

September 11, 2013

The following represents raw output from R for the models and graphics used in Chapter 7 (p. 198), Table 7.5. The data presented here are not the actual results published in the text because we re-estimated the models. The results published in the book are from models estimated on the PittGrid cluster of high performance computers at the University of Pittsburgh in March of 2012. We forgot to save some of the raw output (including diagnostics and fit) from those runs, and re-estimated the models in August 2013 at George Mason University using their cluster of high performance computers known as ARGO.¹ The substantive interpretation of the two runs is the same, although there are differences in standard errors between the models presented here and those published in the book.

This code (with some verbal output of intermediate iterations omitted for space) includes two ERGMs (109th congress and 110th congress) and their diagnostics and fit graphics. The script took about 8.5 days to run on the ARGO cluster computer at George Mason University.

Comments are embedded below. In this output we use two tests to look for degeneracy and find mixed results. Combined with the diagnostic plots, we have some confidence that the models are not degenerate; however, they fail one test suggesting a larger MCMC sample size may be warranted. We note, however, that our MCMC sample size is 1 million and the models take a very long time to run on very good machines, so we are skeptical that we can improve on what we have.

```
> #LOAD COSPONSORSHIP OBJECTS
> load("cosponsordata09.RData")
>
> #REQUIRED PACKAGES: statnet.common, network, robustbase, Matrix, lattice, trust, nlme, coda,
ergm
> .libPaths(c('~'/R/x86_64-redhat-linux-gnu-library/3.0', .libPaths()))
>
> library(ergm, lib.loc="/home/jvictor3/R/x86_64-redhat-linux-gnu-library/3.0/")
Loading required package: statnet.common
Loading required package: network
network: Classes for Relational Data
Version 1.7.2 created on March 15, 2013.
copyright (c) 2005, Carter T. Butts, University of California-Irvine
                Mark S. Handcock, University of Washington
                David R. Hunter, Penn State University
                Martina Morris, University of Washington
For citation information, type citation("network").
Type help("network-package") to get started.

Loading required package: robustbase
Loading required package: Matrix
Loading required package: lattice
Loading required package: trust
Loading required package: nlme
Loading required package: coda

ergm: version 3.1-0, created on 2013-04-17
Copyright (c) 2013, Mark S. Handcock, University of California -- Los Angeles
                David R. Hunter, Penn State University
```

¹ ARGO is a research computing cluster provided by the Office of Research Computing at George Mason University, VA. More information is available at <http://orc.gmu.edu>

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Pavel N. Krivitsky, Penn State University
Martina Morris, University of Washington

Based on "statnet" project software (statnet.org).
For license and citation information see statnet.org/attribution
or type citation("ergm").

NOTE: If you use custom ERGM terms based on 'ergm.userterms' version
prior to 3.1, you will need to perform a one-time update of the package
boilerplate files (the files that you did not write or modify) from
'ergm.userterms' 3.1 or later. See help('eut-upgrade') for
instructions.

NOTE: Dynamic network modeling functionality (STERGMs) has been moved
to a new package, 'tergm'.

```
>  
> cospon109.23<-  
ergm(cospon109.net~edges+m2star+triangle+edgecov(cauc109.aff.dichot.net)+edgecov(comm109.aff.dichot.net)+nodematch("party")+nodematch("state")+nodematch("gender")+nodematch("leader")+nodematch("black")+nodecov("term")+nodecov("electpct"), eval.loglik=TRUE, verbose=TRUE, burnin=60000, MCMCsamplesize=1000000)
```

Comment [JNV1]: Note that we have an MCMC sample size of 1 million.

```
Evaluating network in model  
Initializing Metropolis-Hastings proposal.  
Initializing model.  
Fitting initial model.  
MPLE covariate matrix has 186859 rows.  
Fitting ERGM.  
Density guard set to 1334523 from an initial count of 66442 edges.  
Iteration 1 of at most 20 with parameter:
```

	edges	m2star
	-1.501397666	-0.014903877
	triangle	edgecov.cauc109.aff.dichot.net
	0.018538217	0.098506281
edgecov.comm109.aff.dichot.net		nodematch.party
	0.471502223	0.397170242
nodematch.state		nodematch.gender
	1.902250113	0.147172704
nodematch.leader		nodematch.black
	-0.065340726	0.306970405
nodecov.term		nodecov.electpct
	-0.006645904	-0.000151502

Sampler accepted 10.077% of 100000000 proposed steps.

