PLAYING POKER USING TSP METHOD

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ABSTRACT

The majority of the time, a deck of 52 cards is utilized in games of poker, since there is going to be betting involved. In this way, we may look at the game's logic mathematically even though it seems to be based on whim and unpredictability. We utilized the TSP (Traveling Salesman Problem) approach to solve n-person games while playing the poker game. This strategy shortens the duration of a game of poker while reducing the chance of dropping a sizable sum. Casinos may adhere to unique regulations, although a home game might operate the same game entirely differently. Additionally, there are various different types of poker games, and there are several types and even localized versions of the same game under each type of game.

Keywords – Poker game, TSP method, Bet, Call, Fold, Showdown

I. INTRODUCTION

Since the turn of the twentieth century, gambling has grown in prominence. From its humble beginnings as a game played mainly for fun among small groups of those interested, card games has developed into a game that is enjoyed by many people, spectators as well as players, both in real life and online, including numerous skilled players and tournaments offering rewards worth millions of dollars. Usually, a few participants must place a forced wager [1]. A player that doubles another player's wager may also raise it. Once everyone involved had ultimately folded or called their final wager, the gambling round is over. Every time a player drops out of a round, the winner is awarded without having seen the other players' cards. During the last round of gambling, if a plurality of players is still alive, there is a confrontation where the cards dealt are disclosed as the player holding the best hand wins [4]. Here we are going to see few types of Poker model [5]

II. PRELIMINARIES

Definition 2.1: The measurement of the possibility that anything will happen in an arbitrary trial is called probability. A value from zero to one, were 0 denotes inability and 1 denotes accuracy, is used to quantify probabilities. Probability for a phenomenon increases the likelihood that it will truly occur. The definition of possibility is thus given as a true-valued set function P that allocates a number P (A), known as the Possibility of the event A, to every event A in the sample space S so that the characteristics that follow are met:

- $P(A) \geq 0$
- $P(S) = 1$
- If A_1, A_2, A_3 are event and $A_i \cap A_j = \varphi$, $i \neq j$, then $P(A_1 \cup A_2 \cup A_3 \cup \ldots\ldots \cup A_k) = P(A_1) + P(A_2) + \ldots. + P(A_k)$ for every positive integer k, and $P(A_1 \cup A_2 \cup A_3 \ldots.) = P(A_1) + P(A_2) + P(A_3)\ldots.$ for an infinite, but countable, number of events [7].

Definition 2.2: Each result is paired with its probability to produce probability distributions.

- The likelihood ratio D of occurrence A with likelihood P(A), and event B with probability P (B),…, and with probability, event P(Z) is,

$$D = (A, P(A)), (B, P(B)) \ldots (Z, P(Z)),$$

Where $P(A) + P(B) + \ldots + P(Z) = 1$, and $A \cup B \cup \ldots \cup Z$ is the sample space of all possible outcomes.

Definition 2.3: Each possible result in a probability distribution is denoted by a number, and we may calculate the projected value, or < EV >, of that distribution. The definition of < EV > is the sum of the worth of each result times the likelihood of that outcome. We have to act in a manner that optimizes expected value if we are to win any game [3].

Definition 2.4: An enumeration comprises an exhaustive, sequential list of every item in a set of items. The phrase is often utilized in mathematical concepts to mean an order of every component of a set.

Definition 2.5: When you have "a" ways to do everything and "b" ways to do a different thing that means there are "a.b" methods to carry out each act, according to the multiplication principle [1].

Definition 2.6: The conceptual basis for imagining social scenarios involving rival participants is game theory. In some ways, game theory can be seen as the science of strategy, or at the very least as the best possible way for distinct, rival agents to make decisions in a tactical context.

Definition 2.7: Individuals use a standard 52-card deck for playing a deck of poker. Poker is a wagering activity that requires both skill and luck. Participants in poker place wagers towards one another based on the strength of their respective poker cards. Chips, which are often composed of ceramic or plastic, are used to place bets [3].

Definition 2.8: A decision-maker's preferences, values, and opinions form the foundation for their reasoning processes. Each step of choice-making results in an end result, and these can or cannot lead to action [6].

Definition 2.9: A very effective and well-liked tool for manufacturing and categorisation is the decision tree. A decision tree is a tree structure that resembles a schematic, in which every internal node indicates a test of an attribute, every branch a test result, and every node in the leaf (Terminal Node) a class label.

Definition 2.10: Identifying the shortest distance connecting a list of points and places that ought to be explored is the goal of the mathematical challenge known as the Travelling Salesman challenge (TSP) [2].

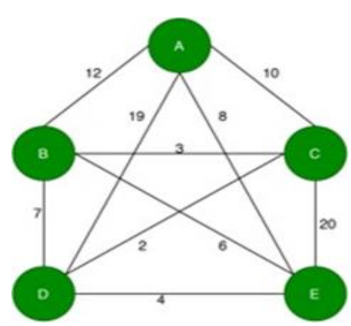

Figure 2.1 Travelling Salesman Problem

Theorem 2.11 The first formula is the theoretical basis of the Bayes theorem.

$$\boldsymbol{P(A/B) = P(A)\frac{P(B/A)}{B}}$$

Where A and B are events and P (B) ≠ 0.

$\boldsymbol{P(A/B)}$ is a conditionally probability: The likelihood that event A will take place if B is true. The posterior probability of A given B is another name for it.

$\boldsymbol{P(B/A)}$ is a conditionally probability: the likelihood that event B will occur if condition A is true. It can also mean the Likelihood of A given a fixed B. because,

$$\boldsymbol{P(B/A) = L(A/B)}$$

The likelihoods of seeing A and B, P (A) and P (B), accordingly, in the absence of any specific parameters are also known as the marginal probability or prior probability. It must be two distinct events, A and B.

