GAME THEORY

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WHAT IS GAME THEORY ?

Game theory is a theoretical framework for conceiving social situations among competing players. In some respects, game theory is the **science of strategy**, or at least the optimal decision-making of independent and competing actors in a strategic setting.

The focus of game theory is the game, which serves as a model of an interactive situation among *rational* players.

WHAT IS AUCTION THEORY ?

- Auction theory is an applied branch of economics which deals with how participants act in auction markets.
- It also researches on how the features of auction markets encourages the predictable outcomes.
- It is a tool used to inform the design of real-world auctions. Sellers use this theory to gain **higher profits** while it also allows buyers to buy items at a **lower cost** than the market price. The conference of the price between the buyer and seller is an economic equilibrium.

TYPES OF AUCTIONS DISCUSSED HERE :

01 The Ascending-Bid (English) auction

02 The Descending -Bid (Dutch) auction

ASSUMPTIONS WHILE ANALYSING THE DATA

- Each player is rational and he/she knows his/her valuation but not the exact valuation of other players.
- All players will try to maximize their payoffs and minimize their competitors' payoffs by strategising their bids in a particular manner.
- Auctioneer has no idea about any player's valuation and he/she does not favour any of the player.
- Unlike normal open-bid auctions, both the games have certain twists due to which humar psychology will play a major role in deciding ones' actions.

THE ASCENDING-BID AUCTION

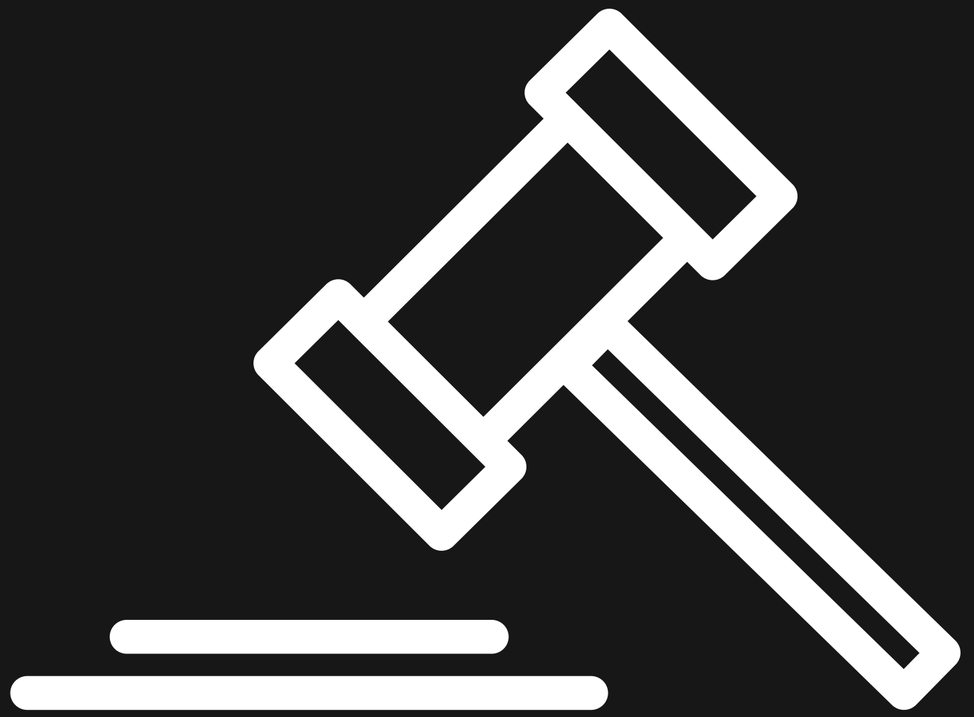
This is an open bid auction in which the auctioneer starts the bidding from a pre-decided **base price** and then the bidders **increase** the bid one-by-one.

The bidder who is willing to pay the **highest price** wins and pay a higher price than other bidders.

Equilibrium is achieved when the **second-highest paying bidder drops out** and the winner pays the price equals to his/her bid.

