

For this final project, I will be analyzing 4 variables:

**Consumer Confidence Index-** Seasonally Adjusted and Normalized (100)

<https://fred.stlouisfed.org/series/CSCICP03USM665S>

**Housing Price Index-**

<https://catalog.data.gov/dataset/fhfa-house-price-indexes-hpis-948c6>

**Federal Funds Rate-**

<https://fred.stlouisfed.org/series/DFF>

**Government Job Openings-** Seasonally Adjusted (in thousands)

<https://fred.stlouisfed.org/series/JTS9000JOL>

These are variables which I thought would be likely to be related over time. However, it's interesting to note that most of them didn't have predictive causality for the others.

For this analysis, pages 2-13 show the chosen ARIMA models along with their forecasts, generally chosen off the SBC for asymptotic consistency. It also displays the DF test for unit root (in all of them, we could not reject the null of a unit root being present at the 5% level). It's also going to display the MSE for those forecasts, along with some graphs displaying the forecasts compared to the actual data.

Pages 14-20 is going to display 5 VAR tests that were run:

Consumer Confidence Index and Federal Funds Rate

Housing Price Index and Federal Funds Rate

Consumer Confidence Index and Housing Price Index

Federal Funds Rate and Government Job Openings

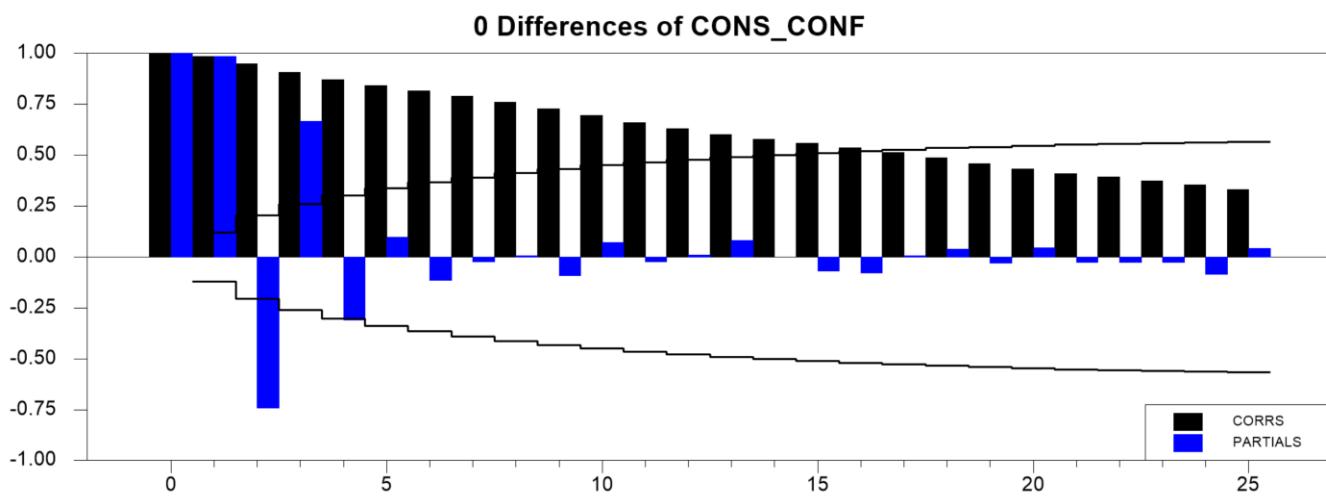
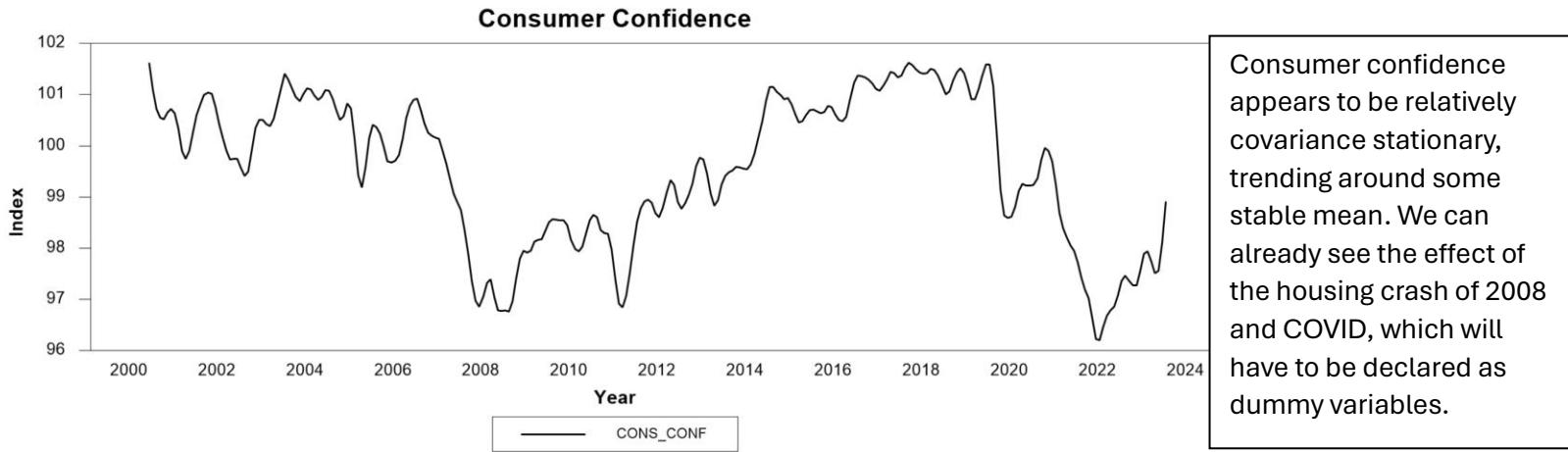
Consumer Confidence Index and Government Job Openings

Of all of these, there were only 2 that displayed predictive causality at the 5% level: Federal Funds Rate has Granger causality for the Housing Price Index, and Consumer Confidence Index for the Housing Price Index. I developed forecasts only for those variables which did have that predictive causality. Nonetheless,, the ARIMA models proved to be more accurate considering the MSE. I also differenced the data in the VAR model for stationarity and converted it back into levels.

Pages 21 and beyond has the full RATS file showing all of the models run.

## Preliminary Analysis Correlation Matrix

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



Seems to follow an AR(3) model, and is covariance stationary as autocorrelations converge to 0. Now, let's make sure we account for the effects of the covid variable and the housing crash.

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

Model seems to be best fitted by ARMA(3,1) model based on the AIC. While ARIMA(2,1,1) had a lower SBC, it had a higher MSE, so we'll stick with the non-differenced model (it's already stationary anyways). The COVID and HCRASH (housing crash of '08) variables were not significantly different from 0. **Please see program file for all models run.**

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

UFORECAST(FROM=2023:02,TO=2024:01,EQUATION=CONS\_CONF\_ARMA,STDERRS=CONS\_CONF\_STDE\_A,PRINT) 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

@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

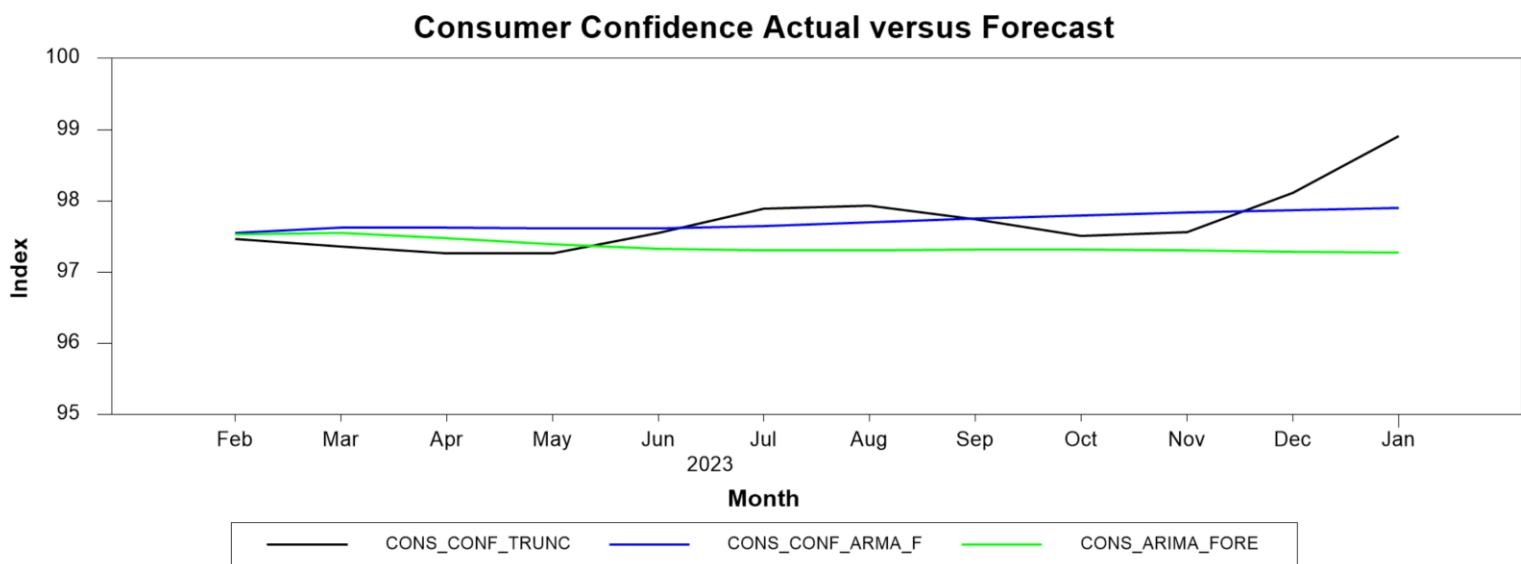
5%(\*) -2.87220

10% -2.57241

T-Statistic -2.00878

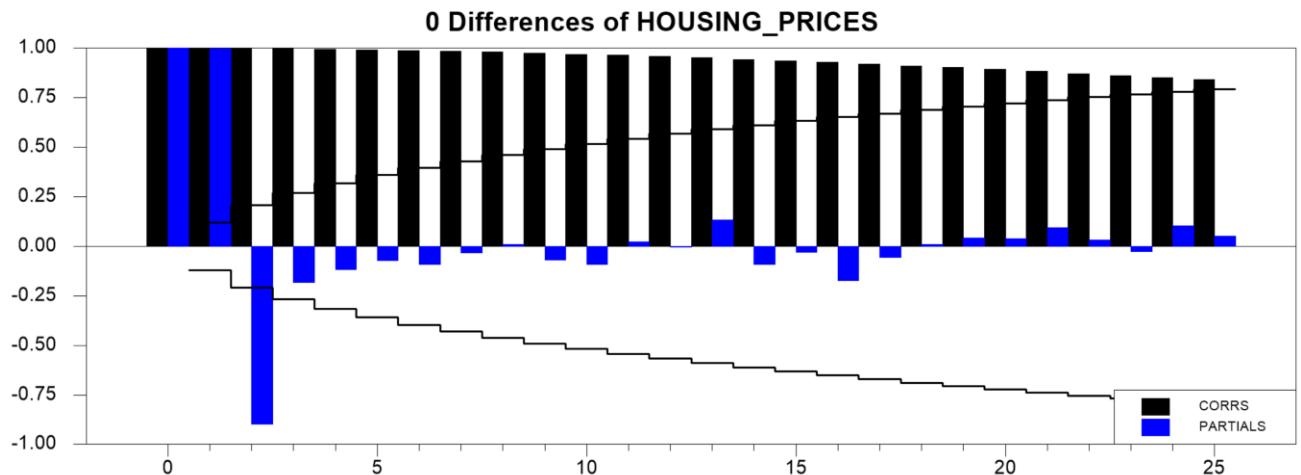
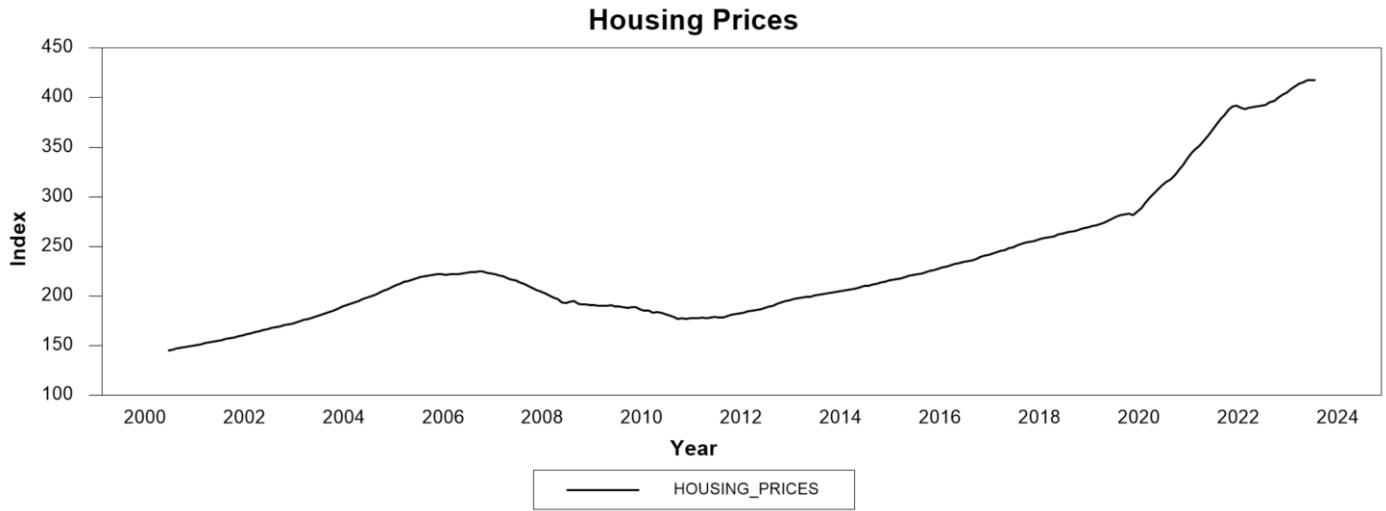
\*FOUND EVIDENCE OF A UNIT ROOT

Not stationary after all....



Above is a graph comparing our chosen ARMA model forecast, versus the ARIMA forecast, and actual data.

VAR models analyzed in page 15.



Housing Prices ARE NOT covariance stationary; in fact, it looks like these follow a deterministic time trend. The autocorrelations graph confirms this. These will have to be made stationary before we include it in the VAR model. We will also include the COVID variable for the models for this one as, ironically, it seems to have exponentially increased housing prices, despite a lower consumer confidence index.

```
BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=2,MA=1) HOUSING_PRICES
# COVID
*BEST MODEL THUS FAR
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
```

ARIMA(2,1,1) with a COVID variable provides the fit with the lowest SBC. TIME variable no longer needed now that we differenced the data, per T stat, and it didn't improve model information criteria.

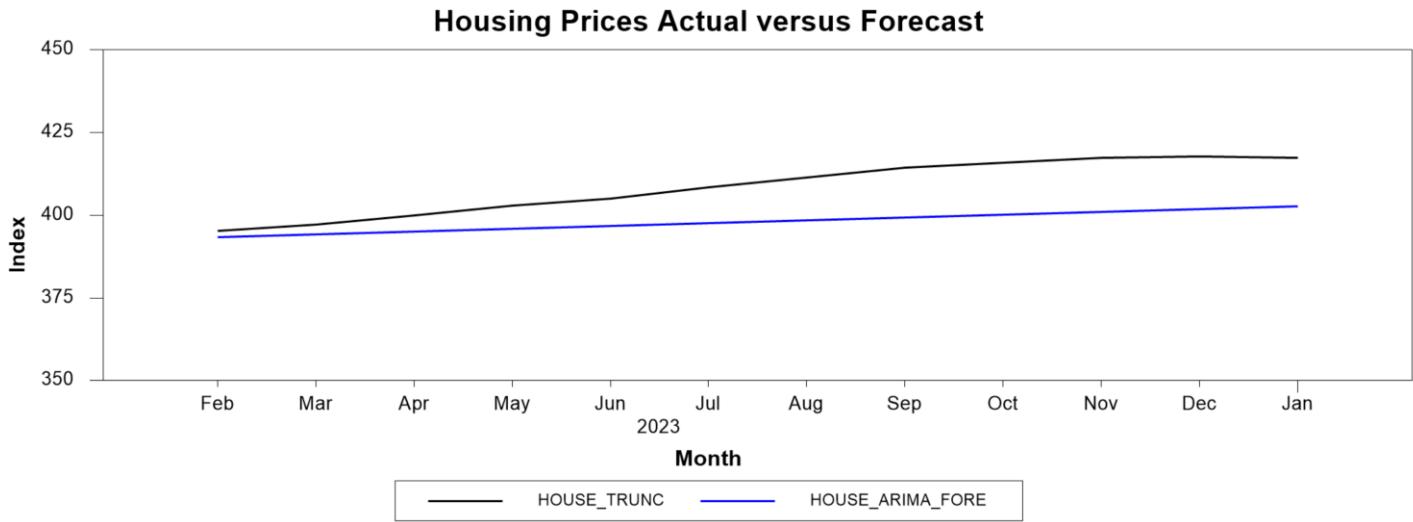
Variable	Coeff	Std Error	T-Stat	Signif
1. CONSTANT	0.860711867	0.553748095	1.55434	0.12132954
2. AR{1}	1.401242800	0.151119694	9.27240	0.00000000
3. AR{2}	-0.423020353	0.137880964	-3.06801	0.00238445
4. MA{1}	-0.750037294	0.122047641	-6.14545	0.00000000
5. COVID	0.778099025	0.494047154	1.57495	0.11649365

