Poker Math That Matters

Simplifying the Secrets of No-Limit Hold'em

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By

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Acknowledgements

One of the most valuable things for a professional poker player to have is friends who understand the game. Being a professional poker player can make you feel like you’re on an island. Having those friends really helps you feel more connected. Outside of that benefit, these friends have not only enriched my life, but have also taken a lot of time to help me develop my poker game. I would not be the player I am today had it not been for their generous efforts.

I'd like to give special thanks to Steven Gallaher and Matt Hanes for patiently helping me learn the mathematics involved in analyzing poker situations. Without them, it's doubtful I ever would have understood the mathematical concepts I present in this book.

About Owen Gaines

I was always a bit fascinated with poker and had read a small book or two on it long before I ever got a chance to try playing. Then, one day in 2004, a friend told me I could play poker online. I decided to check it out. I knew very little about poker at that point, but I bought a lot of books on limit hold'em, joined a poker forum, and began to work very hard learning the game. I deposited $300, but I lost that rather quickly in the $.50/$1 limit hold'em games. I decided to give poker one more $300 attempt. That one stuck. I started to see the hard work pay off and built up a nice bankroll for the limit hold'em games. Since my hourly rate playing poker was double that of my entry-level, nine-to-five job, I felt playing poker professionally was the best option for me. So, I started playing poker professionally in the summer of 2005. From there, I played about a million hands of limit hold'em and experienced good results.

In early 2007, after a short break from the tables, I set aside $300 to mess around playing no-limit hold'em. I had never really been interested in no-limit, but I had heard good things and decided to check it out. Fortunately all of my limit experience helped me transition to no-limit very easily. I started playing a lot of no-limit and worked my way up the stakes. I also found I really enjoyed playing no-limit. In 5 months, I turned the $300 into $30,000 and have been playing no-limit hold'em as my main game ever since.

As of the summer of 2010, I've played about three million hands of poker and have been playing professionally for over five years, providing the sole income for a family of five. Online poker fits my family's lifestyle very well, and my family and friends have all adjusted to it.

I’ve always enjoyed teaching and have taught in several different fields. In early 2009, I started offering personal poker coaching and making poker-training videos for dragthebar.com. I’ve had a great time helping others develop their poker skills, and I hope players continue to improve from my efforts in this book.

About this Book

While I'm normally a quick learner with new material, understanding how to play good poker came to me a bit more slowly than I had hoped. Often times a concept would finally sink in and I would find myself wondering why I'd never seen someone explain it in a simpler manner. The mathematics of poker was certainly one of those topics. I got a hold of every book on poker math I could find, but none of them was helping me. Who cares about the odds to **flop** a straight flush or that 19,600 flops can come down? It seemed I was always left with a pile of numbers and no way to put the pieces together to really play great poker. I continued working on my own and probing for information; finally, the pieces started coming together. Understanding the mathematics of poker has made a dramatic difference in my poker game. This book is an attempt to help those who do not have a strong inclination to math or game theory but would really like to improve their poker skills. I designed this material in an attempt to not leave any reader behind. I started with the most basic concepts and worked up from there. When finished with this book, you will be able to think clearly about no-limit hold’em and analyze even some of the most complex decisions in the game. This will make you a force at the tables, and your wallet will thank you. Besides, as a friend of mine likes to say, winning is just *way* more fun!

Because poker is full of jargon, many times beginning players quickly get lost when reading a poker book. To avoid this, every time I introduce a term I consider poker jargon, I've put the font in bold so you know you'll be able to look up that term in the glossary at the back of the book.

Throughout this book, you will see hand notations for **hole cards**. When you see an "s" at the end of the hand (like 67s), this indicates the hand is suited. When you see an "o" at the end of the hand (like 67o), this indicates the hand is **offsuit**. If neither letter is present after the hand, this means it includes both suited and offsuit hands. I use a similar notation when describing the **community cards**. KTs2 would be a flop where the K and T are the same suit and the 2 is a different suit. When you see a "+" after a hand (like TT+), it indicates that hand and every other hand type that's stronger than it. So, TT+ indicates a pair of Ts, but also every pair higher than that (JJ, QQ, KK and AA). AT+ indicates AT but also every other non-pair A holding with a card higher than a T (AJ, AQ, AK). Also, I also like to use the term "Villain" to describe an opponent in a hand. So, of course, that makes us the "Hero".

I'm also a firm believer in testing your comprehension of the material presented in a given chapter. So, you'll find a quiz after every chapter. Take your time, and make sure you understand the material before moving on. If you'd like to practice a concept more, you can always grab a deck of cards and make your own scenarios. The better you grasp the concepts, the more thoroughly you'll be able to apply the concepts in real-time at the poker table.

Finally, you'll notice I'm rounding numbers and using estimates in most of the math I present in this book. This book is designed for practical use at the poker table. My goal is not precision three places to the right of the decimal.

Introduction

Why Math Matters

Poker is a seemingly simply game on the surface. But, as many people coming to learn the game have discovered, it's actually quite complex. However, every complex decision in poker can really be boiled down to two things, the two keys to good poker. So, without further ado, here are the two keys to good poker.

1. Accurate assumptions
2. Making the best decision

It's so simple, but it really defines the decision process for players. This concept is the foundation of anything I do with poker and will really help beginners and experts alike put the game in perspective, create goals and analyze poker situations.

Let's begin by defining these two keys. First, let's look at accurate assumptions. I find it easiest to break this into two sections. One is concerning our opponent's **range** of hands, and the other is how he will play that range. This key uses deductive reasoning to determine what hands are likely for the opponent to have. Players like to call this "**hand-reading**". This key also uses deductive reasoning to predict what decisions (like betting, calling or folding) the opponent will make with those hands.

The second key is making the best decision. We'll simply say this key involves making the decision that makes the most money. After we've determined our assumptions in the first key, the second key comes along with mathematics to show us what play makes us the most money on average. And, of course, that's the focus of this book. We use mathematics to decide what play is best.

Let’s talk a bit about how to develop these skills. Take a few seconds to examine Figure 1.

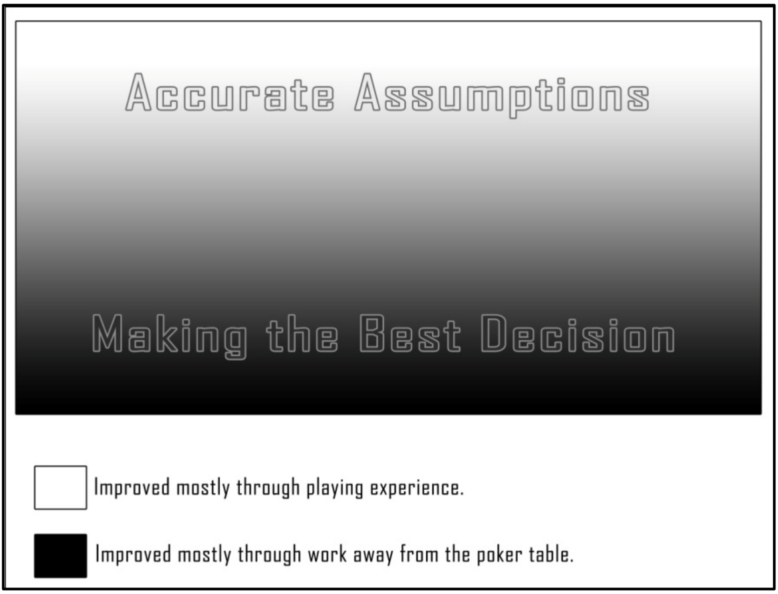

Figure 1. How the two keys to good poker are improved.

Notice I’ve shown that developing accurate assumptions is mostly improved through playing experience while making the best decision is mostly improved through away from the table work. I’m going to submit to you that making the best decision is the most important part to develop, especially for a beginner. Let’s take a look at a hand example to see this at work.

Hero's hole cards - 6♦7♦

Villain's hole cards - Unknown

Flop - 4♠5♦A♦

Looking at this flop, we can see our hand has a lot of ways to make a very strong hand. Any diamond will give us a **flush**. Also, a 3 or an 8 will give us the best **straight** possible. That's a lot of cards that can give us a very powerful hand. Now, let's pretend the pot is $75, and we have $1,000 left in our **stacks**. Villain makes a $60 bet.

Now, let's go through the two keys to good poker and fill in the blanks. First of all, what are our assumptions about his hand range, i.e. what hands do we believe he can have? Just as we get started answering that, he flips his hand over for some reason and shows us A♠K♠. Well, no need for assumptions now. We *know* his hand. The next part is our assumptions about his strategy, i.e. how he plays that hand. Just as we start to think about that, he truthfully declares to us that he'll not fold to any size raise we make. He's ready to get **all-in** with the hand. Again, we have no need for assumptions. We *know* his strategy. So, the first key to good poker is covered. Now let's change the rules to this game just a bit and say we can either fold or **push**. We have no other option. Which is the best decision of the two? Now, you may answer fold or push, but you need to understand why. Now let's change his hand and make it K♦Q♦. We'll use the same strategy and rules as before. Now are you going to fold or push? Why? Are you certain?

Notice that even though the first key to good poker is completely answered, we still are not ready to play good poker because we do not know how to make the best decision. And in real poker, all the hand-reading in the world will do you no good if you do not know what to do with the information you gain. So, making the best decision is the most important key to focus on at first. And notice it's the key that's most improved through time spent away from the tables. This means most of your time as a beginner should be spent away from the tables. Many beginners want to just play, play, and play. And while experience is important, you can now see how important it is to dedicate valuable time away from the tables working on your poker skills. The work you'll be doing away from the poker table will involve math.

Some would say that math isn't important in poker. They like to call themselves "feel players". They just feel out the situation and make the decision they think is best. However, do not be fooled. The good players saying this are actually *feeling* the math in the game. There isn't a good poker player who doesn't understand the numbers we're going to go over in this book.

Do not get worried; math scares me as much as it scares you. Math has never been a strong subject for me. I worked really hard over a long period of time to understand the math in poker, but the reward has been great. I've simplified everything I've learned and designed easy shortcuts for you. After you've mastered the material in this book, you'll be able to make the best decision quickly at the poker table and rake in the chips.

Quiz

(Answers on pg. 153)

1. What are the two keys to good poker?

2. Into what two sections can we break up accurate assumptions?

3. Which of the two keys to good poker is developed mostly through playing experience?

4. On which of the two keys to good poker should beginners spend a lot of time?

5. How can we use mathematics in poker?

Measurements

Your Surroundings

There are many things to consider in just a single decision during a NLHE (no-limit hold'em) cash game. Let's begin by getting familiar with these different variables. First let's talk about how most of the variables in the game are quantified.

Most of the measurements in NLHE are based on the size of the big blind (bb). Let's say we've come to a game where the blinds are $0.50/$1. The majority of the measurements in the game will be based on $1 increments since that's the size of the big blind. The term **"buy-in"** is used to define how much money a person brings to the table. In online games, normally the minimum a person can bring to the table is 20 times the size of the big blind, and the maximum buy-in is normally 100 times the size of the big blind. Since the big blind is $1, 20 times the bb would be $20, and 100 times the bb would be $100. Even though poker sites vary on the amount you can bring to the table, 100 times the bb is the standard meaning when someone talks about a buy-in. For this reason, a $0.50/$1 NLHE game is often referred to as a NL100 game.   The amount of chips a person has in front of them while playing is commonly called their stack. When someone talks about a player's stack size, they're talking about how much money they have at the table. Table 1 shows a common breakdown of stack sizes.

Table 1. Common descriptions of stack sizes.

Times the big blind	Description
1 – 40	Short Stack
41 – 80	Medium Stack
81 – 100	Deep Stack

While the table shows 100 times the big blind as a deep stack, some people still consider that to be a medium stack and do not consider stacks to be deep until players are around 150 times the big blind or more.

A player's stack size can drastically impact their strategy. Many players feel the biggest stack in the game is going to push people around. However, this idea is mostly for tournaments and has little to do with cash games. The smallest stack in a hand is called the **effective stack** for the hand. For example, let's say player A has a $50 stack, and player B has a $400 stack. If these two players got involved in a hand, we would say the effective stack size for the hand is $50. Player A only has $50 so that's the maximum amount that can be wagered in the hand. Since stack sizes are so important in a hand, when you're asking someone about a hand, always make sure you include the effective stack size of the hand. For example, if player A and B got involved in a hand, I would start discussing the hand with someone like this.

"I'm in a NL100 game. The effective stack size is $50."

One last thing I'll mention about stack sizes is the best player at the table generally wants to have more money than everyone else. The better player wants to **cover** worse players so that if he does get a good hand, he can get the bad player's entire stack.

Another measurement to understand is concerning **upswings** and **downswings**. When a player wins or loses a lot of money in a given period of time, these wins or losses are often referred to as swings. An upswing is winning a lot, and a downswing is losing a lot. These swings are often measured in buy-ins. So, if a NL100 player won $500 in a **session**, he would say he had a 5 buy-in upswing since $100 is the standard buy-in there. Similarly, if he lost $500 in a session, he would say he had a 5 buy-in downswing. The swings in poker can be extreme. Having a 7-10 buy-in downswing for a professional player can be very commonplace. Many professionals experience 20 buy-in downswings with some regularity. Some professionals have even reported having 40 buy-in downswings. This leads us to another measurement, **bankrolls**.

Players have bankrolls to reduce their chance of losing all the money they have set-aside to play the game. A bankroll is also measured in buy-ins. Let's say you decided you wanted to have a 30 buy-in bankroll. You wanted to play in a NL100 game. How much money would you need? A buy-in in a NL100 game is $100. So, 30 buy-ins would be $3,000.

It's common for beginners to overestimate the number of times they're going to end a session having won money. Over the millions of hands I've played, I've won money in a little more than half of my sessions. Of course, this means I've lost money in about half of my sessions. A common mistake beginners make is to deposit $300 and then sit down to a NL100 game. This player is only armed with three buy-ins, and even a good player can drop three buy-ins very quickly in this game.

A frequent question from beginners is "What is the right size bankroll?" Or in other words, they would like to know how many buy-ins they should have for the game they're playing. Well, first things first. A bankroll is for a winning player. A losing player does not need a bankroll; he needs a budget. As a beginner, there's a good chance you will not be a winning player for a while. So, make sure you're playing at a game size where losing many buy-ins is not going to have a large negative impact on your finances or your emotions. As a general guideline, I like to see an amateur have at least 30 buy-ins for their game. If someone is planning to go pro, I would like to see them have at least 100 buy-ins and 6-12 months of living expenses saved on top of that. For those who have put a certain amount of money into a game and do not want to add more, it's important to understand this concept. If you lose a certain portion of that money, you need to move down in stakes. So, if that NL100 player wanted to keep 30 buy-ins for his game, he may start with \$3,000. However, if he loses \$1,000, now he only has \$2,000 left, which is only 20 buy-ins for the NL100 game. If he has decided on 30 buy-ins, he now needs to move down to NL50 until he can rebuild his bankroll for the NL100 game. Moving down is very common for players, but it takes a good deal of discipline to do. Bankroll management is a very important skill. I've often told professional players "If you don't stress your bankroll, it will stress you!"

The final measurement we're going to discuss is **win rates**. A win rate is the measure of a player's results in the game. It lets a player know at what pace they're either winning or losing money. A win rate is measured in a specific number of big blinds per every 100 hands (bb/100). So, if a NL100 player won \$1 in 100 hands, he would have a win rate of 1 bb/100. Win rates get a lot of attention by players because we're extremely interested in our results in terms of money won or lost. However, it's important to understand there are many factors that can dramatically impact a win rate over many, many hands. I've played 100,000-hand sections with dramatically different win rates even though I was playing the same stakes during both those sections. For a beginning player, it's simply best not to focus a lot of attention on your win rate and rather focus your energy and attention on learning the game.

I also want to make you familiar with two different terms of measurement for win rates so you're not confused if you look at some poker sites or forums. I always refer to NLHE win rates in terms of big blinds, using lowercase "b"s. However, some players talk about a win rate in terms of big bets (BB) with two uppercase "B"s.[1] These both measure a win rate, but simply use a different tool to measure. It's like deciding whether to use inches or centimeters when measuring something. Without getting into the history of these different measurements, simply understand that a big bet is twice the size of a big blind. So, 1 BB/100 is equal to 2 bb/100. Some have categorized win rates as shown in Table 2.

Table 2. Common descriptions for win rates.

bb/100	Description
0 – 4	Marginal winner
4 – 7	Nice win rate
7+	Crushing the game

However, as I said, win rates can vary based on many different criteria. I've played in games where I would be extremely proud to have a long-term win rate of 1 bb/100. I've played in other games where I'd be very disappointed not to have a long-term win rate of 8 bb/100. Again, the important thing for beginners is not to focus on the money but rather their thought process.

[1] This is especially common in limit hold'em.

Quiz

(Answers on pg. 154)

1. What is an 80 times stack in a NL25 game?

2. If you wanted to have a 40 buy-in bankroll for the NL50 game, how much money would you need?

3. If a NL25 player went on a 15 buy-in downswing, how much money did he lose?

Thinking About Bets in No-Limit Hold'em

I remember when I first sat down to a NLHE game. I had only played limit hold'em up to that point, so it was very strange to be able to bet any amount I wanted. It was also a bit intimidating. I had no idea what bet sizes were good or why they would be better than any other size. Later in this book, you'll learn the purposes behind sizing your bets well, but for now let's simply talk about how you should *think* about bet sizes in NLHE.

A friend was telling me about a hand he played at a casino. He had bluffed the river with 6 high, and his opponent had called his bet with A high. "He called $80 with A high!" he exclaimed. I had no idea whether I should be surprised or not. Good NLHE players do not think about bets in terms of amounts of money. The proper way to think about bet sizes is in their relation to the size of the current pot before the bet was made. For example, in my friend's story, if the pot were $1,000 before he bluffed, $80 could be considered a very small bet. However, if the pot were only $5 before he bluffed, $80 could be considered a gigantic bet. So, bets are spoken of in terms of their relation to the pot. Table 3 shows the terminology for a bet made into a $100 pot.

Table 3. Terminology for a bet into a $100 pot.

Monetary Bet Size	Understood As
$25	1/4 Pot Bet
$33	1/3 Pot Bet
$50	1/2 Pot Bet
$66	2/3 Pot Bet
$75	3/4 Pot Bet
$100	Pot Bet
$200	2x Pot Bet

Later in this book, you'll understand why this is important. For now, it's just important to get used to the terminology and understand that just because a bet seems like a lot of money to you, doesn't mean it's a large bet.

The second thing I'd like to show you about sizing bets in NLHE is how to make both a **min-raise** and a **pot-size raise**. Some internet poker sites have buttons you can press that will size your bets to these amounts; however, it's important you know how to do this yourself. For example, let's say your opponent bets $50. The minimum amount you're allowed to raise in a NLHE game is double the size of your opponent's bet. So, you could not raise to $80.[2] The minimum raise allowed is double the size of his bet, which would be $100. If you have $100 left and you wish to raise, you must put in at least $100.

Now let's discuss the pot-size raise. We'll say the pot is $100, and your opponent bets $50. A common misconception is that a pot-size raise would be $300 (double the $150 in the pot right now). However, this is not correct. Making a pot-size bet can be done in two easy steps.

1. Take the amount you must call and double it.
2. Add the results from number one to the size of the pot (*including* your opponent's bet).

So, let's do these two steps with our example.

1. Our opponent's bet was $50. We double that and get $100.
2. The pot including our opponent's bet is $150. We add the results from number one ($100) to $150, and our pot-size raise would be $250.

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[2] The only exception would be if you only had $80 remaining in your stack.

Here's why this works. If we were to call the $50 bet, the pot would total $200. To then match the pot, we would bet $200. That's our total of $250. I just find it easier to use the two-step process I outlined above. We'll discuss the purpose of a pot-size raise including other bet sizes later in this book. For now, I'd just like you just to be familiar with your surroundings and options at the table.

Quiz

(Answers on pg. 154)

1. Is a $100 bet large or small?

2. How would a player refer to a $50 bet into a $100 pot?

3. If you wanted to make a 2/3 bet into a $12 pot, what would the amount be?

4. If the pot is $80, and your opponent bets $50, how much money would you put in to make a pot-size raise?

5. If the pot is $12, and your opponent bets $10, how much money would you put in to make a pot-size raise?

Your Expectations

When I was a 12-year old boy, I went fishing with my grandfather. After fishing a couple hours, I pulled in a really big Northern Pike. Well, the fish wasn't the only thing hooked that day. I was immediately hooked as well. I wanted to fish all day every day after that. It was such a great feeling to pull in that monster!

Poker stories often start the same way. Many times a beginning NLHE player will sit down at a table and just go on a tear, and that's it. They're officially a poker player and want to play all day every day. Sometimes they'll even pull out a calculator and get started figuring out all the money they're going to make. They'll never have to work again! Many beginning players have come to me and told me their expectations about the money they're going to make and how easy it's going to be. Recently a guy came to me and told me about a session of playing a \$0.05/\$0.10 game where he made \$100. He said if he could just make that amount even in a week, he'd be happy. So, he's planning on playing the game a bit more often to get a hold of that \$100 a week. Well, let's take a peek at his expectations and see how realistic that is. What information do we need to figure out how much money he'll make in a NL10 game in a week? Here's what we need.

1. The number of hands he plays in an hour.
2. The number of hours he plays in a week.
3. The size of the big blind in the game he plays.
4. His estimated win rate.

Let's go over each of these briefly. We'll start with the number of hands played in an hour. This number can vary depending on the type of game a player is playing, where he's playing and the number of tables he's playing. For example, if someone is playing at a **6-max** table, he'll play more hands in an hour than if he's playing at a **full-ring** table where there are normally 9-10 players. Also, playing online, you'll see many more hands in an hour than playing at a live table. At an online, full-ring table you may play about 75 hands an hour. At a 6-max, online game you will play about 100 hands an hour. Now, online you also have the luxury of playing more than one table at a time. So, if you played 4 online 6-max tables simultaneously, you may get about 400 hands in an hour. This may seem hard to believe, but with practice a person can get quite good at this. After years of playing multiple tables, it's now very easy for me to play over 1,000 hands in an hour online.

The number of hours a week is self-explanatory. However, I will add here that many professional poker players consider 30 hours a week to be a very full schedule.

You should already be familiar with what a win rate is from the "Your Surroundings" section of this book.

Let's get back to our friend hoping to make an extra $100 a week playing NL10. We'll put all these variables together to get some grounded expectations. Here are the steps to figure this out.

1. Hands per hour * hours played = total hands
2. Totals hands / 100 = 100-hand sections
3. Size of the big blind * bb/100 = money won per 100-hand sections
4. 100-hand sections * money won per 100-hand sections = money won

Let's say my friend plays four tables of 6-max $0.05/$0.10 NLHE online. He would average about 400 hands an hour. He plays for 30 hours a week, and estimates his win rate at 7 bb/100. Let's plug in the numbers.

1. 400 * 30 = 12,000
2. 12,000 / 100 = 120
3. $0.10 * 7 = $0.70
4. 120 * $0.70 = $84

As you can see, his expectation of $100 a week from NL10 is a bit ambitious. Not only that, he's averaging $2.80 an hour. He may be much better off flipping burgers in terms of dollars per hour.

Eventually it's good to think in terms of an hourly earn. If the previous equation we had gives you $10 an hour, then this is how you should think about an hour spent at the table. A good example of how this helps is playing micro-stakes. As I said before, most beginning players want to play a lot. However, they may be spending all that time with an expectation of $1 an hour. Is that how you really want to spend your time? So, for those coming to this game for money, which is probably most people reading this book, you need to view the micro-stakes game as a stepping-stone. Micro-stakes should be used as a way for you to learn the game. Focus on learning the game there and not playing 15 tables for 10 hours a day. Another important reason to think about the game in terms of an hourly earn is when you're down a lot in a session. Let's say you've just started playing, and you're down five buy-ins in one hour. Many times a player will say "I'm going to keep playing for another hour to try to get my money back." This is bad thinking. If you decided to play for another hour, you should value that next hour in terms of your hourly earn. However, it will probably be worse than that because we just tend to play worse when things aren't going well. So, my biggest recommendation is simply not to worry about the money when you get started. Focus on learning the game and properly applying the concepts you learn. It's really best just to concede that you're probably going to lose money for a while and not even be concerned about it. Play at a level where you do not have to worry about losing buy-ins. The nice thing about this game is you get to decide how much you're going to pay for your education. A beginner who decides to start at NL200 is going to pay more for his education than if he decided to learn at NL25. When you first come to the game, putting money on the back burner is really hard to do. After all, that's why you've come. But it will be the best thing you can do to reach your goal. Also, realize that not losing money is quite an accomplishment in this game. This is because of the **rake** in poker. The rake is how casinos make their money having poker tables. The casino takes a certain percentage out of a pot. Many online casinos rake 5% of the pot. The rake is a larger percentage of your hourly earn at micro-stakes than it is at larger stakes. The rake often accounts for a 10 bb/100 win rate at micro-stakes games. So, if you've broken even over 10,000 hands of micro-stakes play, you've actually beat the game at around 10 bb/100. Congratulations!

There's a healthy mix of luck and skill in poker that doesn't allow the better player to win all the time. This is a good thing for poker. However, it does present some problems for beginning players. Beginning players often rely on their financial results to determine if they're playing well or not. However, they may be playing well and still be losing badly. Or, they may be playing very poorly and still be winning at a very good rate. The results in poker can be very deceptive. Sometimes one of the worst things for a beginning player is to win a lot of money when they first get started playing the game. Now their expectations are far from reality, and they may become close-minded to studying the game and learning. They have it all figured out! It's just a matter of time before reality will come knocking. Your thought process is the true way to measure your skills and progress. As you improve your thought process, your financial results will take care of themselves over time.

