

# Economics using Machine Learning: Double Auctions

## 1 Introduction

I tried to model the pricing mechanism of ride sharing apps as a Double auction and then for each participant in the market, be it the passenger or the driver, we try to get their bids as close as to their true valuation so as to maximize their rewards.

## 2 Task I:

In order to calculate the rewards for each market participant, we need to know their true valuation of the product (taxi ride here). In task I we calculated the true valuations of the participants based on the different factors. The different factors considered here are:

**Passenger: luxury, urgency, tour length, time of the day.**

True valuation for a passenger is given by:

$$\text{true\_valuation} = C_1 \text{tour\_length} + C_2 \mathbb{I}_{\{\text{luxury}\}} + C_3 \mathbb{I}_{\{\text{urgency}\}} + C_4 \mathbb{I}_{\{\text{peak\_hours}\}}$$

**Driver: car type, tour length, time of the day.**

True valuation for a driver is given by:

$$\text{true\_valuation} = D_j \text{tour\_length} * \mathbb{I}_{\{\text{car\_type}=j\}} + D_p \mathbb{I}_{\{\text{peak\_hours}\}} + D_n \mathbb{I}_{\{\text{night\_time}\}}$$

## 3 Task II:

Now we have the true valuations of the market participants which even the participants do not know. They will start bidding and in each round will receive a noisy reward and based on that reward will try to learn about the true valuations.

1. The drivers will bid the lowest amount they are willing to accept for a ride and similarly the passengers will bid the highest possible amount they are willing to pay.
2. The market maker/ auctioneer will then decide the market price at which the trades will happen.
3. For that the drivers bids are sorted in ascending order and the passengers bids are sorted in descending order and the price is decided by the average price mechanism.
4. Reward for all the participating drivers and customers is calculated according to the true valuation and for the non participants, the reward is designed to be zero.
5. From the next iteration, each seller/driver will bid according to his/her Lower Confidence bound(LCB) and each buyer/passenger will bid according to his Upper Confidence bound(UCB).
6. Social welfare regret is calculated for different horizons and plotted to see that the regret comes out to be sub-linear.