Self directed activities 11 all qs

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```
# Packages used:

# library(tidyverse)
# library(lubridate)
# library(janitor)
# library(forecast)
# library(vars)
```

```
dt <- read.csv("TGY.csv")
GDP <- ts(dt$GDP, start=c(1960,1), end=c(2024,2), frequency=4)
Tax <- ts(dt$Tax, start=c(1960,1), end=c(2024,2), frequency=4)
Govt <- ts(dt$Govt, start=c(1960,1), end=c(2024,2), frequency=4)

GDP <- window(GDP, start=c(1980,1), end=c(2019,4))
Tax <- window(Tax, start=c(1980,1), end=c(2019,4))
Govt <- window(Govt, start=c(1980,1), end=c(2019,4))

DGDP <- diff(GDP)*100  # pct growth per qtr
DTax <- diff(Tax)*100
DGovt <- diff(Govt)*100
```

Q1

Replicate the VAR model selection exercise in Lecture 11 for the trivariate model including Tax, Govt and GDP.

```
# Set up data frame with the variables to include in the VAR
DY <- data.frame(DTax=DTax, DGovt=DGovt, DGDP=DGDP)

# VAR() command can estimate with fixed lag length,
# or search over lag lengths like this:
VARp <- VAR(DY, lag.max=8, ic="AIC")

# Residual autocorrelation test:
print(serial.test(VARp, lags.pt=12)$serial)
```

```
##
##  Portmanteau Test (asymptotic)
##
## data:  Residuals of VAR object VARp
## Chi-squared = 85.618, df = 81, p-value = 0.3415
```

Q2

Replicate the impulse response analysis in which a +1 unit impulse to DGDP is specified and responses to all three of DTax, DGovt and DGDP are calculated from the model.

```
# Compute the Impulse Reponses using VAR_TGY:
IRF <- irf(VARp,
    impulse="DGDP",                       # impulse to DGDP only
    ortho=FALSE,                          # 1 unit impulse
    response=c("DTax","DGovt", "DGDP"), # responses by all vars
    n.ahead=8)

print(IRF$irf)
```

```
## $DGDP
##            DTax       DGovt       DGDP
##  [1,] 0.0000000  0.00000000 1.00000000
##  [2,] 1.0140886 -0.18813224 0.31164414
##  [3,] 1.1138927 -0.05280198 0.30767606
##  [4,] 0.2287983 -0.22617349 0.20967897
##  [5,] 0.6298350 -0.24736472 0.10145758
##  [6,] 0.2904837 -0.17865732 0.05251712
##  [7,] 0.2165424 -0.16362245 0.05400105
##  [8,] 0.1909429 -0.15655978 0.02080831
##  [9,] 0.1380602 -0.10138513 0.02213901
```

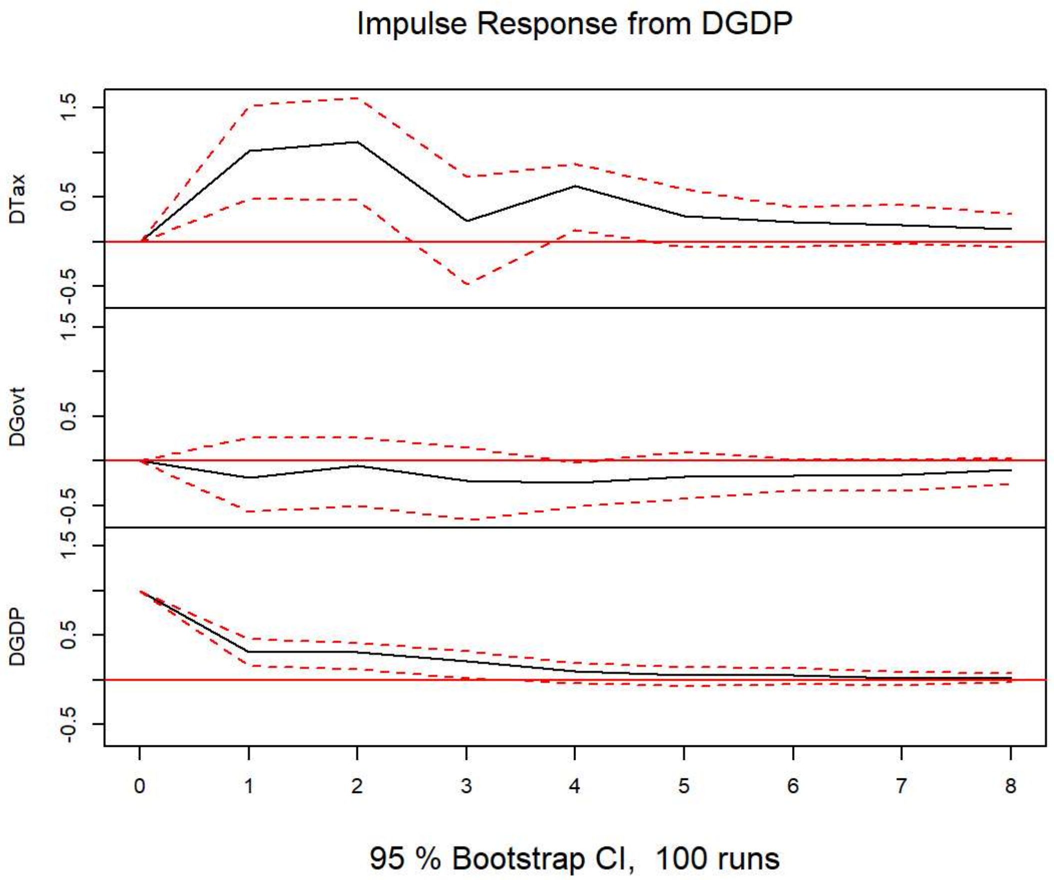
```
print(IRF$Lower)
```

