Analysis and Design of Supply-Driven Strategies in TAC SCM

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AAMAS 2004: Workshop on Trading Agent Design and Analysis
July 20th, 2004

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Work supported in part by the National Science Foundation under awards NSF/IIS-0084202 and NSF/EIA-9986042.

Overview

- A Priori Analysis
- MinneTAC Sales Strategies
  - MaxEProfit
  - DemandDriven
- Performance Analysis
  - High-Demand Games
  - Low-Demand Games
- Analysis of Start-Effect
- Conclusions

TAC SCM - A Priori Analysis

Bottleneck is the factor which limits PCs production on a day. Types of bottlenecks:

Demand bottleneck if the demand for PCs is less than the agents' production capacities and the amount of available supplies.

Production bottleneck if the limiting factor is the agents' production capacities.

Supply bottleneck if the limiting factor is the amount of supplies.

A supply bottleneck is most likely (from game analysis).

MinneTAC: Performance Analysis

- The a priori analysis led us to decide on a *supply-driven* strategy, i.e. we sell from the inventory of finished goods.
- TAC SCM 2003 - 50% discount of parts on first day
- Order many components up front: good in high-demand games, but bad in low-demand games.

W. Ketter, E. Kryzhnyaya, S. Damer, C. McMillen, A. Agovic, J. Collins and M. Gini. “MinneTAC Sales Strategies for Supply Chain TAC.” in Third Int’l Conf. on Autonomous Agents

Sales Strategies

- We focused on the sales strategy, to try to sell at as high a price as we think the market will bear,
- We developed two sales strategies, called MaxEProfit and DemandDriven.

Sales Strategies: MaxEProfit (1)

Determines offer price to maximize expected profit margin from a potential customer order:

$$E[ProfitMargin] = ProfitMargin \times p(order|price)(x)$$

where $ProfitMargin = \frac{price - cost}{price}$ with the constraint

$$price \geq targetAveragePrice$$

$ProfitMargin$ is calculated on the agent's moving average cost of the components. $targetAveragePrice$ is an internal parameter.

Sales Strategies: MaxEProfit (2)

- Makes offers only from uncommitted finished goods inventory.
- Sorts offers by Expected Profit Margin.
- Reserves a fraction of the PCs offered according to the estimated probability of receiving an order, $reserved\_qty = RFQ\_qty \times p(order|price)(RFQ)$
- Inventory is controlled by pulling stock.
- Procurement and production work to maintain target inventory levels until late in the game.

Sales Strategies: DemandDriven (1)

DemandDriven differs from MaxEProfit in how:

1. it sets offer prices, and
2. it estimates the probability of offer acceptance

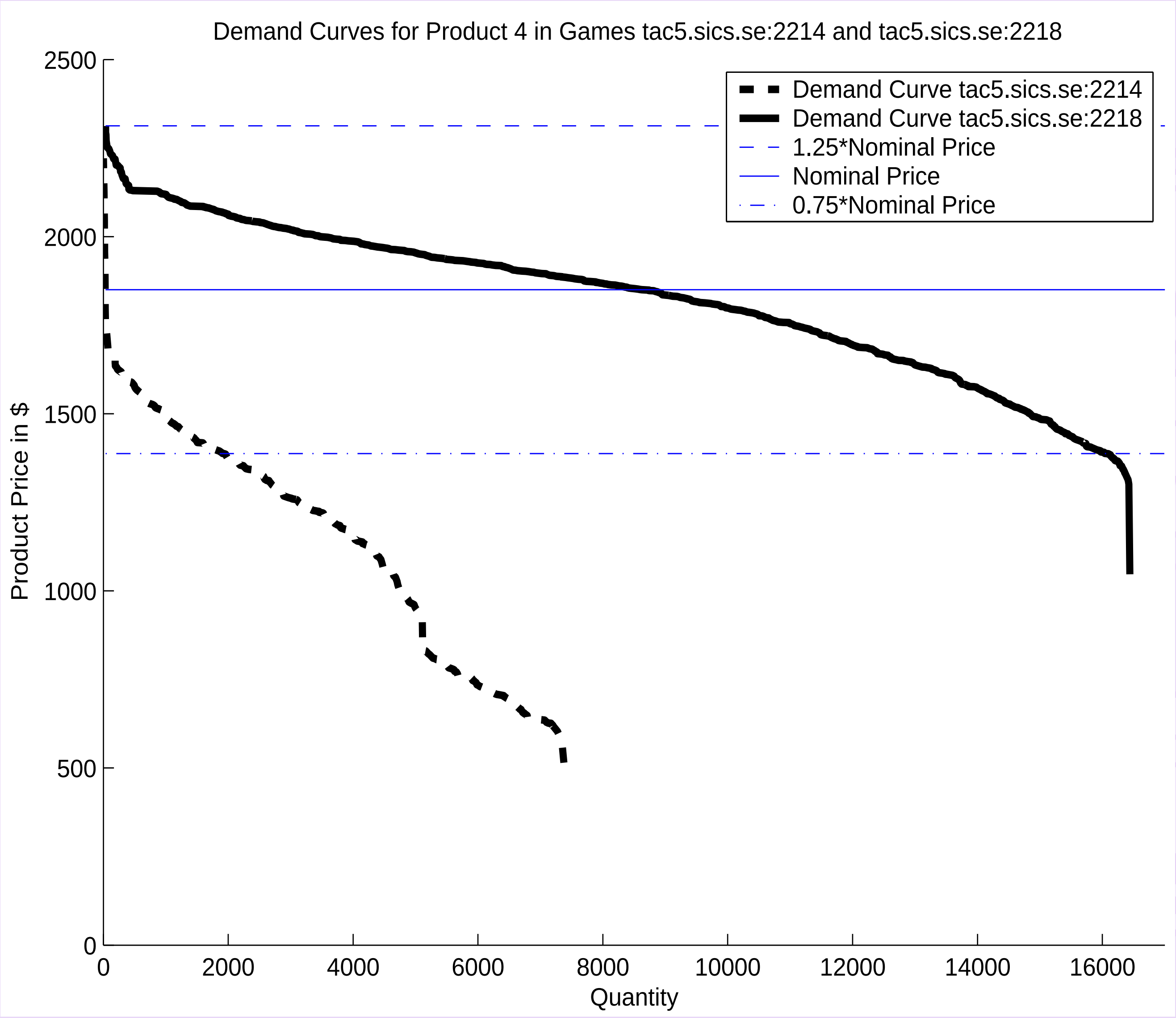
Sales Strategies: DemandDriven (2)