Quiz

(Answers on pg. 155)

1. How much would a player make if he played NL10 for 5,000 hands at 12 bb/100?

2. If you played 10,000 hands but **tilted** off 1 buy-in, by how many bb/100 would that impact your win rate over that number of hands?

3. How should most players view the micro-stakes?

4. How can you determine how much you pay for your poker education?

5. Why can it be a bad thing when a new player makes a lot of money right away?

Getting Started with Numbers

Working with Fractions, Percentages and Ratios

Let's get started by introducing some gambling terms. The first term to introduce is probability. Probability is used to describe the number of times a thing will happen out of the total chances for it to happen. This is written as a fraction.

$$\frac{1}{7}$$

This fraction is read aloud "1 out of 7". The total number of possible outcomes is on the bottom (7), and the target outcome is on the top (1).

Let's look at an example. You are standing in front of four doors. Behind one of these doors is a new car. What is the probability that you pick the door with the car behind it? Let's start with the bottom number of the fraction. Again, this is the number of total outcomes. You have four total outcomes. You could pick any one of the four doors. So, the number four goes on the bottom. The top number is the number of target outcomes. There is only one door with a car behind it, so you only have one target outcome. The number one goes on the top. The probability of you picking the car is one out of four ($\frac{1}{4}$).

How about rolling a die? What is the probability of rolling a 5? Let's start with the bottom number again. There are six total outcomes for our roll. There is only one 5 on the die, so the top number is a one. The probability of us rolling a 5 is $\frac{1}{6}$.

Now let's see at how to express probability as a percentage. A percentage is stating the same thing as a fraction. The key to understanding what a percentage is all about is to understand the origin and meaning of this word. English has this word from the Latin phrase "per centum" which means "by the hundred". So, 100 is the key. When we use a percentage, we're talking about a fraction where the bottom number is always 100. When you say 25%, it means 25 per 100, which is the fraction $\frac{25}{100}$. So, 50% is the same as saying 50 out of 100.

Let's look at how to convert a fraction to a percentage. We'll use the fraction $\frac{1}{4}$. The line between the two numbers represents division. So, this is one divided by four. When we take a calculator and do one divided by four, our calculator reads 0.25. This is a decimal. In order to convert a decimal to a percentage, we move the decimal point two numbers to the right. So, 0.25 is 25%. All these numbers represent the same thing.

$\frac{1}{4}$ = 0.25 = 25%

They all represent the same part of a whole.

Let's do one more for good measure. This time let's use the die example again. The probability of rolling a five is $\frac{1}{6}$. Let's convert this to percentage.

1 / 6 = 0.166

We move the decimal point two places to the right and we have 16.6%.

The last topic to cover in this section is odds. When players talks about the odds against something, it's described as a ratio. A ratio describes something differently than a fraction. The ratio compares two numbers. A ratio looks like this.

5:1

It has two numbers with a colon between them. The first number tells us how often something *does not* happen. The second number tells us how often something *does* happen. This ratio is read aloud "five to one".

Let's get back to those doors again. There are four doors, and one has a car behind it. What are the odds against you picking the car? Again, the first number describes how many times something did not happen. Three of those doors you could pick would not have the car behind them. Three is the first number in the ratio. The second number describes how many times something did happen. One door you could pick would have the car behind it. The second number is a one. The odds of you picking the car from these four doors are 3:1 against.

Let's practice with the die again. What are the odds against you rolling a 5? How many outcomes are there which are *not* a 5? They are 1, 2, 3, 4 and 6. That's a total of total of five outcomes. So, the first number is a five. There is only one outcome that is a 5. So, the second number is a one. The odds against you rolling a 5 on the die are 5:1.

Let's see how the fraction and ratio relate to one another. When the odds against something to happen are m:n, the probability of it happening is $\frac{n}{m+n}$.

$$m{:}n = \frac{n}{m+n}$$

Let's look at the probability and odds against rolling the 5. The probability is $\frac{1}{6}$, and the odds against are 5:1. Notice if you add together the two numbers in the ratio you get the bottom number of the probability fraction. This is because the number of times something doesn't happen plus the number of times something does happen equals all the times possible. And the bottom number of the probability fraction represents to the total possible outcomes. Now, the right number of the ratio is the number of times it did happen. This is the same number represented by the top of our probability fraction. So, we can then see how to convert a ratio to a fraction.

Let's take the ratio 6:1. What would the corresponding fraction be? We know this ratio is telling us something doesn't happen six times and does happen one time. This means there are seven total chances. So, that's the bottom number of the probability fraction. The right number of the ratio lets us know this thing happens one time, which is what we're after on the top of our fraction. So, saying 6:1 is the same as saying $\frac{1}{7}$. Let's just take this one step further and convert a fraction to a ratio.

Let's take the fraction $\frac{1}{3}$. What is the corresponding ratio? Let's do the easy part first and put the one on the right side of the ratio (?:1). This tells us the thing will happen one time. Now, if something *will* happen one time out of three, how many times will it *not* happen? Here we take the three total chances and subtract the one time is happened and we see that it *did not* happen two times. So, two is the number of the left side of our ratio. The probability $\frac{1}{3}$ can be said as 2:1 against.

Let's do one more of these. Let's take the fraction $\frac{2}{5}$. Again, the easy part first and put the two times it does happen on the right of our ratio (?:2). Then we need to find out how many times it doesn't happen to complete our ratio. The total chances are five, and it does happen two. So, we subtract two from five, and we get three. There are three times this doesn't happen. So, the ratio is 3:2. We could even add the percentage in here.

2 / 5 = 0.40 = 40%

$\frac{2}{5}$ = 3:2 = 0.4 = 40%

They all represent the same part of a whole.

In 1968, The Doors released an album called *Waiting for the Sun*. On it, there was a song called "Five to One". Here are a couple lines from the song. "Five to one, baby, one in five. No one here gets out alive". Do you see the mistake in the lyrics? 5:1 is not the same as $\frac{1}{5}$. The ratio 5:1 is equal to one out of six. But, this material is much more useful than correcting the lyrics to classic rock tunes. This is the foundation to understanding profitable gambling.

Quiz

(Answers on pg. 157)

1. Convert $\frac{1}{4}$ to a ratio.

2. Convert $\frac{1}{8}$ to a percentage.

3. Convert 5:1 to a fraction.

4. Convert 2:1 to a percentage.

5. Convert 9:2 to a fraction.

6. What are the odds against rolling a 1 or a 2 when rolling one die?

7. What is the probability of rolling two 4s when rolling two dice?

Expectation Value

You’re walking down the street, and a stranger approaches you. He would like to make a bet with you. He will flip a fair coin. If it lands on heads, you owe him $10. If it lands on tails, he owes you $15. Does this sound like a bet you’d like to take? If you accept, how much would you expect to make on average? These are important questions. So, let’s get started gathering the information we need to get the answers.

We’re going to use the math we learned in the previous section to really get to the core of profitable gambling and the secret to raking in the chips in poker. Let’s start this with a little review from the previous section by examining probability and odds with our coin situation. Remember, we want the coin to land on tails because he then owes us $15.

What is the probability of the coin landing on tails? Remember the bottom number is the total possible outcomes. The coin has heads and tails, so there are only two outcomes. The bottom number is two. The outcome we’re after is tails and there’s only one of those, so the top number is one. The probability of the coin landing on tails is one out of two. What percentage of time will this happen? Let’s convert $\frac{1}{2}$ to a percentage by dividing one by two, and we get 0.50. We convert that to a decimal, and we get 50%.

What are the odds against the coin landing on tails? It does happen one time, and it does not happen one time. The odds against the coin landing on tails are 1:1.

So, we have all this work done. However, this is just the start for us to decide if we want to accept this bet and how much we would make on average.

Now I'd like to introduce a term that is the bedrock of profitable gambling: **expectation value**. This is commonly called EV for short. Expectation value is the *average amount* of money you can expect to win or lose when you make a wager. If the average amount is less than zero, then you're going to lose money on average. This is called a negative EV bet (-EV). If the average amount is more than zero, then you're going to make money on average. This is called a plus EV bet (+EV). A wager right at zero is called neutral EV. The goal of profitable gambling is to be involved in +EV bets as much as possible and to avoid –EV bets. Your next question should be "How do I know if the bet is +EV or –EV?" Here's how. There are three steps.

1. Identify each possible outcome and the probability of it happening.
2. Multiply the probability of each outcome by the result it has.
3. Add together all the results from step two.

Let's get back to our coin story and go through these three steps to find the EV of this wager.

1. The coin only has two possible outcomes, heads and tails. They both will happen 50% of the time. It's easiest for me to use the decimal for the probability, which is 0.5 in this case. Notice the percentages added together equal 100%. This is very important because there are no other possible outcomes (assuming it never lands on its edge). So, step one is complete, and we're on to step two.

2. If the coin lands on heads, we will lose $10. We then multiply this result by the probability of it happening.

0.5 * (-$10) = (-$5)

Now let's do the tails. When the coin lands on tails, we will win $15. This happens 50% as the time as well.

0.5 * $15 = $7.5

Step two is done, and we're on to step three.

3. Here we add together the results from step two.

   (-$5) + $7.5 = $2.5

   Our expected value for accepting this bet is $2.50.

Notice that if we just flip the coin one time, we will never have $2.50. The EV tells us how what we can expect to win *on average* if we accept this bet. Since the EV is more than zero, this bet is called a +EV bet. Being involved in +EV bets is smart gambling. You want to be able to make +EV bets in poker and then mass produce them. Imagine you could flip this coin with this wager five times a minute. That would be $12.50 a minute. If you could flip it for an hour, that would be $750 an hour. Mass-producing +EV bets is pretty powerful stuff. Just looking at the chandeliers when you walk through a casino door will tell you that. Let's look at one more example.

A friend gives you a die and offers to pay you $3 any time you roll a 2. However, if do not roll a 2, you will owe him $1. Let's check the EV of this wager.

1. We have one outcome for each number on the die. Each number has a probability of $\frac{1}{6}$ or 0.166 each.

2. Rolling a 2 has an outcome of winning $3. Rolling a 1, 3, 4, 5 or 6 all have an outcome of losing $1.

   Rolling a 1: 0.166 * (-$1) = (-$0.166)
   Rolling a 2: 0.166 * $3 = $0.498
   Rolling a 3: 0.166 * (-$1) = (-$0.166)
   Rolling a 4: 0.166 * (-$1) = (-$0.166)
   Rolling a 5: 0.166 * (-$1) = (-$0.166)
   Rolling a 6: 0.166 * (-$1) = (-$0.166)

3. Let's add together the results from step two.

   (-$0.166)+ $0.498 + (-$0.166) + (-$0.166) + (-$0.166) + (-$0.166) = (-$0.332)

We come up with about negative 33 cents a roll. The EV is below zero, so it's a -EV bet. These are not the types of bets we want to take. We can also see the power of mass-producing -EV bets. If we could roll this five times a minute, we would lose $1.65 every minute. Rolling at this pace for an hour would give us a rate of losing $99 an hour. This doesn't sound like the type of bet I want to take!

Making money in poker is all about being involved in +EV plays as often as possible and avoiding -EV plays as often as possible.

Quiz

(Answers on pg. 158)

1. Someone has the four As face down on a table. You have one chance to try to pick the A♠. If you pick it correctly, they'll pay you $3. If you do not, you pay $1. What is the EV of this wager?

2. There are three cups upside down on a table. Underneath one is a green ball. Underneath another is a red ball. Underneath another is an orange ball. If you pick green, you win $5. Pick red, you lose $2. Pick orange, you lose $1. What is the EV of picking one cup?

3. Someone holds out a deck of cards. If you pick out a K, they'll give you $10. If you do not, you owe them $1. What is the EV of this wager?

4. Someone holds out a deck of cards. If you pick out a spade, they will give you $4. However, if you pick out the A♠, they'll give you $20. It will cost you $1 to draw. What is the EV of this wager?

5. Someone gives you two dice. They offer to pay you $37 if you roll two 6s. However, it will cost you $1 a roll. What is the EV of this wager?

Hit the Deck

Counting Outs

We've now laid the foundation to begin understanding how to make good decisions when having the opportunity to make a wager. Now it's time to begin applying this math to poker.

When watching poker on TV, you'll often see a percentage next to the players' cards. The percentage is letting the viewers know how often each player is going to win the hand by the river. I've often heard new players say "If I could only know those percentages, I could do alright." Well, there's a lot more to playing good poker than knowing what those percentages are; however, it is a critical skill to be able to estimate that percentage fairly accurately. The start of this process is by being able to count **outs**.

What is an out? An out is a card that can come on a future **street**(s) that can give you the best hand. So, thinking about outs only applies when you do not have the best hand and there are more cards to be dealt. Let's say you are playing a hand, and you're on the turn.

Hero: Q♠T♥

Villain: K♦7♣

Board: 6♠9♦2♣K♥

You're the hero, and your opponent is the villain. It just makes sense, we're the good guys, and they're the bad guys, right? The villain has a pair of Ks, and you only have Q high. So you definitely do not have the best hand. However, there is one card left to come on the river. What cards will give you the best hand? Neither a Q nor a T will help you because neither pair will beat his pair of Ks. However, if a J falls on the river, that will give you a straight for the best hand. So, a J is an out for you. How many Js are left in the deck? There are four of them. So, you have four outs in this hand. Being able to count or estimate your outs is a critical skill in poker. Let's count our outs in this hand.

Hero: 5♠6♠

Villain: A♦K♦

Board: A♠7♠Q♦2♥

How many outs do we have? Neither a 5 nor a 6 on the river will give you a winning hand, and there's no way to get a straight. However, if another spade comes, you will have a flush. There are 13 spades in a deck, and we see 4 on the board. This leaves nine other spades in the deck. You have nine outs.

This is pretty simple, but there are several aspects of outs that people miss. There are **backdoor outs**, **hidden outs** and **chopping outs**.

Let's talk a bit about backdoor outs. Backdoor outs apply on the flop only. They add a little extra value to your hand. But, they require a combination of turn and river cards that both help your hand. A classic example is called a backdoor flush draw. Let's look at this example.

Hero: 4♠5♠

Villain: A♣K♦

Board: K♥9♦4♣

You end up getting all-in on the flop. If we look at your outs here, you need to get either a 4 or 5 on the turn or river to make two pair and beat his pair of Ks. There are three 5s left, and two 4s left. This gives you five outs. If you were playing on TV, they would put 18% next to your hand. Your opponent would have the remaining 82%. I'll show you how to get these percentages in the next section; however, for now, I just want to show you the impact of a backdoor flush draw. Now, instead of the board being K94 with the 9♦, let's change it to K94 with the 9♠. This is the same suit as our two cards.

Hero: 4♠5♠

Villain: A♣K♦

Board: K♥9♠4♣

Now, if the turn and river are both spades, you would have a flush. This is a chance for improvement you didn't have when there was no spade on the flop. If this were on TV, you would have 22% and your opponent would have 78%. This is about a 4% increase for you.

Another backdoor draw is a backdoor straight draw. Let's look at this example.

Hero: 6♠7♠

Villain: A♣K♦

Board: K♥2♦6♣

Again, if you were to get all-in here, you need a 6 or 7 either on the turn or river. This is a total of five outs, and you again would have 18% next to your hand, and your opponent would have 82%. However, let's change the board (changing the 2♦ to a 5♦).

Hero: 6♠7♠

Villain: A♣K♦

Board: K♥5♦6♣

Now you have the chance for the turn and river to come an 8 and 9, a 4 and 8, or a 3 and 4. Any of those three combinations of turn and river cards would give you a straight. This is a chance for improvement you didn’t have before. Now your hand would have a 23% chance to win, and your opponent would have the remaining 77%. This is about a 5% improvement from the previous board.

Some backdoor straight draws are stronger than others. For example, if the board were K♥4♦6♣, you would still have a backdoor straight draw. However, your percentage would go down to 21%. This is because we lost a straight chance. When the board contained a 5, you had three chances for the straight. Now with the board having a 4 instead of a 5, you only have two chances for the straight. The turn and river need to come down either a 5 and 8 or a 3 and 8. So, this hurts your winning percentage a bit. The same is true if the board were K♥3♦6♣. You have the chance for a backdoor straight, but the board must come specifically a 4 and 5, giving you only one chance for a straight. With that, your percentage would be 20%. But, these specifics aren’t nearly as important as recognizing a backdoor draw and realizing on average it adds about 4%.

Having multiple backdoor draws can add quite a bit of value to a hand. Let's look at this example.

Hero: 6♠7♠

Villain: A♣K♦

Board: K♥5♠6♣

Now you have both the backdoor flush draw and the backdoor straight draw. Now your percentage would change to 26%. This is about an 8% increase from when you have no backdoor draws. This is a significant increase and can really impact how you play a hand. Now, in terms of counting outs, if you're going to see both the turn and river, you can add an extra out for a backdoor draw. So again, looking at your board here, you have the five outs for the 4s and 5s in the deck, but you also have the backdoor flush draw and backdoor straight draw. Since you're all-in and will be seeing both the turn and the river, you can add one out for each backdoor draw. So, we can say you have seven outs in this hand. This is easy enough, but sometimes things are not so obvious. Sometimes the outs get a little sneaky.

Let's talk about those hidden outs. Sometimes we have more outs than we first think. Future cards can often take our opponent's cards out of play and vice versa.

Hero: A♠Q♣

Villain: 3♣3♦

Board: T♥T♦8♠5♣

Of course, your opponent has a pair of 3s, and you only have A high. How many outs do you have? Many times people only think about an A or Q to give them a pair. There are three As left, and three Qs left. That would be six outs. However, your hand is much stronger than that verses 33. If the river came an 8, you now would win the hand. Your best five cards would be

TT88A. Your opponent's best hand would be the board, TT885. You win because you have the highest kicker with the two pair on the board. So, an 8 is an out for you. There are three of those. But wait! That's not all. A 5 on the river gives the same result. So, you have three more outs. This is a total of 12 outs with your AQ. Let's do one more example.

Hero: K♠K♥

Villain: 5♣5♦

Board: J♥J♦5♠

Your opponent has a **set** of 5s. How many outs do you have? Well, you have the two Ks, which would give you Ks full of Js beating your opponent's 5s full of Js. However, you also have two Js as outs. A J would give you Js full of Ks beating your opponent's Js full of 5s. So, you have a total of four outs. Keep an eye out for the possibility of having more outs than is obvious.

Let's introduce chopping outs. Sometimes at the end of a hand, players will have the same hand. This is a tie and the players split the pot. This is called a chop. Here's an example.

Hero: K♠K♦

Villain: A♣A♦

Board: 5♥6♦7♣8♠9♠

You both would have a straight and would split the pot. That's a chop. While chopping a pot isn't our first choice, it certainly beats losing the pot. Here's an example of seeing some chopping outs.

Hero: A♠2♥

Villain: A♣7♦

Board: A♥Q♦6♣3♠

You're behind since his 7 kicker plays. How many outs do you have? Well, you certainly have the three 2s left to give you two pair. So, that's three outs to a win. However, what happens if the river is a 3? At that point you have AA33Q, and so does your opponent! You tie and will chop the pot. So, you have three outs to a chop with the 3s. The same is true if the river is a 6. You will have AA66Q, and so will he. This is another chop. You have now have a total of six outs to a chop. What if the river is a Q? Think carefully. At this point, you'll have AAQQ6; however, your opponent has AAQQ7, so he wins. His 7 now plays, and he has you **outkicked**. So, in this hand you have three outs to a win, and six outs to a chop.

When you have the worst hand and are trying to hit an out, it's called drawing. You're on a draw. Table 4 shows common draws and the number of outs to a better hand than you currently hold.

Table 4. Common draws.

Draw	Outs
Gutshot (aka Gutter or Belly Buster)	4
Pair (not pocket pair)	5
Open-Ended Straight Draw (OESD)	8
Double Gutter (aka Double Belly Buster)	8
Four-flush (aka Flush Draw)	9
Open-Ended Straight Flush Draw (OESFD)	15

Gutshot straight draw (aka Gutter or Belly Buster) – You need to fill in one card to make a straight. Here we need a 4 to complete a straight.

Hero: 6♠7♠

Villain: A♣K♦

Board: K♥5♦3♣

Pair – You have two different hole cards, and one of them paired a card on the board. This is different than a **wired pair** which is when you have a pair as your hole cards. Here we need either a 7 or a 6 to improve to two pair or **trips**.[3]

Hero: 6♠7♠

Villain: A♣K♦

Board: K♥5♦6♣

Open-ended straight draw (aka Outside Straight draw, and abbreviated as OESD) – You have four cards in a row and can catch a straight on either side of them. Here we need either a 3 or a 8 to complete our straight. We have eight outs to the straight.

Hero: 6♠7♠

Villain: A♣K♦

Board: K♥5♦4♣

[3] Three of a kind is often called trips or a set; however, these are different and vary greatly in value. Trips is when one of your hole cards matches a pair on the board. A set is when a card on the board matches the pair you have as your hole cards.

<u>Double Gutter (aka Double Belly Buster)</u> – You can fill in one card to make a straight in two spots. Sometimes these are hard to see and take some experience to catch quickly. Here we need either an 8 or a 4 to complete our straight. We have eight outs to our straight.

Hero: 6♠7♠

Villain: A♣K♦

Board: K♥5♦9♣3♠

<u>Four-flush (aka Flush draw)</u> – You have four cards of a single suit and need one more. Here we need a spade to complete our flush. We have nine outs to the flush.

Hero: 6♠7♠

Villain: A♣K♦

Board: K♠2♠Q♥

<u>Open-ended straight flush draw (abbreviated as OESFD)</u> – You not only have four cards of a single suit, you also have four cards in a row and can hit a straight on either end. Here we need either a 5, a T or a spade. We have 15 outs to a straight or flush. This is a very powerful draw and will often win the pot more than 50% of the time from the flop to the river when your opponent has a pair.

Hero: 6♠7♠

Villain: A♣K♦

Board: K♣8♠9♠

Soon, many of these will become ingrained in your mind, and you won't even have to think about them. Also, many times you'll need to add these together. Perhaps you'll have a gutter and a pair, and you'll add them together for nine outs. A great way to practice counting outs is to take a deck of cards and deal out two sets of hole cards. Then deal out the flop. Find out who has the worst hand, and count their outs. With time and practice, you'll become very proficient at counting outs.

Quiz

(Answers on pg. 160)

For the following questions, answer how many outs the hero has (do not forget chopping and backdoor outs).

1. Hero: 8♦J♥

   Villain: K♦A♦

   Board: 5♣Q♦K♥A♥

2. Hero: 3♣3♦

   Villain: A♣J♣

   Board: J♦8♦2♥A♠

3. Hero: K♠9♠

   Villain: J♠J♥

   Board: 4♥8♥6♦A♣

4. Hero: 5♣7♣

   Villain: K♦J♦

   Board: J♥6♥9♥2♦

5. Hero: A♦J♠

   Villain: 7♠8♠

   Board: 7♥5♥2♣4♣

6. Hero: 7♣6♣

   Villain: A♣Q♣

   Board: Q♠8♥7♦K♣

7. Hero: 6♥7♠

   Villain: A♠Q♠

   Board: 4♠7♦Q♦2♠

8. Hero: 5♥6♥

   Villain: A♥J♥

   Board: 8♦9♦2♥K♥

9. Hero: Q♦K♥

   Villain: A♠J♠

   Board: J♦2♥T♣J♣

10. Hero: 6♣7♦

    Villain: K♦K♣

    Board:Q♣8♦4♦T♠

11. Hero: A♠J♥

    Villain: K♥K♠

    Board: 2♥8♦9♦7♣

12. Hero: T♣8♣

    Villain: K♦4♦

    Board: K♥9♠Q♠6♥

13. Hero: T♥T♠

    Villain: A♥4♥

    Board: T♣3♥8♥K♥

14. Hero: 7♠8♠

    Villain: 9♥A♥

    Board: 9♠K♣A♣T♠

15. Hero: 8♣6♣

    Villain: A♣A♦

    Board: 6♦4♠7♣T♥

16. Hero: A♦A♥

    Villain: 8♦9♣

    Board: 8♠T♠4♥9♥

17. Hero: 6♥7♥

    Villain: J♦J♥

    Board: 3♥9♥4♣A♠

18. Hero: A♠5♠

    Villain: A♥7♥

    Board: A♦6♣3♥Q♠

19. Hero: A♠Q♣

    Villain: 5♣5♦

    Board: J♥6♥8♦J♠

20. Hero: J♠J♥

    Villain: 5♠5♦

    Board: A♦A♣5♣6♣

21. Hero: K♣T♣

    Villain: 6♣6♦

    Board: 4♣4♦9♦4♠

22. Hero: 4♠5♠

    Villain: A♥8♦

    Board: 5♦A♠9♣

23. Hero: 6♣8♣

    Villain: J♦J♥

    Board: 6♥7♦2♠

24. Hero: A♥2♠

    Villain: A♠T♥

    Board: A♦A♣Q♣5♣

25. Hero: 4♣5♣

    Villain: A♣T♥

    Board: 3♣6♣K♣T♣

The 4/2 Rule

I hope you've taken some time to practice counting outs on your own and are getting pretty quick at it. Remember in our previous section, we talked about the percentage we often see on TV when players are in a hand. In this section, we're going to talk about that percentage, where it comes from and how to get it quickly at the table.

