthly Data From 2001:04 To 2023:01
Usable Observations                        262
Degrees of Freedom                         255
Centered R^2                         0.9814365
R-Bar^2                              0.9809997
Uncentered R^2                       0.9895715
Mean of Dependent Variable       1.4059923664
Std Error of Dependent Variable  1.5949516765
Standard Error of Estimate       0.2198505653
Sum of Squared Residuals        12.325239121
Regression F(6,255)                  2246.9393
Significance Level of F              0.0000000
Log Likelihood                         28.6652
Durbin-Watson Statistic                 2.0261
Q(36-3)                                55.1586
Significance Level of Q              0.0091352

    Variable                          Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONSTANT                     -0.129007774  0.060487933     -2.13279  0.03389765
2.  AR{1}                         0.109588572  0.063183792      1.73444  0.08404825
3.  AR{2}                         0.252357430  0.062251979      4.05381  0.00006697
4.  AR{3}                         0.143125809  0.060477656      2.36659  0.01870064
5.  TIME                          0.001089840  0.000394974      2.75927  0.00621302
6.  COVID                        -0.248324660  0.090196645     -2.75315  0.00632691
7.  HCRASH                        0.000697710  0.090434856      0.00772  0.99385037

@regcrits

Information Criteria
AIC          -0.158
SBC          -0.049
Hannan-Quinn -0.114
(log) FPE    -0.158

*HOUSING CRASH SEEMED TO HAVE A LASTING EFFECT ON FEDERAL FUND RATE-- LET'S CREATE
 A MORE LONG-LASTING VARIABLE TO ACCOUNT FOR TIME TO ECONOMIC RECOVERY
SET HCRASH_FED = T>=2008:01.AND.T<=2014:12
BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=3) FED_FUND * 2023:01
# TIME COVID HCRASH_FED

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in    10 Iterations. Final criterion was  0.0000031 <=  0.0000100

Dependent Variable FED_FUND, differenced 1 times
Monthly Data From 2001:04 To 2023:01
Usable Observations                        262
Degrees of Freedom                         255
Centered R^2                         0.9817698
```

```
R-Bar^2                              0.9813408
Uncentered R^2                       0.9897587
Mean of Dependent Variable       1.4059923664
Std Error of Dependent Variable  1.5949516765
Standard Error of Estimate       0.2178680787
Sum of Squared Residuals         12.103957429
Regression F(6,255)                 2288.7943
Significance Level of F             0.0000000
Log Likelihood                        31.0385
Durbin-Watson Statistic                2.0217
Q(36-3)                               54.8204
Significance Level of Q             0.0098949

    Variable                         Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONSTANT                    -0.085157811  0.058915065     -1.44543  0.14956396
2.  AR{1}                        0.106635320  0.061917591      1.72221  0.08624336
3.  AR{2}                        0.244007892  0.061066373      3.99578  0.00008444
4.  AR{3}                        0.135322261  0.059737499      2.26528  0.02433474
5.  TIME                         0.001056810  0.000372713      2.83545  0.00494299
6.  COVID                       -0.272527580  0.088569215     -3.07700  0.00231891
7.  HCRASH FED                  -0.116754469  0.053811235     -2.16970  0.03095302

@REGCRITS

Information Criteria
AIC          -0.176
SBC          -0.067
Hannan-Quinn -0.132
(log) FPE    -0.176

*BETTER AKAIKE INFORMATION CRITERIA BUT WORSE SBC COMPARED TO MODEL WITHOUT CRASH-
WE'LL KEEP ARIMA(3,1,0) FOR FED_FUND
@DFUNIT (LAGS=4) FED_FUND

Dickey-Fuller Unit Root Test, Series HOUSING_PRICES
Regression Run From 2001:02 to 2024:01
Observations        277
With intercept
Using fixed lags 0
Null is unit root. Reject in left tail.

Sig Level    Crit Value
1%(**)         -3.45554
5%(*)          -2.87209
10%            -2.57235

T-Statistic     8.84899

UFORECAST(FROM=2023:02,TO=2024:01,EQUATION=FED_ARIMA,STDERRS=FED_ARIMA_STD,PRINT)
FED_ARIMA_FORE

 Entry    FED_FUND
 2023:02 4.655230494
 2023:03 5.006101169
 2023:04 5.280478283
 2023:05 5.528489553
 2023:06 5.758529661
 2023:07 5.969550625
 2023:08 6.170725389
 2023:09 6.363994449
```

```
 2023:10 6.551733801
 2023:11 6.736005044
 2023:12 6.917910652
 2024:01 7.098431120

@UFOREERRORS FED_FUND FED_ARIMA_FORE 2023:02 2024:01

Forecast Analysis for FED_FUND
From 2023:02 to 2024:01
Mean Error                  -0.9439317
Mean Absolute Error          0.9439317
Root Mean Square Error       1.0457898
Mean Square Error            1.093676
Theil's U                    7.245444

Mean Pct Error              -0.182429
Mean Abs Pct Error           0.182429
Root Mean Square Pct Error   0.199143
Theil's Relative U           6.500393
FILTER(TYPE=CENTERED,WIDTH=1) FED_FUND 2023:02 2024:01 FED_FUND_TRUNC
GRAPH(STYLE=LINE,HEADER="Federal Funds Rate Actual versus
Forecast",VLABEL="Rate",HLABEL="Month",KEY=BELOW, MAX=10, MIN=0) 2
# FED ARIMA FORE
# FED FUND TRUNC