```
## $DGDP
##              DTax      DGovt         DGDP
##  [1,]  0.00000000  0.0000000  1.00000000
##  [2,]  0.47356362 -0.5729270  0.15067827
##  [3,]  0.47139112 -0.4984241  0.11899391
##  [4,] -0.47711323 -0.6578079  0.02537840
##  [5,]  0.13078154 -0.5184675 -0.03978178
##  [6,] -0.06330900 -0.4213221 -0.07174838
##  [7,] -0.06355519 -0.3320403 -0.04690145
##  [8,] -0.02796048 -0.3385352 -0.05631666
##  [9,] -0.05722497 -0.2584474 -0.02216919
```

```
print(IRF$Upper)
```

```
## $DGDP
##            DTax        DGovt       DGDP
##  [1,] 0.0000000  0.000000000 1.00000000
##  [2,] 1.5246334  0.257222183 0.45955827
##  [3,] 1.6176475  0.262939179 0.41820511
##  [4,] 0.7247245  0.146856830 0.32843229
##  [5,] 0.8696703 -0.017891889 0.19245112
##  [6,] 0.5901083  0.100046424 0.13870135
##  [7,] 0.3937206  0.016305725 0.12860385
##  [8,] 0.4147052  0.008150071 0.08856161
##  [9,] 0.3152800  0.020324219 0.07679197
```

```
plot(IRF)
```



Q3

Obtain the estimated conditional covariance matrix for the VAR in question 1, and calculate its Choleski factorisation.

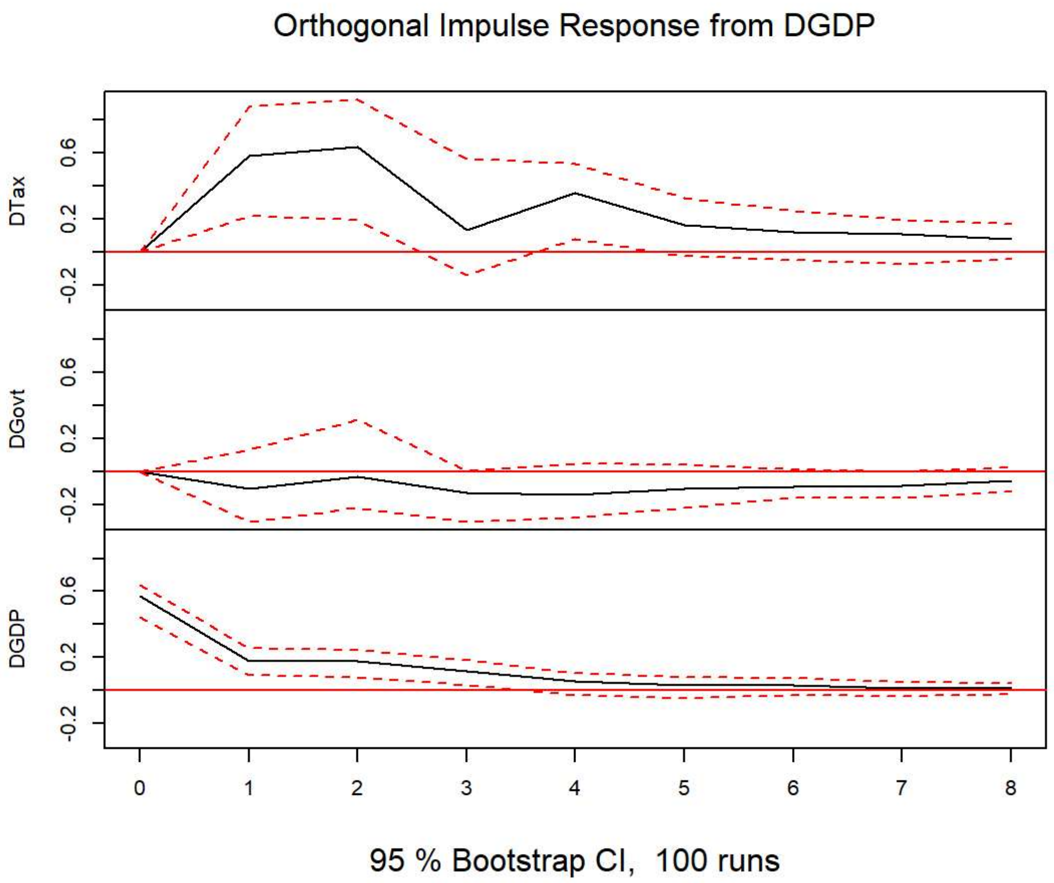
```
Sigma <- summary(VARp)$covres
C <- chol(Sigma)
```

Q4

Use the Choleski orthogonalisation approach to compute the impulse to DGDP implied by this model, and compute the impulse responses for all three variables. Compare to those in question 2.