As I've already said, this percentage tells us how often the player will win the hand on average by the river. Many players call it the equity in the hand, or more specifically, the **showdown equity** in the hand.

Player A – 19%

Player B – 81%

*If the hand went to **showdown***, player A would win the pot 19% of the time, and player B would win the pot the remaining 81% of the time. Being able to estimate your equity is important in poker. We'll talk about why in the next section, but for now, let's find out how to estimate this percentage quickly when we're playing. Of course, there is computer software you can use to help you get equities in a given hand. One very popular one is Pokerstove. It's very easy to use, and it's free. You can download it at pokerstove.com. Let's use this example.

Hero: A♠T♠

Villain: A♦A♥

Board: 5♠6♠2♦

We'd like to know how often we're going to win this hand if we always saw the hand through to the river. We can input the hand into Pokerstove. After we press evaluate, we see we'll win this hand about 37% of the time (See Figure 3).

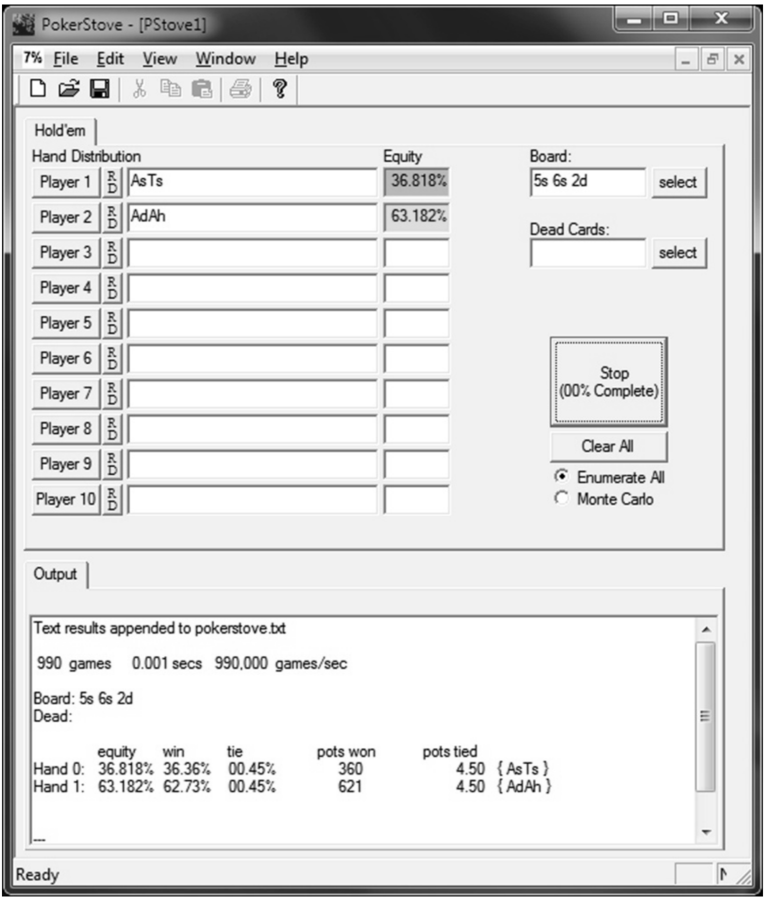

Figure 3. Screenshot from Pokerstove.

Most poker players would say they have 37% equity. And of course, our opponent has the remaining 63% equity. That's pretty simple, right? But, of course, we're not going to be able to use this software when we're playing. So, let's learn how to get this percentage quickly when playing.

Remember we defined an out as a card that can come on a future street(s) that can give you the best hand. We learned how to count outs. Counting outs gives us an easy way to estimate equity. There's a rule call the 4/2 rule. Here's how it goes. If you are on the flop and going to see both the turn and the river (like if you get all the money in on the flop), you can multiply your outs by four for an estimate of your equity. If you are on the turn, you can multiply your outs by two for an estimate of your equity.

So, in our example hand, we have a flush draw. This is nine outs. We're on the flop, so we can multiply our outs by 4 to come up with 36%. As we saw in Pokerstove, this is the actual equity. That's pretty simple, right? Let's say the turn would come the K♥. Now we're on the turn, and we still have nine outs. However, since we're on the turn, we would now multiply our outs by two. This would be 18%. Let's see how close we are. We'll put K♥ on the turn and evaluate the equity again.

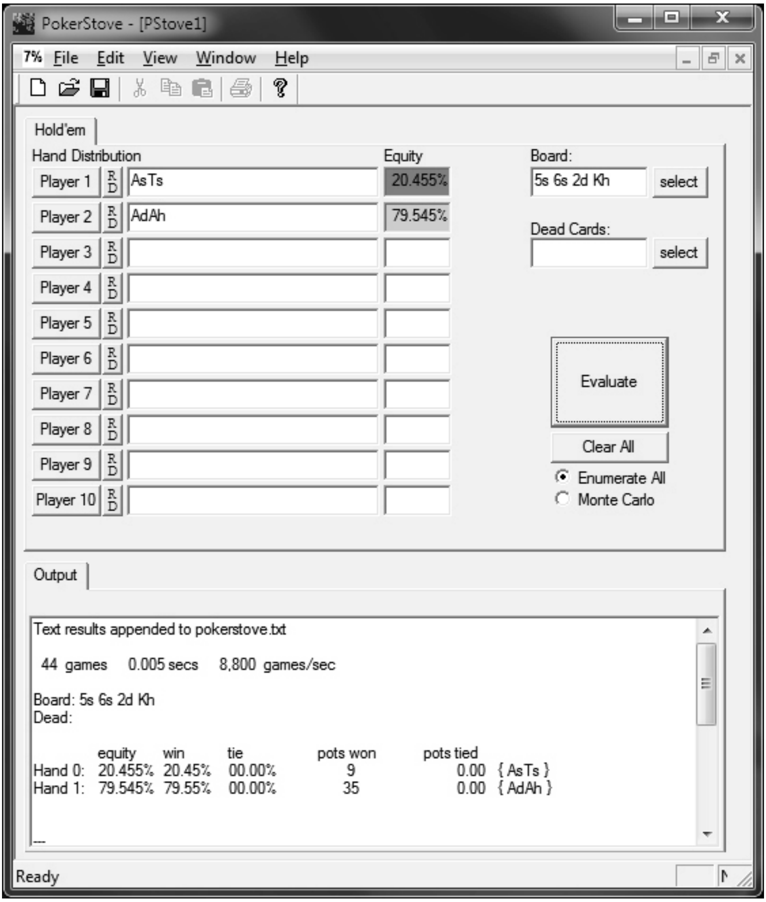

Figure 4. Screenshot from Pokerstove.

So, our estimate of 18% is very close as Pokerstove is showing 20% (See Figure 4).

Let's try one more.

Hero: J♥7♠

Villain: A♦Q♠

Board: A♥9♠T♦

What is our equity in the hand at this point? We start with our outs. We only have four 8s as our outs.[4] We're on the flop and going to see both the turn and river, so we multiply our outs times 4 and get an estimate of 16%. If you evaluate this in Pokerstove, you'll find the equity to be 18%. Our estimate is very close. Let's have the turn come a 5♦ and check our equity there. We now take our four outs and multiply times 2 and get an estimate of 8%. Again, if you evaluate this in Pokerstove, you'll find the equity is 9%. So, you see we can get very close with the 4/2 rule.

So, have this software out and deal out some hands. Count your outs, and estimate your equity. Then, enter the hand in Pokerstove, and see how you did. It's a good way to practice and get very quick at this. After some time, it'll practically just be instinctive as you play.

You'll notice I've been stressing that when you're on the flop, this equity applies only when you're going to see this river. A common occurrence of this is when you get all the money in on the flop. However, if there is still betting to be had on the turn, you may make a common mistake. If you're not all-in on the flop and there may be betting on the turn, you need to multiply your outs by two to only account for winning on the next card.

[4] We also have one combination of a backdoor straight with a K and Q on the board. Villain has a Q, so the backdoor is devalued a bit here. Since it's only one combination, I'm going to ignore it.

Also, do not forget about backdoor outs. Remember these are worth one out on the flop. So, if you were going to see the turn and river, they're worth about 4% equity.

It's not necessary that you understand the math involved in getting these percentages; however, I'm going to include it here for those who like to know the whys in life. Let's start with the turn in our J7 hand. We had four outs. We already estimated our equity at 8% and found out it was actually 9%. Where does this number come from? Well, we know there are four 8s in the deck. How many unknown cards are left? Well, we know there are 52 cards in a deck. We also know our two cards, our opponent's two cards and the three cards on the flop. This is a total of seven cards that we know.

52 – 7 = 45

There are 45 unknown cards. There are four 8s in there somewhere. The chances of an 8 coming next are $\frac{4}{45}$. We divide 4 by 45 to get our percentage. When we do that, we get 9%.

Going from the flop is a bit more complicated than that. We need to find out how often we hit an 8 on either the turn or the river. The method I use is to find out the times we do *not* hit our 8 and subtract that from one. What are the chances we do *not* hit our 8 on the turn? Again, we have 45 unknown cards and four 8s. So, there are 41 cards that aren't 8s. The probability of not hitting our 8 on the turn is $\frac{41}{45}$. Now, let's move on to the river after we **miss** the turn. We now know another card, so we now have 44 unknown cards. There are still four 8s in the deck, so there are 40 cards that are not 8s. The probability of not hitting our 8 on the river is $\frac{40}{44}$.

We can multiply these fractions together to find out how often we do not hit our 8 on the turn or river when we're all-in on the flop.

$\frac{41}{45} * \frac{40}{44} = \frac{1640}{1980} = 0.828$

Now we subtract that from one to find out how often we do hit the 8.

1 - 0.82 = 0.18 = 18%.

This is exactly what Pokerstove gave us.

So, that's the background for understanding where the equity percentages come from. However, as you've seen, using the 4/2 rule is a very easy way to come up with your equity estimate. We'll find out why estimating equity is important in future sections. However, for now, continue to practice estimating your equity.

One thing I didn't talk about yet is estimating your equity preflop. Preflop equities mean very little unless you're going to be getting all-in preflop. If you're not, the strength of your hand is much more defined by other factors like your position, the amount of money remaining in your stack, your opponents and how your hand will play **postflop**. In order to determine your all-in preflop equity, it's easiest to just get used to knowing them from messing around with a software like Pokerstove. However, that's not the point of this lesson. Later in this book, I'll list some of the more common all-in preflop situations I've committed to memory.

Quiz

(Answers on pg. 171)

Estimate the hero's equity for the following hands. For further practice you can estimate hero's equity in the quiz from the section on counting outs. You can use Pokerstove to see how you did.

1. Hero: 8♣9♣

   Villain: A♣J♥

   Board: 7♦8♦2♠A♠

2. Hero: A♣A♥

   Villain: 5♥6♥

   Board: 7♦8♦2♠A♠

3. Hero: 3♣3♦

   Villain: J♦J♥

   Board: 3♠5♣5♦

4. Hero: 9♦6♦

   Villain: J♦J♥

   Board: 3♠5♣5♦2♦

5. Hero: 9♦6♦

   Villain: Q♦Q♥

   Board: 7♣8♣2♠

6. Hero: Q♦Q♥

   Villain: A♥J♥

   Board: 7♣8♣2♠J♦

Putting It Together

Pot Odds

Get your thinking caps on because this is a very important section. So far we've learned many important concepts: how to work with fractions and ratios, what EV is and how to create an EV calculation, how to count outs and then how to quickly estimate the probability of winning from either the flop or turn. Now we're going to discuss the concept of **pot odds**. This section is going to tie together everything we've learned so far to show us how math works to help us play perfectly if all the cards were turned over.

The idea of pot odds starts with us comparing the size of the pot with the size of the bet we must call. This is normally expressed in a ratio. This is a reward to risk ratio. So, pretend we're on the flop in a hand, and the pot is $10. It's the villain’s turn, and he bets $10. The pot would now be $20, and it’s $10 for us to call. We’d be getting 20:10. We then reduce this to 2:1. We’re getting 2:1 odds on our call. These odds will tell us how often we need to win the hand if we call in order to at least break even.

Let’s go back to what we learned previously and convert this to a fraction. The fraction would be $\frac{1}{3}$ or 33.3%. So, in order to at least break even with our call, we need to win at least 33.3% of the time. Of course, we’d prefer to win money instead of just breaking even, so we want to win more than 33.3% of the time. Another way to approach this problem is using the equation x / (x+y) where x is the amount we must call, and y is the pot before our call. In this case, x = $10 and y = $20.

So, the equation looks like this.

10 / (10 + 20)

10/30 = 0.333

I give different methods so you can use the one with which you feel the most comfortable.

We'll do one more for practice. Let's imagine that same $10 pot, except this time our opponent bets $5. Now we're getting 15:5 which can be reduce to 3:1. Turning this into a percentage, we get $\frac{1}{4}$ or 25%. Or, we could use the x / (x+y) method.

x=5 and y=15

5 / (5+15)

5/20 = 0.25

So, if we make the call and win 25% of the time, we will break even with our call. And again, we want to win the pot more than 25% so we're actually making money on average.

Let's run four trials of this situation and watch how it works. If we won the pot one time out of four and lost the pot the other three times, our results would look like this.

1st time we lose $5.

2nd time we lose $5.

3rd time we lose $5.

4th time we win $15.

When we sum all the results, we get zero.

-\$5 - \$5 - \$5 + \$15 = 0

So, you see we've broken even over this scenario. Now, there's an even shorter way to approximate this percentage at the table that requires only a minimal amount of memory. In NLHE, you come across the same bet sizes very frequently in terms of how much the opponent bets compared to the pot. So, we can just list those and memorize how often we need to be good for each one. We can look at what our opponent bet in relation to the pot and estimate how often we need to be good.

Table 5. Percent we must win after villain bets.

His Bet	We Must Win >
2x the size of the pot	40%
Pot-size	33%
2/3 the size of the pot	28%
1/2 the size of the pot	25%
1/3 the size of the pot	20%
1/4 the size of the pot	16%

Just by memorizing Table 5, you can normally get right on or very close to how often you need to win in order not to lose money on your call. You may even want to put this little chart by your monitor until you find you no longer need it.

Let's tie this together with everything we've learned so far with an example.

Hero: 5♠6♠

Villain: A♦A♣

Board: K♠T♠2♥

We have a flush draw. The pot is $25. Our opponent has $24 left in his stack, and we have him covered. He's first to act and goes all-in. Do we call or fold? We can do this problem right at the table in just a couple seconds. Let's look at our pot odds. He bet almost the pot. So, from memorizing our chart, we know we've got to be good about 33%. Now, how often will we win? We count our outs and see we have nine outs to win. Using our 4/2 rule, we multiple our 9 outs times 4 (since we're all-in on the flop) and come up with 36%. This is greater than the 33% we need, so we should call. Not too bad, right?

Although it may seem cumbersome now, you will become very quick with this after some practice. You could run an EV calculation to check the EV of this call when you're away from the table. Realize in the wager, when we win, we'll win $49. This is $25 in the pot, and our opponent's $24 bet. When we lose, we'll lose the $24 we put in to call.

0.36($49) - 0.64($24) = EV

$17.64 – $15.36 = $2.28

I do want to show you an alternate way to calculate your EV. This way you can use whichever method you like the best. We can multiply the total pot after we call by the probability we'll win it. Then we subtract what we had to call.

0.36($73) – $24 = EV

$26.28 - $24 = $2.28

So, with this call our EV is $2.28

Let's try one more.

Hero: A♠K♥.

Villain: J♣T♦

Board: J♠9♣8♦2♥

The pot is $40. Our opponent bets $10. Should we call or fold? We see his bet was 1/4 pot, so we know from Table 5 we need to have 16% equity to call. We now look at our outs and see we have six outs. Using the 4/2 rule, we multiply 6 times 2 and get 12%. This is smaller than the 16% we need, so we should fold. Again, we can run an EV calculation to check the EV of this call when we're away from the table.

0.12($50) - 0.88($10) = EV

$6 - $8.8 = (-$2.80)

Or

0.12($60) - $10 = EV

$7.20 – $10 = (-$2.80)

Examining pot odds can be done in seconds at the table. Make sure you take time to memorize Table 5 and practice until you're very comfortable with this process.

Quiz

(Answers on pg. 174)

For the following questions, answer call or fold.

1. Hero: 8♣9♣

   Villain: A♣J♥

   Board: 7♦8♦2♠A♠

   Pot was $10, and villain goes all-in for $5.

2. Hero: A♣A♥

   Villain: 5♥6♥

   Board: 7♦8♦J♠

   Pot was $24.   Hero goes all-in for $28. What should villain do?

3. Hero: A♣Q♦

   Villain: J♦J♥

   Board: 3♠5♣5♦

   Pot was $10. Villain goes all-in for $6.50.

4. Hero: 9♦6♦

   Villain: J♦J♥

   Board: 3♠5♣5♦2♦

   Pot was $20. Villain goes all-in for $10.

Implied Odds

In this section, we'll be discussing how the decision of whether or not to call or fold is impacted by having money left to bet. This idea is called **implied odds**. Implied odds is looking at your reward to risk ratio in the light of future betting. Let's start out with an example.

Hero: 6♠7♠

Villain: A♦K♠

Board: 4♠5♦A♥K♣

The villain bets $5 into a $10 pot. We can quickly determine if we have immediate pot odds to call this bet. Our opponent bet 1/2 pot, so we know we need 25% equity to call. We have eights outs to the **nuts**, and we're on the turn. So, our equity is about 16%. This is less than the 25% we need, so looking only at this, we should fold. However, what we still need to know is if we still have money to bet on the river. If we have more money to bet, we may be able to call.

One important point to make here is that we know his hand in this example, but he cannot know our hand. Why would it be a problem if he knew our hand? If he knew our hand, he would just check and fold on the river if we made our straight. If he does this, we won't get any money from him on the river. This really highlights an important consideration with implied odds. How easy is it to spot your draw? A draw like a flush draw is very easy to spot. Imagine there are two cards of the same suit on a flop, and you called your opponent’s turn bet. If the river brings that same suit, your opponent is going to be concerned about that flush and may not pay you off or pay you as much. However, a draw like an open-ended straight draw, as we have in this example, is pretty disguised. If an 8 comes on the river, he may miss that straight possibility altogether.

In any case, we know his hand, and he doesn't know ours. So, we're almost certain to get money from his two pair if we make our straight. Now, let's say he has another $20 left on the river. We call his $5 bet on the turn even though are immediate odds tell us we should fold. The river is an 8, and he goes all-in for his pot size bet of $20. We happily call. We made an extra $20 off our turn call. So, let's go back to looking at our odds on the turn. If we include his $20 in our odds, instead of getting 15:5 (3:1) on our turn call, we'd be getting 35:5 which is 7:1. With 7:1, we only need to be good 12.5% of the time. We're going to win 16% of the time, so we'd be able to call if we knew we could get our opponent's stack when we hit.

This brings us to another important concept with implied odds. The stronger the opponent's hand is, the greater our implied odds. The weaker our opponent's hand is, the weaker our implied odds. Using our example hand, if our opponent held JJ instead of AK, it's very unlikely we would get a lot of money from him on the river. Most likely he'd check and fold to a river bet, and then you wouldn't get any money from him on the river. Your turn call would have lost money. Figuring out if your opponent has a strong hand or not will take time and experience. That's part of hand-reading. We'll get to dealing with the fact that we can't see our opponent's cards later in this book. For now, let's get back to figuring out how to calculate implied odds at the table.

When looking at implied odds, we add the amount we think we'll win to our odds when we need to make the call. However, this is pretty difficult for me to do at the table. So, here's a quick way for you to estimate how much you need to win in order to justify a call.

Table 6. Multiplication factor to calculate implied odds based on our equity.

Our Equity	Multiply his bet by:
35%	2x
25%	3x
20%	4x
15%	6x
10%	9x

Table 6 shows how much money we need to make when calling a bet. This is based on our equity. Let's use a quick example to show this at work. Let's say you're in a hand and you have 20% equity on the turn. The pot is $20, and your opponent bets $10. Since you have 20% equity, you look at the bet you must call and multiply it times 4 (See Table 6). His bet is $10, so we need $40. Now, there is already $30 in the pot (The $20 plus his $10.), so we subtract that from what we need.

$40 - $30 = $10

So, we need $10 more to breakeven on this call. Notice if we call, the pot would be $40. So, we need to be able to get a 1/4 pot bet on the river.

Let's look at our 67s versus AK hand again. Remember, we know his hand, he doesn't know ours. He has $20 left after his $5 bet, and we know his hand is very strong. He bets $5 into a $10 pot. We know we'll catch our straight about 16% of the time, but looking only at immediate pot odds, we need to be good 25% to call. So, we consider how much we need to get on the river to at least break even. Looking at our chart, we can estimate we need about 6x more (a bit less) than his turn bet. His turn bet was $5, so we need $30 (6 x 5) to make the call.

There's already $15 in the pot, so we subtract that from $30 and find out we need $15 more on the river. He has $20 left and has a strong hand, so getting that $15 should be pretty easy. And better yet, we should get more than $15 on the river which is what we're really after. So, if our opponent only had $10 left to bet on the river, we would need to fold here.

Quiz

(Answers on pg. 176)

Use estimations to answer the following questions.

1. Hero: 9♦6♦

   Villain: A♣J♥

   Board: 7♦8♦2♠A♠

   The pot was $10. Villain bet $15. How much more do you need?

2. Hero: 9♣3♣

   Villain: A♥A♣

   Board: 7♦8♦J♠4♣

   The pot was $10. Villain bet $10. How much more do you need?

3. Hero: A♣Q♦

   Villain: J♦J♥

   Board: 3♠5♣5♦

   The pot was $10. Villain bet $8. How much more do you need assuming you see the river with no further turn betting?

World of the Unknown

Combinations

Up to this point, we've only been looking at situations where our opponent's cards are face up. Now, while it would certainly be profitable for us to see our opponent's cards, we all know that's not how poker is played. We do not know our opponent's cards, and that's the unknown part of the game that forces us to make assumptions. However, we can understand the building blocks for those two hidden cards. When we're making assumptions about our opponent's holding, we're building what we call a range of hands. We're not just giving him one hand like saying "I'm putting you on AK." We build a range by saying "I think you could have hands like AK, AQ or some small **pocket pairs**." This is a range of hands, and we can understand the probability distribution of that range to help us make mathematical decisions based on the assumptions about his range.

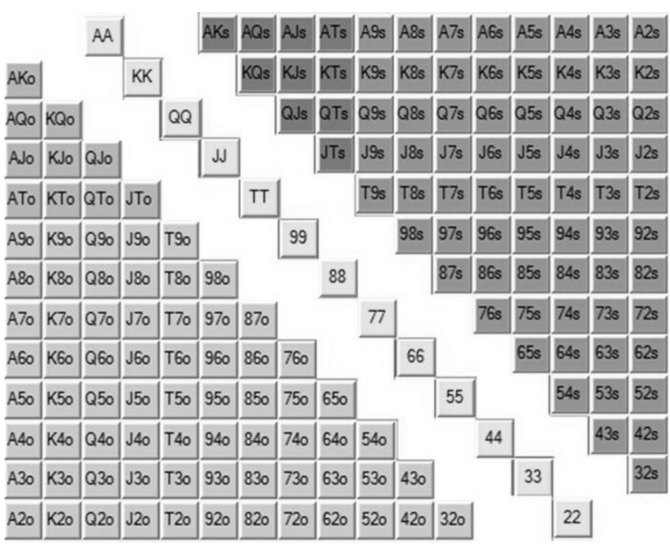

Figure 5. PokerStove hand range selector separated to show the three categories of hands.

When we look at the hand range selector in Pokerstove, we see three different categories of hands: paired, unpaired suited and unpaired off-suit (See Figure 5). This layout shows 169 possible types of starting hands.[5] What is the probability of picking two cards out of a deck and getting one of these types of starting hands? Perhaps you would say it's 1 out of 169. However, this is not correct. There are different possibilities for each type of hand, and this is important to understand when working with ranges. Let's take a look at it.

First, we'll look at paired hands which are 22-AA. When you have four cards, what is the number of different ways we can put them together to create a unique combination (See Figure 6)?

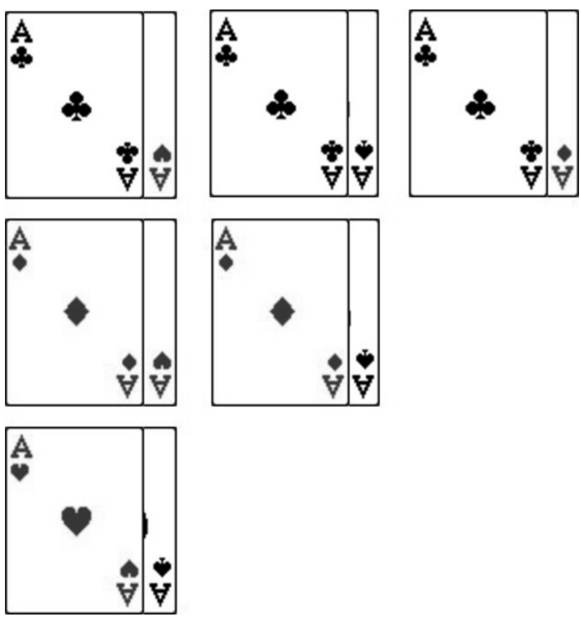

Figure 6. Four cards can be combined to make six unique combinations

[5] There are actually 1326 unique combinations of starting hands in hold'em. This range selector groups all suited and offsuit hands. So, 5♠6♠, 5♦6♦, 5♥6♥ and 5♣6♣ are all represented in 56s.