@REGCRITS

Information Criteria
AIC 2.349
SBC 2.430
Hannan-Quinn 2.382
(log) FPE 2.349

UFORECAST(FROM=2023:02,TO=2024:01,EQUATION=HOUSE\_ARIMA,PRINT) HOUSE\_ARIMA\_FORE

Entry	HOUSING_PRICES	@uforeerrors HOUSING_PRICES HOUSE_ARIMA_FORE 2023:02 2024:01
2023:02	393.4268487	Forecast Analysis for HOUSING_PRICES
2023:03	394.2824485	From 2023:02 to 2024:01
2023:04	395.1376312	Mean Error 10.4896046
2023:05	395.9927580	Mean Absolute Error 10.4896046
2023:06	396.8479827	Root Mean Square Error 11.6764138
2023:07	397.7033684	Mean Square Error 136.338640
2023:08	398.5589381	Theil's U 4.978334
2023:09	399.4146977	
2023:10	400.2706454	
2023:11	401.1267765	Mean Pct Error 0.025435
2023:12	401.9830849	Mean Abs Pct Error 0.025435
2024:01	402.8395642	Root Mean Square Pct Error 0.028190
		Theil's Relative U 4.867271



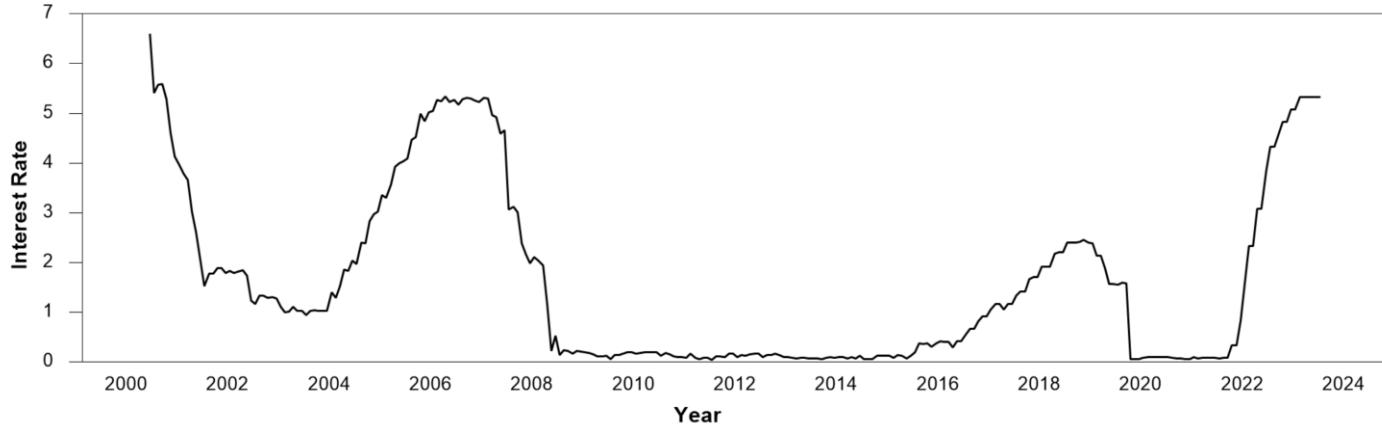
```
@DFUNIT(LAGS=3) HOUSING_PRICES
Dickey-Fuller Unit Root Test, Series HOUSING_PRICES
Regression Run From 2001:04 to 2024:01
Observations      275
With intercept
Using fixed lags 3
Null is unit root. Reject in left tail.

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

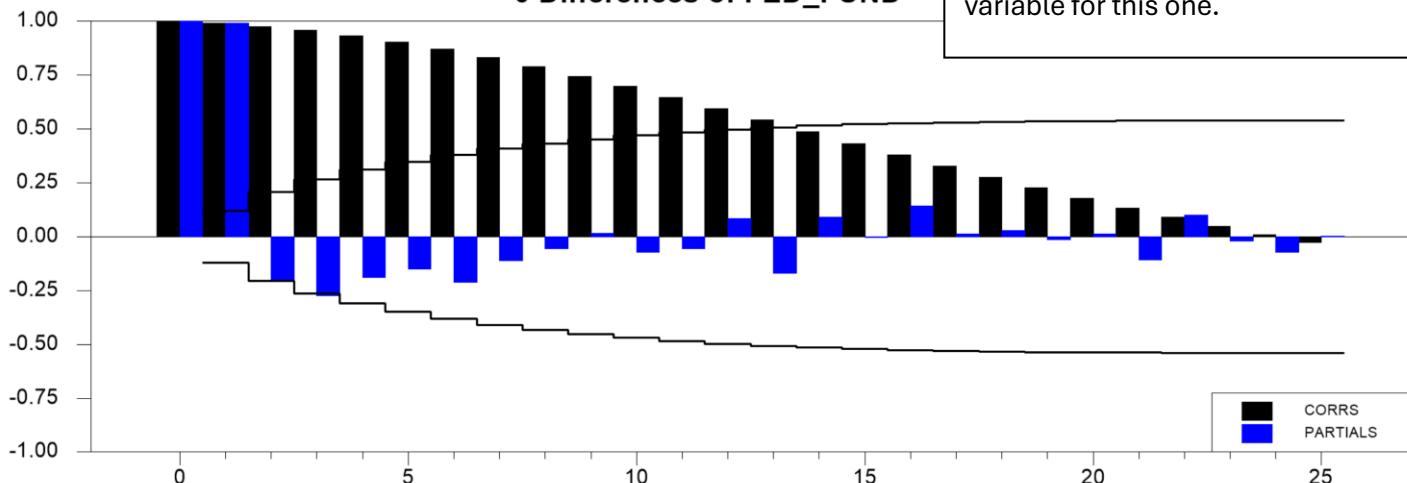
T-Statistic     0.63118
```

We have evidence of a unit root.  
Forecast was a little more off than I  
expected; hopefully, VAR model will  
be better.

### Federal Funds Rate



### 0 Differences of FED\_FUND



Potential stochastic trend- Looks like I'm going to have to include the COVID and HOUSING\_CRASH variable for this one.

```
@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.
```

Evidence of a unit root

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

T-Statistic 8.84899

```
*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      0.00000000
Log Likelihood                28.6652
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

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

Entry      FED_FUND          @UFOREERRORS FED_FUND FED_ARIMA_FORE 2023:02 2024:01
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

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
```

```

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

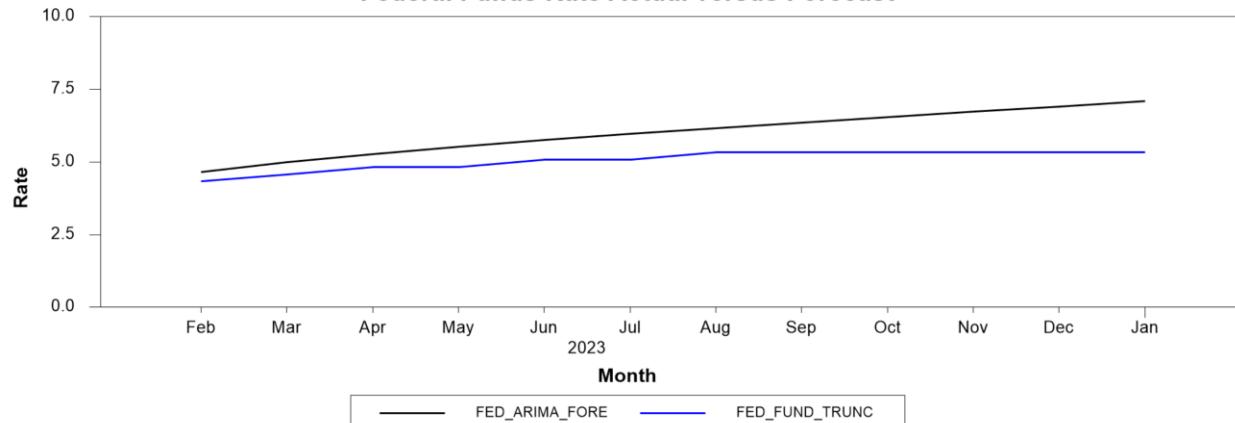
@REGCRITS

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

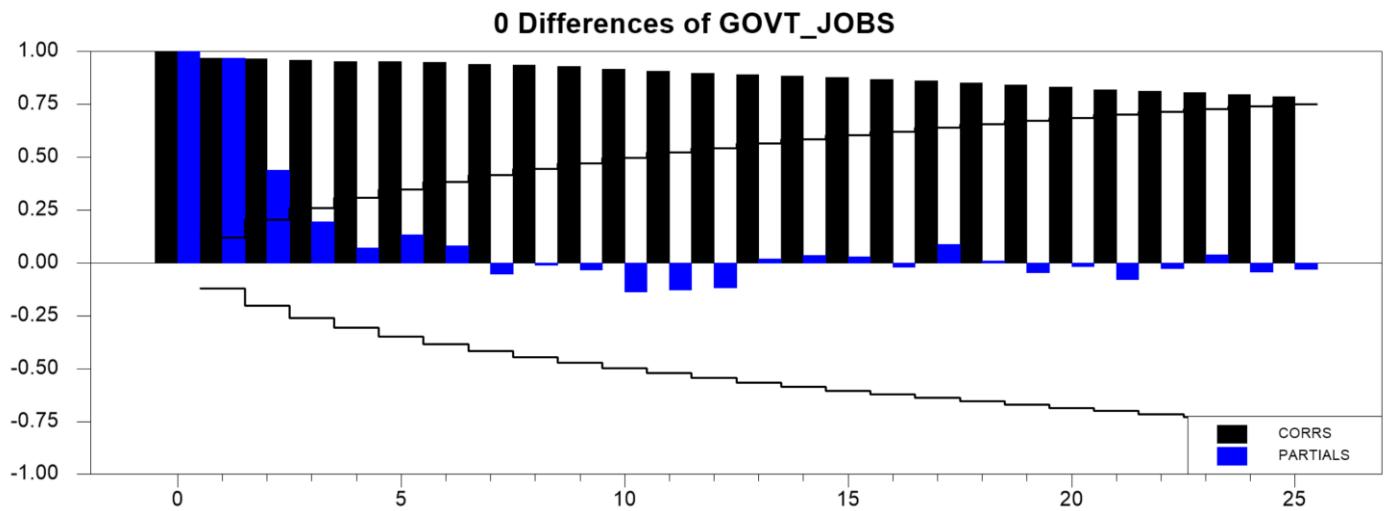
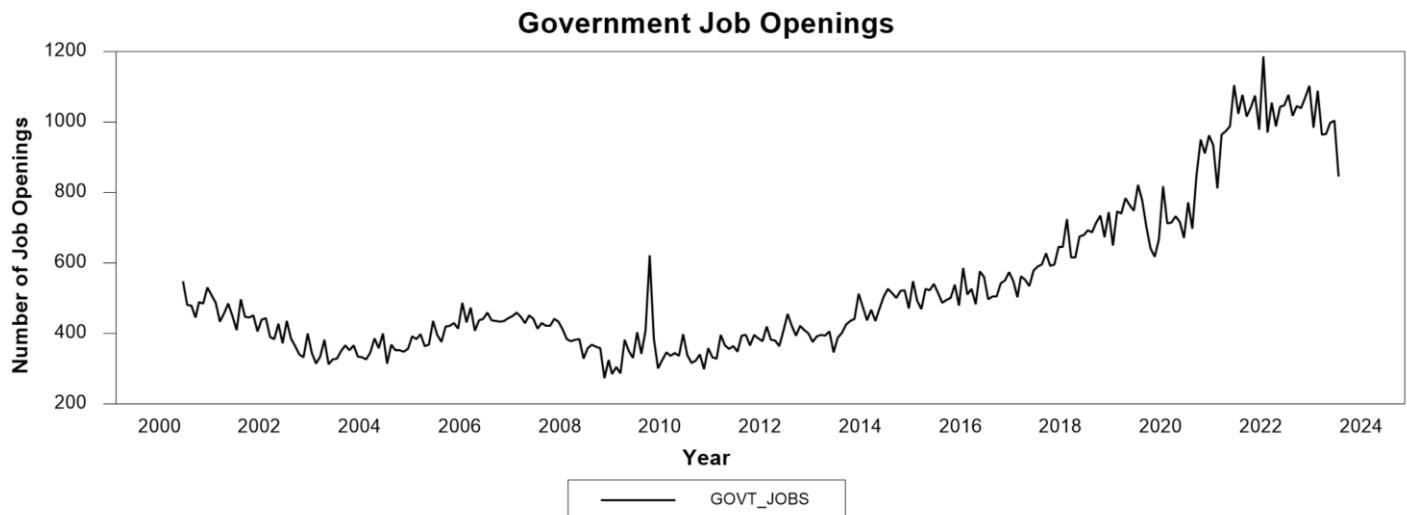
```

\*BETTER AKAIKE INFORMATION CRITERIA BUT WORSE SBC COMPARED TO MODEL WITHOUT CRASH- WE'LL KEEP ARIMA(3,1,0) FOR FED\_FUND

Federal Funds Rate Actual versus Forecast



Using our chosen  
ARIMA(3,1,0) model



Government job openings likely have some seasonality and seem to follow a time trend, they're not covariance stationary. Tested for monthly seasonality (but yielded low R^2).

@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

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

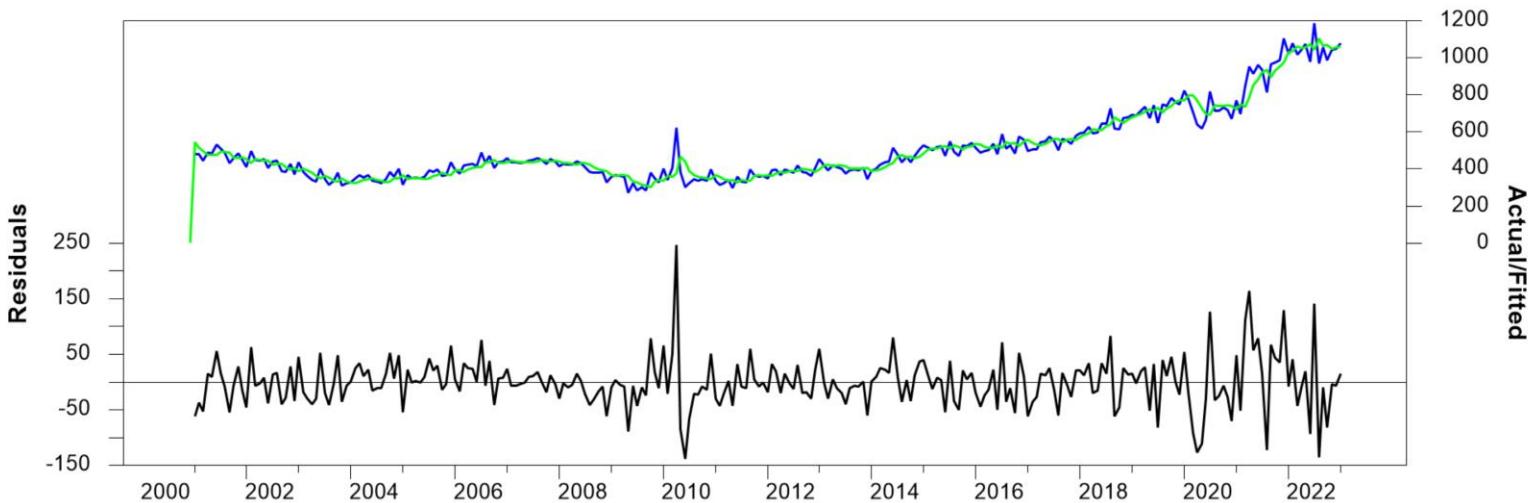
Our chosen model is ARIMA(0,1,1)  
with a differenced TIME variable for  
government jobs based on the  
lowest SBC out of those run.

