Marketing Under Conditions of Chaos

Percolation Metaphors and Models

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A new concept for the study of marketing phenomena is introduced. Derived from the area of statistical topology and central to the emerging theory of "chaos," percolation describes a process of deterministic flow through a stochastic medium. Contrasted to diffusion, in which a random flow progresses through a deterministic medium, percolation is suggested as a useful metaphor for marketing management and as a more appropriate source of models for the study of consumer adoption processes. Examples and potential applications are given, and areas for future research are suggested.

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As the study of "chaos" in physics and mathematics has revolutionized the physical sciences, new theories and methods have become available to the social sciences as well. Because marketing has frequently been the beneficiary of other disciplines' innovations, chaos theory may provide opportunities to reconceptualize familiar problems within the business domain.

The purpose of this article is to introduce a new metaphor and source of models for the study of marketing and consumer behavior, known as percolation. As a key concept in the area of stochastic chaos theory, percolation describes a specific type of movement dynamic of phenomena through various "media." As alternatives to the popular diffusion models, percolation models may provide unique insights in the conceptualization of marketing and in the analysis of interpersonal influence within the consumer adoption process. As Morrison (1991) observes, the function of models is to provide a conceptual framework. It is our intention to provide a nonmathematical introduction to these alternative models as the preliminary groundwork for a new conceptual framework in marketing. Toward this end, we will: (1) provide a basic overview of dynamic systems and stochastic chaos theory, (2) contrast the concepts of percolation and diffusion, and (3) describe in greater detail some of these alternative percolation models.

Characterizing Dynamic Systems
in Marketing

As marketing models are representations of dynamic systems, a discussion of these systems' properties provides a useful starting point for evaluation and comparison. We begin by categorizing dynamic marketing systems into four distinct families, based loosely upon the work of Morrison (1991). Each of these families of dynamic systems encompasses specific marketing phenomena and implies specific models as appropriate for the analysis of these phenomena.

For the purposes of this discussion, we have chosen to segregate intraindustry determinants of commercial success from those that are environmental or extraindustry. Conforming to contemporary marketing thought, we suggest that market or environmental (extraindustry) factors play a potentially greater role in determining success or failure than those endogenous to the industry. We further presume that a higher degree of uncertainty and uncontrollability characterizes these environmental factors, which makes their impact upon businesses effectively stochastic. Finally, we suggest that it is the marketing efforts or actions of a given organization that contribute primarily deterministic inputs to the outcome of success or failure and thus form the basis of a logical "discipline" or methodological expression in the practice of marketing.

Solvable Systems

The first type of dynamic system is designated a Type I or solvable system. This type of system is relatively simple and essentially deterministic, such that the modeling of phenomena within these systems generally results in insignificant error or resid-
ual components. We suggest that conditions of this type characterize very few actual situations in marketing management, as these systems imply both a high degree of certainty regarding market, environmental, and other exogenous conditions, and also a complete understanding of the mechanics of competition and other elements endogenous to a given industry (see Figure 1). We label models of this type of marketing system “cookbooks,” as they imply that simple data and minimal parameter specification will yield flawless results.

**Estimable Systems**

The second type of system, called a Type II or estimable system, is where useful solutions can be approximately derived using basic mathematical models. Models of these systems contain some error. Yet this error is “manageable” in that it is assumed to be randomly and independently distributed, and thus does not significantly bias outcomes. Furthermore, it is possible to adequately understand and appropriately specify the parameters of these models, because Type II systems are largely deterministic with only minor components of randomness. Examples of this type of model in physics are those used in determining or controlling satellite orbits.

In marketing, Type II systems could be characterized as those in which a high level of certainty regarding market or environmental conditions is possible, yet where imperfect knowledge regarding intrasystem dynamics exists. Significantly, most marketing models assume a system of this type. One class of deterministic marketing models that rely upon Type II assumptions are those describing processes of innovation or product diffusion. As Lilien, Koder, and Moorthy (1992, p. 473) note, “innovation diffusion is a deterministic process,” and thus, most diffusion models are deterministic by design. Competitive game theory models in the economics discipline also tend to operate within the perceived environment of Type II systems, because factors exogenous to the industry are ignored under the assumption that they impact all firms equally.