*Let's move on now to our final variable, GOVT_JOBS
*GOVT_JOBS likely to follow monthly seasonality- let's try it
SEASONAL DEC
SET NOV = DEC{-1}
SET OCT = DEC{-2}
SET SEP = DEC{-3}
SET AUG = DEC{-4}
SET JUL = DEC{-5}
SET JUN = DEC{-6}
SET MAY = DEC{-7}
SET APR = DEC{-8}
SET MAR = DEC{-9}
SET FEB = DEC{-10}
SET JAN = DEC{-11}
LINREG GOVT_JOBS * 2023:01
# DEC NOV OCT SEP AUG JUL JUN MAY APR MAR FEB JAN

Linear Regression - Estimation by Least Squares
Dependent Variable GOVT_JOBS
Monthly Data From 2000:12 To 2023:01
Usable Observations                        266
Degrees of Freedom                         254
Centered R^2                         0.0026356
R-Bar^2                             -0.0405573
Uncentered R^2                       0.8751625
Mean of Dependent Variable       509.17293233
Std Error of Dependent Variable  192.95959148
Standard Error of Estimate       196.83366572
Sum of Squared Residuals         9840846.9585
Regression F(11,254)                   0.0610
Significance Level of F              0.9999930
Log Likelihood                     -1776.4056
Durbin-Watson Statistic                0.0726

```

Variable	Coeff	Std Error	T-Stat	Signif
1. DEC	515.45454545	41.96507854	12.28294	0.00000000
2. NOV	507.13636364	41.96507854	12.08472	0.00000000
3. OCT	505.68181818	41.96507854	12.05006	0.00000000
4. SEP	497.13636364	41.96507854	11.84643	0.00000000
5. AUG	520.77272727	41.96507854	12.40967	0.00000000
6. JUL	505.86363636	41.96507854	12.05440	0.00000000
7. JUN	499.36363636	41.96507854	11.89950	0.00000000
8. MAY	515.22727273	41.96507854	12.27752	0.00000000
9. APR	498.95454545	41.96507854	11.88976	0.00000000
10. MAR	496.18181818	41.96507854	11.82368	0.00000000
11. FEB	524.04347826	41.04265648	12.76826	0.00000000
12. JAN	522.95652174	41.04265648	12.74178	0.00000000

*R^2 is too low

```
LINREG GOVT_JOBS * 2023:01
# COVID HCRASH TIME
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Linear Regression - Estimation by Least Squares
Dependent Variable GOVT_JOBS
Monthly Data From 2000:12 To 2023:01

Usable Observations	266
Degrees of Freedom	263
Centered R^2	0.1027901
R-Bar^2	0.0959672
Uncentered R^2	0.8876985
Mean of Dependent Variable	509.17293233
Std Error of Dependent Variable	192.95959148
Standard Error of Estimate	183.46721559
Sum of Squared Residuals	8852637.6486
Log Likelihood	-1762.3307
Durbin-Watson Statistic	0.0848

Variable	Coeff	Std Error	T-Stat	Signif
1. COVID	28.361425502	44.127175979	0.64272	0.52096561
2. HCRASH	42.998404102	39.128817484	1.09889	0.27281945
3. TIME	3.289723472	0.083882620	39.21818	0.00000000

```
@regactfit


BOXJENK(DIFFS=1,CONST,AR=1,MA=1) GOVT_JOBS
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Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in 9 Iterations. Final criterion was 0.0000062 <= 0.0000100

Dependent Variable GOVT JOBS, differenced 1 times
Monthly Data From 2001:02 To 2024:01

Usable Observations	276
Degrees of Freedom	273
Centered R^2	0.9532266
R-Bar^2	0.9528839
Uncentered R^2	0.9933876
Mean of Dependent Variable	530.96014493
Std Error of Dependent Variable	215.83750253
Standard Error of Estimate	46.85021767
Sum of Squared Residuals	599219.41044
Log Likelihood	-1451.8786
Durbin-Watson Statistic	1.9615

```
Q(36-2)                                35.1939
Significance Level of Q              0.4114396

    Variable                          Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  CONSTANT                       1.644541784  1.242037034      1.32407  0.18658791
2.  AR{1}                         -0.054685453  0.105704333     -0.51734  0.60533529
3.  MA{1}                         -0.537384383  0.090229976     -5.95572  0.00000001

@REGCRITS

Information Criteria
AIC          10.550
SBC          10.602
Hannan-Quinn 10.571
(log) FPE    10.550


BOXJENK(REGRESSORS,CONST,AR=2) GOVT_JOBS
# TIME

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in     3 Iterations. Final criterion was  0.0000046 <=  0.0000100

Dependent Variable GOVT_JOBS
Monthly Data From 2001:02 To 2024:01
Usable Observations                      276
Degrees of Freedom                       272
Centered R^2                        0.9513821
R-Bar^2                             0.9508458
Uncentered R^2                      0.9931269
Mean of Dependent Variable        530.96014493
Std Error of Dependent Variable   215.83750253
Standard Error of Estimate         47.85276241
Sum of Squared Residuals          622849.22881
Regression F(3,272)                  1774.2148
Significance Level of F              0.0000000
Log Likelihood                      -1457.2160
Durbin-Watson Statistic                2.1336
Q(36-2)                               48.3586
Significance Level of Q              0.0524579

    Variable                          Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  CONSTANT                     104.35295725 135.53930734      0.76991  0.44202189
2.  AR{1}                          0.51083889   0.05547582      9.20832  0.00000000
3.  AR{2}                          0.43417450   0.05515431      7.87200  0.00000000
4.  TIME                           2.79225176   0.71617349      3.89885  0.00012181

@REGCRITS

Information Criteria
AIC          10.596
SBC          10.661
Hannan-Quinn 10.622
(log) FPE    10.596

BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=1,MA=1) GOVT_JOBS * 2023:01
# TIME

Box-Jenkins - Estimation by LS Gauss-Newton
```

```
Convergence in    10 Iterations. Final criterion was  0.0000008 <=  0.0000100

Dependent Variable GOVT_JOBS, differenced 1 times
Monthly Data From 2001:02 To 2023:01
Usable Observations                        264
Degrees of Freedom                         260
Centered R^2                         0.9466999
R-Bar^2                              0.9460849
Uncentered R^2                       0.9932847
Mean of Dependent Variable         509.12878788
Std Error of Dependent Variable    193.66983803
Standard Error of Estimate          44.96942158
Sum of Squared Residuals           525784.70800
Log Likelihood                      -1377.3639
Durbin-Watson Statistic                 1.9987
Q(36-2)                                36.9281
Significance Level of Q                 0.3351382

    Variable                         Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONSTANT                    -3.973369543  2.041374406     -1.94642  0.05268155
2.  AR{1}                        0.036807784  0.096586534      0.38109  0.70345058
3.  MA{1}                       -0.654300570  0.073517539     -8.89992  0.00000000
4.  TIME                         0.046007653  0.013264900      3.46838  0.00061266

@REGCRITS

Information Criteria
AIC          10.472
SBC          10.540
Hannan-Quinn 10.500
(log) FPE    10.472


BOXJENK(DIFFS=1,CONST,AR=1,MA=1) GOVT_JOBS * 2023:01

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in     9 Iterations. Final criterion was  0.0000088 <=  0.0000100

Dependent Variable GOVT_JOBS, differenced 1 times
Monthly Data From 2001:02 To 2023:01
Usable Observations                        264
Degrees of Freedom                         261
Centered R^2                         0.9446696
R-Bar^2                              0.9442456
Uncentered R^2                       0.9930289
Mean of Dependent Variable         509.12878788
Std Error of Dependent Variable    193.66983803
Standard Error of Estimate          45.73001920
Sum of Squared Residuals           545812.24529
Log Likelihood                      -1382.2985
Durbin-Watson Statistic                 2.0021
Q(36-2)                                34.2186
Significance Level of Q                 0.4572503

    Variable                         Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONSTANT                     2.197093970  1.213516977      1.81052  0.07136542
2.  AR{1}                       -0.011437542  0.106067813     -0.10783  0.91421153
3.  MA{1}                       -0.565695606  0.088114795     -6.41998  0.00000000
```

```
@REGCRITS

Information Criteria
AIC          10.502
SBC          10.556
Hannan-Quinn 10.524
(log) FPE    10.502

BOXJENK(DIFFS=1,REGRESSORS,CONST,MA=1, DEFINE=GOVT_ARIMA) GOVT_JOBS * 2023:01
# TIME

Box-Jenkins - Estimation by LS Gauss-Newton
Convergence in     7 Iterations. Final criterion was  0.0000069 <=  0.0000100

Dependent Variable GOVT_JOBS, differenced 1 times
Monthly Data From 2001:01 To 2023:01
Usable Observations                        265
Degrees of Freedom                         262
Centered R^2                         0.9461031
R-Bar^2                              0.9456916
Uncentered R^2                       0.9932291
Mean of Dependent Variable         509.02641509
Std Error of Dependent Variable    193.30987464
Standard Error of Estimate          45.04923439
Sum of Squared Residuals           531711.58208
Log Likelihood                      -1383.5655
Durbin-Watson Statistic                 1.9544
Q(36-1)                                38.2799
Significance Level of Q                0.3229033

    Variable                          Coeff      Std Error      T-Stat      Signif
************************************************************************************
1.  CONSTANT                      -4.557263803  2.095339717     -2.17495  0.03052827
2.  MA{1}                         -0.628856595  0.048059489    -13.08496  0.00000000
3.  TIME                           0.049259440  0.013639554      3.61151  0.00036476


@REGACTFIT
@REGCRITS

Information Criteria
AIC          10.472
SBC          10.526
Hannan-Quinn 10.494
(log) FPE    10.472

@DFUNIT (LAGS=3) GOVT JOBS

Dickey-Fuller Unit Root Test, Series GOVT_JOBS
Regression Run From 2001:03 to 2024:01
Observations        276
With intercept
Using fixed lags 0
Null is unit root. Reject in left tail.

Sig Level    Crit Value
1%(**)         -3.45562
5%(*)          -2.87213
10%            -2.57237
```

```
T-Statistic    -1.83661
*EVIDENCE OF UNIT ROOT

UFORECAST(FROM=2023:02,TO=2024:01,EQUATION=GOVT_ARIMA,PRINT) GOVT_ARIMA_FORE

  Entry    GOVT_JOBS
  2023:02 1075.856216
  2023:03 1084.500483
  2023:04 1093.194008
  2023:05 1101.936793
  2023:06 1110.728838
  2023:07 1119.570142
  2023:08 1128.460705
  2023:09 1137.400528
  2023:10 1146.389610
  2023:11 1155.427952
  2023:12 1164.515553
  2024:01 1173.652413

@UFOREERRORS GOVT_JOBS GOVT_ARIMA_FORE 2023:02 2024:01

Forecast Analysis for GOVT JOBS
From 2023:02 to 2024:01
Mean Error                    -113.05277
Mean Absolute Error            113.05277
Root Mean Square Error         143.61068
Mean Square Error            20624.027564
Theil's U                        1.839689

Mean Pct Error                -0.118280
Mean Abs Pct Error             0.118280
Root Mean Square Pct Error     0.156545
Theil's Relative U             1.891496

