

# No Limit Texas Hold'em Tournament Strategy: A Manually Computed Monte-Carlo Simulation

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## ABSTRACT

We will be holding at least one No Limit Texas Hold'em poker tournament around the campfire in the evening on the Sentinel Peak field trip. All are invited to play. There will be an entry fee of \$5. In this handout we describe poker for the interested and scientifically literate beginner, starting with hand ranks and probabilities. We then describe the game of Texas Hold'em, the variation we will be playing, and No Limit Hold'em tournaments in particular. We conclude with a short primer on Hold'em strategy and tactics.

*Subject headings:* Monte Carlo Simulation – Poker – Texas Hold'em – No Limit Hold'em Tournaments

## 1. INTRODUCTION

The game of poker is a study in probability and psychology. Understanding probability allows proper computation of betting, payoffs, and when to cut your losses; psychology gives insight into what's your opponent's hand, whether he's bluffing, and whether you can get her to fold without having to even show your hand. Master both, and you've got a chance.

However, poker is also a game dominated by stochasticity. Even the best players won't win every game – not even close. Professional poker players can make money, but the standard deviation of their winnings is high. In a single game, or single tournament, anything can happen.

To our knowledge, poker cash games were played on only one previous LPL fieldtrip, the Southern New Mexico trip in Spring 2001. However, it was tragically interrupted by the great Jim Richardson Meteoriteathon for the Third Millennium, and so was not as successful as it might otherwise have been.

## 2. POKER: HANDS AND PROBABILITIES

All possible groupings of 5 playing cards are equally probable to occur in any given random 5-card sample. A hand with the Ace, King, Queen, Jack, and 10 of spades (As, Ks, Qs, Js, 10s) is exactly as probable as 3 of clubs, 5 of diamonds, 8 of spades, 9 of clubs, and King of hearts (3c, 5d, 8s, 9c, Kh). In the game of poker, the goal is to obtain into your hand one of several low-entropy groupings of cards. The lower the entropy of these groupings (and therefore the lower your probability of drawing them randomly), the more valuable they are. Hence the first hand listed above, As, Ks, Qs, Js, 10s, will very likely make you a large amount of money, while the second hand, 3c, 5d, 8s, 9c, Kh, will get you a whole lot of nothing.

A poker hand is always composed of exactly 5 cards.

Some of the low-entropy hands are multiple instances of a single number card, like, say, four 8s, or 3 queens. The more complex groupings are a full house, which is three of any one number card and two of any other; a straight, which is 5 continuous cards of any suit such as 3, 4, 5, 6, 7; a flush, which is any 5 cards all of the same suit (e.g. 3h, 7h, 10h, Qh, Ah); and a straight-flush, both a straight and a flush simultaneously (7d, 8d, 9d, 10d, Jd). For straights only, an Ace can be either high (10, J, Q, K, A) or low (A, 2, 3, 4, 5), but NOT both at the same time (NO K, Q, A, 2, 3 wraparounds!). In all other cases, Aces are high. The order of poker hands and their probabilities are listed in Table 1.

Frequently, two of the same type of hand will show down against one another. In this case, the hand that involves higher cards in its important elements will win: Qs Qd 8c 9c 10s beats 8h 8s Qs Ks As. Similarly Jc Jd Jh 2c 5c beats 10d 10h 10s As 2h in three of a kind; 9d 10c Jc Qc Kd beats 3s 4h 5s 6h 7s in straights; Ac 9c 6c 3c 2c beats Kc Qc 9c 3c 2c in flushes (watch this one!); and 8c 8d 8h 7d 7h beats 5d 5h 5s Ac As in full houses.

In case of a tie between the important elements in a hand, the hand with the highest card not involved in making the low-entropy hand wins. This deciding card is then called the 'kicker'. 8c 8d 8h 8s 10s beats 8c 8h 8s 4s, Ac Ad Kc 10c 4s beats As Ac 10c 4s 2d, and Ac 10d 4d 3d 2c beats Ac 9s 8s 7s 6s. If the two highest non-important-element cards are the same, then neither is the 'kicker', and the process proceeds down to the next highest card to determine the winner.

If two hands are identical, they split the pot. Note that this CAN happen, because **there are no suit rankings in poker**. 3c 3d As Ks Js and 3s 3h As Ks Js are the same; they tie and split the pot. The 3s does NOT beat the 3d.