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

@REGCRITS

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

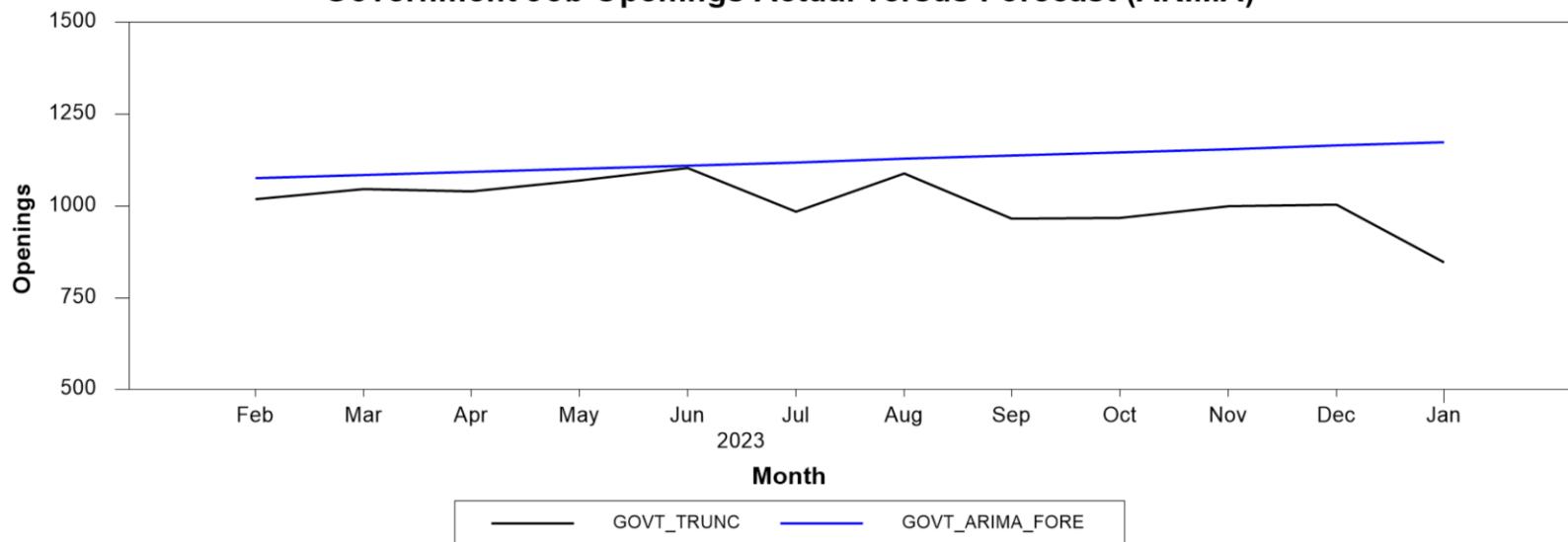
### Actual/Fitted and Residuals



UFORECAST (FROM=2023:02, TO=2024:01, EQUATION=GOVT\_ARIMA, PRINT) GOVT\_ARIMA\_FORE

Entry	GOVT_JOBS	@UFOREERRORS GOVT_JOBS GOVT_ARIMA FORE 2023:02 2024:01
2023:02	1075.856216	Forecast Analysis for GOVT_JOBS
2023:03	1084.500483	From 2023:02 to 2024:01
2023:04	1093.194008	Mean Error -113.05277
2023:05	1101.936793	Mean Absolute Error 113.05277
2023:06	1110.728838	Root Mean Square Error 143.61068
2023:07	1119.570142	Mean Square Error 20624.027564
2023:08	1128.460705	Theil's U 1.839689
2023:09	1137.400528	
2023:10	1146.389610	Mean Pct Error -0.118280
2023:11	1155.427952	Mean Abs Pct Error 0.118280
2023:12	1164.515553	Root Mean Square Pct Error 0.156545
2024:01	1173.652413	Theil's Relative U 1.891496

Government Job Openings Actual versus Forecast (ARIMA)



Does Consumer Confidence have predictive causality for the Federal Funds Rate or vice versa, or is there feedback?

-Using @varlagselect to select # of lags for VAR

```
@varlagselect(lags=9,crit=sbc)
# CONS_CONF_DIF FED_FUND_DIF
```

VAR Lag Selection

Lags SBC/BIC

0	-0.0493643
1	-0.7467691
2	-1.3679479
3	-1.4116599*
4	-1.3594295
5	-1.3218135
6	-1.2518673
7	-1.1713055
8	-1.1075547
9	-1.0396715

```
SYSTEM(MODEL=CONSCONF_FEDFUND)
VARIABLES CONS_CONF_DIF FED_FUND_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 0.118166425  
Sum of Squared Residuals 3.7282021444  
Durbin-Watson Statistic 1.9139

Variable	Coeff	Std Error	T-Stat	Signif
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	0.00000000
FED_FUND_DIF		0.8244	0.4813797

Neither variable has predictive causality for the other.

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	0.00000000

Do Housing Prices have predictive causality for the Federal Funds Rate or vice versa, or is there feedback?

YES! There's Granger causality for the federal funds rate causing housing prices.

```
@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

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	0.00000000
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

At the 5% level, we can no longer claim housing prices have predictive causality for the federal funds rate.

FORECAST (MODEL=HOUSINGDIF\_FEDFUND\_TRUNC, FROM=2023:02, TO=2024:01, RESULT=VARFORE1, STDERRS=VARFORE1STD, PRINT)

Entry	HOUSING_DIF	FED_FUND_DIF
2023:02	0.600943589	0.25541688
2023:03	0.511784703	0.16346455
2023:04	0.495183875	0.08293196
2023:05	0.488647938	0.04541362
2023:06	0.508666717	0.01922231
2023:07	0.532256859	0.00553969
2023:08	0.561065922	-0.00275303
2023:09	0.589838509	-0.00704555
2023:10	0.618044431	-0.00924915
2023:11	0.644538898	-0.01013131
2023:12	0.669095411	-0.01029218
2024:01	0.691552480	-0.01004227

\* THAT'S THE DIFFERENCED DATA, HAVE TO TURN IT BACK INTO LEVELS TO GET AN ACCURATE MSE

```
SET VARFORE1(1) 2023:02 2024:01 = VARFORE1(1)+HOUSING_PRICES{12}
PRINT 2023:02 2024:01 VARFORE1(1)
```

ENTRY	VARFORE1(1)
2023:02	378.500943589
2023:03	383.051784703
2023:04	388.095183875
2023:05	391.878647938
2023:06	392.548666717
2023:07	390.622256859
2023:08	389.251065922
2023:09	390.689838509
2023:10	391.478044431
2023:11	391.814538898
2023:12	392.379095411
2024:01	393.261552480

@UFOREERRORS VARFORE1(1) HOUSING\_PRICES

```
Forecast Analysis for VARFORE1(1)
From 2023:02 to 2024:01
Mean Error           -19.157365
Mean Absolute Error  19.157365
Root Mean Square Error 19.927269
Mean Square Error    397.096037
Theil's U             7.876788

Mean Pct Error        -0.049142
Mean Abs Pct Error   0.049142
Root Mean Square Pct Error 0.051061
Theil's Relative U    7.848864
```

Comparing this MSE for the VAR forecast for housing prices with the ARIMA(2,1,1) forecast in page 7, our MSE is lower in the ARIMA forecast over the VAR forecast, so that method resulted in a better forecast for housing prices. I believe this is likely because the initial forecast doesn't introduce the complexity of the relationship that the federal funds rate may have, but rather it simply relies on past error terms and the values of its previous terms lagged.

```
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

Does Consumer Confidence have predictive causality for Housing Prices or vice versa, or is there feedback?

YES! Consumer Confidence has Granger predictive causality for Housing Prices.

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

Variable	Coeff	Std Error	T-Stat	Signif
1. CONS_CONF_DIF{1}	1.436254911	0.058923107	24.37507	0.000000000
2. CONS_CONF_DIF{2}	-1.053387733	0.086144946	-12.22809	0.000000000
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		

At the 5% level, we can no longer claim housing prices have predictive causality for consumer confidence.

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	0.000000000
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		

FORECAST(MODEL=CONSCONF\_HOUSINGDIF\_TRUNC, FROM=2023:02, TO=2024:01, RESULT=VARFORE2, STDERRS=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

The MSE from our 2<sup>nd</sup> VAR model forecasting housing prices using the Granger causality from the consumer confidence index is better than the forecast in which the Federal funds had Granger Causality, but nowhere near as good our original ARIMA model for housing prices. This is likely because there's way too many factors that influence consumer confidence that don't always overlap with housing prices; thus, it's just better to use an integrated autoregressive moving average model.

```
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 -0.0000872727
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}	0.0000302845	0.000285602	1.06038	0.28992133
4. GOVT_JOBS_DIF{2}	-0.0000028886	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	0.00000000		

Does the Federal Fund Rate have predictive causality for the number of Government Job Openings or vice versa, or is there feedback?

No, neither variable has predictive causality for the other at the 5% level.

```
@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=CONSCONF_GOVTIJOBS)
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

#### One last VAR F-Test....

Does Consumer Confidence have some type of predictive causality for the number of Government Job Openings or vice versa, or is there feedback?

No, neither variable has predictive causality for the other at the 5% level.

```
@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

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	0.00000000
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	0.00000000

```

1 OPEN DATA "C:\Users\chris\Downloads\final_project.xlsx"
2 CALENDAR(M) 2000:12
3 DATA(FORMAT=XLSX,ORG=COLUMNS,LEFT=2) 2000:12 2024:01
  CONS_CONF<<"consumer_confidence" FED_FUND<<"federal_funds_rate" $
4 GOVT_JOBS<<"govt_job_openings" HOUSING_PRICES<<"housing_price_index"
5 *Preliminary Graph
6 GRAPH(STYLE=LINE,HEADER="Consumer
  Confidence",VLABEL="Index",HLABEL="Year",KEY=BELOW) 1
7 # CONS_CONF
8 GRAPH(STYLE=LINE,HEADER="Federal Funds Rate",VLABEL="Interest
  Rate",HLABEL="Year",KEY=BELOW) 1
9 # FED_FUND
10 GRAPH(STYLE=LINE,HEADER="Government Job Openings",VLABEL="Number of Job
  Openings",HLABEL="Year",KEY=BELOW) $
11 1
12 # GOVT_JOBS
13 GRAPH(STYLE=LINE,HEADER="Housing Prices",VLABEL="Index",HLABEL="Year",KEY=BELOW) 1
14 # HOUSING_PRICES
15
16 @bjident CONS_CONF
17 @bjident HOUSING_PRICES
18 @bjident FED_FUND
19 @bjident GOVT_JOBS
20
21 cmom(corr,print)
22 #CONS_CONF HOUSING_PRICES FED_FUND GOVT_JOBS
23
24 Correlation Matrix
25           CONS_CONF   HOUSING_PRICES   FED_FUND   GOVT_JOBS
26 CONS_CONF      1.000000000   -0.309086671   0.111522668  -0.220913557
27 HOUSING_PRICES -0.309086671      1.000000000   0.177606998   0.931548691
28 FED_FUND        0.111522668      0.177606998   1.000000000   0.169682267
29 GOVT_JOBS       -0.220913557      0.931548691   0.169682267   1.000000000
30
31 *Let's declare variables for COVID, HOUSING CRASH AND TIME
32 *COVID SEEMED TO HAVE ABOUT A 2 YEAR EFFECT
33 SET COVID * 2024:01 = T>=2020:04.AND.T<=2022:01
34 SET HCRASH * 2024:01 = T>2008:01.AND.T<=2009:12
35 SET TIME * 2024:01 = T
36
37 *We'll start forecasting CONS_CONF (already stationary)
38
39 *First let's try ARMA(3,1) with COVID and HCRASH
40 BOXJENK(REGRESSORS,CONST,AR=3,MA=1) CONS_CONF
41 # COVID HCRASH
42
43 Box-Jenkins - Estimation by LS Gauss-Newton
44 Convergence in      8 Iterations. Final criterion was  0.0000065 <=  0.0000100
45
46 Dependent Variable CONS_CONF
47 Monthly Data From 2001:03 To 2023:01
48 Usable Observations          263
49 Degrees of Freedom           256
50 Centered R^2                 0.9935155
51 R-Bar^2                      0.9933635
52 Uncentered R^2                0.9999987
53 Mean of Dependent Variable    99.647979658
54 Std Error of Dependent Variable 1.409185676
55 Standard Error of Estimate     0.114798546
56 Sum of Squared Residuals       3.3737487897
57 Log Likelihood                  199.6502

```

```

58 Durbin-Watson Statistic          1.9842
59 Q(36-4)                         26.8986
60 Significance Level of Q        0.7225698
61
62      Variable                  Coeff   Std Error   T-Stat   Signif
63 ****
64 1.  CONSTANT                   99.17804637  0.85977680  115.35325  0.00000000
65 2.  AR{1}                      1.97194423  0.07275676  27.10324  0.00000000
66 3.  AR{2}                      -1.46521550 0.13225004 -11.07913  0.00000000
67 4.  AR{3}                      0.48030510  0.06848451  7.01334  0.00000000
68 5.  MA{1}                      0.46978363  0.07448446  6.30714  0.00000000
69 6.  COVID                       -0.04798531 0.03702271 -1.29610  0.19610663
70 7.  HCRASH                      -0.04721108 0.03698447 -1.27651  0.20293174
71
72 @regcrits
73
74 Information Criteria
75 AIC           -1.457
76 SBC           -1.349
77 Hannan-Quinn -1.414
78 (log) FPE     -1.457
79
80
81 *hmmm COVID and HOUSING CRASH not significantly different from 0, ARMA(3,1) has
both lower AIC and SBC...
82 @DFUNIT(LAGS=4) CONS_CONF
83
84 Dickey-Fuller Unit Root Test, Series CONS_CONF
85 Regression Run From 2001:05 to 2024:01
86 Observations    274
87 With intercept
88 Using fixed lags 4
89 Null is unit root. Reject in left tail.
90
91 Sig Level      Crit Value
92 1%(**)         -3.45578
93 5%(*)          -2.87220
94 10%            -2.57241
95
96 T-Statistic    -2.00878
97
98 *FOUND EVIDENCE OF A UNIT ROOT
99 BOXJENK(REGRESSORS,CONST,AR=3) CONS_CONF
100 # COVID HCRASH
101
102 Box-Jenkins - Estimation by LS Gauss-Newton
103 Convergence in      5 Iterations. Final criterion was  0.0000031 <= 0.0000100
104
105 Dependent Variable CONS CONF
106 Monthly Data From 2001:03 To 2023:01
107 Usable Observations          263
108 Degrees of Freedom           257
109 Centered R^2                 0.9927537
110 R-Bar^2                      0.9926127
111 Uncentered R^2                0.9999986
112 Mean of Dependent Variable   99.647979658
113 Std Error of Dependent Variable 1.409185676
114 Standard Error of Estimate   0.121118523
115 Sum of Squared Residuals     3.7701120017
116 Regression F(5,257)          7041.8717
117 Significance Level of F      0.00000000

```

```

118 Log Likelihood          185.0432
119 Durbin-Watson Statistic    1.6133
120 Q(36-3)                  44.6456
121 Significance Level of Q   0.0849021
122
123      Variable           Coeff     Std Error     T-Stat     Signif
124 ****
125 1.  CONSTANT            98.84730719  1.20751212  81.86030  0.00000000
126 2.  AR{1}                2.20867578  0.04715583  46.83781  0.00000000
127 3.  AR{2}                -1.87004306  0.08687195 -21.52643  0.00000000
128 4.  AR{3}                0.65404587  0.04704773  13.90175  0.00000000
129 5.  COVID               -0.05610449  0.05037965 -1.11363  0.26647669
130 6.  HCRASH              -0.05737295  0.05033916 -1.13973  0.25546074
131
132 @REGCRITS
133
134 Information Criteria
135 AIC          -1.354
136 SBC          -1.259
137 Hannan-Quinn -1.316
138 (log) FPE   -1.354
139
140 BOXJENK(CONST,AR=3) CONS CONF * 2023:01
141
142 Box-Jenkins - Estimation by LS Gauss-Newton
143 Convergence in      4 Iterations. Final criterion was 0.0000000 <= 0.0000100
144
145 Dependent Variable CONS_CONF
146 Monthly Data From 2001:03 To 2023:01
147 Usable Observations        263
148 Degrees of Freedom         259
149 Centered R^2              0.9926820
150 R-Bar^2                   0.9925973
151 Uncentered R^2             0.9999985
152 Mean of Dependent Variable 99.647979658
153 Std Error of Dependent Variable 1.409185676
154 Standard Error of Estimate 0.121244989
155 Sum of Squared Residuals   3.8073899880
156 Regression F(3,259)        11711.1365
157 Significance Level of F    0.0000000
158 Log Likelihood             183.7493
159 Durbin-Watson Statistic    1.6163
160 Q(36-3)                   44.2811
161 Significance Level of Q    0.0907702
162
163      Variable           Coeff     Std Error     T-Stat     Signif
164 ****
165 1.  CONSTANT            98.84363271  1.19836154  82.48231  0.00000000
166 2.  AR{1}                2.20864317  0.04698447  47.00794  0.00000000
167 3.  AR{2}                -1.86912105  0.08656066 -21.59319  0.00000000
168 4.  AR{3}                0.65312289  0.04687839  13.93228  0.00000000
169
170 @REGCRITS
171
172 Information Criteria
173 AIC          -1.359
174 SBC          -1.291
175 Hannan-Quinn -1.332
176 (log) FPE   -1.359
177
178 BOXJENK(CONST,AR=3,MA=1) CONS_CONF * 2023:01

```

```

179
180 Box-Jenkins - Estimation by LS Gauss-Newton
181 Convergence in      9 Iterations. Final criterion was  0.0000061 <=  0.0000100
182
183 Dependent Variable CONS_CONF
184 Monthly Data From 2001:03 To 2023:01
185 Usable Observations          263
186 Degrees of Freedom          258
187 Centered R^2                0.9934319
188 R-Bar^2                     0.9933301
189 Uncentered R^2              0.9999987
190 Mean of Dependent Variable  99.647979658
191 Std Error of Dependent Variable 1.409185676
192 Standard Error of Estimate   0.115087341
193 Sum of Squared Residuals    3.4172347768
194 Log Likelihood             197.9661
195 Durbin-Watson Statistic     1.9833
196 Q(36-4)                     27.1968
197 Significance Level of Q    0.7084407
198
199      Variable           Coeff      Std Error      T-Stat      Signif
200 ****
201 1. CONSTANT            99.16965175  0.85957702  115.37029  0.000000000
202 2. AR{1}                 1.97411024  0.07278773  27.12147  0.000000000
203 3. AR{2}                 -1.46815916 0.13228915 -11.09811  0.000000000
204 4. AR{3}                 0.48112237  0.06840549   7.03339  0.000000000
205 5. MA{1}                 0.46227749  0.07478586   6.18135  0.000000000
206
207 @REGCRITS
208
209 Information Criteria
210 AIC                  -1.460
211 SBC                  -1.378
212 Hannan-Quinn -1.427
213 (log) FPE      -1.460
214
215 *FOUND EVIDENCE OF UNIT ROOT IN DF TEST; LET'S TRY DIFFERENCED DATA
216 BOXJENK(DIFFS=1,CONST,AR=3,MA=1) CONS_CONF * 2023:01
217
218 Box-Jenkins - Estimation by LS Gauss-Newton
219 Convergence in      20 Iterations. Final criterion was  0.0000082 <=  0.0000100
220
221 Dependent Variable CONS_CONF, differenced 1 times
222 Monthly Data From 2001:04 To 2023:01
223 Usable Observations          262
224 Degrees of Freedom          257
225 Centered R^2                0.9933459
226 R-Bar^2                     0.9932423
227 Uncentered R^2              0.9999987
228 Mean of Dependent Variable  99.644511260
229 Std Error of Dependent Variable 1.410757512
230 Standard Error of Estimate   0.115971571
231 Sum of Squared Residuals    3.4564971343
232 Log Likelihood             195.2177
233 Durbin-Watson Statistic     1.9999
234 Q(36-4)                     26.6163
235 Significance Level of Q    0.7357266
236
237      Variable           Coeff      Std Error      T-Stat      Signif
238 ****
239 1. CONSTANT            -0.013160008 0.020915998 -0.62918  0.52978759