```
IRF <- irf(VARp,
    impulse="DGDP",                     # impulse to DGDP only
    ortho=TRUE,                     ##### switched to TRUE
    response=c("DTax","DGovt", "DGDP"), # responses by all vars
    n.ahead=8)

plot(IRF)
```

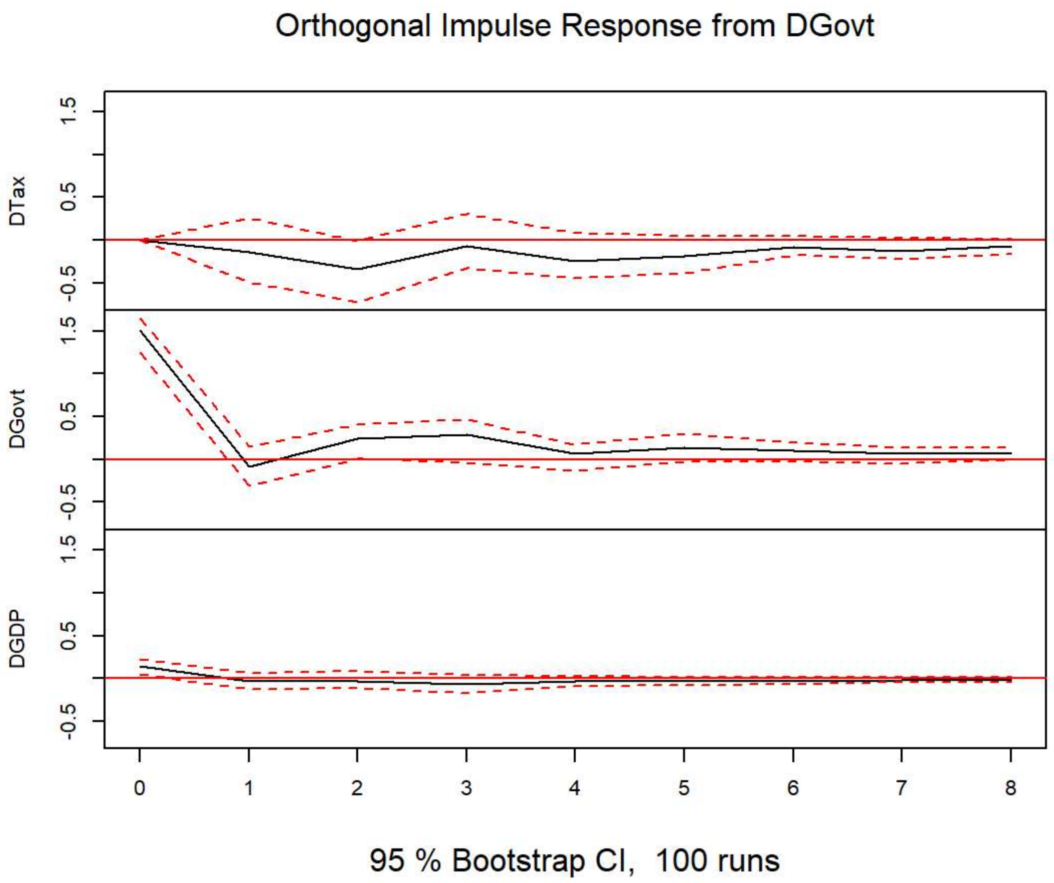


Q5

Use the Choleski orthogonalisation approach to compute the impulse to DGovt implied by this model, and compute the impulse responses for all three variables.