Back from unconstrained MCMC. Average statistics:

	edges	m2star
	12741.3777	9452910.9660
	triangle	edgecov.cauc109.aff.dichot.net
	18638229.1029	7779.2179
edgecov.comm109.aff.dichot.net		nodematch.party
	916.0218	1735.2436
nodematch.state		nodematch.gender
	-748.5161	6463.1475
nodematch.leader		nodematch.black
	10045.6558	6476.8933
nodecov.term		nodecov.electpct
	183202.8101	1837426.1570

Average estimating equation values:

[1]	12741.3777	9452910.9660	18638229.1029	7779.2179	916.0218
[6]	1735.2436	-748.5161	6463.1475	10045.6558	6476.8933
[11]	183202.8101	1837426.1570			

Convergence test P-value: 0e+00

Calling MCML Optimization...

Using Newton-Raphson Step with step length 0.5 ...

Using lognormal metric (see control.ergm function).

Optimizing loglikelihood

The log-likelihood improved by 14.36

[Omitted verbal output of iterations 2-19]

```

Iteration 20 of at most 20 with parameter:
      edges                m2star
-1.5013976029            -0.0149138047
      triangle edgecov.cauc109.aff.dichot.net
0.0184992845              0.0985062790
edgecov.comml109.aff.dichot.net      nodematch.party
0.4715022488              0.3971703184
      nodematch.state      nodematch.gender
1.9022501206              0.1471727745
      nodematch.leader      nodematch.black
-0.0653406734            0.3069704892
      nodecov.term          nodecov.electpct
-0.0066454216            -0.0001432039
Sampler accepted 9.924% of 10000000 proposed steps.
Back from unconstrained MCMC. Average statistics:
      edges                m2star
12893.8700                9537101.0310
      triangle edgecov.cauc109.aff.dichot.net
18796397.0270              7850.5613
edgecov.comml109.aff.dichot.net      nodematch.party
937.2500                    1790.6374
      nodematch.state      nodematch.gender
-752.9025                   6562.8273
      nodematch.leader      nodematch.black
10169.1000                  6580.7090
      nodecov.term          nodecov.electpct
185150.4038                 1859057.3884
Average estimating equation values:
 [1] 12893.8700 9537101.0310 18796397.0270 7850.5613 937.2500
 [6] 1790.6374 -752.9025 6562.8273 10169.1000 6580.7090
[11] 185150.4038 1859057.3884
Convergence test P-value: 0e+00
Calling MCMLE Optimization...
Using Newton-Raphson Step with step length 0.5 ...
Using lognormal metric (see control.ergm function).
Optimizing loglikelihood
Starting MCMC s.e. computation.
The log-likelihood improved by 19.98
Evaluating log-likelihood at the estimate.

This model was fit using MCMC. To examine model diagnostics and check for degeneracy, use the
mcmc.diagnostics() function.
Warning messages:
1: In control.ergm.toplevel(control, ...) :
  Passing burnin to ergm(...) is deprecated and may be removed in a future version. Specify it as
control.ergm(MCMC.burnin=...) instead.
2: In control.ergm.toplevel(control, ...) :
  Passing MCMCsamplesize to ergm(...) is deprecated and may be removed in a future version.
Specify it as control.ergm(MCMC.samplesize=...) instead.
> summary(cospon109.23)

=====
Summary of model fit
=====

Formula: cospon109.net ~ edges + m2star + triangle + edgecov(cauc109.aff.dichot.net) +
      edgecov(comml109.aff.dichot.net) + nodematch("party") + nodematch("state") +
      nodematch("gender") + nodematch("leader") + nodematch("black") +
      nodecov("term") + nodecov("electpct")

Iterations: 20

Monte Carlo MLE Results:

      Estimate Std. Error MCMC % p-value
edges      -1.5013976  1.0666162    98 0.15924
m2star     -0.0149147  0.0003870    66 < 1e-04 ***
triangle    0.0184976  0.0011250    53 < 1e-04 ***
edgecov.cauc109.aff.dichot.net  0.0985063  0.0431180    27 0.02234 *
edgecov.comml109.aff.dichot.net  0.4715022  0.0400373    34 < 1e-04 ***
nodematch.party  0.3971703  0.0396703     6 < 1e-04 ***

```

Comment [JNV2]: Below is the main output table for the 109th Congress cosponsorship ERGM.

```

nodematch.state      1.9022501  0.0582352    1 < 1e-04 ***
nodematch.gender    0.1471728  0.0483333    24 0.00233 **
nodematch.leader    -0.0653407  0.0876256    81 0.45586
nodematch.black     0.3069705  0.2547177    92 0.22815
nodecov.term        -0.0066454  0.0061945    77 0.28336
nodecov.electpct    -0.0001434  0.0044596    97 0.97435
---

```

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

Null Deviance: 259315 on 187056 degrees of freedom
Residual Deviance: 259398 on 187044 degrees of freedom

```

AIC: 259422 BIC: 259544 (Smaller is better.)

