Finance & Economics Club

GAME THEORY

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OVERVIEW

- Introduction
- Auction types
- Theory Auctions

- Game 1
- Implementation
- Payoff

- Game 2
- Implementation
- Payoff

Introduction

This project on Game Theory is well-researched, it focuses on the analysis of experimental data through the utilization of two games that we have designed for two different types of auctions.

"Finance is not merely about making money. It's about achieving our deep goals and protecting the fruits of our labor.
It's about stewardship and, therefore, about achieving the good society."
- Robert J. Shiller

AUCTION

What is auction?

Auction is a mechanism of allocating a particular object at a certain price.

TYPES OF AUCTIONS

We will be analysing two types of Auctions

1. ***First-price, sealed-bid auction***
2. ***Second-price, sealed-bid (vickrey) auction***

A good auction is

- **Efficient** - encourages competitive bidding, transparency, and accurate pricing mechanisms.
- **Revenue Maximising** - extracts highest possible price from the buyer who gets the object.

Auction Types

First-price, sealed-bid auction

Bidders submit private bids, **highest wins and pays their bid**

Second-price, sealed-bid (vickrey) auction

Bidders submit private bids, **highest wins, pays second-highest bid**; encourages truthful valuations.

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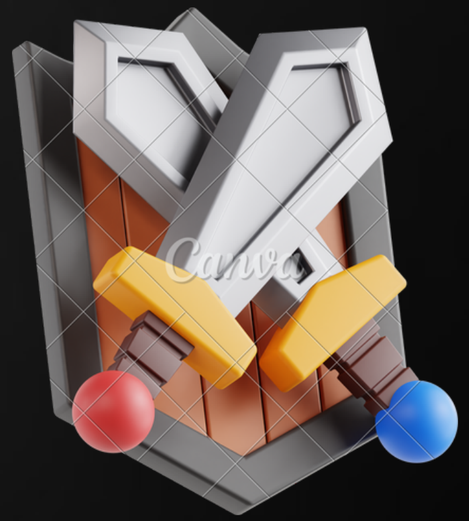
Game 1
Auction Empires

BASED ON THE PRINCIPLE OF FIRST PRICE AUCTION

IMPLEMENTATION



- Each player owns a kingdom with some number of gold coins and no initial soldiers.
- There has been tension between the kingdoms and each player wishes to establish dominance over other provinces.
- In order to do so they want to recruit professional men from foreign countries through a trader(let’s say x gold coins per soldier). In order to do so, they must partake in a First Price Sealed Bid Auction held by the trader.
- The trader decides to sell his soldiers in various rounds rather than all at once, in order to increase his payout. He thus holds a number of rounds and sells a fixed amount of soldiers each round to the person with the highest bid.
- The kingdoms will want to win the maximum rounds possible in order to achieve the end goal of being the one with the maximum number of soldiers.
- The final winner will be the one with maximum soldiers at the end of all rounds.

BEHAVIOURAL ANALYSIS

- The bidder can estimate the winning bid if his/her bid loses and can bid accordingly for the next round .
- Since the trader decides how many soldiers to sell each round, the kingdom will want to bid higher if the number of soldiers is high for that particular round.
- Next bid of the winner depends how he/she analyses the previous bid amount as if it was way high or just the right amount.
- By conducting a thorough behavioural analysis across multiple rounds it can be assessed how players adapt to changing circumstances, appraise value, form strategies, and interact with each other in their quest for dominance over the provinces.

Link to the code

https://colab.research.google.com/drive/1j8pjyLgQosvswp7UA9dJ-CAXBDu5D_Ha?usp=sharing

- The code runs a simulation of the game depending on the number of rounds to be played.
- The code takes into account the kingdoms bidding based on the number of soldiers being sold per round.
- The code declares the kingdom with the highest bid as the winner and the highest number of soldiers at the end of the game as the winner of the game.

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Game 2

Cards Against Convention

Based on second-price, sealed-bid (vickrey) auction

IMPLEMENTATION

- The player's goal in this game is to achieve the highest card sum possible by completing two sub rounds i.e two card dealings.
- 1st round - Each player is dealt a card from a set of cards numbered 1-10
- Following the initial round, each player has the opportunity to place a bid for a specific amount, with the victor of the bid determined through a Vickrey auction. The winner is awarded one face card (at random), while the remaining players receive a second card numbered between 1 and 10.
- The player with the highest total sum is declared the winner of the game.Unlike a normal auction the winner increases his/her probability to win the final amount.
- The game is repeated 5 times and the player winning the most number of games is declared as the overall winner.
- The winner is given a certain amount of prize money which is declared pregame making the players bid accordingly.

BEHAVIOURAL ANALYSIS

- The simulation of the game is done based on the following assumptions -
  - We assumed that each player has an initial bias of how much he would bid depending on the card he gets.
  - The bid of each player is dependent on 2 factors - his initial bias and the card he gets. The dependence of the bid on the card is multiplied with the initial bias in order to get the final bid.
  - Another assumption is that no player wants to have a net negative gain at the end of the game, ie, no player would bid higher than the price money.
  - Each player takes a calculated approach to doing his best in winning the game.
  - Each player is unaware of the bid that the other players have bid in that particular round.
- The game was modelled after observing a few real-life versions and their outcomes.
- The general trend of the game was that the person who got the lowest first card bid higher in order to maximise his/her chances in that round whereas the player with the highest first round card also bids higher as if he bids highest, he is almost sure to win. The simulation was designed similarly which makes the highest and lowest cards the highest bidders and the middle cards the relatively lower bidders.
- It was observed that in general that the winner of the bid generally won the round.

PAYOFF

The final winner after 5 rounds will pay the second highest bids in each round he/she wins.

Link to the excel sheet-

https://docs.google.com/spreadsheets/d/1ZW-HdLI2qoF9XIRkIzYFWIYWbc_-_bmroogFvMCN-kM/edit?usp=sharing

Link to the code:

https://colab.research.google.com/drive/1kbdIzPCvAFznVmzCGiNuldxGVdlUFSRD?usp=sharing

- The code is modelled in such a way that it tales into account the inherant bias of the players, as well as the card dependence.
- The inherant bias is modeled in such a way that, every player is randomly assigned a value which is roughly 1 to 15 percent deviated from the mean value (mean value is defined to be the total winnings divided by the number of rounds.)
- The card dependence is fashioned such that it gives the lowest and highest card the highest dependence and the middle cards the lowest dependence.
- The code declares the person with the highest sum after the 2 sub- rounds as the winner of the round, and the winner of the game is thw one who wins the most rounds.

THANK YOU!

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