Inferring Latent Influence Diffusion Networks in The United States Senate

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Influence In The U.S. Congress

Figure: John McCain [R] and Charles Schumer [D].

Legislative Influence

- ▸ Want to measure the influence of legislators on each other.

- ▸ Measurement: seniority? position? money? **personal relationships**?

- ▸ Use temporal patterns in bill cosponsorship as evidence.

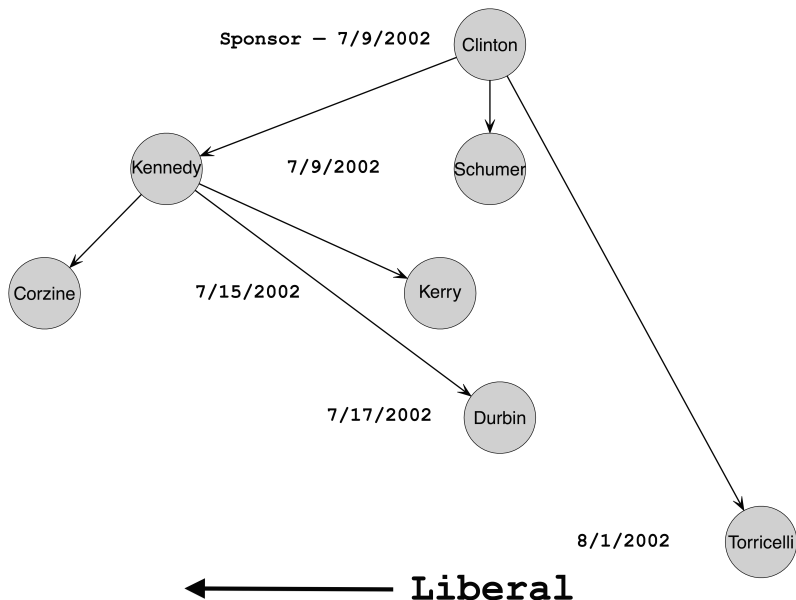## Example Bill: S.2715, emergency unempl. benefits for 9/11 victims

Sponsor

- Clinton – 7/9/02

Cosponsors

- Kennedy – 7/9/02
- Schumer – 7/9/02
- Corzine – 7/15/02
- Kerry – 7/15/02
- Durbin – 7/17/02
- Torricelli – 8/1/02

Want To Infer: Influence Relationships

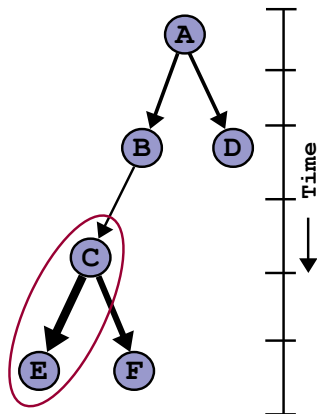# Inferring Influence

Inference Strategy

- Assume cosponosrship patterns arise from underlying cascade of influence.

- Aggregate over many bills to infer underlying influence network.

- Gomez Rodriguez, M., Leskovec, J., & Krause, A. (2010). "**Inferring networks of diffusion and influence**". *KDD*

