Abstract

This dissertation addresses the optimization of product assortment in vending machines under conditions of uncertain information. In the retail industry, decision-making processes often require handling incomplete or noisy data, making it essential to develop methods that account for such uncertainties. This research formulates the vending machine assortment problem using Partially Observable Markov Decision Processes (POMDPs), enabling dynamic decision-making under limited observations.

The proposed methodology integrates a product selection model that captures consumer purchasing behavior and a POMDP-based optimization framework to improve vending machine operations. The study provides a comprehensive framework for modeling the state transitions, observation functions, and reward structures involved in assortment optimization. It also introduces practical strategies for assortment exchange that agents can implement in real-world scenarios. Numerical simulations are conducted to evaluate the performance of the proposed approach, demonstrating its effectiveness in maximizing expected rewards and improving vending machine operations.

The key contributions of this research are as follows: (1) the formulation of the assortment optimization problem as a decision-making process under uncertainty, (2) the development of a novel method for solving this problem in vending machine settings, and (3) an exploration of its applicability to other business sectors with similar decision-making challenges." The findings suggest that the proposed method offers a solution to the assortment optimization problem and provides valuable insights for improving decision-making processes in uncertain environments.

Keywords: Decision-making under uncertain information, Assortment optimization problem, Vending machine, Partially Observable Markov Decision Processes, Product selection model, Numerical simulation