Network Homework 6

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Part I Background

In this project, we are going to use dynamic network model to simulate data and analysis. The network that can change over time (or we can say the network have multi-status) can be seen as dynamic network. It is based on the ERGMs and it can grow or shrink (in terms of nodes).

Also, the package we are going to use in this project is RSiena. The package can be used to deal with longtitude network data. There is a basic network variable and also there is a behavior variable that is a dependent variable. It is a node characteristic that changes over time, the evolution of which may considered in a co-evolutionary model.

By using the simulated model and data, we can get two models and analysis those results and statistics. And if the t-ratio is smaller than 0.1 (absolute value), it should be converge and 0.15 is reasonable. Four significant, we divide the estimation by standard error and the result should be larger than four, so it should be significant.

Part II Question I

At first, we extracted four period network data from whole data.

```{r}
fr_w1=Coevolve$fr_w1
fr_w2=Coevolve$fr_w2
fr_w3=Coevolve$fr_w3
fr_w4=Coevolve$fr_w4
```

Then we operated them into another network data by using sienaDependent.

```{r}
w1 <- cbind(get.edgelist(fr_w1), 1)
w2 <- cbind(get.edgelist(fr_w2), 1)
w3 <- cbind(get.edgelist(fr_w3), 1)
w4 <- cbind(get.edgelist(fr_w4), 1)
w1s <- spMatrix(37, 37, w1[,1], w1[,2], w1[,3])
w2s <- spMatrix(37, 37, w2[,1], w2[,2], w2[,3])
w3s <- spMatrix(37, 37, w3[,1], w3[,2], w3[,3])
w4s <- spMatrix(37, 37, w4[,1], w4[,2], w4[,3])
fr4wav2 <- sienaDependent(list(w1s,w2s,w3s,w4s))
fr4wav2
```

```{r}
smoke <- array(
   c(V(fr_w1)$smoke, V(fr_w2)$smoke,
      V(fr_w3)$smoke, V(fr_w4)$smoke),
   dim=c(37,4))
smokebeh <- sienaDependent(smoke,
   type = "behavior")
smokebeh
```

```{r}
friend <- sienaDataCreate(fr4wav,smokebeh,gender)
friend
```

```
Dependent variables:  fr4wav, smokebeh
Number of observations: 4

Nodeset                     Actors
Number of nodes                 37

Dependent variable fr4wav
Type               oneMode
Observations       4
Nodeset            Actors
Densities          0.13 0.13 0.13 0.13

Dependent variable smokebeh
Type               behavior
Observations       4
Nodeset            Actors
Range              0 - 1
```

So we get the data friend

```{r}
frndeff <- getEffects(friend)
frndeff
```

```
  name     effectName                       include fix   test  initialValue parm
1 fr4wav   constant fr4wav rate (period 1) TRUE    FALSE FALSE    2.00405   0
2 fr4wav   constant fr4wav rate (period 2) TRUE    FALSE FALSE    2.00405   0
3 fr4wav   constant fr4wav rate (period 3) TRUE    FALSE FALSE    2.00405   0
4 fr4wav   outdegree (density)             TRUE    FALSE FALSE   -0.80750   0
5 fr4wav   reciprocity                     TRUE    FALSE FALSE    0.00000   0
6 smokebeh rate smokebeh (period 1)        TRUE    FALSE FALSE    0.20811   0
7 smokebeh rate smokebeh (period 2)        TRUE    FALSE FALSE    0.20811   0
8 smokebeh rate smokebeh (period 3)        TRUE    FALSE FALSE    0.20811   0
9 smokebeh smokebeh linear shape           TRUE    FALSE FALSE    0.56173   0
```

