GENETIC ALGORITHMS AS A TOOL TO SOLVING RESEARCH PROBLEMS IN MARKETING

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ABSTRACT

The complexity involved in analyzing and making sensible and useful predictions from huge amounts of data that have been collected, is a major impediment to progress in various streams of research in modern marketing management. For estimations of complex intrinsically nonlinear models, the restrictions placed by traditional modeling and optimization techniques affect the quality of the parameter estimates. Research, often in these scenarios, have resorted to data analysis and prediction formulated as search problems. Over the past decade genetic algorithms (a randomized search procedure) is being used in various fields such as social sciences, economics, and finance as a valuable accessory for data analysis and prediction. However, only a limited number of studies in marketing have exploited the power of genetic algorithms in modeling real world situations.

As posited by Goldberg (1989), Genetic Algorithms are search algorithms based on the mechanisms of natural selection and natural genetics. In other words, the genetic algorithm iterates toward a solution through a process that in many ways parallels the Darwinian process of natural selection.

Given a specified optimization problem, the algorithm starts with the initial population of random candidate solutions (the first generation) and then selects a subset of the population to contribute offsprings to the next generation of candidate solutions. As in natural systems, the new offspring inherits a blend of the traits from the previous generation. The key to this process is selectivity. Not all population members are given an equal chance of contributing offspring to the next generation so that only a select few actually contribute. In particular population members most likely to contribute are those possessing traits favorable to solving the optimization problem; least likely to contribute are those possessing unfavorable traits. In this way, a new population of candidate solutions (the second generation) is built from the most desirable traits of the initial population. As iterations continue from one generation to the next, traits most favorable to reaching a solution thrive and grow, but those least favorable dies out. Eventually the initial population evolves to one that contains a solution to the optimization problem, and the iterations terminate.

The genetic algorithm does not rely on a point-to-point search. Instead the search proceeds from one population of points to another, each consisting of m points. In this way, the search sweeps through the parameter space in many directions simultaneously and thereby reduces the probability of convergence to false optima. The search is randomized but structured. It differs from purely random methods in that each new population of points evolves from a process that assesses and selectively combines information from previous populations.

The genetic algorithm has two main limitations. First, a genetic-algorithm search can entail many evaluations of the objective function and, consequently, much execution time. Given the present rate of progress in computer technology, however, the required computational expense is most likely a temporary limitation. The second limitation is that, like other direct search methods, convergence of the genetic algorithm does not necessarily occur at a single optimum solution. The search will typically find a point that is close enough to the maximum. Then a gradient-type algorithm (when started from the found point) will efficiently converge to the maximum. The genetic algorithm is best viewed as a potentially valuable complement to traditional algorithms.

Marketing Applications of Genetic Algorithms

Estimation of Complex Intrinsically Nonlinear Models. Marketing phenomena such as the probabilistic forecasting of future customer purchases based on historical purchase behaviors and the analysis of diffusion models are intrinsically nonlinear. Studies have resorted to iterative search algorithms to estimate parameters in these situations. Given, the advantage of genetic algorithms over traditional iterative procedures, the above situations are an attractive avenue for the application of genetic algorithms.

Game Theory. Genetic algorithm solutions (also agents) can be simulated to iterate in environments characterized by high competitive intensity. The performance of the artificial agents can be compared with the performance of managers. Applied to marketing this translates to issues such as understanding brand competition. Genetic algorithms can be used to understand the effect of a late entrant into the market place. Issues such as should the existing companies now bring in new features, should they improve on market share, or should there be mergers, can be addressed by using genetic algorithms to simulate the environment.

Market Segmentation. Genetic algorithms can contribute significantly in solving problems related to effective market segmentation and therefore in developing efficient direct marketing strategies. Strategies such as timing of catalogs and promotional materials depend upon the characteristics specific to customers. Genetic algorithms can be used to develop rules necessary to categorize customers accurately into different segments. Even a small increase in accuracy in efficiently segmenting customers significantly affects the profitability of the company.

Overall, a myriad of research problems in marketing can benefit from the application of genetic algorithms.

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