FILTER(TYPE=CENTERED,WIDTH=1) GOVT_JOBS 2023:02 2024:01 GOVT_TRUNC
GRAPH(STYLE=LINE,HEADER="Government Job Openings Actual versus Forecast
(ARIMA)",VLABEL="Openings",HLABEL="Month",$
 KEY=BELOW, MAX=1500, MIN=500) 2
# GOVT_TRUNC
# GOVT_ARIMA_FORE

*NOW LET'S DO OUR VARs; LET'S MAKE SURE EVERYONE IS STATIONARY
DIFF CONS_CONF / CONS_CONF_DIF
@BJIDENT CONS_CONF_DIF
DIFF FED_FUND / FED_FUND_DIF
@BJIDENT FED_FUND_DIF
DIFF GOVT JOBS / GOVT JOBS DIF
@BJIDENT GOVT JOBS DIF
DIFF HOUSING PRICES / HOUSING DIF
@BJIDENT HOUSING_DIF

*OK, now let's start our VAR analysis- but first let's look at cross-correlations
CROSS(FROM=-12,TO=12,RESULTS=CROSSCORS) CONS_CONF_DIF FED_FUND_DIF
* 9
Cross Correlations of Series CONS_CONF_DIF and FED_FUND_DIF
Monthly Data From 2001:01 To 2024:01


   -12      -11      -10       -9       -8       -7       -6       -5
    -4       -3
-0.07018 -0.03541  0.01596  0.06788  0.06665  0.00847 -0.00684  0.01540  0.06189
```

```
     0.09560
1751    -2       -1        0        1        2        3        4        5
     6        7
1752  0.10360  0.12708  0.18167  0.14222  0.08516  0.06781  0.02821  0.00563  0.01134
     0.03821
1753    8        9        10       11       12
1754  0.07617  0.09993 -0.00624 -0.06441 -0.02035
1755 CROSS(FROM=-12,TO=12,RESULTS=CROSSCORS) FED_FUND_DIF HOUSING_DIF
1756
1757 Cross Correlations of Series FED_FUND_DIF and HOUSING_DIF
1758 Monthly Data From 2001:01 To 2024:01
1759 *8
1760
1761   -12      -11      -10       -9       -8       -7       -6       -5
     -4       -3
1762 -0.03380  0.05388  0.11313  0.08857  0.09490  0.13822  0.13806  0.11192  0.10269
     0.08346
1763    -2       -1        0        1        2        3        4        5
     6        7
1764  0.10016  0.17983  0.15081  0.16443  0.18284  0.21039  0.19799  0.21500  0.25253
     0.25731
1765    8        9        10       11       12
1766  0.27631  0.26351  0.25647  0.27489  0.26237
1767
1768 @varlagselect(lags=9,crit=sbc)
1769 # CONS_CONF_DIF FED_FUND_DIF
1770
1771 VAR Lag Selection
1772 Lags SBC/BIC
1773    0 -0.0493643
1774    1 -0.7467691
1775    2 -1.3679479
1776    3 -1.4116599*
1777    4 -1.3594295
1778    5 -1.3218135
1779    6 -1.2518673
1780    7 -1.1713055
1781    8 -1.1075547
1782    9 -1.0396715
1783
1784 SYSTEM(MODEL=CONSCONF_FEDFUND)
1785 VARIABLES CONS_CONF_DIF FED_FUND_DIF
1786 LAGS 1 TO 3
1787 DET Constant
1788 END(SYSTEM)
1789 ESTIMATE
1790
1791 VAR/System - Estimation by Least Squares
1792 Monthly Data From 2001:04 To 2024:01
1793 Usable Observations                        274
1794
1795 Dependent Variable CONS_CONF_DIF
1796 Mean of Dependent Variable       -0.005999015
1797 Std Error of Dependent Variable   0.243881458
1798 Standard Error of Estimate        0.118166425
1799 Sum of Squared Residuals         3.7282021444
1800 Durbin-Watson Statistic                1.9139
1801
1802     Variable                         Coeff      Std Error      T-Stat      Signif
1803 ********************************************************************************
1804 1.  CONS_CONF_DIF{1}              1.428593796  0.058857156     24.27222  0.00000000
```

```
2.  CONS_CONF_DIF{2}            -1.051273782  0.083951561    -12.52239  0.00000000
3.  CONS_CONF_DIF{3}             0.288254610  0.059568804      4.83902  0.00000221
4.  FED_FUND_DIF{1}             -0.002033664  0.032402898     -0.06276  0.95000316
5.  FED_FUND_DIF{2}              0.018870865  0.031458920      0.59986  0.54911003
6.  FED_FUND_DIF{3}              0.040114556  0.030917928      1.29745  0.19559528
7.  Constant                    -0.001450398  0.007157825     -0.20263  0.83957772

    F-Tests, Dependent Variable CONS_CONF_DIF
              Variable          F-Statistic     Signif
    ******************************************************
    CONS_CONF_DIF                   291.3499    0.0000000
    FED_FUND_DIF                      0.8244    0.4813797


Dependent Variable FED_FUND_DIF
Mean of Dependent Variable       -0.000948905
Std Error of Dependent Variable   0.237174711
Standard Error of Estimate        0.219134121
Sum of Squared Residuals         12.821276764
Durbin-Watson Statistic              2.0293

