Optimizing selling and pricing strategies

Overview
In many industries, operators must continuously decide when to sell products, how much to sell, and at what price. These decisions are difficult because asset value changes over time, operational costs accumulate, and unpredictable events (market fluctuations, demand shifts, or sudden losses) can strongly affect long-term profit.
This project aims to build a decision-making system that learns optimal selling and pricing strategies through interaction with a dynamic environment. We propose to design a custom management simulation in which an AI agent controls selling and pricing decisions for a growing asset under uncertain market and risk conditions.

Problem
How can an intelligent system learn effective selling and pricing strategies in a dynamic market with changing asset value, operating costs, and unpredictable events?
We will build a realistic simulation environment capturing dynamics and an AI agent that learns strategies maximizing long-term reward.

Proposed System & Environment Design
We will construct a simulation environment where we will simulate how assets change over time (e.g. agricultural goods that grow, decay, and fluctuate in value). The agent will manage an inventory with limited capacity. We will present a non-static market where demand changes over time and unexpected events like market shocks or sudden drops in supply may occur. There will also be operational costs such as storage and holding penalties.
At each timestep, the agent will decide how much to sell and how to set or adjust selling prices. The objective is to maximize cumulative long-term reward.

Existing Approaches & Related Work

1. Beer Game
One existing study on the “Beer Game” supply chain simulation utilizes deep RL. This approach addresses the same core challenge as our proposal. In the study, researchers trained agents in a simulated environment and found that AI can discover non-obvious strategies to reduce the “Bullwhip Effect”. The agents also found success in minimizing long-term costs, a problem where rule-based models typically fail. Our project builds on this foundation by adding on to the agent’s scope to include dynamic pricing and the evolution of value-changing assets.

Source: https://arxiv.org/abs/1708.05924

2. Dynamic pricing under competition using RL

Kastius and Schlosser (2021) applied Deep Q-Networks and Soft Actor-Critic Algorithms to Dynamic Pricing in a competitive environment. The results indicate that RL Agents can generate optimal long term revenue in an environment with Strategic Competitors and

Stochastic Demand. While their work primarily focuses on Price Decisions, it is still closely in line with our proposed framework.

Source: https://hdl.handle.net/10419/287698