```

```

240 2. AR{1} 1.039521505 0.175151044 5.93500 0.00000001
241 3. AR{2} -0.561631336 0.224298250 -2.50395 0.01290208
242 4. AR{3} 0.037354797 0.135421537 0.27584 0.78289195
243 5. MA{1} 0.416697309 0.165745686 2.51408 0.01254622
244
245 @REGCRITS
246
247 Information Criteria
248 AIC -1.444
249 SBC -1.363
250 Hannan-Quinn -1.412
251 (log) FPE -1.444
252
253 BOXJENK(DIFFS=1,CONST,AR=2,MA=1) CONS_CONF * 2023:01
254
255 Box-Jenkins - Estimation by LS Gauss-Newton
256 Convergence in 9 Iterations. Final criterion was 0.0000054 <= 0.0000100
257
258 Dependent Variable CONS_CONF, differenced 1 times
259 Monthly Data From 2001:03 To 2023:01
260 Usable Observations 263
261 Degrees of Freedom 259
262 Centered R^2 0.9933582
263 R-Bar^2 0.9932813
264 Uncentered R^2 0.9999987
265 Mean of Dependent Variable 99.647979658
266 Std Error of Dependent Variable 1.409185676
267 Standard Error of Estimate 0.115507993
268 Sum of Squared Residuals 3.4556029656
269 Log Likelihood 196.4978
270 Durbin-Watson Statistic 1.9905
271 Q(36-3) 27.1706
272 Significance Level of Q 0.7521692
273
274 Variable Coeff Std Error T-Stat Signif
275 ****
276 1. CONSTANT -0.013074714 0.020383491 -0.64144 0.52180640
277 2. AR{1} 0.997297729 0.070539020 14.13824 0.000000000
278 3. AR{2} -0.504871151 0.066061521 -7.64244 0.000000000
279 4. MA{1} 0.454548714 0.074001376 6.14244 0.000000000
280
281 @REGCRITS
282
283 Information Criteria
284 AIC -1.456
285 SBC -1.388
286 Hannan-Quinn -1.429
287 (log) FPE -1.456
288
289 *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)
290 BOXJENK(CONST,AR=3,MA=1,DEFINE=CONS_CONF_ARMA) CONS_CONF * 2023:01
291
292 Box-Jenkins - Estimation by LS Gauss-Newton
293 Convergence in 9 Iterations. Final criterion was 0.0000061 <= 0.0000100
294
295 Dependent Variable CONS_CONF
296 Monthly Data From 2001:03 To 2023:01
297 Usable Observations 263
298 Degrees of Freedom 258

```

```

299 Centered R^2          0.9934319
300 R-Bar^2              0.9933301
301 Uncentered R^2        0.9999987
302 Mean of Dependent Variable 99.647979658
303 Std Error of Dependent Variable 1.409185676
304 Standard Error of Estimate 0.115087341
305 Sum of Squared Residuals 3.4172347768
306 Log Likelihood      197.9661
307 Durbin-Watson Statistic 1.9833
308 Q(36-4)               27.1968
309 Significance Level of Q 0.7084407
310
311      Variable           Coeff     Std Error    T-Stat   Signif
312 ****
313 1.  CONSTANT          99.16965175  0.85957702 115.37029 0.00000000
314 2.  AR{1}              1.97411024  0.07278773 27.12147 0.00000000
315 3.  AR{2}              -1.46815916 0.13228915 -11.09811 0.00000000
316 4.  AR{3}              0.48112237  0.06840549 7.03339 0.00000000
317 5.  MA{1}              0.46227749  0.07478586 6.18135 0.00000000
318
319 UFORECAST (FROM=2023:02,TO=2024:01,EQUATION=CONS_CONF_ARMA,STDERRS=CONS_CONF_STDE_A,P
      RINT) CONS CONF ARMA F
320
321 Entry    CONS CONF
322 2023:02 97.54865886
323 2023:03 97.62794816
324 2023:04 97.63145420
325 2023:05 97.61665051
326 2023:06 97.62042685
327 2023:07 97.65130275
328 2023:08 97.69958853
329 2023:09 97.75139613
330 2023:10 97.79763392
331 2023:11 97.83608199
332 2023:12 97.86902406
333 2024:01 97.89985350
334
335 @uforeerrors CONS_CONF CONS_CONF_ARMA_F 2023:02 2024:01
336
337 Forecast Analysis for CONS_CONF
338 From 2023:02 to 2024:01
339 Mean Error            0.00351004
340 Mean Absolute Error   0.28575015
341 Root Mean Square Error 0.37586217
342 Mean Square Error     0.141272
343 Theil's U              1.154557
344
345 Mean Pct Error        0.000019
346 Mean Abs Pct Error   0.002917
347 Root Mean Square Pct Error 0.003821
348 Theil's Relative U    1.154164
349
350 *hmmm I wonder if using our ARIMA(2,1,1) model would yield a lower MSE...
351 BOXJENK(DIFFS=1,CONST,AR=2,MA=1,DEFINE=CONSCONF_ARIMA_F) CONS_CONF * 2023:01
352
353 Box-Jenkins - Estimation by LS Gauss-Newton
354 Convergence in      9 Iterations. Final criterion was 0.0000054 <= 0.0000100
355
356 Dependent Variable CONS_CONF, differenced 1 times
357 Monthly Data From 2001:03 To 2023:01
358 Usable Observations

```

263

```

359 Degrees of Freedom 259
360 Centered R^2 0.9933582
361 R-Bar^2 0.9932813
362 Uncentered R^2 0.9999987
363 Mean of Dependent Variable 99.647979658
364 Std Error of Dependent Variable 1.409185676
365 Standard Error of Estimate 0.115507993
366 Sum of Squared Residuals 3.4556029656
367 Log Likelihood 196.4978
368 Durbin-Watson Statistic 1.9905
369 Q(36-3) 27.1706
370 Significance Level of Q 0.7521692
371
372 Variable Coeff Std Error T-Stat Signif
373 ****
374 1. CONSTANT -0.013074714 0.020383491 -0.64144 0.52180640
375 2. AR{1} 0.997297729 0.070539020 14.13824 0.00000000
376 3. AR{2} -0.504871151 0.066061521 -7.64244 0.00000000
377 4. MA{1} 0.454548714 0.074001376 6.14244 0.00000000
378
379 UFORECAST(FROM=2023:02,TO=2024:01,EQUATION=CONSCONF_ARIMA_F,PRINT) CONS_ARIMA_FORE
380
381 Entry CONS CONF
382 2023:02 97.52665549
383 2023:03 97.55172121
384 2023:04 97.48183362
385 2023:05 97.39284354
386 2023:06 97.33274180
387 2023:07 97.31109460
388 2023:08 97.31321317
389 2023:09 97.31961868
390 2023:10 97.31830089
391 2023:11 97.30711634
392 2023:12 97.28999094
393 2024:01 97.27192220
394
395 @uforeerrors CONS_CONF CONS_ARIMA_FORE 2023:02 2024:01
396
397 Forecast Analysis for CONS_CONF
398 From 2023:02 to 2024:01
399 Mean Error 0.34792396
400 Mean Absolute Error 0.44696460
401 Root Mean Square Error 0.61469111
402 Mean Square Error 0.377845
403 Theil's U 1.888181
404
405 Mean Pct Error 0.003538
406 Mean Abs Pct Error 0.004555
407 Root Mean Square Pct Error 0.006241
408 Theil's Relative U 1.886450
409
410
411 *It doesn't, let's keep our ARMA(3,1) model
412
413 GRAPH(STYLE=LINE,HEADER="Consumer Confidence Actual versus
Forecast",VLABEL="Index",HLABEL="Month",KEY=BELOW, MAX=100,MIN=95) $
414 3
415 # CONS_CONF_TRUNC
416 # CONS_CONF_ARMA_F
417 # CONS_ARIMA_FORE
418

```

```

419
420
421 *We can now move on to our 2nd variable, housing prices
422
423
424 @bjautofit(pmax=5,qmax=5,crit=SBC) HOUSING_PRICES
425
426 BIC analysis of models for series HOUSING_PRICES
427   MA
428 AR      0          1          2          3          4          5
429 0 3838.2139 3465.7545 3215.8914 2958.8296 2584.4722 2378.1869
430 1 1138.6854 931.3911 847.8495 794.1699 776.2157 767.4900
431 2 690.6713 2405.8604 686.7825* 2273.0316 696.2989 701.8675
432 3 687.2675 699.5293 2552.1781 1537.9589 698.6159 703.9354
433 4 689.3634 690.9006 694.0901 2496.4134 703.9134 1475.4069
434 5 693.7328 697.3447 703.9213 706.2561 708.5432 717.2180
435
436 *ARMA(2,2) seems to be the choice without a trend... let's try now with a trend
437
438 BOXJENK(REGRESSORS,CONST,AR=2,MA=2) HOUSING_PRICES * 2023:01
439 # TIME HCRASH
440
441 Box-Jenkins - Estimation by LS Gauss-Newton
442 NO CONVERGENCE IN 100 ITERATIONS
443 LAST CRITERION WAS 0.1355711
444 TRY INCREASING ITERS OPTION
445
446 Dependent Variable HOUSING_PRICES
447 Monthly Data From 2001:02 To 2023:01
448 Usable Observations                      264
449 Degrees of Freedom                        257
450 Centered R^2                            0.9998212
451 R-Bar^2                                0.9998170
452 Uncentered R^2                           0.9999890
453 Mean of Dependent Variable             223.76700758
454 Std Error of Dependent Variable       57.36807657
455 Standard Error of Estimate            0.77610248
456 Sum of Squared Residuals              154.80010965
457 Log Likelihood                         -304.1363
458 Durbin-Watson Statistic                2.0273
459 Q(36-4)                                 40.2874
460 Significance Level of Q               0.1492237
461
462   Variable           Coeff     Std Error    T-Stat    Signif
463 ****
464 1. CONSTANT        -6201.53161 48882.69046  -0.12687 0.89914598
465 2. AR{1}             1.92262   0.03367   57.10419 0.00000000
466 3. AR{2}             -0.92254  0.03381  -27.28757 0.00000000
467 4. MA{1}             -0.23148  0.07404  -3.12630 0.00197361
468 5. MA{2}             -0.11283  0.06971  -1.61866 0.10674785
469 6. TIME              -6.53812  27.81272  -0.23508 0.81433653
470 7. HCRASH            -0.35215  0.45199  -0.77910 0.43664050
471 *NO CONVERGENCE- LET'S TRY DIFFERENCING
472 BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=2,MA=1) HOUSING_PRICES * 2023:01
473 # HCRASH TIME
474
475 Box-Jenkins - Estimation by LS Gauss-Newton
476 Convergence in 11 Iterations. Final criterion was 0.00000018 <= 0.0000100
477
478 Dependent Variable HOUSING_PRICES, differenced 1 times
479 Monthly Data From 2001:03 To 2023:01

```

```

480 Usable Observations 263
481 Degrees of Freedom 257
482 Centered R^2 0.9998213
483 R-Bar^2 0.9998178
484 Uncentered R^2 0.9999891
485 Mean of Dependent Variable 224.05897338
486 Std Error of Dependent Variable 57.28060165
487 Standard Error of Estimate 0.77309573
488 Sum of Squared Residuals 153.60299099
489 Log Likelihood -302.4624
490 Durbin-Watson Statistic 1.9830
491 Q(36-3) 40.1499
492 Significance Level of Q 0.1829119
493
494 Variable Coeff Std Error T-Stat Signif
495 ****
496 1. CONSTANT -0.166306954 0.980870096 -0.16955 0.86549708
497 2. AR{1} 1.331030814 0.194255956 6.85194 0.00000000
498 3. AR{2} -0.367841730 0.172000055 -2.13861 0.03340990
499 4. MA{1} -0.668286478 0.168459245 -3.96705 0.00009443
500 5. HCRASH -0.590749867 0.515477265 -1.14603 0.25285074
501 6. TIME 0.007580946 0.005783800 1.31072 0.19112222
502
503 @regcrits
504
505 Information Criteria
506 AIC 2.353
507 SBC 2.448
508 Hannan-Quinn 2.392
509 (log) FPE 2.353
510
511 BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=2) HOUSING_PRICES
512 # TIME HCRASH
513
514 Box-Jenkins - Estimation by LS Gauss-Newton
515 Convergence in 7 Iterations. Final criterion was 0.0000021 <= 0.0000100
516
517 Dependent Variable HOUSING_PRICES, differenced 1 times
518 Monthly Data From 2001:03 To 2023:01
519 Usable Observations 263
520 Degrees of Freedom 258
521 Centered R^2 0.9998173
522 R-Bar^2 0.9998144
523 Uncentered R^2 0.9999888
524 Mean of Dependent Variable 224.05897338
525 Std Error of Dependent Variable 57.28060165
526 Standard Error of Estimate 0.78027930
527 Sum of Squared Residuals 157.07963129
528 Regression F(4,258) 352920.5196
529 Significance Level of F 0.00000000
530 Log Likelihood -305.4056
531 Durbin-Watson Statistic 2.0299
532 Q(36-2) 42.7816
533 Significance Level of Q 0.1435902
534
535 Variable Coeff Std Error T-Stat Signif
536 ****
537 1. CONSTANT -0.055009776 0.645616304 -0.08521 0.93216445
538 2. AR{1} 0.703129714 0.061698510 11.39622 0.00000000
539 3. AR{2} 0.137733019 0.062371806 2.20826 0.02810603
540 4. TIME 0.007466399 0.003996808 1.86809 0.06288295

```

```

541 5. HCRASH           -0.795067300  0.526886314    -1.50899  0.13252442
542
543 @regcrits
544
545 Information Criteria
546 AIC          2.368
547 SBC          2.450
548 Hannan-Quinn 2.401
549 (log) FPE   2.368
550
551 BOXJENK(REGRESSORS,CONST,AR=2,MA=1) HOUSING_PRICES * 2023:01
552 # HCRASH TIME
553
554 Box-Jenkins - Estimation by LS Gauss-Newton
555 Convergence in 15 Iterations. Final criterion was 0.0000004 <= 0.0000100
556
557 Dependent Variable HOUSING_PRICES
558 Monthly Data From 2001:02 To 2023:01
559 Usable Observations            264
560 Degrees of Freedom             258
561 Centered R^2                  0.9998191
562 R-Bar^2                       0.9998156
563 Uncentered R^2                0.9999889
564 Mean of Dependent Variable    223.76700758
565 Std Error of Dependent Variable 57.36807657
566 Standard Error of Estimate   0.77905800
567 Sum of Squared Residuals     156.58829404
568 Log Likelihood              -305.6523
569 Durbin-Watson Statistic      1.9350
570 Q(36-3)                      45.3453
571 Significance Level of Q     0.0745179
572
573 Variable                   Coeff      Std Error      T-Stat      Signif
574 ****
575 1. CONSTANT                 -19.7956853  453.4960423  -0.04365  0.96521613
576 2. AR{1}                     1.9164468   0.0333563   57.45386  0.00000000
577 3. AR{2}                     -0.9172272   0.0338360  -27.10803  0.00000000
578 4. MA{1}                     -0.2725871   0.0729542  -3.73642  0.00022983
579 5. HCRASH                    -0.1953149   0.4594618  -0.42509  0.67112177
580 6. TIME                      1.4230875   1.5342172   0.92757  0.35449972
581
582 @regcrits
583
584 Information Criteria
585 AIC          2.369
586 SBC          2.463
587 Hannan-Quinn 2.407
588 (log) FPE   2.369
589
590 LINREG HOUSING_PRICES
591 # Constant TIME HCRASH COVID
592
593 Linear Regression - Estimation by Least Squares
594 Dependent Variable HOUSING_PRICES
595 Monthly Data From 2000:12 To 2023:01
596 Usable Observations            266
597 Degrees of Freedom             262
598 Centered R^2                  0.6927409
599 R-Bar^2                       0.6892227
600 Uncentered R^2                0.9809096
601 Mean of Dependent Variable   223.17853383