- Makes offers with the goal of selling out the inventory by the end of the game.
- Determines the offer price based on a target probability of receiving a customer order.
- Computes $target\_prob$ from the reverse cumulative density function (CDF) of the order probability.

$$target\_prob = \min(1, \frac{avail\_FG + daily\_production \times days\_left}{estimated\_demand})$$

where $avail\_FG$ is the number of finished goods available (per PC type),

High-Demand vs Low-Demand Games (1)



High-Demand vs Low-Demand Games (2)

Minimum, average and maximum score of each strategy in games at Int’l Conf. on Electronic Commerce 2003. MaxEProfit works better in high-demand games, but is generally worse in low-demand games.

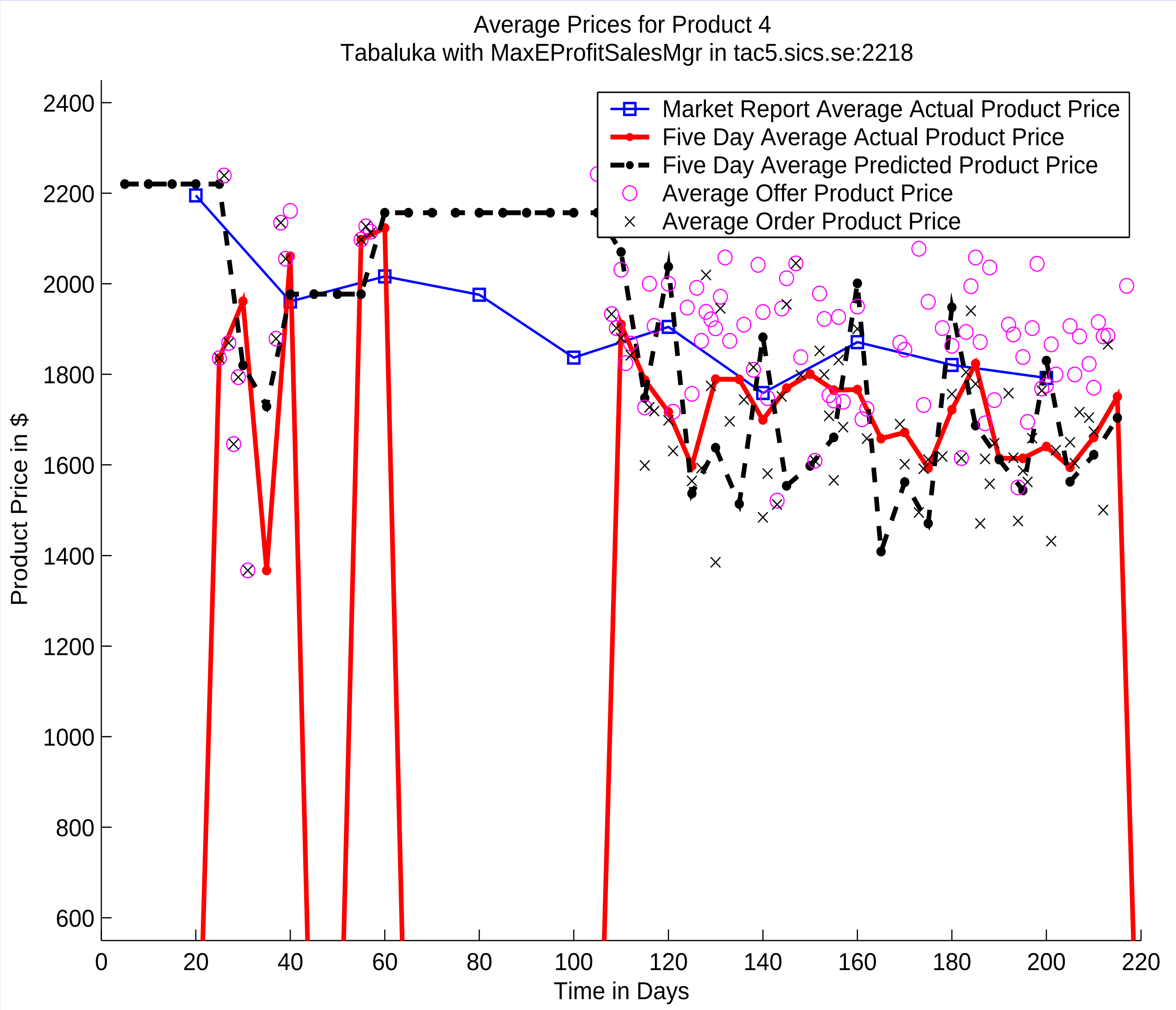
Strategy	*High*			*Low*		
	Values (in $M)					
	Min	Avg	Max	Min	Avg	Max
MaxEProfit	-12.02	12.30	35.99	-66.90	-44.44	-7.36
DemandDriven	-23.65	8.70	30.89	-57.15	-34.49	30.89