**Chaotic Systems**

The third form of dynamic system (Type III) is described as a turbulent or chaotic system, as its “trajectory” may exhibit sudden and unpredictable changes. Examples of these chaotic systems are studied within the discipline of climatology. Unlike Type I and II systems, chaotic systems display large stochastic components and relatively smaller deterministic influences. Significantly, Type III systems are the most difficult type of system to model (Morrison, 1991). Not only are models of chaotic systems susceptible to large and critical errors, their parameters are often difficult to identify or describe. Because they are the least susceptible to study using conventional tools of analysis, Type III systems have only recently received the attention of scientists and mathematicians. Models of percolation are examples of tools that have been specifically designed for studying certain processes occurring within chaotic systems.

In the study of marketing, Type III systems would occur where there is a solid understanding of competitive dynamics, yet great uncertainty regarding the moderating effects of the market environment. It is our contention that a majority of marketing situations can be characterized in this manner—that is, marketing decisions typically take place within chaotic environments. To date, however, most research in marketing has utilized models and tools designed for Type II systems, and may thus be inappropriate given the complexity of business phenomena (Dunipace, Mix, and Poole, 1993).

**Random Systems**

Finally, the fourth type of system (Type IV) is characterized as random—the simplest example being a roulette wheel. Because these systems are purely stochastic, they can be modeled through the use of probability theory. In marketing, this type of system would be described by conditions where poor knowledge of competitive mechanisms is present and where there is equally poor potential to accurately predict changes in environmental conditions.

**Deterministic versus Stochastic Chaos**

Because we have asserted that marketing typically occurs within situations characterizable as chaotic, a more thorough understanding of this type of system may facilitate the study of marketing phenomena (Hibbert and Wilkinson, 1994). It is thus important to clarify the distinction between deterministic and stochastic chaos (also known as nonrandom and random chaos). Processes of deterministic chaos typically generate random-looking, nonrepeating patterns of outcome. Yet these processes are governed by deterministic sequences or causes, such as the simple iteration of a growth rule. (The calculation of π is a simple example of deterministic chaos, because a sim-
ple formula generates a nonrepeating sequence that could be mistaken for random digits.) As a result, deterministic chaos represents a system that contains hidden order. This underlying order can conceivably be discovered by the researcher. In this way, deterministic-chaotic systems are more comparable to Type I or Type II systems if the underlying order can be discovered and precisely specified, and Type IV systems if the order cannot be determined. Although the concept of deterministic chaos has received the most attention in the popular literature, this is probably due less to the relevance of the concept for realistic problem solving, and more to (1) the intricacy and beauty of the "geometric fractals" (Stanley, 1991) created by computer programs employing these simple principles, or (2) the conceptual elegance of the notion that complex outcomes can result from simple causes.

In contrast to the underlying order of deterministic chaos, stochastic chaos describes a system in which complex or chaotic outcomes result from stochastically governed (but statistically estimable) antecedents or influences. As such, stochastic chaos can be said to characterize Type III systems. Despite being overshadowed by discussions of deterministic chaos in the recent literature, stochastic chaos is potentially more important to the social sciences, because it more accurately characterizes those systems typically found in natural or social settings (Stanley, 1991). Although there have been some efforts to incorporate the concept of deterministic chaos into the marketing discipline (Dunipace, Mix, and Poole, 1993; Herbig, 1990; Herbig and Golden, 1991; Hibbert and Wilkinson, 1994; Mix, 1993), the potential contributions of stochastic chaos have been virtually ignored.

**Diffusion and Percolation Contrasted as Marketing Metaphors**

Now we introduce the concept of percolation, contrasting it to the most popular metaphor in marketing—that of diffusion. Although diffusion and percolation describe related physical processes, their differences are relevant when these concepts are used as frameworks for marketing analysis.

**Diffusion and Percolation as Physical Processes**

As the concepts of percolation and diffusion originated in the discipline of physics, a simple example from this area will provide the clearest definition of these terms. Consider the physical phenomenon of a fluid spreading randomly through a given medium. (A disease spreading throughout a population, a branching process, or a product or innovation spreading through a market are analogous events.) In this case, the random mechanism may appropriately be ascribed to either the fluid or the medium. If this process is a randomly flowing fluid spreading throughout a deterministic medium, the process is termed *diffusion* (Frisch and Hammersley, 1963; Hammersley and Handscomb, 1964). The simplest example of this process is seen as a two-dimensional random walk. In this example, a "particle" (the fluid) moves randomly in steps within a confined space, and each movement of this particle is independent of its previous history. If this process continues indefinitely, the particle will eventually visit every point within the confines of the space.