```

> pdf('cospon109.diagnostics.pdf')
> mcmc.diagnostics(cospon109.23)
Sample statistics summary:

```

```

Iterations = 60000:100059900
Thinning interval = 100
Number of chains = 1
Sample size per chain = 1e+06

```

1. Empirical mean and standard deviation for each variable, plus standard error of the mean:

	Mean	SD	Naive SE	Time-series SE
edges	12893.9	77.38	0.07738	3.795
m2star	9537101.0	8598.35	8.59835	402.407
triangle	18796397.0	3249.33	3.24933	174.695
edgecov.cauc109.aff.dichot.net	7850.6	31.60	0.03160	1.412
edgecov.comml109.aff.dichot.net	937.3	37.11	0.03711	1.807
nodematch.party	1790.6	72.13	0.07213	3.689
nodematch.state	-752.9	18.09	0.01809	1.181
nodematch.gender	6562.8	72.69	0.07269	3.608
nodematch.leader	10169.1	65.53	0.06553	3.082
nodematch.black	6580.7	75.80	0.07580	3.727
nodecov.term	185150.4	925.79	0.92579	44.826
nodecov.electpct	1859057.4	10735.21	10.73521	523.112

2. Quantiles for each variable:

	2.5%	25%	50%	75%	97.5%
edges	12740	12841	12894	12945	13048
m2star	9520158	9531381	9537022	9542729	9554046
triangle	18790232	18794163	18796358	18798578	18802902
edgecov.cauc109.aff.dichot.net	7788	7829	7851	7872	7912
edgecov.comml109.aff.dichot.net	865	912	938	962	1012
nodematch.party	1647	1743	1791	1839	1932
nodematch.state	-789	-765	-753	-740	-719
nodematch.gender	6422	6513	6562	6611	6712
nodematch.leader	10043	10124	10169	10214	10299
nodematch.black	6428	6530	6582	6631	6731
nodecov.term	183372	184528	185147	185752	187039
nodecov.electpct	1837959	1851704	1859064	1866228	1880572

Are sample statistics significantly different from observed?

	edges	m2star	triangle	edgecov.cauc109.aff.dichot.net
diff.	12893.870	9537101.03	18796397.0	7850.561
test stat.	3397.471	23700.17	107595.2	5561.634
P-val.	0.000	0.00	0.0	0.000
	edgecov.comml109.aff.dichot.net	nodematch.party	nodematch.state	
diff.	937.2500	1790.6374	-752.9025	
test stat.	518.6026	485.4595	-637.2689	
P-val.	0.0000	0.0000	0.0000	
	nodematch.gender	nodematch.leader	nodematch.black	nodecov.term
diff.	6562.827	10169.10	6580.709	185150.404
test stat.	1819.106	3299.02	1765.569	4130.396
P-val.	0.000	0.00	0.000	0.000

nodecov.electpct Overall (Chi^2)

Comment [JNV3]: Look for degeneracy. In this table, statistically significant p-values suggest the possibility of degeneracy. The solution might be to increase the MCMC sample size to greater than 1 million, but the models already take more than a week to run on a high performance cluster. We look for other evidence of degeneracy below.

diff.	1859057.388	NA
test stat.	3553.845	76088346839
P-val.	0.000	0

Sample statistics cross-correlations:

	edges	m2star	triangle
edges	1.0000000	0.8224280	0.8939540
m2star	0.8224280	1.0000000	0.6564950
triangle	0.8939540	0.6564950	1.0000000
edgecov.cauc109.aff.dichot.net	0.4774784	0.4398400	0.4189530
edgecov.comml09.aff.dichot.net	0.5502236	0.4372643	0.5041647
nodematch.party	0.9078166	0.6798280	0.8717031
nodematch.state	0.2333579	0.2864667	0.1752380
nodematch.gender	0.9408654	0.7593020	0.8563844
nodematch.leader	0.8906887	0.7213334	0.8139971
nodematch.black	0.9792526	0.7941953	0.8946931
nodecov.term	0.8989621	0.7611966	0.7601782
nodecov.electpct	0.9924249	0.8209513	0.8881943
edges	edgecov.cauc109.aff.dichot.net		0.4774784
m2star			0.4398400
triangle			0.4189530
edgecov.cauc109.aff.dichot.net			1.0000000
edgecov.comml09.aff.dichot.net			0.2650678
nodematch.party			0.4236934
nodematch.state			0.1297783
nodematch.gender			0.4584484
nodematch.leader			0.4292331
nodematch.black			0.4775984
nodecov.term			0.4911724
nodecov.electpct			0.4764488
edges	edgecov.comml09.aff.dichot.net	nodematch.party	
m2star			0.5502236
triangle			0.4372643
edgecov.cauc109.aff.dichot.net			0.5041647
edgecov.comml09.aff.dichot.net			0.2650678
nodematch.party			1.0000000
nodematch.state			0.5160617
nodematch.gender			0.0962589
nodematch.leader			0.5080761
nodematch.black			0.4946243
nodecov.term			0.5360121
nodecov.electpct			0.4619822
edges	nodematch.state	nodematch.gender	
m2star			0.5466270
triangle			0.9030696
edgecov.cauc109.aff.dichot.net			0.2333579
edgecov.comml09.aff.dichot.net			0.2864667
nodematch.party			0.1752380
nodematch.state			0.1297783
nodematch.gender			0.4584484
nodematch.leader			0.0962589
nodematch.black			0.5080761
nodecov.term			0.1714627
nodecov.electpct			0.8636775
edges	nodematch.state	nodematch.black	nodematch.leader
m2star			nodematch.black
triangle			nodecov.term
edgecov.cauc109.aff.dichot.net			0.8989621
edgecov.comml09.aff.dichot.net			0.7611966
nodematch.party			0.7601782
nodematch.state			0.8100447
nodematch.gender			0.2152800
nodematch.leader			0.2152129
nodematch.black			0.2168928
nodecov.term			0.2345715
nodecov.electpct			0.9400853
edges	nodematch.leader	nodematch.black	nodecov.term
m2star			0.8989621
triangle			0.7611966
edgecov.cauc109.aff.dichot.net			0.7601782
edgecov.comml09.aff.dichot.net			0.8100447
nodematch.party			0.2152800
nodematch.state			0.2152129
nodematch.gender			0.2168928
nodematch.leader			0.8382457
nodematch.black			1.0000000
nodecov.term			0.8747652
nodecov.electpct			0.8749249
edges	nodematch.leader	nodematch.black	nodecov.term
m2star			0.8749249
triangle			1.0000000
edgecov.cauc109.aff.dichot.net			0.8749249
edgecov.comml09.aff.dichot.net			1.0000000
nodematch.party			0.9006612
nodematch.state			
nodematch.gender			
nodematch.leader			
nodematch.black			
nodecov.term			
nodecov.electpct			

