

VAR / SVAR

2024-10-31

```
library(vars)
```

```
## Warning: 패키지 'vars'는 R 버전 4.3.3 에서 작성되었습니다
```

```
## 필요한 패키지를 로딩중입니다: MASS
```

```
## 필요한 패키지를 로딩중입니다: strucchange
```

```
## Warning: 패키지 'strucchange'는 R 버전 4.3.3 에서 작성되었습니다
```

```
## 필요한 패키지를 로딩중입니다: zoo
```

```
## Warning: 패키지 'zoo'는 R 버전 4.3.3 에서 작성되었습니다
```

```
##
```

```
## 다음의 패키지를 부착합니다: 'zoo'
```

```
## The following objects are masked from 'package:base':
```

```
##
```

```
##      as.Date, as.Date.numeric
```

```
## 필요한 패키지를 로딩중입니다: sandwich
```

```
## Warning: 패키지 'sandwich'는 R 버전 4.3.3 에서 작성되었습니다
```

```
## 필요한 패키지를 로딩중입니다: urca
```

```
## Warning: 패키지 'urca'는 R 버전 4.3.3 에서 작성되었습니다
```

```
## 필요한 패키지를 로딩중입니다: lmtest
```

```
## Warning: 패키지 'lmtest'는 R 버전 4.3.2 에서 작성되었습니다
```

```
library(svars)
```

```
## Warning: 패키지 'svars'는 R 버전 4.3.3 에서 작성되었습니다
```

```
## Registered S3 method overwritten by 'svars':
```

```
##      method          from
```

```
##      stability.varest vars
```

```
library(readxl)
```

```
## Warning: 패키지 'readxl'는 R 버전 4.3.3 에서 작성되었습니다
```

```
insurance = read_excel("C:/temp/seed/insurance.xlsx")
```

```
head(insurance)
```

```
## # A tibble: 6 × 9
##   date      CD unemployment      CCI      CPI      KOSPI      whole annuity universal
##   <chr> <dbl>      <dbl>      <dbl>      <dbl>      <dbl>      <dbl>      <dbl>      <dbl>
## 1 2014...    0      -0.1    9.92e-4  4.15e-3 -0.0190  1.61e-3 -1.73e-3 -0.00127
## 2 2014...    0      0.400 -2.99e-3 -2.70e-3  0.0553  1.48e-3  1.38e-3  0.00131
## 3 2014...    0      -0.6    9.95e-4 -8.25e-4 -0.0170 -1.51e-3  1.43e-3  0.00041
## 4 2014...    0      0.4    -2.98e-3 -1.19e-3 -0.0149  3.00e-5 -2.10e-3 -0.00171
## 5 2014...    0      -0.3    -2.00e-3  9.96e-4  0.0288 -1.52e-3  7.00e-4  0.00109
## 6 2014...    0      0.1    3.99e-3 -2.93e-3 -0.0131  4.51e-3 -3.40e-4 -0.000210

tail(insurance)

## # A tibble: 6 × 9
##   date      CD unemployment      CCI      CPI      KOSPI      whole annuity
##   <chr>      <dbl>      <dbl>      <dbl>      <dbl>      <dbl>      <dbl>
## 1 2022_07  0.0743      0      0.000990 -0.00179  0.191  0.00143  1.12e-3
## 2 2022_08 -0.0451     -0.300  0.00197 -0.00571 -0.0414  0.0000100 -5.60e-4
## 3 2022_09 -0.0705      0.500 -0.00494  0.00267 -0.145  0.00145 -5.60e-4
## 4 2022_10  0.128     -0.200 -0.000000974  0.00137  0.199 -0.00291  2.79e-3
## 5 2022_11 -0.126     -0.100 -0.00397 -0.00394  0.0130  0.00292  2.28e-3
## 6 2022_12 -0.0707      0.400 -0.0000247  0.00257 -0.175 -0.00146 -6.63e-3
## # [i] 1 more variable: universal <dbl>

insurance = subset(insurance, select = -date)
str(insurance)