Here is the original effect table based on friend data. And then we can add kinds of effects to it.

```
frndeff1 <- includeEffects(frndeff1,sameX,
interaction1="gender",name="fr4wav")

frndeff1 <- includeEffects(frndeff1,egoX,
interaction1="gender",name="fr4wav")

frndeff1 <- includeEffects(frndeff1,altX,
interaction1="gender",name="fr4wav")

frndeff1 <- includeEffects(frndeff1,egoX,
interaction1="smokebeh",name="fr4wav")

frndeff1 <- includeEffects(frndeff1,altX,
interaction1="smokebeh",name="fr4wav")

frndeff1 <- includeEffects(frndeff1,sameX,
interaction1="smokebeh",name="fr4wav")

frndeff1 <- includeEffects(frndeff1,avSim,
interaction1="fr4wav",name="smokebeh")

frndeff1 <- includeEffects(frndeff1,totSim,
interaction1="fr4wav",name="smokebeh")
```

And I got the following result.

```{r}
frndeff1
```

	name	effectName	include	fix	test	initialValue	parm
1	fr4wav	constant fr4wav rate (period 1)	TRUE	FALSE	FALSE	2.00405	0
2	fr4wav	constant fr4wav rate (period 2)	TRUE	FALSE	FALSE	2.00405	0
3	fr4wav	constant fr4wav rate (period 3)	TRUE	FALSE	FALSE	2.00405	0
4	fr4wav	outdegree (density)	TRUE	FALSE	FALSE	-0.80750	0
5	fr4wav	reciprocity	TRUE	FALSE	FALSE	0.00000	0
6	fr4wav	transitive triplets	TRUE	FALSE	FALSE	0.00000	0
7	fr4wav	gender alter	TRUE	FALSE	FALSE	0.00000	0
8	fr4wav	gender ego	TRUE	FALSE	FALSE	0.00000	0
9	fr4wav	same gender	TRUE	FALSE	FALSE	0.00000	0
10	fr4wav	smokebeh alter	TRUE	FALSE	FALSE	0.00000	0
11	fr4wav	smokebeh ego	TRUE	FALSE	FALSE	0.00000	0
12	fr4wav	same smokebeh	TRUE	FALSE	FALSE	0.00000	0
13	smokebeh	rate smokebeh (period 1)	TRUE	FALSE	FALSE	0.20811	0
14	smokebeh	rate smokebeh (period 2)	TRUE	FALSE	FALSE	0.20811	0
15	smokebeh	rate smokebeh (period 3)	TRUE	FALSE	FALSE	0.20811	0
16	smokebeh	smokebeh linear shape	TRUE	FALSE	FALSE	0.56173	0
17	smokebeh	smokebeh average similarity	TRUE	FALSE	FALSE	0.00000	0
18	smokebeh	smokebeh total similarity	TRUE	FALSE	FALSE	0.00000	0

Part III Question II

Question 2
```{r}
myalgorithm <- sienaAlgorithmCreate(projname='coevolve')
RSmod1<-siena07(myalgorithm,data=friend,effects=frndeff,batch=T,verbose = F,useCluster = T,initC = T,nbrNodes = 3,returnDeps=TRUE)
```

```
siena07 will create an output file coevolve.txt .

Start phase 0
theta:  2.004  2.004  2.004 -0.808  0.000  0.208  0.208  0.208  0.562

Start phase 1
Phase 1 Iteration 1 Progress: 0%
Phase 1 Iteration 4 Progress: 0%
Phase 1 Iteration 10 Progress: 0%
Phase 1 Iteration 25 Progress: 0%
```

