

The Best Hand

By Dhruvit Kothari

Blog/Article Link-

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What is the first thing that strikes you when you hear the word ‘Poker’? Almost immediately, the thought of the legendary James Bond movie, Casino Royale, pops up in my head. ‘Bond Poker Money’ instantly became my new mantra for living – it was not optimal though, given that I was barely a twelve-year old!

Now, poker has numerous variants but the most popular – and the one featured in ‘Casino Royale’ – is **Texas Hold’em Poker**. For those who are not well versed with the ins and outs of poker, take my word and do not lose interest just yet. Poker has gained immense popularity in the last decade thanks to the advent of television and International Poker Tournaments where the prize pools often go as high as 80 million dollars (boy, isn’t that a lot of money!). Thus, through this article, I aim to leave you pondering upon a great deal of gambling know-how, some random statistics and finally, an insight into the crazy world of poker.

Disclaimer: Do not let this article serve as inspiration for you to gamble away your savings for some moolah!

Texas Hold’em Poker is a variant of poker which is usually played with 2-10 players. The goal is simple: win as many chips you can, one pot at a time. The players are first dealt two cards face-down, each called ‘Hole Cards’ followed by five ‘Community Cards’ dealt face up in three stages. In the first

stage, three community cards are dealt in a series called the 'Flop'; in the second stage, a single card called the 'The Turn/Fourth Street' is dealt; in the final stage, again a single card called the 'The River or Fifth Street' is dealt. The community cards are shared by all the players, hence the name 'community'. So, in total, a player has access to seven cards during the game. As the betting rounds proceed, the respective community cards are dealt, thereby giving a player more information about his hand. Now, we have come across a new term 'Hand'. Let's deal with it. To win a game of poker, a player needs to have the 'Best Hand' and he should not have folded during the game. Your 'Hand' is the best combination of 5 cards out of the 7 cards you have access to during the game. All players in the game use the community card in conjunction with their own hole cards to make their best possible five-card poker hand.

Each hand here has a respective rank and this is important to win the game. After all the rounds of betting, there is a 'showdown' where the players compare their respective Best Hands. The Hand with the highest ranking wins the game and subsequently all the money that was bet for the hand, known as the pot. In case of a tie, the remaining cards in their hands are compared.