III. POKER MODELS

A. Uniform Poker Model

Cards Models are mathematically solvable versions of the full-ring play of poker. Let's pretend that we are engaging in two-player zero-sum games. Player 1 and Player 2 will be the contestants' names. In this kind of game, one participant gains something from the other, which remains zero. We'll also suppose that each hand is split separately and at random. Although neither player knows of their opponent's hand power, they are equally conscious of the importance of each other's hands. This is a gambling system for every model. Player 2 reacts by his individual decisions, either to call or fold, in response to Player 1's decision to place a wager decide to bet on the card. In all of our hypotheses, we are neglecting additional poker possibilities, such as player 1's ability to check-raise, check-call, or player 2's ability to wager what he has or elevate in response to player 1's stake, in addition to typical gambling strategies. The two sets of cards are examined in the showdown, which concludes the play and the pot of money is won by the hand with its greatest value.

By using TSP method, the Uniform poker model is shown diagrammatically with explanation.

Rule: If Player 1 had an option to Check or Bet and Player 2 will decide to whetherCall or Fold.

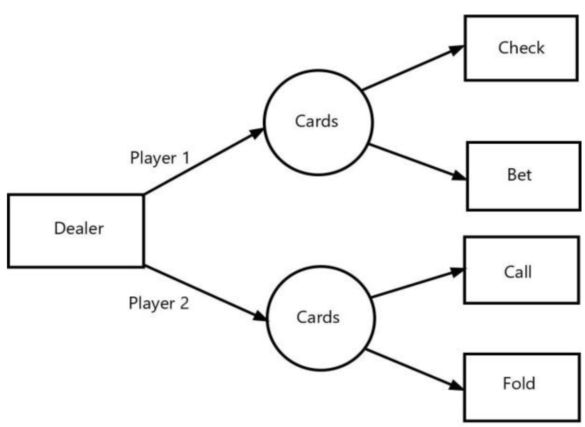

Figure 3.1 Uniform Poker Model: Rule

Round 1: If Player 1 checks his cards and Player 2 had an option to Call or Fold.

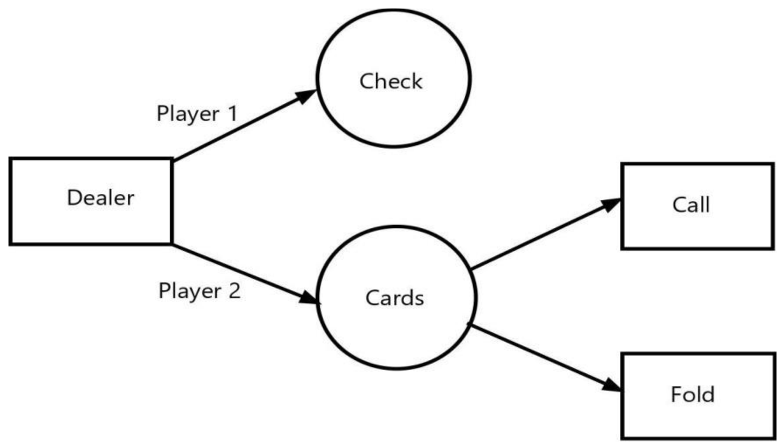

Figure 3.2 Uniform Poker Model: Round 1

Case 1: If Player 1 Check and Player 2 Call the game. When they showdown their cards, it is compared to determine the winner.

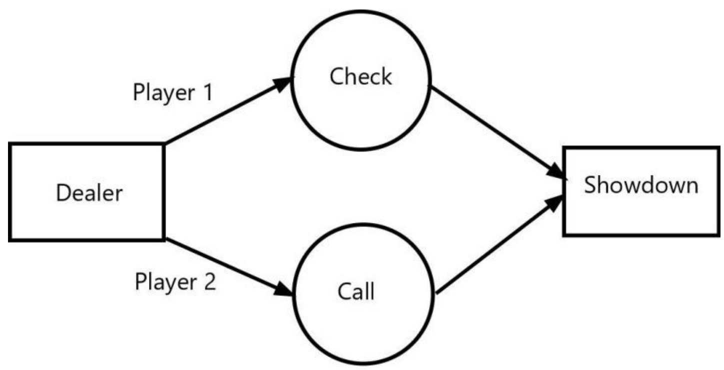

Figure 3.3 Uniform Poker Model: Round 1: Case 1

Case ii): If Player 1 Check and Player 2 Fold, the game will end. Then, Player 1 winsthe game.

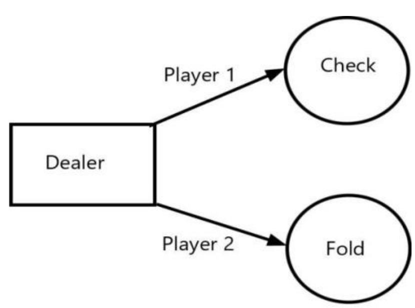

Figure 3.4 Uniform Poker Model: Round 1: Case 2

Round 2: If Player 1 bet the game and Player 2 had an option to Call orFold.

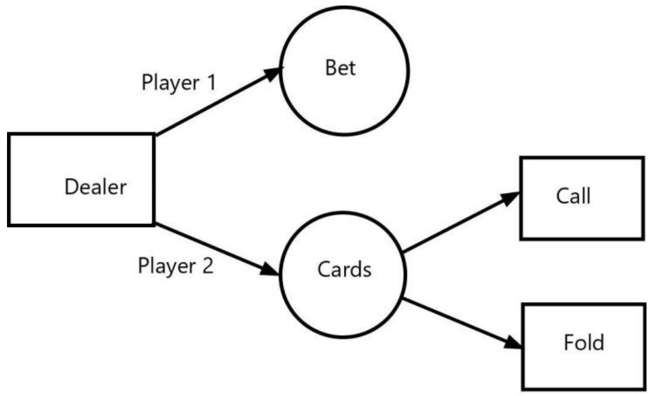

Figure 3.5 Uniform Poker Model: Round 2

Case i): If Player 1 Bet and Player 2 Call the game. When they showdown their cards, it is compared to determine the winner.