```

edges 0.9924249
m2star 0.8209513
triangle 0.8881943
edgecov.cauc109.aff.dichot.net 0.4764488
edgecov.comml09.aff.dichot.net 0.5466270
nodematch.party 0.9030696
nodematch.state 0.2345715
nodematch.gender 0.9400853
nodematch.leader 0.8836501
nodematch.black 0.9709892
nodecov.term 0.9006612
nodecov.electpct 1.0000000

```

Sample statistics auto-correlation:

```

Chain 1
edges m2star triangle edgecov.cauc109.aff.dichot.net
Lag 0 1.0000000 1.0000000 1.0000000 1.0000000
Lag 100 0.9991689 0.9990873 0.9993083 0.9989984
Lag 200 0.9983372 0.9981744 0.9986172 0.9979968
Lag 300 0.9975049 0.9972597 0.9979257 0.9969955
Lag 400 0.9966710 0.9963438 0.9972332 0.9959937
Lag 500 0.9958384 0.9954285 0.9965410 0.9949967
edgecov.comml09.aff.dichot.net nodematch.party nodematch.state
Lag 0 1.0000000 1.0000000 1.0000000
Lag 100 0.9991569 0.9992355 0.9995279
Lag 200 0.9983131 0.9984706 0.9990573
Lag 300 0.9974687 0.9977049 0.9985890
Lag 400 0.9966256 0.9969392 0.9981211
Lag 500 0.9957826 0.9961757 0.9976543
nodematch.gender nodematch.leader nodematch.black nodecov.term
Lag 0 1.0000000 1.0000000 1.0000000 1.0000000
Lag 100 0.9991884 0.9990966 0.9991733 0.9991473
Lag 200 0.9983775 0.9981933 0.9983465 0.9982940
Lag 300 0.9975664 0.9972897 0.9975190 0.9974403
Lag 400 0.9967547 0.9963836 0.9966900 0.9965855
Lag 500 0.9959445 0.9954779 0.9958636 0.9957324
nodecov.electpct
Lag 0 1.0000000
Lag 100 0.9991581
Lag 200 0.9983152
Lag 300 0.9974714
Lag 400 0.9966260
Lag 500 0.9957815

```

Sample statistics burn-in diagnostic (Geweke):

