VAR Fisher example Chapter 4

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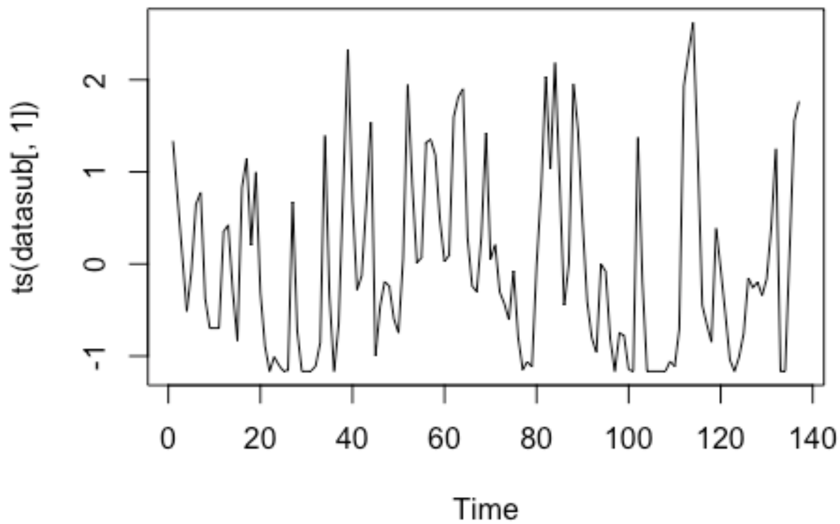
Set up the environment:

```
library(vars)

library(signal)
```

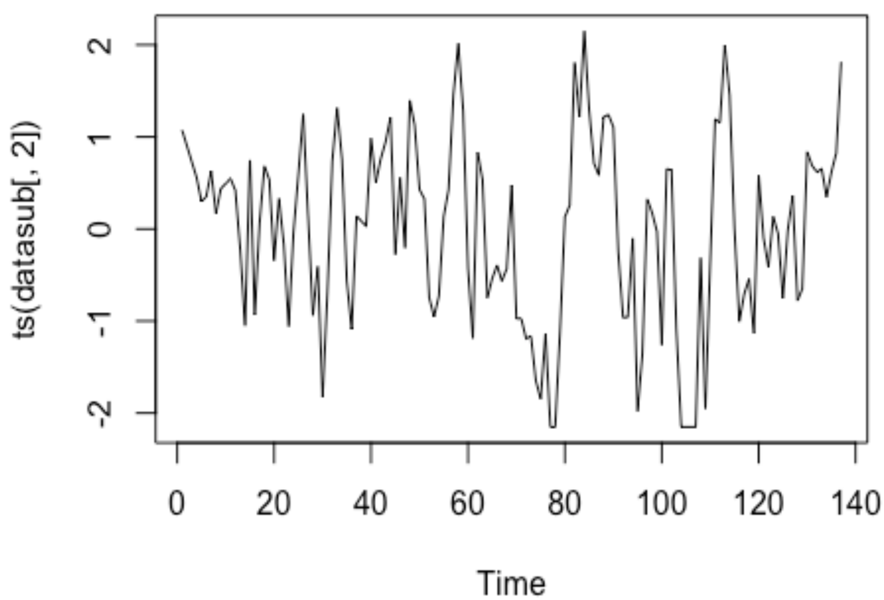
Prepare data

Start by selecting one individual and a handful of variables.