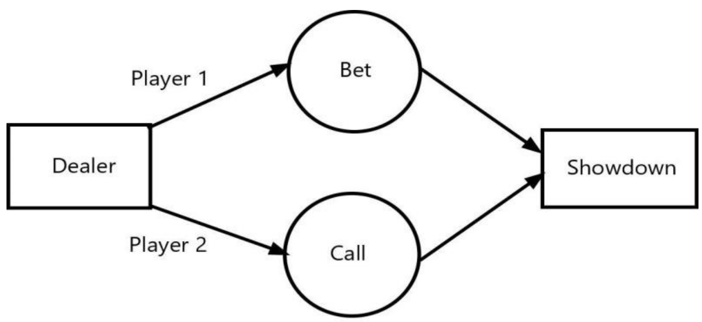

Figure 3.6 Uniform Poker Model: Round 2: Case 1

Case ii): If Player 1 Bet and Player 2 Fold, the game will end. Then Player 1 wins thegame.

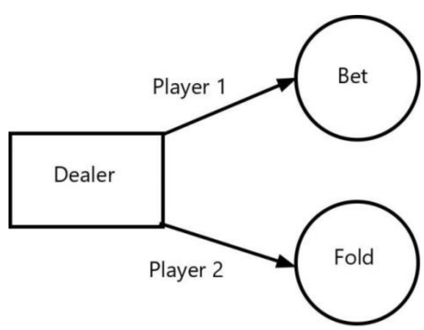

Figure 3.6 Uniform Poker Model: Round 2: Case 2

B. Borel Poker

In this concept, each participant makes an ante payment of one unit before receiving their unique, uniformly distributed cards at chance. When playing first of all, Player 1 has two choices: either break the card he has, which means discarding it, or remain in the hole. Player 1 under this instance concedes the game to player 2, giving up his stake to the prize and awarding player 2 the money. Player 1 forfeits his bet when he unfolds, and Player 2 gains one unit. By using TSP method, the Borel poker model is shown diagrammatically with explanation.

Rule: If Player 1 had an option to Bet or Fold and Player 2 will decide to whether Call or Fold.

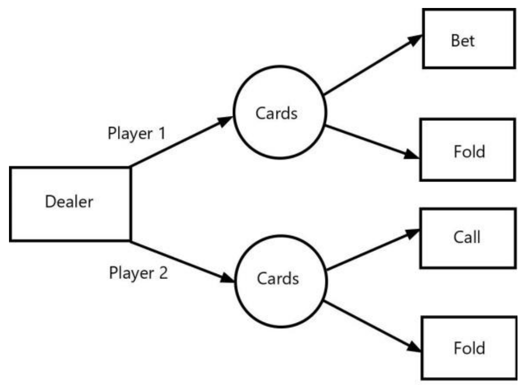

Figure 3.7 Borel Poker: Rule

Round 1: If Player 1 bet the game and Player 2 had an option to Call or Fold.

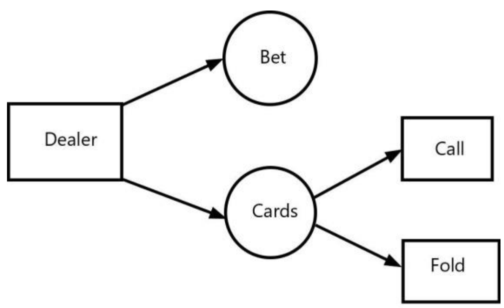

Figure 3.8 Borel Poker: Round 1

Case i): If Player 1 Bet and Player 2 Call the game. When they showdown their cards, it is compared to determine the winner.

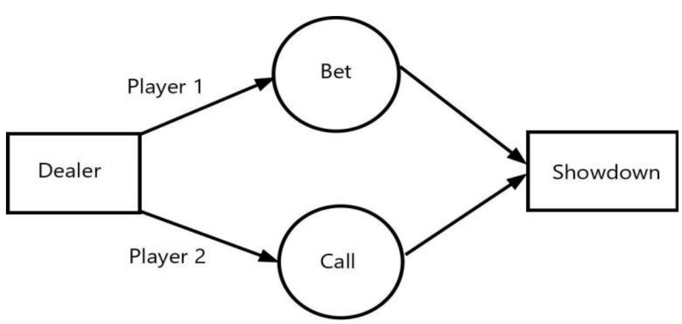

Figure 3.9 Borel Poker: Round 1: Case 1

Case ii): If Player 1 Bet and Player 2 Fold, the game will end. Then Player 1 wins thegame.

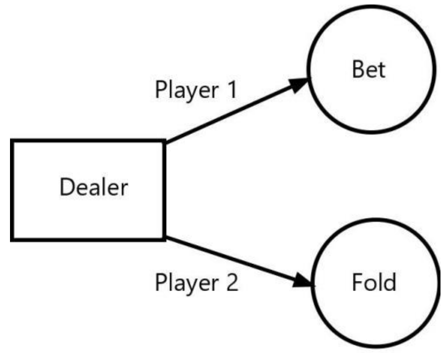

Figure 3.10 Borel Poker: Round 1: Case 2

Round 2: If Player 2 had an option to Call or Fold and Player 1 must fold.

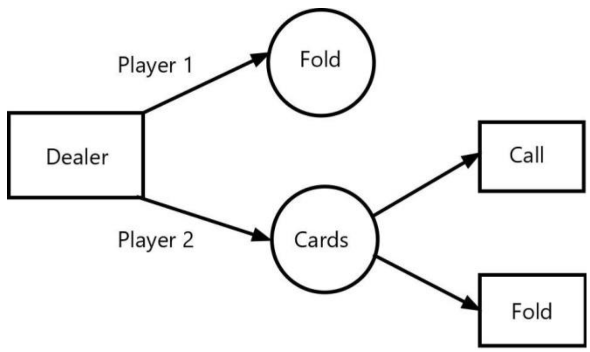

Figure 3.11 Borel Poker: Round 2

Case i): If Player 2 Call and Player 1 Fold, the game will end. Then Player 2 wins the game.

