Chapter 6

Doing the Maths

Premises and Assumptions

In my experience maths is a subject that invokes strong passions in people. A great many people love maths and find it intriguing and a great many people find it terrifying and utterly incomprehensible. Very few people are actually indifferent towards maths. If you are lucky enough to like maths and have a good feel for it then this chapter won't be daunting. However, if maths freaks you out then you might be tempted to skip this chapter altogether. Don't. You simply can't play poker successfully without having some understanding of the maths. As mentioned previously, knowledge of maths allows you to make precise statements or ask precise questions about situations.

We have already seen a fair amount of maths in this book but in this chapter we are going to analyse some situations very deeply. I don't think that any of the maths is particularly difficult but it will require some concentration to follow the arguments. My main aim with this chapter is to give a good idea of how one goes about carefully defining the premises of a situation and how this leads on to useful calculations.

"Clean" Examples

Example 1

You are playing short-handed FL and you are in the big blind with 9♣-6♣. Everyone folds round to the small blind who opens with a raise. You have a reasonable line on the small blind and he is not a compulsive stealer in this situation. You have seen him fold here and also just call. You have also seen him occasionally decline to complete from the blinds even when offered pot odds of around 6-to-1 or 7-to-1. Thus you strongly suspect he has a decent hand here. You also know that he is very showdown bound, especially when he has announced that he has any kind of hand in the pre-flop play. He is the kind of player who will *always* go to the river with A-K, more or less regardless of the board or action. Nevertheless you have position with good pot odds and, of course, you make a no-brainer call.

The flop brings good and bad news. It is A♣-Q♥-4♣ giving you a flush draw but it is also not hard to observe that it pretty much crashes into your opponent's tight-ish range. Thus it is unlikely that you will be able to use the strength of your draw to push him off a better hand.

Naturally he bets, bringing the pot to 2.5BB and it's up to you. Anyone who knows anything about limit hold'em should now instinctively be thinking – 'Raise! – as a semi-bluff or as a prelude to taking a free card on the turn.' Raising is tempting and certainly comes into consideration. However, if we then get three-bet we will end up regretting our play as we will be paying more than necessary for our draw. So, what to do?

This is an ideal situation for blending maths and poker skills. Firstly we need to do some maths. When we get some answers we can then apply this to the situation and we will have maximum information for our decision. In the following analysis we are going to have to make some assumptions so that the calculations do not become unwieldy. For example, we may occasionally make our flush and lose or we may occasionally not make our flush but win. Let's assume these possibilities balance out. Let's also assume that since our opponent is solid and almost certainly has a decent

hand, it will not be possible to get him to fold and we will have to show down the best hand to win.

1. Passive play

Firstly let's assume we play the hand passively. We will call the flop and then call the turn and just hope we hit our draw. We know that a flush draw is basically 2-to-1 to hit with two cards to come. If we miss it will cost us 1.5BB. If we hit we are going to win 2.5BB plus whatever we can pick up on the turn and river. If this includes raising and getting paid off then this will climb to 5.5BB. However, sometimes the third flush card will scare our opponent and we may only pick up 4.5BB. Let's say 5BB as a compromise. Thus, playing the hand out three times means we lose 1.5BB twice and once win 5BB. We show a profit of 2BB or 0.66BB overall.

2. Successful free card raise

This time we raise on the flop and our opponent cooperates by calling and then checking the turn. We will now only bet again if we hit our hand. Thus if we miss we will lose just 1BB. If we hit we will pick up 3BB (there were 2.5BB after our opponent's flop bet and his call of our raise has brought this up to 3BB) plus whatever we get on the turn and river. If we are lucky enough to hit on the turn this could be 5BB but if we hit on the river our opponent may well be suspicious of the third flush card (especially after our turn check) and check-call, thus limiting us to 4BB. Overall 4.5BB seems like a reasonable payoff. With this scenario, playing the hand out three times means we lose 1BB twice and once win 4.5BB. We show a profit of 2.5BB or 0.83BB overall.

[As an aside I would like to mention that the free card raise play on the flop has become rather unfashionable and nowadays even looks slightly quaint. A few years ago, everyone was doing it but the drawbacks became apparent and it lost popularity. There are two big problems with the play. Firstly when you raise the flop and then check the turn you are effectively sticking a big sign on your head that says, "I have a drawing hand," and announcing your hand to the world in poker is generally a –EV decision. Secondly, players aren't so polite any more. When you raise the flop they

are much less impressed than they used to be and three-bet very freely. Thus you often end up paying extra bets with a weaker hand and not even taking the initiative.