GAME 01:

LETS GO BIDDING



(THE ASCENDING-BID AUCTION)

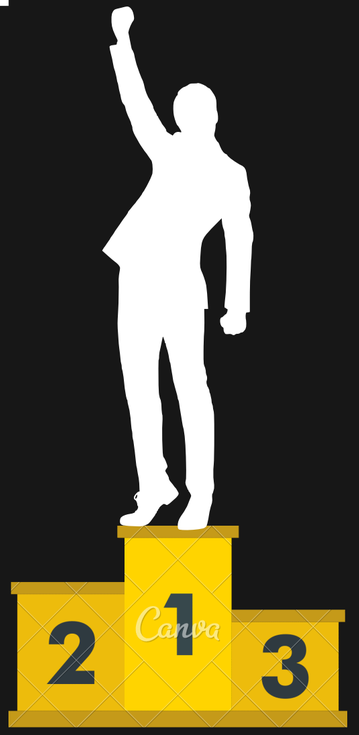
DETAILED EXPLANATION :

- No. of players - **4**
- No. of obejcts to be auctioned - **10** (For simplicity, here we take a car as the obejct to be auctioned.), therefore 10 rounds of bidding will take place in the complete auction.
- All players will have the same purse amount - **$5000**
- All cars will have the same base price - **$1000**
- Bids will be increased only in **multiples of $100**
- **Minimum number of cars** to be eligible for winning - **2**
- All cars will have a **different rating.** This rating is not pre-decided but it will be decided by the bidders itself in the following manner :
    1. Before every round, each player will give the auctioneer a number between **1-10** and these numbers wouldn't be disclosed to his/her fellow bidders.

2. The rating for that round will be the average of the numbers given by the bidders.
3. This rating will not be disclosed till the end of the game.

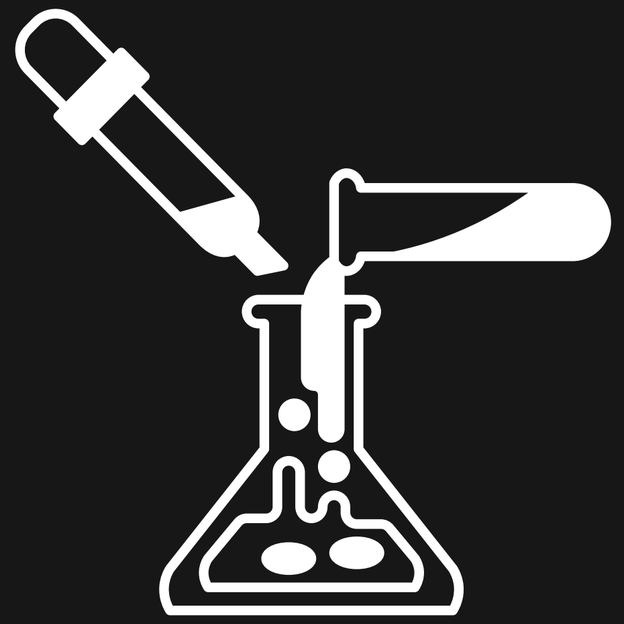
- $$X = \frac{\text{rating of the round} * \text{winning bid of that round}}{\text{sum of ratings of all rounds}}$$

- X will be calculated for each round and the bidder having **highest sum of X** at the end of 10 rounds will win.
- If any player exceeds his/her purse,then the second-highest bid will win that round.



EXPERIMENTATION, OBSERVATIONS & DEVIATIONS :

