



SIENA: Longitudinal modeling of social networks

Maurits de Klepper
(*PhD-candidate/lecturer*)



Overview

- non-mathematical intro to actor-based models
 - Kansas University Summer Institute in Statistics, "Social Network Dynamics", June 15-19, 2009.
- using SIENA



History

- Simulation Investigation for Empirical Network Aalysis
- For friendship networks
- <http://stat.gamma.rug.nl/stocnet/>
- <http://stat.gamma.rug.nl/siena.html>



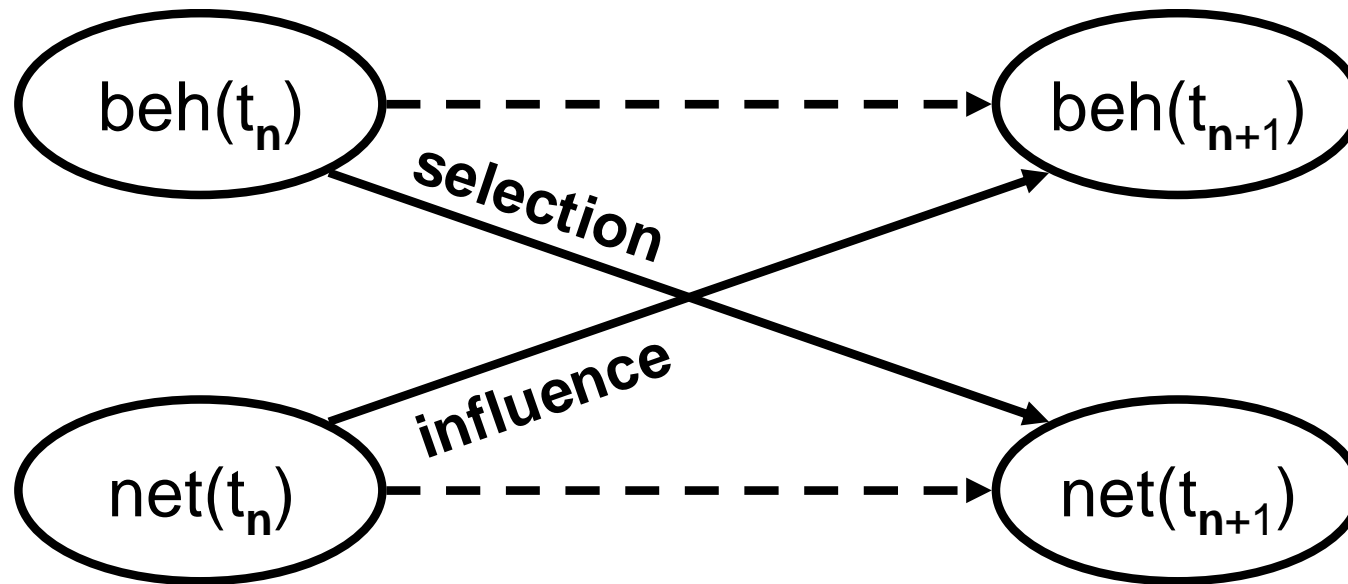


Main application

- *How are ties formed?*
- Any tie
- There's more....



Dual causality





Data requirements

- 10-1000 actors
- $M \geq 2$
- complete network
- 1 DV
- same set of actors for every M
- *state* change
 - future depends on past



Panel design

- Few rules of thumb....
- # measurement moments, spacing?





Example: Studies Gerhard van de Bunt

- Longitudinal study: panel design.
- Study of 32 freshman university students,
- 7 waves in 1 year.

See van de Bunt, van Duijn, & Snijders,
*Computational & Mathematical
Organization Theory*, **5** (1999), 167 – 192.



Why use SIENA? Why care?

- (networks) autocorrelation
- combines network as well as actor effects
- change modeled as continuous, or “reaction chains”
- what are the alternatives?
 - SEM or HLM
 - See Steglich et al (2007)



Continuous time simulation

- Latent change is simulated
- Actors take random turns in maintaining/changing one outgoing tie (mini-steps)
- Actors are myopic in time
- Tie-state change (transition probability) is based on the tie with the most 'value'
- Value is based on chosen parameters



How are the simulations tested as being 'significant'?