```

```

602 Std Error of Dependent Variable      57.55122604
603 Standard Error of Estimate         32.08331442
604 Sum of Squared Residuals          269686.83489
605 Regression F(3,262)                 196.9002
606 Significance Level of F            0.00000000
607 Log Likelihood                   -1297.9999
608 Durbin-Watson Statistic           0.0189
609
610      Variable                      Coeff     Std Error    T-Stat   Signif
611 ****
612 1. Constant                      148.4723775  4.2025393  35.32921  0.00000000
613 2. TIME                           0.5348088  0.0285642  18.72307  0.00000000
614 3. HCRASH                         -4.1945061  7.0754790  -0.59282  0.55381100
615 4. COVID                          44.3962334  7.9160378   5.60839  0.00000005
616
617 *LET'S REMOVE THE HOUSING CRASH VARIABLE
618
619 LINREG HOUSING_PRICES
620 # Constant TIME COVID
621
622 Linear Regression - Estimation by Least Squares
623 Dependent Variable HOUSING PRICES
624 Monthly Data From 2000:12 To 2023:01
625 Usable Observations                266
626 Degrees of Freedom                  263
627 Centered R^2                       0.6923288
628 R-Bar^2                            0.6899891
629 Uncentered R^2                     0.9808840
630 Mean of Dependent Variable        223.17853383
631 Std Error of Dependent Variable   57.55122604
632 Standard Error of Estimate       32.04373110
633 Sum of Squared Residuals          270048.58480
634 Regression F(2,263)                 295.9043
635 Significance Level of F            0.00000000
636 Log Likelihood                   -1298.1781
637 Durbin-Watson Statistic           0.0188
638
639      Variable                      Coeff     Std Error    T-Stat   Signif
640 ****
641 1. Constant                      147.83837823  4.05917026  36.42084  0.00000000
642 2. TIME                           0.53673959  0.02834285  18.93739  0.00000000
643 3. COVID                          44.56007613  7.90145104   5.63948  0.00000004
644
645 @regcrits
646
647 Information Criteria
648 AIC      9.791
649 SBC      9.845
650 Hannan-Quinn 9.812
651 (log) FPE   9.791
652
653 BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=2,MA=1) HOUSING_PRICES * 2023:01
654 # TIME COVID
655
656 Box-Jenkins - Estimation by LS Gauss-Newton
657 Convergence in 19 Iterations. Final criterion was 0.0000054 <= 0.0000100
658
659 Dependent Variable HOUSING_PRICES, differenced 1 times
660 Monthly Data From 2001:03 To 2023:01
661 Usable Observations                263
662 Degrees of Freedom                  257

```

```

663 Centered R^2          0.9998216
664 R-Bar^2               0.9998181
665 Uncentered R^2        0.9999891
666 Mean of Dependent Variable 224.05897338
667 Std Error of Dependent Variable 57.28060165
668 Standard Error of Estimate 0.77252298
669 Sum of Squared Residuals 153.37547896
670 Log Likelihood       -302.2675
671 Durbin-Watson Statistic 1.9759
672 Q(36-3)                39.8739
673 Significance Level of Q 0.1909347
674
675      Variable           Coeff     Std Error    T-Stat   Signif
676 ****
677 1. CONSTANT          -0.253814593 1.031064881 -0.24617 0.80574912
678 2. AR{1}              1.392696998 0.160356802  8.68499 0.00000000
679 3. AR{2}              -0.420442265 0.143307077 -2.93386 0.00365024
680 4. MA{1}              -0.744692933 0.132200271 -5.63307 0.00000005
681 5. TIME               0.007235520 0.006002637  1.20539 0.22916137
682 6. COVID              0.771935212 0.496125354  1.55593 0.12095583
683
684 @regcrits
685
686 Information Criteria
687 AIC          2.352
688 SBC          2.447
689 Hannan-Quinn 2.390
690 (log) FPE   2.352
691
692 BOXJENK(CONST,AR=2,MA=2) HOUSING_PRICES * 2023:01
693
694 Box-Jenkins - Estimation by LS Gauss-Newton
695 NO CONVERGENCE IN 35 ITERATIONS. FINAL NORMED GRADIENT 176.43236
696 SUBITERATIONS LIMIT EXCEEDED.
697 ESTIMATION POSSIBLY HAS STALLED OR MACHINE ROUND OFF IS MAKING FURTHER PROGRESS
   DIFFICULT
698 TRY DIFFERENT SETTING FOR EXACTLINE, DERIVES OR ALPHA ON NLPAR
699 RESTARTING ESTIMATION FROM LAST ESTIMATES OR DIFFERENT INITIAL GUESSES/PMETHOD
   OPTION MIGHT ALSO WORK
700
701 Dependent Variable HOUSING_PRICES
702 Monthly Data From 2001:02 To 2023:01
703 Usable Observations      264
704 Degrees of Freedom       259
705 Centered R^2            0.9998205
706 R-Bar^2                 0.9998177
707 Uncentered R^2          0.9999890
708 Mean of Dependent Variable 223.76700758
709 Std Error of Dependent Variable 57.36807657
710 Standard Error of Estimate 0.77460544
711 Sum of Squared Residuals 155.40351964
712 Log Likelihood         -304.6498
713 Durbin-Watson Statistic 1.9929
714 Q(36-4)                  42.3904
715 Significance Level of Q 0.1035761
716
717      Variable           Coeff     Std Error    T-Stat   Signif
718 ****
719 1. CONSTANT          -1936.37417 51588.07700 -0.03754 0.97008711
720 2. AR{1}              1.95133   0.02790   69.94983 0.00000000
721 3. AR{2}              -0.95130   0.02818   -33.76348 0.00000000

```

```

722 4. MA{1} -0.28191 0.06874 -4.10106 0.00005510
723 5. MA{2} -0.14406 0.06776 -2.12608 0.03444307
724
725 *NO CONVERGENCE IN BJAUTOFIT RECCOMENDATION
726
727 BOXJENK(CONST,AR=2,MA=1) HOUSING_PRICES
728
729 Box-Jenkins - Estimation by LS Gauss-Newton
730 Convergence in 16 Iterations. Final criterion was 0.0000000 <= 0.0000100
731
732 Dependent Variable HOUSING_PRICES
733 Monthly Data From 2001:02 To 2024:01
734 Usable Observations 276
735 Degrees of Freedom 272
736 Centered R^2 0.9998664
737 R-Bar^2 0.9998650
738 Uncentered R^2 0.9999896
739 Mean of Dependent Variable 231.80416667
740 Std Error of Dependent Variable 67.65018985
741 Standard Error of Estimate 0.78614416
742 Sum of Squared Residuals 168.10215967
743 Log Likelihood -323.2026
744 Durbin-Watson Statistic 1.9603
745 Q(36-3) 44.3859
746 Significance Level of Q 0.0890500
747
748 Variable Coeff Std Error T-Stat Signif
749 ****
750 1. CONSTANT 27.4621380 283.0718192 0.09701 0.92278614
751 2. AR{1} 1.9049837 0.0343360 55.48060 0.00000000
752 3. AR{2} -0.9045374 0.0347239 -26.04938 0.00000000
753 4. MA{1} -0.2267623 0.0715785 -3.16802 0.00170982
754
755 @REGCRITS
756
757 Information Criteria
758 AIC 2.378
759 SBC 2.444
760 Hannan-Quinn 2.405
761 (log) FPE 2.378
762
763 BOXJENK(DIFFS=1,CONST,AR=2,MA=1) HOUSING_PRICES
764
765 Box-Jenkins - Estimation by LS Gauss-Newton
766 Convergence in 6 Iterations. Final criterion was 0.0000032 <= 0.0000100
767
768 Dependent Variable HOUSING PRICES, differenced 1 times
769 Monthly Data From 2001:03 To 2024:01
770 Usable Observations 275
771 Degrees of Freedom 271
772 Centered R^2 0.9998671
773 R-Bar^2 0.9998656
774 Uncentered R^2 0.9999896
775 Mean of Dependent Variable 232.11261818
776 Std Error of Dependent Variable 67.57881174
777 Standard Error of Estimate 0.78343998
778 Sum of Squared Residuals 166.33389326
779 Log Likelihood -321.0767
780 Durbin-Watson Statistic 1.9977
781 Q(36-3) 38.3283
782 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  0.000000000
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

```

```

844 Monthly Data From 2001:03 To 2023:01
845 Usable Observations 263
846 Degrees of Freedom 257
847 Centered R^2 0.9998216
848 R-Bar^2 0.9998181
849 Uncentered R^2 0.9999891
850 Mean of Dependent Variable 224.05897338
851 Std Error of Dependent Variable 57.28060165
852 Standard Error of Estimate 0.77252298
853 Sum of Squared Residuals 153.37547896
854 Log Likelihood -302.2675
855 Durbin-Watson Statistic 1.9759
856 Q(36-3) 39.8739
857 Significance Level of Q 0.1909347
858
859      Variable Coeff Std Error T-Stat Signif
860 ****
861 1. CONSTANT -0.253814597 1.031064878 -0.24617 0.80574912
862 2. AR{1} 1.392696999 0.160356803 8.68499 0.00000000
863 3. AR{2} -0.420442267 0.143307077 -2.93386 0.00365024
864 4. MA{1} -0.744692935 0.132200271 -5.63307 0.00000005
865 5. COVID 0.771935213 0.496125353 1.55593 0.12095583
866 6. TIME 0.007235520 0.006002637 1.20539 0.22916136
867
868 @REGCRITS
869
870 Information Criteria
871 AIC 2.352
872 SBC 2.447
873 Hannan-Quinn 2.390
874 (log) FPE 2.352
875
876
877 BOXJENK(CONST,AR=2,MA=1) HOUSING_PRICES
878
879 Box-Jenkins - Estimation by LS Gauss-Newton
880 Convergence in 16 Iterations. Final criterion was 0.0000000 <= 0.0000100
881
882 Dependent Variable HOUSING_PRICES
883 Monthly Data From 2001:02 To 2024:01
884 Usable Observations 276
885 Degrees of Freedom 272
886 Centered R^2 0.9998664
887 R-Bar^2 0.9998650
888 Uncentered R^2 0.9999896
889 Mean of Dependent Variable 231.80416667
890 Std Error of Dependent Variable 67.65018985
891 Standard Error of Estimate 0.78614416
892 Sum of Squared Residuals 168.10215967
893 Log Likelihood -323.2026
894 Durbin-Watson Statistic 1.9603
895 Q(36-3) 44.3859
896 Significance Level of Q 0.0890500
897
898      Variable Coeff Std Error T-Stat Signif
899 ****
900 1. CONSTANT 27.4621380 283.0718192 0.09701 0.92278614
901 2. AR{1} 1.9049837 0.0343360 55.48060 0.00000000
902 3. AR{2} -0.9045374 0.0347239 -26.04938 0.00000000
903 4. MA{1} -0.2267623 0.0715785 -3.16802 0.00170982
904

```

```

905 @REGCRITS
906
907 Information Criteria
908 AIC          2.378
909 SBC          2.444
910 Hannan-Quinn 2.405
911 (log) FPE   2.378
912
913
914 BOXJENK(DIFFS=2,REGRESSORS,CONST,AR=2,MA=1) HOUSING_PRICES
915 # COVID
916
917 Box-Jenkins - Estimation by LS Gauss-Newton
918 Convergence in    13 Iterations. Final criterion was  0.0000099 <=  0.0000100
919
920 Dependent Variable HOUSING_PRICES, differenced 2 times
921 Monthly Data From 2001:04 To 2023:01
922 Usable Observations           262
923 Degrees of Freedom            257
924 Centered R^2                 0.9998091
925 R-Bar^2                      0.9998061
926 Uncentered R^2                0.9999884
927 Mean of Dependent Variable   224.35022901
928 Std Error of Dependent Variable 57.19477893
929 Standard Error of Estimate   0.79636450
930 Sum of Squared Residuals     162.98847859
931 Log Likelihood              -309.5808
932 Durbin-Watson Statistic      2.0779
933 Q(36-3)                      51.0398
934 Significance Level of Q      0.0233458
935
936      Variable           Coeff      Std Error      T-Stat      Signif
937 ****
938 1.  CONSTANT             -0.027079711  0.040144785  -0.67455  0.50056731
939 2.  AR{1}                 -1.192477557  0.065954010  -18.08044 0.000000000
940 3.  AR{2}                 -0.264222436  0.060501797  -4.36718  0.00001826
941 4.  MA{1}                 0.970196793  0.030943347  31.35397 0.000000000
942 5.  COVID                  0.249893417  0.143174614   1.74538  0.08211472
943
944 @regcrits
945
946 Information Criteria
947 AIC          2.409
948 SBC          2.491
949 Hannan-Quinn 2.442
950 (log) FPE   2.409
951
952 BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=2,MA=1,DEFINE=HOUSE ARIMA) HOUSING PRICES *
2023:01
953 # COVID
954
955 Box-Jenkins - Estimation by LS Gauss-Newton
956 Convergence in    19 Iterations. Final criterion was  0.0000024 <=  0.0000100
957
958 Dependent Variable HOUSING_PRICES, differenced 1 times
959 Monthly Data From 2001:03 To 2023:01
960 Usable Observations           263
961 Degrees of Freedom            258
962 Centered R^2                 0.9998207
963 R-Bar^2                      0.9998180
964 Uncentered R^2                0.9999890

```

```

965 Mean of Dependent Variable      224.05897338
966 Std Error of Dependent Variable 57.28060165
967 Standard Error of Estimate     0.77282404
968 Sum of Squared Residuals       154.09230621
969 Log Likelihood                 -302.8806
970 Durbin-Watson Statistic        1.9731
971 Q(36-3)                         40.1143
972 Significance Level of Q        0.1839328
973
974      Variable            Coeff   Std Error   T-Stat   Signif
975 ****
976 1. CONSTANT                   0.860711867 0.553748095 1.55434 0.12132954
977 2. AR{1}                       1.401242800 0.151119694 9.27240 0.00000000
978 3. AR{2}                       -0.423020353 0.137880964 -3.06801 0.00238445
979 4. MA{1}                       -0.750037294 0.122047641 -6.14545 0.00000000
980 5. COVID                        0.778099025 0.494047154 1.57495 0.11649365
981
982 UFORECAST(FROM=2023:02, TO=2024:01, EQUATION=HOUSE_ARIMA, PRINT) HOUSE_ARIMA_FORE
983
984      Entry      HOUSING_PRICES
985      2023:02    393.4268487
986      2023:03    394.2824485
987      2023:04    395.1376312
988      2023:05    395.9927580
989      2023:06    396.8479827
990      2023:07    397.7033684
991      2023:08    398.5589381
992      2023:09    399.4146977
993      2023:10    400.2706454
994      2023:11    401.1267765
995      2023:12    401.9830849
996      2024:01    402.8395642
997
998 @uforeerrors HOUSING_PRICES HOUSE_ARIMA_FORE 2023:02 2024:01
999
1000 Forecast Analysis for HOUSING_PRICES
1001 From 2023:02 to 2024:01
1002 Mean Error                  10.4896046
1003 Mean Absolute Error          10.4896046
1004 Root Mean Square Error       11.6764138
1005 Mean Square Error           136.338640
1006 Theil's U                   4.978334
1007
1008 Mean Pct Error              0.025435
1009 Mean Abs Pct Error           0.025435
1010 Root Mean Square Pct Error   0.028190
1011 Theil's Relative U           4.867271
1012
1013 FILTER HOUSING PRICES 2023:02 2024:01 HOUSE TRUNC
1014 GRAPH(STYLE=LINE, HEADER="Housing Prices Actual versus
Forecast", VLABEL="Index", HLABEL="Month", KEY=BELOW, MAX=450, MIN=350) 2
1015 # HOUSE_TRUNC
1016 # HOUSE_ARIMA_FORE
1017
1018 @DFUNIT(LAGS=3) HOUSING_PRICES
1019
1020 Dickey-Fuller Unit Root Test, Series HOUSING_PRICES
1021 Regression Run From 2001:04 to 2024:01
1022 Observations                275
1023 With intercept
1024 Using fixed lags 3

```

```

1025 Null is unit root. Reject in left tail.
1026
1027 Sig Level      Crit Value
1028 1%(**)          -3.45570
1029 5%(*)           -2.87217
1030 10%             -2.57239
1031
1032 T-Statistic     0.63118
1033 *EVIDENCE OF A UNIT ROOT
1034
1035
1036
1037 *Let's move on to our next variable, the FED_FUND
1038 LINREG FED_FUND * 2023:01
1039 # TIME COVID HCRASH
1040
1041 Linear Regression - Estimation by Least Squares
1042 Dependent Variable FED_FUND
1043 Monthly Data From 2000:12 To 2023:01
1044 Usable Observations          266
1045 Degrees of Freedom          263
1046 Centered R^2                -0.4099369
1047 R-Bar^2                     -0.4206588
1048 Uncentered R^2              0.2070731
1049 Mean of Dependent Variable  1.4719548872
1050 Std Error of Dependent Variable 1.6717944076
1051 Standard Error of Estimate 1.9926350454
1052 Sum of Squared Residuals    1044.2663335
1053 Log Likelihood            -559.3249
1054 Durbin-Watson Statistic    0.0165
1055
1056      Variable            Coeff      Std Error      T-Stat      Signif
1057 ****
1058 1. TIME               0.007231950  0.000911048   7.93806  0.000000000
1059 2. COVID              -1.684616250  0.479264685  -3.51500  0.00051766
1060 3. HCRASH              0.277790614  0.424977578   0.65366  0.51390231
1061
1062 @REGCRITS
1063
1064 Information Criteria
1065 AIC                  4.236
1066 SBC                  4.289
1067 Hannan-Quinn        4.257
1068 (log) FPE            4.236
1069
1070 BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=1) FED_FUND
1071 # TIME COVID
1072
1073 Box-Jenkins - Estimation by LS Gauss-Newton
1074 Convergence in      8 Iterations. Final criterion was 0.0000027 <= 0.0000100
1075
1076 Dependent Variable FED_FUND, differenced 1 times
1077 Monthly Data From 2001:02 To 2024:01
1078 Usable Observations          276
1079 Degrees of Freedom          272
1080 Centered R^2                0.9835792
1081 R-Bar^2                     0.9833980
1082 Uncentered R^2              0.9910060
1083 Mean of Dependent Variable  1.5950724638
1084 Std Error of Dependent Variable 1.7584944992
1085 Standard Error of Estimate 0.2265795130