High-Demand vs Low-Demand Games (3)

Game	*Agents and their Result (in $M)*						*Demand*
	1	2	3	4	5	6	#RFQ/day
2214	team2	RedSox	MinneTAC	arnoch	RedAgent	Eini	99.44
	-10.43	-18.3	-31.06	-34.87	-38.08	-39.83	
2218	Tabaluka	RedAgent	arnoch	MinneTAC	team2	Eini	299.66
	31.23	30.69	23.24	20.8	8.86	7.89	

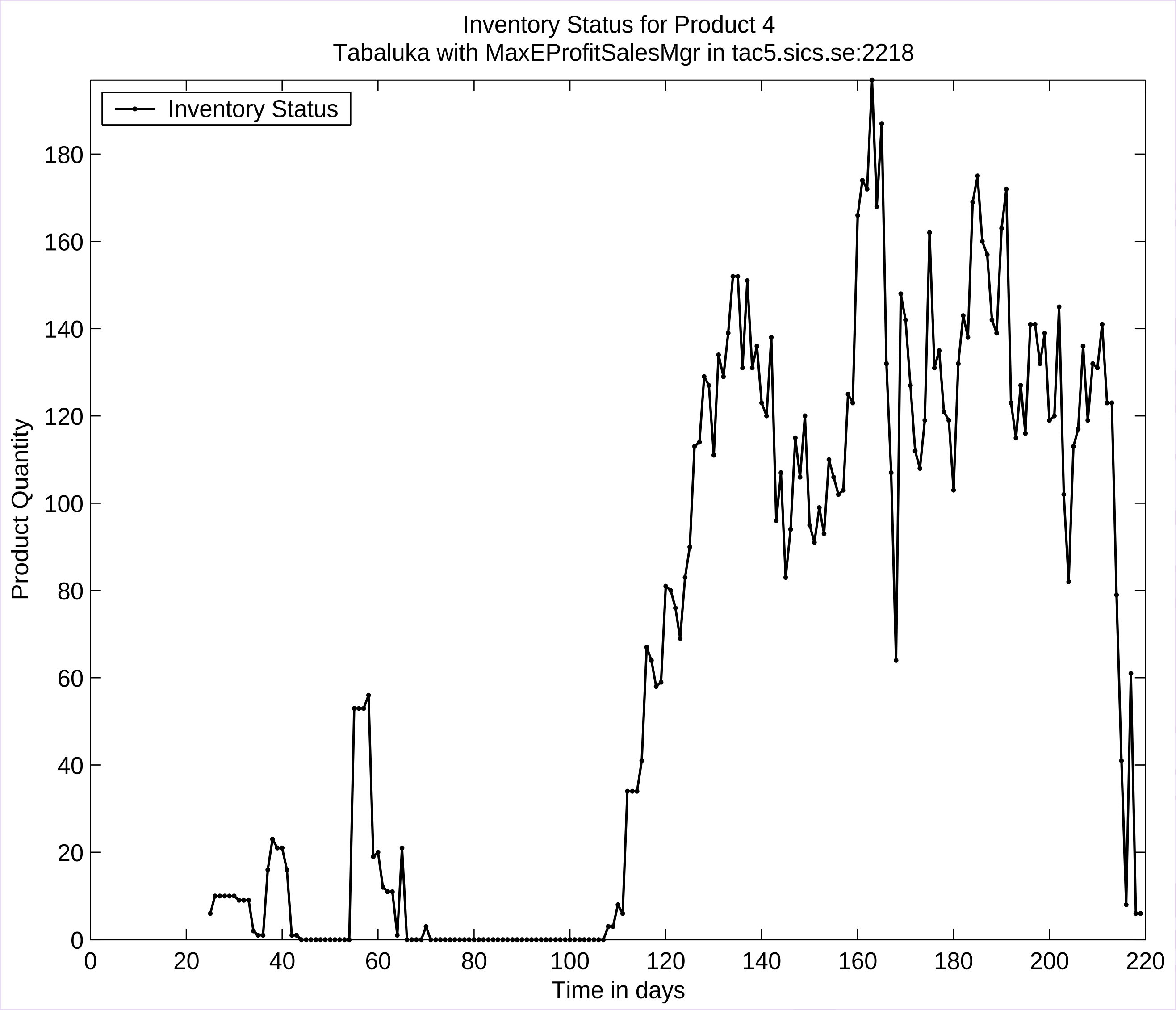
Table 1. Summary of two games. #RFQ/day is mean number of RFQs/day. Customer RFQs are issued over 219 days in a game. Eini and MinneTAC use DemandDriven and Tabaluka uses MaxEProfit.