Traces of Influence

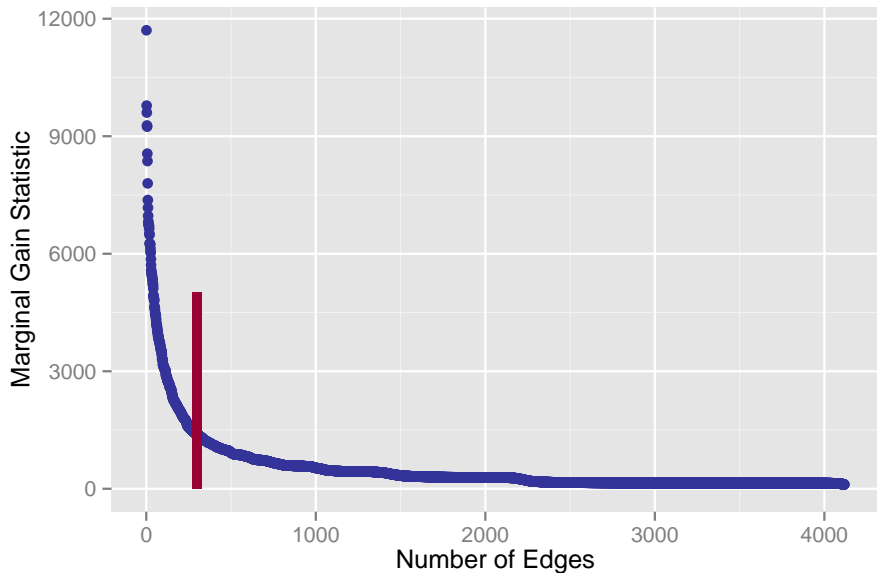**Bill Cosponsorship Delay**
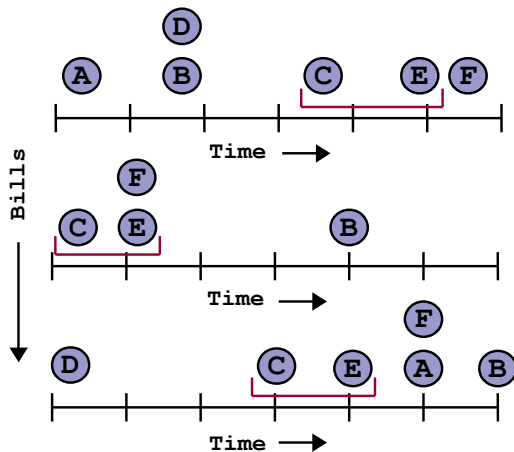
Temporal Cascades

Diffusion Model

- Want to infer best network to explain observed cascades.

$$P(\Delta) \propto e^{-\frac{\Delta}{\alpha}} \qquad (1)$$

- Δ – time difference between action for two nodes.
- α – inverse average time diff. between a node and its potential parents

How Many Edges to Include in Network?

Model Selection

Cross Validation

- Jensen, D. D., & Cohen, P. R. (2000). **Multiple Comparisons in Induction Algorithms**. *Machine Learning*, 309338.

10-fold cross-validation
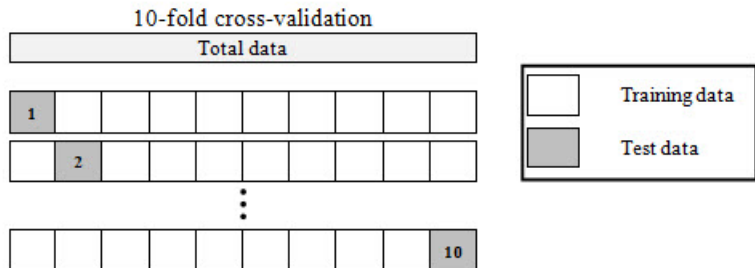
Strategy

- Predict when Senators will cosponsor in held-out sample.

- Fit event history models for model selection.

- Optimization over # edges and hyper-parameter (10 80/20 splits)

- Grid Search!

Rare Events Logistic Regression

- King, G., & Zeng, L. (2001). **Logistic regression in rare events data**. *Political Analysis*, 9(2), 137163.