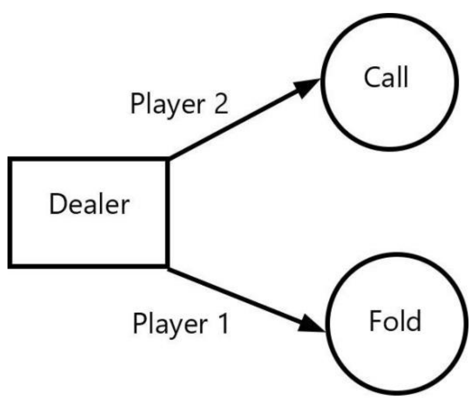

Figure 3.12 Borel Poker: Round 2: Case 1

Case ii): In this case, only Player 1 or Player 2 can fold, not both players can fold atthe same time.

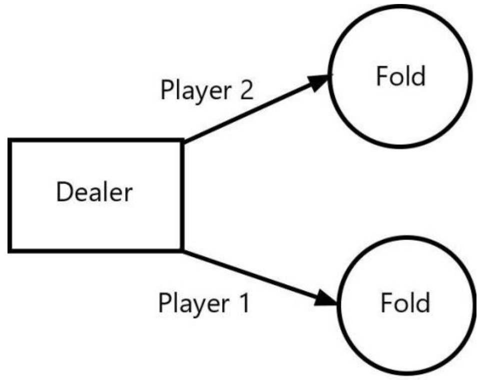

Figure 3.13 Borel Poker: Round 2: Case 2

C. Von Neumann's Poker

A seemingly tiny distinction occurs in Von Neumann's Poker Model, yet it has a significant effect on how the activity is performed. In this model, once Player 1 plays and Player 2 called, the cards are contrasted identically in Borel's model even if Player 1 fails to risk the cash or give up his bonus. The alternatives available to player 1 in this scenario are to evaluate the cards or to gamble with it. By using TSP method, the Von Neumann's Poker Model is represented throughdiagrammatically with explanation.

Advantage: In Von Neumann's Poker Model, Player 1 has the advantage (i.e.) Player 1 won't surrender his ante and also he will not bet only in Round 1

Rule: If Player 1 had an option to Check or Bet and Player 2 will decide to whetherCall or Fold.

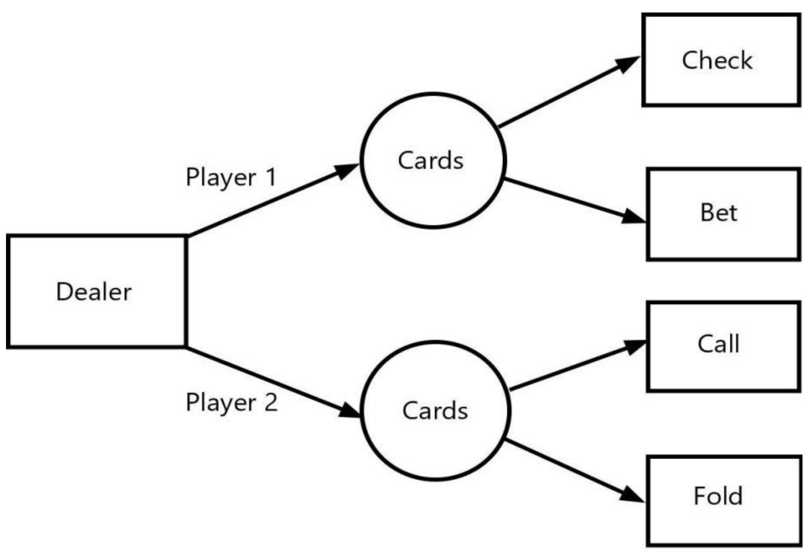

Figure 3.14 Von Neumann's Poker: Rule

Round 1: If both Player 1 and Player 2 will Check their cards. When they showdown their cards, it is compared to determine the winner.

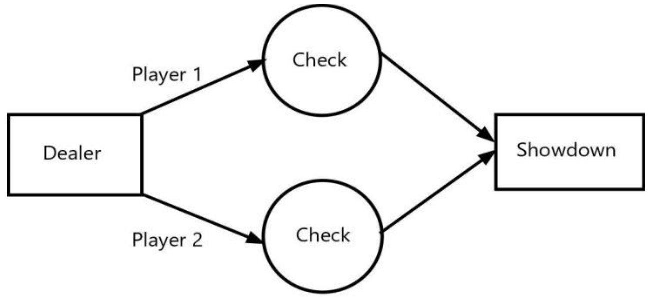

Figure 3.15 Von Neumann's Poker: Round 1

Round 2: If Player 1 checks his cards and Player 2 had an option to Call or Fold.

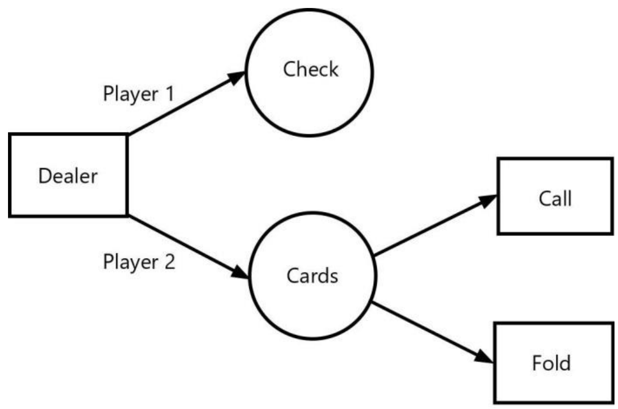

Figure 3.16 Von Neumann's Poker: Round 2

Case i): If Player 1 Check and Player 2 Call the game. When they showdown their cards, it is compared to determine the winner.

