A FAIR DYNAMIC PRICING POLICY FOR THE HOTEL INDUSTRY

ERRIKOS STREVINIOTIS\textsuperscript{1}, ATHINA GEORGARA\textsuperscript{2}, FILIPPO BISTAFFA\textsuperscript{2}, GEORGIOS CHALKIADAKIS\textsuperscript{1}

\textsuperscript{1}Technical University of Crete, Chania, Greece
\textsuperscript{2}Artificial Intelligence Research Institute (IIIA), Barcelona, Spain

\textbf{5\textsuperscript{th}} Games, Agents, and Incentives Workshop (GAIW’23)
INTRODUCTION

• Plethora of platforms rising in the international market
  • Amazon, Netflix, Booking etc.

• Two sided platforms:
  1. Providers of services-products
  2. Customers who buy services-products

• Such platforms usually adopt *pricing policies* in order to determine the price of their services-products
THE PROBLEM

• Pricing policies’ goal: balance the likelihood of selling an item with the profit gained by this sale

• Unfair policies → suffer long-term losses

• Need for dynamic and fair pricing policies
  • Challenging problem 😞
  • Providers-side fairness
  • Costumers-side fairness

• Solution?

Game Theoretic approach for proving multi-sided fairness
## OUR DOMAIN

Booking platform for hotel rooms

<table>
<thead>
<tr>
<th>Hotels</th>
<th>Rooms</th>
<th>Reservations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Several hotels (or providers) exist in a city</td>
<td>• Each hotel contains several available rooms of various types</td>
<td>• Customers can book an available room for a specific date</td>
</tr>
</tbody>
</table>
OUR GOAL

- Dynamic pricing policy
  - Adjust the price of each room based on the supply and demand in the platform
  - Adjust the price of each room based on the “quality” of the product
- No overpricing
  - Providers will not charge rooms with prices considered unreasonably high by the customers (for instance during high season)
OUR APPROACH: A *game theoretic solution*

- Exploit *Owen values* to characterise *power* of each room per timestamp based on:
  - *supply* and *demand* of each *hotel*
  - *supply* and *demand* of each *room type*
- Determine room’s *profit margin* in accordance with the Owen values
- More *popular* rooms are allowed larger profit margins
  - Provider-side fairness: better quality (more popular) products are promoted
  - Customer-side fairness: price is indicative of product’s quality (popularity)
MAIN IDEA (TOY EXAMPLE)

- Profit proportional to the quality.
- At $t_1$, $h_{green}$ has the largest margin of profit, since it possesses the highest occupancy rate, i.e., 75%.
- Similarly, at $t_2$, $h_{red}$ and $h_{blue}$ have the largest margin of profit. But since they share the first place the have smaller profit comparing to $h_{green}$ at $t_1$. 
CONCLUSIONS & FUTURE WORK

**In this work...**
- Game Theoretic approach for dynamic pricing policy
- Multi-sided fairness
- Prices based on supply and demand in the market
- Reflect the product's popularity

**In the future...**
- Employment of an exposure-opportunity policy that reflects the power of each hotel
- Provide explanations regarding the proposed room prices
- Employment to other domains
THANK YOU!!!

>> cd AAMAS2023/GAIW

>> read "Fair Dynamic Pricing Policy for the Hotel Industry"

>> contact
Errikos Streviniotis: estreviniotis@tuc.gr
Athina Georgara: ageorg@iiia.csic.es
Filippo Bistaffa: filippo.bistaffa@iiia.csic.es
Georgios Chalkiadakis: gehalk@tuc.gr

>> exit