Here is the model we built.

```
Estimates, standard errors and convergence t-ratios

                                                  Estimate    Standard      Convergence
                                                              Error         t-ratio
Network Dynamics
   1. rate constant fr4wav rate (period 1)         1.1474 (      0.2344 )     0.0279
   2. rate constant fr4wav rate (period 2)         1.1202 (      0.2057 )    -0.0958
   3. rate constant fr4wav rate (period 3)         1.1387 (      0.2122 )    -0.0203
   4. eval outdegree (density)                    -3.1799 (      0.8590 )    -0.0509
   5. eval reciprocity                             0.8095 (      0.3658 )    -0.0243
   6. eval transitive triplets                     0.0863 (      0.0867 )    -0.0697
   7. eval gender alter                           -0.3091 (      0.4259 )    -0.0023
   8. eval gender ego                              0.2890 (      0.4670 )    -0.1026
   9. eval same gender                             1.2786 (      0.4137 )    -0.0304
  10. eval smokebeh alter                          0.7442 (      0.4212 )     0.0229
  11. eval smokebeh ego                           -0.0466 (      0.2997 )     0.0335
  12. eval same smokebeh                           1.2390 (      1.3380 )    -0.0176

Behavior Dynamics
  13. rate rate smokebeh (period 1)                0.2970 (      0.1637 )     0.1129
  14. rate rate smokebeh (period 2)                0.3161 (      0.1782 )     0.0554
  15. rate rate smokebeh (period 3)                0.3072 (      0.3177 )    -0.0104
  16. eval smokebeh linear shape                  13.6460 (   1061.5170 )     0.0761
  17. eval smokebeh average similarity           122.1568 (  14378.4129 )    -0.2900
  18. eval smokebeh total similarity             -15.4698 (   1903.4595 )    -0.1361

Overall maximum convergence ratio:    1.2624
```

And here is the summary of the model from where we can get a lot of statistics.

Part IV Question III

Question 3

```r
el1 <- RSmod1$sims[[1]][[1]][[1]][[1]]
sb1 <- RSmod1$sims[[1]][[1]][[2]][[1]]
el2 <- RSmod1$sims[[1]][[1]][[1]][[2]]
sb2 <- RSmod1$sims[[1]][[1]][[2]][[2]]
el3 <- RSmod1$sims[[1]][[1]][[1]][[3]]
sb3 <- RSmod1$sims[[1]][[1]][[2]][[3]]

sim1 <- graph.data.frame(el1,directed = TRUE)
sim2 <- graph.data.frame(el2,directed = TRUE)
sim3 <- graph.data.frame(el3,directed = TRUE)

w2s=spMatrix(37,37,el1[,1],el1[,2],el1[,3])
w3s=spMatrix(37,37,el2[,1],el2[,2],el2[,3])
w4s=spMatrix(37,37,el3[,1],el3[,2],el3[,3])

fr4wav4=sienaDependent(list(w1s,w2s,w3s,w4s))
smoke_sim=array(c(V(fr_w1)$smoke,sb1,sb2,sb3),dim=c(37,4))
smoke_beh_sim=sienaDependent(smoke_sim,type="behavior")
friend_sim=sienaDataCreate(fr4wav4,smoke_beh_sim,gender)
```

By following the method shown in the PowerPoint Lecture 9, we can re-simulate data based on the RSmod1. And after adding effects to it, we can use these two to get two corresponding models.

Here are the statistics about model 1.

Estimates, standard errors and convergence t-ratios

	Estimate	Standard Error	Convergence t-ratio
Network Dynamics			
1. rate constant fr4wav4 rate (period 1)	1.1464	(0.2167)	0.0118
2. rate constant fr4wav4 rate (period 2)	4.1290	(0.5047)	-0.0169
3. rate constant fr4wav4 rate (period 3)	3.2824	(0.4344)	-0.0010
4. eval outdegree (density)	-3.0690	(0.3475)	-0.0156
5. eval reciprocity	0.9207	(0.1477)	-0.0233
6. eval transitive triplets	0.0922	(0.0461)	-0.0025
7. eval gender alter	-0.1430	(0.2353)	-0.0026
8. eval gender ego	0.2226	(0.2288)	0.0192
9. eval same gender	1.5052	(0.2601)	-0.0015
10. eval smoke_beh_sim alter	0.1661	(0.2491)	0.0077
11. eval smoke_beh_sim ego	0.1664	(0.2465)	-0.0448
12. eval same smoke_beh_sim	0.6941	(0.3721)	-0.0366
Behavior Dynamics			
13. rate rate smoke_beh_sim (period 1)	0.3217	(0.1690)	0.0943
14. rate rate smoke_beh_sim (period 2)	0.7774	(0.3720)	0.0333
15. rate rate smoke_beh_sim (period 3)	1.1094	(0.4726)	-0.0122
16. eval smoke_beh_sim linear shape	0.4258	(0.5195)	0.0066
17. eval smoke_beh_sim average similarity	1.0252	(7.3823)	0.0143
18. eval smoke_beh_sim total similarity	0.2900	(1.5820)	0.0147

