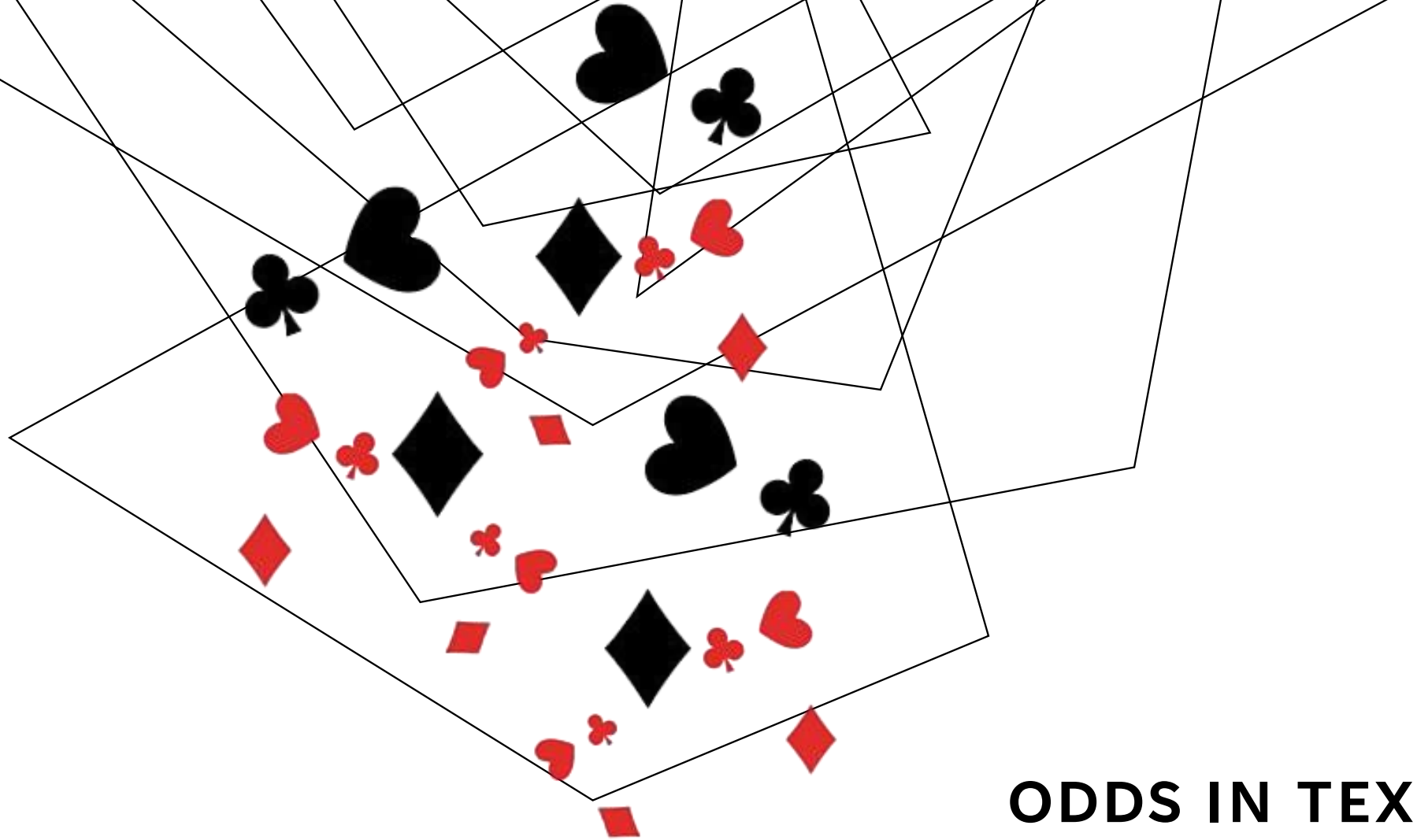


ODDS IN TEXAS HOLD'EM POKER

Andrea Fumagalli

HOW TO PLAY POKER

Texas Hold'em is a very popular poker variant. Here is a summary of its main rules:

Objective: The player tries to get the best possible combination of cards to win the pot, which is made up of the bets of the other players.

Dealing the cards: Each player is dealt two cards face down ("hole cards").

Preflop: Players place their bets based on their initial cards.

Flop: Three community cards are placed face up on the table. A new betting round begins.