- when the simulations comes close to the 'target' state
- parameter significance expressed in basic t-statistics



The model

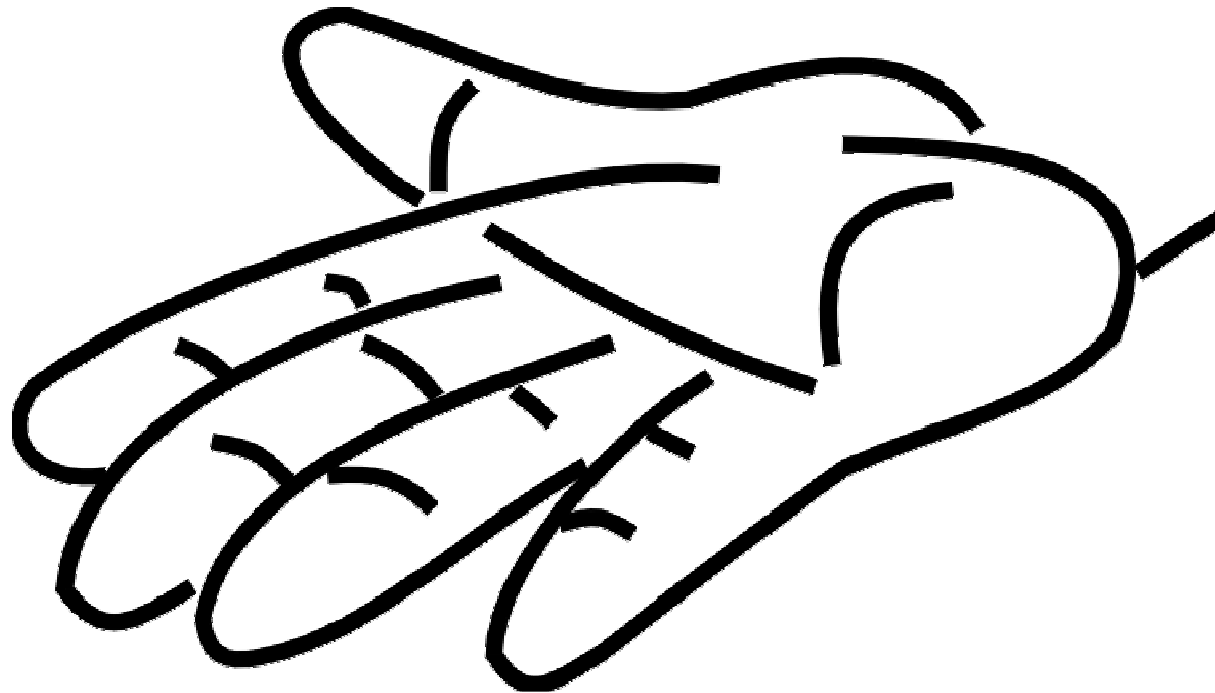
Network evolution function of...

1. structural effects
2. explanatory actor variables
3. explanatory dyadic variables



