Extended abstract:
Neighborhoods and Individual Preferences: A Markovian Model
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An important question in sociology concerns the relationship between individual behavior and collective outcomes. When individuals' actions or choices are interdependent, macro-level patterns are not simply aggregates of micro-level characteristics and behavior (Coleman 1994; Granovetter 1978). Tipping or threshold models (Schelling 1971, 1978; Granovetter 1978; Granovetter and Soong 1983) provide one useful framework for connecting individual actions to population-level outcomes. These models rest on two-way interaction: individual actions may be influenced by the actions of others who act in a given way, while changes in individual behavior alter the makeup of the population. These social interaction models account for the "emergence" of collective properties from the behavior of individuals, and can also explain why the same individuals may experience a wide range of social outcomes, depending on the structure of their interaction.

One area where we observe interdependent behavior is in the study of neighborhood formation and change. Any person who moves is both responding to neighborhood composition and also (by leaving one neighborhood and entering another) changing neighborhood composition. Schelling (1971, 1972, 1978) laid the conceptual groundwork for modeling the relationship between individual preferences and behavior on the one hand and the evolution of neighborhoods on the other. Using rudimentary computational models applied to artificial agents, he showed how the preferences of individuals about where to live give rise to (often unanticipated) aggregate patterns of residential segregation. These patterns, moreover, may be at odds with the majority of individuals' preferences. Schelling's work assumed that people respond to neighborhoods based on a threshold function. More recently, Bruch and Mare (2006) extend on Schelling's work to examine the implications of alternative assumptions about how individuals evaluate neighborhoods (based on their race-ethnic composition) for aggregate patterns of residential differentiation. They couple their model with survey data to determine what assumptions about individual preferences are most plausible.

Both Schelling and Bruch and Mare rely on agent-based (microsimulation) models to draw inferences about the relationship between individuals' choices about where to live and aggregate patterns of segregation. Agent-based modeling, which provides a flexible framework for capturing systemic properties of interacting individuals, has grown in popularity in recent years. But agent-based models, despite their power to model complex situations, are in themselves complex structures and the key determinants of their dynamic behavior are often hard to understand and distill into simple conclusions.

Bruch and Mare also formulate a simple stylized Markov chain model to capture the key features of their agent-based models. In this Markovian model, individual preferences in the form of probabilities of moving or staying are functions of neighborhood composition, and the equilibrium states of the model represent possible macrolevel patterns of segregation (or its absence). Here we present the results of a complete analytical treatment of the equilibrium properties of this model and some extensions. Two results are especially interesting. First, the analytics yield an exact condition for the minimum strength that individual preferences must have in order to yield stable segregation patterns. Thus we can relate observed preferences to observed macrolevel patterns of differentiation. Second, the analysis shows that under Schelling-type rules, segregation is the only stable equilibrium possible.

We argue that simple formal models have the potential to usefully illuminate the relationship between individual choices and collective population-level patterns.

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