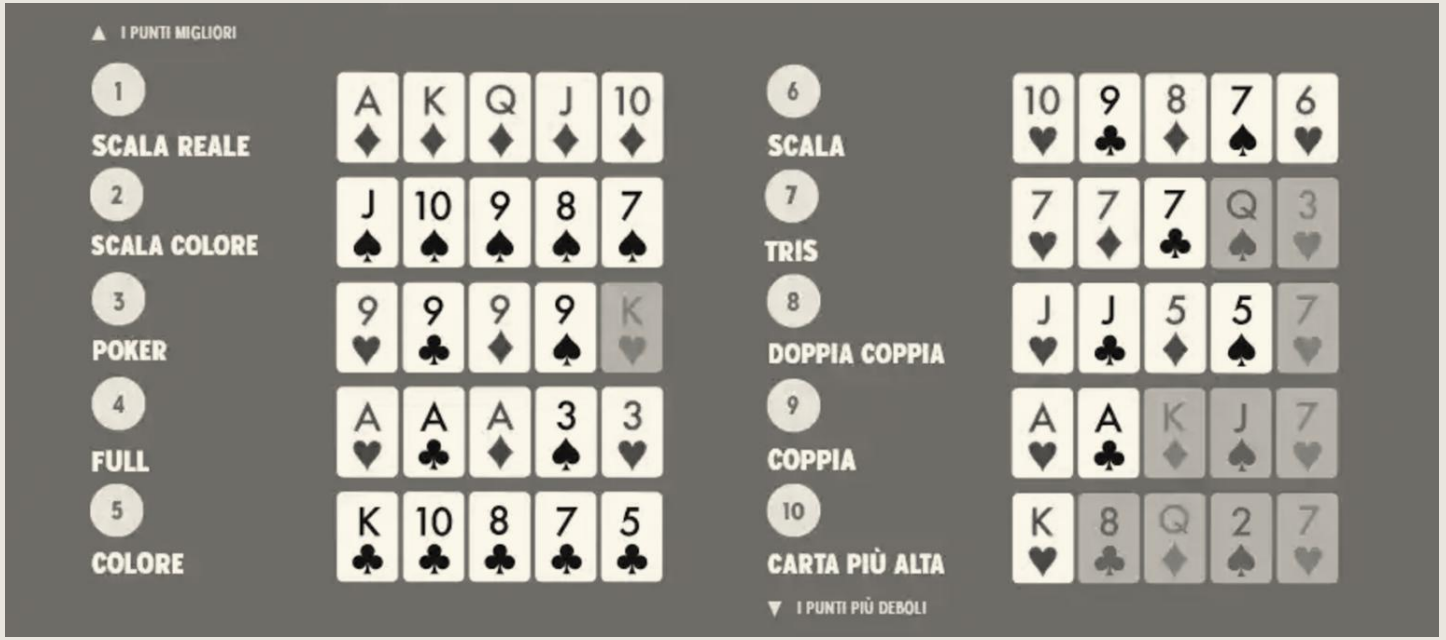
Turn: A fourth community card is placed face up on the table. Betting continues.

River: A fifth and final community card is placed face up on the table. The final betting round takes place.

Card combinations:

• Players can use their two personal **hole cards** along with the five community cards to form the best possible hand.

• Hand combinations range from lowest to highest, such as pair, three of a kind, straight, flush, full house, four of a kind, straight flush, and royal flush.



CLASSIC PROBABILITY

What is the probability of having a certain starting hand?

Let's say we want to know the probability of having hole cards **A♥K♥**

Let's calculate how many total combinations can be made from a 52-card deck by drawing 2 cards

$$\binom{52}{2}$$

So

$$\frac{52!}{2! \times (52-2)!}$$

Solving the calculation we get that there are 1326 combinations of drawing 2 cards from a deck of 52

To find the probability of a given starting hand we need to use the formula

$$\frac{Favorable\ cases}{Total\ cases}$$

So

$$\frac{1}{1326}$$

By solving the calculation we obtain that the probability of having specifically **A♥K♥** or any combination of cards is of the

0,075%

What is the probability of having a certain starting hand?

Let's say we want to know the probability of having a TT+ pair as hole cards, that is, all TT, JJ, QQ, KK and AA pairs combined for each suit.

There are in total $\binom{4}{2}$ combinations of pairs for each card value, this is multiplied by each value, we get **6 x 5 = 30**.