    Variable                       Coeff      Std Error      T-Stat      Signif
*******************************************************************************
1.  CONS CONF DIF{1}             0.214823560  0.109147850      1.96819  0.05008092
2.  CONS_CONF_DIF{2}            -0.228915376  0.155684253     -1.47038  0.14263567
3.  CONS_CONF_DIF{3}             0.148459839  0.110467568      1.34392  0.18011436
4.  FED_FUND_DIF{1}              0.097898405  0.060089662      1.62921  0.10444876
5.  FED_FUND_DIF{2}              0.248459999  0.058339100      4.25889  0.00002849
6.  FED_FUND_DIF{3}              0.161632899  0.057335855      2.81905  0.00517720
7.  Constant                     0.001276139  0.013273853      0.09614  0.92348203

    F-Tests, Dependent Variable FED_FUND_DIF
              Variable          F-Statistic     Signif
    ******************************************************
    CONS_CONF_DIF                     1.3996    0.2432932
    FED_FUND_DIF                     13.7956    0.0000000


@varlagselect(lags=8,crit=sbc)
# HOUSING_DIF FED_FUND_DIF

VAR Lag Selection
Lags SBC/BIC
   0 3.65839723
   1 2.37411466
   2 2.32971150*
   3 2.36311444
   4 2.43405254
   5 2.46879059
   6 2.52321435
   7 2.60056429
   8 2.67141400

SYSTEM(MODEL=HOUSINGDIF_FEDFUND)
VARIABLES HOUSING_DIF FED_FUND_DIF
LAGS 1 TO 2
DET Constant
END(SYSTEM)
ESTIMATE

VAR/System - Estimation by Least Squares
```

```
Monthly Data From 2001:03 To 2024:01
Usable Observations                        275

Dependent Variable HOUSING_DIF
Mean of Dependent Variable        0.9836727273
Std Error of Dependent Variable   1.5431636271
Standard Error of Estimate        0.7826675531
Sum of Squared Residuals          165.39349463
Durbin-Watson Statistic                 2.0278

    Variable                         Coeff      Std Error      T-Stat      Signif
*******************************************************************************
1.  HOUSING_DIF{1}                0.729306214  0.059701314     12.21592  0.00000000
2.  HOUSING_DIF{2}                0.152246912  0.059596014      2.55465  0.01117861
3.  FED_FUND_DIF{1}               0.398249711  0.205935079      1.93386  0.05417532
4.  FED_FUND_DIF{2}              -0.413368547  0.197356549     -2.09453  0.03714521
5.  Constant                      0.110189390  0.057282988      1.92360  0.05545644

    F-Tests, Dependent Variable HOUSING_DIF
              Variable           F-Statistic     Signif
    ********************************************************
    HOUSING DIF                    376.5468    0.0000000
    FED FUND DIF                     3.4489    0.0331883


Dependent Variable FED_FUND_DIF
Mean of Dependent Variable       -0.000872727
Std Error of Dependent Variable   0.236744885
Standard Error of Estimate        0.221982800
Sum of Squared Residuals         13.304618160
Durbin-Watson Statistic                 2.1063

    Variable                         Coeff      Std Error      T-Stat      Signif
*******************************************************************************
1.  HOUSING_DIF{1}               -0.003436692  0.016932687     -0.20296  0.83931761
2.  HOUSING_DIF{2}                0.022520356  0.016902822      1.33234  0.18387090
3.  FED_FUND_DIF{1}               0.150239005  0.058407999      2.57223  0.01063956
4.  FED_FUND_DIF{2}               0.241406006  0.055974927      4.31275  0.00002263
5.  Constant                     -0.018622068  0.016246793     -1.14620  0.25272738

    F-Tests, Dependent Variable FED_FUND_DIF
              Variable           F-Statistic     Signif
    ********************************************************
    HOUSING_DIF                      2.4462    0.0885392
    FED_FUND_DIF                    15.0770    0.0000006

@varlagselect(lags=8,crit=sbc)
# CONS CONF DIF HOUSING DIF

VAR Lag Selection
Lags SBC/BIC
   0 3.78824084
   1 1.76898139
   2 1.16740230
   3 1.15588432*
   4 1.20930637
   5 1.27354278
   6 1.34372717
   7 1.41331552
   8 1.48039752
```

```
SYSTEM(MODEL=CONSCONF_HOUSINGDIF)
VARIABLES CONS_CONF_DIF HOUSING_DIF
LAGS 1 TO 3
DET Constant
END(SYSTEM)
ESTIMATE

VAR/System - Estimation by Least Squares
Monthly Data From 2001:04 To 2024:01
Usable Observations                      274

Dependent Variable CONS_CONF_DIF
Mean of Dependent Variable       -0.005999015
Std Error of Dependent Variable   0.243881458
Standard Error of Estimate        0.118123477
Sum of Squared Residuals          3.7254925952
Durbin-Watson Statistic                 1.9367

    Variable                         Coeff      Std Error      T-Stat      Signif
*******************************************************************************
1.  CONS_CONF_DIF{1}              1.436254911  0.058923107     24.37507  0.00000000
2.  CONS CONF DIF{2}             -1.053387733  0.086144946    -12.22809  0.00000000
3.  CONS CONF DIF{3}              0.295122430  0.060105518      4.91007  0.00000159
4.  HOUSING DIF{1}               -0.010571984  0.009350577     -1.13062  0.25922812
5.  HOUSING_DIF{2}                0.015487611  0.011178514      1.38548  0.16706193
6.  HOUSING_DIF{3}               -0.008505194  0.009342317     -0.91039  0.36343559
7.  Constant                      0.002023097  0.008664591      0.23349  0.81555967

    F-Tests, Dependent Variable CONS_CONF_DIF
              Variable           F-Statistic     Signif
    *****************************************************
    CONS_CONF_DIF                   295.4613    0.0000000
    HOUSING_DIF                       0.8898    0.4469027