Let's look at the four As. We'll start with the A♣. It can be paired one time with the other three As. Then the A♦ can be paired with the A♥ and the A♠. It's already been paired with the A♣, so we can't count that one again. Now this leaves the A♥ being paired with the A♠. And the A♠ has already been paired with each of the others. So, this gives us six different unique combinations for pairing the As. There are six combinations of a paired hand per rank. One way to do this, without physically combining the cards, is to take the total number of cards in the group and then add together all the remaining numbers down to zero.[6] We have four cards in the group of As.

3 + 2 + 1 = 6

Let's look at the impact of removing a card. Let's say the flop has come down KA3. How many combinations of 33 can our opponent have for a set of 3s? Remember we said there are six combinations of pairs, but this isn't correct now. One of the 3s is shown, so there are only three more possible for him to hold. How many unique, two-card combinations can be created from three cards?

2 + 1 = 3

There are three different combinations for him to hold a pair of 3s when one of the 3s is exposed.

Let's look at unpaired hands. We'll combine both the suited and unsuited combinations of these holdings. Let's find out how many combinations there are of our opponent having an unpaired hand like AK (See Figure 7).

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[6] Using the "combin" function in a spreadsheet software like Microsoft Excel will give you these answers quickly. For example, if, in a cell, you type "=combin(4,2)", the result will be 6. Entering "=combin(52,2)" will produce 1,326. This is the number of unique hold'em starting hands.

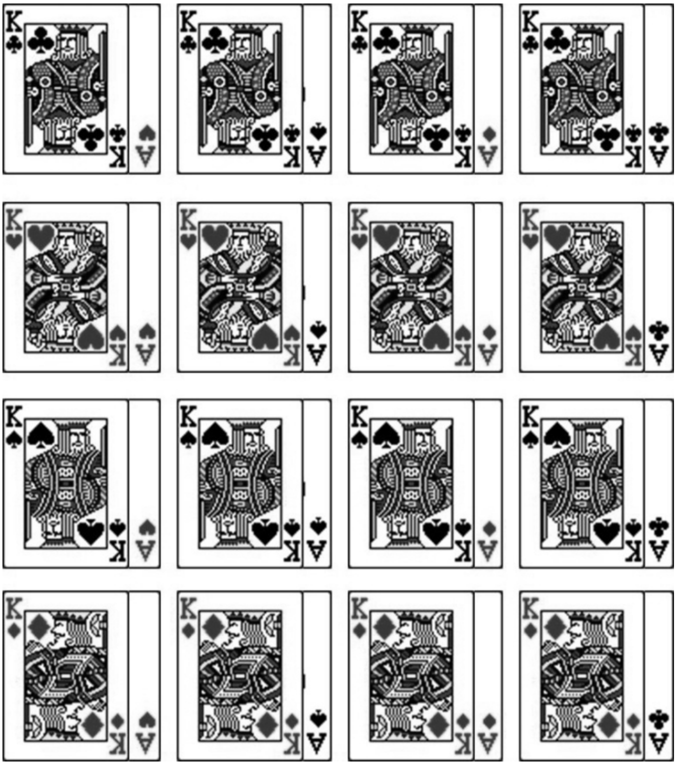

Figure 7. Two groups containing four cards each can create 16 unique combinations.

We have four As and 4 Ks in the deck. The K♣ can pair with each A for four combinations. The K♥ does the same for four combinations as does the K♠ and the K♦. This gives us four combinations for each K, and we have four Ks. This is a total of 16 combinations for an unpaired hand. With unpaired hands, you can simply multiply the two numbers together. We have four As and four Ks.

4 x 4 = 16

Again, let's look at the impact of removing a card. Let's say the flop has come down KA3. How many combinations of AQ can our opponent have? One of the As is shown, so there are only three more possible for him to hold. There are three As and four Qs.

3 x 4 = 12

There are 12 different ways for him to hold AQ.

Let's look at a hand distribution for an assumed range. Let's say someone raises, and we assume that they only have QQ+ and AQ+. So, for QQ, KK and AA there are six combinations for each of those pairs. That's a total of 18 combinations of pairs. For AK and AQ there are 16 of each for a total of 32 combinations. So, he can have a total of 50 combinations (18 + 32). We'd like to know how often he has a big pair. We'll divide the pair combinations by the total combinations.

18 / 50 = 0.36

We see he'll have a big pair 36% of the time.

Understanding the probability distribution of our opponent's range has immense value. Let's look at a simple illustration on a river decision.

Hero: K♣Q♠

Villain: AQ+, TT

Board: Q♦T♥2♠6♣2♦

Our opponent bets the pot. Which is better, calling or folding? In order to decide, we begin with our pot odds. He bet pot, so in order to call we know we need to be good at least 33% of the time. We beat AK, but we lose to AQ and TT. We can look at the probability distribution of these hands to know how often we're going to win. Let's break it down.

We'll start by analyzing the hands that beat us. How many combinations of AQ and TT are there? We have a Q, and there's one on the board. So there are only two Qs and four As to make AQ.

4 x 2 = 8

There is one T on the board, so there are three combinations of TT. There are 11 combinations that beat us (8 + 3).

Now, let's look at the hands we beat. How many combinations of AK are there? We have a K, so there are three Ks and four As.

4 x 3 = 12

There are 11 combinations that beat us, and 12 combinations we beat. This is a total of 23 combinations. We can divide the combinations of AK by the total combinations to see how often we will win if we call.

12/23 = 0.52

We will win about 52% of the time. We only need to be good 33% to break even, so we have an easy call.

Doing this type of math at the table isn't a common occurrence for me. I've put in a lot of hours away from the table working on these types of situations and have developed a good feel for different situations. The best way to do this is to be active in poker forums like dragthebar.com and find spots to work these types of problems out. The more you do these, the more you'll find yourself getting very good at estimating these situations in real time. You can even mark hands during a session and commit to analyzing a few of these each day. Before you know it, you'll find yourself getting faster and faster at doing them and getting a much stronger, accurate feel for this math at the table.

One final thing I want to touch on in this section is suited hands. Imagine a flop has come down J♥7♥2♣. You feel your opponent would play any two suited cards. Looking at Figure 6, we can see there are 78 possible suited hands of a given suit. Table 7 shows how many combinations of a suited holding our opponent can have after a given number of that suit has been exposed.

Table 7. Possible combinations of a suited holding after a given number of that suit has been exposed.

Cards Exposed From Suit	Possible Combinations
1	66
2	55
3	45
4	36
5	28
6	21

When we remove two of those cards because they're on the flop, there are 55 possible combinations our opponent can have to give him a flush draw. However, you will only rarely encounter an opponent who will play any two suited cards. If I encounter a very loose opponent, and I feel he has a flush draw, I'll think in terms of how many suited hands I think he plays. If I think he plays about half of them, and I do not hold a heart, I'll assume he has about 27 suited holdings. This is about half of the 55 possible holdings. If it is a tighter opponent who would only hold connected suited cards, he could have around eight suited hands. Be aware of how the cards on the board can affect your opponent's potential holding. For example, let's say the turn in our imaginary flop came down the A♥. This now removes all the suited A holdings villain could have had in his range. Creating these assumptions will take hand-reading experience.

Quiz

(Answers on pg. 178)

1. Hero: 8♦J♥

   Villain: AA

   Board: 5♣Q♦K♥A♥

   How many combinations are there in villain's range?

2. Hero: 3♣3♦

   Villain: AJ

   Board: J♦8♦2♥A♠

   How many combinations are there in villain's range?

3. Hero: K♠9♠

   Villain: JJ

   Board: 4♥8♥6♦A♣

   How many combinations are there in villain's range?

4. Hero: 5♣7♣

   Villain: AJ, 66

   Board: J♥6♥9♥2♦

   How many combinations are there in villain's range?

5. Hero: A♦J♠

   Villain: AA

   Board: 7♥5♥2♣4♣

   How many combinations are there in villain's range?

6. Hero: 7♣6♣

   Villain: ATs

   Board: Q♠8♥7♦K♣

   How many combinations are there in villain's range?

7. Hero: 6♥7♠

   Villain: QQ, A♦3♦

   Board: 4♠7♦Q♦2♠

   How many combinations are there in villain's range?

8. Hero: 5♥6♥

   Villain: 99, QJ

   Board: 8♦9♦2♥K♥

   How many combinations are there in villain's range?

9. Hero: Q♦K♥

   Villain: AJ

   Board: J♦2♥T♣J♣

   How many combinations are there in villain's range?

10. Hero: 6♣7♦

    Villain: AQ, 88

    Board: Q♣8♦4♦T♠

    What percentage of the time does the villain have a set?

Equity Versus a Range

We've already learned how to estimate our equity postflop verses certain hands. We went over the 4/2 rule for that. Let's do a quick review with an example.

Hero: A♦A♠

Villain: 3♦4♣

Board: 5♥6♠J♣.

We get all-in on the flop. Our opponent has eight outs with two cards to come. He has about 32% equity. This means we have the remaining equity, which is 68%. However, we didn't talk about how we got all-in.

Let's say the pot was $25. We bet $25 on the flop, and the opponent shoved all-in for $100. We have to call $75 more. Now what do we do? We've learned to look at our pot odds first. The pot is $150, and we have to call $75. We're getting 2:1 and need to be good 33% of the time. When we know he has 3♦4♣, this is an easy call. However, again, poker doesn't work like this in real life. We don't know what he's holding. Since we don't know his cards, we have to work with assumptions concerning what range of hands we believe he can hold given the certain actions he's taken. So, without talking about why we're assuming this range, let's give him an assumed range of 78, 55 and 66. [7] This is a very narrow range. A narrow range is always easier to work with, so we're going to start here. We still know for sure we're getting 2:1. What we do not know is our equity against his assumed range. That's what we're working on in this

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[7] Notice our assumed range does not include his actual hand. Welcome to real poker. Sometimes we run into the strongest part of villain's range; other times we run into the weakest part of it. Sometimes we're not even in the ballpark.

section. As usual, we'll talk about how to do this exactly, and then give a shortcut for table play. Again, there is no substitute for away from the table work to develop a good feel for this at the table.

Determining your equity against a range is done in four steps.

1. Determine your equity against each hand in the range.
2. Multiply that equity by the number of combinations for that hand.
3. Add together the results from step two for each hand in the range.
4. Divide the results from step three by the total combinations in the hand range.

Let's work this one out. We'll start by determining our equity against each hand in his range.

78: 66%

55: 9%

66: 9%

We're in great shape against 78, but we're absolutely crushed by 55 and 66.

Let's move on to step two and multiply the equity by the number of combinations for that hand.

78: 0.66 * 16 = 10.56

55: .09 * 3 = 0.27

66: .09 * 3 = 0.27

Moving on to step three, we add together these sums.

10.56 + 0.27 + 0.27 = 11.1

And finally step four is to divide the results from step three by the total number of combinations in the range. The total number of combinations is 22 (16 + 3 + 3).

11.1 / 22 = 0.504

So, our total equity against his range is 50%. We need more than 33% for a +EV call. We still have an easy call even though a quarter of the time villain is going turn over a set and have our hand crushed.

Again, we can check our work by entering his range into Pokerstove (See Figure 8).

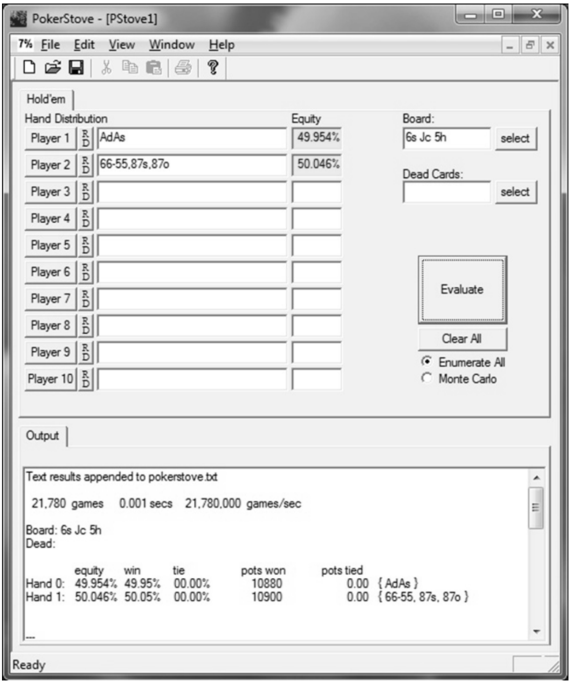

Figure 8. Examining our equity verses a range in Pokerstove.

Now, obviously we're going to have a tough time doing this at the table. So, here are a few quicker methods to do this at the table. We can look at the makeup of his range. About 25% of the time he has a set.

6 / 22 = 0.27

So, the other 75% of the time he has the OESD. About 75% of the time we have 66% equity, and 25% of the time we have 9% equity. Here are four different methods to figure out our average equity.

1. Find out what 3/4 of 66 is and what 1/4 of 9 is. Then sum the results.

   3/4 of 66 + 1/4 of 9 = Average Equity

   49.5 + 2.25 = 51.75

2. You have 66% equity 3 times and 9% equity 1 time. You can add those together and divide the sum by four.

   ((66 * 3) + (9 * 1)) / 4 = Average Equity

   207 / 4 = 51.75

3. Find 3/4 of the way from 9 to 66. You can do this by subtracting 9 from 66, and then dividing that result by 4. Finally subtract that results from 66.

   66 - 9 = 57

   57 / 4 = 14

   66 - 14 = 52

4. The fourth method I've termed the "mental slider" method. We'll abbreviate it to the "MS Method". Very simply I know I need to get 3/4 of the way between 9 and 66. I simply visually a slider in my head and move it up to where I feel 3/4 of the way would be (See Figure 9).

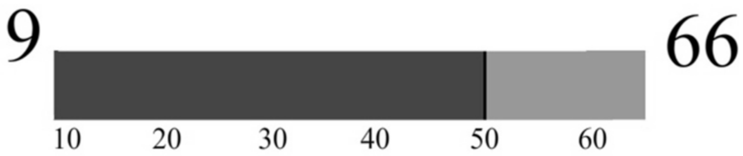

Figure 9. The MS method finding 3/4 of the way from 9 to 66.

Obviously the MS Method is not an exact science, but I do it basically because it gets me very close to the actual percentage, and I can do it quickly without a lot of mental effort at the table.

Let’s do one more for good measure. We’ll make it a preflop example. We have A♠K♠ in early position and raise to $3. The tight small blind shoves over our raise for $18 total. We start with our pot odds. The pot is $21.[8] We must call $15. We’re getting about 1.4:1 here, so we need to be good a little over 40% of the time. Now we’ll look at our assumed range for the tight small blind. Let’s say he can have JJ+ and AK. Let’s examine our equity against the hands in his range. Again, preflop equities in situations like this you’ll need to use a tool like Pokerstove and then get used to the numbers it produces.

[8] I often ignore the big blind to help account for the rake.

AA: 3 combinations– 12%

KK: 3 combinations – 34%

QQ: 6 combinations – 46%

JJ: 6 combinations – 46%

AK: 9 combinations – 51%

Looking at this problem, I'd use the MS method and think this way. We can work quickly by grouping hands against which we have roughly the same amount of equity. We see that with QQ, JJ and AK. Those hands total 21 combinations. Against 21 combinations, we have around 50%. Against the other 6 combinations, we're around 20% (combining AA and KK and averaging them quickly). By dividing the 20% equity group by the total number of combinations, we can see the 20% group is about 25% of his total range (6 / 27 = 0.22). So, about 25% of the time we have 20% equity, and the other 75% of the time we have a little less than 50%. We can use the mental slider to get close to 3/4 of the way between 20 and 50. We'll land somewhere right next to 40. Remember we need a bit over 40% equity to call, so, we would have around a break-even call. Notice if he could have TT as well, we have 6 more combinations where we have 46% equity, and our equity would climb a little bit. If he could have AQ, our equity against that hand is a whopping 75%, and there would be 12 combinations of that, which would increase our equity substantially. So, against a range like TT+ and AQ+, we're actually a slight favorite and have a super easy call. Now, you can go through the more precise methods and find out with which one you're most comfortable.

Some of the more math-minded readers may be frustrated by all my rounding and estimating. But, estimates are ok. First of all, I’ve found they're much easier for most people to use. It's much easier to think about 25% of a number instead of 22% of a number. When you’re a couple percentages off in your final answer, it’s not a huge deal for a couple reasons. First, a close decision is a close decision. In terms of EV, it’s not a large amount one way or the other. For example, let's say you needed 45% equity to make a call. You estimated your equity and came up with 47%, so you called. Later you realized the more accurate answer given your assumptions was 44%, and you would have folded. If you were to calculate the EV for those numbers, you'd find out the results are very close to one another and matter little.

The second reason estimates are ok is because you’re working with a guess on his range and are probably off at least a hand or two. This doesn't mean we get ridiculously sloppy, but we are working with an educated guess in real time.

As you get practice examining these situations, you'll soon become very proficient estimating your equity against an assumed range, almost as if it were second nature.

Quiz

(Answers on pg. 181)

1. Hero: J♠J♦

   Villain: 78, AT

   Board: 5♦6♣T♥

   What is hero's equity assuming we're all-in?

2. Hero: J♠A♠

   Villain: QQ, KK, 55, 44

   Board: 5♦4♠T♠

   What is hero's equity assuming we're all-in?

3. Hero: 3♠3♥

   Villain: KT, TT, 55, A♦K♦

   Board: 5♦3♦T♠

   What is hero's equity assuming we're all-in?

4. Hero: Q♥T♥

   Villain: AK, AT, 66, 78

   Board: 5♦6♦T♠J♥

   What is hero's equity assuming we're all-in?

Which Bucks?

There are four different ways we can look at results when we're at the poker table. We can look at real-bucks, Sklansky-bucks, G-bucks and reciprocal-bucks.

Let's take an example where we have K♣K♥ preflop in a $5/$10 NLHE game. It folds to us on the button, and we raise to $35. The big blind **reraises** to $100. We both started with $1,000 preflop. We reraise him to $280. He shoves. He's a tighter player, so we assume when he shoves, his range is JJ+ and AK. We both flip our cards over, and he reveals AA. We're crushed. The board comes down Q♥2♠4♦6♣K♠. Our 18% equity comes through, and we win the hand. Let's break down our results for each of the bucks.

Real-bucks is simply what we won or lost in a given hand. Examining the real-bucks is very simple here. We used to have $1,000 in our stack, but now we have $2,000. We made $1,000 in the hand. Looking at real-bucks results in a hand is a terrible way to examine your play. Sometimes we played horribly in a hand, but still won. Sometimes we played brilliantly and still lost. How did we play in this hand?

Sklansky-bucks is a term coined from a concept introduced by author David Sklansky.   Let's take a look at the Sklansky-bucks as we examine our call preflop. When we had to put all our money in, we had $720 left in our stack. The pot was $1280. We were getting a little worse than 2:1 on our call, so we needed to have about 36% to call. We had 18% equity when we called, so the EV equation of our call could look like this.

0.18($1,280) + 0.82(-$720) = EV

$230.40 - $590.40 = (-$360)

So, we lost $360 in Sklansky-bucks in this hand. However, looking at our Sklansky-bucks in a hand is a fairly poor way to examine our play too. We did not know exactly what the villain was holding when we got our money in. If we knew he held AA, of course we would fold. We're dealing with an unknown factor and have to do our best to make assumptions about his range. The only thing we can do when the cards are flipped over is gather information about our opponent's strategy for future use. We got our money in badly here, but that doesn't mean we played poorly.

G-bucks is a concept the well-known poker player Phil Galfond introduced to examine our expectation value verses a range. Here we analyze our expectation value in a hand verses our opponent's assumed range. Obviously we don't know the big blind's hand, so we have to make some assumptions concerning what types of hands he'll raise all-in preflop in this situation. During that hand, we believed the villain would push all-in with JJ+ and AK. Let's take a look at the G-bucks. Against this range, KK has 66% equity. So, our EV equation of our call could look like this.

$0.66(\$1,280) + 0.34(-\$720) = EV$

$\$844.80 - \$244.80 = \$600$

Given our assumptions about the villain's range, our G-bucks on the call were $600. So, this was a great call given the information available to us in the hand. The G-bucks is a good way to analyze your poker decision because it takes into account the unknown factor of the villain's hole cards.

Reciprocal-bucks is a bit outside the focus of this book, but I want to include it here. It's a concept introduced by author Tommy Angelo. Reciprocal-bucks has to do with our strategy as opposed to our opponent's strategy. In other words, if the tables were turned, would either of us have played the hand differently? The answer in this situation is most likely "No." We both would have gotten the money in preflop. Since there is no difference in our strategies, neither of us won or lost reciprocal-bucks in this hand. The time will come when we have AA, and the villain will have KK, and the hand will most likely play out very similarly. Our reciprocal-bucks were $0.

Let's take a look at all four of those results.

- Real-bucks - $2,000
- Sklansky-bucks - (-$360)
- G-bucks - $600
- Reciprocal-bucks - $0

One of the main points I want to make in this section is to not be discouraged when your opponent flips over his hand and you are in a position where you have bad equity. Our job is to do the best we can gathering information about the villain's strategy in order to create a range. Sometimes we run into the strongest part of that range. Sometimes we run into the weakest part of that range. Sometimes we didn't have his specific hand in our assumed range at all. That's poker, and we have to enjoy the ride.

Quiz

(Answers on pg. 184)

Calculate the real-bucks, Sklansky-bucks and G-bucks for each hand.

1. Hero: J♠J♦

   Villain's assumed range: 78, AT

   Board: 5♦6♣T♥

   You both started with $20 and put $5 in preflop. The pot is now $10. Villain goes all-in for $15, and you call. Villain turns over 9♦9♠. The final board is 5♦6♣T♥A♠5♠.

2. Hero: A♠J♠

   Villain's assumed range: KQ, AK, 9♠T♠

   Board: K♠6♠5♦

   You both started with $15 and put $5 in preflop. The pot is now $10. Villain goes all-in for $10, and you call. Villain turns over K♦Q♠. The final board is K♠6♠5♦Q♦3♥.

Aggression

Bluffing

We're going to begin examining the math behind aggression in poker. We'll start with bluffing. The ability to bluff is a big part of poker. We can use it to **exploit** opponents and also to help us get value from our strong hands when playing against good, observant opponents. Some have said "Bluff just enough to get the job done." However, I've found this to be too narrow in playing poker. How do you decide whether a bluff is a profitable play or not?

You may remember the equation x / (x + y) where x is the size of the bet we must call, and y is the size of the pot before our call. Well, the equation to determine how often our opponent must fold when we bluff is the same, except now x is the amount of our bet instead of the amount of our call. So let's say the pot is $10, and we bluff the pot with a $10 bet.

x = $10

y = $10

10 / (10 + 10)

10 / 20 = 0.50

So, our opponent must fold more than 50% of the time to have a +EV bluff. Now, let's take this scenario to the next step. Our opponent is deciding whether or not to call our pot-size bet. He again uses the x / (x + y) method and comes up with the need to be good 33% of the time.

Take a second and think about that. The reason x / (x + y) works in both these situations is because it's always a reward to risk ratio. We're risking a certain amount to win a certain amount. The caller always has to be good less often because by the time it gets to him, the pot is larger. Let's examine Table 8.

Table 8. Reward:Risk ratio at work.

Ratio	Considering Bluffing	Considering Calling	Must be Good >
Risking x to win .5x	Pot-Size Raise		67%
Risking x to win .8x	1/2 Pot-Size Raise		55%
Risking x to win x	Pot Bet	Never Happens	50%
Risking x to win 1.5x	2/3 Pot Bet	Call 2x Pot	40%
Risking x to win 2x	1/2 Pot Bet	Call Pot	33%
Risking x to win 3x	1/3 Pot Bet	Call 1/2 Pot	25%

In this table, "x" will always represent the same amount. In our example, we were risking x to win exactly x. We must win more than 50% of the time. By the time the action got to the caller, he was risking x to win 2x. So, he must be good greater than 33% of the time. Notice, in hold'em, you will never have to risk x to win x *when calling*. This is because the pot is always larger than what you'll have to call. This is even true preflop because of the blinds posted. If the pot is $1, and your opponent bets $9,000, you'll be risking $9,000 to win $9,001.

9,000 / (9,000 + 9,001)

9,000 / 18,001 = 0.499

Notice the two rows on the top of Table 8: a half-pot *raise* and a pot-size *raise*. Making a pot-size raise is much different than making a pot-size bet because you have to put a lot more money in the pot to offer your opponent 2:1. A pot-size raise is similar to making a bet that's 2x pot since, in both cases, you'll need your opponent to fold 67% of the time.

Determining how much to bluff is tricky business. Some have said you want to bet just enough to get the job done. While that makes sense, what that job *is* needs to be defined. Let's look at an example.

Hero: A♠4♠

Villain: TT, JT, QJ, KJ, AJ, KQ, AK

Board: 2♠5♠9♥J♦K♣

The pot is $100. You have $180 left, and your opponent has you covered. You're thinking about bluffing with your A high since you don’t feel it's ever good here. You're thinking about making a pot-size bet. When you make a pot-size bet, you need your opponent to fold 50% of the time to break even. You have the following assumptions. To a pot-size bet, you'll feel he'll fold TT, JT, QJ and AJ, but he'll call with his KJ, KQ and AK. What percent of his range is he folding?

TT, JT, QJ and AJ total 39 combinations. KJ, KQ and AK total 30 combinations. His folding range consists of 39 out of 69 combinations.

