


Chapter 9


Simulating Competitive Market Dynamics: Gaining an Edge Through Predictive Analytics

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ABSTRACT

This study examines competitive market dynamics through the lens of predictive analytics, where multiple predictors, including machine learning models and service providers, compete for user attention and influence decisions. Users' choices feed back into the predictors' learning process, creating a complex adaptive loop that influences the quality of predictions. A theoretical model is proposed, treating both user and predictor decisions as probabilistic outcomes shaped by their historical states and actions. Findings reveal that optimal competition enhances predictive performance, while excessive or insufficient competition degrades it. This framework reflects behaviours akin to multi-agent competitive games. To validate the model, numerical experiments are presented in regression, classification, and consensus-clipping scenarios. Further, the study applies this concept to retail analytics,

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proposing a data-driven benchmarking framework. Using model-based clustering and competitive learning, it segments stores based on performance dynamics and delivers tailored recommendations through optimization techniques. This work provides strategic insights for both regulators and businesses seeking to refine their prediction systems and enhance market competitiveness.

1. INTRODUCTION

The increasing volume of electronic communications and advanced social network analysis methods has stimulated demand for anticipatory capabilities in the social sciences. Predictive analysis aims to provide actionable warnings about significant events, enabling analysts to make informed decisions based on a quantitative basis for timely intervention (Colbaugh & Glass, 2009). A strong big data analytics capability can help firms build a competitive advantage by strengthening their dynamic capabilities, which in turn positively impact marketing and technological capabilities (Mikalef et al., 2020). Predictive analytics, such as event classification, regression modeling, link prediction, and recommendation tools inspired by natural language processing, represent a growing technological area with the capacity to foster competitive advantages when harnessed for ex ante insight (Hain & Jurowetzki, 2020). Market datasets contain historical prices for key consumer products (Larose & Larose, 2014). The advertising intensity associated with these prices is a surrogate measure of a firm's competitive actions and can be used to infer the firm's predictive model of competition (Lin & Kolcz, 2012). Given data from one firm in an industry, the predictive model of competition can be inferred through machine learning (Eckerson, 2012). The firm can then use this purchase prediction model as a competitive prediction engine for its products, and its extensions to other products are tractable via the contractibility of products' shared attributes.

Nowadays, Business analytics significantly enhances strategic decision-making, operational efficiency, and innovation in emerging markets; however, challenges like data privacy and security require supportive frameworks for optimal benefits (Abiola Moshood Komolafe et al., 2024). The resulting model, although implicit, is a rational expectancy equilibrium model of competition and has multiple advantages over conventional methods, including greater flexibility in expression, resolution of data sparsity, and the ability to generalize across products. Because Big data and marketing analytics positively impact a firm's marketing capabilities, such as marketing planning, implementation, brand management, customer relationship management, and product development management (Cao et al., 2022). Due to its ability to readily extend to new contexts/situations, this model suggests potential gains for data-intensive firms in gaining and maintaining a competitive edge through

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