```

Chain 1
Fraction in 1st window = 0.1
Fraction in 2nd window = 0.5

```

```

edges m2star
1.1743 1.3657
triangle edgecov.cauc109.aff.dichot.net
0.3848 0.8007
edgecov.comml09.aff.dichot.net nodematch.party
0.5547 0.7343
nodematch.state nodematch.gender
0.5784 1.0365
nodematch.leader nodematch.black
0.5978 1.5880
nodecov.term nodecov.electpct
1.0589 1.0309

```

P-values (lower = worse):

```

edges m2star
0.2402694 0.1720188
triangle edgecov.cauc109.aff.dichot.net
0.7003748 0.4232939
edgecov.comml09.aff.dichot.net nodematch.party
0.5790950 0.4627889
nodematch.state nodematch.gender

```

Comment [JNV4]: Look for degeneracy. In the statistics below produced for the Geweke test, we seek to accept the null hypothesis. Here the lack of statistical significance suggests the model is **not** degenerate.

```

0.5630252          0.2999599
nodematch.leader   nodematch.black
0.5499982          0.1122860
nodecov.term       nodecov.electpct
0.2896671          0.3025987
Loading required package: latticeExtra
Loading required package: RColorBrewer
> dev.off()
null device
      1
>
> pdf('cospon109.23.gof.pdf')
> cospon109.23.gof<-gof(cospon109.23)
> plot(cospon109.23.gof)
> dev.off()
null device
      1
*****
***** BEGIN 110TH CONGRESS ESTIAMTION *****
*****
*****

> cospon110.24<-
ergm(cospon110.net~edges+m2star+triangle+edgecov(cauc110.aff.dichot.net)+edgecov(comm110.aff.dich
ot.net)+nodematch("party")+nodematch("state")+nodematch("gender")+nodematch("leader")+nodematch("
black")+nodecov("term")+nodecov("electpct"), eval.loglik=TRUE, verbose=TRUE, burnin=60000,
MCMCsamplesize=1000000)
Evaluating network in model
Initializing Metropolis-Hastings proposal.
Initializing model.
Fitting initial model.
MPLC covariate matrix has 190308 rows.
Fitting ERGM.
Density guard set to 1534796 from an initial count of 76413 edges.
Iteration 1 of at most 20 with parameter:
      edges          m2star
-0.678127387        -0.013774453
      triangle edgecov.cauc110.aff.dichot.net
0.015295113          0.200507201
edgecov.comm110.aff.dichot.net          nodematch.party
0.471505420          0.192536356
nodematch.state          nodematch.gender
2.013473755          0.137964732
nodematch.leader          nodematch.black
-0.082216660          0.303899506
nodecov.term          nodecov.electpct
-0.002122753          -0.003923201
Sampler accepted 10.094% of 100000000 proposed steps.
Back from unconstrained MCMC. Average statistics:
      edges          m2star
9359.981          8062176.011
      triangle edgecov.cauc110.aff.dichot.net
18110323.504          7445.125
edgecov.comm110.aff.dichot.net          nodematch.party
468.366          6801.049
nodematch.state          nodematch.gender
-1300.219          4877.946
nodematch.leader          nodematch.black
7974.625          4102.179
nodecov.term          nodecov.electpct
121352.832          1405196.898
Average estimating equation values:
[1] 9359.981 8062176.011 18110323.504 7445.125 468.366
[6] 6801.049 -1300.219 4877.946 7974.625 4102.179
[11] 121352.832 1405196.898
Convergence test P-value: 0e+00
Calling MCMLE Optimization...
Using Newton-Raphson Step with step length 0.5 ...
Using lognormal metric (see control.ergm function).

```

Optimizing loglikelihood
The log-likelihood improved by 12.08

[Omitted verbal output of iterations 2-19]

Iteration 20 of at most 20 with parameter:

edges	m2star
-0.678127332	-0.013782154
triangle	edgecov.cauc110.aff.dichot.net
0.015250437	0.200507246
edgecov.comml10.aff.dichot.net	nodematch.party
0.471505442	0.192536378
nodematch.state	nodematch.gender
2.013473763	0.137964787
nodematch.leader	nodematch.black
-0.082216617	0.303899580
nodecov.term	nodecov.electpct
-0.002122178	-0.003917083

Sampler accepted 9.946% of 100000000 proposed steps.

Back from unconstrained MCMC. Average statistics:

edges	m2star
9468.0954	8134376.4223
triangle	edgecov.cauc110.aff.dichot.net
18258440.5916	7535.4337
edgecov.comml10.aff.dichot.net	nodematch.party
480.6399	6859.7660
nodematch.state	nodematch.gender
-1305.8181	4946.4698
nodematch.leader	nodematch.black
8065.7139	4173.3980
nodecov.term	nodecov.electpct
122720.4689	1420402.6224

Average estimating equation values:

[1]	9468.0954	8134376.4223	18258440.5916	7535.4337	480.6399
[6]	6859.7660	-1305.8181	4946.4698	8065.7139	4173.3980
[11]	122720.4689	1420402.6224			

Convergence test P-value: 0e+00

Calling MCML Optimization...

Using Newton-Raphson Step with step length 0.5 ...

Using lognormal metric (see control.ergm function).

Optimizing loglikelihood

Starting MCMC s.e. computation.

The log-likelihood improved by 18.5

Evaluating log-likelihood at the estimate.

This model was fit using MCMC. To examine model diagnostics and check for degeneracy, use the `mcmc.diagnostics()` function.

Warning messages:

1: In `control.ergm.toplevel(control, ...)` :

Passing `burnin` to `ergm(...)` is deprecated and may be removed in a future version. Specify it as `control.ergm(MCMC.burnin=...)` instead.

2: In `control.ergm.toplevel(control, ...)` :

Passing `MCMCsamplesize` to `ergm(...)` is deprecated and may be removed in a future version. Specify it as `control.ergm(MCMC.samplesize=...)` instead.

> `summary(cospon110.24)`

=====
Summary of model `Fit`
=====

Formula: `cospon110.net ~ edges + m2star + triangle + edgecov(cauc110.aff.dichot.net) + edgecov(comml10.aff.dichot.net) + nodematch("party") + nodematch("state") + nodematch("gender") + nodematch("leader") + nodematch("black") + nodecov("term") + nodecov("electpct")`

Iterations: 20

Monte Carlo MLE Results:

	Estimate	Std. Error	MCMC %	p-value
edges	-0.6781273	1.3470966	99	0.6147
m2star	-0.0137830	0.0004001	81	<1e-04 ***

Comment [JNV5]: Below is the main output for the 110th cosponsorship ERGM.