## tibble [108 × 8] (S3: tbl_df/tbl/data.frame)
##  $ CD          : num [1:108] 0 0 0 0 0 ...
##  $ unemployment: num [1:108] -0.1 0.4 -0.6 0.4 -0.3 ...
##  $ CCI          : num [1:108] 0.000992 -0.00299 0.000995 -0.002985 -0.002002 ...
##  $ CPI          : num [1:108] 0.004147 -0.002696 -0.000825 -0.001191 0.000996 ...
##  $ KOSPI        : num [1:108] -0.019 0.0553 -0.017 -0.0149 0.0288 ...
##  $ whole        : num [1:108] 0.00161 0.00148 -0.00151 0.00003 -0.00152 ...
##  $ annuity      : num [1:108] -0.00173 0.00138 0.00143 -0.0021 0.0007 ...
##  $ universal    : num [1:108] -0.00127 0.00131 0.00041 -0.00171 0.00109 ...

insurance_whole = subset(insurance, select = c(CD, unemployment, CCI, CPI, KOSPI, whole))
head(insurance_whole)

## # A tibble: 6 × 6
##   CD unemployment      CCI      CPI      KOSPI      whole
##   <dbl>      <dbl>      <dbl>      <dbl>      <dbl>      <dbl>
## 1      0      -0.1    0.000992  0.00415 -0.0190  0.00161
## 2      0      0.400 -0.00299 -0.00270  0.0553  0.00148
## 3      0      -0.6    0.000995 -0.000825 -0.0170 -0.00151
## 4      0      0.4    -0.00298 -0.00119 -0.0149  0.0000300
## 5      0     -0.3    -0.00200  0.000996  0.0288 -0.00152
## 6      0      0.1    0.00399 -0.00293 -0.0131  0.00451

insurance_annuity = subset(insurance, select = c(CD, unemployment, CCI, CPI, KOSPI, annuity))
head(insurance_annuity)

## # A tibble: 6 × 6
##   CD unemployment      CCI      CPI      KOSPI      annuity
##   <dbl>      <dbl>      <dbl>      <dbl>      <dbl>      <dbl>
## 1      0      -0.1    0.000992  0.00415 -0.0190 -0.00173
## 2      0      0.400 -0.00299 -0.00270  0.0553  0.00138
## 3      0      -0.6    0.000995 -0.000825 -0.0170  0.00143
## 4      0      0.4    -0.00298 -0.00119 -0.0149 -0.00210
```

```
## 5      0      -0.3    -0.00200    0.000996    0.0288    0.000700
## 6      0      0.1     0.00399   -0.00293   -0.0131   -0.000340

insurance_universal = subset(insurance, select = c(CD, unemployment, CCI, CPI, KOSPI, universal))
head(insurance_universal)

## # A tibble: 6 × 6
##      CD unemployment      CCI      CPI      KOSPI universal
##    <dbl>      <dbl>    <dbl>    <dbl>    <dbl>      <dbl>
## 1      0      -0.1    0.000992  0.00415  -0.0190  -0.00127
## 2      0      0.400 -0.00299  -0.00270   0.0553   0.00131
## 3      0      -0.6    0.000995 -0.000825  -0.0170   0.00041
## 4      0      0.4    -0.00298  -0.00119  -0.0149  -0.00171
## 5      0      -0.3   -0.00200    0.000996   0.0288   0.00109
## 6      0      0.1     0.00399  -0.00293  -0.0131  -0.000210

max_lags = 12
lag_selection_whole = VARselect(insurance_whole, lag.max = max_lags, type = "const")
print(lag_selection_whole$selection)

## AIC(n)  HQ(n)  SC(n) FPE(n)
##      12      12      1      12

lag_selection_annuity = VARselect(insurance_annuity, lag.max = max_lags, type = "const")
print(lag_selection_annuity$selection)

## AIC(n)  HQ(n)  SC(n) FPE(n)
##      12      12      1      12

lag_selection_universal = VARselect(insurance_universal, lag.max = max_lags, type = "const")
print(lag_selection_universal$selection)

## AIC(n)  HQ(n)  SC(n) FPE(n)
##      12      12      1      12
```

##최적시차 문제!!! 10~15 사이에서 max_lags 를 설정했는데 max_lags 값에 따라서 최적시차가 결정됨 -> 일관적이지 않음

##그래서 우선 sc(n)은 계속 1 이 나와서 p=1 로 분석을 진행하긴 할건데 일관된 최적시차가 아니라서 이래도 될런지~

```
var_model_whole = VAR(insurance_whole, p=1)
summary(var_model_whole)