The generally preferred semi-bluffing line these days is to call the flop and raise the turn. This is a much "stronger" play and can often generate more fold equity. However at the end of the day it isn't helpful to consider lines in terms of whether they are fashionable or not. What counts is the EV of each play. If you have zero (or very close to it) fold equity against a particular opponent then a successful free card raise is the cheapest way to play a drawing hand. It doesn't matter much that you announce on the turn that you are drawing since your strategy in the pot is based on an accurate technical method of maximising the value of your outs and deception is irrelevant.]

3. Unsuccessful free card raise

This time we raise on the flop but our opponent refuses to crawl into his shell and instead three-bets. Now we revert to our passive strategy but we have paid over the odds for our draw. When we miss our draw we will drop 2.5BB. On the occasions when we get lucky we will pick up 3.5BB plus whatever we get on the turn and river. Let's say that – as with "scenario 1" – this turns out to be another 2.5BB, bringing the reward to 6BB. Now playing the hand out three times means we lose 2.5BB twice and pick up 6BB once – a profit of 1BB or just 0.33 overall.

Conclusion

In summary we can see that the successful free card raise yields the best outcome – gaining us 0.17BB over passive play. However, when we get three-bet this ends up costing us 0.33BB – basically twice the gain from the successful free card play. Now we can make an informed decision. Our free card raise play needs to work around 66% of the time for it to give good value. If it turns out that half the time our opponent is three-betting us then we are better off going passive. Now we know what the numbers are we can again ask a precise question, 'Based on what I know of my opponent is there one chance in three that he will play back at me?'

In this particular case with the rather dangerous A♣-Q♥-4♣ flop we may well conclude that the danger of a three-bet is too great and thus more +EV play is to play the draw passively. If we had a different flop texture, e.g. K♣-9♣-2♥ and we held 8♣-6♣ then the free card play is much more likely to be the most profitable line. Of course in this situation we may decide that we have sufficient fold equity (even against a highly showdown-bound opponent) that barrelling becomes a more +EV play, but that's another story – and as an exercise you might like to try and work out the maths for this particular scenario.

Example 2

This example is again from a battle in the blinds after the early players and button have folded. It actually occurred in a low limit game I was playing on Party Poker. On this occasion I was in the small blind holding A♠-3♠ and naturally open raised. I had no specific information on the big blind other than that he appeared to be a fairly weak/passive player who seemed reluctant to take the initiative. He completed and we took the flop heads up and it came down K♠-Q♦-J♥. Naturally I made the continuation bet and unfortunately the big blind called.

He is not the kind of player who will make a random float here without a hand so his range most likely consists mainly of K-x, Q-x and J-x with occasional A-x and 10-x hands. Of course he should be raising with his stronger holdings but since he appears to be a weak/passive player the strong paired hands are the major component of his range.

The turn brought K♠-Q♦-J♥-6♠, creating a flush draw. I had been prepared to play check/fold if the turn had been unhelpful but now that the flush draw has materialised I am clearly going to play. Betting is obviously possible since I now have a lot of outs against better hands but as he had called on a flop which should help me as the pre-flop raiser there didn't seem to be a great deal of fold equity for a bet. Even though I have picked up outs if I am behind (as is highly likely) I am still in a –EV situation regarding bets that go into the pot on the turn.

I could barrel the turn and river hoping to get a weak hand such as J-x or

5-5 to fold but this didn't seem very likely to succeed. Playing check/call on the turn is possible but then I am purely playing for my outs as, having shown weakness by checking the turn, a bluff on the river has close to zero chance of success. So I decided upon a plan of checking the turn, being happy enough to take a free card if he happened to check behind and planning to check raise the turn if he bet.

The point of this play was to attempt to generate some fold equity from my drawing hand. I didn't really have any hard information on this player but check raising the turn is a strong play and I thought that if he wasn't terribly showdown-bound he might take the view that I had trapped him and I could get folds from J-x and possibly even Q-x, either at once or on the river. Ideally I would have wanted to see a WTS figure for him but I didn't have one.

As it turned out the plan failed miserably. He did indeed bet, called the check raise and then called again when the river blanked off. He showed up with the very strong hand K-10. Incidentally he has rather underplayed his hand here as I would certainly be inclined to raise pre-flop with K-10 and furthermore a flop raise is pretty much mandatory with top pair good kicker and an open straight draw. Simply calling as he did cannot be right because it alerts me to the fact that he has a piece of the flop whilst failing to get value from weaker hands that I may have such as A-x, J-x, 10-x etc. However, I did say that he seemed a weak, passive player so we don't need to be too surprised at this inferior line.

Clearly in this particular case I had badly overplayed my hand – particularly unfortunate since he was missing value with his passive line and I handed it back to him on a plate by betting his hand for him. Nevertheless K-10 is right at the top end of his range here and he could easily have been much weaker than this. So is there any merit in my check raising play? At the time my hunch was that if he folded anything more than about 20% of the time then it would be a profitable play, so I was curious to crunch the numbers and see what conclusions could be reached.