The parameters

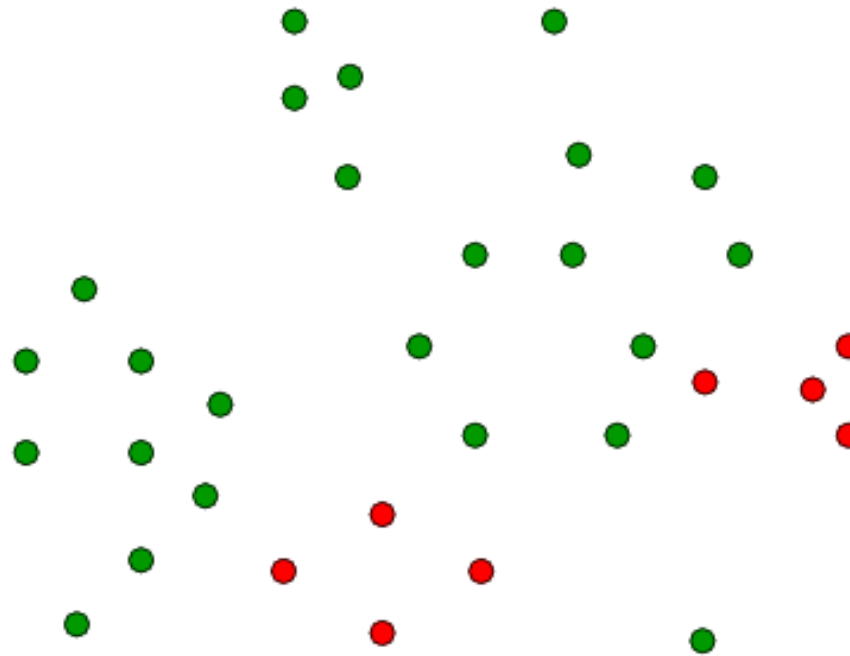
- Handout



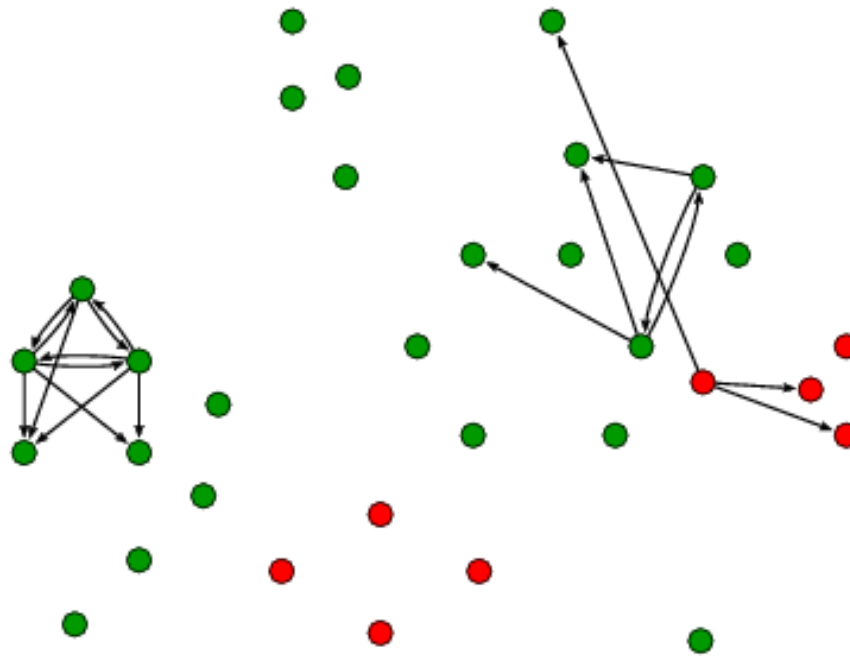
Friendship between students t_0

● Women

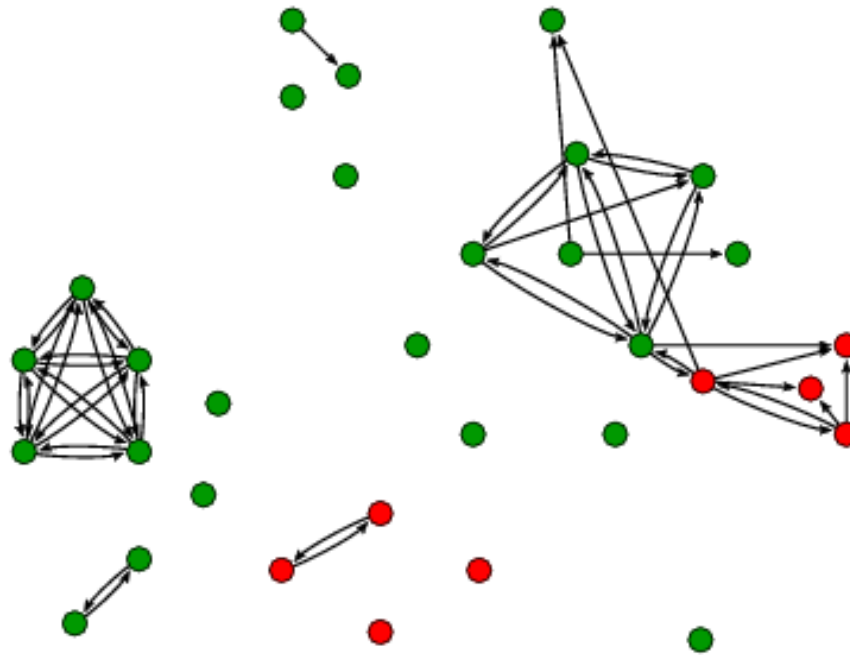
● Men



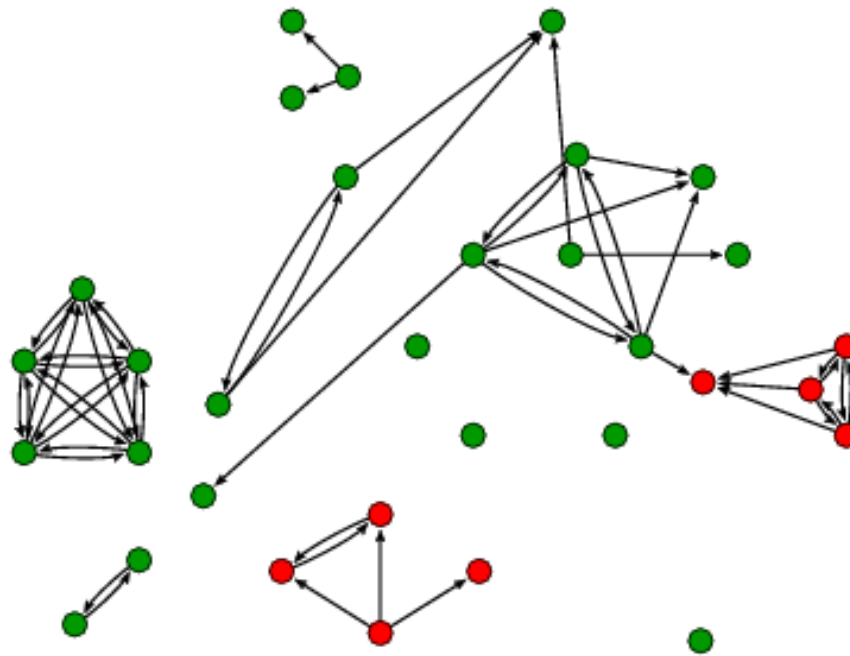