Overall maximum convergence ratio: 0.1599

From the result, we can get that for all convergence t-ratio are good and they can be excellent convergence (abs value smaller than 0.1). And overall convergence ratio is reasonable. And based on both estimation and standard error, we can calculate approximately that item 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18 are not significant (not larger than 4).

And here is the result of model 2.

```
Estimates, standard errors and convergence t-ratios

                                          Estimate   Standard   Convergence
                                                       Error      t-ratio
Network Dynamics
   1. rate constant fr4wav4 rate (period 1)  1.1200  ( 0.1907   )   -0.0490
   2. rate constant fr4wav4 rate (period 2)  4.0578  ( 0.4960   )   -0.0220
   3. rate constant fr4wav4 rate (period 3)  3.2307  ( 0.3978   )   -0.0377
   4. eval outdegree (density)              -2.9046  ( 0.2900   )    0.0286
   5. eval reciprocity                       1.0000  ( 0.1538   )    0.0570
   6. eval same gender                       1.6615  ( 0.2266   )    0.0250
   7. eval same smoke_beh_sim                0.5444  ( 0.2639   )    0.0431

Behavior Dynamics
   8. rate rate smoke_beh_sim (period 1)     0.2600  ( 0.1500   )   -0.0230
   9. rate rate smoke_beh_sim (period 2)     0.5135  ( 0.2715   )   -0.0052
  10. rate rate smoke_beh_sim (period 3)     0.9391  ( 0.3681   )    0.0200
  11. eval smoke_beh_sim linear shape       -0.1664  ( 0.4302   )    0.0091

Overall maximum convergence ratio:    0.1044
```

All t-ratio are good and they can be convergence (abs value smaller than 0.1) and max convergence ratio is good. In terms of significance, item 7, 8, 9, 10, 11 are not significant (not larger than 4).

So, based on the results above, we can say that the model two is better as the ratio is smaller so it can be more possible to converge and less non-significant variables.

Part V Appendix

---

title: "Network_HW6"

author: "Chenrui Xu"

date: "2021/3/28"

output: html_document

```{r}

```
library(igraph)
library(UserNetR)
library(RSiena)
library(Matrix)
data(Coevolve)
set.seed(999)
```

```{r}
fr_w1=Coevolve$fr_w1
fr_w2=Coevolve$fr_w2
fr_w3=Coevolve$fr_w3
fr_w4=Coevolve$fr_w4
```

```{r}
matw1 <- as.matrix(get.adjacency(fr_w1))
matw2 <- as.matrix(get.adjacency(fr_w2))
matw3 <- as.matrix(get.adjacency(fr_w3))
matw4 <- as.matrix(get.adjacency(fr_w4))
```

```{r}
fr4wav<-sienaDependent(
```

```
    array(c(matw1,matw2,matw3,matw4),
    dim=c(37,37,4)), sparse=FALSE)
class(fr4wav)
fr4wav
```