##
## VAR Estimation Results:
## =====
## Endogenous variables: CD, unemployment, CCI, CPI, KOSPI, whole
## Deterministic variables: const
## Sample size: 107
## Log Likelihood: 1586.205
## Roots of the characteristic polynomial:
## 0.5927 0.5927 0.5021 0.3944 0.3944 0.1216
## Call:
## VAR(y = insurance_whole, p = 1)
##
##
## Estimation results for equation CD:
```

```

## =====
## CD = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + whole.l1 + const
##
##               Estimate Std. Error t value Pr(>|t|)
## CD.l1          -0.3925753  0.0947837  -4.142 7.21e-05 ***
## unemployment.l1 0.0008732  0.0152177   0.057  0.954
## CCI.l1          0.8624571  1.7212058   0.501  0.617
## CPI.l1         -0.3850176  1.4020172  -0.275  0.784
## KOSPI.l1       -0.0822362  0.0890453  -0.924  0.358
## whole.l1        0.3664926  0.7186978   0.510  0.611
## const          0.0004669  0.0057855   0.081  0.936
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.05982 on 100 degrees of freedom
## Multiple R-Squared: 0.1774, Adjusted R-squared: 0.128
## F-statistic: 3.593 on 6 and 100 DF, p-value: 0.00288
##
##
## Estimation results for equation unemployment:
## =====
## unemployment = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + whole.l1 + const
##
##               Estimate Std. Error t value Pr(>|t|)
## CD.l1          -1.084637  0.499541  -2.171  0.0323 *
## unemployment.l1 -0.608760  0.080202  -7.590 1.71e-11 ***
## CCI.l1         -0.567193  9.071326  -0.063  0.9503
## CPI.l1          2.486536  7.389096   0.337  0.7372
## KOSPI.l1        0.451510  0.469298   0.962  0.3383
## whole.l1       -3.679004  3.787776  -0.971  0.3338
## const          0.002189  0.030491   0.072  0.9429
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.3153 on 100 degrees of freedom
## Multiple R-Squared: 0.3897, Adjusted R-squared: 0.3531
## F-statistic: 10.64 on 6 and 100 DF, p-value: 4.051e-09
##
##
## Estimation results for equation CCI:
## =====
## CCI = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + whole.l1 + const
##
##               Estimate Std. Error t value Pr(>|t|)
## CD.l1           1.248e-02  5.321e-03   2.345  0.0210 *
## unemployment.l1 -4.865e-04  8.543e-04  -0.570  0.5703
## CCI.l1         -1.877e-01  9.663e-02  -1.942  0.0549 .
## CPI.l1          3.843e-02  7.871e-02   0.488  0.6264
## KOSPI.l1       -3.301e-03  4.999e-03  -0.660  0.5105
## whole.l1        4.335e-02  4.035e-02   1.075  0.2852
## const         -9.438e-05  3.248e-04  -0.291  0.7720
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.003358 on 100 degrees of freedom
## Multiple R-Squared: 0.1091, Adjusted R-squared: 0.05563
## F-statistic: 2.041 on 6 and 100 DF, p-value: 0.06711

```

```

##
##
## Estimation results for equation CPI:
## =====
## CPI = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + whole.l1 + const
##
##               Estimate Std. Error t value Pr(>|t|)
## CD.l1          7.378e-03  6.313e-03   1.169   0.2453
## unemployment.l1 1.250e-03  1.014e-03   1.233   0.2205
## CCI.l1          9.830e-02  1.146e-01   0.857   0.3932
## CPI.l1         -2.446e-01  9.338e-02  -2.619   0.0102 *
## KOSPI.l1        6.960e-03  5.931e-03   1.173   0.2434
## whole.l1        1.085e-01  4.787e-02   2.267   0.0255 *
## const          -4.427e-05  3.854e-04  -0.115   0.9088
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.003985 on 100 degrees of freedom
