Agents for Dynamic Pricing

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Software Agents
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Selling Agents

- In today’s market, agents represent different buyers’ interests.
- Selling agents can make timely pricing decisions for sellers.
- Dynamic pricing is well suited to agents – computationally intense, frequent decisions.
- Maybe agents can make better decisions than a human?
Dynamic Pricing

- Changing prices over time based on:
  - Predicted and observed market changes

- Changing prices per individual
  - Price discrimination
  - Based on an individual buyer’s behavior
  - NOT our focus
Why Dynamic Pricing?

- Buyers are willing to pay different prices
- In a fixed-price marketplace, seller is forced to choose price point
- Dynamic pricing can capture demand elasticity

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Tomorrow’s Examples

- **Airline auctioning off airline tickets**
  - Learns perfect demand curve during auction → changes prices to meet demand.

- **Grocer selling fruit**
  - Watches supply (the inventory levels and produce quality) → adjusts the prices to sell entire inventory.

- **Theatre selling play tickets**
  - Responds to external conditions (play reviews and time of year) → fluctuates prices to maximize revenue.
Our Approach

- *Software agents* can work to observe market changes and adjust prices.

- A *market simulator* can be used to determine which agent strategies are best for each type of market.
Market Simulator

- Theoretical analysis can solve for the optimal dynamic pricing solution, but difficult to apply to real-world market.
- Simulations provide numerical results for specific situations.
Learning Curve: Market Simulator

**INPUTS**

- Market scenario
- Buyer behaviors
- Seller strategies

**OUTPUTS**

- Revenue results
- Market behavior

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- **Market Variations**
  - Average Bid Amount vs. Day (Consumer Demand)
  - Seller Strategy Behavior

- **Revenue at Different Initial Reserve Prices under Increasing Demand**

- **Number of Released Seats at Different Demand Levels**

- **Reserve Pricing Strategy with Constant Demand and Initial RP=350**

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Learning Curve: Seller Strategies

- *Derivative Following* – examine success and make incremental changes
- *Myopically Optimal* – analyze entire market and make best response
- *Dynamic Programming* – analyze market and consider time to make best response
- *Reinforcement Learning* – over time, agent learns which strategy decisions are more profitable

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Learning Curve Simulator

**Buyer Behavior**
- Valuation: ○ Private  ○ Public
- Product Differentiation: □ Yes  ✔ No
- Lifetime in Market: 5 days
- Price Sensitive: □ Yes  ✔ No

**Demand Curve:**
- ○ ○ ○ ○ ○

**Seller Strategies**
- Derivative Following: ○ ○ ○ ○
- Myoptic Optimal: ○ ○ ○ ○
- Dynamic Programming: ○ ● ○ ●
- Reinforcement Learning: ○ ○ ○ ○

**Market Results**
- Market Mechanism: posted-price
- Number of Buyers: 400
- Days in Market: 30
- Remaining Inventory: 35
- Best performer: Seller D

**RUN SIMULATOR**

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Learning Curve’s Goals

- Goal: Make conclusions about the success of different agent strategies under different market conditions.

- Goal: Create a tool that a seller can use to test strategies for his/her own real-world market.
Thanks

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