39 / 69 = 0.565

That's about 56% of his total range. Your bluff is +EV given these assumptions. Looking at our chart and not changing his folding range, you could even bluff $125 on the river. But, you do not need to bluff that much. We realize that, in general, as we lower our bet size, his calling range increases. As we raise our bet size, his calling range decreases. When we're trying to fold out those Js, we need to make assumptions about what bet size he starts to call with them and keep our bet just over that hump. Obviously if he'd fold his Js to a $33 bet (1/3 pot), we'd rather make that bet. Looking at the EV of each of these bet sizes, we see these results.

Betting \$125: 0.56(\$100) + 0.44(-\$125) = \$56 - \$55 = \$1

Betting \$100: 0.56(\$100) + 0.44(-\$100) = \$56 - \$44 = \$12

Betting \$33: 0.56(\$100) + 0.44(-\$33) = \$56 - \$14.52= \$41.48

But, if he started to call with his Js to a \$33 bet, we'd need to reconsider. A 1/3 pot bluff must work 25% of the time. If he now calls with his Js, only the TT combinations are folding. The TT combinations represent 6 out of 69 combinations, for about 8% of his range. Obviously that's lower than the needed 25%. Looking at our EV of that bluff, we have the following.

.08(\$100) + 0.92(-\$33) = EV

\$8 - \$30.36 = (-\$22.36)

So, we need to think about our opponent's range and what he'll fold to different sized bluffs. Saying "bet enough to get the job done" is a bit narrow for the purposes of poker. Our job isn't to bet just enough to fold a certain range. It's to choose the line that makes the most money. We can even look at another option here. Let's say we shove. Let's say our assumptions are if we shove, he'll only call with KJ. KJ is 9 combinations out of 69. This is 13% of his range, which means he's folding 87% of his range. When we shove \$180 into a \$100 pot, to break even we need to have it work 64% of the time (180 / 280). Let's look at the EV for shoving given our assumptions.

0.87(\$100) + 0.13(-\$180) = EV

\$87 - \$23.40 = \$63.60

Notice this is more profitable than any other option we've listed so far. So, our job is to make the decision that makes us the most money. There are a lot of possibilities as the bet sizes and folding ranges change. You may be looking at the all this thinking "How on earth am I going to figure this out, especially while I'm playing?" There's no magic wand answer. The best recommendation I can give you in this book is to spend plenty of time away from the table working on different scenarios. This will help you develop a strong intuition when you're playing. You'll begin to get used to different ranges and what sizes work well against those ranges. It's hard work and takes a lot of effort and dedication. The great players have done so.

Quiz

(Answers on pg. 184)

1. Hero: 3♦4♠

   Villain:

   Fold - 78
   Call - KJ, AJ, AT

   Board: 5♦6♣T♥J♥J♦

   Is a 1/2 pot bet profitable?

2. Hero: 5♠4♠

   Villain:

   Fold - 78

   Call - JJ, QQ, KK, AA

   Board: 6♠8♠2♥T♥9♥

   Is a pot bet profitable?

3. Hero: 2♥2♦

   Villain:

   Fold - 99, 67, T9

   Call - AT, KT, AQ

   Board: 6♠3♥T♥Q♠J♠

   Is a 2/3 pot bet profitable?

4. Hero: Q♠A♠

   Villain:

   Fold - 89

   Call - JT, J9, KT, 33

   Board: 6♠3♥8♥J♠K♦

   Is a 1/3 pot bet profitable?

Semi-bluffing

Semi-bluffing is a powerful tool in poker. It's important to learn when to use it and how to use it correctly. Bluffing and semi-bluffing bring us into the world of **fold equity**. Fold equity is a term we use to describe what we gain when our opponent folds. Our opponent can only fold after we've shown aggression by either betting or raising. Fold equity gives us more than one way to win a pot. We can make the best hand, or our opponent can fold. In the previous section, I talked about bluffing. We learned how to think about the reward to risk ratio. Our examples were on the river where we always had the worst hand. Now, as we explore the power of fold equity, we're going to look at the more complicated semi-bluffing. Semi-bluffing is when you're betting with a hand you doubt is good right now but has a good chance to improve on a later street. Because of this, you cannot semi-bluff on the river. Let's begin by looking at an example.

We have a 100x stack and hold A♦Q♦ on the button in a 100NL game. An early position player **limps,** and we raise to $4. The big blind started with $40 and calls. The limper folds. The flop is 7♦9♦3♥. The pot is $9. The big blind has $36 left. We decide to bet $9, and he calls. The pot is now $27, and the big blind has $27 left. The turn is the K♣. The big blind bets out for $12.

As we examine our pot odds, we can see he bet just under 1/2 pot, which means we're getting a little better than 3:1 and need to have greater than about 23% equity to continue in the hand. Let's make some assumptions about his range to see how we're doing against that assumed range. I've given you no information about this player to help you formulate a range, so I'm just going to give you a range to work with. Let's say we assume his range to be AK, 88, TT and 89s.

Let's do a quick exercise to estimate our equity against that range. We’ll analyze his hand range: 9 combinations of AK, 12 total combinations of 88 and TT, and 3 combinations of 89s. These hands divide well into two groups.

Group 1: Against 88, TT, and 89s, we have roughly 15 outs with 1 card to come for an estimated 30% equity.[9]

Group 2: Against AK, we only have roughly the 9 flush outs for a total of 18% equity.

So, the 2 groups are 30% equity and 18% equity. Notice the 30% equity group contains 15 combinations, and the 18% equity group contains 9 combinations. So, the 30% group "weighs" quite a bit more than the 18% group. I'd use the MS Method here to find about 2/3 the way up from 18 to 30. The exact middle I know is 24, so I'd slide it a bit higher than that and estimate about 27% equity against this range. If you put this in Pokerstove, you'll find it gives us 28% equity. We're close, and close will do just fine.

Remember we needed 23% to call his bet, so we have the immediate odds to call his turn bet. Against his AK, it's likely we even make more money on the river as well, so there are some implied odds to consider. But, we can call without even considering implied odds.

However, we always need to make sure we consider all our options. We can fold. The EV of folding is always 0, so we know that's already worse than calling and out of the question. We can call, and we already explored that briefly. But, we can also raise. We can even raise to different amounts. Remember, only through aggression can we take advantage of fold equity.

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[9] I say "roughly" because against some of the TT and 88 hands, he has a diamond which reduce our flush outs by one.

We can **minraise** or shove and every amount in between. This aggression will give us more than one way to win the hand. We can make the best hand for showdown, or he can fold. Let's look at shoving.

First, let's make some assumptions about how he'll respond to a shove with his range. Let's say he'll call with AK and TT, but will fold 88 and 89s. There are 15 combinations he calls with, and 9 combinations he folds. So, he folds 37% of the time.

We have about $87 left in our stack, but our stack doesn't matter here because the big blind has less money than we do. He had $27 left in his stack on the turn and then bet $12. So, he now has $15 left. There is currently $39 in the pot. We can move all-in, which will risk $27 to win the current $39 pot. Going back to the reward to risk table (See Table 8), we know when risking x to win about 1.4x, we need to him to fold about 40% of the time. He's only folding 37% of the time. Does that mean raising is not good? No. In the bluffing section, we were always looking at a straight bluff with no chance of improvement. Here we have showdown equity in the hand to go along with our fold equity. Let's look at a detailed way to figure out how often he needs to fold when we shove. If this look complicated, do not be concerned. At the end of this section, I'm going to show you a shortcut to do this at the table.

Fold%(pot won when he folds) + Call%(amount we win/lose when he calls)

Here we're going to let x equal the percentage of times he folds.

x($39) + (1-x)(0.24($54) + 0.76(-$27)) > 0

39x + (1-x)($12.96 – $20.52) > 0

39x + (1-x)(-7.56) > 0

$39x - 7.56 + 7.56x > 0$

$46.56x > 7.56$

$x > 0.1624$

He has to fold more than 16% of the time in order for our shove to be +EV. I often like to test my work to make sure I did it correctly. Here we can plug in the percentages.

$0.1624(\$39) + 0.8376(0.24(\$54) + 0.76(-\$27)) > 0$

$\$6.33 + 0.8376(\$12.96 - \$20.52) > 0$

$\$6.33 + 0.8376(-\$7.56) > 0$

$\$6.33 - \$6.33 > 0$

Our work checks out. Notice he is folding 37% of the time, and we only needed him to fold 16%. So, obviously the shove is +EV. Let's look at the EV of this shove.

$0.37(\$39) + 0.63(0.24(\$54) + 0.76(-\$27)) = EV$

$\$14.43 + 0.63(-\$7.56) = EV$

$\$14.43 - \$4.76 = \$9.67$

Let's compare this to the EV of the calling.

$0.28(\$39) + 0.72(-\$12) = EV$

$\$10.92 - \$8.64 = \$2.28$

So, we can see the power of the semi-bluff here. We often win the whole pot uncontested, and when we do win on the river if he calls, we win a bigger pot.

There are three key variables when analyzing whether or not a semi-bluff shove is a good move.

1. The size of the pot in relation to the money left. The larger the **stack to pot ratio,** the more often he must fold. This is because we're proportionally risking more.

2. How often he folds. Normally the smaller the stack to pot ratio, the less often he'll fold and vice versa. This is because our opponent is normally aware of the reward to risk ratio to some extent.[10]

3. Your showdown equity. The more showdown equity you have, the less often he'll have to fold.

Now, I promised a shortcut, so here it is. We're going to look at our reward to risk ratio in this shortcut.

The pot is currently $39. We have to shove $27. Remember when we shove, we have equity. So, shoving isn't risking $27 to win $39. We have to find out what we're actually risking. Our shortcut has three steps.

1. Total pot size times our equity.
2. Subtract the result from step one from our bet.
3. Examine the reward to risk ratio.

Let's examine these three steps from our example.

1. The final pot would be $81. Our equity against his all-in range is 24%. That would about $20.[11]

[10] Even though they may not know the math, most people will be more cautious calling a large amount to win a small amount and vice versa.
[11] I would do this quickly by thinking of 80 divided by 4.

$81(0.24) = $19.44

2. Our shove is $27.

   $27 - $20 = $7

3. We're risking $7 to win $39.

   7 / 46 = 0.15

We come up with 15%, which is almost exactly what we need. This shortcut can be done very quickly rounding like this and is very effective. Let's look at one more example using this shortcut.

Let's say you're in a hand preflop against an aggressive player. You've been fighting a lot preflop with raises and reraises. You both start with $100. You have KJo in the big blind. He open raises on the button to $3. You reraise to $8. He reraises you to $25. You know he can have a lot of monster hands here, but you also believe he's bluffing a lot as well. Calling here isn't an attractive play because you miss so often on the flop, do not have the initiative and are **out of position**. You'd like to find out how often he has to fold in order to have a +EV shove. This is a preflop semi-bluff shove.

The pot is currently $33. You have $92 left in your stack. Remember if you shove here, you will certainly have showdown equity. So, shoving isn't risking $92 to win $33. We have to find out what we're actually risking. Let's use our shortcut. I'm not going to show the math here and just display how I would think in the hand.

1. To start this, we need to estimate our equity verses his all-in range. Let's assume he'll call our shove with TT+

and AQ+. Our equity with KJo against that range is about 30%. So, when we get all the money in, we'll own 30% of that pot. The final all-in pot will be about \$200. And, 30% of \$200 is \$60.[12]

2. If we subtract that from the amount we have to shove, which is \$92, we get \$32.

3. We're risking \$32 to win \$33. This is about x to win x, so we need to have him fold 50% of the time. You can check the work with the long equation we did before.

We can even take this a step further and find out what percentage of hands he would have to reraise to make our shove +EV. He is calling with about 4% of hands. What number times 50% equals 4?

$0.50x = 4$

$x = 8$

He would have to reraise with more than 8% of hands to make our shove +EV.

So, you are now equipped to do a lot of work away from the table examining semi-bluffs and have a quick way to estimate how often they need to fold when you're at the table. As you work with more of these, you'll get very quick at this.

[12] I would do this quickly by thinking about what 10% of \$200 is and then multiplying that times 3.

Quiz

(Answers on pg. 188)

Assume villain always has us covered. Use estimations to answer the following questions.

1. Hero: 3♦4♠

   Villain: T♣9♣

   Board: 5♦6♣T♥J♥

   Pot was $10. We shove $20. How often does villain have to fold?

2. Hero: 5♠4♠

   Villain: A♦A♣

   Board: 6♠Q♠K♥

   Pot was $10. We shove $30. How often does villain have to fold?

3. Hero: A♠K♥

   Villain: T♣8♣

   Board: 6♠3♥T♥

   Pot was $10. We shove $24. How often does villain have to fold?

4. Hero: Q♠A♠

   Villain:

   Fold - 89, 99, TT

   Call - AJ, J9, 33

   Board: 6♠3♥8♥J♠

   Pot was \$10. We shove \$25. Is a shove profitable?

Value-Betting

Value-betting is one of the most important skills in poker. The term itself is a little bit tricky because we're always thinking of value when we're betting. The reason we bluff is because we believe it has more value than not bluffing. However, the term value-betting is reserved for betting when we believe we have the best hand. We're trying to extract as much value as we can when we actually have the goods.

There are common misconceptions about value-betting I'd like to address. Often times I hear players say "I want worse hands to call." Or they say "I'm trying to not lose my customer." It's important to realize that when we're betting for value, we're still executing the second key to good poker. The goal is to maximize value. Sometimes we maximize value by getting small, steady payouts and other times we maximize value by getting the infrequent, big payoff. Let's use an extreme example to see this at work.

Hero: A♦J♦

Villain:

> Call up to $8 – A9, A2, AJ, AQ, K♦Q♦
> Call all-in for $500 - K♦Q♦

Board: 2♣5♦8♦A♥7♦

We'll pretend that villain has $500 left on the river. The villain will never raise any of our bets; he'll call with his entire range. However, he'll only call up to $8 with his entire range. But with his flush, he'll put the rest of his money in the pot. So, we'll say we can only make either an $8 bet or a $500 bet. Notice the villain has 29 combinations in his range. His flush hand is only one combination, which represents about 3.5% of his total range.

His pair hands represent 96.5% of his range. If our goal is to not lose a customer, it's obvious which bet size we should make. If we bet $8, we keep our customer every time. Also, if our goal is to get worse hands to call, we get them all to call with the $8 bet. However, let's examine the EV of both of these bets.

The $8 bet gets called 100% of the time, so, the EV of the $8 bet is $8.

$8(1) = $8

The $500 bet only gets called about 3.5% of the time.

$500(.035) = $17.50

The EV of the $500 bet is $17.50. This is more than double the EV of the $8 bet even though it's getting called much less often. So, in this extreme example, we are better off going for that big payoff.

Now let's tweak the example a bit. We'll give the villain $100 left. Now look at our EV of a $100 bet.

$100(0.035) = $3.50

Here the EV of the $8 bet is more than double the big payoff. So, when he has $100 left, we're better off going for the small, steady payout. But, not every example is this cut and dry.

Much like choosing your bluff sizes, choosing your value bet sizes can be tricky business. The best way to improve is through analyzing situations away from the table and getting used to common situations. That way you can quickly recognize those situations when you come across them and will know what to do.

Now, let's say villain will always raise with his flush, but still will always call with his pairs. His raise will be an all-in raise, and we'll give him a \$500 stack again. Let's examine our choices again.

The EV of the \$500 bet is still the same. He's calling 3.5% of the time, and the EV is \$17.50. However, let's examine the \$8 bet.

$\$8(0.965) + \$500(.035) = EV$

$\$7.72 + \$17.50 = \$25.22$

So, we get action with our \$8 bet 100% of the time, and we still get the benefit of the big payoff 3.5% of the time. Notice our EV is \$25.22. This is obviously better than the \$17.50 EV of the \$500 bet. If we wanted to, we could figure out how often he needs to raise with his flush in order for the \$8 bet to be better than the \$500 bet. We can let x equal the percentage of time he raises with his flush. We will solve for x where the result is greater than \$17.50.

$\$8(1-x) + \$500(x) > \$17.5$

$8 - 8x + 500x > 17.5$

$8 + 492x > 17.5$

$492x > 9.5$

$x > .0193$

He has the flush 3.5% of the time. We can find out how often he must raise with his flush by dividing .0193 by .035.

$.0193 / .035 = 0.551$

So, if he'll raise with his flush a bit over 55% of the time, we're better off just betting the \$8.

We’re starting to get a glimpse at how tricky it can be to properly size our value bets. It’s takes a very good grasp of our opponent’s strategy to do this well at the table. That requires hard work and experience, but the rewards show up with a much improved win rate.

As a general rule, when you're value-betting, you want your opponent calling with more than 50% worse hands than better hands. To demonstrate this, we can imagine we bet $1. We'll let x equal the percent villain calls with a worse hand. So 1-x will be the percentage he calls with a better hand.

$x(\$1) + (1-x)(-\$1) > 0$

$1x - 1 + 1x > 0$

$2x = 1$

$x = 0.5$

Given this, sometimes we have assumptions that do not allow us to bet. For example, let's say we're on the river with T♠T♣. The board has come down 2♥3♦8♥J♦A♥. Our opponent is a conservative, timid player. We've bet half-pot on both the flop and turn. Our opponent has called both our bets. Once he called the turn, we gave him the assumed range of 99, 89 or a flush draw. The A♥ on the river removes a lot of the flush draw combinations we had given him. We feel he'll play mostly connected, suited hands with perhaps a few **1-gappers** in his range. So, we'll give him about 10 combinations of made flushes. There are 18 combinations we beat, and 10 have us beat. We have the best hand the vast majority of the time at 64%. However, this doesn't mean we should bet. Since our opponent is conservative and timid, the A♥ is likely to have scared our opponent. It would be a reasonable to assume that he will no longer call a bet with either his 99 or 89. That leaves only the hands that beat us. Our bet never gets called by a worse hand. Say we bet $10 on the river.

0.64($0) + 0.36(-$10) = EV

$0 - $3.60 = (-$3.60)

Checking is certainly better than any of our betting options.

Let's go one step further with this hand and say our assumptions have changed, and he would call with his 89. This certainly isn't logical if he'll fold 99, but let's go with it for the sake of this example. We can analyze his range: 89 represents 43% of his range, 99 represents 21%, and the suited hands are 36%.

0.21($0) + 0.43($10) + 0.36(-$10) = EV

$0 + $4.30 - $3.60 = $0.70

We have a +EV bet because he's calling with more than 50% worse hands than better hands. However, there are other things to consider.

Against aggressive opponents, we may have to consider the impact of being raised as a bluff. If we fold to his raise, we'll need to have him call a bit more than 50% of the time to make up for the times we fold to a worse hand. It's a good exercise to examine different bet sizes when you're working on a situation away from the table. Maybe you work out three or four different bet sizes and examine them. You may have different assumptions for each bet size. Sometimes you'll be surprised at what you find. For example, let's say you have the nuts on the river. Betting large with the nuts is normally a good plan. However, if you're against an aggressive opponent, you may find that a smaller bet might induce a raise from a large portion of his hands that he'd normally fold to a large bet. The same is true when considering whether or not to bet. Against any aggressive player, it may be more beneficial to check and left him bluff if he'll bluff with a larger number of weak combinations than he'll call with.

Again, quality time spent away from the table working on value bets will help you develop a good intuition to draw from at the poker table.

Quiz

(Answers on pg. 191)

1. Hero: K♥Q♥

   Villain:

   Call $20: QT, AJ, QJ, J9

   Board: Q♠2♣9♥J♠7♦

   Is a $20 value bet profitable? If so, what is the EV?

2. Hero: K♥Q♥

   Villain:

   Call $20: QT, AJ, QJ, J9

   Bluff raise (you'll fold): 55

   Board: Q♠2♣9♥J♠7♦

   Is a $20 value bet profitable?

3. Hero: K♥Q♥

   Villain:

   Call $20: QT, AJ, QJ, Q7

   Bluff raise (you'll fold): 55

   Board: Q♠2♣9♥J♠7♦

   The pot is $20. Is a $20 value bet profitable?

4. Hero: A♦J♦

   Villain has $60 left:

   Call up to $20 – A9, AT, AK, AQ, J9, JT, QJ

   Call all-in for $60 – AK, J9, JT, QJ

   Board: 2♣5♦J♥A♥J♠

   Which bet is more profitable?

5. Hero: A♦J♦

Villain has $60 left:

Call up to $20 – A9, AT, AK, AQ, J9, JT, QJ
Shove $60 as bluff after your $20 bet (you'll call) – 78
Call all-in for $60 – AK, J9, JT, QJ

Board: 6♣5♦J♥A♥J♠

Which bet is more profitable?

6. Hero is out of position: K♥Q♥

Villain:

If you bet:
Call $20 bet: QT, AJ, QJ, J9
If you check (you'll call):
Bet $20: QT, QJ, J9, AT

Board: Q♠2♥9♥J♠3♦

Is it better to bet or check/call?

7. Hero is out of position: K♥Q♥

Villain:

If you bet:

Call $20 bet: QT, J9

If you check:

Bet $20: QT, QJ, J9, AQ

Board: Q♠2♣9♥J♠7♦

The pot is $20 before anyone bets. Villain only has $20 left in his stack. What's the best action to take?

At the Table

A Bit of Memory

Up to this point, I've used very few methods that require any memory. However, there are a few situations that come up very frequently where it will benefit you to commit a few things to memory. Mostly this consists of preflop scenarios and hands that clash on a given flop. Memorizing these situations will just save you energy when playing in real time.

Table 9 shows situations that are good to memorize when estimating your equity preflop. This is useful information if you're going to be getting all-in preflop. Note the unpaired hands in the examples are all offsuit holdings. When you hold a suited hand instead of an offsuit hand, you're preflop equity generally increases by about 4%.

Table 9. All-in preflop equity for hand groups.

Situation	Example	Equities
Overcard vs. 2 middle cards	A8o vs. QJo	57% vs. 43%
Overcard vs. 1 middle card	ATo vs. Q7o	65% vs. 35%
2 overcards vs. 2 under cards	55 vs. AKo	55% vs. 45%
Pair vs. 1 overcard	88 vs. A2o	70% vs. 30%
Pair vs. 2 undercards	KK vs. 87o	82% vs. 18%
Pair vs. 1 undercard	AA vs. AKo	93% vs. 7%
Overpair vs. underpair	AA vs. 55	81% vs. 19%

Another good thing to commit to memory is strong preflop hands compared to strong preflop ranges. Again, this is useful when you're going to be getting all-in preflop. Many times after you've reraised with a hand like JJ, someone will shove over you. You need to think about their range to estimate your equity and then consider your pot odds in order to decide whether to fold or call. Table 10 gives some very common situations in which I find myself when facing shoves from my opponents. The villain's ranges I provide in this chart are my assumptions about what the villain is holding. If you find your assumptions are different for situations you're running into frequently, figure out what your equity is verses those ranges and memorize those.

Table 10. All-in preflop equity with strong hands verses strong ranges.

Villain's Range	Hero's Holding	Hero's Equity
JJ+, AK	QQ	47%
JJ+, AK	AKs	43%
JJ+, AK	AKo	40%
JJ+, AK	JJ	38%
JJ+, AK	TT	34%
TT+, AQ	QQ	55%
TT+, AQ	AKs	52%
TT+, AQ	AKo	49%
TT+, AQ	JJ	47%
TT+, AQ	TT	40%
TT+, AQ	AQs	38%
TT+, AQ	99	37%
TT+, AQ	AQo	34%

The final preflop numbers I want to include in this book are ones that I use much less frequently. I use these when I want to analyze the profitability of certain plays. Table 11 shows how often different types of hole cards will flop different hand strengths. Here’s an example of using this information. One of the players at my table has been **3-betting** my preflop raises a lot. I've noticed he's also been betting almost every time on the flop when I call preflop. I'd like to examine how often I'll flop at least a flush draw if I call his 3-bet preflop with a hand like 46s. I can use the information in Table 11 to figure that out.

Table 11. Hole cards flopping hands.

Hole cards	Flop	Percentage
Pocket pair	Set or better	12%
Suited unpaired	Flush	1%
Suited unpaired	Four-flush	11%
Suited unpaired	Backdoor flush draw	42%
Unpaired	Pair	27%
Unpaired	Two pair	2%
Unpaired	Trips	1%
Connectors	Straight	1%
Connectors	Open-ended straight draw	10%
1-Gapper	Straight	1%
1-Gapper	Open-ended straight draw	8%

For the final part in this section, we should be familiar with some of the common clashing hands on a given flop. Table 12 shows some of these situations. The equities given are assuming you will be seeing both the turn and the river.

Table 12. Clashing flops.

Situation	Example	First Hand's Equity
Flush draw vs. set	A♠J♠ vs. 8♦8♥ Board: 2♠3♦8♠	26%
Overpair vs. pair + flush draw	A♦A♠ vs. 5♥7♥ Board: J♥2♥7♣	50%
Pair vs. flush draw + overcard	A♣J♣ vs. K♥K♦ Board: 2♣7♣J♥	52%

These are some of the more common situations I commit to memory. Again, you may discover you're thinking heavily about a certain situation frequently while playing. If that's the case, be sure to analyze that situation and commit it to memory so you're not spending energy on it at the poker table.