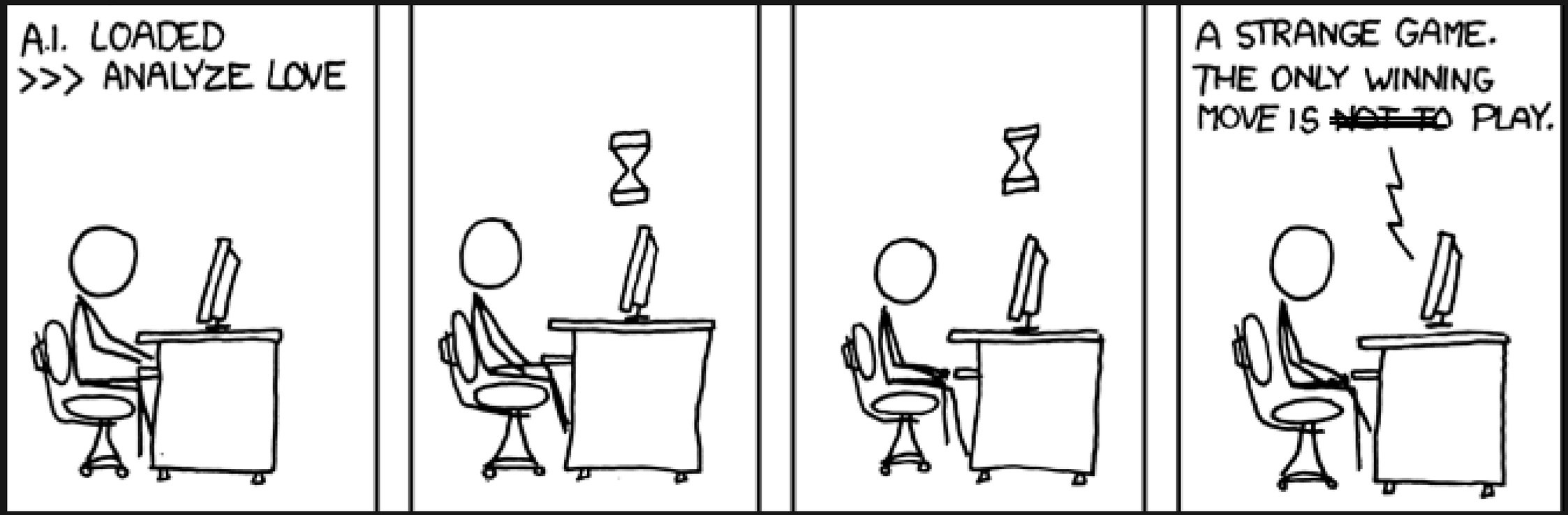
- No. of times the game was played - **3**
- Sample size in 1 game - **4**
- Total sample size - 4*3 = **12**
- Generally, while playing any auction game, players have the thinking to **save their money** but here, we observed that the **player who exhausted his/her purse completely had a higher probability of winning.**
- Also, the players gave the ratings in each round according to their strategy of whether they wanted to buy that car or not. Most of them gave lower ratings to the cars they didn't wanted to buy and vice versa, in order to increase or decrease the rating for their benefit.



- The players continuosly try to **influence the rating** of each round to maximize their payoffs.
- We have kept a minimum number of cars which a player has to buy to be eligible for winning the game so that **no player can win by just putting all his purse in one car** which he/she thinks will have a high rating.
- Most of the observations were in line with the existing theory but had some deviations due to the twist in game
- We also observed that the players who were able to read other players' minds more efficiently, won by just **bidding higher in the rounds that they thought, had a higher rating**.
- This game deviates from a normal open-bid auction due to the **rating aspect** of the game.

SPREAD SHEET LINK:

https://docs.google.com/spreadsheets/d/1QKp81dHRIQ4-WR50vznH_N7AFUq_B6SgDB0r1SeWdbg/edit?usp=sharing



THE DESCENDING-BID AUCTION

This is alson an open bid auction in which the auctioneer starts the bidding from a pre-decided base price and then **decrease the price till a bidder bids .**

The bidder who is willing to pay the highest price wins and pay a higher price than other bidders.

Equilibrium is achieved when any of the **bidder is ready to buy the item at the price asked** by the auctioneer at that point of time.

GAME 02:

THE LEAPING BENJAMIN

(THE "DESCENDING"-BID AUCTION)

DETAILED EXPLANATION :

- No. of players - **4**
- No. of obejcts to be auctioned - 8
- All players will have the same purse amount - **$10,000**
- All objects will have the same base price - **$5000**
- Bids will be decreased only in **multiples of $500.**
- **The object will have a minimum bidding price of $2,000.**
- **However the game is unlike a normal descending bid as the price will also increase in subsequent 2 steps..**
- **Minimum number of objects to be eligible for winning - 2**
- **The goal of each player is to satify the minimum object criterion along with minimizing their expense saving the most till the end.**

CONTINUED:

Step 1

Starting from 5000$, decreasing the bid till the first bidder bids. If only 1 player bids then the object will be owned by the player

Step 2

If more than 1 player bids at the same price, then price will be increased by **n*$250** (n>1) where n is the number of bidders.

Step 3

The last part will be a sealed bid with the new base price where only the players who initially bidded will take part and will give a sealed bid to the auctioneer and the highest bid will win, in case of same bids random toss will be used to decide who will own the object.