Contrasted to this process is one in which there is a deterministic movement of fluid through a stochastic medium. This phenomenon is called *percolation* (Frisch and Hammersley, 1963; Hammersley and Handscomb, 1964). In the simple example, the particle (fluid) again takes "steps" in space, but the direction taken in these steps is influenced or dictated by the medium, rather than the behavior or properties of the fluid. Thus, the "random" state of the medium governs the motion of the particle or fluid and contributes the stochastic element to the flow or process. Further, each point within the medium can now be seen to have a given probability of accommodating the fluid, and the fluid is thus excluded from some areas altogether. In the percolation process, then, only a portion of the medium can ever be occupied by the particle-fluid, whereas in diffusion, the particle will implicitly infiltrate every point in the medium if allowed to travel indefinitely.

Recall the proper domains of diffusion and percolation processes. Diffusion typically describes a process occurring within a deterministic environment. As a result, diffusion models in both physics and marketing make assumptions consistent with Type II dynamic systems. Conversely, percolation is governed by stochastic environmental influences, and models of these processes thus conform to chaotic or Type III system assumptions.

**Physical Process Metaphors in Marketing**

In applying the diffusion/percolation metaphors to the marketing discipline, it would seem most realistic to portray the "active" or motile element (as in the fluid) as the firm, brand, or marketing communication, whereas the environment through which the movement occurs (the medium) can legitimately be compared to the market. Yet note what this characterization implies for the marketing implementation of these metaphors and models. Using this assignment of analogies, the diffusion metaphor literally implies that the firm is a random mover through the market, and that every constituent of this market will eventually accommodate the firm's efforts and adopt the brand or innovation. Within the conceptual domain of the diffusion metaphor then, one cannot logically discuss the "probability" that a particular part of the medium or market will adopt the product or innovation. An individual probability of adoption can only exist within a medium/market that is stochastic in nature.

Because diffusion portrays a random flow through a deterministic medium, this metaphor is also paradigmatically consistent with the "population ecology" perspective in the management discipline. Based upon the notion that organizational forms evolve as environmentally ill-adapted firms are replaced with superior versions, population ecology clearly implies that the
efforts of the organization in determining later outcomes (success or failure) tend to exhibit an essentially random execution. The validity of these efforts is then assumed to be established by criteria inherent in the environment. This view of organizational performance thus implies that the laws of the environment become, de facto, the sole determinants of success or failure (Alchian, 1950; Aldrich, 1979; Astley and Fombrun, 1983; Hannan and Freeman, 1977).

The percolation metaphor, on the other hand, suggests that the enterprise deterministically moves through a market in which each individual or segment has some unique probability of adopting or proving receptive to the firm's activities. This metaphor also implies that the deterministic actions (flow) of an organization are mediated by the stochastic influences of the environment. As numerous contemporary writers have noted, the volatility and unpredictability of environmental factors is both increasing and also resulting in a greater impact upon organizational decision-making and outcomes (Ackoff, 1981; Mitroff, 1987; Perrow, 1984). The aggregate effects of governmental, economic, ecological, and social influences upon businesses determine a larger and larger proportion of the overall outcome as the complexity and global interconnectedness of organizational actions increase. As Mitroff (1987, p. 9) notes: "Everything everywhere now truly has the potential to affect everything else."

The environmental factors, which due to their complexity exhibit an essentially random or stochastic effect upon marketing processes, are thus becoming proportionately more influential. This uncertainty impacts the firm in a manner that tends to render managerial decision-making more risky. As such, the relationship between strategic action and eventual market outcome is increasingly becoming more influenced by stochastic mediators, and thus more tenuous. In other words, the business environment is becoming increasingly chaotic (Waterman, 1987). This conceptualization of marketing as a process that occurs in chaotic environments is also more logically consistent with that of the economics discipline, where individual enterprises are assumed to deterministically pursue rational methods of maximization (microeconomics), whereas the environment is governed by primarily stochastic influences (macroeconomics) (Herbig, 1990).