Quiz

(Answers on pg. 197)

1. How often will you flop a four-flush with suited hole cards?

2. How often will you flop an open-ended straight draw with connectors?

3. How much equity does a flush draw have verses a set on the flop assuming you're all-in?

Chunking

A fascinating thing about a no-limit game is how the pot grows exponentially. Your preflop wager may only be three big blinds. However, by the river, a pot-size bet may be for 60 big blinds. Beginning players often **slowplay** a big hand on the flop and/or turn only to discover they now have a tiny pot on the river and a bunch of money behind. Out of desperation to get paid off with their big hand, they often shove all the money in the middle, making a massive **overbet**. Learning how to chunk your stack in order to comfortably get all-in is a very important no-limit skill. It's betting with purpose. This math is a little different than what we've covered so far as it's not counting combinations or estimating equity. We're simply figuring out how to divide our stack up into chunks. Watch how this can work.

With a 100x stack, it's very simple. Let's pretend you're in a $0.50/$1 NLHE game and have a 100x stack. You open with a pot-size raise preflop ($3.50). Everyone else folds to the big blind, who also has a 100x stack. He calls. You're **heads up** against the big blind, and the pot is $7.50. You now have $96.50 left in your stack.

You bet pot on the flop, and he calls. The pot is now $22.50. You now have $87 left in your stack.

You bet pot on the turn, and he calls. The pot is now $67.50. You now have $66.50 left in your stack. This is all set for a pot-size bet on the river to get you all-in. If you make four pot-size bets against one player, that will be the end of a 100x stack. However, watch how one tiny detail can change things.

Let's say you open to $3 preflop instead of $3.50. Now the preflop pot is only $6.50 instead of the $7.50 it was before.

Seems like a small thing, right? Let's run it out again. You now have $97 left in your stack.

You bet pot on the flop, and he calls. The pot is now $19.50. You now have $90.50 left in your stack.

You bet pot on the turn, and he calls. The pot is now $58.50. You now have $71 left in your stack. Now in order to get all your money in, you have to bet $71 into a $58.50 pot. This can be a significant change to your opponent's mentality in terms of whether he feels like he should call your river bet.

Notice the difference in those two scenarios started with 50 cents. In terms of the difference in your stack and the pot, that 50 cents resulted in a $13.50 difference. You went from having $1 less than the pot on the river to having $12.50 more than the pot on the river. The extra $1 in the preflop pot turns into $9 by the time the turn betting is over and $27 by the time the hand is over. There are many important things to point out about this phenomenon of exponential growth.

The first thing is the importance of the amount you bring to a table. If you bring 100x or more, be prepared to face some very large river bet decisions. Because the river is the final stage in the hand, it’s the point at which the maximum amount of information has been revealed. All the cards are out, and all the betting patterns and tells have been revealed. It’s the point at which the more experienced player has the greatest advantage. Unfortunately for the beginner, it’s also the point where the big money is won or lost. More often than not, the beginner is going to take a beating on the big-money streets. Because of this, my recommendation for many beginners is to start with a 40x stack. This can easily turn hold’em into a game with three rounds of betting instead of four. Watch the pot unfold when we start with

40x. We make a pot-size preflop raise and get one caller. The pot is $7.50. You now have $36.50 left in your stack.

You bet the pot on the flop, and he calls. The pot is now $22.50. You now have $27 left in your stack. You have a bit more than a pot-size bet left on the turn. There is little to no betting left to be had on the river. This can save the beginner both headaches and money while he's developing his skills.

You can also think of how multiple callers would impact a hand. Imagine if we raised pot preflop, and three players called. Now the pot on the flop might be up to $12. What a difference this makes in getting your stack in!

Notice thinking in terms of big blinds instead of money can simplify the betting among different stakes. It doesn't matter if you're playing $0.50/$1 or $500/$1,000. If you started with 100x stacks and have one opponent, the money is all gone after four pot-size bets. It often helps to think in terms of big blinds instead of actual money.

Another thing we can tinker with is getting out of the box with our bet-sizing. Something I've noticed is that many players play NLHE as if it's actually pot-limit hold'em. You rarely see players get creative with their betting. However, thinking in terms of chunking our stack gives us the control to determine how many streets of betting we'll allow to take place. How many streets do you want to play? You decide. In a video I recently made for dragthebar.com, I played the following hand.

I had a 100x stack and opened with a pot-size raise in early position holding A♠K♦. A loose and aggressive player called me in middle position, and everyone else folded. He started the hand with a 50x stack. The flop was A♥J♥T♦. I considered this to be a very good flop for my situation. I felt my opponent had all sorts of As, Js and Ts in his range and was in no way folding any pair on the flop. Also, I thought his range was packed with **broadways** and middle cards that would give him all sorts of straight draws. He was also playing many suited hands so could easily have had about 30 combinations of flush draws in his range. In other words, my opponent was going to be calling a flop bet a lot. Also, it's a flop where a weak hand like a small pocket pair isn't going to be calling much of a bet anyway. My opponent wasn't a good player, so I felt he would be happy to call a very large bet. Another interesting thing about this flop is that is can change dramatically after the turn and river. Another heart or a broadway card can dramatically change how we each view the board and interpret our hand strength. So, I decided I wanted to end this hand on the turn. The preflop pot contained 8 big blinds. My opponent had about 46 big blinds left in his stack. If I bet the pot on the flop, the turn pot would contain 24 big blinds, and he would still have 36 big blinds in his stack. So, I decided I would overbet the flop. I bet 14 big blinds, and he called. This gave us a 36 big blind pot on the turn and only 32 big blinds left in his stack. Getting all-in on the turn was a very comfortable call for him at that point. So, thinking about chunking and getting creative with my bet-sizing, I was able to dictate how many streets I wanted to allow betting to happen.

This creative betting can also take place preflop. The size of our preflop raise creates our stack to pot ratio (aka SPR) on the flop. Analyzing the SPR in a hand can be a quick way to think about chunking. The SPR is a product of dividing the effective stack size on the flop by the size of the preflop pot. For example, if we make a pot-size raise preflop, and the big blind calls, the preflop pot is 7.5 big blinds. If we started with 100x, we now have about 96.5 big blinds left.

96.5 / 7.5 = 12.86

So, we end up with an SPR of about 13. As we saw, an SPR of 13 gives us a pot-size bet on each postflop street. If we minraised preflop, and the big blind called, the pot would be 4.5 big blinds preflop. We would have 98 big blinds left. Our SPR would be 22. An SPR of 22 would make it impossible to get our whole stack in unless someone raises or overbets a street postflop. Now, that may not actually be a bad thing. Maybe your hand and situation isn't one where you're going to be comfortable getting all-in very often. You get to cater to these situations preflop with your bet sizes. You can't always design your SPR because you can't be certain how many players will call. But, you can certainly head that direction. You'll find that playing live will give you much more room to work with preflop bet-sizing. Whereas online, it's very rare, almost awkward, to see a preflop raise larger than four big blinds if no one has already entered the pot. The idea of SPR was first introduced to the poker community by a book entitled *Professional No-Limit Hold'em*. I recommend that book for those interested in learning more about the topic of SPR and how you can use it. I merely introduce it here so you can think more clearly about chunking up your stack. Table 13 shows some betting lines you can take to get all-in by the river given different SPRs.

Table 13. Chunking options with common SPRs.

SPR	Chunking Option
13	Pot, pot, pot
9	Pot, 3/4 pot, 3/4 pot
7	3/4 Pot, 3/4 pot, 3/4 pot
5.5	Pot, half-pot, half-pot
3.5	Half-pot, half-pot, half-pot

Quiz

(Answers on pg. 198)

1. What is a danger of slowplaying?

2. If there were pot-size bets on all three postflop streets, what would the difference be between a $5 preflop pot and a $7 preflop pot in terms of the size of the final pot?

3. Hero’s stack: 80 big blinds

   Villain’s stack: 70 big blinds

   Pot: 8 big blinds

   What’s the SPR?

4. How might we create lower SPRs?

5. What factors might make it difficult to create an SPR we may desire?

Set-Mining

Sets are one of the biggest money makers in any poker player's database of hands. They have the potential to win some massive pots. **Set-mining** can be very profitable. Looking back to Table 11, you'll see that a pocket-pair flops a set or better about 12% of the time. Many players have gotten into the habit of calling with any pocket pair and then simply folding if they do not flop a set. However, if they do flop a set, they do their best to get all the money in the middle. Let's begin approaching set-mining through the most optimistic eyes.

Thinking in terms of ratios, the odds against a pocket pair flopping a set are about 8:1. So, let's assume that every time you flop a set, you'll be able to get all-in. Let's say your opponent raised to \$1 preflop. You called the \$1 preflop with the idea of flopping your set or folding. Let's find out how much money you'd have to win in order to break even.

$0.12(\$x) + 0.88(-\$1) > 0$

$0.12x - \$0.88 > 0$

$0.12x > \$0.88$

$x > \$7.33$

In order to break even, you'd have to get about \$6.33 postflop since his \$1 is in preflop too. So, if we could call with a pocket pair and win our opponent's stack every time, we'd always have to make sure he started with about 8 times more than what we had to pay to see the flop, and we'd be all set. But, it's not that easy. There are many factors that make the need for our implied odds to get higher and higher.

First of all, the above calculation assumes we have 100% equity when we flop a set. This is certainly not the case. When most sane opponents want to get a lot of money in on the flop, they're normally going to have something they like. Maybe they flopped a flush draw, and you have 75% equity. Maybe they flopped a straight, and you have 35% equity. In fact, you may be drawing to one out if someone flopped a bigger set. The point is, you do not have 100% equity.

Let's say you have 3♥3♠ and call a $1 preflop raise from your opponent who started with $8. You flop 3♦7♠Q♦, and your opponent gets all-in with his K♦K♥. Your opponent has 13% equity. Here's your flop EV getting all-in.

0.87($7) + 0.13(-$7) = EV

$6.09 - $0.91 = $5.18

This is more than $1 short of what we needed to get postflop. However, it's one of the best situations we can expect to get postflop. Let's say that our average equity when we get all-in postflop against a sane opponent is 80%. This number will change depending on the types of hands with which your opponent will put in the rest of his money. Looser players may be willing to get their money in the middle with much worse equity on average than more timid players. However, let's use this 80% as an example. How much money would our opponent have to have in his stack?

0.80(x) + 0.20(-x) > $6.33

0.80x – 0.20x > $6.33

0.60x > $6.33

x > $10.55

Given an assumption of averaging 80% equity when getting all-in, our opponent would need to stack with almost 11 times what we had to call preflop. However, there's more to the story.

When our opponent starts with KK, and we flop a set, an A will also hit the flop about 16% of the time. We may be very unlikely to get our opponent's stack now since he may be afraid we have an A. Of course, this gets worse when he holds QQ as a K and/or an A may flop. This cuts down on our implied odds.

You also need to consider how well you play postflop. Will you have a hard time folding 88 when the flop comes 67s3, and the villain bets pot? Do you read hands well enough to handle these situations in a way that maximizes your earnings and/or minimizes your losses? Also, many times you'll be out of position postflop, and it will be difficult to extract money from much of your opponent's range.

A good tip here is to set-mine when you know your opponent's range is strong. If your opponent is a tight player and raises from early position, he's likely to have a very strong hand range. If your opponent is a loose and aggressive player and raises from late position, his hand range is likely quite weak. The stronger hand ranges will find more reasons to get all-in on many more flops than a weaker hand range.

Some players have recommended set-mining only if your opponent has started with 25 times the amount you have to call preflop. While I think this is a bit excessive, I think we've seen the point clearly. We need more implied odds to strictly set-mine than we may think by looking at the odds of flopping a set or better. If you play well postflop and have a good handle on your opponent's strategy, my recommendation would be making sure your opponent has about 15 times what you must call preflop. This is just a generalization, and table conditions and past hands may cause you to tweak this number in one direction or the other.

Quiz

(Answers on pg. 198)

1. How often will you flop a set or better when calling preflop with a pocket pair?

2. What are some of the factors to consider when determining whether or not it's profitable to call preflop with a pocket pair?

How Much to Bet?

So far, we've learned how to think about bet sizes by comparing them to the pot. We've also learned how to think about bet sizes on the river given our opponent's range and what percentage of his range will call different bet sizes. We've even learned how to think about bet sizes in terms of chunking up our stack. Now we're going to look at sizing our bets given our opponent's range when we're on the flop and turn. This is different than what we've looked at so far because our opponent will almost always have some amount of showdown equity. We have to consider that if we do not bet, we give him a free chance to realize that equity. What's worse, we may even give him more money after he improves. Letting an opponent draw for free and then paying him more money when he hits is certainly an unattractive idea.

Figuring a good bet size does not a have an easy prescription. Some have suggested that beginners default to a 2/3 pot bet when they're trying to get value for a hand. That's a decent default in my opinion. However, as we try to improve our game, we want to move beyond a default bet size.

Thinking about maximizing value from your opponent's range always takes precedence over making bets to chunk in your stack. Let's look at an example of this.

You have A♦A♥ and raise preflop. The big blind calls. He's a very tight and uncreative player. You both started with $100. The pot is $7.50, and the flop comes down A♠7♣2♥. Your opponent checks. You look at your SPR and realize it's 13. You know you need to bet pot on three streets to get all-in without overbetting on any street. However, you believe your opponent's range is comprised mostly of smaller pockets pairs. That range does not have many hands that are willing to put all their money in on this flop. The only legitimate hands that would want to get the money in are worse sets. The worse sets will play themselves out for stacks more often than not regardless of what we bet. Given your assumptions regarding your opponent's range, you may want to make a very small bet to induce action from your opponent's weaker range. Maybe he'll make a call with 66 if you only bet 1/4 of the pot. You may even consider checking since there is so little value in making a sizable bet. These actions will not build the pot in a manner that allows you to chunk your stack in easily, but it's the best course of action given your opponent's weak range on this flop.

Now let's change our opponent and the flop. We have A♦A♥ again, but the flop is now T♣J♣6♠. The big blind is now a loose player who likes to call with any sort of draw or pair postflop. Preflop he would call with any broadway hands, any suited hands and any pocket pairs. Now this flop connects well with much of our opponent's range. He has a lot of pairs and all sorts of straight and flush draws. We now have a reason to begin thinking about how we want to chunk up our stack.

A big part of bet sizing is thinking about what type of odds we're offering our opponent. We're taking the idea of pot odds and flipping it around. Now we're the villain, and we're betting into the pot. When it gets to our opponent, what type of odds will he have to call? We want villain to make a mistake, so we're rooting for him to call when he does not have the pot odds to call profitably. When the villain makes a mistake, we reap the profits. The amount we profit is proportional to the size of his mistake. I often see players make large bets and openly tell the rest of the table "I need to get those drawing hands to fold." They are content to win what's in the pot already. However, that's not good thinking. We're trying to maximize our earnings. If our opponent can call profitably, we prefer they fold. If our opponent cannot call profitably, we prefer they call. Let's look at an example.

Hero: A♣A♠

Villain: 5♦6♦

Board: 3♠4♠K♥Q♥

The pot is $10, and we have $10 left in our stack. The villain has eight outs with one card to come. His equity is about 16%. If we bet 1/4 pot, he would have about a neutral EV call since he would need about 16% equity. Since he's not losing any money, we're not making any money. However, this is still better than checking. If we check, we're giving away 16% of the current pot. If we bet $5, then villain would need to have 25% equity. He does not have that much, so his call is -EV. Let's look at the EV of his call.

0.16($15) + 0.84(-$5) = EV

$2.40 - $4.20 = (-$1.80)

On average, he loses $1.80 if he calls.[13] Where does that money go? It goes to us. If he calls, we will own 84% of a $20 pot. That's $16.80. If he folds, we get the $10 pot and our $5 back. The difference is $1.80. Yes, sometimes your opponent will draw out on you, and that will cost you the pot. But, we make more money when we bet and he makes an unprofitable call. So, we're not trying to blow our opponent off a draw when he cannot call profitably. Obviously, if we could bet the whole $10, and he would call, that would be even better for us. When he cannot call profitably, we want to bet as much as he will call. Even if

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[13] This is assuming we can play perfectly on the river so he has no implied odds.

he *can* call profitably, if we have the best hand, we should still bet (See Appendix B).

So far in this section, we've only discussed situations where we've known our opponent's hand. When we don't know our opponent's hand, we have to consider that he is likely to have implied odds against us. Let's go back to our previous example.

Hero: A♦A♥

Villain: Unknown

Board: T♣J♣6♠.

Again, our villain is loose and aggressive. The pot is again $7.50, and we have $96.50 behind. We know he can have draws like KQ as well as draws like 3♣4♣. If a club comes on a later street, he is capable of bluffing with his unimproved KQ. If a 9 comes on a later street, he is capable of bluffing with his unimproved flush draw. Now we're in a situation where we can't play perfectly on the river, and we're probably going to have to pay him off sometimes.[14] Because he has implied odds, we'll want to bet larger in this spot to cut down on his implied odds as much as possible. We're still wanting him to make a bad call, but we want to make his strategy -EV through the whole hand. We can now look at implied odds through the eyes of our villain. Let's say we bet $8 on this flop. The villain has 16% equity to the turn. This means he needs six times our turn bet. That's $48. There is already about $24 in the pot. So, he would need to get

[14] Notice how valuable hand-reading is. If our opponent is more predictable, we can practically play like his hand is face up. Against an opponent who doesn't bluff, we can proceed very simply in this hand. We bet the largest amount we think the player will call with typical draws. Then we can simply fold to his aggression if draws are completed by future cards. Also, notice the value of being perceived as an aggressive player.

more than $24 from us when he hits his draw. We'll need to decide how we want to approach the hand. Larger SPRs make playing these spots difficult. But, as you can see, if we're willing to put the rest of the money in, and we wish to significantly cut down villain's implied odds, we may have to do something creative here. We may consider different ideas like overbetting the pot or even going for a check/raise if we can.

As always, we need to consider the distribution of villain's range when we're betting. Here's an example of that.

Hero: A♦K♥

Villain: QJ, 5♣6♣, T♣9♣

Board: A♠7♣ Q♣8♥

We have raised in late position, and a tight player called in the big blind. The pot is $10, and we have $15 in the effective stack. We're ahead of villain's entire range; however, some of his draws have much more equity than others. He has 12 combinations of pair hands drawing to 5 outs. He has 2 combinations of an OESFD drawing to 15 outs. So, 86% of his range is drawing to only 5 outs. We could bet enough that the villain couldn't profitably call with 15 outs, but if that meant he would fold with his 5 out draws, we need to reconsider. We assume villain will call up to $5 with his whole range; however, he'll call all-in with his huge draws. He has 11% equity with the 5 out draw, and 34% equity with his OESFD. If we bet pot, he'll need to be good 33% and has a profitable call. We'll examine the EV of both shoving and betting $5. Let's start with the shove. Here is his EV when we shove.

0.34($25) + 0.66($15) = EV

$8.50 - $9.90 = (-$1.40)

It's obviously a mistake for him to call, and we profit. However, he only makes that mistake 14% of the time. When he calls, we'll own 66% of a $40 pot. He folds 86% of the time, and we win the $10 pot. Here's our EV when we shove.

0.14(0.66($40)) + 0.86($10) = EV

0.14($26.40) + $8.60 = EV

$3.70 + $8.60 = $12.30

When we bet $5, notice he can call profitably with his big draws.

0.34($15) + 0.66(-$5) = EV

$5.10 - $3.30 = $1.80

So, we allow him to make $1.80 when he calls with his OESFD. However, he's making a mistake calling with his QJ.

0.11($15) + 0.89(-$5) = EV

$1.65 - $4.45 = (-$2.80)

The QJ hand makes up a significant portion of his range. So much so, that our EV when we bet $5 is greater than when we shove. Our total equity against his whole range is 85%. We'll win a $20 pot 85% of the time.

0.85($20) = $17

So, even though we allow the villain to draw profitably with a portion of his range, we do better by having the larger portion make a mistake. Obviously this example is simplified as we have ignored river betting and position, but the lesson is clear. Keep the makeup of the villain's range in mind when you're betting.

The key is to try to get our opponent to make the biggest mistake we can get him to make. We're rooting for him to call when the odds are not in his favor.

Quiz

(Answers on pg. 200)

1. What is wrong with thinking “I want to blow my opponent off a draw?”

2. Hero: Q♣Q♦

   Villain: 8♣A♣

   Board: 2♣5♦9♣K♥

   The pot is $20. Estimate the minimum bet hero can make to give the villain a –EV call.

3. Hero: A♣Q♦

   Villain: 8♥9♦

   Board: 2♣5♦8♣A♥

   The pot is $20. How much money are we giving away if we check, letting the villain see the river for free?

4. Hero: Q♣Q♦

   Villain: 8♣7♣

   Board: 2♣5♦9♣K♥

   The pot is $20. You have $40 in the effective stack. The villain is passive and never folds a flush draw. What is the best bet size?

5. When might we allow some draws in a range to draw profitably?

6. If our opponent is aggressive, can have many draws and there is money left to bet on future streets, how should we adjust the size of our bets?

Balanced Play

The concept of balance is a hot topic in poker discussions today. It's often called optimal play or, what is probably more clearly termed, game theory optimal play. My preference is to call it balanced play. The topic has been so hot that I'd consider this book incomplete without at least giving a few thoughts on it. Instead of elaborating on the mechanics of balanced poker, I'd like to offer some perspective to help players discover what paths to take in learning to play poker.

Before we get to discussion regarding what balanced play is all about, let's begin by discussing its counterpart, exploitive play. The idea behind exploitive play is to take advantage of weaknesses in your opponent's game. Exploitive play is a more responsive form of poker. We're making decisions in response to our opponent's strategy. Some obvious examples would be:

- If he folds too much, we bluff more.
- If he calls too much, we bluff less.
- If he bluffs too much, we call more.
- If he bluffs too little, we call less.

We take advantage of the weaknesses in a player's strategy with whatever type of betting decision that's appropriate in that situation. In terms of expectation value, in general, the basic idea behind exploitive play is to make the decision in a hand that yields the result bringing us the most money on average. This is called choosing the maximally exploitive play or strategy. In this regard, that decision might be called the optimal play, which is why I stated earlier that we should be a bit more specific when we use the term "optimal". Making the optimal decision in exploitive play is to choose the betting decision that has the highest expectation value. That has been the theme of this book. Making a betting decision that follows a game theory optimal decision may be a totally different decision. Referring to balanced play by saying "optimal poker" may easily be taken to mean that playing a balanced strategy is superior to playing an exploitive play. This isn't always the case. Taking a look at a maximally exploitive strategy will get us closer to thinking properly about playing balanced poker.

Playing a maximally exploitive strategy has us making drastic changes in our play. Here’s an example to show this in action. Let’s say we get to a river, and our opponent bets the pot. We have a bluff catcher, and we’re left with a decision of whether or not to call. When someone bets the pot, we need to be good better than 33% of the time in order to make a +EV call. This means our opponent must be bluffing more than 33% of the time in order for us to have a +EV call. Now, let’s say we know our opponent has only bluffs. How often do we call? We obviously call 100% of the time. Let’s say we know our opponent is never bluffing. How often do we call? We obviously never call. However, what is the maximally exploitive play if our opponent bluffs 50% of the time? Some people feel that we should now call a bit more frequently; however, this would not be the maximally exploitive strategy. The maximally exploitive strategy is to call 100% of the time. When playing a maximally exploitive strategy, we call 100% of the time whether the opponent is bluffing 34% of the time or 100% of the time. Anytime his bluffing frequency is over 33%, we call 100%. Each time we fold a bluff catcher, we lose some expectation value. The same is true if the opponent were only bluffing 25% of the time. Some may feel we should now fold sometimes. However, this is not maximally exploiting the weakness in our opponent’s strategy. The maximally exploitive decision is to always fold. This is true whether he’s bluffing 32% of the time or never bluffing. Each time we call with a bluff catcher, we lose some EV. So, you see that a maximally exploitive strategy has us making very dramatic swings in our decision frequencies. We go from always calling to never calling and vice versa.

Now, here’s the concern for many players. “If I start folding or calling 100% of the time in this situation, will my opponent start to notice and begin changing his play?” For example, if we feel he’s not bluffing enough, and we’re folding all the time, will he start to notice we’re folding a lot and start launching more bluffs? Having an opponent begin making these adjustments is called counter-exploitation. We discover our exploitive play opens us up to counter-exploitation. Our responsive play has allowed our opponent to act responsively to our play as well. There are two requirements for us to be concerned about counter-exploitation.

1. Our opponent must observe the exploitable behavior.
2. Our opponent must properly act on his observations.

There are couple different ways to respond when we are concerned with being counter-exploited. One response to the fear of being counter-exploited is to simply let it happen and try to stay one step ahead of our opponent. For example, our opponent has been bluffing too much in spots, and we’ve been calling with all our bluff catchers. We suddenly realize that he’s really toned down his bluffing frequencies. Now, we can respond to this and start folding all our bluff catchers. This game can go on and on. It’s often called a leveling game by poker players.

Another response is to start to pull back on our maximally exploitive strategy. For example, we feel our opponent is bluffing too much, and we know our maximally exploitive strategy is to call every time with our bluff catchers. However, we fear our opponent is good enough to detect the weakness in that strategy and is also good enough to make a proper adjustment. So, in order to avoid that detection, perhaps we only call 90% of the time. We lose some immediate value by not calling every time; however, we probably delay, maybe even avoid, him detecting the high frequency of our calling. We start to bring this teeter-tottering strategy to the center a bit. We're developing a more defensive strategy, and this finally brings us to the idea of a balanced strategy.