Friendship between students t_1 (3 wk)



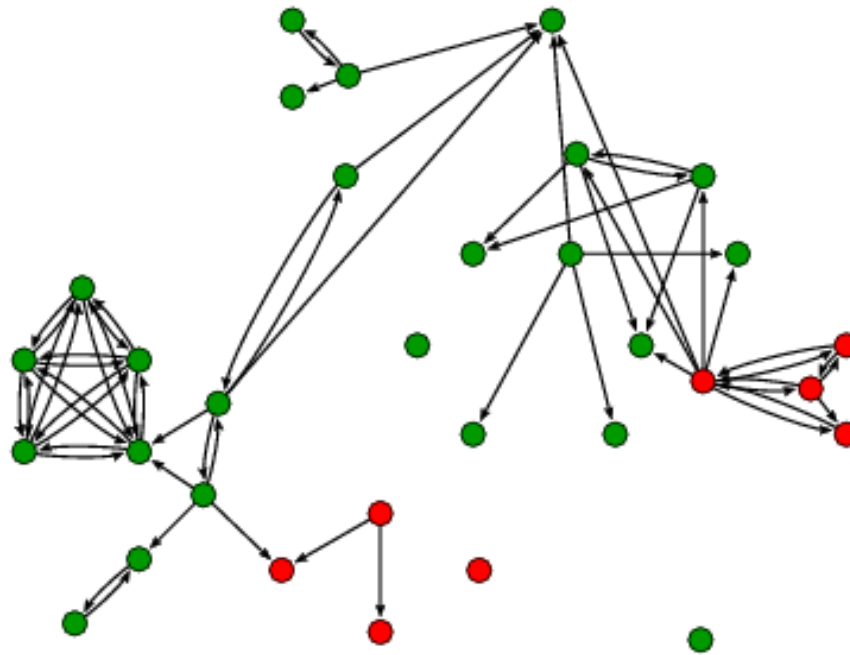
Friendship between students t_2 (6 wk)



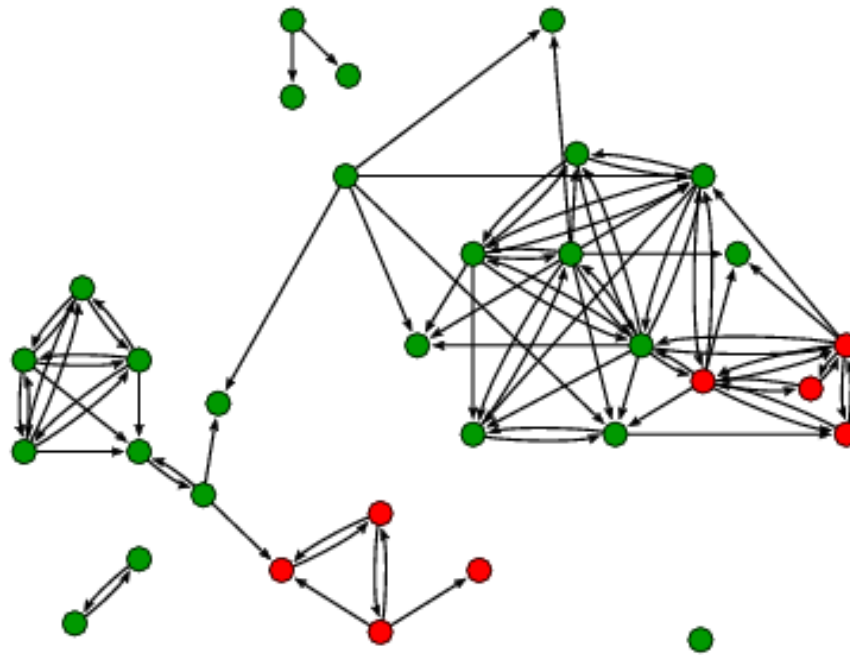
Friendship between students t_3 (9 wk)