**Diffusion as a Metaphor for the Consumer Adoption Process**

Originating in physics and subsequently adopted in epidemiology, the diffusion metaphor in marketing suggests that the adoption of new products or services follows a pattern closely analogous to the spread of infectious diseases (Bhat, 1984). As the focus of thousands of analyses and scientific discussions, the "diffusion of innovations" is the most studied concept in the social sciences (Rogers, 1983, 1976). Due to its perceived relevance and development, this concept has also proven popular in marketing. As a result, the diffusion metaphor has become deeply entrenched in the accepted conceptualization of marketing.

**Diffusion as a Forecasting Concept**

Within the marketing discipline, the diffusion metaphor has traditionally been employed as a conceptual adjunct to the science of forecasting. In traditional diffusion models, the analysis of the consumer adoption process has primarily focused upon three groups of variables. The first of these groups includes the rate of diffusion at a given point in time, the cumulative number of adopters at a given point in time, the total number of potential adopters in a population (the market potential), and the rate at which adoption occurs (Sultan, Farley, and Lehmann, 1990).

The second group of variables found in some "external influence" (Lekvall and Wahlbin, 1973) diffusion models (as given in Fourn and Woodlock, 1960) represent elements external to the adopting unit that are driving the diffusion process, such as advertising and other marketing mix components. The coefficient for this group of variables is typically called the "coefficient of innovation" (Bass, 1969, p. 217) and captures the probability that an individual will adopt an innovation independent of other consumers (Sultan, Farley, and Lehmann, 1990). (As noted previously, this implementation thus clearly contradicts the actual definition of a true diffusion process.)

Finally, diffusion models often also include variables that account for the situation where consumers learn from those who have adopted earlier. The coefficient for these variables is called the "coefficient of imitation" and describes an "internal influence" diffusion model (such as in Mansfield, 1961).

As can be seen from this brief summary, the first group of "sales forecasting" variables in diffusion models quantify the consequences of consumer purchases over time and thus define the overall sales potential for a given product at a given point in time. In contrast, the second and third groups of variables in these models represent efforts to explain the relative importance of the influences to which consumers may be subject in a given situation or product category. Thus, each of the elements in these diffusion models describes the "influences" or "results" of the adoption process from an aggregate perspective and for the purposes of forecasting. Furthermore, as Elashberg and Chatterjee (1986) observe, these deterministic models used in forecasting the diffusion of products or ideas are limited in their effectiveness by the numerous stochastic elements present in the marketing environment.

**Network Analysis as Employed within the Diffusion Metaphor**

More recently, the patterns of "diffusion" have been studied using the techniques of social network or neural network analysis (Jacobicucci and Hopkins, 1992). As network analysis attempts to determine the influence of one "node" upon neighboring nodes (Kurubarahalli and Yip, 1994), this form of investiga-
tion shifts the focus of the diffusion metaphor away from the individual's role in the cumulative outcome and toward the dyadic or relational aspects of the adoption phenomenon within the context of a "network" (Scott, 1991). Network analysis has thus become a method for identifying the communication structure of a system and the methods by which these structures affect the patterns of diffusion (Rogers and Agarwala-Rogers, 1976).

For lack of more appropriate metaphors, network analysis in marketing has largely been employed within the conceptual framework of diffusion. These methods would seem more appropriately applied within the metaphor of percolation, however, due to their focus on relational rather than attributive data. Furthermore, social network analysis generally occurs from the perspective of mathematical topology (Lewin, 1951), the primary domain of percolation theory.

Percolation as a Metaphor for the Consumer Adoption Process

In contrast to diffusion, and parallel with the goals of social network analysis, the concept of percolation provides the opportunity to analyze the exact manner in which internal influences to the adoption process occur. This is possible because percolation is studied from the perspective of a geometric analysis (specifically, statistical topology), such that communication or influence between given pairs of individuals can be examined. Thus, whereas diffusion models generally focus on the cumulative effects of sequential adoption, percolation models focus on the sequential steps in the process of flow (or adoption), and can thus be used to analyze the same events from a dyadic or relational standpoint. Because of this focus, we feel that percolation models have less potential as forecasting tools than as constructs for understanding relational aspects of communication and adoption. Thus, our discussion will avoid mathematical formulae used to predict sales or adoption rates.