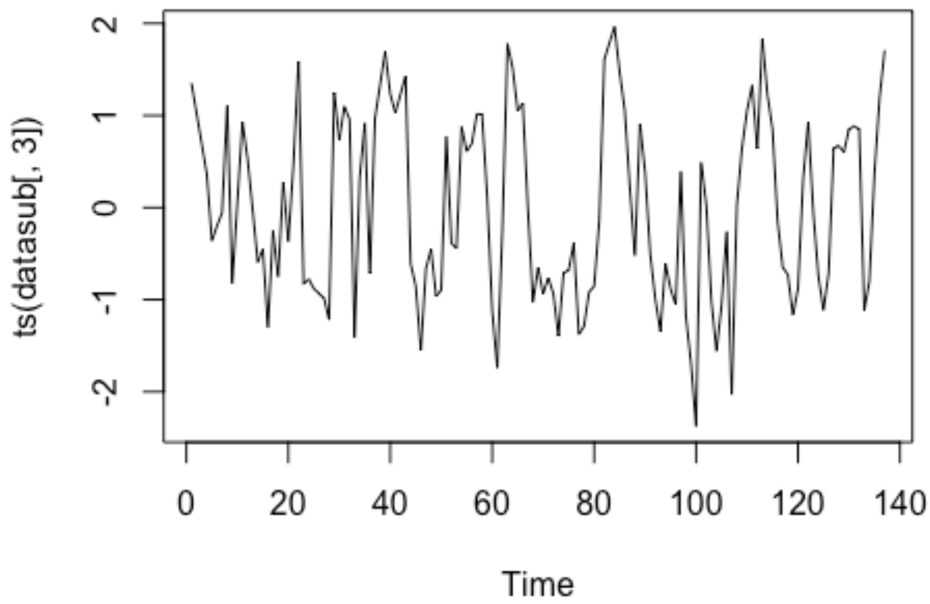
```
load("~/Dropbox/Classes/IAV/Data/Fisher/FisherData.Rdata")
# The list 'FisherDataInterp' contains the interpolated data for all individu
als.

# Select a few variables from the first person.
datasub <- cbind(FisherDataInterp[[1]]$angry, FisherDataInterp[[1]]$irritable
, FisherDataInterp[[1]]$anhedonia)

# scale and give names
colnames(datasub) <- c("angry", "irritable", "anhedonia")
datasub <- scale(datasub, center = TRUE, scale = TRUE)

# plot the data

plot(ts(datasub[,1]))
```




```
plot(ts(datasub[,2]))
```




```
plot(ts(datasub[,3]))
```



Test for trends

```
time <- seq(1:length(datasub[,1])) # create time vector
coeffs <- NULL
# test for linear trend across the selected variables
for (p in 1: length(datasub[1,])){
  fit<- lm(datasub[,p] ~ time)  #run a simple regression predicting time
  coeffs[p] <- fit$coefficients[2]
}
max(coeffs) # the max coefficient here is zero with rounding

## [1] -0.0005243933

# linear trends not seen
```

Test the univariate order.

```
ar(datasub[,1])

##
## Call:
## ar(x = datasub[, 1])
##
## Coefficients:
##       1        2        3        4
##  0.7097  -0.2385  -0.0703   0.1634
##
## Order selected 4  sigma^2 estimated as  0.6395
```

```r
ar(datasub[,2])

##
## Call:
## ar(x = datasub[, 2])
##
## Coefficients:
##      1
## 0.6032
##
## Order selected 1  sigma^2 estimated as  0.6409

ar(datasub[,3])

##
## Call:
## ar(x = datasub[, 3])
##
## Coefficients:
##      1
## 0.5566
##
## Order selected 1  sigma^2 estimated as  0.6953
```

The first variable (anger) appears to have an AR(4) process, whereas the others are AR(1).

We can test for the VAR order, which will tell us how many lags to include for our multivariate investigations. Note that sometimes this will be smaller than one of the variables univariate order.

