

> RSmod1

Estimates, standard errors and convergence t-ratios

	Estimate	Standard Error	Convergence t-ratio
<b>Network Dynamics</b>			
1. rate constant fr4wav rate (period 1)	1.1465	( 0.2126 )	-0.0554
2. rate constant fr4wav rate (period 2)	1.1278	( 0.2110 )	-0.0710
3. rate constant fr4wav rate (period 3)	1.1110	( 0.2155 )	-0.1309
4. eval outdegree (density)	-2.9177	( 0.3838 )	0.1242
5. eval reciprocity	0.8088	( 0.2279 )	0.0212
6. eval transitive triplets	0.0831	( 0.0844 )	-0.0130
7. eval same gender	1.1271	( 0.3226 )	-0.0346
8. eval smokebeh alter	0.6661	( 0.3630 )	0.0191
9. eval smokebeh ego	-0.0865	( 0.3025 )	0.0265
10. eval same smokebeh	1.0745	( 0.4013 )	-0.0715
<b>Behavior Dynamics</b>			
11. rate rate smokebeh (period 1)	0.3001	( 0.1808 )	0.0076
12. rate rate smokebeh (period 2)	0.3495	( 0.2184 )	0.0454
13. rate rate smokebeh (period 3)	0.3322	( 0.2150 )	0.0616
14. eval behavior smokebeh linear shape	5.0198	( 24.2600 )	0.0009
15. eval behavior smokebeh average similarity	24.9066	( 126.6016 )	-0.0815
16. eval behavior smokebeh total similarity	-2.2109	( 12.6726 )	0.1308

Total of 2305 iteration steps.

- For a coevolution model, the **parameter estimates are presented in two sections.**
- The **network dynamics section** contains the estimates pertaining to the tie formation(i.e., the fr4wav dependent variable).
- Conversely, the **behavior dynamics section** contains estimates related to changes in the network member behavior variable, here it is smoking status.

> RSmol1

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- The convergence t-ratios are not traditional t-statistics assessing the size of the parameter estimates. Instead, they represent tests of the lack of convergence for each estimate, so **small values indicate good convergence**.
- The RSiena manual suggests that absolute values **less than 0.10 indicate excellent convergence**, and absolute values **less than 0.15 are reasonable**.
- Here we see that all of the network dynamics parameters have excellent convergence, while a few of the behavior parameters show only reasonable convergence.

```
> R5mod1
```

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

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1. <b>rate</b> constant fr4wav rate (period 1)	1.1465	( 0.2126 )	-0.0554
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```
Total of 2305 iteration steps.
```

- The **rate estimates** correspond to the estimated number of **opportunities for change per actor for each period** (where period 1 is the time from wave 1 to wave2).
- The **eval estimates are the weights in the network evaluation function**. they represent the relative “attractiveness” of a particular network state for each actor. For example, the **positive estimate** for same gender indicates that actors are more likely to form new ties (or maintain existing ties) with other actors who have the same gender as them.

```
> RSmod1
```

```
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4. eval outdegree (density)	-2.9177	( 0.3838 )	0.1242
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11. rate rate smokebeh (period 1)	0.3001	( 0.1808 )	0.0076
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14. eval behavior smokebeh linear shape	5.0198	( 24.2600 )	0.0009
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```
Total of 2305 iteration steps.
```

1	5.3927
---	--------

2	5.3450
---	--------

3	5.1554
---	--------

4	7.6021
---	--------

5	3.5489
---	--------

6	0.9845
---	--------

7	3.4938
---	--------

8	1.8349
---	--------

9	0.2859
---	--------

10	2.6775
----	--------

11	1.6598
----	--------

12	1.6002
----	--------

13	1.5451
----	--------

14	0.2069
----	--------

15	0.1967
----	--------

16	0.1744
----	--------

- The significance of these evaluation function weights can be determined by dividing the estimates by their standard errors.
- These are distributed as  $t$ -statistics, so any absolute values greater than 2 are significant at the 0.05 significance level.



- For our example, we can see that our friendship formation is more likely with alters who have the **same gender (7)** and **same smoking (10)** status as the ego. Conversely, it appears that the main effects of **ego smoking (9)** and **alter smoking (8)** are not significant predictors of tie formation.

# Adjustments and build subsequent models

- Typically, we will make adjustments and build subsequent models based on what we learned from earlier models.
- For this example, we will drop a few non-significant predictors. To do this we simply update the effects object with either new predictors, or by listing the predictors that we would like to drop. A dropped predictor is indicated by the 'include = FALSE' option

```
frndeff2 <- includeEffects(frndeff,totsim,  
                           interaction1="fr4wav",  
                           name="smokebeh",  
                           include=FALSE)  
  
frndeff2 <- includeEffects(frndeff2,transTrip,  
                           name="fr4wav",  
                           include=FALSE)
```

