Overview

Political phenomenon are characterized by interdependence across multiple relational contexts. I present a multilayer network approach to modeling these complex phenomena. This approach:
- Does not require assumptions about independence between connected systems;
- Affords inferential leverage in the type of theoretical tests we can conduct;
- Yields models with better fit to the observed data.

Methodological Approach

An exponential random graph model is a statistical model that can test the different kinds of factors that underly the generative process of the observed network. In an ERGM, the probability of observing a network $Y = \{Y_{ij} \}$ is specified as

$$\Pr(Y; \theta) = \kappa^{-1} \exp(\theta'x(Y)).$$

where $x$ is a vector function that yields observed network statistics computed on $Y$.

The multilayer network approach extends the $Y$ matrix and the function vector $x$.

- **Layers** are the organizing principle of multilayer networks.
- Nodes are organized by types onto layers.
- Types are defined by the combination of all relevant node-attributes.
- Incident layers define tie type.

The adjacency matrix of a multilayer network is partitioned into blocks.
- Main diagonal blocks are intralayer ties; off diagonal blocks are interlayer ties.
- Network configurations are counted on the relevant blocks.

Illustration: Conflict in the Levant

For example, different types of conflict two-star clusters involve different strategic considerations.

**Figure 1.** Conflict in the Levant, 1985-1992

- Strategic considerations for actors facing political conflict span across different types of conflicts.
- For example, different types of conflict two-star clusters involve different strategic considerations.

**Figure 2.** Different Types of Conflict Clusters

- Figure 3. Levantine Conflict, Multilayer Representation

- The adjacency matrix of a multilayer network is partitioned into blocks.

**Figure 4.** Levantine Conflict, Matrix Representation

- Main diagonal blocks are intralayer ties; off diagonal blocks are interlayer ties.
- Network configurations are counted on the relevant blocks.

**Figure 5.** Policy communication as a multilayered network

I fit two models, one with dependence across the two communication networks and one without. I find that the cross-layer dependence term fits better and affords better understanding of policy communication networks.

**Application: Policy Communication**

Leifeld and Schneider, 2012, “Information Exchange in Policy Networks,” *AJPS*

- Transaction cost approach to political and scientific communication
- Reciprocity and influence in different types of communication channels should span multiple layers.

**Figure 6.** Network configurations for a dyad on two layers

**Figure 7.** Model Fit Comparisons

| Table 1. Policy communication as a multilayered network |
|--------------------------|--------------------------|--------------------------|
|----------------------------|----------------------------|----------------------------|------|------|
| Political Communication    | 2.88*                      | 0.65                      | 0.50 | 0.26 |
| Influence of Scientific Comm. | 0.81*                      | 0.25                       | 0.53 | 0.26 |
| Scientific Communication   | 2.87*                      | 0.62                       | 7.60* | 2.51 |
| Influence of Political Comm. | 1.76*                      | 0.53                       | 0.87 | 0.54 |
| Cross-layer Dependence     |                           |                            | 0.08 | 0.52 |
| Interlayer Reinforcement   | 1.75*                      | 0.62                       | 0.87 | 0.54 |
| Interlayer Reciprocity (F) | 0.87                       | 0.54                       | 0.08 | 0.52 |
| Scientific Arc: Political Reciprocity (G) | -5.71* | 0.65 |