Dependent Variable HOUSING_DIF
Mean of Dependent Variable       0.9844525547
Std Error of Dependent Variable  1.5459330645
Standard Error of Estimate       0.7765982272
Sum of Squared Residuals         161.02898331
Durbin-Watson Statistic                 1.9842

    Variable                         Coeff      Std Error      T-Stat      Signif
*******************************************************************************
1.  CONS_CONF_DIF{1}              0.770380760  0.387387683      1.98866  0.04775993
2.  CONS_CONF_DIF{2}             -0.365998252  0.566356614     -0.64623  0.51868362
3.  CONS CONF DIF{3}             -0.261607153  0.395161402     -0.66203  0.50852549
4.  HOUSING DIF{1}                0.683720722  0.061475010     11.12193  0.00000000
5.  HOUSING DIF{2}                0.119756313  0.073492709      1.62950  0.10438656
6.  HOUSING_DIF{3}                0.097229455  0.061420698      1.58301  0.11460340
7.  Constant                      0.092609185  0.056965015      1.62572  0.10518886

    F-Tests, Dependent Variable HOUSING_DIF
              Variable           F-Statistic     Signif
    *****************************************************
    CONS_CONF_DIF                     3.7891    0.0109278
    HOUSING_DIF                     269.1601    0.0000000

@varlagselect(lags=8,crit=sbc)
# FED_FUND_DIF GOVT_JOBS_DIF
```

```
VAR Lag Selection
Lags SBC/BIC
   0 10.7897302
   1 10.5938724
   2 10.5380307*
   3 10.5736027
   4 10.6275766
   5 10.6581004
   6 10.7299145
   7 10.8104777
   8 10.8672075

SYSTEM(MODEL=FEDFUND_GOVTJOBS)
VARIABLES FED_FUND_DIF GOVT_JOBS_DIF
LAGS 1 TO 2
DET Constant
END(SYSTEM)
ESTIMATE

VAR/System - Estimation by Least Squares
Monthly Data From 2001:03 To 2024:01
Usable Observations                        275

Dependent Variable FED FUND DIF
Mean of Dependent Variable       -0.000872727
Std Error of Dependent Variable   0.236744885
Standard Error of Estimate        0.223338294
Sum of Squared Residuals         13.467598225
Durbin-Watson Statistic                2.1077

    Variable                         Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  FED_FUND_DIF{1}                0.167655311  0.058383328      2.87163  0.00440740
2.  FED_FUND_DIF{2}                0.254976398  0.055687579      4.57869  0.00000715
3.  GOVT_JOBS_DIF{1}               0.000302845  0.000285602      1.06038  0.28992133
4.  GOVT_JOBS_DIF{2}              -0.000028886  0.000285629     -0.10113  0.91952183
5.  Constant                      -0.000175011  0.013498693     -0.01297  0.98966527

    F-Tests, Dependent Variable FED_FUND_DIF
              Variable           F-Statistic     Signif
    ********************************************************
    FED_FUND_DIF                    17.8770    0.0000001
    GOVT_JOBS_DIF                    0.7829    0.4581208


Dependent Variable GOVT_JOBS_DIF
Mean of Dependent Variable         1.334545455
Std Error of Dependent Variable   54.124795707
Standard Error of Estimate        47.563467570
Sum of Squared Residuals          610816.53077
Durbin-Watson Statistic                1.9960

    Variable                         Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  FED_FUND_DIF{1}                 9.80024857  12.43366503      0.78820  0.43126960
2.  FED_FUND_DIF{2}                -2.63016930  11.85956208     -0.22178  0.82465571
3.  GOVT_JOBS_DIF{1}               -0.55712541   0.06082345     -9.15971  0.00000000
4.  GOVT_JOBS_DIF{2}               -0.21127655   0.06082918     -3.47328  0.00059865
5.  Constant                        2.73129461   2.87476296      0.95009  0.34291423

    F-Tests, Dependent Variable GOVT_JOBS_DIF
```

```
              Variable           F-Statistic     Signif
     ******************************************************
     FED_FUND_DIF                      0.3130    0.7315403
     GOVT_JOBS_DIF                    42.3040    0.0000000

@varlagselect(lags=8,crit=sbc)
# CONS_CONF_DIF GOVT_JOBS_DIF

VAR Lag Selection
Lags SBC/BIC
   0 10.8958940
   1  9.9874927
   2  9.4044805
   3  9.3881527*
   4  9.4242808
   5  9.4881865
   6  9.5573341
   7  9.6304664
   8  9.7042769

SYSTEM(MODEL=CONSCONF_GOVTJOBS)
VARIABLES CONS CONF DIF GOVT JOBS DIF
LAGS 1 TO 2
DET Constant
END(SYSTEM)
ESTIMATE

VAR/System - Estimation by Least Squares
Monthly Data From 2001:03 To 2024:01
Usable Observations                     275

Dependent Variable CONS_CONF_DIF
Mean of Dependent Variable       -0.006575745
Std Error of Dependent Variable   0.243623813
Standard Error of Estimate        0.123428448
Sum of Squared Residuals          4.1133371024
Durbin-Watson Statistic                1.5847

    Variable                       Coeff      Std Error      T-Stat      Signif
*******************************************************************************
1.  CONS_CONF_DIF{1}              1.234053594  0.045266440     27.26200  0.00000000
2.  CONS_CONF_DIF{2}             -0.688226013  0.045079875    -15.26681  0.00000000
3.  GOVT_JOBS_DIF{1}              0.000103758  0.000158315      0.65539  0.51277469
4.  GOVT_JOBS_DIF{2}             -0.000065252  0.000158178     -0.41252  0.68028535
5.  Constant                     -0.003401616  0.007475014     -0.45506  0.64942829