Use Model Log Likelihood For Selection.
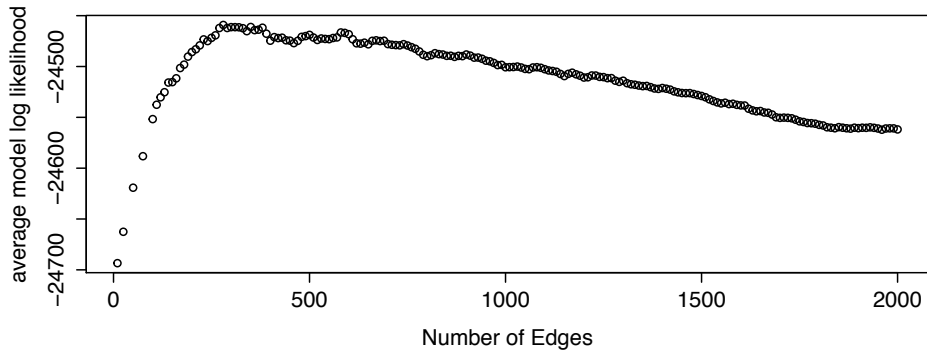
Cross Validation Results
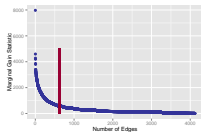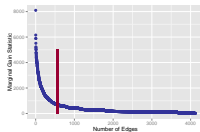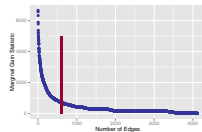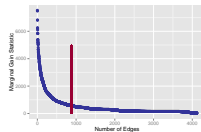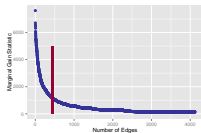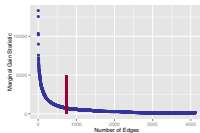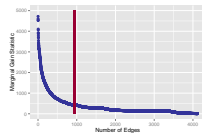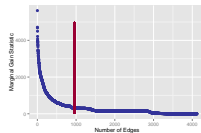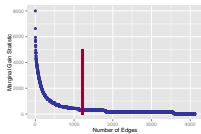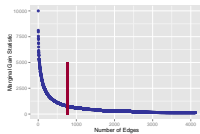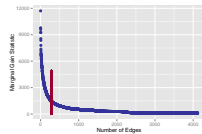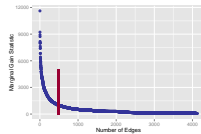
Large Variation in Optimal Network Size