A perfectly balanced strategy is a strategy that cannot be exploited. If we want to measure how balanced a strategy is, we can do so by finding out how exploitable it is. Again, let's look at our example where our opponent bets $10 into a $10 pot. We know when he always bluffs or never bluffs his strategy is very exploitable. However, as he approaches a 33% bluffing frequency, the EV of any decision we make begins to approach 0. As a matter of fact, if he were to bluff exactly 33% of the time, we would not be able to exploit him in any way. No decision we make has any value. Even though he may be able to make more money by changing his bluffing frequencies, making this balanced play has defended him against being counter-exploited. This is the essence of balanced play, defense. Now, let's talk about balanced play a bit.

"Balanced" poker just sounds good, doesn't it? The word balance just tends to have positive connotations. But, developing a perfectly balanced game of poker is not a possibility. The game is simply too complicated for even today's most advanced computers. However, approaching balanced poker in certain situations is certainly a possibility. But, let's consider what we've learned so far and think about why we would want to play a balanced game of poker? Remember that exploitive play is when we're playing against opponents who have a static strategy or predictably changing strategy. Against opponents who do not fit this mold, we need to begin thinking about balanced poker. There are only two practical reasons why we would want to try to play a balanced game. One would be that we have no information on our opponent. Our opponent is brand new to us, and we have few assumptions to make about his strategy. However, this situation probably won't exist long for a good player. Good players are experts at gathering and using information. It just takes a couple orbits for an expert to start classifying players with a decent amount of accuracy.

The second reason to play a balanced game is because our opponent is better at exploitive play than we are. We feel he will win the battle of information. He'll gain information more quickly and accurately than us. He'll use the information better than us. He'll adjust to our adjustments better than we will do to him. Or more simply put, we're outmatched. In this case, we would be better off playing a balanced game and taking away the edge our opponent has in the exploitive game. However, this scenario shows us something more important. We're probably not practicing good table selection.

In my opinion, the idea of developing a balanced game is stressed much too heavily for the vast majority of poker players. In fact, many players today are wasting a lot of time trying to work out a balanced game. This is not to say that understanding balanced play is useless or that it has no application in poker today. However, the vast majority of poker players are small-stakes and micro-stakes players. When you log into many poker sites, there are tens of thousands of players. Most of them are bad at poker. Many times you can play a maximally exploitive game with no fear whatsoever of counter-exploitation. If you are finding yourself in a position where you are worried about being counter-exploited so much you want to play a totally balanced game of poker, there's a much simpler solution. Find a different table. When a player pool is large, good table selection will beat balanced poker every day of the week. And at the stakes most players play, there is no shortage of bad players. Now, if you are so bad at poker, you can't exploit players at small stakes, you need to know that you'll not be able to play a balanced game of poker. Understanding balanced poker and approaching implementing it requires advanced understanding of the game. By the time a struggling small-stakes player can begin developing a balanced game, they'd be better off exploiting all the bad players.

So, what value does balance have? Thinking about balanced poker can help you grow in your poker theory and come up with new ideas. Understanding balanced poker can help you think about how to make adjustments to win an information battle. And understanding balanced poker will help you out in situations where you are simply forced to be sitting with players playing a superior strategy to yours. As you reach higher limits where the player pools are extremely small and the majority of players are very tough, developing a well-balanced strategy can take on a lot more importance. For most advanced players, however, much of what can be accomplished in thinking about balanced poker comes along intuitively. They can feel the spots that have glaring holes in their strategy and can work to balance those if they need to.

But, for mid-stakes players on down to micro-stakes players, dedicating a lot of time developing balanced strategies is not the most +EV way to spend their time. Having said that, I enjoy thinking about balanced poker, and it certainly has its place in poker discussions. However, when I hear a micro-stakes player talking about not making a play because it's unbalanced, I just sigh a bit. Even if those players could manage to play a well-balanced game, the choice to play it instead of maximally exploiting the poor players littering those limits would not be optimal.

Quiz

(Answers on pg. 202)

1. If your opponent bets $20 into a $20 pot and is bluffing 30% of the time, how often would you fold when playing a maximally exploitive strategy?

2. What two criteria must be met for you to be concerned about counter-exploitation?

3. What are two responses when we fear counter-exploitation?

1. What are some reasons why spending a lot of time developing a balanced game of poker would be a waste of time for most poker players?

4. When should you be concerned about developing more balanced strategies?

Summary

Champions

Often times when I mention working on poker away from the poker table, many players ask “What can I do away from the table?” Well, I hope you’ve gotten a feel for the many ways you can improve your game away from the table. We’ve spent a lot of time showing you how to analyze hold’em situations. The measure of benefit you gain will be directly related to the time and effort you spend using this information away from the poker table to improve your game. I stressed many times that working on these situations away from the table will help you internalize them. You’ll begin to develop an intuition about certain situations.

I’ve always appreciated hearing the stories of champions like Michael Jordan and Larry Bird. There’s a thread running through all the stories. The thread is dedication and practice. They were always the first ones in the gym and the last ones out. While talent is to be envied, hard work will take you a long way. You’ll know when you’re sitting across the table from someone who hasn’t been working. It’s just a matter of time until his chips get shipped your way.

Several times a week, I’ll make sure I note a few hands while I’m playing. It may be a hand where I felt uncomfortable or where I had a new idea I wanted to analyze. I then spend a few hours breaking them down to discover some new edge I can push at the poker tables. Also, discussing strategy in a poker forum, like those at dragthebar.com, will help your game tremendously. The help I’ve received from poker forums has been invaluable.

Congratulations on making your way through this book. I hope it helped you gain an understanding of how to make the best decision in a poker hand. You are now well-equipped to answer one of the two keys to good poker. You probably noticed how I always gave you the assumptions regarding our opponent's range and asked yourself "How do I get those assumptions?" My next book will be focusing on the other key to good poker, accurate assumptions. I'll see you then.

Enjoy your games.

Appendix A

True EV and Evaluative EV

Evaluative EV is not a term I've seen used in poker circles, but I think it best describes what poker players are doing when they evaluate the EV of different betting sizes. True EV and evaluative EV are answering different questions. Evaluative EV answers "What bet size is better?" True EV answers "How much richer will I be after I make this wager?"

Let's look at an example to see the distinction between these two terms.

Hero: A♥A♠

Board: A♣A♦2♦J♠8♠

Looking at this example, we would typically analyze the situation by only looking at the hands we felt had any chance of calling. Perhaps that range looks like this:

Villain:

- Call $20 – KJ, 22, 88
- Call $80 – 22, 88

We have 18 combinations in this range. We could then analyze the EV of each bet given this range assuming villain never raises. The EV of betting $20 is:

0.67($20) = $13.40

The EV of betting $80 is:

0.33($80) = $26.40

Comparing these two bet sizes, we just answered our question "How much should we bet?" The $80 bet is a more profitable bet than $20 given our assumptions.

Now, let's pretend that villain also has 50 combinations of absolute trash. He'll never call or raise with any of those hands. He'll simply fold to any bet we make. We're not concerned about those hands at all. They do not impact our betting decision. However, if we want to know how much richer we will bet after we make this wager, we will need to know the villain's entire range regardless of whether or not he calls. After we've added 50 combinations to villain's range, we now have 68 total combinations that represent villain's *entire* range. We can now find out how much richer we will be after making each wager. The true EV of the $20 wager is:

0.26($20) = $5.20

The true EV of the $80 bet is:

.09($80) = $7.20

The actual results of doing an evaluative EV calculation mean nothing in terms of what we'll actually make.[15] It's only useful as a comparison to some other bet size to see which is best. We do this because it's easier than spelling out the entirety of someone's potential range. We only look at the parts of the range that are relevant to our betting. When we're value-betting, we're only interested in the loosest calling range given a small bet we would consider making. When bluffing, we're only interested in the range of hands that beat us and what percent of those hands we can get to fold. It's just easier that way.

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[15] The exception would be if the range we're concerned about actually is his entire range.

Appendix B

When Villain is +EV

We've learned that when our opponent has a -EV call, we profit. However, what if he has a +EV call? Does that mean we're losing money by betting? If so, should we bet at all? Let's look at an example.

Hero: A♣A♠

Villain: 5♦6♦

Board: 3♠4♠K♥Q♥

The pot is $10, and we have $2 left in our stack. Villain has 18% equity. Let's look at villain's EV if we shove.

0.18($12) + .88(-$2) = EV

$2.16 - $1.76 = $0.40

Villain makes money with his call. That means we're losing money. Does that mean we shouldn't bet? Let's work it out. We'll look at two options: checking and shoving.

If we check, we're giving villain a free chance at the $10 pot. We win the $10 pot 82% of the time.

0.82($10) = $8.20

If we bet, we own 82% of a $14 pot that costs us $2 to create.

0.82($14) - $2 = $9.48

So, we're still better of betting than checking; however, we would make more ($10) if he would fold.

Just because villain has a +EV call does not mean he wants us to bet. Just because villain has a +EV call does not mean we shouldn't bet. But, if he has a +EV call, we prefer he folds because we make more money.

Quiz Answers

Why Math Matters Quiz Answers

1. What are the two keys to good poker?

   Answer: Accurate assumptions and making the best decision.

2. Into what two sections can we break up accurate assumptions?

   Answer: Our opponent's range and what betting decisions they'll make with that range.

3. Which of the two keys to good poker is developed mostly through playing experience?

   Answer: Accurate assumptions

4. On which of the two keys to good poker should beginners spend a lot of time?

   Answer: Making the best decision.

5. How can we use mathematics in poker?

   Answer: Mathematics shows us which decision is the best play.

Your Surroundings Quiz Answers

1. What is an 80 times stack in a NL25 game?

   Answer: $0.25 * 80 = $20

2. If you wanted to have a 40 buy-in bankroll for the NL50 game, how much money would you need?

   Answer: A typical buy-in at NL50 is $50.

   $50 * 40 = $2,000

3. If a NL25 player went on a 15 buy-in downswing, how much money did he lose?

   Answer: $25 * 15 = $375

Thinking About Bets in No-Limit Hold'em Quiz Answers

1. Is a $100 bet large or small?

   Answer: This is a trick question since we do not have complete information. We need to know the size of the pot before the $100 bet was made.

2. How would a player refer to a $50 bet into a $100 pot?

   Answer: A half-pot bet.

3. If you wanted to make a 2/3 bet into a $12 pot, what would the amount be?

   Answer: $8

4. If the pot is $80, and your opponent bets $50, how much money would you put in to make a pot-size raise?

   Answer: $230

5. If the pot is $12, and your opponent bets $10, how much money would you put in to make a pot-size raise?

   Answer: $42

Your Expectations Quiz Answers

1. How much would a player make if he played NL10 for 5,000 hands at 12 bb/100?

   Answer:

   5000 / 100 = 50
   $0.10 * 12 = $1.20
   50 * $1.20 = $60

2. If you played 10,000 hands but **tilted** off 1 buy-in, by how many bb/100 would that impact your win rate over that number of hands?

   Answer:

   10,000 / 100 = 100

   100 / 100 = 1 bb/100

   If you lost 100 big blinds over one-hundred 100-hand sections, you would lose 1 big blind every 100-hand section.

3. How should most players view the micro-stakes?

   Answer: As a stepping-stone to bigger stakes.

4. How can you determine how much you pay for your poker education?

   Answer: By choosing in what size game you're going to begin playing while you learn.

5. Why can it be a bad thing when a new player makes a lot of money right away?

   Answer: Because he may become close-minded to learning and not spend any time studying the game.

Working with Fractions, Percentages and Ratios Quiz Answers

1. Convert $\frac{1}{4}$ to a ratio.

   Answer: 3:1

2. Convert $\frac{1}{8}$ to a percentage.

   Answer: 12.5%

3. Convert 5:1 to a fraction.

   Answer: $\frac{1}{6}$

4. Convert 2:1 to a percentage.

   Answer: 33.3%

5. Convert 9:2 to a fraction.

   Answer: $\frac{2}{11}$

6. What are the odds against rolling a 1 or a 2 when rolling one die?

Answer: Probability is $\frac{2}{6}$ which can be reduced to $\frac{1}{3}$. The odds against are 2:1.

7. What is the probability of rolling two 4s when rolling two dice?

   Answer: $\frac{1}{36}$

Expectation Value Quiz Answers

1. Someone has the four As face down on a table. You have one chance to try to pick the A♠. If you pick it correctly, they'll pay you $3. If you do not, you pay $1. What is the EV of this wager?

   Answer:

   A♠: $\frac{1}{4}$ = 0.25

   Other As: $\frac{3}{4}$ = 0.75

   0.25(3) + 0.75(-1) = x

   0.75 - 0.75 = 0

2. There are three cups upside down on a table. Underneath one is a green ball. Underneath another is a red ball. Underneath another is an orange ball. If you pick green, you win $5. Pick red, you lose $2. Pick orange, you lose $1. What is the EV of picking one cup?

   Answer:

   Each cup is $\frac{1}{3}$ = 0.33

   0.33($5) + 0.33(-$2) + 0.33(-$1) = x

   $1.65 - $0.66 - $0.33 = $0.66

3. Someone holds out a deck of cards. If you pick out a K, they'll give you $10. If you do not, you owe them $1. What is the EV of this wager?

   Answer:

   Kings: $\frac{4}{52}$ = 0.077

   Not kings: $\frac{48}{52}$ = 0.923

   0.077($10) + 0.923(-$1) = x

   $0.77 -$0.923 = (-$0.153)

4. Someone holds out a deck of cards. If you pick out a spade, they will give you \$4. However, if you pick out the A♠, they'll give you \$20. It will cost you \$1 to draw. What is the EV of this wager?

   Answer:

   A♠: $\frac{1}{52}$ = 0.019

   Other spades: $\frac{12}{52}$ = 0.231

   Not spades: $\frac{39}{52}$ = 0.75

   .019(\$19) + 0.231(\$3) + 0.75(-\$1) = x

   \$0.361 + \$0.693 - \$0.75 = \$0.304

5. Someone gives you two dice. They offer to pay you \$37 if you roll two 6s. However, it will cost you \$1 a roll. What is the EV of this wager?

   Answer:

   Double sixes: $\frac{1}{36}$ = .028

   Other rolls: $\frac{35}{36}$ = 0.972

   .028(\$36) + 0.972(-\$1) = x

   \$1.008 – \$0.972 = \$.036

Counting Outs Quiz Answers

For the following questions, answer how many outs the hero has (do not forget chopping and backdoor outs).

1. Hero: 8♦J♥

   Villain: K♦A♦

   Board: 5♣Q♦K♥A♥

   - Four Ts - Straight wins

   Total - 4 outs

2. Hero: 3♣3♦

   Villain: A♣J♣

   Board: J♦8♦2♥A♠

   - Two 3s - Set wins

   Total - 2 outs

3. Hero: K♠9♠

   Villain: J♠J♥

   Board: 4♥8♥6♦A♣

   - Three Ks - Pair wins

   Total - 3 outs

4. Hero: 5♣7♣

   Villain: K♦J♦

   Board: J♥6♥9♥2♦

   - Four 8s - Straight wins

   Total - 4 outs

5. Hero: A♦J♠

   Villain: 7♠8♠

   Board: 7♥5♥2♣4♣

   - Three As - Pair wins
   - Three Js - Pair wins
   - Four 3s - Straight wins

   Total - 10 outs

6. Hero: 7♣6♣

   Villain: A♣Q♣

   Board: Q♠8♥7♦K♣

   - Three 6s - Two pair wins
   - Two 7s - Trips wins

   Total - 5 outs

7. Hero: 6♥7♠

   Villain: A♠Q♠

   Board: 4♠7♦Q♦2♠

   - Two 7s - Trips wins
   - Two 6s - Two pair wins (Note the 6♠ gives villain a flush.)

   Total - 4outs

8. Hero: 5♥6♥

   Villain: A♥J♥

   Board: 8♦9♦2♥K♥

   - Three 6s - Pair wins
   - Three 5s - Pair wins
   - Three 7s - Straight wins (Note the 7♥ gives him a flush.)

   Total - 9 outs

9. Hero: Q♦K♥

   Villain: A♠J♠

   Board: J♦2♥T♣J♣

   - Four 9s - Straight wins
   - (Note that while an A gives you a straight, it gives him a full house.)

   Total - 4 outs

10. Hero: 6♣7♦

    Villain: K♦K♣

    Board:Q♣8♦4♦T♠

    - Four 5s - Straight wins
    - Four 9s - Straight wins

    Total - 8 outs

11. Hero: A♠J♥

    Villain: K♥K♠

    Board: 2♥8♦9♦7♣

    - Three As - Pair wins
    - Four Ts - Straight wins

    Total - 7 outs

12. Hero: T♣8♣

    Villain: K♦4♦

    Board: K♥9♠Q♠6♥

    - Four Js - Straight wins
    - Four 7s - Straight wins

    Total - 8 outs

13. Hero: T♥T♠

    Villain: A♥4♥

    Board: T♣3♥8♥K♥

    - One T - Quads wins
    - Three 3s - Full house wins
    - Three 8s - Full house wins
    - Three Ks - Full house wins

    Total - 10 outs

14. Hero: 7♠8♠

    Villain: 9♥A♥

    Board: 9♠K♣A♣T♠

    - Eight spades - Flush wins (Not A♠ as it gives villains a full house.)
    - Three Js - Straight wins (Note the J♠ is included in the flush outs.)
    - Three 6s - Straight wins (Note the 6♠ is included in the flush outs.)

    Total - 14 outs

15. Hero: 8♣6♣

    Villain: A♣A♦

    Board: 6♦4♠7♣T♥

    - Four 5s - Straight wins
    - Four 9s - Straight wins
    - Two 6s - Trips wins
    - Three 8s - Two pair wins

    Total - 13 outs

16. Hero: A♦A♥

    Villain: 8♦9♣

    Board: 8♠T♠4♥9♥

    - Three Ts - Straight wins
    - Three 4s - Two pair wins
    - Two As - Set wins

    Total - 8 outs

17. Hero: 6♥7♥

    Villain: J♦J♥

    Board: 3♥9♥4♣A♠

    - Eight hearts - Flush wins (Note villain has the J♥.)
    - Three 5s - Straight wins (Note the 5♥ is included in the flush outs.)

    Total - 11 outs

18. Hero: A♠5♠

    Villain: A♥7♥

    Board: A♦6♣3♥Q♠

    - Three 5s - Two pair wins
    - Three 3s - Two pair chops
    - Three 6s - Two pair chops

    Total - 3 outs to a win and 6 outs to a chop

19. Hero: A♠Q♣

    Villain: 5♣5♦

    Board: J♥6♥8♦J♠

    - Three As - Two pair wins
    - Three Qs - Two pair wins
    - Three 6s - Two pair wins (Note while we both have two pair, our A plays and is the best kicker.)
    - Three 8s - Two pair wins (Same note as above.)

    Total - 12 outs

20. Hero: J♠J♥

Villain: 5♠5♦

Board: A♦A♣5♣6♣

- Two Js - Full house wins
- Two As - Full house wins (Note while we both have a full house, we have As full of Js while he only has As full of 5s.)

Total - 4 outs

21. Hero: K♣T♣

Villain: 6♣6♦

Board: 4♣4♦9♦4♠

- Three Ks - Full house wins
- Three Ts - Full house wins
- One 4 - Two pair wins (Note while we both have quads, our king is the highest kicker.)
- Three 9s - Full house chops

Total - 7 outs to a win and 3 outs to a chop

22. Hero: 4♠5♠

    Villain: A♥8♦

    Board: 5♦A♠9♣

    - Two 5s - Trips wins
    - Three 4s - Two pair wins
    - One backdoor spades out - Flush wins (Remember to look for backdoor flush and straight outs. We count them roughly as one out each.)

    Total - 6 outs

23. Hero: 6♣8♣

    Villain: J♦J♥

    Board: 6♥7♦2♠

    - Two 6s - Trips wins
    - Three 8s - Two pair wins
    - One backdoor out - straight wins

    Total - 6 outs

24. Hero: A♥2♠

Villain: A♠T♥

Board: A♦A♣Q♣5♣

- Three 2s - Full house wins
- Three Qs - Full house chops
- Three 5s - Full house chops
- Four Ks - Trips chops
- Four Js - Trips chops

Total - 3 outs to a win and 14 outs to a chop

25. Hero: 4♣5♣

Villain: A♣T♥

Board: 3♣6♣K♣T♣

- Two clubs (2♣ and 7♣) - Flush wins

Total - 2 outs

The 4/2 Rule Quiz Answers

1. Hero: 8♣9♣

   Villain: A♣J♥

   Board: 7♦8♦2♠A♠

   Answer: We have five outs, and we're on the turn.

   5 x 2 = 10

2. Hero: A♣A♥

   Villain: 5♥6♥

   Board: 7♦8♦2♠A♠

   Answer: We'll turn this problem around a bit and start with the villain's equity. We can then subtract the villain's equity from 100 to get the hero's equity since the equities added together equal 100. The villain has eight outs, and we're on the turn.

   8 x 2 = 16

   Now we subtract 16 from 100 and get 84.

3. Hero: 3♣3♦

   Villain: J♦J♥

   Board: 3♠5♣5♦

   Answer: We'll do the same as question #2. Villain has four outs, and we're on the flop.

   4 x 4 = 16

   100 - 16 = 84

4. Hero: 9♦6♦

   Villain: J♦J♥

   Board: 3♠5♣5♦2♦

   Answer: Hero has 11 outs, and we're on the turn.

   11 x 2 = 22

5. Hero: 9♦6♦

   Villain: Q♦Q♥

   Board: 7♣8♣2♠

   Answer: Hero has eight outs, and we're on the flop.

   8 x 4 = 32

6. Hero: Q♦Q♥

   Villain: A♥J♥

   Board: 7♣8♣2♠J♦

   Answer: Villain has five outs, and we're on the turn.

   5 x 2 = 10

   100 - 10 = 90

Pot Odds Quiz Answers

For the following questions, answer call or fold.

1. Hero: 8♣9♣

   Villain: A♣J♥

   Board: 7♦8♦2♠A♠

   Pot was $10 and villain goes all-in for $5.

   Answer: With 5 outs, we can estimate our equity at 10%. Getting 3:1 we need 25% equity. Fold.

2. Hero: A♣A♥

   Villain: 5♥6♥

   Board: 7♦8♦J♠

   Pot was $24. Hero goes all-in for $28. What should villain do?

   Answer: Villain has 8 outs for 32% equity. He's getting a little worse than 2:1 so he needs to have about 35% equity. Fold.

3. Hero: A♣Q♦

   Villain: J♦J♥

   Board: 3♠5♣5♦

   Pot was $10. Villain goes all-in for $6.50.

   Answer: With 6 outs, we have about 24% equity. Villain bet about 2/3 pot, so we need to have about 28% equity. Fold.

4. Hero: 9♦6♦

   Villain: J♦J♥

   Board: 3♠5♣5♦2♦

   Pot was $20. Villain goes all-in for $10.

   Answer: With 11 outs, we have about 22% equity. Villain bet 1/2 pot, so we need to have about 25% equity. Fold.

Implied Odds Quiz Answers

1. Hero: 9♦6♦

   Villain: A♣J♥

   Board: 7♦8♦2♠A♠

   The pot was $10. Villain bet $15. How much more do you need?

   Answer: With 15 outs on the turn, we have about 30% equity. This means we need about 2x villain's bet.

   15 x 2 = 30

   There's already $25 in the pot, so we only need $5 more.

2. Hero: 9♣3♣

   Villain: A♥A♣

   Board: 7♦8♦J♠4♣

   The pot was $10. Villain bet $10. How much more do you need?

   Answer: With four outs on the turn, we have about 8% equity. This means we need about 9x villain's bet.

   10 x 9 = 90

   There's already $20 in the pot, so we need $70 more.

3. Hero: A♣Q♦

   Villain: J♦J♥

   Board: 3♠5♣5♦

   The pot was $10. Villain bet $8. How much more do you need assuming you see the river with no further turn betting?

   Answer: With 6 outs on the flop, we have about 24% equity. This means we need about 3x villain's bet.

   8 x 3 = 24

   There's already $18 in the pot, so we need $6 more.

Combinations Quiz Answers

1. Hero: 8♦J♥

   Villain: AA

   Board: 5♣Q♦K♥A♥

   How many combinations are there in villain's range?

   Answer: 3

2. Hero: 3♣3♦

   Villain: AJ

   Board: J♦8♦2♥A♠

   How many combinations are there in villain's range?

   Answer: 9

3. Hero: K♠9♠

   Villain: JJ

   Board: 4♥8♥6♦A♣

   How many combinations are there in villain's range?

   Answer: 6

4. Hero: 5♣7♣

   Villain: AJ, 66

   Board: J♥6♥9♥2♦

   How many combinations are there in villain's range?

   Answer: AJ = 12, 66 = 3

   Total = 15

5. Hero: A♦J♠

   Villain: AA

   Board: 7♥5♥2♣4♣

   How many combinations are there in villain's range?

   Answer: 3

6. Hero: 7♣6♣

   Villain: ATs

   Board: Q♠8♥7♦K♣

   How many combinations are there in villain's range?

   Answer: 4

7. Hero: 6♥7♠

   Villain: QQ, A♦3♦

   Board: 4♠7♦Q♦2♠

   How many combinations are there in villain's range?

   Answer: 4

8. Hero: 5♥6♥

   Villain: 99, QJ

   Board: 8♦9♦2♥K♥

   How many combinations are there in villain's range?

   Answer: 99 = 3, QJ = 16

   Total = 19

9. Hero: Q♦K♥

   Villain: AJ

   Board: J♦2♥T♣J♣

   How many combinations are there in villain's range?

   Answer: 8

10. Hero: 6♣7♦

    Villain: AQ, 88

    Board: Q♣8♦4♦T♠

    What percentage of the time does the villain have a set?