    F-Tests, Dependent Variable CONS CONF DIF
              Variable           F-Statistic     Signif
    ******************************************************
    CONS_CONF_DIF                   391.5204    0.0000000
    GOVT_JOBS_DIF                     0.5417    0.5824130


Dependent Variable GOVT_JOBS_DIF
Mean of Dependent Variable        1.334545455
Std Error of Dependent Variable  54.124795707
Standard Error of Estimate       47.463217120
Sum of Squared Residuals         608244.38442
Durbin-Watson Statistic                1.9906

    Variable                       Coeff      Std Error      T-Stat      Signif
```

```
********************************************************************************
1.  CONS_CONF_DIF{1}              22.63387594  17.40677195      1.30029  0.19460994
2.  CONS_CONF_DIF{2}             -19.63233821  17.33503018     -1.13252  0.25841892
3.  GOVT_JOBS_DIF{1}              -0.56082656   0.06087861     -9.21221  0.00000000
4.  GOVT_JOBS_DIF{2}              -0.21378647   0.06082595     -3.51472  0.00051605
5.  Constant                       2.70808711   2.87444421      0.94213  0.34697059

    F-Tests, Dependent Variable GOVT_JOBS_DIF
              Variable           F-Statistic     Signif
    ******************************************************
    CONS_CONF_DIF                    0.8852    0.4138350
    GOVT_JOBS_DIF                   42.7971    0.0000000

*Now to create our forecast, let's truncate ones that do exhibit casuality
SYSTEM(MODEL=HOUSINGDIF_FEDFUND_TRUNC)
VARIABLES HOUSING_DIF FED_FUND_DIF
LAGS 1 TO 2
DET Constant
END(SYSTEM)
ESTIMATE * 2023:01

VAR/System - Estimation by Least Squares
Monthly Data From 2001:03 To 2023:01
Usable Observations                      263

Dependent Variable HOUSING_DIF
Mean of Dependent Variable       0.9338022814
Std Error of Dependent Variable  1.5423269791
Standard Error of Estimate       0.7771772469
Sum of Squared Residuals         155.83315407
Durbin-Watson Statistic                2.0475

    Variable                        Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  HOUSING_DIF{1}                0.724118488  0.060743447     11.92093  0.00000000
2.  HOUSING_DIF{2}                0.162262753  0.060765504      2.67031  0.00805947
3.  FED_FUND_DIF{1}               0.302033929  0.206973630      1.45929  0.14570257
4.  FED_FUND_DIF{2}              -0.481507882  0.201454009     -2.39016  0.01755895
5.  Constant                      0.100693749  0.057364633      1.75533  0.08039002

    F-Tests, Dependent Variable HOUSING_DIF
              Variable           F-Statistic     Signif
    ******************************************************
    HOUSING_DIF                    371.8472    0.0000000
    FED_FUND_DIF                     3.4484    0.0332696


Dependent Variable FED FUND DIF
Mean of Dependent Variable       -0.004714829
Std Error of Dependent Variable   0.240082314
Standard Error of Estimate        0.225353235
Sum of Squared Residuals         13.102292760
Durbin-Watson Statistic                2.0913

    Variable                        Coeff      Std Error      T-Stat      Signif
********************************************************************************
1.  HOUSING_DIF{1}               -0.005013967  0.017613398     -0.28467  0.77612704
2.  HOUSING_DIF{2}                0.023253232  0.017619794      1.31972  0.18809763
3.  FED_FUND_DIF{1}               0.159876302  0.060014852      2.66395  0.00820930
4.  FED_FUND_DIF{2}               0.246356886  0.058414362      4.21740  0.00003423
5.  Constant                     -0.017533669  0.016633665     -1.05411  0.29281990
```

```
2171
2172      F-Tests, Dependent Variable FED_FUND_DIF
2173                Variable           F-Statistic     Signif
2174      ******************************************************
2175      HOUSING_DIF                        2.1604    0.1173553
2176      FED_FUND_DIF                      14.6339    0.0000010
2177
2178  FORECAST(MODEL=HOUSINGDIF_FEDFUND_TRUNC,FROM=2023:02,TO=2024:01,RESULT=VARFORE1,STDE
      RRS=VARFORE1STD,PRINT)
2179
2180
2181     Entry     HOUSING_DIF  FED_FUND_DIF
2182       2023:02  0.600943589   0.25541688
2183       2023:03  0.511784703   0.16346455
2184       2023:04  0.495183875   0.08293196
2185       2023:05  0.488647938   0.04541362
2186       2023:06  0.508666717   0.01922231
2187       2023:07  0.532256859   0.00553969
2188       2023:08  0.561065922  -0.00275303
2189       2023:09  0.589838509  -0.00704555
2190       2023:10  0.618044431  -0.00924915
2191       2023:11  0.644538898  -0.01013131
2192       2023:12  0.669095411  -0.01029218
2193       2024:01  0.691552480  -0.01004227
2194  * THAT'S THE DIFFERENCED DATA, HAVE TO TURN IT BACK INTO LEVELS TO GET AN ACCURATE
      MSE
2195  SET VARFORE1(1) 2023:02 2024:01 = VARFORE1(1)+HOUSING_PRICES{12}
2196  PRINT 2023:02 2024:01 VARFORE1(1)
2197
2198
2199   ENTRY      VARFORE1(1)
2200   2023:02   378.500943589
2201   2023:03   383.051784703
2202   2023:04   388.095183875
2203   2023:05   391.878647938
2204   2023:06   392.548666717
2205   2023:07   390.622256859
2206   2023:08   389.251065922
2207   2023:09   390.689838509
2208   2023:10   391.478044431
2209   2023:11   391.814538898
2210   2023:12   392.379095411
2211   2024:01   393.261552480
2212
2213  @UFOREERRORS VARFORE1(1) HOUSING_PRICES
2214
2215  Forecast Analysis for VARFORE1(1)
2216  From 2023:02 to 2024:01
2217  Mean Error                 -19.157365
2218  Mean Absolute Error         19.157365
2219  Root Mean Square Error      19.927269
2220  Mean Square Error          397.096037
2221  Theil's U                    7.876788
2222
2223  Mean Pct Error              -0.049142
2224  Mean Abs Pct Error           0.049142
2225  Root Mean Square Pct Error   0.051061
2226  Theil's Relative U           7.848864
2227
2228  * Let's truncate our other model
2229  SYSTEM(MODEL=CONSCONF_HOUSINGDIF_TRUNC)
```