```
> 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	fr4wav	transitive triplets	TRUE	FALSE	FALSE	0.00000	0
7	fr4wav	same gender	TRUE	FALSE	FALSE	0.00000	0
8	fr4wav	smokebeh alter	TRUE	FALSE	FALSE	0.00000	0
9	fr4wav	smokebeh ego	TRUE	FALSE	FALSE	0.00000	0
10	fr4wav	same smokebeh	TRUE	FALSE	FALSE	0.00000	0
11	smokebeh	rate smokebeh (period 1)	TRUE	FALSE	FALSE	0.20811	0
12	smokebeh	rate smokebeh (period 2)	TRUE	FALSE	FALSE	0.20811	0
13	smokebeh	rate smokebeh (period 3)	TRUE	FALSE	FALSE	0.20811	0
14	smokebeh	behavior smokebeh linear shape	TRUE	FALSE	FALSE	0.56173	0
15	smokebeh	behavior smokebeh average similarity	TRUE	FALSE	FALSE	0.00000	0
16	smokebeh	behavior smokebeh total similarity	TRUE	FALSE	FALSE	0.00000	0

```
> frndeff2
```

	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	same gender	TRUE	FALSE	FALSE	0.00000	0
7	fr4wav	smokebeh alter	TRUE	FALSE	FALSE	0.00000	0
8	fr4wav	smokebeh ego	TRUE	FALSE	FALSE	0.00000	0
9	fr4wav	same smokebeh	TRUE	FALSE	FALSE	0.00000	0
10	smokebeh	rate smokebeh (period 1)	TRUE	FALSE	FALSE	0.20811	0
11	smokebeh	rate smokebeh (period 2)	TRUE	FALSE	FALSE	0.20811	0
12	smokebeh	rate smokebeh (period 3)	TRUE	FALSE	FALSE	0.20811	0
13	smokebeh	behavior smokebeh linear shape	TRUE	FALSE	FALSE	0.56173	0
14	smokebeh	behavior smokebeh average similarity	TRUE	FALSE	FALSE	0.00000	0

- Now the next model can be estimated. RSiena allows us to use the estimates obtained from a previous model as the starting values for the new model estimation.
- In this case we specify that the starting values should be based on the estimates contained in RSmod1, using the **prevAns** option. This is also sometimes helpful for improving the convergence of the individual weight estimates.

```
myalgorithm <- sienaAlgorithmCreate(projname='coevol2')
set.seed(999)
RSmod2 <- siena07(myalgorithm, data = friend, |
  effects = frndeff2,
  prevAns=RSmod1, batch=TRUE,
  verbose=FALSE, useCluster=TRUE,
  initC=TRUE, nbrNodes=3,
  returnDeps=TRUE)
```

By dropping some non-significant variables and starting with previously estimated weight estimates, we have improved the convergence, now all effects have excellent convergence.

```
> RSm0d1
Estimates, standard errors and convergence t-ratios
```

	Estimate	Standard Error	Convergence t-ratio
Network Dynamics			
1. rate constant fr4wav rate (period 1)	1.1557	( 0.2183 )	-0.0209
2. rate constant fr4wav rate (period 2)	1.1181	( 0.2029 )	-0.1048
3. rate constant fr4wav rate (period 3)	1.1688	( 0.2180 )	0.1685
4. eval outdegree (density)	-3.0040	( 0.3896 )	0.0308
5. eval reciprocity	0.7829	( 0.2428 )	-0.0758
6. eval transitive triplets	0.0876	( 0.0753 )	-0.0169
7. eval same gender	1.1660	( 0.3113 )	-0.0456
8. eval smokebeh alter	0.6906	( 0.3728 )	-0.0382
9. eval smokebeh ego	-0.0806	( 0.2840 )	-0.0011
10. eval same smokebeh	1.1354	( 0.4276 )	-0.0502
Behavior Dynamics			
11. rate rate smokebeh (period 1)	0.2930	( 0.1773 )	-0.0183
12. rate rate smokebeh (period 2)	0.3496	( 0.1964 )	0.1051
13. rate rate smokebeh (period 3)	0.3230	( 0.1869 )	-0.0224
14. eval behavior smokebeh linear shape	4.7034	( 17.3843 )	0.0431
15. eval behavior smokebeh average similarity	21.2632	( 87.1505 )	-0.1806
16. eval behavior smokebeh total similarity	-1.7108	( 9.2608 )	0.0446

Total of 2309 iteration steps.

```
> RSm0d2
Estimates, standard errors and convergence t-ratios
```

	Estimate	Standard Error	Convergence t-ratio
Network Dynamics			
1. rate constant fr4wav rate (period 1)	1.1346	( 0.2059 )	-0.0307
2. rate constant fr4wav rate (period 2)	1.1319	( 0.1994 )	0.0051
3. rate constant fr4wav rate (period 3)	1.1233	( 0.2273 )	0.0190
4. eval outdegree (density)	-3.0572	( 0.4280 )	0.0776
5. eval reciprocity	0.8666	( 0.2623 )	0.1611
6. eval same gender	1.4104	( 0.3224 )	0.1054
7. eval smokebeh alter	0.7011	( 0.3903 )	-0.0281
8. eval smokebeh ego	-0.0694	( 0.2950 )	0.0482
9. eval same smokebeh	1.2048	( 0.4473 )	0.0395
Behavior Dynamics			
10. rate rate smokebeh (period 1)	0.3099	( 0.1562 )	-0.0305
11. rate rate smokebeh (period 2)	0.3676	( 0.3674 )	-0.0769
12. rate rate smokebeh (period 3)	0.3641	( 0.2154 )	0.0372
13. eval behavior smokebeh linear shape	8.2314	( 108.3796 )	-0.0381
14. eval behavior smokebeh average similarity	23.3629	( 325.0972 )	0.0714

Total of 2281 iteration steps.