# Assignment 6 Spring 2020

**DUE DATE:** Wednesday $19^{th}$, May 2021.

I pledge to the Honor Code and to obey all rules for taking and performing homework assignments as specified by the course instructor.

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**There are two questions.**

**Question1.**

Consider the monthly unemployment rates of Michigan, Illinois, and Indiana from 1976.1 to 2017.2. Build a VAR model for this 3-dimensional time series. Simplify (or refine) the model by removing insignificant parameters with threshold of t-ratio 1.645, and perform model checking.The data are in m-unrate-MIILIN.txt.

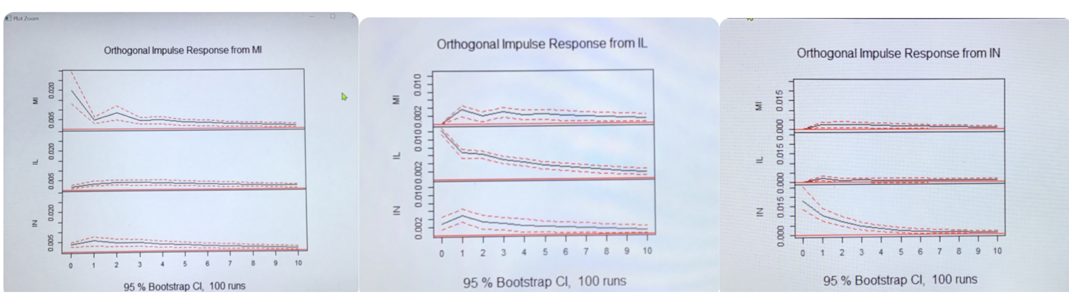
1.1 Write down the final fitted model.

Choose lag(2) according to BIC criteria with 1.645 threshold

Fitt model

$$
\begin{vmatrix} \widehat{MI} \\ \widehat{IL} \\ \widehat{IN} \end{vmatrix} = \begin{vmatrix} \begin{matrix} 0.192 \\ (0.0441) \end{matrix} & \begin{matrix} 0.206 \\ (0.0563) \end{matrix} & \begin{matrix} 0.130 \\ (0.0127) \end{matrix} \\ \begin{matrix} 0.105 \\ (0.0274) \end{matrix} & \begin{matrix} 0.528 \\ (0.0453) \end{matrix} & \begin{matrix} 0.101 \\ (0.0306) \end{matrix} \\ \begin{matrix} 0.152 \\ 0.0405 \end{matrix} & \begin{matrix} 0.273 \\ (0.0678) \end{matrix} & \begin{matrix} 0.574 \\ (0.0392) \end{matrix} \end{vmatrix} \begin{vmatrix} MI_{e-1} \\ IL_{t-1} \\ IN_{t-1} \end{vmatrix} + \begin{vmatrix} \begin{matrix} 0.3035 \\ (0.044) \end{matrix} & \begin{matrix} 0 \\ (0) \end{matrix} & \begin{matrix} 0 \\ (0) \end{matrix} \\ \begin{matrix} 0.0491 \\ (0.0279) \end{matrix} & \begin{matrix} 0.183 \\ (0.0441) \end{matrix} & \begin{matrix} 0.0849 \\ (0.0309) \end{matrix} \\ \begin{matrix} 0 \\ (0) \end{matrix} & \begin{matrix} -0.168 \\ (0.061) \end{matrix} & \begin{matrix} 0 \\ (0) \end{matrix} \end{vmatrix} \begin{vmatrix} MI_{t-2} \\ IL_{t+2} \\ IN_{t-2} \end{vmatrix}
$$

1.2 Obtain the plots of impulse response function of the fitted model and explain the relationship among the monthly unemployment rates of Michigan, Illinois, and Indiana from 1976.1 to 2017.2.

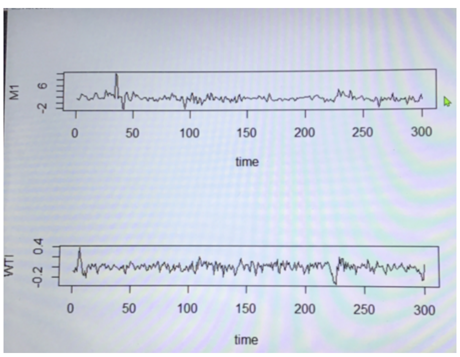


1.7. charge in MI unemployment rate will brings positively correlate effect to IL and IN. And, it is very strong effective for MI itself. After 1st period the effect will be lower and it will convert to steadly state point. For effect from IL, it positively impact MI, IL, IN for about 3 period and convert to steady state after.
In conclusion, the unemployment shock of each country will positively affect unemployment of others countries. (convert to stready state)

**Question2.**

Consider the monthly growth rate of M1 money supply of China and the growth rate of monthly crude oil price. The original data are from FRED. The crude oil prices are MCOILWTICO, Western Texas Intermediate. The data are in m-m1cnwti.txt with first column containing M1 series.