## Multiple R-Squared: 0.1344, Adjusted R-squared: 0.0825
## F-statistic: 2.589 on 6 and 100 DF, p-value: 0.02255
##
##
## Estimation results for equation KOSPI:
## =====
## KOSPI = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + whole.l1 + const
##
##               Estimate Std. Error t value Pr(>|t|)
## CD.l1          0.1613471  0.0945846   1.706   0.0911 .
## unemployment.l1 0.0117567  0.0151858   0.774   0.4406
## CCI.l1          0.7863557  1.7175902   0.458   0.6481
## CPI.l1         -1.2311697  1.3990721  -0.880   0.3810
## KOSPI.l1       -0.5252122  0.0888582  -5.911 4.75e-08 ***
## whole.l1        0.8839511  0.7171881   1.233   0.2206
## const          -0.0002503  0.0057733  -0.043   0.9655
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.0597 on 100 degrees of freedom
## Multiple R-Squared: 0.2825, Adjusted R-squared: 0.2395
## F-statistic: 6.563 on 6 and 100 DF, p-value: 7.21e-06
##
##
## Estimation results for equation whole:
## =====
## whole = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + whole.l1 + const
##
##               Estimate Std. Error t value Pr(>|t|)
## CD.l1          1.871e-02  1.005e-02   1.862   0.0655 .
## unemployment.l1 1.813e-03  1.613e-03   1.124   0.2638
## CCI.l1          2.009e-01  1.825e-01   1.101   0.2736
## CPI.l1         -2.014e-01  1.486e-01  -1.355   0.1783
## KOSPI.l1       -4.079e-03  9.439e-03  -0.432   0.6666
## whole.l1       -6.016e-01  7.618e-02  -7.897 3.78e-12 ***
## const          2.044e-05  6.133e-04   0.033   0.9735
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##

```

```

## Residual standard error: 0.006342 on 100 degrees of freedom
## Multiple R-Squared: 0.462, Adjusted R-squared: 0.4297
## F-statistic: 14.31 on 6 and 100 DF, p-value: 1.029e-11
##
##
## Covariance matrix of residuals:
##          CD unemployment      CCI      CPI      KOSPI
## CD      3.579e-03 -2.868e-03  1.189e-06 -2.129e-05  4.399e-04
## unemployment -2.868e-03  9.941e-02 -9.882e-05  2.090e-04 -6.791e-04
## CCI      1.189e-06 -9.882e-05  1.128e-05 -5.426e-07  1.048e-05
## CPI     -2.129e-05  2.090e-04 -5.426e-07  1.588e-05 -1.272e-05
## KOSPI    4.399e-04 -6.791e-04  1.048e-05 -1.272e-05  3.564e-03
## whole   -4.234e-05 -9.658e-05 -2.102e-06  2.801e-06  7.191e-06
##          whole
## CD      -4.234e-05
## unemployment -9.658e-05
## CCI      -2.102e-06
## CPI      2.801e-06
## KOSPI    7.191e-06
## whole   4.021e-05
##
## Correlation matrix of residuals:
##          CD unemployment      CCI      CPI      KOSPI      whole
## CD      1.000000 -0.15207  0.005918 -0.08930  0.12318 -0.11160
## unemployment -0.152073  1.00000 -0.093327  0.16638 -0.03608 -0.04831
## CCI      0.005918 -0.09333  1.000000 -0.04055  0.05226 -0.09869
## CPI     -0.089299  0.16638 -0.040546  1.00000 -0.05349  0.11085
## KOSPI    0.123183 -0.03608  0.052261 -0.05349  1.00000  0.01899
## whole   -0.111598 -0.04831 -0.098688  0.11085  0.01899  1.00000

var_model_annuity = VAR(insurance_annuity, p=1)
summary(var_model_annuity)

##
## VAR Estimation Results:
## =====
## Endogenous variables: CD, unemployment, CCI, CPI, KOSPI, annuity
## Deterministic variables: const
## Sample size: 107
## Log Likelihood: 1626.283
## Roots of the characteristic polynomial:
## 0.6423 0.6423 0.455 0.3611 0.3611 0.1214
## Call:
## VAR(y = insurance_annuity, p = 1)
##
##
## Estimation results for equation CD:
## =====
## CD = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + annuity.l1 + const
##
##          Estimate Std. Error t value Pr(>|t|)
## CD.l1      -0.4060854  0.0931553  -4.359 3.17e-05 ***
## unemployment.l1 -0.0001934  0.0151032  -0.013  0.990
## CCI.l1      0.5878375  1.7762961  0.331  0.741
## CPI.l1     -0.3831947  1.4032579  -0.273  0.785
## KOSPI.l1    -0.0788260  0.0893838  -0.882  0.380
## annuity.l1   -0.3102048  1.0706522  -0.290  0.773
## const      0.0004767  0.0057905  0.082  0.935
## ---

```

```

## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.05988 on 100 degrees of freedom