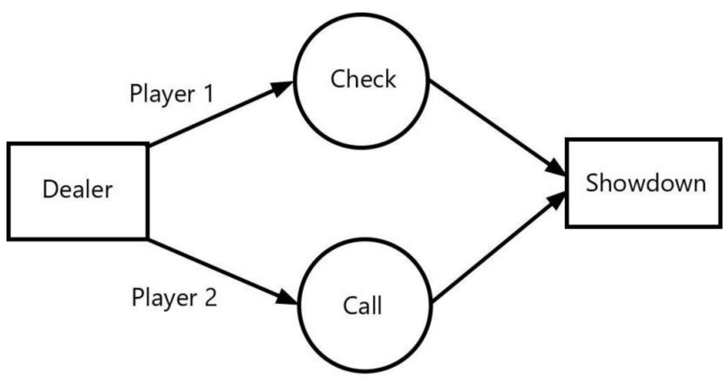

Figure 3.17 Von Neumann's Poker: Round 2: Case 1

Case ii): If Player 1 Check and Player 2 Fold, the game will end. Then Player 1 winsthe game.

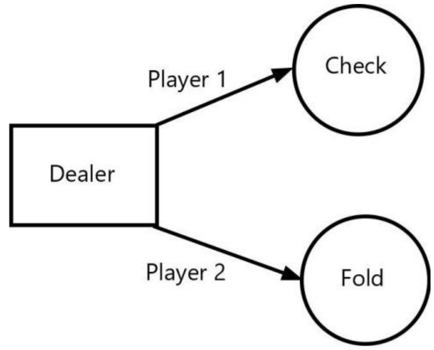

Figure 3.18 Von Neumann’s Poker: Round 2: Case 2

Round 3: If Player 1 bet the game and Player 2 had an option to Call orFold.

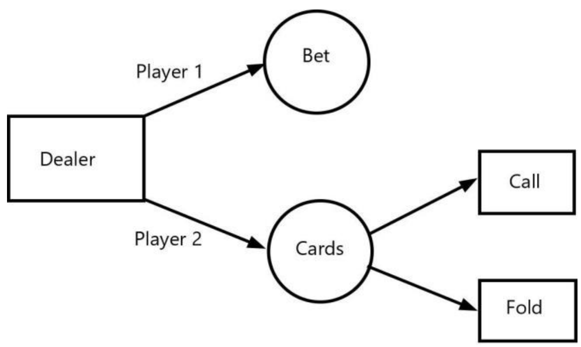

Figure 3.19 Von Neumann’s Poker: Round 3

Case i): If Player 1 Bet and Player 2 Call the game. When they showdown their cards, it is compared to determine the winner.

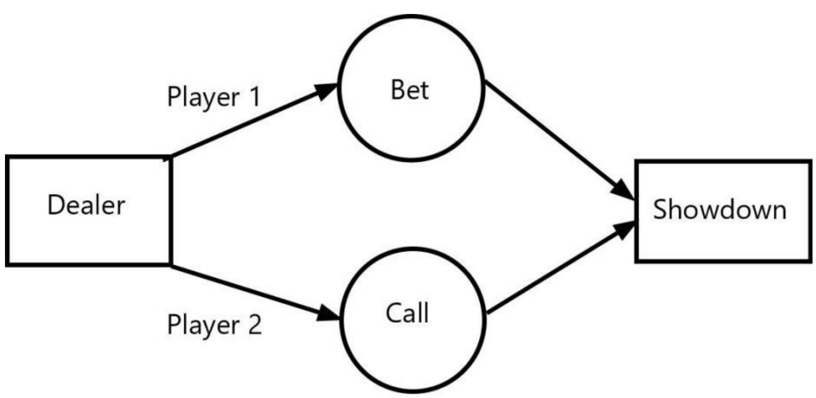

Figure 3.20 Von Neumann’s Poker: Round 3: Case 1

Case ii): If Player 1 Bet and Player 2 Fold, the game will end. Then Player 1 wins thegame.

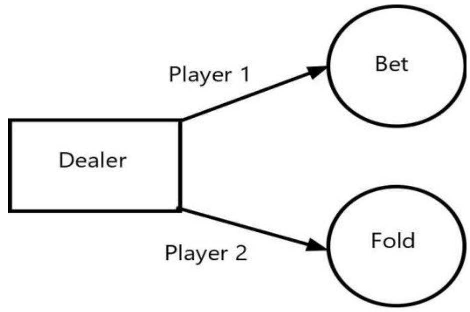

Figure 3.21 Von Neumann's Poker: Round 3: Case 2

D. Half Street Games

Instead of using random distributions, betting games using real decks are prepared to analyze their results. In all actuality, half-street games were models for poker. These games' traits include,

In darkness, the first player shall verify. He made any bets. This suggests that unless player 2 takes action, player 1 won't be aware of the power of their hand. After then, the second player can choose either to verify or wager. Here is a showdown and the cards are evaluated to decide who wins if both parties examine. Here don't exist limitations on the scope of the wagers for Player 2. The first player gets the choice to give up or rise if the second player plays. When the decks clash at the showdown if player 1 calls, the most powerful card wins. By using TSP Method, the Half Street game is represented through diagrammaticallywith explanation.

Rule: In Half Street game, Player 1 acts as Check in dark and Player 2 will decide towhether Check or Bet.

