title: “Ch 5 PFA in dynr” author: “Sy-Miin Chow” date: “March 9, 2017” output: pdf_document —

Generating Data

```
rm(list=ls())
setwd("~/Dropbox/CRC BOOK/Code for online supplement/Chapter 5/dynr")
set.seed(12345678)
library(mvtnorm)
# setting up matrices
time      <-1000
npad      <- 0 #Occasions to throw out to wash away the effects of initial condition
ne        <- 2 #Number of latent variables
ny        <- 6 #Number of manifest variables
psi       <- matrix(c(2.77, 2.47,  # Residual variance-covariance matrix
                      2.47, 8.40),
                    ncol = ne, byrow = T)
lambda    <- matrix(c(1, 0,        # Lambda matrix containing contemporaneous relations among
                      2, 0,        # observed variables and 2 latent variables.
                      1, 0,
                      0, 1,
                      0, 2,
                      0, 1),
                    ncol = ne, byrow = TRUE)
theta     <- diag(.5, ncol = ny, nrow = ny)  # Measurement error variances.
epsilon   <- rmvnorm(time, mean = c(0, 0, 0, 0, 0, 0), sigma = theta)  # Measurement errors.
  #t(chol(theta)%*%matrix(rnorm(ny*time),ncol=time)) #
beta      <- matrix(c(0.5, 0,    # Lagged directed relations among variables.
                      0.4, 0.5),
                    ncol = ne, byrow = TRUE)
zeta      <- mvtnorm::rmvnorm(time+npad, mean = c(0, 0), sigma = psi)# Latent variable residuals.
  #t(chol(psi)%*%matrix(rnorm(ne*time),ncol=time))
a0        <- c(0,0)
etaC      <- matrix(0, nrow = ne, ncol = time + npad) # Set up matrix for contemporaneous variables.
etaL      <- matrix(0, nrow = ne, ncol = time + npad + 1) # Set up matrix for lagged variables.

etaL[,1]  <- a0
# generate factors
for (i in 1:(time+npad)){
  etaC[ ,i]   <- beta %*% etaL[ ,i] + zeta[i, ]
  etaL[ ,i+1] <- etaC[,i]
}
etaC <- etaC[,(npad+1):(npad+time)]
etaL <- etaL[,(npad+1):(npad+time)]
eta <- t(etaC)

# generate observed series
y   <- matrix(0, nrow = time, ncol = ny)
for (p in 1:nrow(y)){
  y[p, ] <- lambda %*% eta[p, ] + epsilon[p, ]
}

write.csv(y,"temp.csv",row.names=FALSE)
```

```
#Write out mkfm6 data files
filey = "ch5mkfm6.dat"
write(time,file=filey,append=F)
write(a0,file=filey,ncolumn=ne,append=T)
write(t(y),file=filey,ncolumn=ny,append=T)
```

```
# Load packages
require(dynr)
```

Specify dynr recipes

```
#Define the dynamic model
# Define the dynamic model - the matrix B
 dynamics <- prep.matrixDynamics(
    values.dyn=matrix(c(.5, 0, .3, .5), ncol=2,byrow=T),
    params.dyn=matrix(c('phi11', 'fixed', 'phi21', 'phi22'), ncol=2,byrow=T),
    isContinuousTime=FALSE)

meas <- prep.measurement(
    values.load=matrix(c(1,0,
                         2,0,
                         1,0,
                         0,1,
                         0,2,
                         0,1),ncol=2,byrow=T), #Starting values for entries in Lambda
    params.load=matrix(c('fixed',0,
                         'lambda21',0,
                         'lambda31',0,
                         0,'fixed',
                         0,'lambda52',
                         0,'lambda62'),
                       ncol=2,byrow=T), #Labels for fixed and freed parameters in Lambda
    #values.int = rep(0.1,6),
    #params.int = paste0('int',1:6),
    state.names=c("eta1","eta2"), #Labels for latent variables in eta(t)
    obs.names=paste0('V',1:6) #Labels for observed variables in y(t)
  )

#Note that in dynr, prep.initial sets the structure of E(eta(1|0)) and Cov(eta(1|0))
  initial <- prep.initial(
    values.inistate=c(0, 0),
    params.inistate=c('fixed', 'fixed'),#initial means fixed to a vector of zeros.
    values.inicov=matrix(c(2,0,0,2),ncol=2),
    params.inicov=matrix(c('fixed','fixed','fixed','fixed'),ncol=2)) #initial covariance fixed to a
  #diagonal matrix of 2s for compatibility with mkfm6 output. Could also be freely estimated   #with mu

  #Process and measurement noise covariance matrices
    mdcov <- prep.noise(
    values.latent=matrix(c(2,.5,
                           .5,6),ncol=2,byrow=T),
    params.latent=matrix(c('psi_11','psi_12',
                           'psi_12','psi_22'),ncol=2,byrow=T),
    values.observed=diag(rep(.5,6),6),
    params.observed=diag(paste0('var_e',1:6),6)
    )
```