MaxEProfit: High-Demand (1)



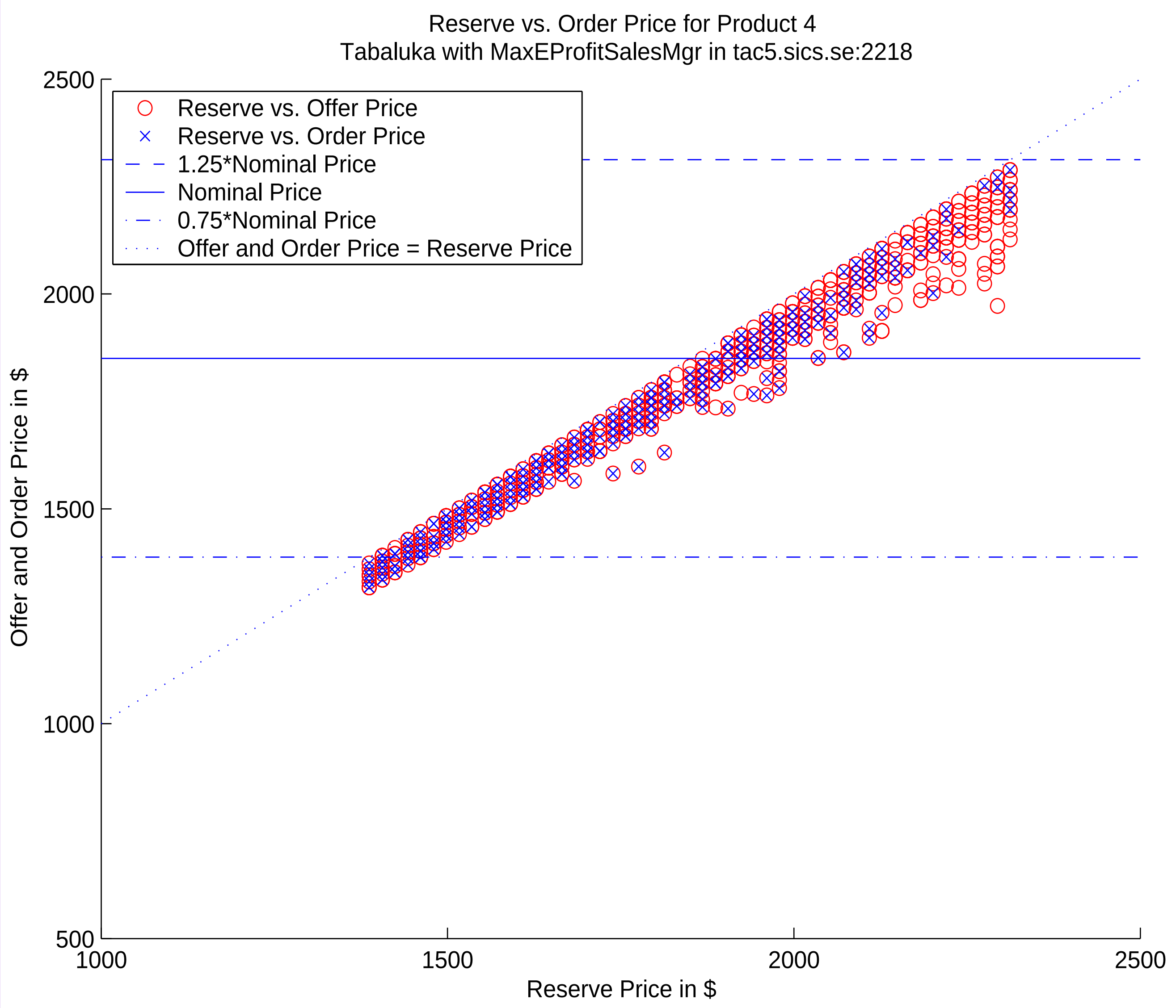
Game 2218 - market report: Predicted vs actual values of MaxEProfi t for product 4.

MaxEProfit: High-Demand (2)