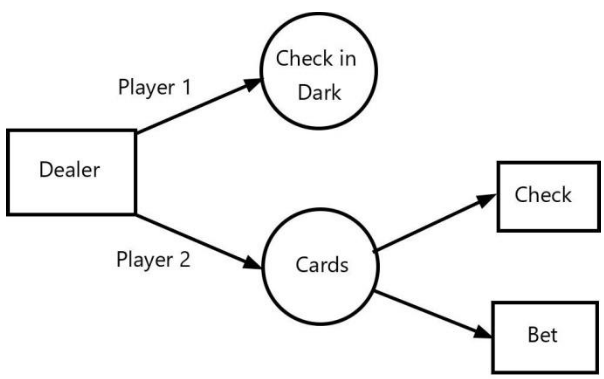

Figure 3.22 Half Street Games

Round 1: If Player 1 acts as Check in dark and Player 2 Check his cards. When they showdown their cards, it is compared to determine the winner.

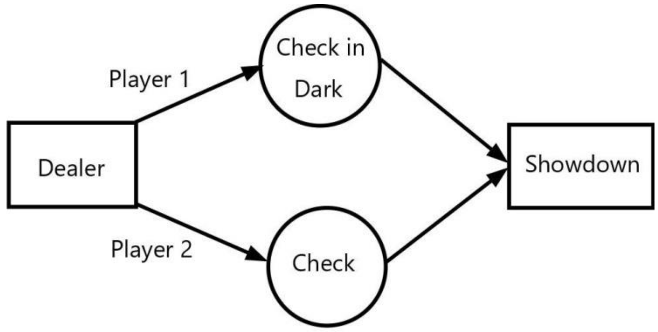

Figure 3.23 Half Street Games: Round 1

Round 2: If Player 2 bet the game and Player 1 had an option to Call or Fold.

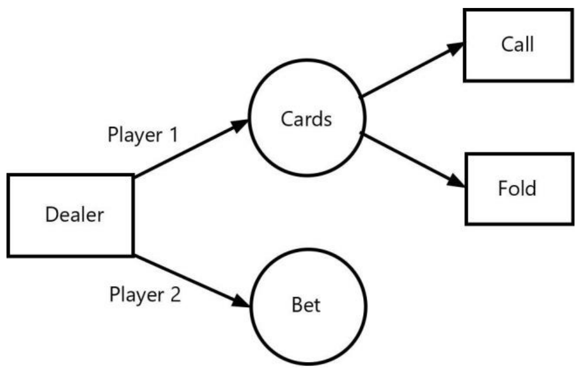

Figure 3.24 Half Street Games: Round 2

Case i): If Player 2 Bet and Player 1 Call the game. When they showdown their cards,it is compared to determine the winner.

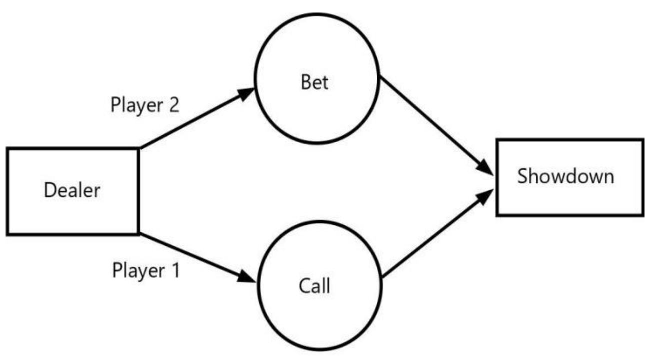

Figure 3.25 Half Street Games: Round 2: Case 1

Case ii): If Player 2 Bet and Player 1 Fold, the game will end. Then Player 2 wins the game.

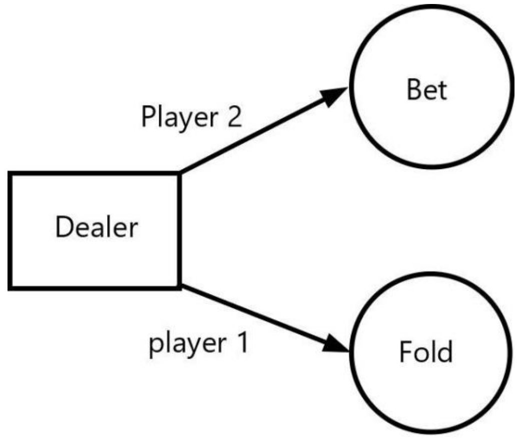

Figure 3.26 Half Street Games: Round 2: Case 2

E. The Clairvoyance Game

Player 2 is considered clairvoyant in this game, which means that in addition to knowing the worth of his own hand, he further knew the worth of the other player's hand. Player 1 will immediately verify the information in accordance with the game's regulations, and Player 2 then decides either wager or verify. Player 2 has a huge lead over Player 1 in this match. If player 2 has a better hand than player 1, player 2 could put up for worth and force player 1 to make an additional wager during his plays. Player 2 may just verify and only loses the pot if Player 1 has a stronger hand. The ability of player 2 to defeat player 1 using a few medium-strength hands—either through a gamble or a wager that player 1 may call—should be of utmost importance. Player 2 ought to never make a losing wager in this match.

Advantage: In the Clairvoyance game, Player 2 has the advantage (i.e.) Player 2 knowsthe value of his own card and also the value of Player 1's cards. By using TSP Method, the Clairvoyance game is represented through diagrammaticallywith explanation.

Rule: If Player 1 checks his card and Player 2 will decide to whether Check orBet.

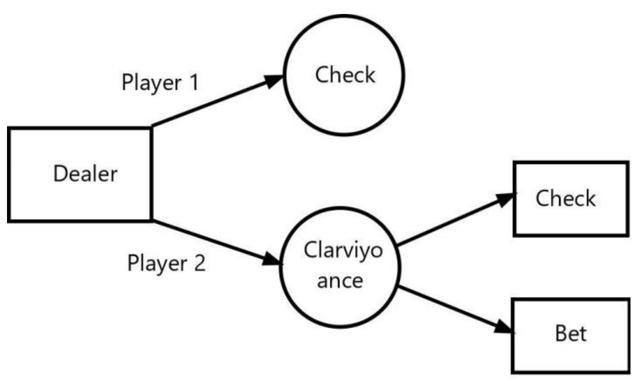

Figure 3.27 Clairvoyance Game

Case i): If both Player 1 and Player 2 will Check their cards. When they showdowntheir cards, it is compared to determine the winner.