## Multiple R-Squared: 0.1759, Adjusted R-squared: 0.1265
## F-statistic: 3.558 on 6 and 100 DF, p-value: 0.003099
##
##
## Estimation results for equation unemployment:
## =====
## unemployment = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + annuity.l1 + const
##
##              Estimate Std. Error t value Pr(>|t|)
## CD.l1          -0.976040   0.492829  -1.980   0.0504 .
## unemployment.l1 -0.598578   0.079902  -7.491 2.77e-11 ***
## CCI.l1           0.869798   9.397332   0.093   0.9264
## CPI.l1           2.480836   7.423807   0.334   0.7389
## KOSPI.l1         0.436421   0.472877   0.923   0.3583
## annuity.l1       0.298105   5.664187   0.053   0.9581
## const           0.002116   0.030634   0.069   0.9451
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.3168 on 100 degrees of freedom
## Multiple R-Squared: 0.384, Adjusted R-squared: 0.347
## F-statistic: 10.39 on 6 and 100 DF, p-value: 6.289e-09
##
##
## Estimation results for equation CCI:
## =====
## CCI = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + annuity.l1 + const
##
##              Estimate Std. Error t value Pr(>|t|)
## CD.l1           1.233e-02  5.160e-03   2.390   0.0187 *
## unemployment.l1 -5.845e-04  8.366e-04  -0.699   0.4863
## CCI.l1          -1.493e-01  9.839e-02  -1.518   0.1323
## CPI.l1           3.797e-02  7.773e-02   0.489   0.6263
## KOSPI.l1        -3.925e-03  4.951e-03  -0.793   0.4298
## annuity.l1       1.144e-01  5.930e-02   1.929   0.0565 .
## const          -9.461e-05  3.207e-04  -0.295   0.7686
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.003317 on 100 degrees of freedom
## Multiple R-Squared: 0.1311, Adjusted R-squared: 0.07901
## F-statistic: 2.516 on 6 and 100 DF, p-value: 0.02612
##
##
## Estimation results for equation CPI:
## =====
## CPI = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + annuity.l1 + const
##
##              Estimate Std. Error t value Pr(>|t|)
## CD.l1           4.594e-03  6.349e-03   0.724   0.471
## unemployment.l1  9.576e-04  1.029e-03   0.930   0.355
## CCI.l1           7.638e-02  1.211e-01   0.631   0.530
## CPI.l1          -2.446e-01  9.564e-02  -2.558   0.012 *
## KOSPI.l1         7.108e-03  6.092e-03   1.167   0.246

```

```

## annuity.l1      3.487e-02  7.297e-02  0.478  0.634
## const          -4.253e-05  3.947e-04 -0.108  0.914
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.004081 on 100 degrees of freedom
## Multiple R-Squared: 0.09202, Adjusted R-squared: 0.03755
## F-statistic: 1.689 on 6 and 100 DF, p-value: 0.1314
##
##
## Estimation results for equation KOSPI:
## =====
## KOSPI = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + annuity.l1 + const
##
##              Estimate Std. Error t value Pr(>|t|)
## CD.l1         0.1430615  0.0933578  1.532  0.129
## unemployment.l1 0.0094618  0.0151360  0.625  0.533
## CCI.l1        0.8223773  1.7801583  0.462  0.645
## CPI.l1       -1.2334403  1.4063090 -0.877  0.383
## KOSPI.l1     -0.5271175  0.0895782 -5.884 5.34e-08 ***
## annuity.l1    0.7418967  1.0729801  0.691  0.491
## const       -0.0002403  0.0058031 -0.041  0.967
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.06001 on 100 degrees of freedom
## Multiple R-Squared: 0.2751, Adjusted R-squared: 0.2316
## F-statistic: 6.325 on 6 and 100 DF, p-value: 1.149e-05
##
##
## Estimation results for equation annuity:
## =====
## annuity = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + annuity.l1 + const
##
##              Estimate Std. Error t value Pr(>|t|)
## CD.l1         5.422e-04  6.672e-03  0.081  0.9354
## unemployment.l1 5.724e-04  1.082e-03  0.529  0.5979
## CCI.l1        9.548e-02  1.272e-01  0.750  0.4548
## CPI.l1       -2.061e-01  1.005e-01 -2.051  0.0429 *
## KOSPI.l1     5.849e-04  6.402e-03  0.091  0.9274
## annuity.l1   -6.515e-01  7.669e-02 -8.496 1.92e-13 ***
## const        2.071e-05  4.148e-04  0.050  0.9603
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.004289 on 100 degrees of freedom