### 3. NO LIMIT TEXAS HOLD'EM TOURNAMENT PLAY

#### 3.1. Texas Hold'em

The game of Texas Hold'em starts with every player receiving two cards. These are referred to as your **hole cards**. Then there is a round of betting. Here, the player must decide whether they be in or out of the pot. The two (sometimes one) players to the left of the dealer have forced bets before the cards are dealt; these bets are called **blinds**. During the first round of betting, the player must decide whether they want to fold their hand, call and match the blind, or raise the bet. Action then ensues.

Once all of the bets are collected, the dealer takes the next card and “burns” it by placing it in the discard pile. This is done to prevent the possibility of cheating. Three cards are dealt face up; this is known as the **flop**. A round of betting then ensues starting with the player to the immediate left of the dealer. During the betting round, a player can check (not bet) if that option is available, bet, raise, or fold. When that is over, another card is dealt face up; this is the **turn**, after which is another round of betting. Finally, a fifth and final card is dealt face up, the **river**. A final round of betting ensues. When all the betting is over, the player with the best five-card poker hand wins the pot.

#### 3.2. Tournament Rules and Style

There are two ways of playing poker. One is a **cash game** where the chips have a cash value, and what you win or lose in a pot corresponds 1:1 to your profit/loss for the session. The other, and arguably more exciting way to play, is a **tournament**. Here, the chips do not have an explicit cash value. Every player initially pays a **buy-in** and receives the same amount of chips. Our tournament buy-in is \$5. In contrast, the buy-in for the main event of the World Series of Poker (the one you see featured on ESPN) is \$10,000.

Once all of the players have assembled, the poker tournament begins. The blinds for a hand start at a low number, and increase after a fixed period of time. This structure is illustrated in Table 2, and for our tournament, the blinds increase every 20 minutes. In our tournament, if a player loses all of his chips during the first hour of play, the player is allowed to continue playing in the tournament as he has the option to **rebuy** for the same price as the buy-in and receive the same initial amount of chips. The objective of the poker tournament is to win all of the chips; then, you will be declared the winner and receive a percentage of the total prize pool (buy-ins plus rebuys). The payouts are 50% for 1st, 30% for 2nd, and 20% for 3rd.

### 4. BASIC STRATEGY AND TACTICS

You should fold way more than half the time. It costs a lot to see a hand to a showdown at the end – if you start poorly and end up pushing a bad position to its logical conclusion, you will almost certainly get an early exit from

TABLE 1  
POKER HAND RANK AND PROBABILITIES

Hand	Probability	Example
Royal Flush	0.0000015	10d Jd Qd Kd Ad
Straight Flush	0.0000139	3c 4c 5c 6c 7c
Four of a Kind	0.0002401	Jc Jd Jh Js 2c
Full House	0.0014406	Kc Ks Kd 5c 5h
Flush	0.0019654	3h 7h 8h 10h Kh
Straight	0.0039246	7d 8h 9h 10h Jc
Three of a Kind	0.0211285	Ac Ad As 3c Qh
Two Pair	0.0475390	Jd Jc 6h 6s 7s
Pair	0.4225690	6d 6h 2s Jc Ac
High Card	0.5011774	4s 7s 8c 10h Ks

NOTE.—Probabilities assume a random hand of 5 cards.

TABLE 2  
BLIND STRUCTURE

Level	Small Blind	Big Blind
1	1	2
2	2	4
3	3	6
4	5	10
5	10	20
6	15	30
7	20	40
8	30	60
9	40	80
10	50	100
11	75	150
12	100	200

NOTE.—Blinds go up every 20 minutes. Each player receives 100 in chips initially.

the tournament. The biggest mistake most people make in Texas Hold'em is to not fold often enough (Proctor 2005, personal communication). Your goal should be to WIN the BIG hands. Don't sweat the small stuff, and don't mind losing small hands.

#### 4.1. Pre-flop

After you get your first two cards, evaluate them and decide whether to even bother playing this hand. Although you might get lucky, if your hold cards are 3d 8c, you would be foolish to bet on such a low-probability event as winning that hand. Good hole cards comprise: a pair, face cards, suited cards, and/or connecting cards. One thing to keep in mind though is that playable hands increase in general as the number of total players at the table decreases, and as your position relative to the button (dealer) changes. Unfortunately, this topic is beyond the scope of this hand-out.

##### 4.1.1. Pairs

It is easy to see that starting with a pair is a good thing. It already beats half of the hands out there, and has a chance to go on to become three or four of a kind, a full house, or two pair. It means that while other players might be trying to cobble together a complex, low probability hand like a flush, you're sitting pretty knowing that you have a hand that can win when your opponent's flush doesn't pan out.