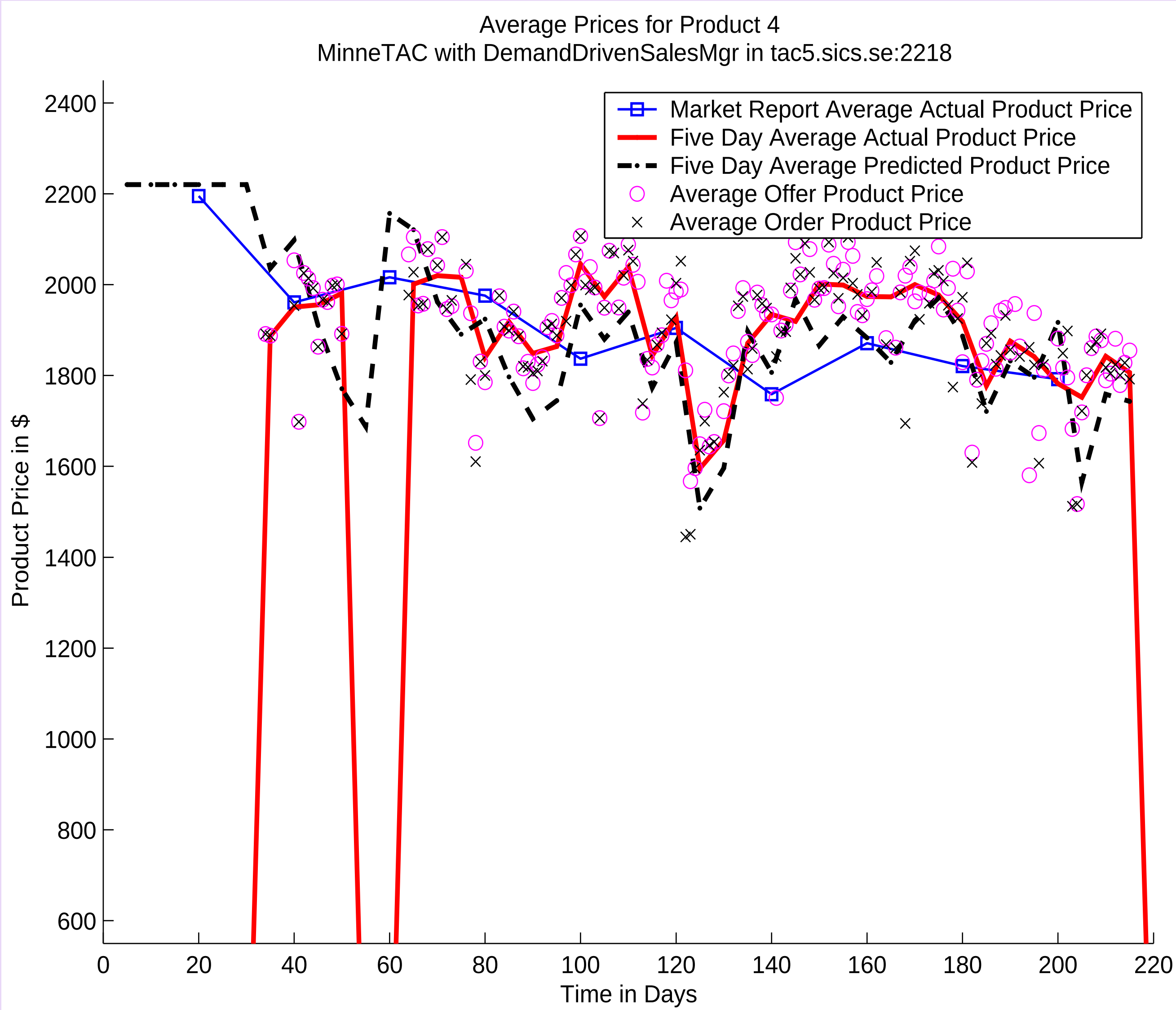
Game 2218 - inventory status: MaxEProfi t for product 4.

MaxEProfit: High-Demand (3)