Friendship between students t_4 (12 wk)



Friendship between students t_5 (18 wk)





Interpretation parameters

- behavioral patterns – change rules
- not: network descriptives
- but: has descriptive properties....
- tip: both look at networks descriptives as well as parameters
- outdegree ‘weird duck in the pond’
 - usually negative
 - more non-ties than ties
 - density below 0.5



Interaction effects

- Many are already implemented

User-defined:

- Ego effects x all effects
- Actor sim. x dyadic (x reciprocity)
- Actor sim. x transitivity (p. 29)
- Reciprocity x transitivity (p. 29)



The model: the functions

Objective/evaluation function (v)

- How are ties formed?
- Change determination process

• Rate function

- How fast do actors change ties?
- Change opportunity process

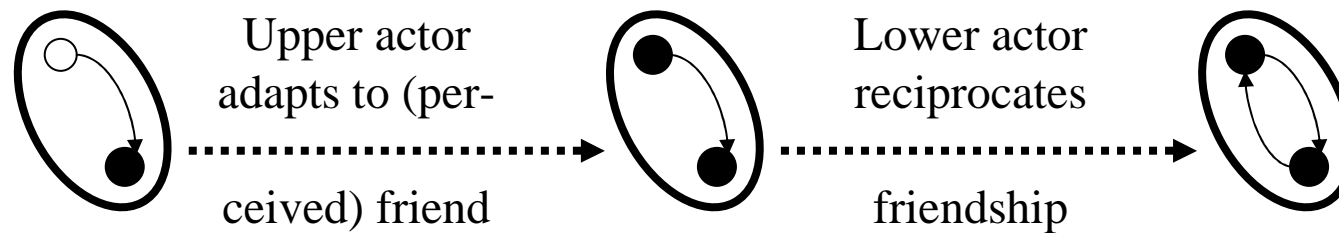
• Endowment function (e)

- What's the added 'value/loss' of dissolving ties?



Causal reciprocation

- If not....danger of causal misattribution



- So check them both out...

Selection & influence (Steglich et al., 2007)

<i>Friendship dynamics</i>	Rate 1	11.29	(0.87)
	Rate 2	8.82	(0.85)
	Outdegree	-2.77	(0.06)
	Reciprocity	2.48	(0.09)
	Sex similarity	0.96	(0.08)
	Drinking similarity	0.89	(0.47)
	Smoking similarity	0.30	(0.12)
<i>Smoking dynamics</i>	Rate 1	4.94	(1.62)
	Rate 2	3.94	(1.40)
	Linear preference	-2.55	(0.58)
	Squared preference	2.69	(0.37)
	Ave. similarity	2.92	(1.24)
	Sex (F)	-0.05	(0.29)
<i>Alcohol consumption dynamics</i>	Rate 1	1.70	(0.32)
	Rate 2	2.69	(0.63)
	Linear preference	0.45	(0.18)
	Squared preference	0.07	(0.12)
	Ave. similarity	7.42	(2.52)
	Sex (F)	-0.06	(0.22)



Convergence problems

- Incorrect data input/coding
- Bad starting values for parameters
- Wrong model
- Outliers
- Collinearity
- Too many weak effects
- Very strong effects



New stuff

1. Goodness of fit, score tests (paper Schweinberger).
2. Bayesian estimation; Maximum Likelihood estimation (Koskinen & Snijders, J.Stat.Plann.Inf. 2007).
3. Explained variation (R^2) (Snijders, Math.Soc.Sci. 2004).
4. Non-directed relations
5. Random actor effects ~ unobserved heterogeneity.
6. Multilevel network analysis (meta analysis approach) (Snijders & Baerveldt, J.Math.Soc. 2003).
7. Valued relations; Multivariate relations.



(Before) tomorrow

- Read:
 - Snijders, Steglich & Van de Bunt (2008)
 - SIENA-manual
- Explore some models
 - Use your own data set