```

```

1086 Sum of Squared Residuals          13.964010997
1087 Regression F(3, 272)             5430.7712
1088 Significance Level of F        0.0000000
1089 Log Likelihood                 20.1536
1090 Durbin-Watson Statistic         1.9948
1091 Q(36-1)                         122.9632
1092 Significance Level of Q        0.0000000
1093
1094      Variable                  Coeff   Std Error   T-Stat   Signif
1095 ****
1096 1.  CONSTANT                 -0.098977354 0.033093063 -2.99088 0.00303669
1097 2.  AR{1}                      0.146731514 0.057648073  2.54530 0.01147097
1098 3.  TIME                       0.000807086 0.000216665  3.72503 0.00023745
1099 4.  COVID                      -0.176958219 0.063068126 -2.80583 0.00538119
1100
1101 @REGCRITS
1102
1103 Information Criteria
1104 AIC              -0.110
1105 SBC              -0.044
1106 Hannan-Quinn -0.083
1107 (log) FPE       -0.110
1108
1109 BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=1,MA=1) FED FUND * 2023:01
1110 # TIME COVID
1111
1112 Box-Jenkins - Estimation by LS Gauss-Newton
1113 Convergence in    49 Iterations. Final criterion was 0.0000099 <= 0.0000100
1114
1115 Dependent Variable FED_FUND, differenced 1 times
1116 Monthly Data From 2001:02 To 2023:01
1117 Usable Observations            264
1118 Degrees of Freedom            259
1119 Centered R^2                 0.9803319
1120 R-Bar^2                      0.9800281
1121 Uncentered R^2               0.9889573
1122 Mean of Dependent Variable   1.4376136364
1123 Std Error of Dependent Variable 1.6297276319
1124 Standard Error of Estimate   0.2303163252
1125 Sum of Squared Residuals     13.738812896
1126 Log Likelihood                15.5558
1127 Durbin-Watson Statistic       2.0255
1128 Q(36-2)                       101.5052
1129 Significance Level of Q      0.0000000
1130
1131      Variable                  Coeff   Std Error   T-Stat   Signif
1132 ****
1133 1.  CONSTANT                 -0.103083422 0.037347552 -2.76011 0.00619090
1134 2.  AR{1}                      0.302277509 0.169376391  1.78465 0.07548856
1135 3.  MA{1}                      -0.131430047 0.182643769 -0.71960 0.47242151
1136 4.  TIME                       0.000868559 0.000257494  3.37312 0.00085692
1137 5.  COVID                      -0.191922894 0.069328643 -2.76831 0.00604178
1138
1139 @REGCRITS
1140
1141 Information Criteria
1142 AIC              -0.072
1143 SBC              0.009
1144 Hannan-Quinn -0.040
1145 (log) FPE       -0.072
1146

```

```

1147 BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=2) FED_FUND * 2023:01
1148 # COVID TIME
1149
1150 Box-Jenkins - Estimation by LS Gauss-Newton
1151 Convergence in      9 Iterations. Final criterion was  0.0000070 <=  0.0000100
1152
1153 Dependent Variable FED_FUND, differenced 1 times
1154 Monthly Data From 2001:03 To 2023:01
1155 Usable Observations          263
1156 Degrees of Freedom          258
1157 Centered R^2                0.9813105
1158 R-Bar^2                     0.9810207
1159 Uncentered R^2              0.9895024
1160 Mean of Dependent Variable  1.4219011407
1161 Std Error of Dependent Variable 1.6126759913
1162 Standard Error of Estimate   0.2221707808
1163 Sum of Squared Residuals     12.734842808
1164 Regression F(4,258)          3386.6327
1165 Significance Level of F     0.00000000
1166 Log Likelihood              24.9765
1167 Durbin-Watson Statistic    2.0806
1168 Q(36-2)                     61.7598
1169 Significance Level of Q     0.0024862
1170
1171      Variable            Coeff      Std Error      T-Stat      Signif
1172 ****
1173 1.  CONSTANT           -0.116811644  0.047642152  -2.45185  0.01487561
1174 2.  AR{1}               0.156569123  0.060036999   2.60788  0.00964151
1175 3.  AR{2}               0.238009695  0.058461753   4.07120  0.00006224
1176 4.  COVID               -0.228906884  0.082673022  -2.76882  0.00603410
1177 5.  TIME                0.000992227  0.000324892   3.05402  0.00249434
1178
1179 @REGRITS
1180
1181 Information Criteria
1182 AIC                  -0.144
1183 SBC                  -0.063
1184 Hannan-Quinn        -0.112
1185 (log) FPE            -0.144
1186
1187 *BEST ONE SO FAR
1188 BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=3) FED_FUND * 2023:01
1189 # COVID TIME
1190
1191 Box-Jenkins - Estimation by LS Gauss-Newton
1192 Convergence in      9 Iterations. Final criterion was  0.0000082 <=  0.0000100
1193
1194 Dependent Variable FED FUND, differenced 1 times
1195 Monthly Data From 2001:04 To 2023:01
1196 Usable Observations          262
1197 Degrees of Freedom          256
1198 Centered R^2                0.9814365
1199 R-Bar^2                     0.9810739
1200 Uncentered R^2              0.9895715
1201 Mean of Dependent Variable  1.4059923664
1202 Std Error of Dependent Variable 1.5949516765
1203 Standard Error of Estimate   0.2194207717
1204 Sum of Squared Residuals     12.325241611
1205 Regression F(5,256)          2706.9005
1206 Significance Level of F     0.00000000
1207 Log Likelihood              28.6652

```

```

1208 Durbin-Watson Statistic          2.0260
1209 Q(36-3)                         55.1460
1210 Significance Level of Q        0.0091626
1211
1212      Variable                  Coeff   Std Error   T-Stat   Signif
1213 ****
1214 1.  CONSTANT                 -0.128866515 0.058090656 -2.21837 0.02740739
1215 2.  AR{1}                    0.109453056 0.061695374 1.77409 0.07723709
1216 3.  AR{2}                    0.252210180 0.060807113 4.14771 0.00004572
1217 4.  AR{3}                    0.143043090 0.059722236 2.39514 0.01733326
1218 5.  COVID                   -0.248241226 0.089970720 -2.75913 0.00621385
1219 6.  TIME                     0.001089182 0.000388961 2.80024 0.00549586
1220
1221 @REGCRITS
1222
1223 Information Criteria
1224 AIC             -0.165
1225 SBC             -0.070
1226 Hannan-Quinn -0.127
1227 (log) FPE       -0.165
1228
1229 BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=4) FED FUND * 2023:01
1230 # TIME COVID
1231
1232 Box-Jenkins - Estimation by LS Gauss-Newton
1233 Convergence in    9 Iterations. Final criterion was 0.0000075 <= 0.0000100
1234
1235 Dependent Variable FED_FUND, differenced 1 times
1236 Monthly Data From 2001:05 To 2023:01
1237 Usable Observations           261
1238 Degrees of Freedom            254
1239 Centered R^2                 0.9813478
1240 R-Bar^2                      0.9809072
1241 Uncentered R^2                0.9895123
1242 Mean of Dependent Variable   1.391111111
1243 Std Error of Dependent Variable 1.5796871377
1244 Standard Error of Estimate   0.2182757644
1245 Sum of Squared Residuals     12.101654573
1246 Regression F(6,254)          2227.2871
1247 Significance Level of F      0.0000000
1248 Log Likelihood               30.4458
1249 Durbin-Watson Statistic      2.0342
1250 Q(36-4)                      56.3287
1251 Significance Level of Q      0.0049993
1252
1253      Variable                  Coeff   Std Error   T-Stat   Signif
1254 ****
1255 1.  CONSTANT                 -0.124657036 0.067197037 -1.85510 0.06474098
1256 2.  AR{1}                    0.094708458 0.062332138 1.51942 0.12990154
1257 3.  AR{2}                    0.227848919 0.062273219 3.65886 0.00030804
1258 4.  AR{3}                    0.120530231 0.062780344 1.91987 0.05599409
1259 5.  AR{4}                    0.126819382 0.060506202 2.09597 0.03707437
1260 6.  TIME                     0.001081854 0.000442001 2.44763 0.01505774
1261 7.  COVID                   -0.245961302 0.092706488 -2.65312 0.00847785
1262
1263 @REGCRITS
1264
1265 Information Criteria
1266 AIC             -0.172
1267 SBC             -0.063
1268 Hannan-Quinn -0.128

```

```

1269 (log) FPE      -0.172
1270
1271 *SBC STARTS GOING DOWN FROM HERE ARIMA(3,1,0) THUS FAR
1272 *Let's try it with housing crash
1273
1274 BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=3) FED_FUND * 2023:01
1275 # TIME COVID HCRASH
1276
1277 Box-Jenkins - Estimation by LS Gauss-Newton
1278 Convergence in    10 Iterations. Final criterion was  0.0000052 <=  0.0000100
1279
1280 Dependent Variable FED_FUND, differenced 1 times
1281 Monthly Data From 2001:04 To 2023:01
1282 Usable Observations                  262
1283 Degrees of Freedom                   255
1284 Centered R^2                        0.9814365
1285 R-Bar^2                            0.9809997
1286 Uncentered R^2                      0.9895715
1287 Mean of Dependent Variable          1.4059923664
1288 Std Error of Dependent Variable    1.5949516765
1289 Standard Error of Estimate        0.2198505653
1290 Sum of Squared Residuals           12.325239121
1291 Regression F(6,255)                2246.9393
1292 Significance Level of F           0.0000000
1293 Log Likelihood                   28.6652
1294 Durbin-Watson Statistic          2.0261
1295 Q(36-3)                           55.1586
1296 Significance Level of Q          0.0091352
1297
1298      Variable            Coeff      Std Error      T-Stat      Signif
1299 ****
1300 1.  CONSTANT          -0.129007774  0.060487933  -2.13279  0.03389765
1301 2.  AR{1}              0.109588572  0.063183792   1.73444  0.08404825
1302 3.  AR{2}              0.252357430  0.062251979   4.05381  0.00006697
1303 4.  AR{3}              0.143125809  0.060477656   2.36659  0.01870064
1304 5.  TIME               0.001089840  0.000394974   2.75927  0.00621302
1305 6.  COVID              -0.248324660  0.090196645  -2.75315  0.00632691
1306 7.  HCRASH             0.000697710  0.090434856   0.00772  0.99385037
1307
1308 @regcrits
1309
1310 Information Criteria
1311 AIC      -0.158
1312 SBC      -0.049
1313 Hannan-Quinn -0.114
1314 (log) FPE      -0.158
1315
1316 *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
1317 SET HCRASH_FED = T>=2008:01.AND.T<=2014:12
1318 BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=3) FED_FUND * 2023:01
1319 # TIME COVID HCRASH_FED
1320
1321 Box-Jenkins - Estimation by LS Gauss-Newton
1322 Convergence in    10 Iterations. Final criterion was  0.0000031 <=  0.0000100
1323
1324 Dependent Variable FED_FUND, differenced 1 times
1325 Monthly Data From 2001:04 To 2023:01
1326 Usable Observations                  262
1327 Degrees of Freedom                   255
1328 Centered R^2                        0.9817698

```

```

1329 R-Bar^2          0.9813408
1330 Uncentered R^2   0.9897587
1331 Mean of Dependent Variable 1.4059923664
1332 Std Error of Dependent Variable 1.5949516765
1333 Standard Error of Estimate 0.2178680787
1334 Sum of Squared Residuals 12.103957429
1335 Regression F(6, 255) 2288.7943
1336 Significance Level of F 0.0000000
1337 Log Likelihood 31.0385
1338 Durbin-Watson Statistic 2.0217
1339 Q(36-3) 54.8204
1340 Significance Level of Q 0.0098949
1341
1342      Variable           Coeff     Std Error     T-Stat    Signif
1343 ****
1344 1.  CONSTANT        -0.085157811 0.058915065 -1.44543 0.14956396
1345 2.  AR{1}            0.106635320 0.061917591 1.72221 0.08624336
1346 3.  AR{2}            0.244007892 0.061066373 3.99578 0.00008444
1347 4.  AR{3}            0.135322261 0.059737499 2.26528 0.02433474
1348 5.  TIME             0.001056810 0.000372713 2.83545 0.00494299
1349 6.  COVID            -0.272527580 0.088569215 -3.07700 0.00231891
1350 7.  HCRASH FED     -0.116754469 0.053811235 -2.16970 0.03095302
1351
1352 @REGCRITS
1353
1354 Information Criteria
1355 AIC      -0.176
1356 SBC      -0.067
1357 Hannan-Quinn -0.132
1358 (log) FPE   -0.176
1359
1360 *BETTER AKAIKE INFORMATION CRITERIA BUT WORSE SBC COMPARED TO MODEL WITHOUT CRASH-
WE'LL KEEP ARIMA(3,1,0) FOR FED_FUND
1361 @DFUNIT (LAGS=4) FED_FUND
1362
1363 Dickey-Fuller Unit Root Test, Series HOUSING_PRICES
1364 Regression Run From 2001:02 to 2024:01
1365 Observations 277
1366 With intercept
1367 Using fixed lags 0
1368 Null is unit root. Reject in left tail.
1369
1370 Sig Level   Crit Value
1371 1%(**)     -3.45554
1372 5%(*)      -2.87209
1373 10%         -2.57235
1374
1375 T-Statistic 8.84899
1376
1377 UFORECAST(FROM=2023:02,TO=2024:01,EQUATION=FED_ARIMA,STDERRS=FED_ARIMA_STD,PRINT)
FED_ARIMA_FORE
1378
1379 Entry      FED_FUND
1380 2023:02 4.655230494
1381 2023:03 5.006101169
1382 2023:04 5.280478283
1383 2023:05 5.528489553
1384 2023:06 5.758529661
1385 2023:07 5.969550625
1386 2023:08 6.170725389
1387 2023:09 6.363994449

```

```

1388 2023:10 6.551733801
1389 2023:11 6.736005044
1390 2023:12 6.917910652
1391 2024:01 7.098431120
1392
1393 @UFOREERRORS FED_FUND FED_ARIMA_FORE 2023:02 2024:01
1394
1395 Forecast Analysis for FED_FUND
1396 From 2023:02 to 2024:01
1397 Mean Error -0.9439317
1398 Mean Absolute Error 0.9439317
1399 Root Mean Square Error 1.0457898
1400 Mean Square Error 1.093676
1401 Theil's U 7.245444
1402
1403 Mean Pct Error -0.182429
1404 Mean Abs Pct Error 0.182429
1405 Root Mean Square Pct Error 0.199143
1406 Theil's Relative U 6.500393
1407 FILTER(TYPE=CENTERED,WIDTH=1) FED_FUND 2023:02 2024:01 FED_FUND_TRUNC
1408 GRAPH(STYLE=LINE,HEADER="Federal Funds Rate Actual versus
Forecast",VLABEL="Rate",HLABEL="Month",KEY=BELOW, MAX=10, MIN=0) 2
1409 # FED ARIMA FORE
1410 # FED FUND TRUNC
1411
1412
1413
1414 *Let's move on now to our final variable, GOVT_JOBS
1415 *GOVT_JOBS likely to follow monthly seasonality- let's try it
1416 SEASONAL DEC
1417 SET NOV = DEC{-1}
1418 SET OCT = DEC{-2}
1419 SET SEP = DEC{-3}
1420 SET AUG = DEC{-4}
1421 SET JUL = DEC{-5}
1422 SET JUN = DEC{-6}
1423 SET MAY = DEC{-7}
1424 SET APR = DEC{-8}
1425 SET MAR = DEC{-9}
1426 SET FEB = DEC{-10}
1427 SET JAN = DEC{-11}
1428 LINREG GOVT_JOBS * 2023:01
1429 # DEC NOV OCT SEP AUG JUL JUN MAY APR MAR FEB JAN
1430
1431 Linear Regression - Estimation by Least Squares
1432 Dependent Variable GOVT_JOBS
1433 Monthly Data From 2000:12 To 2023:01
1434 Usable Observations 266
1435 Degrees of Freedom 254
1436 Centered R^2 0.0026356
1437 R-Bar^2 -0.0405573
1438 Uncentered R^2 0.8751625
1439 Mean of Dependent Variable 509.17293233
1440 Std Error of Dependent Variable 192.95959148
1441 Standard Error of Estimate 196.83366572
1442 Sum of Squared Residuals 9840846.9585
1443 Regression F(11,254) 0.0610
1444 Significance Level of F 0.99999930
1445 Log Likelihood -1776.4056
1446 Durbin-Watson Statistic 0.0726
1447