Session	Edges	Alpha
81-82	629	0.5
83-84	575	0.25
85-86	608	0.4
87-88	884	0.45
89-90	450	0.3
91-92	732	0.25
93-94	949	0.7
95-96	957	0.3
97-98	1207	0.1
99-00	779	0.4
01-02	298	0.25
03-04	493	0.5
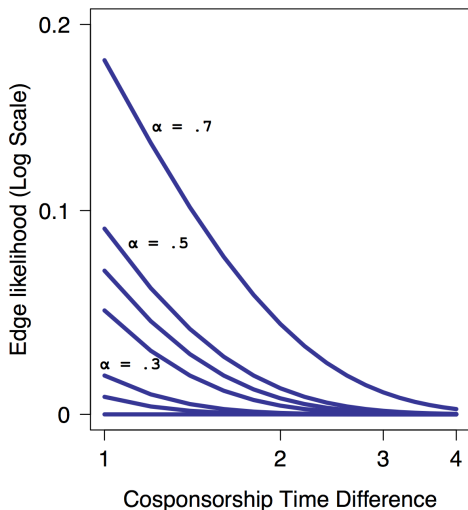
Influence Networks
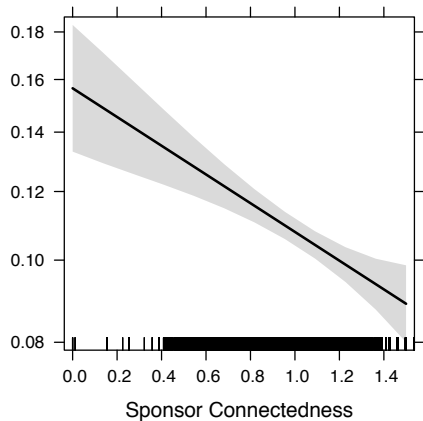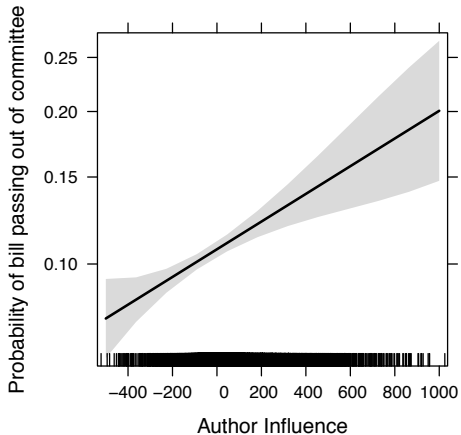
Influence Networks: 1981-2004
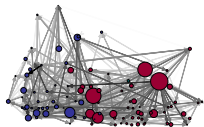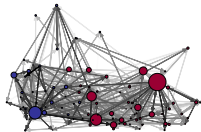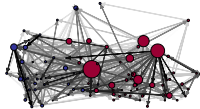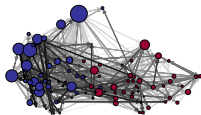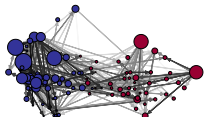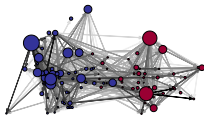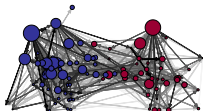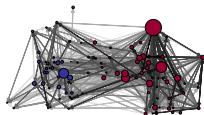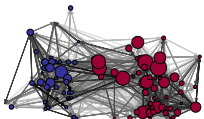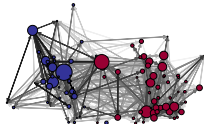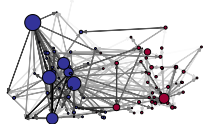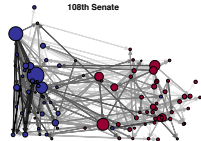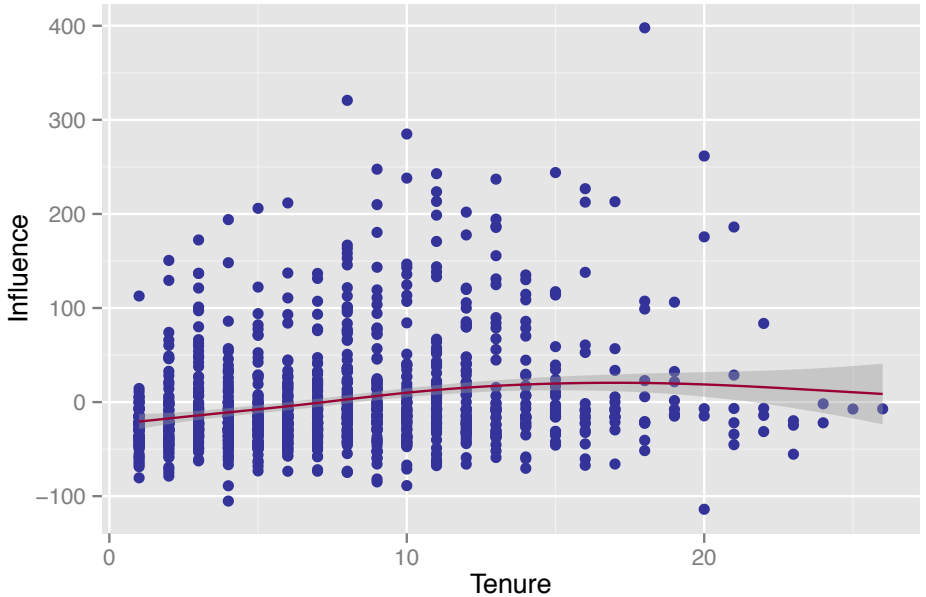
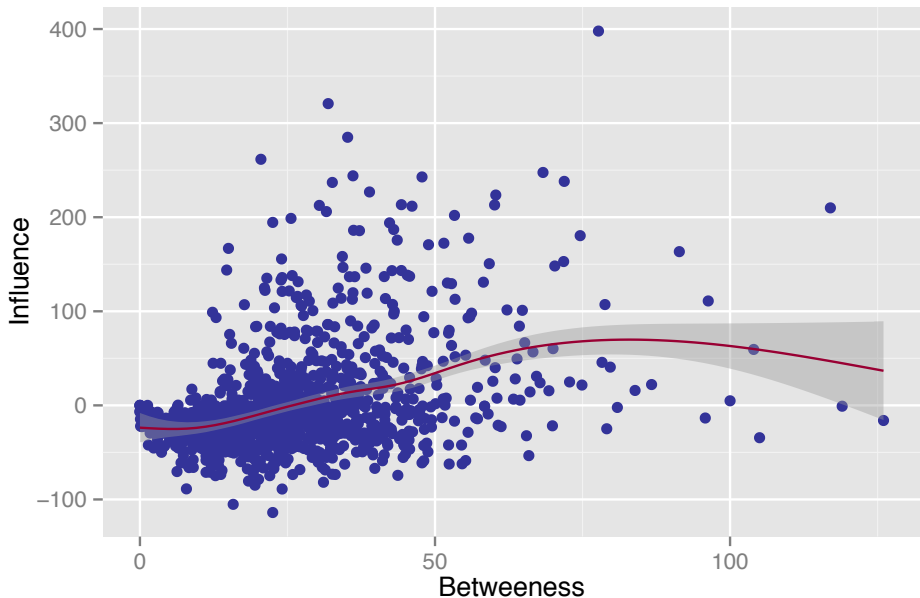# Example Influence Network 2001-2002
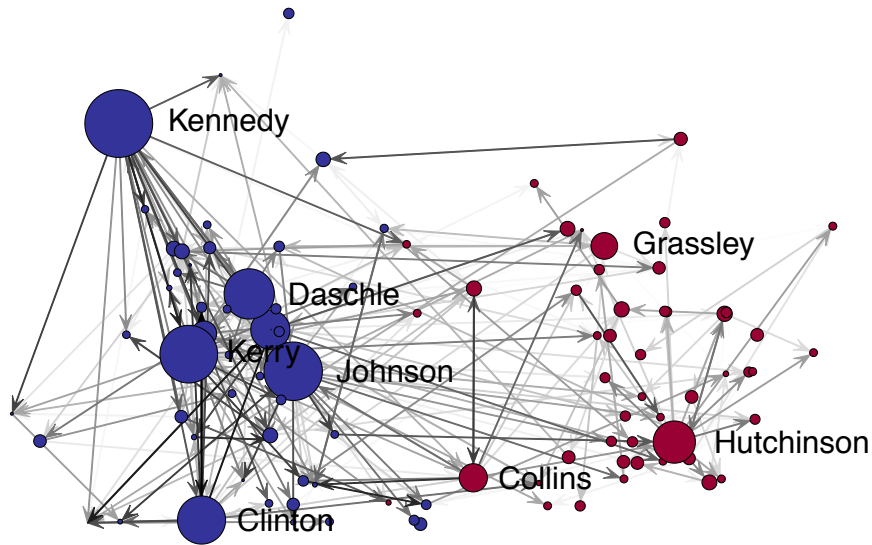
Applications