## Multiple R-Squared: 0.4699, Adjusted R-squared: 0.438
## F-statistic: 14.77 on 6 and 100 DF, p-value: 5.075e-12
##
##
## Covariance matrix of residuals:
##              CD unemployment      CCI      CPI      KOSPI
## CD          3.585e-03  -2.959e-03  3.400e-06 -1.819e-05  4.696e-04
## unemployment -2.959e-03   1.003e-01 -1.109e-04  1.810e-04 -9.113e-04
## CCI          3.400e-06  -1.109e-04  1.100e-05 -3.414e-07  1.048e-05
## CPI         -1.819e-05  1.810e-04 -3.414e-07  1.666e-05 -6.886e-06

```



```

## KOSPI      4.696e-04 -9.113e-04 1.048e-05 -6.886e-06 3.601e-03
## annuity    -2.677e-05 5.824e-05 -2.342e-06 -3.442e-07 2.963e-05
## annuity
## CD         -2.677e-05
## unemployment 5.824e-05
## CCI        -2.342e-06
## CPI        -3.442e-07
## KOSPI      2.963e-05
## annuity    1.839e-05
##
## Correlation matrix of residuals:
##          CD unemployment      CCI      CPI      KOSPI  annuity
## CD          1.00000      -0.15600  0.01712 -0.07445  0.13069 -0.10423
## unemployment -0.15600      1.00000 -0.10560  0.14004 -0.04794  0.04287
## CCI          0.01712      -0.10560  1.00000 -0.02522  0.05265 -0.16464
## CPI          -0.07445      0.14004 -0.02522  1.00000 -0.02812 -0.01966
## KOSPI        0.13069      -0.04794  0.05265 -0.02812  1.00000  0.11513
## annuity     -0.10423      0.04287 -0.16464 -0.01966  0.11513  1.00000

var_model_universal = VAR(insurance_universal, p=1)
summary(var_model_universal)

##
## VAR Estimation Results:
## =====
## Endogenous variables: CD, unemployment, CCI, CPI, KOSPI, universal
## Deterministic variables: const
## Sample size: 107
## Log Likelihood: 1655.944
## Roots of the characteristic polynomial:
## 0.6766 0.5977 0.4386 0.3823 0.3823 0.1537
## Call:
## VAR(y = insurance_universal, p = 1)
##
##
## Estimation results for equation CD:
## =====
## CD = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + universal.l1 + const
##
##          Estimate Std. Error t value Pr(>|t|)
## CD.l1      -0.4110554  0.0929754 -4.421 2.5e-05 ***
## unemployment.l1 -0.0009252  0.0151029 -0.061 0.951
## CCI.l1       0.5706440  1.7137211  0.333 0.740
## CPI.l1      -0.2445087  1.4123719 -0.173 0.863
## KOSPI.l1     -0.0768937  0.0890395 -0.864 0.390
## universal.l1  -1.0150751  1.3560005 -0.749 0.456
## const       0.0004794  0.0057768  0.083 0.934
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.05974 on 100 degrees of freedom
## Multiple R-Squared: 0.1798, Adjusted R-squared: 0.1306
## F-statistic: 3.654 on 6 and 100 DF, p-value: 0.002542
##
##
## Estimation results for equation unemployment:
## =====
## unemployment = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + universal.l1 + const
##

```

```

##               Estimate Std. Error t value Pr(>|t|)
## CD.l1         -0.942698   0.492033  -1.916   0.0582 .
## unemployment.l1 -0.595037   0.079926  -7.445 3.48e-11 ***
## CCI.l1         1.470733   9.069153   0.162   0.8715
## CPI.l1         1.844055   7.474389   0.247   0.8056
## KOSPI.l1       0.420037   0.471204   0.891   0.3748
## universal.l1    4.624232   7.176066   0.644   0.5208
## const         0.002094   0.030571   0.068   0.9455
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.3161 on 100 degrees of freedom