The respective Hand Rankings are as follows –



Source: <https://www.pokernews.com/poker-hands.htm>

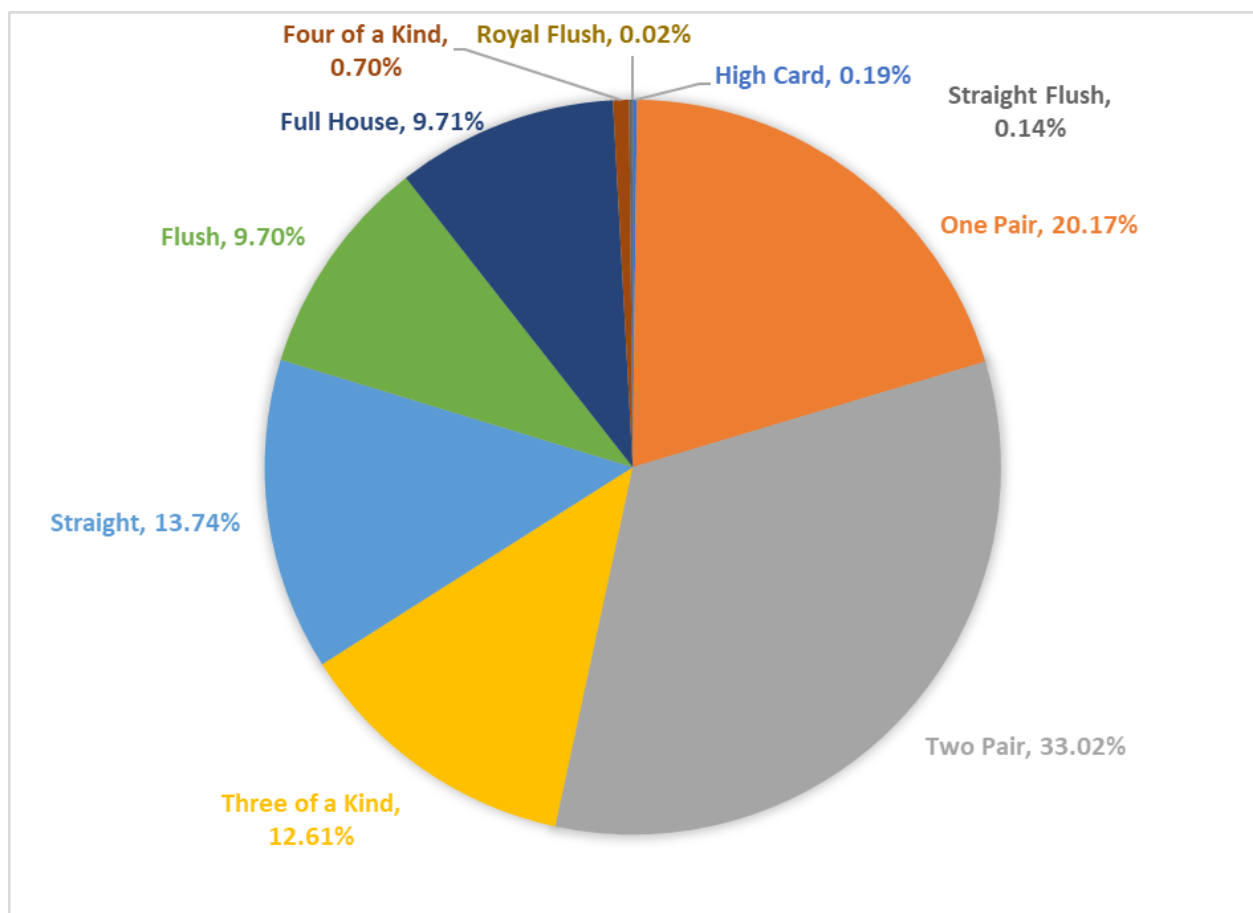
For instance, a player with a Full House (#4) beats a player having Two Pairs (#8).

Now, where there are cards, there is probability and statistics. People often argue that poker is a play of luck or a game requiring skill but I believe it is a fair combination of both. To unravel the mystery of this ‘poker luck’, I could manually calculate the probabilities of different hands and the respective chances of winning a game but my laziness gave me a smarter idea – I programmed a little game of Texas Hold’em Poker and used it to simulate the game a million times, thus easing the process of data collection and inference. I reckon I am the kind of lazy who is being hunted by Bill Gates, no?

The Simulation

Each round of poker was played among five players who did not have the option to fold during the game. The hole cards and community cards were dealt together without any rounds of betting, raising, calling or checking as the aim of this study was to focus on the statistics behind the poker hands. Needless to say, the player with the best hand won the round. I ran the simulation for a 1000 rounds of poker played a 100 times which also helped me account for the variance in the data. The mean of the 100 trials was taken. Here are the results –

Figure 1: Results of the winning poker hand (for 100 trials of 1000 simulated rounds of poker)