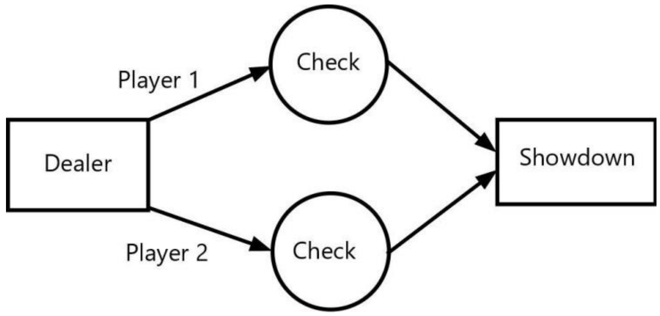

Figure 3.28 Clairvoyance Game: Case 1

Case ii): If Player 2 Bet and Player 1 Fold, the game will end. Then Player 2 wins the game.

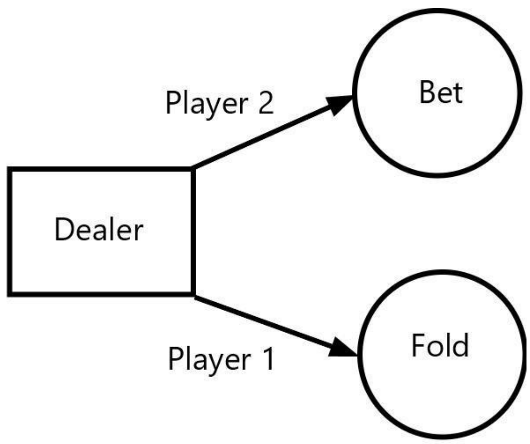

Figure 3.29 Clairvoyance Game: Case 2

F. The AKQ Game

Assume there really are just three cards used in this match: an Ace, a King, and a Queen (AKQ), where A > K > Q. The first card in this deck shall be dealt to each player at will, no replace. Although they lack clairvoyance, players can estimate the power of other rivals' hands by analyzing their very own. Each player playing the match will be dealt precisely a single card drawn from the hand. We must decide the best course of action to take for every match, just as we did in previous games. Player 1 has the choice to gamble or examine after receiving the number eight. As each method has a bigger or similar anticipated worth to any individual counter-strategy from player 2, wagering here outweighs verifying. So, verifying through a card may no longer be used. Similar to player 1, player 2 can take some alternatives out of his plans. Calling with an ace outweighs folding an ace. You can eliminate one of those tactics from the game. As player 1, we are aware that we have to optimize our anticipated return. It follows that wagering a pair remains preferable to verifying using an ace. When Player 1 bets, Player 2 will give up any queen he has because the queen can't beat anyone. A player's personal card ought to never be folded because it always wins. Player 1 is going to gamble with queens, and Player 2 may call with kings, according to the non-dominated methods. By examining the occurrences of various combinations and computing the expected value for each, one can identify the best tactics. The approaches can be categorized as follows:

Player 1 bluffs with queens.

Player 1 checks with queens.

Player 2 calls with kings.

Player 2 folds with kings.

By using TSP Method, the AKQ game is represented through diagrammaticallywith explanation.

Rule: If Player 1 had an option to Check or Bet and Player 2 will decide to whetherCall or Fold.

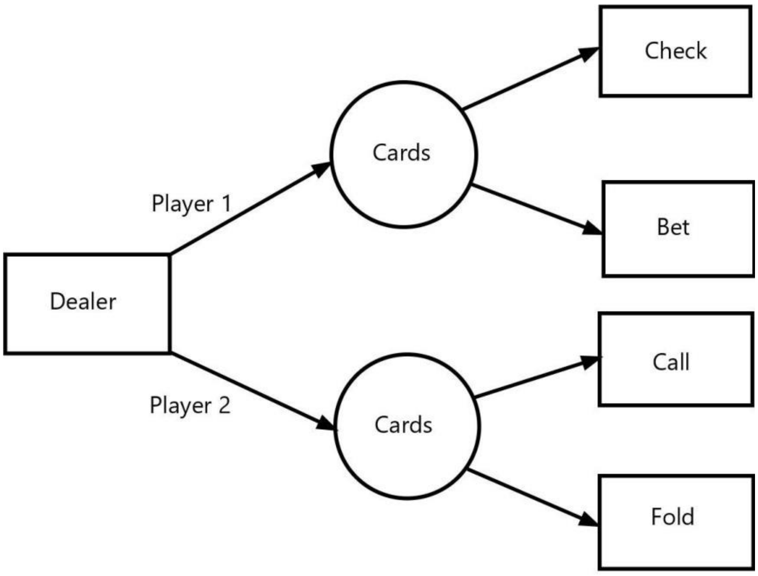

Figure 3.30 AKQ Game

Round 1: If Player 1 checks his cards and Player 2 had an option to Call orFold.

