

Project Proposal: Dynamic Pricing

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Course: CS 238

We will be exploring the problem of setting dynamic prices. Dynamic pricing, or demand pricing, is a business strategy that seeks to adjust the prices set for goods or services in accordance with changing demand, where the demand can be variable over different users (differential pricing) or across time. The problem of setting prices in accordance with demand permeates all of business but is particularly prevalent in industries such as e-Commerce (including retail, Amazon, etc.), transportation (such as Uber, Lyft and airline companies), and hotel and event services (including AirBnB) to name a few. While dynamic pricing evidently and empirically drives increased revenue, it also serves as a means of customization—such as when setting pricing for Airbnb rentals.

We see this as a decision making problem where a business needs to decide on a price at which to offer a good or service. We will start from the most basic instantiation of the problem, where a business has one set consumer profile and one set resource to sell—say a generic consumer and a ream of printer paper. The decision problem becomes what to set the price of one ream of printer paper. The market value would be the highest price this consumer would be willing to pay and is what we would hope is closest to the price we decide to set. In this basic model, we are uncertain about what the perceived value of our product(s) would be to the consumer—essentially what the generic consumer we’ve modeled would be willing to pay. Concretely, and at the most basic level, our uncertainty is in whether the specific consumer profile would make the purchase at a given price. In our basic model, we could use a Markov Decision Process to model the state space of whether a transition for a given price would yield a purchase.

Though we plan to start with a very basic model of the problem, from there, we can flesh out our model, exploring more techniques to approach the decision. We can build a model observing what price a consumer would be willing to go up to rather than just whether they would make a purchase at a given price. We could also expand into specific models of dynamic pricing, such as modeling for setting the price for consumers with different profiles (defined by spending histories, zip code, etc) or time-based pricing (where we also integrate information about the season for instance) or pricing that factors in market conditions. To model this more complex setup, we might migrate to using Partially Observable Markov Decision Processes (POMDP) rather than just Markov Decision Processes.

Finally, in our exploration of the problem, we aim to incorporate Reinforcement Learning techniques, where we learn price setting strategies for the problem. This could be a timely process as the agent would need to learn a new strategy, so we would have to provide a testing environment with sample data. We would start by compiling our own reasonable training environment and potentially look to expand into a more rich and robust environment as time allows.