```
IRF <- irf(VARp,
    impulse="DGovt",                      # impulse to DGDP only
    ortho=TRUE,                      ##### switched to TRUE
    response=c("DTax","DGovt", "DGDP"), # responses by all vars
    n.ahead=8)

plot(IRF)
```

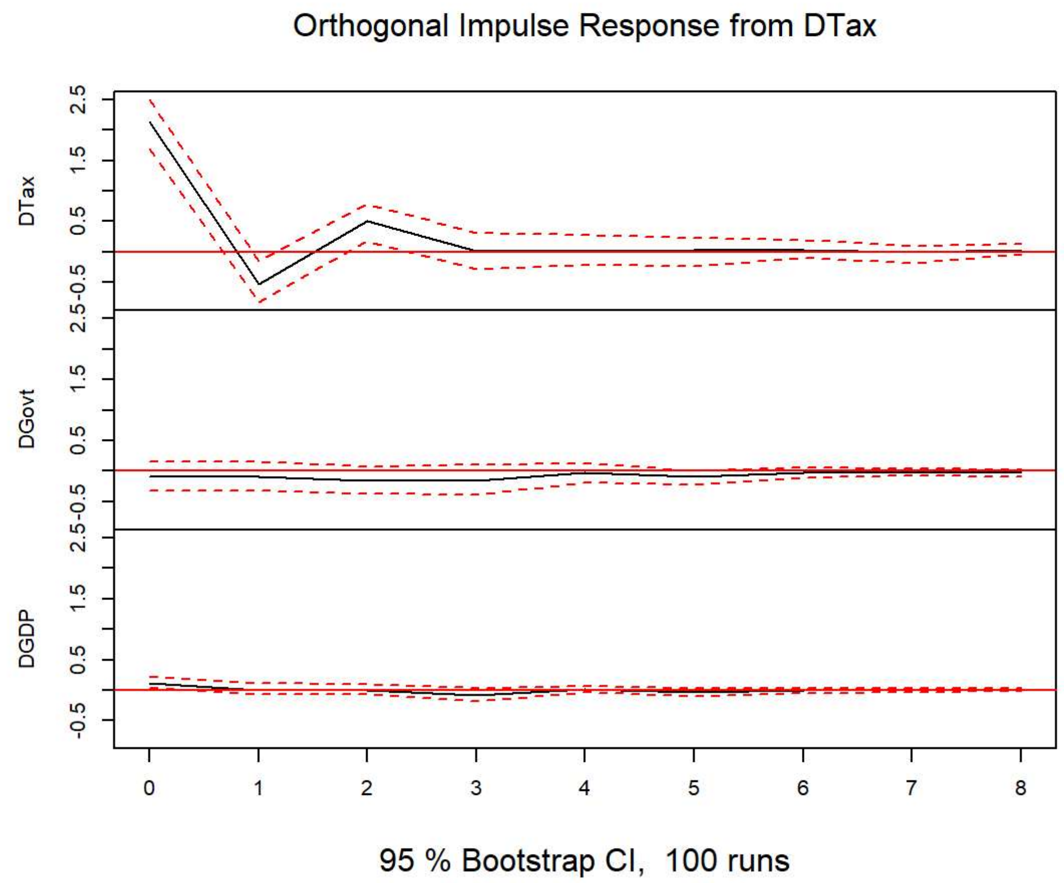


Q6

Use the Choleski orthogonalisation approach to compute the impulse to DTax implied by this model, and compute the impulse responses for all three variables.

```
IRF <- irf(VARp,
    impulse="DTax",                     # impulse to DGDP only
    ortho=TRUE,                     ##### switched to TRUE
    response=c("DTax","DGovt", "DGDP"), # responses by all vars
    n.ahead=8)

plot(IRF)
```


Orthogonal Impulse Response from DTax
DTax
DGovt
DGDP
2.5
1.5
0.5
-0.5
0
1
2
3
4
5
6
7
8
95 % Bootstrap CI, 100 runs