Dynamic Seller Strategies in an Auction Marketplace

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Question

- In a dynamic marketplace, where buyers bid on products, and
- Sellers have agents (*pricebots*) making automated decisions to accept or reject bids,

*How does a seller develop and evaluate pricebot strategies?*
Answer

- Use market simulator as evaluation tool
- Develop a specific market scenario for evaluation
- Implement seller strategies and compare results
The Market Simulator

**INPUTS**

Market variables

Consumer behavior

Seller strategies

**OUTPUTS**

Revenue results

Market behavior

**Simulation**

**INPUTS**

Market variables

- Initial Reserve Price
- Revenue

**OUTPUTS**

Revenue results

- 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
The Market Scenario

- Auction selling airline tickets
- Finite goods, finite time, changing perceived value
- One seller, many buyers
- Reverse, sealed-bid, discriminatory auction
- 30 days to sell 100 seats, seller settles bids at the end of each day
The Market Scenario: Bid Generation

- Consumers are willing to pay different prices (demand elasticity)
- In a fixed-price marketplace, seller is forced to choose price point
- Auctions can capture demand elasticity
The Market Scenario: Bid Generation

- Simulator models portion of demand curve
- Bids fall in a normal distribution around an average bid amt
- Num of bids = Demand
- Avg. bid value = Consumer Valuation
The Market Scenario: A Day in the Life of the Auction...

- At the beginning of the day, the airline releases a certain number of seats at a certain reserve price into the marketplace.
- During the day, buyers send bids to the airline.
- At the end of the day, the airline accepts the bids above the reserve price, up to the number of released seats.
- After winner allocation, the airline chooses the reserve price and the number of seats to release for the next day.
The Seller Strategies

The seller controls two variables each day: reserve price and number of released seats.

- **Strategy 1:**
  - Change reserve price to control the number of seats sold each day.

- **Strategy 2:**
  - Change the number of seats released each day to control the price at which seats are sold.

- Compared with no strategy
  - No change to either reserve price or the number of seats released each day.
Strategy 1: Reserve Pricing

- *Derivative following* strategy.
- Alter the reserve price each day based on how many seats have sold in the auction.
- Goal: To sell all the seats, spread out over the auction.

\[
RP_{i+1} = RP_i + (RP_i)^* \left( \frac{SeatsSold_i}{2*i*(TotalSeats/TotalDays)} \right)
\]
Reserve Pricing Behavior

Reserve Pricing Strategy
with Constant Valuation and Initial RP = $350

Price

Day

Reserve Price
Average Bid Price
Reserve Pricing Behavior

Reserve Pricing Strategy with Increasing Valuation and Initial RP = $350
Reserve Pricing Behavior

Reserve Pricing Strategy
with Decreasing Valuation and Initial RP = $350

Day

Price

Reserve Price

Average Bid Price
Reserve Pricing Behavior

- After about a period of over and under shooting, the reserve price follows the value of the average bid price.
- Sensitivity to the market’s behavior decreases over time.
Reserve Pricing Revenue

- Reserve pricing strategy (■) increased revenue above the no-strategy case (□).
- Each day, the seller only sold seats to the upper half of the bid distribution.
Strategy 2: Seat Releasing

- *Myopically optimal* strategy.
- Alter the number of seats released each day based on the consumer valuation level.
- Goal: Sell more seats at relatively higher valuation levels.

\[
SR_{i+1} = SR_i + SR_i^* \left( \frac{BidPr \ ice_i - BidPr \ ice_{i-1}}{BidPr \ ice_i} \right)
\]
Seat Releasing Behavior

Number of Released Seats at Different Valuation Levels

- Increasing Valuation
- Constant Valuation
- Decreasing Valuation
Seat Releasing Revenue

- Tracking consumer valuation did not significantly increase revenue over no-strategy case.
- Most of the seats were sold when valuation was at a relative low point.
Strategy Conclusions

- Reserve pricing strategy
  - Reserve price followed the average bid price, capturing higher half of distribution
  - Increased revenue over the no-strategy case

- Seat releasing strategy
  - Algorithm for interpreting valuation levels was overly simplified
  - Did not significantly increase revenue
General Conclusions

- This initial study looked at whether or not this method of evaluation was feasible.
- By using a simulator and working with a specific market scenario, we were able to develop and evaluate strategies.
- Strategies produced non-intuitive results. Observing simulated market behavior gave insight into auction strategies.
- Non-deterministic strategies can be evaluated in this method.
Future Work

- Develop more successful strategies
- More complex model of consumer behavior
- Multiple sellers and auction mechanisms, testing strategies against one another
- Other markets: perishable goods, event tickets, natural resources (ex: gas), broadband access
For more information…

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