```

triangle          0.0152485  0.0002508   10 <1e-04 ***
edgecov.cauc110.aff.dichot.net 0.2005072  0.0476957   59 <1e-04 ***
edgecov.comml10.aff.dichot.net 0.4715054  0.0334028   15 <1e-04 ***
nodematch.party   0.1925364  0.1101278   85 0.0804 .
nodematch.state   2.0134738  0.0563487    0 <1e-04 ***
nodematch.gender  0.1379648  0.0342981    2 <1e-04 ***
nodematch.leader -0.0822166  0.0774247   79 0.2883
nodematch.black   0.3038996  0.3061886   94 0.3209
nodecov.term      -0.0021222  0.0035800   47 0.5533
nodecov.electpct -0.0039172  0.0067238   98 0.5602
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

Null Deviance: 264133 on 190532 degrees of freedom
Residual Deviance: 269010 on 190520 degrees of freedom

```

```
AIC: 269034 BIC: 269156 (Smaller is better.)
```

```

> pdf('cospon110.diagnostics.pdf')
> mcmc.diagnostics(cospon110.24)
Sample statistics summary:

```

```

Iterations = 60000:100059900
Thinning interval = 100
Number of chains = 1
Sample size per chain = 1e+06

```

1. Empirical mean and standard deviation for each variable, plus standard error of the mean:

	Mean	SD	Naive SE	Time-series SE
edges	9468.1	86.63	0.08663	4.758
m2star	8134376.4	11623.58	11.62358	566.406
triangle	18258440.6	6985.80	6.98580	484.979
edgecov.cauc110.aff.dichot.net	7535.4	72.65	0.07265	3.923
edgecov.comml10.aff.dichot.net	480.6	39.38	0.03938	2.171
nodematch.party	6859.8	81.88	0.08188	4.728
nodematch.state	-1305.8	19.08	0.01908	1.155
nodematch.gender	4946.5	78.20	0.07820	4.306
nodematch.leader	8065.7	74.69	0.07469	3.956
nodematch.black	4173.4	85.50	0.08550	4.722
nodecov.term	122720.5	1086.49	1.08649	58.041
nodecov.electpct	1420402.6	11050.32	11.05032	602.654

2. Quantiles for each variable:

	2.5%	25%	50%	75%	97.5%
edges	9299	9410	9466	9524	9646
m2star	8112344	8126242	8133953	8142310	8157265
triangle	18244068	18253779	18258475	18263210	18272002
edgecov.cauc110.aff.dichot.net	7400	7485	7533	7582	7687
edgecov.comml10.aff.dichot.net	404	454	481	508	556
nodematch.party	6704	6806	6857	6911	7033
nodematch.state	-1345	-1318	-1306	-1293	-1269
nodematch.gender	4793	4894	4946	4998	5102
nodematch.leader	7921	8017	8063	8114	8221
nodematch.black	4008	4116	4172	4229	4350
nodecov.term	120677	121960	122702	123460	124904
nodecov.electpct	1399048	1413002	1420139	1427557	1443284

Are sample statistics significantly different from observed?

	edges	m2star	triangle	edgecov.cauc110.aff.dichot.net
diff.	9468.095	8134376.4	18258440.59	7535.434
test stat.	1989.825	14361.4	37647.86	1920.704
P-val.	0.000	0.0	0.00	0.000
	edgecov.comml10.aff.dichot.net	nodematch.party	nodematch.state	
diff.	480.6399	6859.766	-1305.818	
test stat.	221.4223	1450.948	-1130.929	
P-val.	0.0000	0.000	0.000	
	nodematch.gender	nodematch.leader	nodematch.black	nodecov.term