## Multiple R-Squared:  0.3865, Adjusted R-squared:  0.3497
## F-statistic: 10.5 on 6 and 100 DF, p-value: 5.183e-09
##
##
## Estimation results for equation CCI:
## =====
## CCI = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + universal.l1 + const
##
##               Estimate Std. Error t value Pr(>|t|)
## CD.l1         1.201e-02  5.214e-03  2.303  0.0234 *
## unemployment.l1 -5.291e-04  8.469e-04  -0.625  0.5335
## CCI.l1        -1.871e-01  9.610e-02  -1.947  0.0543 .
## CPI.l1         2.487e-02  7.920e-02   0.314  0.7542
## KOSPI.l1       -3.540e-03  4.993e-03  -0.709  0.4799
## universal.l1    9.866e-02  7.604e-02   1.298  0.1974
## const        -9.409e-05  3.239e-04  -0.290  0.7721
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.00335 on 100 degrees of freedom
## Multiple R-Squared:  0.1137, Adjusted R-squared:  0.06054
## F-statistic: 2.139 on 6 and 100 DF, p-value: 0.0554
##
##
## Estimation results for equation CPI:
## =====
## CPI = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + universal.l1 + const
##
##               Estimate Std. Error t value Pr(>|t|)
## CD.l1         4.450e-03  6.357e-03   0.700  0.4856
## unemployment.l1 9.700e-04  1.033e-03   0.939  0.3498
## CCI.l1         6.393e-02  1.172e-01   0.546  0.5866
## CPI.l1        -2.478e-01  9.657e-02  -2.566  0.0118 *
## KOSPI.l1       7.248e-03  6.088e-03   1.191  0.2366
## universal.l1    2.430e-02  9.272e-02   0.262  0.7938
## const        -4.233e-05  3.950e-04  -0.107  0.9149
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.004084 on 100 degrees of freedom
## Multiple R-Squared:  0.09058, Adjusted R-squared:  0.03601
## F-statistic: 1.66 on 6 and 100 DF, p-value: 0.1387
##
##
## Estimation results for equation KOSPI:

```

```

## =====
## KOSPI = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + universal.l1 + const
##
##              Estimate Std. Error t value Pr(>|t|)
## CD.l1          0.1388164  0.0935882   1.483   0.141
## unemployment.l1 0.0096092  0.0152025   0.632   0.529
## CCI.l1          0.5334717  1.7250163   0.309   0.758
## CPI.l1         -1.2807898  1.4216810  -0.901   0.370
## KOSPI.l1        -0.5235355  0.0896264  -5.841 6.48e-08 ***
## universal.l1     0.3671835  1.3649380   0.269   0.788
## const          -0.0002354  0.0058149  -0.040   0.968
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.06013 on 100 degrees of freedom
## Multiple R-Squared: 0.2722, Adjusted R-squared: 0.2285
## F-statistic: 6.232 on 6 and 100 DF, p-value: 1.379e-05
##
##
## Estimation results for equation universal:
## =====
## universal = CD.l1 + unemployment.l1 + CCI.l1 + CPI.l1 + KOSPI.l1 + universal.l1 + const
##
##              Estimate Std. Error t value Pr(>|t|)
## CD.l1          3.017e-03  4.983e-03   0.606   0.5462
## unemployment.l1 1.934e-04  8.094e-04   0.239   0.8117
## CCI.l1          5.471e-02  9.184e-02   0.596   0.5527
## CPI.l1         -1.562e-01  7.569e-02  -2.064   0.0416 *
## KOSPI.l1        2.469e-03  4.772e-03   0.517   0.6060
## universal.l1    -6.576e-01  7.267e-02  -9.049 1.2e-14 ***
## const          7.257e-06  3.096e-04   0.023   0.9813
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.003201 on 100 degrees of freedom
## Multiple R-Squared: 0.4993, Adjusted R-squared: 0.4693
## F-statistic: 16.62 on 6 and 100 DF, p-value: 3.265e-13
##
##
## Covariance matrix of residuals:
##              CD unemployment      CCI      CPI      KOSPI
## CD          3.568e-03  -2.871e-03  4.233e-06 -1.805e-05  4.696e-04
## unemployment -2.871e-03   9.993e-02 -1.187e-04  1.792e-04 -9.373e-04
## CCI          4.233e-06  -1.187e-04  1.122e-05 -2.632e-07  1.243e-05
## CPI         -1.805e-05   1.792e-04 -2.632e-07  1.668e-05 -6.250e-06
## KOSPI        4.696e-04  -9.373e-04  1.243e-05 -6.250e-06  3.615e-03
## universal    -3.045e-05   3.377e-05 -2.709e-07  1.468e-06  1.240e-05
## universal
## CD          -3.045e-05
## unemployment 3.377e-05
## CCI         -2.709e-07
## CPI          1.468e-06
## KOSPI        1.240e-05
## universal    1.025e-05
##
## Correlation matrix of residuals:
##              CD unemployment      CCI      CPI      KOSPI universal

```