Stationary Percolation

A simple example of the percolation process is the flow of water through a semiporous rock. Consider a cross-section of this rock as composed of a lattice of solid and open (empty) sites or pores, where each site is open with the probability \( p \), and solid with the probability \( 1-p \). (Neighboring sites in this lattice are relational, and equivalent to the network analysis concept of adjacency.) Figures 2 through 5 depict lattices of varying levels of \( p \) (white representing solid sites and black representing empty sites).

At very low values of \( p \), the open sites within the lattice are isolated (completely surrounded by closed pores), as in Figure 2 (\( p = 0.2 \)). At slightly higher \( p \)-values, some of these open sites form small clusters of nearest neighbor sites—the being finite in that they are also completely surrounded by closed sites, as in Figure 3 (\( p = 0.4 \)). (Clusters in percolation are comparable to the same term in network analysis—see Scott, 1991.) Two open sites belong to the same cluster if they are connected by a path of nearest neighbor open sites, and water may flow between them. Thus, at low \( p \) values, no path connecting the opposite sides of the lattice exists, and the rock or material is nonporous. At large values of \( p \), on the other hand, many connective paths between opposite edges exist, and the material is porous, allowing water to seep through it, as illustrated in Figure 5 (\( p = \)
may assume numerous forms (with the cells being square, honeycomb, triangular, cubic, etc. — each having a unique value of \( p_c \)). A more realistic version of this simple percolation model is where the open or solid sites are not restricted to the geometrically equidistant confines of a regular lattice. This type of percolation model is known as "continuum percolation" or the "Swiss-Cheese" model (Bunde and Havlin, 1991).

**Nonstationary Percolation**

A more complex example, and one which is potentially more relevant to consumer behavior, is that of a forest fire. In this situation, the forest is represented by a two-dimensional matrix populated by trees and empty spaces. As forest fires spread when burning trees ignite immediately neighboring trees, the fire is delimited or contained when gaps of empty spaces prevent further ignition (Pfeitgen, Jurgens, and Sauepe, 1992). Because, in this case, gaps prevent the flow or “percolation” of a fire, the probability of any space containing a tree will be denoted as \( p \), whereas the probability of a space being empty is \( 1-p \). In cases where \( p \) is low, the forest is relatively sparsely populated with trees, and a fire which starts will destroy only a small portion of the forest. The case of a large \( p \), however, is devastating, as almost all of the trees will burn down (see Figure 6).

**Percolation and New Product Adoption**

Stationary and nonstationary percolation are analogous to two different types of consumer adoption situations. In the first example, where the percolation of water through a semiporous rock is illustrated, cells of the media lattice are either solid or empty. In this case, the occurrence of water entering an empty cell or cluster of cells cannot alter the nature of the lattice. Extrapolated to the marketing world, this type of percolation (stationary) relates to situations where the acceptance or purchase of new product categories is “predetermined” by the needs or characteristics of individual consumers. In other words, this type of percolation represents a primarily “innovative” model of adoption. The percolation metaphor also suggests that there is a critical level of consumer acceptance, such that products which do not achieve this level in the marketplace are limited to sales in small clusters or market segments. Conversely, products that exceed this critical level of sales achieve “percolation” or overall market acceptance/saturation, even if some consumers do not adopt the product or innovation. This example would seem to suitably describe the situation where the adoption of new technologies or innovations depends upon a “threshold” level of consumer acceptance. The percolation threshold may also relate to a requisite market share for a new product introduction to become profitable or to remain in production.

In the second example (that of a forest fire), changes occur in the structure of the “lattice” as the “flow” of the fire progresses through the media (forest), resulting in “trees” transforming into spaces as they burn. Specifically, a tree that has burned out completely now functions as an empty space, serving to block the
Figure 6. Nonstationary two-dimensional lattice (forest fire model). Adapted from Prügel, Jürgens, and Sauer (1992).
Further spread of fire. Thus, nonstationary percolation describes a "self-avoiding walk," and may portray a unidirectional or irreversible "flow" or process. Furthermore, trees can only ignite neighboring trees during the interval in which they are burning. Nonstationary percolation is thus an appropriate metaphor for many types of consumer behavior to the extent that an imitative process occurs, or where purchase or adoption results in some change to a buyer. As Herbig (1991, p. 53) notes, "the effects of previous consumption upon tastes cause actual consumption to follow a chaotic path."