```

```

1448      Variable          Coeff      Std Error      T-Stat      Signif
1449 ****
1450 1. DEC           515.45454545 41.96507854 12.28294 0.00000000
1451 2. NOV           507.13636364 41.96507854 12.08472 0.00000000
1452 3. OCT           505.68181818 41.96507854 12.05006 0.00000000
1453 4. SEP           497.13636364 41.96507854 11.84643 0.00000000
1454 5. AUG           520.77272727 41.96507854 12.40967 0.00000000
1455 6. JUL           505.86363636 41.96507854 12.05440 0.00000000
1456 7. JUN           499.36363636 41.96507854 11.89950 0.00000000
1457 8. MAY           515.22727273 41.96507854 12.27752 0.00000000
1458 9. APR           498.95454545 41.96507854 11.88976 0.00000000
1459 10. MAR          496.18181818 41.96507854 11.82368 0.00000000
1460 11. FEB          524.04347826 41.04265648 12.76826 0.00000000
1461 12. JAN          522.95652174 41.04265648 12.74178 0.00000000
1462
1463 *R^2 is too low
1464 LINREG GOVT_JOBS * 2023:01
1465 # COVID HCRASH TIME
1466
1467 Linear Regression - Estimation by Least Squares
1468 Dependent Variable GOVT_JOBS
1469 Monthly Data From 2000:12 To 2023:01
1470 Usable Observations          266
1471 Degrees of Freedom          263
1472 Centered R^2                0.1027901
1473 R-Bar^2                     0.0959672
1474 Uncentered R^2              0.8876985
1475 Mean of Dependent Variable  509.17293233
1476 Std Error of Dependent Variable 192.95959148
1477 Standard Error of Estimate   183.46721559
1478 Sum of Squared Residuals     8852637.6486
1479 Log Likelihood               -1762.3307
1480 Durbin-Watson Statistic     0.0848
1481
1482      Variable          Coeff      Std Error      T-Stat      Signif
1483 ****
1484 1. COVID          28.361425502 44.127175979 0.64272 0.52096561
1485 2. HCRASH         42.998404102 39.128817484 1.09889 0.27281945
1486 3. TIME           3.289723472 0.083882620 39.21818 0.00000000
1487
1488 @regactfit
1489
1490
1491 BOXJENK(DIFFS=1,CONST,AR=1,MA=1) GOVT_JOBS
1492
1493 Box-Jenkins - Estimation by LS Gauss-Newton
1494 Convergence in      9 Iterations. Final criterion was 0.0000062 <= 0.0000100
1495
1496 Dependent Variable GOVT JOBS, differenced 1 times
1497 Monthly Data From 2001:02 To 2024:01
1498 Usable Observations          276
1499 Degrees of Freedom          273
1500 Centered R^2                0.9532266
1501 R-Bar^2                     0.9528839
1502 Uncentered R^2              0.9933876
1503 Mean of Dependent Variable  530.96014493
1504 Std Error of Dependent Variable 215.83750253
1505 Standard Error of Estimate   46.85021767
1506 Sum of Squared Residuals     599219.41044
1507 Log Likelihood               -1451.8786
1508 Durbin-Watson Statistic     1.9615

```

```

1509 Q(36-2) 35.1939
1510 Significance Level of Q 0.4114396
1511
1512      Variable Coeff Std Error T-Stat Signif
1513 ****
1514 1. CONSTANT 1.644541784 1.242037034 1.32407 0.18658791
1515 2. AR{1} -0.054685453 0.105704333 -0.51734 0.60533529
1516 3. MA{1} -0.537384383 0.090229976 -5.95572 0.00000001
1517
1518 @REGCRITS
1519
1520 Information Criteria
1521 AIC 10.550
1522 SBC 10.602
1523 Hannan-Quinn 10.571
1524 (log) FPE 10.550
1525
1526
1527 BOXJENK(REGRESSORS,CONST,AR=2) GOVT_JOBS
1528 # TIME
1529
1530 Box-Jenkins - Estimation by LS Gauss-Newton
1531 Convergence in 3 Iterations. Final criterion was 0.0000046 <= 0.0000100
1532
1533 Dependent Variable GOVT_JOBS
1534 Monthly Data From 2001:02 To 2024:01
1535 Usable Observations 276
1536 Degrees of Freedom 272
1537 Centered R^2 0.9513821
1538 R-Bar^2 0.9508458
1539 Uncentered R^2 0.9931269
1540 Mean of Dependent Variable 530.96014493
1541 Std Error of Dependent Variable 215.83750253
1542 Standard Error of Estimate 47.85276241
1543 Sum of Squared Residuals 622849.22881
1544 Regression F(3,272) 1774.2148
1545 Significance Level of F 0.0000000
1546 Log Likelihood -1457.2160
1547 Durbin-Watson Statistic 2.1336
1548 Q(36-2) 48.3586
1549 Significance Level of Q 0.0524579
1550
1551      Variable Coeff Std Error T-Stat Signif
1552 ****
1553 1. CONSTANT 104.35295725 135.53930734 0.76991 0.44202189
1554 2. AR{1} 0.51083889 0.05547582 9.20832 0.00000000
1555 3. AR{2} 0.43417450 0.05515431 7.87200 0.00000000
1556 4. TIME 2.79225176 0.71617349 3.89885 0.00012181
1557
1558 @REGCRITS
1559
1560 Information Criteria
1561 AIC 10.596
1562 SBC 10.661
1563 Hannan-Quinn 10.622
1564 (log) FPE 10.596
1565
1566 BOXJENK(DIFFS=1,REGRESSORS,CONST,AR=1,MA=1) GOVT_JOBS * 2023:01
1567 # TIME
1568
1569 Box-Jenkins - Estimation by LS Gauss-Newton

```

```

1570 Convergence in      10 Iterations. Final criterion was  0.0000008 <=  0.0000100
1571
1572 Dependent Variable GOVT_JOBS, differenced 1 times
1573 Monthly Data From 2001:02 To 2023:01
1574 Usable Observations          264
1575 Degrees of Freedom          260
1576 Centered R^2                0.9466999
1577 R-Bar^2                     0.9460849
1578 Uncentered R^2              0.9932847
1579 Mean of Dependent Variable 509.12878788
1580 Std Error of Dependent Variable 193.66983803
1581 Standard Error of Estimate 44.96942158
1582 Sum of Squared Residuals    525784.70800
1583 Log Likelihood             -1377.3639
1584 Durbin-Watson Statistic     1.9987
1585 Q(36-2)                     36.9281
1586 Significance Level of Q    0.3351382
1587
1588      Variable            Coeff   Std Error   T-Stat   Signif
1589 ****
1590 1. CONSTANT           -3.973369543 2.041374406 -1.94642 0.05268155
1591 2. AR{1}                0.036807784 0.096586534  0.38109 0.70345058
1592 3. MA{1}                -0.654300570 0.073517539 -8.89992 0.00000000
1593 4. TIME                0.046007653 0.013264900  3.46838 0.00061266
1594
1595 @REGCRITS
1596
1597 Information Criteria
1598 AIC          10.472
1599 SBC          10.540
1600 Hannan-Quinn 10.500
1601 (log) FPE   10.472
1602
1603
1604 BOXJENK(DIFFS=1,CONST,AR=1,MA=1) GOVT_JOBS * 2023:01
1605
1606 Box-Jenkins - Estimation by LS Gauss-Newton
1607 Convergence in      9 Iterations. Final criterion was  0.0000088 <=  0.0000100
1608
1609 Dependent Variable GOVT_JOBS, differenced 1 times
1610 Monthly Data From 2001:02 To 2023:01
1611 Usable Observations          264
1612 Degrees of Freedom          261
1613 Centered R^2                0.9446696
1614 R-Bar^2                     0.9442456
1615 Uncentered R^2              0.9930289
1616 Mean of Dependent Variable 509.12878788
1617 Std Error of Dependent Variable 193.66983803
1618 Standard Error of Estimate 45.73001920
1619 Sum of Squared Residuals    545812.24529
1620 Log Likelihood             -1382.2985
1621 Durbin-Watson Statistic     2.0021
1622 Q(36-2)                     34.2186
1623 Significance Level of Q    0.4572503
1624
1625      Variable            Coeff   Std Error   T-Stat   Signif
1626 ****
1627 1. CONSTANT           2.197093970 1.213516977  1.81052 0.07136542
1628 2. AR{1}                -0.011437542 0.106067813 -0.10783 0.91421153
1629 3. MA{1}                -0.565695606 0.088114795 -6.41998 0.00000000
1630

```

```

1631 @REGCRITS
1632
1633 Information Criteria
1634 AIC          10.502
1635 SBC          10.556
1636 Hannan-Quinn 10.524
1637 (log) FPE    10.502
1638
1639 BOXJENK(DIFFS=1,REGRESSORS,CONST,MA=1, DEFINE=GOVT_ARIMA) GOVT_JOBS * 2023:01
1640 # TIME
1641
1642 Box-Jenkins - Estimation by LS Gauss-Newton
1643 Convergence in      7 Iterations. Final criterion was  0.0000069 <=  0.0000100
1644
1645 Dependent Variable GOVT_JOBS, differenced 1 times
1646 Monthly Data From 2001:01 To 2023:01
1647 Usable Observations           265
1648 Degrees of Freedom            262
1649 Centered R^2                 0.9461031
1650 R-Bar^2                      0.9456916
1651 Uncentered R^2                0.9932291
1652 Mean of Dependent Variable   509.02641509
1653 Std Error of Dependent Variable 193.30987464
1654 Standard Error of Estimate   45.04923439
1655 Sum of Squared Residuals     531711.58208
1656 Log Likelihood              -1383.5655
1657 Durbin-Watson Statistic      1.9544
1658 Q(36-1)                      38.2799
1659 Significance Level of Q      0.3229033
1660
1661      Variable          Coeff      Std Error      T-Stat      Signif
1662 ****
1663 1.  CONSTANT          -4.557263803  2.095339717  -2.17495  0.03052827
1664 2.  MA{1}              -0.628856595  0.048059489  -13.08496 0.00000000
1665 3.  TIME               0.049259440  0.013639554   3.61151  0.00036476
1666
1667
1668
1669 @REGACTFIT
1670 @REGCRITS
1671
1672 Information Criteria
1673 AIC          10.472
1674 SBC          10.526
1675 Hannan-Quinn 10.494
1676 (log) FPE    10.472
1677
1678 @DFUNIT (LAGS=3) GOVT JOBS
1679
1680 Dickey-Fuller Unit Root Test, Series GOVT_JOBS
1681 Regression Run From 2001:03 to 2024:01
1682 Observations       276
1683 With intercept
1684 Using fixed lags 0
1685 Null is unit root. Reject in left tail.
1686
1687 Sig Level      Crit Value
1688 1%(**)        -3.45562
1689 5%(*)         -2.87213
1690 10%           -2.57237
1691

```

```

1692 T-Statistic      -1.83661
1693 *EVIDENCE OF UNIT ROOT
1694
1695 UFORECAST(FROM=2023:02,TO=2024:01,EQUATION=GOVT_ARIMA,PRINT) GOVT_ARIMA_FORE
1696
1697   Entry      GOVT_JOBS
1698   2023:02 1075.856216
1699   2023:03 1084.500483
1700   2023:04 1093.194008
1701   2023:05 1101.936793
1702   2023:06 1110.728838
1703   2023:07 1119.570142
1704   2023:08 1128.460705
1705   2023:09 1137.400528
1706   2023:10 1146.389610
1707   2023:11 1155.427952
1708   2023:12 1164.515553
1709   2024:01 1173.652413
1710
1711 @UFORERRORS GOVT_JOBS GOVT_ARIMA_FORE 2023:02 2024:01
1712
1713 Forecast Analysis for GOVT JOBS
1714 From 2023:02 to 2024:01
1715 Mean Error           -113.05277
1716 Mean Absolute Error  113.05277
1717 Root Mean Square Error 143.61068
1718 Mean Square Error    20624.027564
1719 Theil's U             1.839689
1720
1721 Mean Pct Error       -0.118280
1722 Mean Abs Pct Error   0.118280
1723 Root Mean Square Pct Error 0.156545
1724 Theil's Relative U   1.891496
1725
1726 FILTER(TYPE=CENTERED,WIDTH=1) GOVT_JOBS 2023:02 2024:01 GOVT_TRUNC
1727 GRAPH(STYLE=LINE,HEADER="Government Job Openings Actual versus Forecast
(ARIMA)",VLABEL="Openings",HLABEL="Month",$
1728 KEY=BELLOW, MAX=1500, MIN=500) 2
1729 # GOVT_TRUNC
1730 # GOVT_ARIMA_FORE
1731
1732 *NOW LET'S DO OUR VARs; LET'S MAKE SURE EVERYONE IS STATIONARY
1733 DIFF CONS_CONF / CONS_CONF_DIF
1734 @BJIDENT CONS_CONF_DIF
1735 DIFF FED_FUND / FED_FUND_DIF
1736 @BJIDENT FED_FUND_DIF
1737 DIFF GOVT_JOBS / GOVT_JOBS_DIF
1738 @BJIDENT GOVT_JOBS_DIF
1739 DIFF HOUSING_PRICES / HOUSING_DIF
1740 @BJIDENT HOUSING_DIF
1741
1742 *OK, now let's start our VAR analysis- but first let's look at cross-correlations
1743 CROSS(FROM=-12,TO=12,RESULTS=CROSSCORS) CONS_CONF_DIF FED_FUND_DIF
1744 * 9
1745 Cross Correlations of Series CONS_CONF_DIF and FED_FUND_DIF
1746 Monthly Data From 2001:01 To 2024:01
1747
1748
1749   -12      -11      -10      -9      -8      -7      -6      -5
1750   -4       -3
1750 -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

```

```

1805 2. CONS_CONF_DIF{2}           -1.051273782 0.083951561 -12.52239 0.00000000
1806 3. CONS_CONF_DIF{3}           0.288254610 0.059568804 4.83902 0.00000221
1807 4. FED_FUND_DIF{1}           -0.002033664 0.032402898 -0.06276 0.95000316
1808 5. FED_FUND_DIF{2}           0.018870865 0.031458920 0.59986 0.54911003
1809 6. FED_FUND_DIF{3}           0.040114556 0.030917928 1.29745 0.19559528
1810 7. Constant                 -0.001450398 0.007157825 -0.20263 0.83957772
1811
1812 F-Tests, Dependent Variable CONS_CONF_DIF
1813      Variable          F-Statistic   Signif
1814 ****
1815 CONS_CONF_DIF            291.3499    0.0000000
1816 FED_FUND_DIF            0.8244     0.4813797
1817
1818
1819 Dependent Variable FED_FUND_DIF
1820 Mean of Dependent Variable -0.000948905
1821 Std Error of Dependent Variable 0.237174711
1822 Standard Error of Estimate 0.219134121
1823 Sum of Squared Residuals 12.821276764
1824 Durbin-Watson Statistic 2.0293
1825
1826      Variable          Coeff       Std Error   T-Stat   Signif
1827 ****
1828 1. CONS_CONF_DIF{1}         0.214823560 0.109147850 1.96819 0.05008092
1829 2. CONS_CONF_DIF{2}         -0.228915376 0.155684253 -1.47038 0.14263567
1830 3. CONS_CONF_DIF{3}         0.148459839 0.110467568 1.34392 0.18011436
1831 4. FED_FUND_DIF{1}         0.097898405 0.060089662 1.62921 0.10444876
1832 5. FED_FUND_DIF{2}         0.248459999 0.058339100 4.25889 0.00002849
1833 6. FED_FUND_DIF{3}         0.161632899 0.057335855 2.81905 0.00517720
1834 7. Constant               0.001276139 0.013273853 0.09614 0.92348203
1835
1836 F-Tests, Dependent Variable FED_FUND_DIF
1837      Variable          F-Statistic   Signif
1838 ****
1839 CONS_CONF_DIF             1.3996     0.2432932
1840 FED_FUND_DIF              13.7956    0.0000000
1841
1842
1843 @varlagselect(lags=8,crit=sbc)
1844 # HOUSING_DIF FED_FUND_DIF
1845
1846 VAR Lag Selection
1847 Lags SBC/BIC
1848 0 3.65839723
1849 1 2.37411466
1850 2 2.32971150*
1851 3 2.36311444
1852 4 2.43405254
1853 5 2.46879059
1854 6 2.52321435
1855 7 2.60056429
1856 8 2.67141400
1857
1858 SYSTEM(MODEL=HOUSINGDIF_FEDFUND)
1859 VARIABLES HOUSING_DIF FED_FUND_DIF
1860 LAGS 1 TO 2
1861 DET Constant
1862 END(SYSTEM)
1863 ESTIMATE
1864
1865 VAR/System - Estimation by Least Squares

```

```

1866 Monthly Data From 2001:03 To 2024:01
1867 Usable Observations 275
1868
1869 Dependent Variable HOUSING_DIF
1870 Mean of Dependent Variable 0.9836727273
1871 Std Error of Dependent Variable 1.5431636271
1872 Standard Error of Estimate 0.7826675531
1873 Sum of Squared Residuals 165.39349463
1874 Durbin-Watson Statistic 2.0278
1875
1876      Variable          Coeff      Std Error      T-Stat      Signif
1877 ****
1878 1. HOUSING_DIF{1}      0.729306214  0.059701314  12.21592  0.00000000
1879 2. HOUSING_DIF{2}      0.152246912  0.059596014  2.55465  0.01117861
1880 3. FED_FUND_DIF{1}     0.398249711  0.205935079  1.93386  0.05417532
1881 4. FED_FUND_DIF{2}     -0.413368547  0.197356549 -2.09453  0.03714521
1882 5. Constant            0.110189390  0.057282988  1.92360  0.05545644
1883
1884 F-Tests, Dependent Variable HOUSING_DIF
1885      Variable          F-Statistic      Signif
1886 ****
1887 HOUSING DIF           376.5468  0.0000000
1888 FED FUND DIF          3.4489   0.0331883
1889
1890
1891 Dependent Variable FED_FUND_DIF
1892 Mean of Dependent Variable -0.000872727
1893 Std Error of Dependent Variable 0.236744885
1894 Standard Error of Estimate 0.221982800
1895 Sum of Squared Residuals 13.304618160
1896 Durbin-Watson Statistic 2.1063
1897
1898      Variable          Coeff      Std Error      T-Stat      Signif
1899 ****
1900 1. HOUSING_DIF{1}      -0.003436692  0.016932687 -0.20296  0.83931761
1901 2. HOUSING_DIF{2}      0.022520356  0.016902822  1.33234  0.18387090
1902 3. FED_FUND_DIF{1}     0.150239005  0.058407999  2.57223  0.01063956
1903 4. FED_FUND_DIF{2}     0.241406006  0.055974927  4.31275  0.00002263
1904 5. Constant            -0.018622068  0.016246793 -1.14620  0.25272738
1905
1906 F-Tests, Dependent Variable FED_FUND_DIF
1907      Variable          F-Statistic      Signif
1908 ****
1909 HOUSING_DIF           2.4462   0.0885392
1910 FED_FUND_DIF          15.0770  0.0000006
1911
1912 @varlagselect(lags=8,crit=sbc)
1913 # CONS CONF DIF HOUSING DIF
1914
1915 VAR Lag Selection
1916 Lags SBC/BIC
1917 0 3.78824084
1918 1 1.76898139
1919 2 1.16740230
1920 3 1.15588432*
1921 4 1.20930637
1922 5 1.27354278
1923 6 1.34372717
1924 7 1.41331552
1925 8 1.48039752
1926