To make an analysis we need to consider our possible courses of action on the turn, following the villain's flop call. We are never folding so we can play bet, check/call or check/raise. Firstly let's consider bet and check/call

since much of the time they are likely to amount to the same thing. If we think about general poker principles we should bet either because we are ahead and we want to gain value/protect our hand or because we are behind and we want to generate fold equity (either at once or on subsequent streets). Neither is likely here. Although we are ahead of his 10-x holdings, this is only a small part of his range and we are behind against the much greater part which is of course the paired hands. Also we have close to zero fold equity against paired hands. Finally, although he is passive, he can still have a very good hand and raise us, which is bad for us in EV terms.

So, if we are taking a "passive" line then check/call feels preferable to betting. We can eliminate betting as an option on the turn and simply decide between check/call and check/raise.

After the flop betting the pot stands at 3BB. We have nine clean outs to the flush, three very good outs to the 10 (don't double count the 10♠) and three dirty outs to the ace. A total of 14 outs seems reasonable. We can assume that following our turn check the villain will always bet. Now we have the information we need and can consider each line in turn. A good way to make the analysis is to assume the worst case scenario for the check/raise play which is that the villain *never* folds a better hand. Clearly it will be an inferior play if that is indeed the case but this will give us a value for how much the check/raise play costs in this particular case. When we know this figure we use it to calculate how often the villain needs to fold for our play to become profitable.

Check/call

First the easy bit. If we miss on the river our play costs 1BB because we simply fold to any river action. If we hit on the river we win a minimum of 4BB (there was 3BB in the pot after the flop betting and the villain bet the turn) plus whatever we pick up from the river betting. However, when we consider river play it becomes clear that our implied odds are not very good. If we hit the flush with a low card we will probably be able to check raise and it will probably be paid off, so hitting the flush is worth 2BB "most" of the time. The problem is that because this opponent is so passive he might check behind quite often when we don't win anything on the river.

Our other outs are probably worth less than 1BB as we will have to donk out if a ten hits (and might not even get paid off) and we can't even bet if an ace comes as he is rather unlikely to call with a worse hand. Overall it is hard to believe that we will make more than 1BB on the river when we hit our hand. So, with the check/call line we win 4BB when we hit and lose 1BB when we miss. We have 14 outs from 44 cards, giving:

$$[(14 \times 5BB) + (30 \times -1BB)] / 44 = 40/44BB = 0.9BB$$

Our check/call passive line yields a profit of slightly less than 1BB.

Check/raise

When we analyse the check/raise play we are going to assume that the villain never folds. Since we are taking the initiative with the check raise play we will always bet the river and we will always get called. When we hit we gain 6BB (3BB before the turn, 2BB from the turn check raise and 1BB on the river) but when we miss we lose 3BB. We still have 14 outs and so now the equation is

$$[(14 \times 6BB) + (30 \times -3BB)] / 44 = -6/44BB = -0.1BB$$

Conclusion

Against a villain who is totally showdown-bound our check raise play costs 1BB [0.9BB – (–0.1BB)]. However, if the villain will sometimes fold a better hand, either on the turn or on the river after he fails to improve, then we can regain some of this lost value. If the villain folds a better hand on the turn we gain 4BB and if he calls the check raise but folds on the river we win 5BB, so 4.5BB as a compromise seems reasonable.

We now need to solve a simple equation to complete the calculation. The villain will either call us down or fold so

call + fold = 1

When he calls we lose 1BB and when he folds we gain 4.5BB. To find the breakeven point for the play we need to solve

(−1 x call) + (4.5 x fold) = 0

We know that call + fold = 1, and can rewrite this as

fold = 1 − call

If we now substitute this into the previous equation we get

(−1 x call) + (4.5 x [1 − call]) = 0

which simplifies as follows

(−1 x call) + 4.5 − (4.5 x call) = 0

4.5 − (5.5 x call) = 0

4.5 = 5.5 x call

4.5/5.5 = call

0.82 = call

So, call works out at 82% and fold is 18%. Therefore if the villain can fold a better hand more than 18% of the time the check raise play will be profitable. Is this reasonable? I'd say it's borderline. We stated at the start that we didn't have any reads on the villain other than noting weak/passive

tendencies. This type of player tends to be fairly showdown-bound and I wouldn't expect them to fold K-x and Q-x if the river blanks off. It's possible they might fold low pairs or a weak J-x but this isn't certain and such hands are not a big part of their range (they may well have checked behind on the turn with a hand such as 2-2).

We have a problem here in that once the villain calls the flop and bets the turn it considerably tightens up their range and reduces our fold equity. Overall I would say the check raise play is borderline at best mainly due to the villain's style. It would be more effective against an aggressive villain who was capable of making thin value bets but would also be prepared to get away from hands if they felt they had been trapped.