Read in data and set up data structure in dynr

```
ch5 = read.table('temp.csv',header=TRUE,sep=",")
ch5$ID = rep(1,dim(ch5)[1]) #Add subject ID to the data set
ch5$Time = rep(1:dim(ch5)[1])
# Data
ch52 <- dynr.data(ch5, id="ID", time="Time", observed=paste0("V",1:6))
```

Cook it!

```
#Put recipes and data together to prepare the full model
  model <- dynr.model(dynamics=dynamics, measurement=meas,
                      noise=mdcov, initial=initial, data=ch52,
                      outfile="PFA3.c")
  #Use same upper and lower bounds as in mkfm6


  model@ub[!model$param.names %in% c('psi_11','psi_12','psi_22')] = c(rep(2,3), rep(5,4), #rep(3,6),
rep(log(10),6))
  model@lb[!model$param.names %in% c('psi_11','psi_12','psi_22')] = c(rep(-2,3), rep(-5,4), #rep(-3,6),
  rep(log(1e-10),6))
```

```
  res <- dynr.cook(model)
```

```
  coef(res)
```

```
##      phi11      phi21      phi22   lambda21   lambda31   lambda52
## 0.49610174 0.36953507 0.56883784 1.87850247 0.84347089 1.97849688
##   lambda62     psi_11     psi_12     psi_22     var_e1     var_e2
## 0.96346830 1.06866856 0.77970301 3.67441110 0.21825724 0.05442611
##     var_e3     var_e4     var_e5     var_e6
## 0.23165679 0.25272313 0.27297952 0.16239815
```

```
  summary(res)
```

```
## Coefficients:
##          Estimate Std. Error t value ci.lower ci.upper Pr(>|t|)
## phi11     0.49610    0.03216  15.426  0.43307  0.55914   <2e-16 ***
## phi21     0.36954    0.06901   5.355  0.23428  0.50479   <2e-16 ***
## phi22     0.56884    0.03596  15.817  0.49835  0.63933   <2e-16 ***
## lambda21  1.87850    0.03985  47.139  1.80040  1.95661   <2e-16 ***
## lambda31  0.84347    0.02604  32.392  0.79243  0.89451   <2e-16 ***
## lambda52  1.97850    0.02154  91.872  1.93629  2.02071   <2e-16 ***
## lambda62  0.96347    0.01201  80.226  0.93993  0.98701   <2e-16 ***
## psi_11    1.06867    0.09892  10.803  0.87479  1.26255   <2e-16 ***
## psi_12    0.77970    0.12853   6.066  0.52780  1.03161   <2e-16 ***
## psi_22    3.67441    0.31659  11.606  3.05390  4.29492   <2e-16 ***
## var_e1    0.21826    0.02267   9.629  0.17383  0.26269   <2e-16 ***
## var_e2    0.05443    0.04781   1.138 -0.03928  0.14813    0.128
## var_e3    0.23166    0.02178  10.637  0.18897  0.27434   <2e-16 ***
## var_e4    0.25272    0.02642   9.567  0.20095  0.30450   <2e-16 ***
## var_e5    0.27298    0.06421   4.251  0.14713  0.39883    1e-05 ***
## var_e6    0.16240    0.01965   8.266  0.12389  0.20091   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## -2 log-likelihood value at convergence = 17526.66
## AIC = 17558.66
## BIC = 17637.19
```