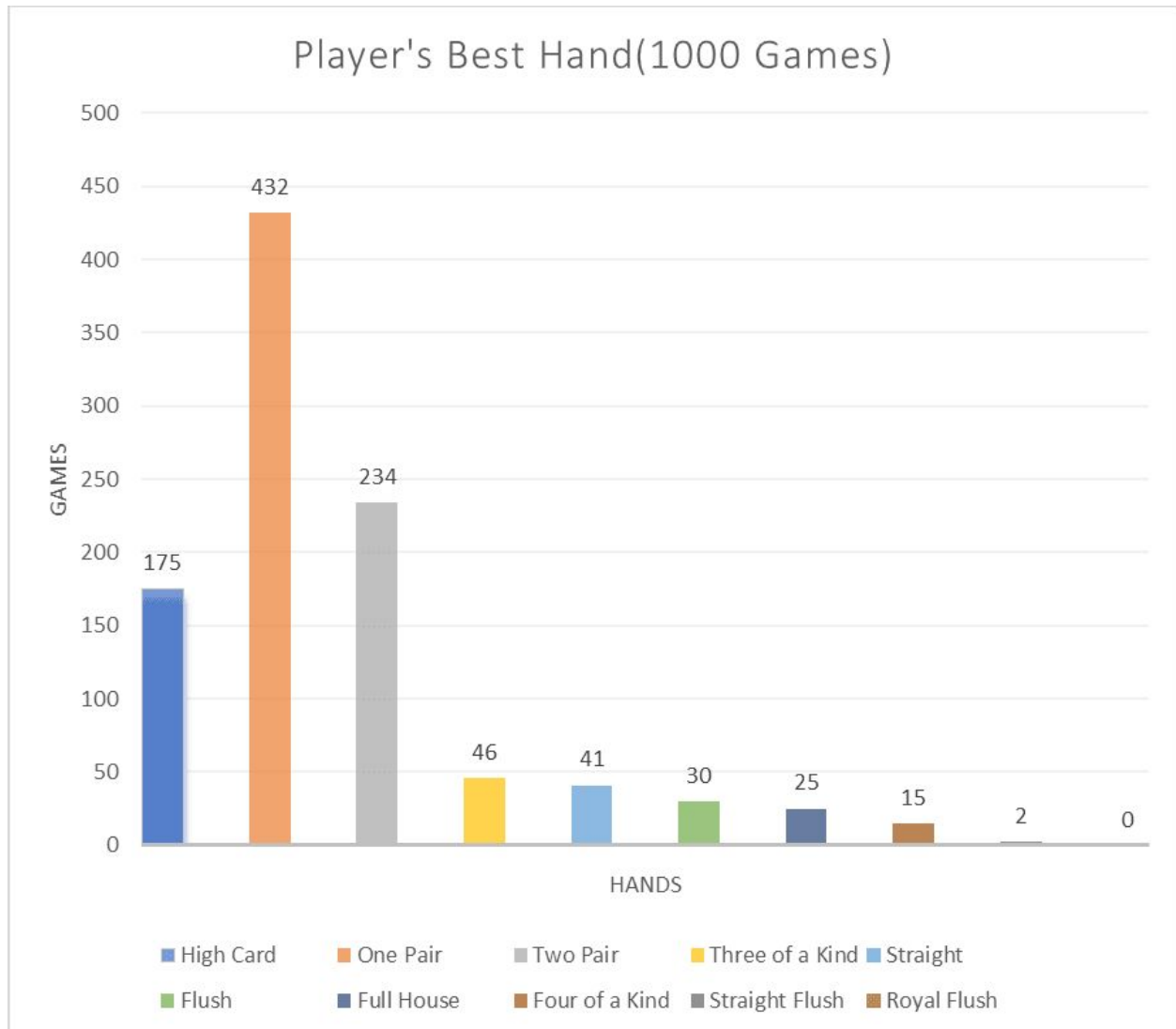
Here, the winning percentage for a hand of Two Pairs is 33.02% which implies that out of the 1000 rounds of poker played, the respective hand was

the winning hand 33% of the times i.e. in 330 out of the 1000 rounds. Likewise, the Royal Flush, has a mere 0.02% chance of being the winning hand. Talk about rare!

However, this data is from the perspective of the game as a whole, a little tidbit of neat information. We shall now look at the game from the player's perspective. To understand this, imagine you are a player. You will naturally want all possible information that can give you an edge over your competitors – in gambling, this little edge can be the difference between you earning millions or losing it all.