```{r}
w1 <- cbind(get.edgelist(fr_w1), 1)
w2 <- cbind(get.edgelist(fr_w2), 1)
w3 <- cbind(get.edgelist(fr_w3), 1)
w4 <- cbind(get.edgelist(fr_w4), 1)
w1s <- spMatrix(37, 37, w1[,1], w1[,2], w1[,3])
w2s <- spMatrix(37, 37, w2[,1], w2[,2], w2[,3])
w3s <- spMatrix(37, 37, w3[,1], w3[,2], w3[,3])
w4s <- spMatrix(37, 37, w4[,1], w4[,2], w4[,3])
fr4wav2 <- sienaDependent(list(w1s,w2s,w3s,w4s))
fr4wav2
```

```{r}
gender_vect <- V(fr_w1)$gender
table(gender_vect)
gender <- coCovar(gender_vect)
gender
```

```

```{r}
smoke <- array(
    c(V(fr_w1)$smoke, V(fr_w2)$smoke,
        V(fr_w3)$smoke, V(fr_w4)$smoke),
    dim=c(37,4))
smokebeh <- sienaDependent(smoke,
    type = "behavior")
smokebeh
```

```{r}
friend <- sienaDataCreate(fr4wav,smokebeh,gender)
friend
```

```{r}
frndeff <- getEffects(friend)
frndeff
```

```{r}
effectsDocumentation(frndeff)
```
```

```

```{r}
frndeff <- getEffects(friend)

frndeff1 <- getEffects(friend)
#frndeff2 <- getEffects(friend)

# frndeff2 <- includeEffects(frndeff2,sameX,
# interaction1="gender",name="fr4wav")
#
# frndeff2 <- includeEffects(frndeff2,sameX,
# interaction1="smokebeh",name="fr4wav")

frndeff1 <- includeEffects(frndeff1,sameX,
interaction1="gender",name="fr4wav")

frndeff1 <- includeEffects(frndeff1,egoX,
interaction1="gender",name="fr4wav")

frndeff1 <- includeEffects(frndeff1,altX,
interaction1="gender",name="fr4wav")

frndeff1 <- includeEffects(frndeff1,egoX,
```
```

```
interaction1="smokebeh",name="fr4wav")

frndeff1 <- includeEffects(frndeff1,altX,
interaction1="smokebeh",name="fr4wav")

frndeff1 <- includeEffects(frndeff1,sameX,
interaction1="smokebeh",name="fr4wav")

frndeff1 <- includeEffects(frndeff1,avSim,
interaction1="fr4wav",name="smokebeh")

frndeff1 <- includeEffects(frndeff1,totSim,
interaction1="fr4wav",name="smokebeh")

frndeff1 <- includeEffects(frndeff1,recip,transTrip,
name="fr4wav")
```

```{r}
frndeff
```

```{r}
frndeff1
```

```

**Question 2**

```{r}
myalgorithm <- sienaAlgorithmCreate(projname='coevolve')
RSmod1<-siena07(myalgorithm,data=friend,effects=frndeff1,batch=T,verbose
= F,useCluster = T,initC = T,nbrNodes = 3,returnDeps=TRUE)
```

```{r}
RSmod1
```

```{r}
RSmod1$sims[[1]]
```

```{r}
summary(RSmod1)
```

```{r}
# myalgorithm <- sienaAlgorithmCreate(projname='coevolve')
```
```

```
# RSmod2<-siena07(myalgorithm,data=friend,effects=
#                         S
#                                 frndeff2,batch=T,verbose = F,useCluster = T,initC =
T,nbrNodes = 3,returnDeps=TRUE)
# RSmod2
```

Question 3

```{r}
el1 <- RSmod1$sims[[1]][[1]][[1]][[1]]
sb1 <- RSmod1$sims[[1]][[1]][[2]][[1]]
el2 <- RSmod1$sims[[1]][[1]][[1]][[2]]
sb2 <- RSmod1$sims[[1]][[1]][[2]][[2]]
el3 <- RSmod1$sims[[1]][[1]][[1]][[3]]
sb3 <- RSmod1$sims[[1]][[1]][[2]][[3]]

sim1 <- graph.data.frame(el1,directed = TRUE)
sim2 <- graph.data.frame(el2,directed = TRUE)
sim3 <- graph.data.frame(el3,directed = TRUE)

w1 <- cbind(get.edgelist(fr_w1), 1)
w1s <- spMatrix(37, 37, w1[,1], w1[,2], w1[,3])
w2s_sim=spMatrix(37,37,el1[,1],el1[,2],el1[,3])
w3s_sim=spMatrix(37,37,el2[,1],el2[,2],el2[,3])
```