Comment [JNV6]: Look for degeneracy. In this table, statistically significant p-values suggest the possibility of degeneracy. The solution might be to increase the MCMC sample size to greater than 1 million, but the models already take more than a week to run on a high performance cluster. We look for other evidence of degeneracy below.

diff.	4946.470	8065.714	4173.3980	122720.469
test stat.	1148.671	2038.640	883.7743	2114.367
P-val.	0.000	0.000	0.0000	0.000

nodecov.electpct Overall (Chi^2)

diff.	1420402.62	NA
test stat.	2356.91	4207453087
P-val.	0.00	0

Sample statistics cross-correlations:

	edges	m2star	triangle
edges	1.0000000	0.8303232	0.7796705
m2star	0.8303232	1.0000000	0.6215310
triangle	0.7796705	0.6215310	1.0000000
edgecov.cauc110.aff.dichot.net	0.8797794	0.7410982	0.6939311
edgecov.comml10.aff.dichot.net	0.5550308	0.4916007	0.4424283
nodematch.party	0.9295476	0.6875901	0.7873776
nodematch.state	0.2248202	0.3210368	0.1454492
nodematch.gender	0.9188841	0.7435726	0.7205150
nodematch.leader	0.9115947	0.7619123	0.7108061
nodematch.black	0.9845845	0.8095194	0.7731694
nodecov.term	0.9150847	0.7612449	0.7029080
nodecov.electpct	0.9941338	0.8285867	0.7730160
edgecov.cauc110.aff.dichot.net			
edges		0.8797794	
m2star		0.7410982	
triangle		0.6939311	
edgecov.cauc110.aff.dichot.net		1.0000000	
edgecov.comml10.aff.dichot.net		0.4813831	
nodematch.party		0.8505782	
nodematch.state		0.1728335	
nodematch.gender		0.8260074	
nodematch.leader		0.8107986	
nodematch.black		0.8787537	
nodecov.term		0.8207075	
nodecov.electpct		0.8808481	
edgecov.comml10.aff.dichot.net	nodematch.party		
edges	0.5550308	0.9295476	
m2star	0.4916007	0.6875901	
triangle	0.4424283	0.7873776	
edgecov.cauc110.aff.dichot.net	0.4813831	0.8505782	
edgecov.comml10.aff.dichot.net	1.0000000	0.4999343	
nodematch.party	0.4999343	1.0000000	
nodematch.state	0.1098906	0.1503656	
nodematch.gender	0.4849380	0.8665001	
nodematch.leader	0.5134142	0.8495367	
nodematch.black	0.5484463	0.9374057	
nodecov.term	0.4767106	0.8335479	
nodecov.electpct	0.5523718	0.9164060	
nodematch.state	nodematch.gender		
edges	0.2248202	0.9188841	
m2star	0.3210368	0.7435726	
triangle	0.1454492	0.7205150	
edgecov.cauc110.aff.dichot.net	0.1728335	0.8260074	
edgecov.comml10.aff.dichot.net	0.1098906	0.4849380	
nodematch.party	0.1503656	0.8665001	
nodematch.state	1.0000000	0.2270858	
nodematch.gender	0.2270858	1.0000000	
nodematch.leader	0.1996868	0.8298838	
nodematch.black	0.2045190	0.9164332	
nodecov.term	0.1901237	0.8703870	
nodecov.electpct	0.2309145	0.9178765	
nodematch.leader	nodematch.black	nodecov.term	
edges	0.9115947	0.9845845	0.9150847
m2star	0.7619123	0.8095194	0.7612449
triangle	0.7108061	0.7731694	0.7029080
edgecov.cauc110.aff.dichot.net	0.8107986	0.8787537	0.8207075
edgecov.comml10.aff.dichot.net	0.5134142	0.5484463	0.4767106
nodematch.party	0.8495367	0.9374057	0.8335479
nodematch.state	0.1996868	0.2045190	0.1901237
nodematch.gender	0.8298838	0.9164332	0.8703870
nodematch.leader	1.0000000	0.9017368	0.7728136