The probability of getting a pair in the hole is 5.88%, about 1 in 20. In a 10-person game, there's about a 50% chance that someone got dealt a pair in each hand. Multiple people with pairs is not that improbable in this context. Don't get too excited – its easy to overbet a pair.

The best hole-pair is AA, known as “pocket rockets” or “bullets”. Its a good hand. However, it loses a lot more often than you might think. Bet it hard, but don't push it farther than it will go. If the flop breaks against you (say, 7c 6c 8c), be VERY cognizant of how your opponents bet, and if you think they've got something that will beat you (3 of a kind or up, in this case a shot at a flush or a straight) give up and go home. Remember, the very worst possible hand you can have in poker isn't 2c 3d 4d 5h 7s. The worst hand is the second-best one. That's the one that you'll bet a lot of money on and lose. Some people will bet everything they have on that AA even when they can see plenty of ways to get beat, and someone betting as if she has made one of those. If you do that, you deserve to lose.

Good pairs are AA, KK, QQ, probably JJ, too. First thing you want to do with these: raise the big blind. If the BB is 20, raise to 40 (maybe higher, like 80 or 100). You are confident that you can win against what any one particular opponent has at the moment. However, a lucky flop for someone else can beat you. Solution: minimize the number of people that can get lucky on the flop. If you don't want to get beat by some loser that stays in 3c 5c (or can stay in for free as the big blind) and gets a flop 3d 3h 5s, get them to fold before they even see the flop. Or,

at least, make them pay for their pathetic low-probability dreams.

If you're the adventurous type, you might even consider going all-in right off the bat on something like this. However, there's a good chance everyone else will just fold and let you just win the blinds, which is an awful waste of KK. This trick is not for the faint-hearted, though, as even 22 has a 20% chance of taking you down. 80% is a bet I'd make any day, but its still one that I'd lose one workday a week.

If you have a middling pair (77-TT), you should probably raise to double the big blind, just to scare out people with nothing at all. Be careful on this one, I (JB) seem to keep losing my shirt on them. A simple QJo (o means 'off-suit', while QJs means 'suited', the same suit and not just spades in this case) has about a 45% chance of beating you. If two opponents stay in, your chances of winning plummet dramatically. You might try to bet high and scare everyone but one opponent away, but if that opponent then has a high pair you could exit the whole tournament early. Better to play your middle pair moderately. Stay in for low-lowmiddle bets, but don't go throwing your money after massive raises or reraises – its probably just not going to make it.

Small pairs like 22-66 are a crap-shoot waiting for another one to pop up to give you 3 of a kind. There's about a 12% chance that it will happen. Not that good if you're only playing against one or two others. I'd call the BB, but not much else. If someone else raises to double the BB they could very well have a higher pair than you, in which case your chances of winning are those 20% (yuck), or they've got two face cards, in which case you've got a formal 55% - 45% advantage if there's only one, but much worse with multiple opponents. If you don't come up with that three of a kind, these are almost guaranteed second-best, and therefore losing, hands.

##### 4.1.2. Face Cards

Two face cards (Jack through Ace) can be a pretty potent hand. In particular, AK (“big slick”) can get you places. If another face card that matches yours pops up, you've got a formidable pair, and a high kicker to boot in case someone ELSE has your same face card pair. Plus you've got a shot at a high straight.

The other reason that face cards, and AK in particular, are valuable is in case the winner has the most probable poker hand: nothing. With fewer players, or with only a few remaining in the hand to see the flop, there's still a reasonably high probability that nobody will end up with anything interesting, and that you're AK will take the pot on high-card alone. Additionally the dealer could flop something phenomenal like QQQ, in which case unless someone else is holding on to a queen or a pair, your AK has a good chance of breaking the resulting QQQ tie.

Formally, AK has only a 45% of beating a pair, and this probability rings true in heads-up play (one on one). However, in a game with 10 people where 8 fold and you have AK up against your opponent's 99, the AK has better

chances: those 8 people might not have folded had they had an A or a K in their hands! Therefore the folders probably siphoned off some low cards, enriching the deck in AK and increasing your chances of getting a high pair to take down the 99.

I would bet AK pretty hard, about as hard as QQ. Raise to double the BB at least, and scare out those people trying to see a lucky flop. However, be much more careful with KQ, KJ, or QJ. Someone else at the table probably has at least one Ace in their hand, and that one will make the difference quite a few cases.

