

## Network Models of the Diffusion of Innovations

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Valente's book, *Network Models of the Diffusion of Innovations*, concisely reviews current theory and research regarding diffusion of innovations, then presses further to propose more discerning models. The author rejects the implicit assumption of uniform knowledge and social pressure that limits many prior diffusion models. Instead, he uses networks analysis techniques to examine in detail the diffusion effects of individual and social factors within a system. The result is a precise approach to modeling diffusion through fine-grained social structures.

In keeping with traditional diffusion research, Valente focuses primarily on adoption of innovation as it is influenced by social characteristics of the individual and the extent of diffusion within the social system. Deviating from traditional diffusion research, he examines influence toward adoption that results from each person's unique social position within the embedding system. He applies this approach to structural as well as cohesion models of social contagion.

Models of diffusion through cohesion describe or predict influence toward adoption that results from direct contact between individuals. In contrast, structural models examine effects of complex relations that arise from the pattern of contacts within a social system. Valente addresses several structural characteristics that may foster diffusion, including centrality, bridging ties, and equivalent roles or positions within the social context. The author gives particular attention to structural equivalence—the extent to which two individuals maintain the same relations with the same others. Examples of cohesion and equivalence models from various disciplines are presented early to provide broad familiarity with the concepts. At the same time, Valente introduces the effects of adoption thresholds and critical mass as seen from multiple research perspectives.

According to the author, thresholds and critical mass models have dominated recent work on innovation adoption and collective behavior. Valente defines a threshold for adoption as “the proportion of a group needed to engage in a behavior before the individual is willing to do so” (page 17). This threshold varies across individuals and is posited to be responsible for earliness or lateness of adoption in response to social influence. Valente advances this research by developing threshold models based on personal networks and applying them to multiple sources of contagion, including cohesion and structural equivalence.

Similarly, Valente presents a detailed explanation and analytic approach to the role of critical mass in systemwide diffusion. Critical mass is the point at which enough people have adopted to sustain diffusion to the remainder of the population. Prior research often treated critical mass as a simple proportion of potential adopters at the system level.

Valente expands the concept by demonstrating that network structures surrounding adopters influence critical mass. Precision afforded by this modeling technique has potential to push this line of research in new and exciting directions.

The arguments for observing and modeling threshold effects within personal networks are clear, and Valente's treatment of the notion is sound. Yet this focus and corresponding tests of adoption thresholds are at once strengths and weaknesses of the book. Valente's work contributes greater understanding of patterns and mechanisms for diffusion, but the methods and assumptions overlook two issues. First, Valente studies only diffusion efforts that resulted in widespread adoption. For example, he examines the successful diffusion of hybrid corn in Brazil, but disregards data from the same study that documented minimal diffusion of similar innovations among other farmers (page 10). By ignoring patterns that occur when an innovation diffuses minimally or only to a subset of the social system, we lose valuable information. To be fair, Valente discusses nondiffusion as the result of exceedingly high thresholds for adoption among members of the social set. Nevertheless, this provides little insight into conditions that predispose a system toward adoption or rejection of an innovation. This shortfall, common to diffusion research, is addressed by recent work that uses simulation models to identify structural conditions necessary for diffusion to occur (Krackhardt, 1996).

A second weakness in the discussion of threshold models is likewise common to this stream of research. An adoption threshold is defined both in terms of its effect on diffusion (above) and as "the exposure level at the time of adoption" (page 141). Given the definition of an adoption threshold as both cause and consequence of adoption, arguments that individual thresholds determine susceptibility to social influence become circular. The claim that personal thresholds determine speed of adoption has not yet been subjected to a strong test, and further investigation of this fundamental assumption appears necessary.

Despite these concerns, threshold models are used profitably to examine diffusion of tetracycline, hybrid corn, and contraception through personal networks in different populations. A thorough and enlightening series of analyses systematically tests relational and structural effects on diffusion. At the same time, Valente examines effects of close relations, broader ties, and of the whole system in the three focal datasets. This meticulous comparison of dissemination under various conditions makes a valuable addition to the existing diffusion literature.

Besides its contributions to diffusion research and modeling, this book would be a good teaching tool. For students in disciplines as varied as marketing, public policy, or technology management, it provides a useful and fairly complete primer of diffusion. The book builds sophisticated theory using detailed explanations, examples, and helpful diagrams, and remains readable throughout. Because of this, *Network Models of the Diffusion of Innovations* should appeal to a broad audience, including novices as well as diffusion researchers.

## References

- Krackhardt, D. (1996). "Organizational viscosity and the diffusion of controversial innovations," *Journal of Mathematical Sociology*, forthcoming.