```
VARIABLES CONS_CONF_DIF HOUSING_DIF
LAGS 1 TO 3
DET Constant
END(SYSTEM)
ESTIMATE * 2023:01

VAR/System - Estimation by Least Squares
Monthly Data From 2001:04 To 2023:01
Usable Observations                        262

Dependent Variable CONS_CONF_DIF
Mean of Dependent Variable       -0.012232214
Std Error of Dependent Variable   0.239223121
Standard Error of Estimate        0.117129039
Sum of Squared Residuals         3.4983989950
Durbin-Watson Statistic                1.9346

    Variable                         Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONS_CONF_DIF{1}              1.408813129  0.060345745     23.34569  0.00000000
2.  CONS_CONF_DIF{2}             -1.009749680  0.087508777    -11.53884  0.00000000
3.  CONS CONF DIF{3}              0.274794237  0.060609228      4.53387  0.00000891
4.  HOUSING DIF{1}               -0.008044264  0.009508427     -0.84601  0.39833800
5.  HOUSING DIF{2}                0.012400992  0.011369967      1.09068  0.27644337
6.  HOUSING_DIF{3}               -0.009435572  0.009450999     -0.99837  0.31904750
7.  Constant                      0.000863832  0.008638190      0.10000  0.92042166

    F-Tests, Dependent Variable CONS_CONF_DIF
              Variable           F-Statistic     Signif
    ******************************************************
    CONS_CONF_DIF                   272.6161    0.0000000
    HOUSING_DIF                       0.8142    0.4869957


Dependent Variable HOUSING_DIF
Mean of Dependent Variable       0.9344274809
Std Error of Dependent Variable  1.5452454133
Standard Error of Estimate       0.7664558242
Sum of Squared Residuals         149.80090528
Durbin-Watson Statistic                2.0080

    Variable                         Coeff      Std Error      T-Stat      Signif
******************************************************************************
1.  CONS_CONF_DIF{1}              0.907883567  0.394883696      2.29912  0.02230719
2.  CONS_CONF_DIF{2}             -0.552206597  0.572630090     -0.96433  0.33579217
3.  CONS_CONF_DIF{3}             -0.201948682  0.396607845     -0.50919  0.61105949
4.  HOUSING DIF{1}                0.673300426  0.062220172     10.82126  0.00000000
5.  HOUSING DIF{2}                0.107949872  0.074401508      1.45091  0.14803401
6.  HOUSING DIF{3}                0.124165955  0.061844384      2.00772  0.04572839
7.  Constant                      0.087951508  0.056525615      1.55596  0.12095818

    F-Tests, Dependent Variable HOUSING_DIF
              Variable           F-Statistic     Signif
    ******************************************************
    CONS_CONF_DIF                     4.3115    0.0054789
    HOUSING_DIF                     265.9262    0.0000000

FORECAST(MODEL=CONSCONF_HOUSINGDIF_TRUNC,FROM=2023:02,TO=2024:01,RESULT=VARFORE2,STD
ERRS=VARFORE2STD,PRINT)

    Entry     CONS_CONF_DIF HOUSING_DIF
```

```
       2023:02    0.19627434 0.888047537
       2023:03    0.04974190 0.824468516
       2023:04   -0.05335462 0.725441237
       2023:05   -0.07458531 0.660113013
       2023:06   -0.04076261 0.664790770
       2023:07    0.00008124 0.711843331
       2023:08    0.01793197 0.758609112
       2023:09    0.01129569 0.782578355
       2023:10   -0.00491154 0.785476925
       2023:11   -0.01630557 0.781168120
       2023:12   -0.01797156 0.781501533
       2024:01   -0.01335062 0.789673151

SET VARFORE2(2) 2023:02 2024:01 = VARFORE2(2)+HOUSING_PRICES{12}
PRINT 2023:02 2024:01 VARFORE2(2)


 ENTRY      VARFORE2(2)
 2023:02   378.788047537
 2023:03   383.364468516
 2023:04   388.325441237
 2023:05   392.050113013
 2023:06   392.704790770
 2023:07   390.801843331
 2023:08   389.448609112
 2023:09   390.882578355
 2023:10   391.645476925
 2023:11   391.951168120
 2023:12   392.491501533
 2024:01   393.359673151


@UFOREERRORS VARFORE2(2) HOUSING_PRICES

Forecast Analysis for VARFORE2(2)
From 2023:02 to 2024:01
Mean Error                 -18.970524
Mean Absolute Error         18.970524
Root Mean Square Error      19.756821
Mean Square Error          390.331960
Theil's U                    7.883457

Mean Pct Error              -0.048638
Mean Abs Pct Error           0.048638
Root Mean Square Pct Error   0.050599
Theil's Relative U           7.859846
```