AX, where X is anything else, has a surprising amount of promise. Ace with 2-5 has a shot at the low straight as well as the high pair or strong kicker. However, its kicker quality is lacking when compared to A with 9 or so through Q.

I almost always at least stay in to see the flop with an Ace and anything else of the same suit. If there's a flush in that suit in Hold'em, nobody else's flush can beat your Ace-high flush. Its a great defense against the second-best hand.

#### 4.1.3. *Suited Cards and Connectors*

Having two cards of the same suit gives you a chance at the flush draw while simultaneously setting you up for a lucky flop that will allow you a good hand that nobody sees coming. However, low suited lose an awful lot of the time. 3c 5c might seem good, suited and close enough for a straight maybe, but even if you get the flush, how sure are you that Mandy doesn't have Ac Qc? She very well might, and then as second-best hand you bet and lose a fortune. With suited cards both under 9 that aren't connected (next to each other, see below), I would strongly consider cutting my losses. You might stay in to see the flop to see if a bunch more of your suit come up, and then see how everyone else bets to see if THEY are going for your flush, TOO. But don't put in much on one of these hands, it ain't worth it.

High suited cards are a different story. If one of your suited cards is a face card, you're in business as you have a good shot at winning a flush-flush showdown. Bet enough to stay in, but no more until your 5th suited card falls. Then bet like there's no tomorrow, assuming it looks like there are no pairs on the board (a pair on the board could give someone a full house or 4 of a kind). Of course, that's not a very subtle bet, as once that third heart falls and you bet to the hilt, if I don't have at least a flush that I think can beat you, I will *sooo* fold. Of course, this leads to bluffing possibilities (to be discussed in the forthcoming Intermediate Strategy article for the fall field trip).-

Suited connectors are a hand that I personally like a lot. This is when your two suited cards are next to one another, like 8d 9d, or 10s Js, or even 5s 6s or so. The advantage to these is that not only do you have the flush draw, and the chance at a lucky and unusual flop, but you also have a good shot at a straight. While none of those are likely things to happen, if they DO happen, you are likely to make BANK on them, so under the right circumstances suited connectors can rock. However, since they are so low

probability, bet the minimum necessary to stay in until you see the flop. If the betting gets too heavy, fold. Especially on low suited connectors, don't push them too far. Try to get in cheap to see the flop, but if it doesn't go well cut your losses and get out.

Connectors themselves, like 89 offsuit, seem like they might be valuable. I (Barnes) never play them. Without your chance at the extra flush draw, these will bleed you dry seeing cards with too few out there that can help you. Clearly with connecting face cards (Section 4.1.2) its a different story, as the pair and kicker possibilities come into play.

#### 4.1.4. *Trash Hands*

Trash hands are hands such as 72o, T4o, A5o, 84s, 63s that are better left unplayed. These hands are classified as "dominated hands" (such as KX, where X is a low rank), "gap" hands where it's possible (but unrealistic) to make a straight (such as 59o), and seemingly random hands like 72o. Yes, any two cards have a chance at winning, but these hands are likely to get you in trouble more often than not. The key to becoming a successful hold'em poker player is recognizing these trash hands, and folding them.

## 4.2. **Post-flop**

The flop is the most critical phase of a hold'em hand. It is here where you have to make the decision whether or not to continue in the hand. Did you hit your face card giving you top pair? Bet hard, and make it expensive for speculative hands (those drawing for a flush or straight) to stay in the hand. Conversely, if you're in a drawing situation, see if you can get away with seeing the next card for as cheaply as possible. (NB: There are certain situations where it is advantageous to bet or raise with a drawing hand. For example, if you have 4 to a flush and hold an A or K. This also depends on the size of the pot and bet, and whether your opponents are likely to call or fold.)

If the flop gave you a whole lotta nothing, you're probably better off just checking/folding instead of trying to bluff and attempting to buy the pot. If you choose to bluff, I recommend that you insure that you have a fairly high number of "outs" (cards that will give you a winning and/or stronger hand) that you can at least hope for in case your bluff does not work.

## 5. **Future Work**

Coming Autumn 2004: sections on Position Relative to Dealer, Chip Position, Betting tactics such as slow-playing and the check-raise, Bluffing, Advanced Flop Strategies, Turn and River Play, Pot Odds and Implied Pot Odds, and Ideal Playing Styles.

Vegas Baby! – DC  
Develop your own strategies, and be unpredictable sometimes. Also, since Dave and I wrote this handout, you know how we play. Use that against us. I would. – JB