# REFINING PRICING STRATEGIES OF RETAIL FIRMS THROUGH GAME THEORY MODELS

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M.Sc in Financial Mathematics

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Thesis submitted in partial fulfillment of the requirements for the degree
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## DECLARATION

I declare that this is my own work and this Thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

Signature: Date:

The supervisor should certify the Thesis with the following declaration.

The above candidate has carried out research for the M.Sc in Financial Mathematics Thesis under my supervision. I confirm that the declaration made above by the student is true and correct.

Name of Supervisor: Dr. Anuradha Mahasinghe

Signature of the Supervisor: Date:

## DEDICATION

I dedicate this MSc thesis to my loving family, whose unwavering support, encouragement, and sacrifices have been my anchor throughout this journey.

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## ABSTRACT

Efficient price setting is crucial for ecommerce and retail businesses, yet implementing pricing strategies pose a challenge. Traditional consumer-oriented pricing approaches based on price sensitivity may not be effective for today as markets are diverse and competitive as well as firms are looking for innovation. This research aims to demonstrate the benefits of analyzing returns of price strategizing processes, regardless of product price elasticity. Pricing among different retail firms, inherently a game-like process, and achieving win-win outcomes should be the goal for a stable market. The objectives include conducting a theoretical study on game theory models applicable to price strategizing automation, implementing these models using computer programs and analyzing the potential gains through comparison with other pricing strategies. Additionally, a proposal for a pricing framework and digital infrastructure for retail businesses will be presented. The methodology involves a comprehensive literature review of game theory models in the domain, evaluating their practicality and suitability for retail contexts using examples and critical analysis. This research primarily explores the application of game theory models to analyze pricing decisions in retail markets. The Bertrand competition model and the game of product differentiation are employed to understand price dynamics, market equilibrium, and product positioning. Mixed Nash Equilibrium (MNE) is utilized to identify optimal strategies, considering the strategic interactions among retailers. Various methods, such as backward induction, linear programming, and Monte Carlo simulation, are applied to calculate MNE based on market characteristics. The study aims to simulate customer behavior using Monte Carlo simulation and analyze strategic interactions among retail firms using game theory models. Stochastic customer behavior is modeled, and lognormal distributions are employed to represent firms' strategies. The Monte Carlo simulation generates payoffs for each firm, which are then inputted into the game theory model to identify optimal strategies and equilibrium points. Fictitious play and the Moran process are employed to analyze dynamic strategy evolution over time. The findings provide valuable insights into the competitive landscape and decision-making processes in the retail industry, assisting firms in formulating effective pricing strategies for achieving desired outcomes.



**Keywords**: game theory, nash equilibrium, mixed nash equilibrium, pricing, strategies, simulation, Bertrand competition

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