Nonstationary percolation is even more relevant to the study of competitive brand purchases in the adoption of durable goods. As Hibbert and Wilkinson (1994) note, most diffusion models are inadequate to the extent that they fail to accommodate the inhibiting effects of competitive brand purchases. This is relevant because the purchase of one brand effectively eliminates the potential for the sale of a competitive product to that consumer. Purchases of one brand of durable good thus reduce the potential for successful "percolation" of rival brands by effectively changing the structure of the market as product adoption progresses cumulatively. As a result, nonstationary percolation would appear to hold promise for the study of first mover or pioneer-brand advantage. In addition, the interpersonal influence that leads to imitative adoptions is likely to have an effect for a limited interval of time for each buyer. As can be seen from these few examples, the percolation metaphor can often conform to marketing situations that confound the diffusion perspective.

**Percolation Models of Cumulative Interpersonal Influence**

An even more interesting example can be derived by modifying the nonstationary or "forest fire" percolation model. If we assign each individual tree a probability of igniting when exposed to a burning neighbor's flames, we can then model the effects of repeated exposures to the fire. In this case, each tree is assigned a probability of burning (which we will call k), but this probability relates to each instance of a neighbor tree's combustion. Thus, although a tree may not ignite from the heat of its "first" neighbor's flames (due to the direction of the wind or the shape of the tree), a second, third, or fourth neighbor's blazes increase the cumulative probability of this tree's combustion. As a result, each tree's cumulative probability of burning is actually much higher than k, and the overall probability of percolation (or complete consumption of the forest) is some product of p, k, and the time required for a tree to completely burn.

This modified nonstationary percolation model would appear to yield a more realistic representation of "imitative" product adoption. This is because the effects of interpersonal influence on product adoption generally impact an individual in a cumulative fashion. A potential adopter is not likely to immediately purchase a product based on his or her first encounter with an owner. More likely, each influencer or opinion leader encountered by a potential adopter will cumulatively increase the probability of adoption.

Moreover, this version of the percolation metaphor suggests that "successful" new ideas or product innovations (those that meet with little resistance, where k is large) "spread like fire through a dry forest," with the end result being high levels of saturation. Conversely, those which meet with greater resistance from the buying public (small k) are likely to only engulf small pockets or segments of the market, eventually smoldering and extinguishing. This model can be made even more complex (and realistic) by intermingling consumers with both high and low probabilities of adopting after a given exposure (k).

**Directions for Further Research**

Although the work presented in this article is merely an attempt to offer a fresh perspective in conceptualizing common marketing problems, it can hopefully serve as an inspiration for others who can develop testable implementations of the percolation model or apply the percolation metaphor in a more comprehensive manner. In the behavioral area, we believe that further research in this direction could lead to insights regarding patterns of influence or communication, or the effects of behavioral or purchase facilitators and inhibitors, particularly the percolation threshold relates to a given set of market or individual attributes. Another avenue could be the application of percolation models to individual brand choice in situations of sequential or nested noncompensatory decision-making.

In marketing management, percolation models could find relevance in the study of advertising response functions or the effects of communication sensitivity or thresholds. The analysis of channel relationships would also seem a fruitful direction for future applications of these ideas.

**Conclusions**

The purposes of this study have been threefold. First, we have suggested that chaotic systems prevail in most marketing environments. To facilitate an understanding of these environments, we have contrasted chaotic and other forms of dynamic systems, and we have distinguished between deterministic and stochastic types of chaos.

Second, we have proposed the concept of percolation as an appropriate metaphor for the marketing and consumer adoption processes and as a proper conceptual framework for the application of network analysis. As metaphors provide the opportunity for useful insights regarding the mechanisms underlying various phenomena (Tsoukas, 1991), new metaphors and models can be employed as catalysts for "unfreezing" entrenched conceptualizations. Due to the dominance of the diffusion metaphor within the marketing literature, other perspectives and insights have been excluded. Although it is now axiomatic to suggest that business environments are becoming increasingly complex and unpredictable (in other words, chaotic), the diffusion metaphors/models that monopolize the marketing dis-
Discipline are only appropriate within systems that are stable and predictable.

Finally, we have described several types of percolation models and have illustrated their suitability for analyzing various relationships within markets.

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References