    Answer: AQ = 12, 88 = 3

    Total = 15

    3 / 15 = 0.20 or 20%

Equity Versus a Range Quiz Answers

1. Hero: J♠J♦

   Villain: 78, AT

   Board: 5♦6♣T♥

   What is hero's equity assuming we're all-in?

   Answer: Against AT, we have about 80% equity. Against 78, we have about 68% equity. There are 12 combinations of AT, and 16 combinations of 78. So, the 78 hand "weighs" a bit more than AT. The middle of 80 and 68 is 74. But, we have to slide it more towards 68. I'd estimate the equity to be in the low 70s. If you Pokerstove it, you'll find our equity to be 71%.

2. Hero: J♠A♠

   Villain: QQ, KK, 55, 44

   Board: 5♦4♠T♠

   What is hero's equity assuming we're all-in?

   Answer: These hands fit well into two groups. We have a lot of outs against his big pairs, but we're crushed by his sets. Against the big pairs, we have about 45% equity (remember against half of the pair hands, you'll only have 8 flush outs instead of 9). Against the sets, we have about 25% equity. There are 12 combinations of big pairs, and 6 combinations of the sets. So, the big pairs are two times more likely than the sets. We have to find 2/3 of the way from 25 up to 45. That middle of 25 and 45 is 35. But, we have to slide it more towards 45. I'd estimate the equity to be in the upper 30s. If you Pokerstove it, you'll find our equity to be 39%.

3. Hero: 3♠3♥

   Villain: KT, TT, 55, A♦K♦

   Board: 5♦3♦T♠

   What is hero's equity assuming we're all-in?

   Answer: Villain's range divides into three categories. KT is in terrible shape with 6% equity. TT and 55 have us in terrible shape by having 96% equity. Then A♦K♦ has about 25% equity. There are 12 combinations of

KT. There are 6 total combinations of his sets, and there is only 1 combination of the AKs. The KT is two times more likely than his sets. So, we find 2/3 the way from 5 to 95. The quickest way for me to think about this is to realize this is almost just finding 2/3 the way from 0 to 100. That answer is 66. So, we need to lower that a bit since we're finding 2/3 of 90. I'd drop that down to about 60. This is our average equity for 18 of the 19 combinations. We have one other combination against which we have about 75% equity. This would raise our equity just a hair. So, I'd estimate our equity to be in the low 60s. If you Pokerstove it, you'll find our equity to be 64%.

4. Hero: Q♥T♥

   Villain: AK, AT, 66, 78

   Board: 5♦6♦T♠J♥

   What is hero's equity assuming we're all-in?

   Answer: Villain's range divides into two categories. AK and 78 are drawing. AT and 66 have us in terrible shape. Looking at the drawing group first, we see AK has 9 outs for 21% equity, and 78 has eight outs for 19% equity.[16] Both these hands are equally likely, so the average is 20% equity. There are 32 combinations where our equity is 80%. Against AT, we have three

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[16] Both these equities are raised a bit from our 4/2 rule. This is to account for the suited diamonds combinations which have much greater equity.

outs for 6% equity. Against 66, we are **drawing dead**. There are 8 combinations of AT, and 3 combinations of 66. We can combine those for an estimated equity of 4%. So, we have 11 combinations where we have 4% equity, and 32 combinations where we have 80% equity. The drawing combinations are three times more likely than the made hands. We have to find 3/4 of the way from 4 to 80. I would just think of 3/4 of 80 and then raise that number slightly. And, 3/4 of 80 is 60. So, I'd estimate my equity to be in the lower 60s. If you Pokerstove it, you'll find our equity to be 60%.

Which Bucks Quiz Answers

1. Hero: J♠J♦

   Villain's assumed range: 78, AT

   Board: 5♦6♣T♥

   You both started with $20 and put $5 in preflop. The pot is now $10. Villain goes all-in for $15, and you call. Villain turns over 9♦9♠. The final board is 5♦6♣T♥A♠5♠.

   Answer:

   - Real-bucks: You have $20 more than you did before the hand started.
   - Sklansky-bucks: You had 90% equity on the flop.

     0.90($25) + 0.10(-$15) = EV

$22.50 - $1.50 = $21

- G-bucks: You had 71% equity against his assumed range.

  0.71($25) + 0.29(-$15) = EV

  $17.75 - $4.35 = $13.40

2. Hero: A♠J♠

   Villain's assumed range: KQ, AK, 9♠T♠

   Board: K♠6♠5♦

   You both started with $15 and put $5 in preflop. The pot is now $10. Villain goes all-in for $10, and you call. Villain turns over K♦Q♠. The final board is K♠6♠5♦Q♦3♥.

   Answer:

   - Real-bucks: You have $15 less than you did before the hand started.
   - Sklansky-bucks: You had 43% equity on the flop.

     0.43($20) + 0.57(-$10) = EV

     $8.60 - $5.70 = $2.90

   - G-bucks: You had 43% equity against his assumed range, which is the same as the Sklansky-bucks.

Bluffing Quiz Answers

1. Hero: 3♦4♠

   Villain:

   Fold - 78
   Call - KJ, AJ, AT

   Board: 5♦6♣T♥J♥J♦

   Is a 1/2 pot bet profitable?

   Answer: A 1/2 pot bet must work more than 33% of the time. Villain is folding 78, which totals 16 combinations. The calling hands consist of 28 combinations.

   16 / 44 = 0.36

   The bluff is profitable.

2. Hero: 5♠4♠

   Villain:

   Fold - 78
   Call - JJ, QQ, KK, AA

   Board: 6♠8♠2♥T♥9♥

   Is a pot bet profitable?

   Answer: A pot bet must work more than 50% of the time. Villain is folding 12 combinations. He's calling with 24 combinations.

12 / 36 = 0.33

The bluff is not profitable.

3. Hero: 2♥2♦

   Villain:

   Fold - 99, 67, T9

   Call - AT, KT, AQ

   Board: 6♠3♥T♥Q♠J♠

   Is a 2/3 pot bet profitable?

   Answer: A 2/3 pot bet must work more than 40% of the time. Villain is folding 30 combinations. He's calling with 36 combinations.

   30 / 66 = 0.45

   The bluff is profitable.

4. Hero: Q♠A♠

   Villain:

   Fold - 89

   Call - JT, J9, KT, 33

   Board: 6♠3♥8♥J♠K♦

   Is a 1/3 pot bet profitable?

Answer: A 1/3 pot bet must work more than 25% of the time. Villain is folding 12 combinations. He's calling with 39 combinations.

12 / 51 = 0.24

The bluff is not profitable.

Semi-Bluffing Quiz Answers

Assume villain always has us covered. Use estimations to answer the following questions.

1. Hero: 3♦4♠

   Villain: T♣9♣

   Board: 5♦6♣T♥J♥

   Pot was $10. We shove $20. How often does villain have to fold?

   Answer: Our equity is around 16%. The final pot will be $50.

   50 * 0.16 = $8

   $20 – $8 = $12

   We're risking $12 to win $10. This is a little over x to win x, so we'll need to have him fold more than 55% of the time.

2. Hero: 5♠4♠

   Villain: A♦A♣

   Board: 6♠Q♠K♥

   Pot was $10. We shove $30. How often does villain have to fold?

   Answer: Our equity is around 39%. The final pot will be $70.

   70 * 0.39 = $27.3

   $30 – $27 = $3

   We're risking $3 to win $10. This is x to win just over 3x, so we'll need to have him fold more than about 23% of the time.

3. Hero: A♠K♥

   Villain: T♣8♣

   Board: 6♠3♥T♥

   Pot was $10. We shove $24. How often does villain have to fold?

   Answer: Our equity is around 24%. The final pot will be $60.

   60 * 0.24 = $14.4

$24 – $14 = $10

We're risking $10 to win $10. This is x to win x, so we'll need to have him fold more than 50% of the time.

4. Hero: Q♠A♠

Villain:

Fold - 89, 99, TT

Call - AJ, J9, 33

Board: 6♠3♥8♥J♠

Pot was $10. We shove $25. Is a shove profitable?

Answer: We have to estimate our equity against his calling range. Against 33, we have 7 outs for 14% equity. Against AJ, we have 12 outs for 24% equity. Against J9, we have 15 outs for 30% equity.

- 33: 14% – 3 combinations
- AJ: 24% – 9 combinations
- J9: 30% – 12 combinations

We can easily see the average of AJ and J9 is going to be about 28%. This gives 21 combinations at 28%. The 33 hand is about 12% of the total range. So, we need to find 88% of the way up from 14 to 28. We can easily see we'll be just slightly lower than 28 at about 26%.

The final pot will be $60.

$60 * 0.26 = $15.60

$25 – $16 = $9

We’re risking $9 to win $10. This is just less than x to win x, so we’ll need villain to fold more than about 47% of the time.

The hands he’s folding consist of 24 combinations. The total combinations are 48.

24 / 48 = 0.5

Villain is folding 50% of the time. This is more than we need. The shove is profitable.

Value-Betting Quiz Answers

1. Hero: K♥Q♥

   Villain:

   Call $20: QT, AJ, QJ, J9

   Board: Q♠2♣9♥J♠7♦

   Is a $20 value bet profitable? If so, what is the EV?

   Answer: In order to have a profitable value-bet, we’ll need the villain to call with a hand we beat more than 50% of the time. We beat QT and AJ, which total 20 combinations. We lose to QJ and J9, which total 15 combinations. A bet is profitable. What’s the EV? The hands we beat comprise about 57% of his range (20/35).

0.57($20) + 0.43(-$20) = EV

11.4 – 8.6 = $2.80

2. Hero: K♥Q♥

Villain:

Call $20: QT, AJ, QJ, J9

Bluff raise (you'll fold): 55

Board: Q♠2♣9♥J♠7♦

Is a $20 value bet profitable?

Answer: Again, we need him to call with a worse hand more than 50% of the time. While we do beat 55, we have to treat that just like losing since he bluff-raises us and we fold. We get value from QT and AJ, which total 20 combinations. We lose to QJ and J9, and we have to add 55 to this group. Those total 21 combinations. We only get value from about 49% of his range (20/41). A bet is not profitable.

3. Hero: K♥Q♥

   Villain:

   Call $20: QT, AJ, QJ, Q7
   Bluff raise (you'll fold): 55

   Board: Q♠2♣9♥J♠7♦

   The pot is $20. Is a $20 value bet profitable?

   Answer: Do not be discouraged if you didn't get this one. It's designed to show the impact of villain stealing from us. Again, QT and AJ give our bet value and total 20 combinations. We lose to QJ and Q7. Those total 12 combinations. We lose to 55 as well, which is 6 combinations. So, the hands that beat us total 18 combinations. We actually have more combinations of hands we beat, which is more than 50%. So, we may be thinking we need to bet. However, what we need to consider is the villain is actually stealing the $20 pot from us as well as our bet. So, our EV would look like this.

   QT and AJ: 53%
   QJ and Q7: 31%
   55: 16%

   0.53($20) + 0.31(-$20) + 0.16(-$40)

   10.6 – 6.2 – 6.40 = (-$2)

   So, even though the villain is calling with more than 50% worse hand, we're still not +EV with our bet because he's stealing the pot from us.

4. Hero: A♦J♦

Villain has $60 left:

Call up to $20 – A9, AT, AK, AQ, J9, JT, QJ

Call all-in for $60 – AK, J9, JT, QJ

Board: 2♣5♦J♥A♥J♠

Which bet is more profitable?

Answer: Villain will call the $20 with his entire range, which contains 44 combinations. We beat all of those. He will call the larger $60 bet with 20 of those combinations. That's 46% of his range. The EV of the $20 bet is $20 since we get called every time and always win. The EV of the $60 bet is:

0.46($60) = $27.60

The $60 bet is more profitable.

5. Hero: A♦J♦

Villain has $60 left:

Call up to $20 – A9, AT, AK, AQ, J9, JT, QJ
Shove $60 as bluff after your $20 bet (you'll call) – 78
Call all-in for $60 – AK, J9, JT, QJ

Board: 6♣5♦J♥A♥J♠

Which bet is more profitable?

Answer: The scenario is the same as question four; however, there's a little twist. The smaller bet will induce a bluff shove from your opponent's missed OESD. This adds a tremendous amount of value to your smaller bet. Nothing in his range will fold; however, 16 of the 60 combinations will give you $60. This is our EV for the $20 bet.

0.73($20) + 0.27($60) = EV

$14.6 + $16.2 = $30.80

Now, let's examine the EV of the $60 bet.

0.33($60) = $19.80

Obviously the EV of the $20 bet is better and highlights the power of inducing bluffs. The astute student may have noticed the EV of the $60 bet is less now than it was in question four even though the bet size and number of combinations calling are both the same. If you're curious, see Appendix A.

6. Hero is out of position: K♥Q♥

Villain:

If you bet:

Call \$20 bet: QT, AJ, QJ, J9

If you check (you'll call):

Bet \$20: QT, QJ, J9, AT

Board: Q♠2♥9♥J♠3♦

Is it better to bet or check/call?

Answer: With the calling range, there are 20 combinations you beat, and 15 combinations that beat you. Here's the EV of betting.

0.57(\$20) + 0.43(-\$20) = EV

\$11.4 – \$8.60 = \$2.80

If we check, his betting range consists of 24 combinations you beat, and 15 combinations that beat you. Here's the EV of check/calling.

0.62(\$20) + 0.38(-\$20) = EV

\$12.40 - \$7.60 = \$4.80

Check/calling \$20 is superior to betting \$20.

7. Hero is out of position: K♥Q♥

   Villain:

   If you bet:

   Call $20 bet: QT, J9

   If you check:

   Bet $20: QT, QJ, J9, AQ

   Board: Q♠2♣9♥J♠7♦

   The pot is $20 before anyone bets. Villain only has $20 left in his stack. What's the best action to take?

   Answer: If we bet, villain calls with eight hands we beat and nine hands that beat us. He's only calling with 47% worse hands, so betting is –EV.

   If we check, villain is betting the pot. We'd need to be good 33% of the time to call. Of his betting range, we only beat QT, which is 8 combinations. The rest of his betting range consists of 25 combinations.

   8 / 25 = 0.32

   Check/calling is –EV. The best move here is to check/fold.

A Bit of Memory Quiz Answers

1. How often will you flop a four-flush with suited hole cards?

   Answer: 11%

2. How often will you flop an open-ended straight draw with connectors?

   Answer: 10%

3. How much equity does a flush draw have verses a set assuming they're all-in on the flop?

   Answer: 26%

Chunking Quiz Answers

1. What is a danger of slowplaying?

   Answer: You will seriously reduce the exponential growth of the pot over multiple streets.

2. If there were pot-size bets on all three postflop streets, what would the difference be between a $5 preflop pot and a $7 preflop pot in terms of the size of the final pot?

   Answer: The $5 pot would grow to $135. The $7 pot would grow to $189. The difference is $54.

3. Hero's stack: 80 big blinds

   Villain's stack: 70 big blinds

   Pot: 8 big blinds

   What's the SPR?

   Answer: We use the effective stack size to determine the SPR because that's all the money that can be wagered in the hand. 70 / 8 = 8.75

4. How might we create smaller SPRs?

   Answer: We can create smaller SPRs by raising larger preflop.

5. What factors might make it difficult to create an SPR we may desire?

   Answer: We can't determine how many callers we'll get. Also, there may be players with different sized stacks left to act. Even if we only get one caller, the effective stack size may be different for each player.

Set-Mining Quiz Answers

1. How often will you flop a set or better when calling preflop with a pocket pair?

   Answer: About 12%.

2. What are some of the factors to consider when determining whether or not it's profitable to call preflop with a pocket pair?

   Answer:

   - The amount of money left in our stacks.
   - Whether or not we have position.
   - The strength of our opponent's range.
   - The type of hands with which our opponent will put in his remaining stack.
   - How well we play postflop.

How Much to Bet Quiz Answers

1. What is wrong with thinking "I want to blow my opponent off a draw?"

   Answer: It's not thinking about getting maximum value in the hand.

2. Hero: Q♣Q♦

   Villain: 8♣A♣

   Board: 2♣5♦9♣K♥

   The pot is $20. Estimate the minimum bet hero can make to give the villain a –EV call.

   Answer: Villain has about 25% equity. We need to bet at least 1/2 pot.

3. Hero: A♣Q♦

   Villain: 8♥9♦

   Board: 2♣5♦8♣A♥

   The pot is $20. How much money are we giving away if we check, letting the villain see the river for free?

   Answer: We give villain a free chance to draw with about 10% equity. So, we're giving him 10% of a $20 pot, which is $2.

4. Hero: Q♣Q♦

   Villain: 8♣7♣

   Board: 2♣5♦9♣K♥

   The pot is $20. You have $40 in the effective stack. The villain is passive and never folds a flush draw. What is the best bet size?

   Answer: This is a very common situation in micro-stakes games. Opponents do not like to fold a flush draw. In this case, we can just go all-in. We get the money in now while he's drawing for his flush instead of letting him keep some after he's missed on the river. We're not trying to blow the villain off a hand; we're getting the maximum value. If the villain were an aggressive bluffer and could fold if we shoved the turn, we may consider betting less on the turn and letting him bluff the river.

5. When might we allow some draws in a range to draw profitably?

   Answer: When the villain's range is weighted heavily towards weaker draws that will call a bet, we may allow the stronger draws to draw profitably because the mistake the majority of his range will make by calling will overcome the amount we give to the stronger draws.

6. If our opponent is aggressive, can have many draws and there is money left to bet on future streets, how should we adjust the size of our bets?

   Answer: We need to increase our bet size to cut down on the opponent's implied odds.

Balance Quiz Answers

2. If your opponent bets $20 into a $20 pot and is bluffing 30% of the time, how often would you fold when playing a maximally exploitive strategy?

   Answer: You would always fold.

3. What two criteria must be met for you to be concerned about counter-exploitation?

   Answer: Your opponent must recognize your exploitable play and be able to counter-exploit it properly.

4. What are two responses when we fear counter-exploitation?

   Answer:

   - Let it happen and stay one step ahead of our opponent.
   - Develop a more defensive strategy.

5. What are some reasons why spending a lot of time developing a balanced game of poker would be a waste of time for most poker players?

   Answer: Beginners would do better learning how to better play an exploitive strategy. There are so many bad players to exploit and thousands of tables from which to choose.

6. When should you be concerned about developing more balanced strategies?

   Answer: When your opponents are good and you have no other options of finding worse opponents.

Glossary

1-Gapper: A preflop hand with a gap in between what would otherwise be a connector. Examples are T8 and 42.

6-Max: A game format where only six players are allowed at the table.

All-In: Wagering all the money in your stack. See "Push" and "Shove"

Backdoor Flush Draw: When you have suited cards as your hole card and one card on the flop matches the suit of your hole cards. You need a card of that suit on both the turn and river to make a flush.

Backdoor Outs: A draw that is present when you're on the flop and need two running cards (the turn and river) to improve you to a better hand.

Backdoor Straight Draw: When you have a straight draw on the flop which requires both a turn and river card to make a straight.

Bankroll: An amount of money a person has set aside which they'll be using to play poker.

Board: All of the community cards as a whole.

Button: The player to the right of the small blind. The is a coveted position as you get to act last posflop.

Buy-In: The amount of money a player brings to a table.

Chopping Outs: Cards to come that can give you a hand that ties the best hand.

Community Cards: The cards placed in the middle of the table that all players may use to make their best hand. See "Board".

Connectors: Hole cards that are next to one another in rank. Examples are JT and 67.

Covered: When one player has more money than his opponent, he is said to have him covered.

Downswing: When a player loses a lot of money relative to the size of the big blind of the game.

Drawing dead: Having no outs. You have 0% equity.

Early position: Players to the left of the big blind. These positions are at a disadvantage because they are often one of the first players that have to act on any street.

Effective Stack Size: The smallest stack involved in a hand.

EV: Short for expectation value.

Expectation Value: The *average amount* of money you can expect to win or lose when you make a wager.

Exploit: To take advantage of an opponent’s weaknesses.

Flop: The first three community cards which are exposed simultaneously. This can also be used as a verb. For example, "I flopped a very strong hand!"

Flush: Five cards of the same suit.

Fold Equity: What we gain when our opponent folds in response to our aggression.

Four-flush: A flush draw needing one more card to complete the flush.

Full-Ring: A game format where 9 to 10 players are allowed sitting at the table.

Hand-Reading: Taking an educated guess at what types of hands your opponent may have as his hole cards.

Heads up: Having only one opponent in a hand.

Hidden Outs: An out that does not directly improve your hand in terms of giving you a straight of flush, but regardless gives you the best hand.

Hole cards: Cards dealt to a player facedown so only he can see them.

Implied odds: Taking future betting into consideration when examining our reward to risk ratio.

Late position: Players to the right of the small blind.

Limp: Just calling preflop instead of raising.

Loose: A player who plays a lot of hands preflop is considered a loose player.

Middle position: Players between early position and late positions.

Min-raise: To raise the smallest amount allowed.

Miss: Another card is dealt on the board, yet your hand does not improve.

Nuts: The best hand possible.

Offsuit: Hole cards that do not have matching suits.

Out: A card that can improve a hand which is not currently the best to being the best hand.

Out of position: Having to act first during a hand.

Outkicked: Having the same pair as your opponent but losing because your kicker is a smaller ranked card than theirs.

Overbet: Betting larger than the pot.

Overcard: A card higher than any card on the flop, or a card higher than either of your hole cards.

Overpair: A pocket pair that is higher than any card on the flop.

Pocket pair: Having a pair as your two hole cards.

Pot Odds: The odds being offered to you by the pot compared to what you must call to continue in the hand.

Postflop: Refers to the play in a hand just after the flop is dealt. It includes play on the flop, turn and river.

Pot: The money already wagered and in the middle of the table. It’s also used to refer to a hand. "There were four people in the pot." means there were four people playing the hand. This can also be used as a verb. "I potted the turn." means that player bet the size of the pot on the turn.

Pot-Size Raise: Raising an amount that offers your opponent 2:1 odds.

Preflop: Refers to the point in the hand after the hole cards have been dealt but before the flop has been dealt.

Push: Wager your entire stack by going all-in.

Rake: The percent the casino takes from a pot.

Range: A group of hands. For example, sometimes you'll hear a player say, "I put him on AK." AK is just a single hand. Good players tend to work with a range of hands. So, instead they may say, "I think he can have hands like TT, 67s and AK."

Reraise: A raise after someone else has raised.

Semi-bluff: A hand which is probably not the best hand right now but has a good chance to improve to the best hand.

Session: How poker players refer to a given period of time (usually one sitting) where they played poker.

Set: Having a pair as your hole cards and a matching rank on the flop.

Set-mining: Calling preflop with a pocket pair with the idea of either catching a set or folding to any aggression from your opponent.

Shove: See "Push".

Showdown: The end of a poker hand where it's determined who has the best hand.

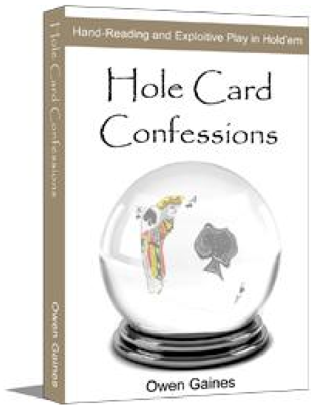
Showdown Equity: The amount of equity a player has if all the community cards were dealt without any further betting.

Slowplay: To check or simply call an opponent's bet instead of betting or raising with the idea of winning more money on later streets.

Stack: The amount of money a player has left to be wagered.

Stack to pot ratio: The size of the pot in relation to the effective stack.

Owen Gaines also wrote Hole Card Confessions: Hand-Reading and Exploitive Play in Hold'em



You’ve seen the poker pros on TV announce an opponent’s hand as if by magic. Now it’s your turn! Owen reveals the secrets to becoming an expert hand-reader. READ HANDS, GET PAID…

Excerpt from Hole Card Confessions:

“If poker is a battle for information, what information am I looking for? How do I find it? What do I do with this knowledge once I’ve found it? I’ll answer these questions and more from the experience I have gained over 3 million hands of analyzing opponents of every variety. That experience gained over that number of hands allows me to make incredibly accurate assumptions about the strategies of different opponent types. This knowledge is one of the most valuable things I can offer other players; it puts them on the fast track to becoming hand-reading experts.

With this information and some experience, you’ll often find your opponent’s hole cards are speaking volumes. It’s just a matter of tuning your ears to their frequency. Once you’re tuned in, you will have obtained a key ingredient needed to become a force at the poker tables.”

Stakes: The size of the blinds in the game you’re playing.

Straight: Five cards of mixed suits in sequence.

Street: A round of betting after another card(s) has been dealt.

Suck Out: When someone wins a hand when they were a large underdog previously in the hand.

Table Selection: Picking the game in which you’re going to play.

Tight: A player who plays very few hands preflop is considered a tight player.

Tilt: When a players makes decisions based on something other than logic. A classic example is when someone is upset for some reason and as a result is playing badly.

Trips: Three of a kind where you have a hole card that matches two cards of the same rank on the board.

Undercard: A card lower than another specified card or group of cards. Example: If the flop was KT3, and a 2 came on the turn. The 2 is an undercard to the flop.

Underpair: A pocket pair that is lower than any of the cards on the board. Also a pocket pair lower than an opponent’s pocket pair.

Upswing: When a player wins a lot of money relative to the big blind of the game.

Value-bet: Betting when one believes he has the best hand.

Win Rate: A player’s rate of earn.

Wired Pair: See “Pocket pair”