EXPERIMENTATION, OBSERVATIONS & DEVIATIONS:

- No. of times the game was played - 3
- Sample size in 1 game - **4**
- Total sample size - 3*4 = **12**
    - From the observations it was seen that different players used different strategies. Some used up large sums of their money in the beginning , while some believed in bidding in the middle as they believed that this would be the time when lesser people bid leading to less or no increase of the bidding price, and some waited till the very end until everyone else had very little left in their wallets.

- It was seen that the players continously try to increase the bid of their opponents by bidding just to increase the amount that the opponent had to pay in the second part of the game(sealed-bid).
- Most of the observations were in line with the existing theory but had some deviations due to the twist in game
- The wallet/purse provided to the players was allotted keeping in mind the minimum object criterion, and the starting bid price of each round.
- We observed that players who bid ,estimating when other players won't bid had higher chances of winning the game then those who didn't, in order to minimize their expenses.
- This game differs from a normal descending bid auction in various aspects:

1. It has elements of ascending bid inculcated in it.
2. It has a sealed bid, closed bid part in it unlike a fully open descending bid which brings in slight variation.

LETS TALK A BIT ABOUT GAME THEORY

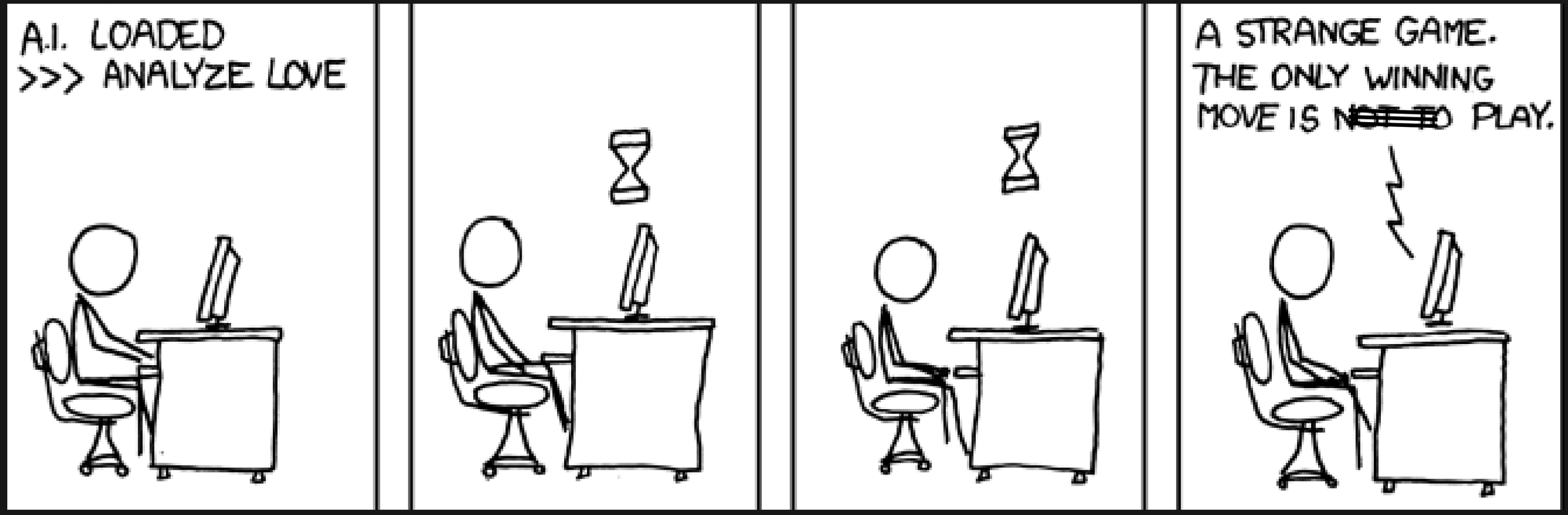
There are two Nash equilibriums possible in the game

- **The Nash equilibrium in which all players pay $2000 acquiring 2 objects each.**
- **In this case all players end up with minimum expenses.**

- **The Nash equilibrium in which all players pay $5000 acquiring 2 objects each**
- **In this case all players end up with maximum expenses and nothing left in the wallet.**

SPREAD SHEET LINK:

https://docs.google.com/spreadsheets/d/17irurG8-a__6hOrK-YW9dUBw3tYhOv_WI7e27CFoIOE/edit?usp=sharing

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