2.1 Obtain the time series plots of the bivariate time series, say $z_t$.



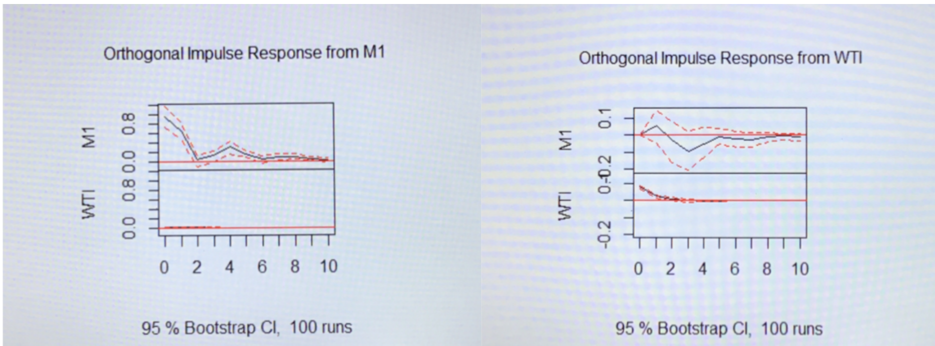

2.2 Build a VAR model for $z_t$, including simplification and model checking. Write down the fitted model.

Choose lag(3) according to BIC criteria with 1.645 threshold fit model

$$\begin{vmatrix} \widehat{MSG} \\ \widehat{COPG} \end{vmatrix} = \begin{vmatrix} 0.5039224 \\ 0.1021361 \\ 0 \\ 0 \end{vmatrix} + \begin{vmatrix} 0.671 & 0 \\ (0.0543) & (0) \\ 0 & 0.303 \\ (0) & (0.0554) \end{vmatrix} \begin{vmatrix} MSG_{t-1} \\ COPG_{t-1} \end{vmatrix} + \begin{vmatrix} -0.4093 & 0 \\ (0.06281) & (0) \\ 0.00964 & 0 \\ (0.0041) & (0) \end{vmatrix} \begin{vmatrix} MSG_{t-2} \\ COPG_{t-2} \end{vmatrix}$$

$$+ \begin{vmatrix} 0.37498 & 0 \\ (0.0544) & (0) \\ -0.00794 & 0 \\ (0.0041) & (0) \end{vmatrix} \begin{vmatrix} MSG_{t-3} \\ COPG_{t-2} \end{vmatrix}$$

2.3 Obtain the impulse response functions of the fitted model. What is the relationship between the M1 money supply of China and crude oil price, which represents commodity prices.




the shock from money supply growth will impact money supply growth for 10 period and convert to steady state and don't impact oil price growth. Shock from oil price growth doesn't have a clear impact on money supply growth and also impact oil price growth for 2 period.

2.4 Obtain 1-step to 6-step ahead predictions of $z_t$ at the forecast origin 2015.2.

```
$M1
           fcst      lower    upper       CI
 [1,] 0.8091018 -1.0789282 2.697132 1.888030
 [2,] 1.6764551 -0.6036171 3.956527 2.280072
 [3,] 1.4855759 -0.7964864 3.767638 2.282062
 [4,] 1.0923405 -1.2109109 3.395592 2.303251
 [5,] 1.2573493 -1.1234082 3.638107 2.380758
 [6,] 1.4498503 -0.9508618 3.850562 2.400712
 [7,] 1.3662892 -1.0357364 3.768315 2.402026
 [8,] 1.3033927 -1.1039559 3.710741 2.407349
 [9,] 1.3667206 -1.0480193 3.781460 2.414740
[10,] 1.3986825 -1.0176658 3.815031 2.416348

$WTI
               fcst      lower     upper        CI
 [1,]  3.680456e-02 -0.1211647 0.1947738 0.1579692
 [2,]  1.511540e-02 -0.1499850 0.1802158 0.1651004
 [3,]  6.096637e-03 -0.1615940 0.1737873 0.1676906
 [4,]  9.409539e-03 -0.1583044 0.1771235 0.1677139
 [5,]  2.392189e-03 -0.1655178 0.1703022 0.1679100
 [6,] -9.518535e-05 -0.1680471 0.1678567 0.1679519
 [7,]  3.473865e-03 -0.1645145 0.1714622 0.1679883
 [8,]  4.839982e-03 -0.1631489 0.1728288 0.1679889
 [9,]  3.278123e-03 -0.1647147 0.1712709 0.1679928
[10,]  2.993862e-03 -0.1650007 0.1709884 0.1679946
```

2.5 Obtain the forecast error variance decomposition and explain it.

```
> #2.5
> fevd(varfit,n.ahead = 6)
$M1
            M1         WTI
[1,] 1.0000000 0.000000000
[2,] 0.9976640 0.002336045
[3,] 0.9971155 0.002884469
[4,] 0.9908030 0.009196979
[5,] 0.9896296 0.010370432
[6,] 0.9897108 0.010289214

$WTI
             M1       WTI
[1,] 0.01089392 0.9891061
[2,] 0.01477258 0.9852274
[3,] 0.03227375 0.9677262
[4,] 0.03247842 0.9675216
[5,] 0.03407249 0.9659275
[6,] 0.03405620 0.9659438
```

The money supply growth will be affected by itself 100% at current period, 0% from oil price growth. However, there are shocks after next period for 6 period ahead of money supply growth will be affect by itself 98.9%, 1.03% from oil price growth. For oil price growth, 6 period ahead, effect from money supply will be 3.4%, 96.6% from itself.