Finance & Economics Club

GAME THEORY

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INTRODUCTION

This research-based project revolves around Game Theory, where we design and conduct experiments using two Auction games to analyze decision-making and how people navigate in strategic situations.

An auction is a sales event wherein potential buyers place **competitive bids** on assets or services either in an open or closed format.

HOW AUCTIONS WORK?

In an open format, all bidders are aware of the bids submitted. In a closed format, bidders are not aware of other bids.

In our project, we have designed the games utilizing a closed-format auction approach.

TYPES OF AUCTION

FIRST-PRICE, SEALED-BID AUCTION

In this closed-bid auction, participants submit sealed bids simultaneously, without knowledge of others' bids.

The highest bidder wins and pays their bid amount.

SECOND-PRICE, SEALED-BID AUCTION

In a Vickrey auction, all bidders submit sealed bids simultaneously. No one knows others' bids.

The highest bidder wins but pays the value of the second-highest bid.

GAME 1

BASED ON THE PRINCIPLE OF FIRST PRICE AUCTION

Implementation

Initial Condition

Players: There are initially 13 players for 13 rounds.
Minimum Bidding Price: $ 52 .

Winner Determination

Round Winner: The player with the highest bid in each round wins that round.
Game Winner: The player with the most eligible round wins becomes the game winner. In case of a tie, a random selection is made.

Four cards will be withdrawn from the deck of cards and labeled as ‘A’ , ‘S’ & ‘T’. Consider the face value of the card for determining round details. For example, if a Jack appears on card 'A', its value is 11.

PayOff Calculation

The payoff for the game-winner will be calculated using the following rules:

a) Average Calculation: Calculate the average of the bids from round 'A'.
b) Standard Deviation Calculation: Calculate the standard deviation of the top 'T1' bidders from round 'S'.
c) Points Calculation: Calculate the points earned by the game-winner based on the following formula:

x = points + 1

Additional Clarifications:

* The game winner is determined based on the number of rounds won.
* Consecutive round wins are summed up to calculate the points.
* The 'A' card is associated with the average of bidders of round A, while the 'S' card is associated with the standard deviation of top 'T1' bidders of round S.
* 'T1' represent the top 'T1' bidders, respectively, from specific rounds. In case of a tie, random selection is done.

PayOff Calculation

Summation of each consecutive round wins

A consecutive round wins + B consecutive round wins +..... + M consecutive round wins: points = floor[(A+1)/2] + floor[(B+1)/2] +.....+ floor[(M+1)/2]

Eg:

(a.) 2 consecutive round wins: points = floor[(2+1)/2] = floor[1.5]= 1

(b.) 3 consecutive round wins: points = floor(3 + 1)/2 = floor[4/2] = 2

(c.) 2 consecutive round wins + 2 consecutive round wins + points consecutive round wins: points = floor[(2+1)/2 + floor[(2+1)/2 + floor(3 + 1)/2 = floor[1.5] + floor[1.5] +floor[4/2] = 1 + 1 + 2 = 4

These rules provide a clear structure for the game and how the game winner's payoff is calculated, considering the chosen cards and their respective rules.

PAYOFF = (AVERAGE OF 'ATH ROUND') + (STANDARD DEVIATION OF 'STH ROUND')^(1/X)

LINK TO EXCEL SHEET

https://docs.google.com/spreadsheets/d/1oF0fFqUJFHZWJYDT8idVJ_9mBxYvCO1xnetFjW_p41g/edit#gid=0

LINK TO CODE

https://colab.research.google.com/drive/11XMcUOuSomznmYPcyNRlP3QQzFCGIW1e?usp=sharing


GAME 2
BASED ON THE PRINCIPLE OF SECOND-PRICE AUCTION

Implementation

Initial Condition

Players: There are initially 13 players for round 0.
Bidding Price: Players can bid between $64 and $4096.

Winner Determination

Round Winner: The player with the highest bid in each round wins that round.

Game Winner: The player with the most eligible round wins becomes the game winner. In case of a tie, a random selection is made.

In case of a tie, a random selection is made.

Implementation

Round 0 - PlayStyle

Players bid simultaneously in round 0.

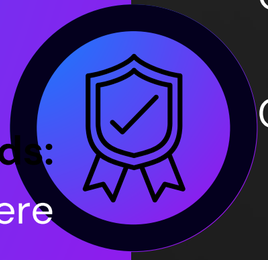
Calculate the Root Mean Square (RMS) of all the bids in round 0.

Convert the nearest integer of the RMS into binary.

Count the number of ones and zeros in the binary representation.

- Play more rounds based on the count (more rounds occur for the more occurring count of zeros/ones). For instance, if there are more zeros, play x more rounds.

- The winner playoff is decided through the yth round among the remaining players (less occurring count times).



Next Rounds Conditions

Player Count for Next x Rounds:
In the next x rounds, only 13 - y players remain, where y is the count of the least bidders who were eliminated.

Playing Style of Next x Rounds:
Random bidding is done in these rounds, and winners are determined in each round.

Round Elimination:
If any round sees bidding where half or more than half of the players bid less than RMS/2, that round won't be eligible for game winner calculation.

PayOff Calculation

The payoff is calculated from the yth round onwards,where y is the count of the least bidders who were eliminated.

Calculate the **Amount** as the integer part of [(second-highest bidder of yth round + third lowest bidder of yth round)/2]

Convert the Amount to binary, and let z be the count of the less occurring zeros or ones in the binary representation.

PAYOFF = AMOUNT + (Z% OF AMOUNT)

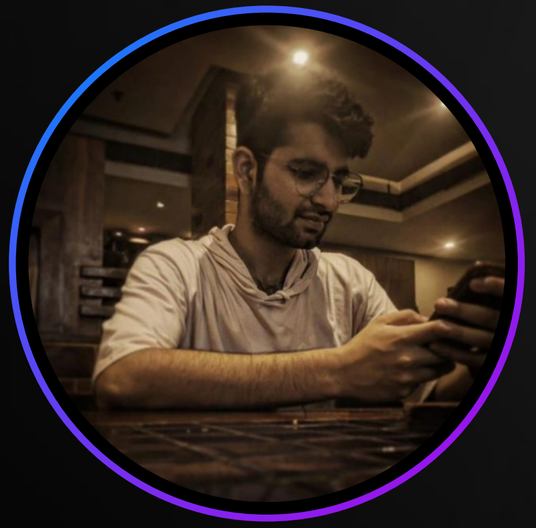
LINK TO EXCEL SHEET

https://docs.google.com/spreadsheets/d/1oF0fFqUJFHZWJYDT8idVJ_9mBxYvCO1xnetFjW_p41g/edit#gid=1687548369

LINK TO CODE

https://colab.research.google.com/drive/18ZoAc808CSL7sYB_f8R-6L2_JSrh77nw?usp=sharing

Our team



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THANK YOU

For watching this presentation