By now, you know that some hands have a lesser probability of winning the game than other hands. For instance, you always have the chance of a High Card (#10) being your best hand irrespective of the other cards served. Seeing this, we can intuitively arrive at the conclusion that the probability of your best hand being the High Card (#10) is more than the probability of, let's say, a Flush (#5).

Figure 2: Players' Best Hands in 1000 Games of Poker



Let's now look at the probabilities of the Best Hands of a player at the end of each round. Note that these probabilities do not imply that the player won or lost the game with the respective hand.

Table 1: Results for the Best Hand of a Player (for 100 trials of 1000 simulated rounds of poker)

| Player's Best Hand in a game of poker | Percentages |
|---------------------------------------|-------------|
|---------------------------------------|-------------|

| | |
|-----------------|--------|
| High Card | 17.80% |
| One Pair | 43.84% |
| Two Pair | 23.47% |
| Three of a Kind | 4.82% |
| Straight | 4.16% |
| Flush | 3.05% |
| Full House | 2.66% |
| Four of a Kind | 0.171% |
| Straight Flush | 0.026% |

Royal Flush

0.002%

Here, a hand of One Pair has a probability of 43.84% which implies that out of 1000 rounds of poker, it is probable that approximately 43% of the times, the player's Best Hand was a pair. This translates to the fact that given any round of poker, the chances of getting One Pair is 0.43. Consequently, this probability is true for all players because the cards are dealt randomly. The odds of getting a Straight Flush during a game of poker is as low as 0.026% and that of a Royal Flush is an insignificant 0.002%.

You must be wondering – what are we going to do with all this data? Well, we are going to find more data and put in line our inferences and conclusions. We now know the probability of each hand occurring and the probability of the respective hand winning a round of poker. Let's apply some statistics to compute the probability of us winning a game given we have a respective hand. And how are we going to go about this? By using our very own concepts of conditional probability and making a few tweaks to the code.

Working

To find the probability of winning a round of poker given that the player has a particular given hand:

$$P(\text{Winning}/\text{GivenHand}) = \frac{P(\text{Winning} \cap \text{GivenHand})}{P(\text{GivenHand})}$$

Note: Here, $P(\text{Winning} \cup \text{Given Hand})$ is the probability for all the players. In order to obtain the probability for a single player, we divide the numerator

in the given formula by the total number of players ‘n’, which in this case is 5.

Table 2: Results for the probability of a player winning a round of poker given a respective hand

| Hand | Probability |
|-----------------|-------------|
| High Card | 0.23% |
| One Pair | 9.35% |
| Two Pair | 30.50% |
| Three of a Kind | 54.96% |
| Straight | 77.27% |
| Flush | 82.49% |

| | |
|----------------|--------|
| Full House | 80.60% |
| Four of a Kind | 94.73% |
| Straight Flush | 96.15% |
| Royal Flush | 100% |

These numbers right here confirm the validity of our model. But as the illustrious British statistician, George Box, once said, “All models are wrong, but some are useful.” This said, it is upon us to interpret the model and extract useful information from it. The figures here show the probability of winning the pot with different hands among five players.

As the likeliness of having each hand decreases, the probability that the particular hand will win you that round of poker increases. Eg. A Royal Flush, ranked number 1, has a 100% chance of winning you the round of poker. Likewise, a Three of a Kind as your best hand will win you the game 55% of the time.

We can use this data to come up with different strategies to bet, raise and fold during the game. Eg. Going ‘all in’ with our best hand being Two Pairs is not the smartest move because there is only a 30% percent chance of us winning the round. On the flipside, not betting everything when you have a Royal Flush is unnecessarily playing down your pot.

Even a rough idea of the probabilities can help us make less risky bets and average our winnings in the long run.

Here, the simple formula to make consistent profits seems to be betting more money when we have a statistical advantage and betting less money when we don't. Again, you can always vary your strategy by calling bluffs and reading the table for more information. Thus, put on your poker face (your mask, if I may) and gamble well!

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Title image credits: <https://www.casino.org/blog>

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