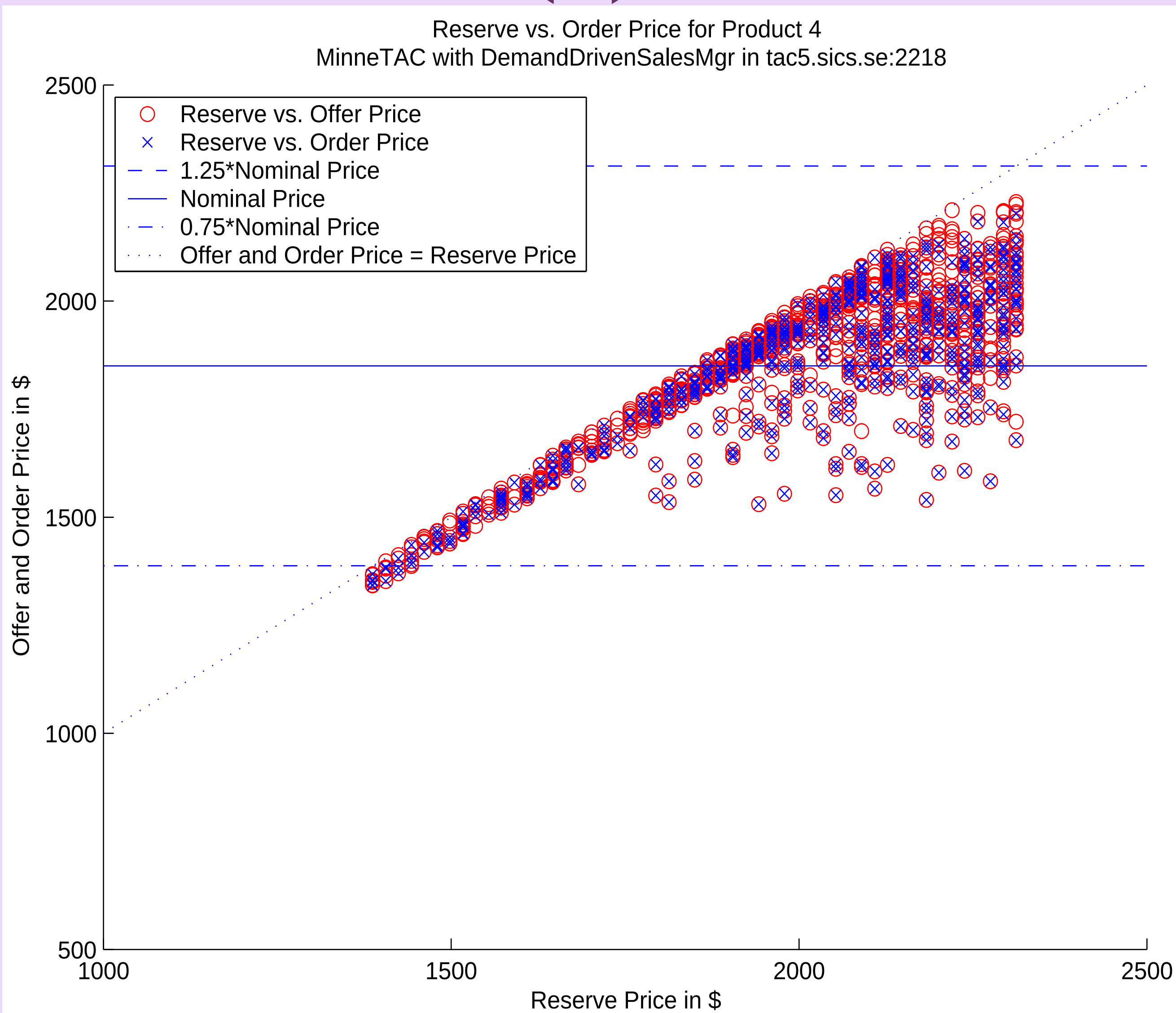
Game 2218 - Offer and order prices of MaxEProfi t vs reserve price for product 4.

DemandDriven: High-Demand (1)



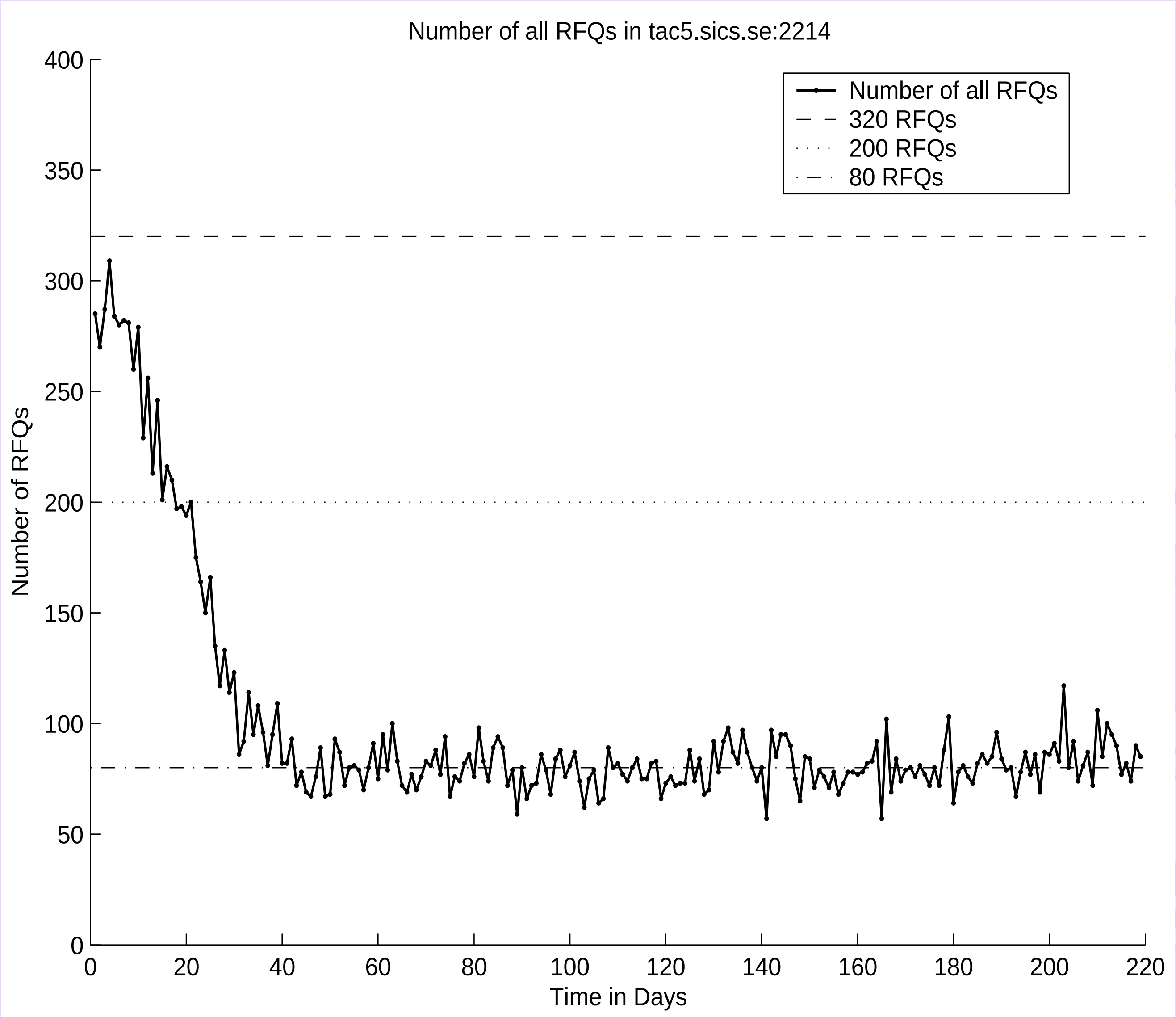
Game 2218 - Market report: Predicted vs actual values of DemandDriven for product 4.