The total combinations by drawing 2 cards are always

$$\frac{52!}{2! \times (52-2)!}$$

So we have **1326** combinations in total

To find the probability of a TT+ pair as a starting hand we still have to use the classic probability formula

$$\frac{Favorable\ Cases}{Total\ Cases}$$

So

$$\frac{6\ x\ 5}{1326}$$

By solving the calculation we obtain a probability of

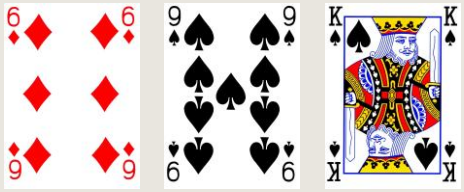
2.26%

GLI OUTS NEL POKER

Outs are the cards that a player needs to conclude his hand. Let's take a practical example: I have a 7 and an 8 in my hand while the cards on the table are 6 9 K.

My Cards:

Flop:



I wonder how likely I am to make a straight, that is, how likely it is that a 5 or a 10 will come up. Since there are four 5s and four 10s in the deck, I will have eight outs.

To calculate the probability of making a straight we must also use in this case the classic probability formula used in the previous examples.
Knowing that there are 47 cards left in the deck and the winning cards are 8,

With this calculation I get that the probability of making a straight on the turn is 17%.

CONDITIONAL PROBABILITY

What is the probability of having a quad on the flop after hitting a pair pre-flop?

First of all we need to calculate the probability of having any pair in our hand pre-flop:

To find the probability of a starting hand pair we need to use the formula

$$\frac{Favorable\ cases}{Total\ cases}$$

So

$$\frac{6\ x\ 13}{1326}$$

By solving the calculation we get that the probability of having any pair in hand

5,88%

Let's calculate how many total combinations can be made from a 52-card deck by drawing 2 cards

$$\binom{52}{2}$$

So

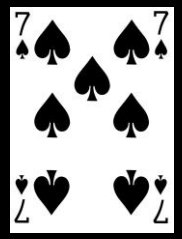
$$\frac{52!}{2!\ \times (52-2)!}$$

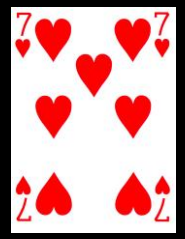
Solving the calculation we get that there are 1326 combinations of drawing 2 cards from a deck of 52

CONDITIONAL PROBABILITY

Now we need to calculate the probability that two of the three cards on the flop are of the same value as those in hand.

There are 50 cards left in the deck, of which all 13 values still have 4 cards in the deck, while of the 7, only 2 remain, the 7 of hearts and the 7 of spades:





Let's calculate how many total combinations can be made from a 50-card deck by drawing 3 cards

$$\binom{50}{3}$$

So

$$\frac{50!}{3! \times (50-3)!}$$

Solving the calculation we get that there are 19600 combinations of drawing 3 cards from a deck of 50

To find the probability of drawing the two remaining 7s out of three cards, you have to think about how to draw the two 7s + 1 random card and use the following formula :

$$\frac{\binom{2}{2} x \binom{48}{1}}{\binom{50}{3}} = \frac{1 \, x \, 48}{19600} = 0{,}00245$$

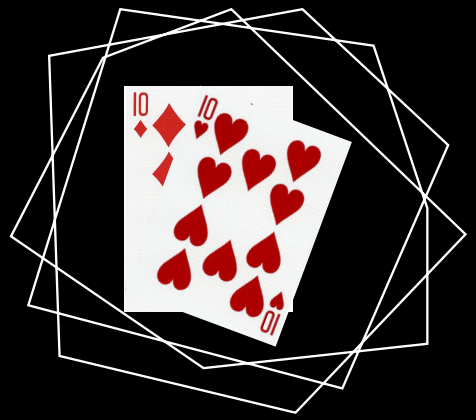
So we can say that the combined probability of having a poker on the flop with a pair pre-flop is :

0,245%

SUMMING UP

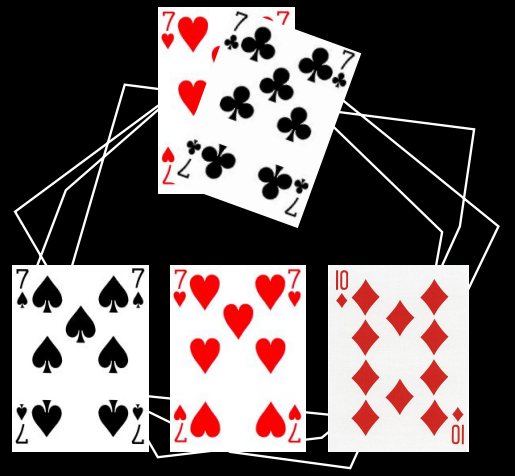
PROBABILITY OF ANY STARTING HAND

0,075%



PROBABILITY OF A TT+ PAIR

2,26%



PREFLOP PAIR POKER ODDS

0,245%