Test VAR order

```r
# test a lag of max 5
fitVAR <- VAR(datasub,
          lag.max = 5,
          ic = c("AIC"))

fitVAR$p

## AIC(n)
##      2

coef(fitVAR)

## $angry
##                  Estimate Std. Error    t value     Pr(>|t|)
## angry.l1      0.577149131 0.08990083  6.4198418 2.431135e-09
## irritable.l1  0.296628055 0.09505902  3.1204619 2.231896e-03
## anhedonia.l1  0.094551368 0.09103247  1.0386554 3.009231e-01
## angry.l2     -0.251922354 0.08815247 -2.8578024 4.980906e-03
## irritable.l2 -0.060261569 0.09882932 -0.6097539 5.431057e-01
## anhedonia.l2 -0.039366974 0.08921514 -0.4412589 6.597700e-01
```

```
## const         -0.001695838 0.06565685 -0.0258288 9.794341e-01
## 
## $irritable
##                   Estimate Std. Error     t value     Pr(>|t|)
## angry.l1      0.0504907830 0.09306297  0.54254427 5.883870e-01
## irritable.l1  0.6252147158 0.09840259  6.35364071 3.375014e-09
## anhedonia.l1 -0.0142713354 0.09423441 -0.15144505 8.798631e-01
## angry.l2     -0.1046741726 0.09125312 -1.14707503 2.534902e-01
## irritable.l2 -0.1100634155 0.10230551 -1.07583077 2.840266e-01
## anhedonia.l2  0.2066270110 0.09235316  2.23735727 2.699262e-02
## const        -0.0007153166 0.06796624 -0.01052459 9.916191e-01
## 
## $anhedonia
##                 Estimate Std. Error     t value     Pr(>|t|)
## angry.l1      0.229183596 0.09641422  2.37707260 1.893152e-02
## irritable.l1  0.059351813 0.10194612  0.58218806 5.614641e-01
## anhedonia.l1  0.524096120 0.09762784  5.36830595 3.610464e-07
## angry.l2     -0.035800618 0.09453919 -0.37868548 7.055488e-01
## irritable.l2 -0.119678918 0.10598958 -1.12915736 2.609432e-01
## anhedonia.l2 -0.058309732 0.09567884 -0.60943183 5.433185e-01
## const        -0.003654942 0.07041374 -0.05190666 9.586840e-01
```

The oiptimal lag order was found to be 2, for a VAR(2) process.

We see that *angry* has a positive AR(1) coefficient and a negative AR(2) coefficient. *angry* also has a positive lag-1 relation with *irritable*.

irritable is predicted by itself at a prior lag, and *anhedonia* at a lag of two. Both are positive relations.

Finally, *anhedonia* has lag-1 positive relations with itself and *angry*.

Obtain covariance matrix

```
ccf(datasub[,2], datasub[,1], plot = FALSE)

## 
## Autocorrelations of series 'X', by lag
## 
##    -18    -17    -16    -15    -14    -13    -12    -11    -10     -9 
##  0.005 -0.065 -0.039  0.026  0.010  0.023 -0.017 -0.161 -0.214 -0.212 
##     -8     -7     -6     -5     -4     -3     -2     -1      0      1 
## -0.174 -0.108  0.068  0.099  0.071  0.061  0.285  0.489  0.506  0.305 
##      2      3      4      5      6      7      8      9     10     11 
##  0.132 -0.009 -0.018  0.072  0.054 -0.068 -0.124 -0.117 -0.129 -0.203 
##     12     13     14     15     16     17     18 
## -0.206 -0.190 -0.184 -0.182 -0.150 -0.090 -0.024

ccf(datasub[,1], datasub[,2], plot = FALSE)

## 
## Autocorrelations of series 'X', by lag
```

```
##
##    -18    -17    -16    -15    -14    -13    -12    -11    -10     -9
## -0.024 -0.090 -0.150 -0.182 -0.184 -0.190 -0.206 -0.203 -0.129 -0.117
##     -8     -7     -6     -5     -4     -3     -2     -1      0      1
## -0.124 -0.068  0.054  0.072 -0.018 -0.009  0.132  0.305  0.506  0.489
##      2      3      4      5      6      7      8      9     10     11
##  0.285  0.061  0.071  0.099  0.068 -0.108 -0.174 -0.212 -0.214 -0.161
##     12     13     14     15     16     17     18
## -0.017  0.023  0.010  0.026 -0.039 -0.065  0.005
```

Notice that order matters here.

Visualizations help to identify patterns.

```
ccf(datasub[,2], datasub[,1], plot = TRUE)
```