Simulating Strategic Interaction on Online Marketplaces

[How to Survive Dynamic Pricing Competition]

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ABSTRACT

@TODO:

1. INTRODUCTION

While for the last couple of centuries prices are defined through rule-based actions, more and more companies base their pricing calculations and strategies on technology and data-driven processes. Not only the actual computation of profit and cost is nowadays algorithm driven but also its update and review strategy. One of the most competitive and advanced fields is the algorithmic trading or high-frequency trading on stock exchanges. But also each one of us experiences nowadays technology driven price calculation on online marketplace like amazon, which we will hereinafter referrer to as dynamic pricing.
Currently, pricing strategies and algorithms exist but handler of those mechanism lack of the possibility to test them appropriately before releases them into the real world where they can create huge loses [1] [2] [3] [4]. We picked up the challenge to create such an environment imitating different market situations and therefore testing how pricing strategies react and interact based on influences and against each other.

Contribution: In this work, we briefly elaborate our progress of building a distributed and scalable platform to imitate market situations and simulate dynamic pricing algorithms and their effects with potential real word settings. Therefore, the following Chapter 3 contains a short introduction into the underlying architecture of the platform. The choreography of different services is described in 4. Chapter 5 will provide insights in the already implemented algorithms and their behaviors. An user facing interface on top of the RESTful API is delineated in 6 and finally Chapter 8 concludes this elaboration.

Check intro in http://faculty.chicagobooth.edu/workshops/omscience/pdf/Spring%202016/Popescu.pdf

2. RELATED WORK

(only own section if we find enough)

Check literature review in http://faculty.chicagobooth.edu/workshops/omscience/pdf/Spring%202016/Popescu.pdf

3. ARCHITECTURE

Confronted with the challenge of creating a high-performance and expandable infrastructure for simulating a marketplace with different merchants and consumers, we created a microservice architecture allowing the user to scale and add single service ad-hoc and on demand. Each service within our architecture implements one business artifact. This architecture pattern comes with the cost of a communication overheat and requires farsighted API design.

Figure 1 describes the underlying architecture as FMC[1] diagram. Avoiding ..
@TODO:

- add some words to microservice architecture / SOA in general
- explain our setup

4. SERVICE CHOREOGRAPHY

@TODO: how do the services interact, how do we secure some major challenges in short sentences.
No ticks or such, but completely free and dynamic, every merchant can check or update prices at any time -> close to real life (unlike eg http://www.informsrmp2017.com/description-challenge.pdf)

- event logs, kafka etc
- fraud / cheating
- (inter service communication (via REST and connection pools))
- (where are limits / bottlenecks?)

[1] http://www.fmc-modeling.org/

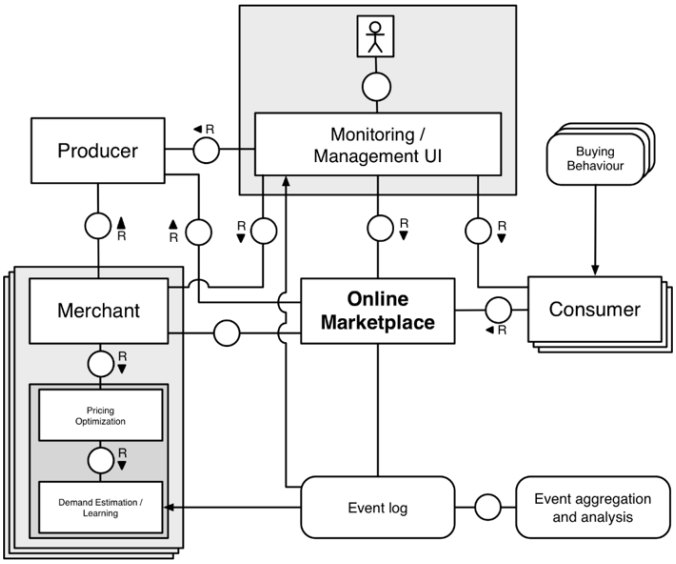

Figure 1: FMC diagram of the Price Wars architecture

5. BEHAVIORS

The addressed solution provides in its default setting already several behaviors for merchants as well as the consumers. The former include known rule-based strategies like the "Gas Station strategy", "Be the n-cheapest", "fix price" as well as a first data-driven approach implementing logistic regression [5]. Additionally, a consumer is included implementing several buying behaviors which can be chosen, weighted and altered on-the-fly. Those behaviors range from very subtle approaches like buying the n-cheapest, first, most expensive or simple random up to more sophisticated methods trying to imitate more complex consumer situations. A sigmoid distribution with twice of the producer price as mean (see fig. 2) is available through the default settings as well as a logistic regression evaluation of provided coefficients which are used to calculate selling probability for consumer to buy.

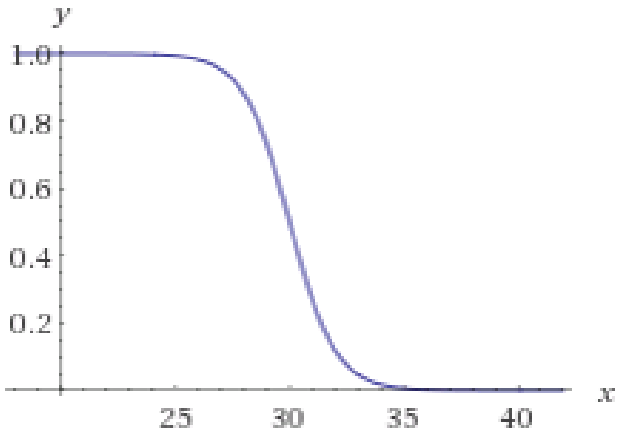

Figure 2: Sigmoid distribution as consumer behavior

6. USER INTERFACE

Figure 3: Price Graphs

TODO: some words regarding the UI, angularJS based. with socket.io for events, orchestrates the service interaction

7. EVALUATION

@TODO: Short evaluation with a few basic strategies to show that our system indeed enables to compare these strategies ...

8. CONCLUSION

@TODO:

9. FUTURE WORK

@TODO:

- short-life products (e.g. plane tickets)
- consumer ratings

The source code and the documentation will be publicly available at
https://github.com/hpi-epic/masterproject-pricewars
while a screencast is accessible under
https://www.youtube.com/watch?v=bqXSi5cv8cE.

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References

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