DemandDriven: High-Demand (2)



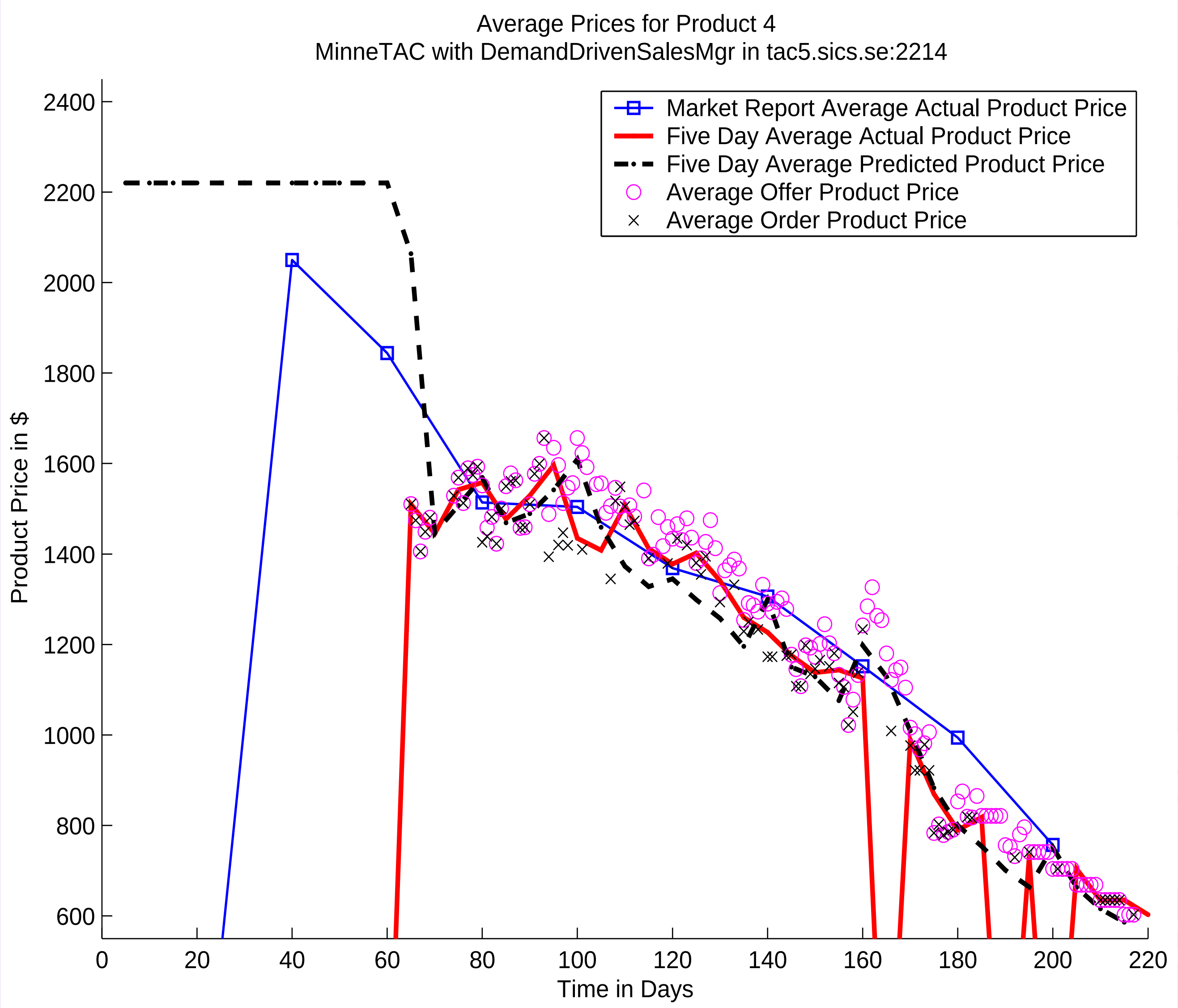
Game 2218 - Offer and order prices of DemandDriven vs reserve price for product 4.