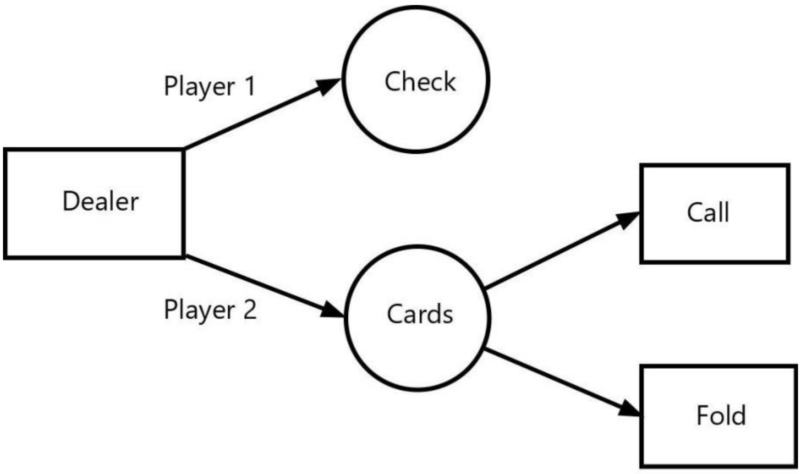

Figure 3.31 AKQ Game: Round 1

Case i): If Player 1 Check and Player 2 Call the game. When they showdown theircards, it is compared to determine the winner.

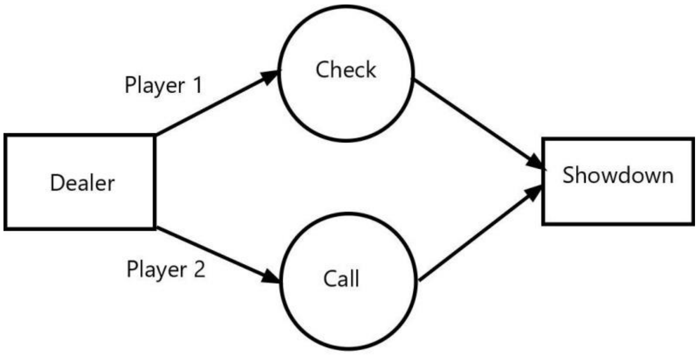

Figure 3.32 AKQ Game: Round 1: Case 1

Case ii): If Player 1 Check and Player 2 Fold, the game will end. Then, Player 1 winsthe game.

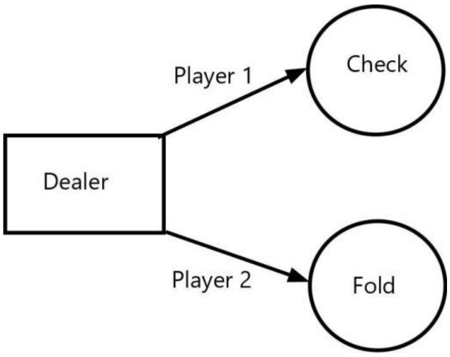

Figure 3.33 AKQ Game: Round 1: Case 2

Round 2: If Player 1 bet the game and Player 2 had an option to Call orFold.

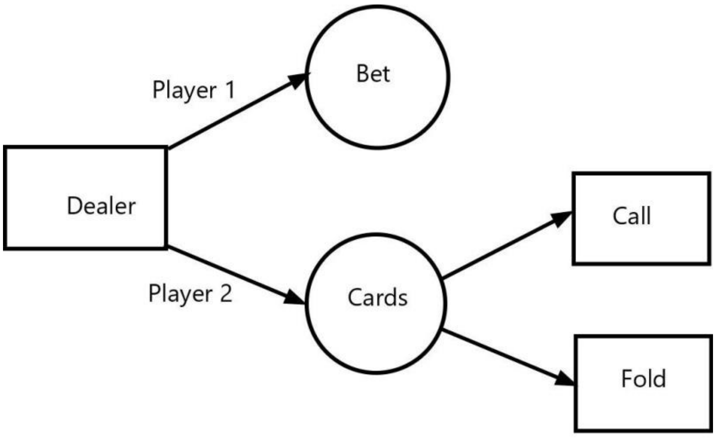

Figure 3.34 AKQ Game: Round 2

Case i): If Player 1 Bet and Player 2 Call the game. When they showdown their cards,it is compared to determine the winner.

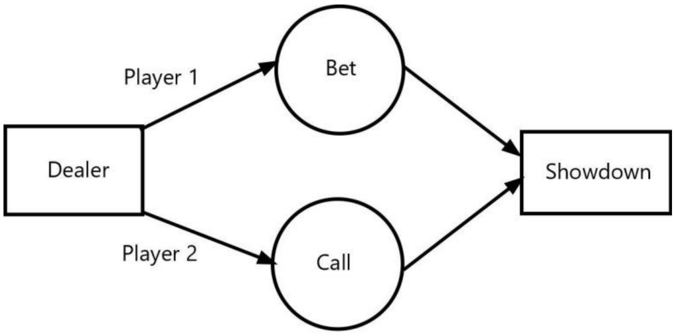

Figure 3.34 AKQ Game: Round 2: Case 1

Case ii): If Player 1 Bet and Player 2 Fold, the game will end. Then Player 1 wins thegame.

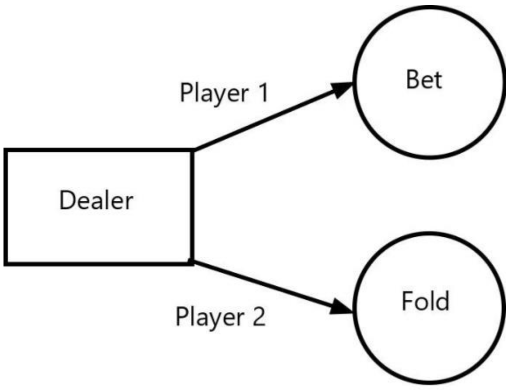

Figure 3.34 AKQ Game: Round 2: Case 2

IV. CONCLUSION

Gambling has many variations, and the following list includes ones that make use of game theory. The Traveling Salesman Problem (TSP), in addition to these expansions, had been used to resolve the gambling issues. The loser will play longer using the standard method, which will result in significant losses. It has been determined that the TSP approach can be utilized for resolving complicated games of poker with ease. so that they don't lose a lot of money and can play for a shorter period of time.

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