```

## CD      1.00000 -0.15203 0.02116 -0.07399 0.13075 -0.15923
## unemployment -0.15203 1.00000 -0.11212 0.13878 -0.04931 0.03337
## CCI      0.02116 -0.11212 1.00000 -0.01923 0.06172 -0.02526
## CPI      -0.07399 0.13878 -0.01923 1.00000 -0.02545 0.11224
## KOSPI     0.13075 -0.04931 0.06172 -0.02545 1.00000 0.06442
## universal -0.15923 0.03337 -0.02526 0.11224 0.06442 1.00000

n=6
A_mat = matrix(NA, n,n)

for (i in 1:n) {
  for (j in 1:n) {
    if (i == j) {
      A_mat[i,j]=1
    }
  }
}

A_mat[1,2]=0
A_mat[1,3]=0
A_mat[1,4]=0
A_mat[1,5]=0
A_mat[1,6]=0
A_mat[2,1]=0
A_mat[2,6]=0
A_mat[2,5]=0
A_mat[3,6]

## [1] NA

A_mat[3,6]=0
A_mat[4,1]=0
A_mat[4,2]=0
A_mat[4,3]=0
A_mat[4,5]=0
A_mat[4,6]=0
A_mat[5,6]=0
A_mat

##      [,1] [,2] [,3] [,4] [,5] [,6]
## [1,] 1 0 0 0 0 0
## [2,] 0 1 NA NA 0 0
## [3,] NA NA 1 NA NA 0
## [4,] 0 0 0 1 0 0
## [5,] NA NA NA NA 1 0
## [6,] NA NA NA NA NA 1

SVAR(var_model_whole, Amat = A_mat, method = "BFGS")

## Warning in SVAR(var_model_whole, Amat = A_mat, method = "BFGS"): Convergence
## not achieved after 100 iterations. Convergence value: 1 .

##
## SVAR Estimation Results:
## =====
##
##
## Estimated A matrix:
##      CD unemployment CCI CPI KOSPI whole
## CD      1.0000 0.000000 0.0000 0.00000 0.00000 0
## unemployment 0.0000 1.000000 98.2083 8.18171 0.00000 0

```

```
## CCI          1.3176    -0.025205    1.0000    1.43173 16.33730    0
## CPI          0.0000    0.000000    0.0000    1.00000    0.00000    0
## KOSPI        -0.3246    2.999401 -31.1452 -2.21428    1.00000    0
## whole        0.0958    0.003962    0.1195    0.08313 -0.01628    1
```

```
SVAR(var_model_annuity, Amat = A_mat, method = "BFGS")
```

```
## Warning in SVAR(var_model_annuity, Amat = A_mat, method = "BFGS"): Convergence
## not achieved after 100 iterations. Convergence value: 1 .
```

```
##
## SVAR Estimation Results:
## =====
```

```
##
## Estimated A matrix:
##           CD unemployment      CCI      CPI      KOSPI annuity
## CD          1.00000    0.000000    0.0000    0.00000    0.00000    0
## unemployment 0.00000    1.000000  98.2106    8.18427    0.00000    0
## CCI          1.30382    0.011637    1.0000    1.42724 -16.25492    0
## CPI          0.00000    0.000000    0.0000    1.00000    0.00000    0
## KOSPI        -0.32076    2.986316 -30.8179 -2.18843 -1.00000    0
## annuity      0.09517    0.002409    0.1217    0.08263    0.02338    1
```

```
SVAR(var_model_universal, Amat = A_mat, method = "BFGS")
```

```
## Warning in SVAR(var_model_universal, Amat = A_mat, method = "BFGS"):
## Convergence not achieved after 100 iterations. Convergence value: 1 .
```

```
##
## SVAR Estimation Results:
## =====
```

```
##
## Estimated A matrix:
##           CD unemployment      CCI      CPI      KOSPI universal
## CD          1.00000    0.000000    0.00000    0.00000    0.00000    0
## unemployment 0.00000    1.000000  98.20972    8.18432    0.00000    0
## CCI          1.30186    0.014364    1.00000    1.42485 -16.22423    0
## CPI          0.00000    0.000000    0.00000    1.00000    0.00000    0
## KOSPI        -0.32279    2.993704 -30.48343 -2.16018 -1.00000    0
## universal    0.09552    0.002619    0.09743    0.08101    0.01863    1
```