```
w4s_sim=spMatrix(37,37,el3[,1],el3[,2],el3[,3])


fr4wav4=sienaDependent(list(w1s,w2s_sim,w3s_sim,w4s_sim))
smoke_sim=array(c(V(fr_w1)$smoke,sb1,sb2,sb3),dim=c(37,4))
smoke_beh_sim=sienaDependent(smoke_sim,type="behavior")
friend_sim=sienaDataCreate(fr4wav4,smoke_beh_sim,gender)



# V(sim1)$smoke <- sb1
# V(sim1)$gender <- V(fr_w4)$gender
# sim1
#
# matsim1=as.matrix(get.adjacency(sim1))
# simwav1=sienaDependent(matsim1,sparse=F)
# simgender_vect1=V(sim1)$gender
# gender1 <- coCovar(simgender_vect1)
#
# smoke1 <- array(V(sim1)$smoke,dim=c(37,1))
# smokebeh1 <- sienaDependent(c(smoke1),type = "behavior")
# smokebeh1
#
#
# w1 <- cbind(get.edgelist(fr_w1), 1)
# w1s <- spMatrix(37, 37, w1[,1], w1[,2], w1[,3])
```

```

```{r}
friend_sim
```

```{r}
frndeff1_sim <- getEffects(friend_sim)
frndeff2_sim <- getEffects(friend_sim)

frndeff2_sim <- includeEffects(frndeff2_sim,sameX,
interaction1="gender",name="fr4wav4")

frndeff2_sim <- includeEffects(frndeff2_sim,sameX,
interaction1="smoke_beh_sim",name="fr4wav4")

frndeff1_sim <- includeEffects(frndeff1_sim,sameX,
interaction1="gender",name="fr4wav4")

frndeff1_sim <- includeEffects(frndeff1_sim,egoX,
interaction1="gender",name="fr4wav4")

frndeff1_sim <- includeEffects(frndeff1_sim,altX,
```
```

```
interaction1="gender",name="fr4wav4")

frndeff1_sim <- includeEffects(frndeff1_sim,egoX,
interaction1="smoke_beh_sim",name="fr4wav4")

frndeff1_sim <- includeEffects(frndeff1_sim,altX,
interaction1="smoke_beh_sim",name="fr4wav4")

frndeff1_sim <- includeEffects(frndeff1_sim,sameX,
interaction1="smoke_beh_sim",name="fr4wav4")

frndeff1_sim <- includeEffects(frndeff1_sim,avSim,
interaction1="fr4wav4",name="smoke_beh_sim")

frndeff1_sim <- includeEffects(frndeff1_sim,totSim,
interaction1="fr4wav4",name="smoke_beh_sim")

frndeff1_sim <- includeEffects(frndeff1_sim,recip,transTrip,
name="fr4wav4")
```

```{r}
RSmod1_sim<-
siena07(myalgorithm,data=friend_sim,effects=frndeff1_simZ,batch=T,verbose
```

= F,useCluster = T,initC = T,nbrNodes = 3,returnDeps=TRUE)

```

```{r}

RSmod2_sim<-

siena07(myalgorithm,data=friend_sim,effects=frndeff2_sim,batch=T,verbose =

F,useCluster = T,initC = T,nbrNodes = 3,returnDeps=TRUE)

```

```{r}

summary(RSmod1_sim)

```

```{r}

summary(RSmod2_sim)

```
```