Predicting Bill Advance Using Author Influence
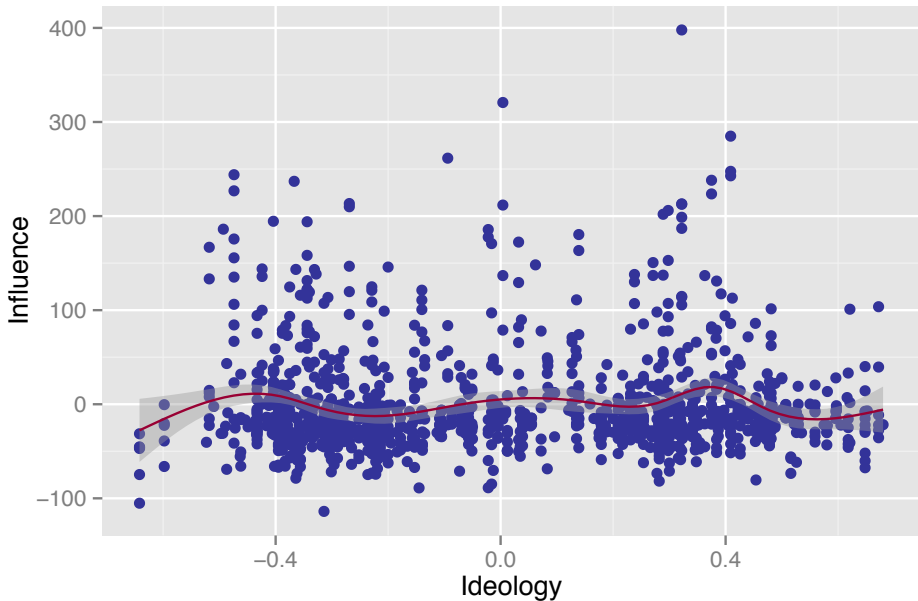
Tenure (Sessions of Congress) and Influence

Co-Cosponsorship Betweeness and Influence

Research Agenda

- Provide influence score/network dataset

- Δ structure of inf. net. over time

- Temporal disaggregation

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Ideology and Influence

Density of Bill Author Influence 2001-2002