```

nodematch.black          0.9017368      1.0000000      0.9031936
nodecov.term             0.7728136      0.9031936      1.0000000
nodecov.electpct        0.9041535      0.9761040      0.9191527
                        nodecov.electpct
edges                    0.9941338
m2star                  0.8285867
triangle                0.7730160
edgecov.cauc110.aff.dichot.net 0.8808481
edgecov.comml10.aff.dichot.net 0.5523718
nodematch.party         0.9164060
nodematch.state         0.2309145
nodematch.gender        0.9178765
nodematch.leader        0.9041535
nodematch.black         0.9761040
nodecov.term             0.9191527
nodecov.electpct        1.0000000

```

Sample statistics auto-correlation:
Chain 1

```

edges m2star triangle edgecov.cauc110.aff.dichot.net
Lag 0 1.0000000 1.0000000 1.0000000 1.0000000
Lag 100 0.9993373 0.9991571 0.9995851 0.9993144
Lag 200 0.9986765 0.9983153 0.9991710 0.9986311
Lag 300 0.9980163 0.9974739 0.9987567 0.9979490
Lag 400 0.9973542 0.9966301 0.9983420 0.9972648
Lag 500 0.9966928 0.9957862 0.9979278 0.9965814
edgecov.comml10.aff.dichot.net nodematch.party nodematch.state
Lag 0 1.0000000 1.0000000 1.0000000
Lag 100 0.9993420 0.9994031 0.9994526
Lag 200 0.9986834 0.9988081 0.9989071
Lag 300 0.9980253 0.9982117 0.9983608
Lag 400 0.9973679 0.9976130 0.9978146
Lag 500 0.9967088 0.9970154 0.9972699
nodematch.gender nodematch.leader nodematch.black nodecov.term
Lag 0 1.0000000 1.0000000 1.0000000 1.0000000
Lag 100 0.9993406 0.9992875 0.9993459 0.9992973
Lag 200 0.9986823 0.9985765 0.9986941 0.9985972
Lag 300 0.9980240 0.9978662 0.9980426 0.9978974
Lag 400 0.9973634 0.9971548 0.9973885 0.9971955
Lag 500 0.9967038 0.9964439 0.9967356 0.9964952
nodecov.electpct
Lag 0 1.0000000
Lag 100 0.9993278
Lag 200 0.9986577
Lag 300 0.9979879
Lag 400 0.9973162
Lag 500 0.9966448

```

Sample statistics burn-in diagnostic (Geweke):
Chain 1

Fraction in 1st window = 0.1
Fraction in 2nd window = 0.5

```

edges m2star
0.08108 0.44596
triangle edgecov.cauc110.aff.dichot.net
-0.23862 0.31240
edgecov.comml10.aff.dichot.net nodematch.party
-0.01347 -0.25189
nodematch.state nodematch.gender
1.80015 -0.14721
nodematch.leader nodematch.black
-0.22050 -0.03114
nodecov.term nodecov.electpct
-0.05650 0.19937

```

P-values (lower = worse):

```

edges m2star
0.93537687 0.65562306
triangle edgecov.cauc110.aff.dichot.net

```

Comment [JNV7]: Look for degeneracy. In the statistics below produced for the Geweke test, we seek to accept the null hypothesis. Here the lack of statistical significance suggests the model is **not** degenerate.

```
0.81139882      0.75473514
edgecov.comml10.aff.dichot.net  nodematch.party
0.98925494      0.80112902
  nodematch.state  nodematch.gender
0.07183641      0.88296658
  nodematch.leader  nodematch.black
0.82547983      0.97515879
  nodecov.term      nodecov.electpct
0.95494011      0.84196999

> dev.off()
null device
  1

>
> pdf('cosponl10.23.gof.pdf')
> cosponl10.24.gof<-gof(cosponl10.24)
> plot(cosponl10.24.gof)
> dev.off()
null device
  1

>
> proc.time()
   user  system elapsed
723633.97   320.99  728797.08
```