Low-Demand Games



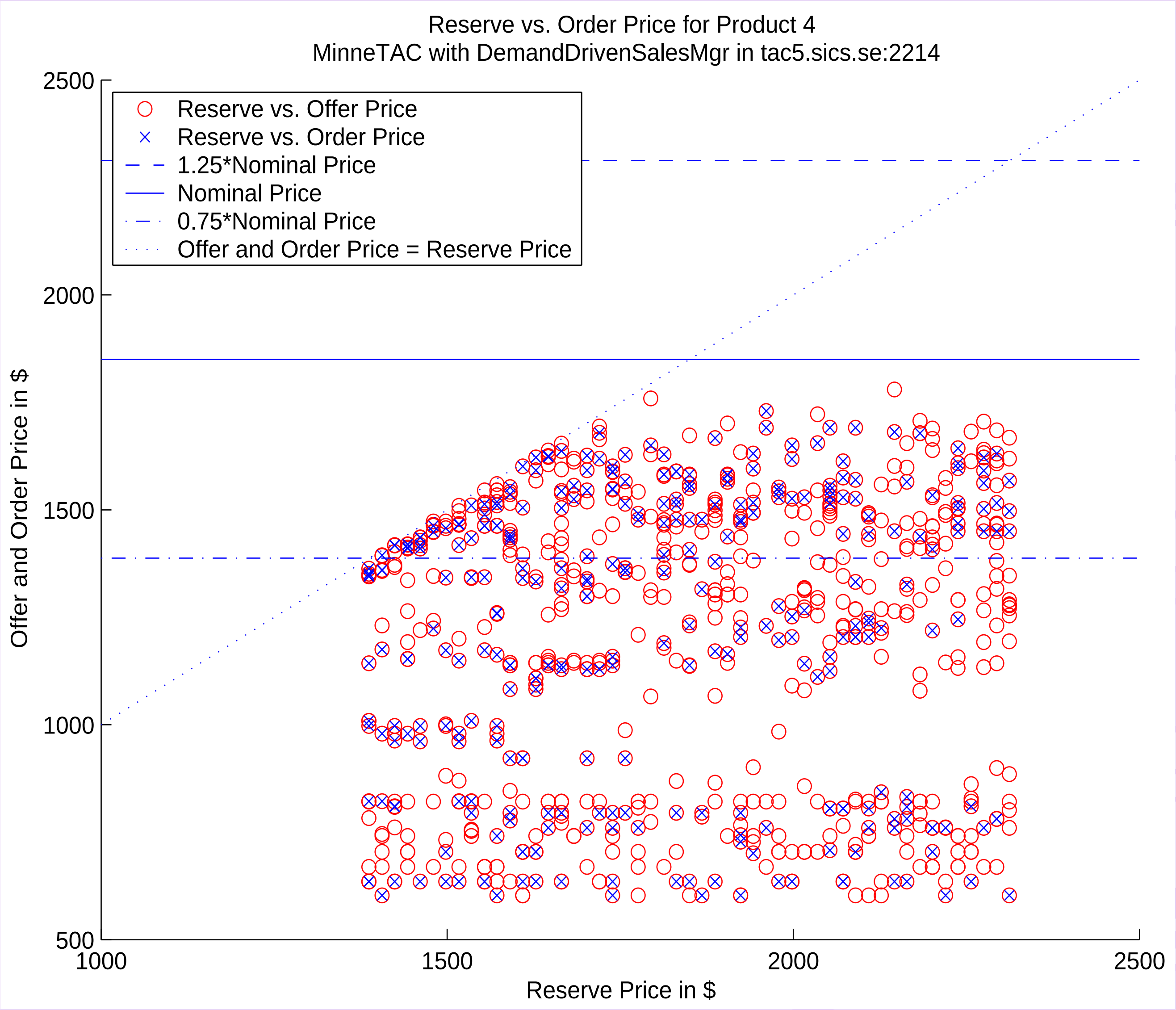
Game 2214 - Total number of RFQs.

DemandDriven: Low-Demand (1)



Game 2214 - Market report: Predicted vs actual values of DemandDriven for product 4.

DemandDriven: Low-Demand (2)



Game 2214 - Offer and order prices of DemandDriven vs reserve price for product 4.

Analysis of Start-Effect (1)

The total volume an agent orders on the first day and the timeliness of the offers that it accepts have a strong impact on that agent's final score.

$$DM = \frac{\sum_{i=1}^{\#RFQs} Value(RFQ_i) \times DueDate(RFQ_i)}{\sum_{i=1}^{\#RFQs} Value(RFQ_i)}$$

where $Value(RFQ_i)$ is computed multiplying the components base price by the quantity in the RFQ, and $DueDate(RFQ_i)$ is the due date of the offer.

Analysis of Start-Effect (2)

Agent	*Total Values (in $M) of*					
	Value RFQs	Timely Offers	Orders	Discount	Final Result	(da
Tabaluka	142.93	57.90	118.48	59.24	31.23	73.
RedAgent	132.03	0.00	14.80	57.40	30.69	91.
arnoch	79.00	7.97	42.24	21.12	23.24	92.
MinneTAC	142.93	28.31	95.46	47.73	20.80	102.
team2	2.00	0.00	2.00	1.00	8.86	51
Eini	142.93	21.18	72.27	36.13	7.89	119.

Conclusions

- A priori analysis: supply-bottleneck
- MinneTAC sales strategies
- Start-effect analysis: first day discount has a large effect on the outcome of the game

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