```

```

1927 SYSTEM (MODEL=CONSCONF_HOUSINGDIF)
1928 VARIABLES CONS_CONF_DIF HOUSING_DIF
1929 LAGS 1 TO 3
1930 DET Constant
1931 END (SYSTEM)
1932 ESTIMATE
1933
1934 VAR/System - Estimation by Least Squares
1935 Monthly Data From 2001:04 To 2024:01
1936 Usable Observations 274
1937
1938 Dependent Variable CONS_CONF_DIF
1939 Mean of Dependent Variable -0.005999015
1940 Std Error of Dependent Variable 0.243881458
1941 Standard Error of Estimate 0.118123477
1942 Sum of Squared Residuals 3.7254925952
1943 Durbin-Watson Statistic 1.9367
1944
1945 Variable Coeff Std Error T-Stat Signif
1946 ****
1947 1. CONS_CONF_DIF{1} 1.436254911 0.058923107 24.37507 0.00000000
1948 2. CONS_CONF_DIF{2} -1.053387733 0.086144946 -12.22809 0.00000000
1949 3. CONS_CONF_DIF{3} 0.295122430 0.060105518 4.91007 0.00000159
1950 4. HOUSING_DIF{1} -0.010571984 0.009350577 -1.13062 0.25922812
1951 5. HOUSING_DIF{2} 0.015487611 0.011178514 1.38548 0.16706193
1952 6. HOUSING_DIF{3} -0.008505194 0.009342317 -0.91039 0.36343559
1953 7. Constant 0.002023097 0.008664591 0.23349 0.81555967
1954
1955 F-Tests, Dependent Variable CONS_CONF_DIF
1956 Variable F-Statistic Signif
1957 ****
1958 CONS_CONF_DIF 295.4613 0.0000000
1959 HOUSING_DIF 0.8898 0.4469027
1960
1961
1962 Dependent Variable HOUSING_DIF
1963 Mean of Dependent Variable 0.9844525547
1964 Std Error of Dependent Variable 1.5459330645
1965 Standard Error of Estimate 0.7765982272
1966 Sum of Squared Residuals 161.02898331
1967 Durbin-Watson Statistic 1.9842
1968
1969 Variable Coeff Std Error T-Stat Signif
1970 ****
1971 1. CONS_CONF_DIF{1} 0.770380760 0.387387683 1.98866 0.04775993
1972 2. CONS_CONF_DIF{2} -0.365998252 0.566356614 -0.64623 0.51868362
1973 3. CONS_CONF_DIF{3} -0.261607153 0.395161402 -0.66203 0.50852549
1974 4. HOUSING_DIF{1} 0.683720722 0.061475010 11.12193 0.00000000
1975 5. HOUSING_DIF{2} 0.119756313 0.073492709 1.62950 0.10438656
1976 6. HOUSING_DIF{3} 0.097229455 0.061420698 1.58301 0.11460340
1977 7. Constant 0.092609185 0.056965015 1.62572 0.10518886
1978
1979 F-Tests, Dependent Variable HOUSING_DIF
1980 Variable F-Statistic Signif
1981 ****
1982 CONS_CONF_DIF 3.7891 0.0109278
1983 HOUSING_DIF 269.1601 0.0000000
1984
1985 @varlagselect(lags=8,crit=sbc)
1986 # FED_FUND_DIF GOVT_JOBS_DIF
1987

```

```

1988 VAR Lag Selection
1989 Lags SBC/BIC
1990    0 10.7897302
1991    1 10.5938724
1992    2 10.5380307*
1993    3 10.5736027
1994    4 10.6275766
1995    5 10.6581004
1996    6 10.7299145
1997    7 10.8104777
1998    8 10.8672075
1999
2000 SYSTEM(MODEL=FEDFUND_GOVTJOBS)
2001 VARIABLES FED_FUND_DIF GOVT_JOBS_DIF
2002 LAGS 1 TO 2
2003 DET Constant
2004 END(SYSTEM)
2005 ESTIMATE
2006
2007 VAR/System - Estimation by Least Squares
2008 Monthly Data From 2001:03 To 2024:01
2009 Usable Observations          275
2010
2011 Dependent Variable FED FUND DIF
2012 Mean of Dependent Variable      -0.000872727
2013 Std Error of Dependent Variable 0.236744885
2014 Standard Error of Estimate     0.223338294
2015 Sum of Squared Residuals       13.467598225
2016 Durbin-Watson Statistic        2.1077
2017
2018      Variable           Coeff      Std Error      T-Stat      Signif
2019 ****
2020 1. FED_FUND_DIF{1}          0.167655311  0.058383328   2.87163  0.00440740
2021 2. FED_FUND_DIF{2}          0.254976398  0.055687579   4.57869  0.00000715
2022 3. GOVT_JOBS_DIF{1}         0.000302845  0.000285602   1.06038  0.28992133
2023 4. GOVT_JOBS_DIF{2}         -0.000028886  0.000285629  -0.10113  0.91952183
2024 5. Constant                -0.000175011  0.013498693  -0.01297  0.98966527
2025
2026 F-Tests, Dependent Variable FED_FUND_DIF
2027      Variable           F-Statistic      Signif
2028 ****
2029 FED_FUND_DIF                  17.8770  0.0000001
2030 GOVT_JOBS_DIF                 0.7829  0.4581208
2031
2032
2033 Dependent Variable GOVT_JOBS_DIF
2034 Mean of Dependent Variable     1.334545455
2035 Std Error of Dependent Variable 54.124795707
2036 Standard Error of Estimate    47.563467570
2037 Sum of Squared Residuals      610816.53077
2038 Durbin-Watson Statistic       1.9960
2039
2040      Variable           Coeff      Std Error      T-Stat      Signif
2041 ****
2042 1. FED_FUND_DIF{1}          9.80024857  12.43366503   0.78820  0.43126960
2043 2. FED_FUND_DIF{2}          -2.63016930  11.85956208  -0.22178  0.82465571
2044 3. GOVT_JOBS_DIF{1}         -0.55712541  0.06082345  -9.15971  0.000000000
2045 4. GOVT_JOBS_DIF{2}         -0.21127655  0.06082918  -3.47328  0.00059865
2046 5. Constant                2.73129461  2.87476296   0.95009  0.34291423
2047
2048 F-Tests, Dependent Variable GOVT_JOBS_DIF

```

```

2049          Variable          F-Statistic      Signif
2050  ****
2051  FED_FUND_DIF           0.3130        0.7315403
2052  GOVT_JOBS_DIF         42.3040       0.0000000
2053
2054 @varlagselect(lags=8,crit=sbc)
2055 # CONS_CONF_DIF GOVT_JOBS_DIF
2056
2057 VAR Lag Selection
2058 Lags SBC/BIC
2059   0 10.8958940
2060   1 9.9874927
2061   2 9.4044805
2062   3 9.3881527*
2063   4 9.4242808
2064   5 9.4881865
2065   6 9.5573341
2066   7 9.6304664
2067   8 9.7042769
2068
2069 SYSTEM(MODEL=CONSCONF_GOVTJOBS)
2070 VARIABLES CONS CONF DIF GOVT JOBS DIF
2071 LAGS 1 TO 2
2072 DET Constant
2073 END(SYSTEM)
2074 ESTIMATE
2075
2076 VAR/System - Estimation by Least Squares
2077 Monthly Data From 2001:03 To 2024:01
2078 Usable Observations          275
2079
2080 Dependent Variable CONS_CONF_DIF
2081 Mean of Dependent Variable      -0.006575745
2082 Std Error of Dependent Variable 0.243623813
2083 Standard Error of Estimate     0.123428448
2084 Sum of Squared Residuals       4.1133371024
2085 Durbin-Watson Statistic       1.5847
2086
2087      Variable          Coeff      Std Error      T-Stat      Signif
2088 ****
2089 1. CONS_CONF_DIF{1}          1.234053594  0.045266440  27.26200  0.00000000
2090 2. CONS_CONF_DIF{2}          -0.688226013  0.045079875 -15.26681  0.00000000
2091 3. GOVT_JOBS_DIF{1}         0.000103758  0.000158315   0.65539  0.51277469
2092 4. GOVT_JOBS_DIF{2}         -0.000065252  0.000158178  -0.41252  0.68028535
2093 5. Constant                -0.003401616  0.007475014  -0.45506  0.64942829
2094
2095 F-Tests, Dependent Variable CONS CONF DIF
2096      Variable          F-Statistic      Signif
2097 ****
2098 CONS_CONF_DIF              391.5204       0.0000000
2099 GOVT_JOBS_DIF             0.5417        0.5824130
2100
2101
2102 Dependent Variable GOVT_JOBS_DIF
2103 Mean of Dependent Variable      1.334545455
2104 Std Error of Dependent Variable 54.124795707
2105 Standard Error of Estimate     47.463217120
2106 Sum of Squared Residuals       608244.38442
2107 Durbin-Watson Statistic       1.9906
2108
2109      Variable          Coeff      Std Error      T-Stat      Signif

```

```

2110 ****
2111 1. CONS_CONF_DIF{1} 22.63387594 17.40677195 1.30029 0.19460994
2112 2. CONS_CONF_DIF{2} -19.63233821 17.33503018 -1.13252 0.25841892
2113 3. GOVT_JOBS_DIF{1} -0.56082656 0.06087861 -9.21221 0.00000000
2114 4. GOVT_JOBS_DIF{2} -0.21378647 0.06082595 -3.51472 0.00051605
2115 5. Constant 2.70808711 2.87444421 0.94213 0.34697059
2116
2117 F-Tests, Dependent Variable GOVT_JOBS_DIF
2118 Variable F-Statistic Signif
2119 ****
2120 CONS_CONF_DIF 0.8852 0.4138350
2121 GOVT_JOBS_DIF 42.7971 0.0000000
2122
2123 *Now to create our forecast, let's truncate ones that do exhibit causality
2124 SYSTEM(MODEL=HOUSINGDIF_FEDFUND_TRUNC)
2125 VARIABLES HOUSING_DIF FED_FUND_DIF
2126 LAGS 1 TO 2
2127 DET Constant
2128 END(SYSTEM)
2129 ESTIMATE * 2023:01
2130
2131 VAR/System - Estimation by Least Squares
2132 Monthly Data From 2001:03 To 2023:01
2133 Usable Observations 263
2134
2135 Dependent Variable HOUSING_DIF
2136 Mean of Dependent Variable 0.9338022814
2137 Std Error of Dependent Variable 1.5423269791
2138 Standard Error of Estimate 0.7771772469
2139 Sum of Squared Residuals 155.83315407
2140 Durbin-Watson Statistic 2.0475
2141
2142 Variable Coeff Std Error T-Stat Signif
2143 ****
2144 1. HOUSING_DIF{1} 0.724118488 0.060743447 11.92093 0.00000000
2145 2. HOUSING_DIF{2} 0.162262753 0.060765504 2.67031 0.00805947
2146 3. FED_FUND_DIF{1} 0.302033929 0.206973630 1.45929 0.14570257
2147 4. FED_FUND_DIF{2} -0.481507882 0.201454009 -2.39016 0.01755895
2148 5. Constant 0.100693749 0.057364633 1.75533 0.08039002
2149
2150 F-Tests, Dependent Variable HOUSING_DIF
2151 Variable F-Statistic Signif
2152 ****
2153 HOUSING_DIF 371.8472 0.0000000
2154 FED_FUND_DIF 3.4484 0.0332696
2155
2156
2157 Dependent Variable FED_FUND_DIF
2158 Mean of Dependent Variable -0.004714829
2159 Std Error of Dependent Variable 0.240082314
2160 Standard Error of Estimate 0.225353235
2161 Sum of Squared Residuals 13.102292760
2162 Durbin-Watson Statistic 2.0913
2163
2164 Variable Coeff Std Error T-Stat Signif
2165 ****
2166 1. HOUSING_DIF{1} -0.005013967 0.017613398 -0.28467 0.77612704
2167 2. HOUSING_DIF{2} 0.023253232 0.017619794 1.31972 0.18809763
2168 3. FED_FUND_DIF{1} 0.159876302 0.060014852 2.66395 0.00820930
2169 4. FED_FUND_DIF{2} 0.246356886 0.058414362 4.21740 0.00003423
2170 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)

```

```

2230 VARIABLES CONS_CONF_DIF HOUSING_DIF
2231 LAGS 1 TO 3
2232 DET Constant
2233 END(SYSTEM)
2234 ESTIMATE * 2023:01
2235
2236 VAR/System - Estimation by Least Squares
2237 Monthly Data From 2001:04 To 2023:01
2238 Usable Observations 262
2239
2240 Dependent Variable CONS_CONF_DIF
2241 Mean of Dependent Variable -0.012232214
2242 Std Error of Dependent Variable 0.239223121
2243 Standard Error of Estimate 0.117129039
2244 Sum of Squared Residuals 3.4983989950
2245 Durbin-Watson Statistic 1.9346
2246
2247      Variable          Coeff      Std Error      T-Stat      Signif
2248 ****
2249 1. CONS_CONF_DIF{1} 1.408813129 0.060345745 23.34569 0.00000000
2250 2. CONS_CONF_DIF{2} -1.009749680 0.087508777 -11.53884 0.00000000
2251 3. CONS_CONF_DIF{3} 0.274794237 0.060609228 4.53387 0.00000891
2252 4. HOUSING_DIF{1} -0.008044264 0.009508427 -0.84601 0.39833800
2253 5. HOUSING_DIF{2} 0.012400992 0.011369967 1.09068 0.27644337
2254 6. HOUSING_DIF{3} -0.009435572 0.009450999 -0.99837 0.31904750
2255 7. Constant 0.000863832 0.008638190 0.10000 0.92042166
2256
2257 F-Tests, Dependent Variable CONS_CONF_DIF
2258      Variable      F-Statistic      Signif
2259 ****
2260 CONS_CONF_DIF 272.6161 0.0000000
2261 HOUSING_DIF 0.8142 0.4869957
2262
2263
2264 Dependent Variable HOUSING_DIF
2265 Mean of Dependent Variable 0.9344274809
2266 Std Error of Dependent Variable 1.5452454133
2267 Standard Error of Estimate 0.7664558242
2268 Sum of Squared Residuals 149.80090528
2269 Durbin-Watson Statistic 2.0080
2270
2271      Variable          Coeff      Std Error      T-Stat      Signif
2272 ****
2273 1. CONS_CONF_DIF{1} 0.907883567 0.394883696 2.29912 0.02230719
2274 2. CONS_CONF_DIF{2} -0.552206597 0.572630090 -0.96433 0.33579217
2275 3. CONS_CONF_DIF{3} -0.201948682 0.396607845 -0.50919 0.61105949
2276 4. HOUSING_DIF{1} 0.673300426 0.062220172 10.82126 0.00000000
2277 5. HOUSING_DIF{2} 0.107949872 0.074401508 1.45091 0.14803401
2278 6. HOUSING_DIF{3} 0.124165955 0.061844384 2.00772 0.04572839
2279 7. Constant 0.087951508 0.056525615 1.55596 0.12095818
2280
2281 F-Tests, Dependent Variable HOUSING_DIF
2282      Variable      F-Statistic      Signif
2283 ****
2284 CONS_CONF_DIF 4.3115 0.0054789
2285 HOUSING_DIF 265.9262 0.0000000
2286
2287 FORECAST(MODEL=CONSCONF_HOUSINGDIF_TRUNC, FROM=2023:02, TO=2024:01, RESULT=VARFORE2, STD
ERRS=VARFORE2STD, PRINT)
2288
2289 Entry CONS_CONF_DIF HOUSING_DIF

```

```

2290      2023:02      0.19627434 0.888047537
2291      2023:03      0.04974190 0.824468516
2292      2023:04      -0.05335462 0.725441237
2293      2023:05      -0.07458531 0.660113013
2294      2023:06      -0.04076261 0.664790770
2295      2023:07      0.00008124 0.711843331
2296      2023:08      0.01793197 0.758609112
2297      2023:09      0.01129569 0.782578355
2298      2023:10      -0.00491154 0.785476925
2299      2023:11      -0.01630557 0.781168120
2300      2023:12      -0.01797156 0.781501533
2301      2024:01      -0.01335062 0.789673151
2302
2303 SET VARFORE2(2) 2023:02 2024:01 = VARFORE2(2)+HOUSING_PRICES{12}
2304 PRINT 2023:02 2024:01 VARFORE2(2)
2305
2306
2307 ENTRY      VARFORE2(2)
2308 2023:02      378.788047537
2309 2023:03      383.364468516
2310 2023:04      388.325441237
2311 2023:05      392.050113013
2312 2023:06      392.704790770
2313 2023:07      390.801843331
2314 2023:08      389.448609112
2315 2023:09      390.882578355
2316 2023:10      391.645476925
2317 2023:11      391.951168120
2318 2023:12      392.491501533
2319 2024:01      393.359673151
2320
2321
2322 @UFOREERRORS VARFORE2(2) HOUSING_PRICES
2323
2324 Forecast Analysis for VARFORE2(2)
2325 From 2023:02 to 2024:01
2326 Mean Error          -18.970524
2327 Mean Absolute Error  18.970524
2328 Root Mean Square Error 19.756821
2329 Mean Square Error   390.331960
2330 Theil's U            7.883457
2331
2332 Mean Pct Error       -0.048638
2333 Mean Abs Pct Error   0.048638
2334 Root Mean Square Pct Error 0.050599
2335 Theil's Relative U   7.859846
2336
2337

```