Mathematics in Poker

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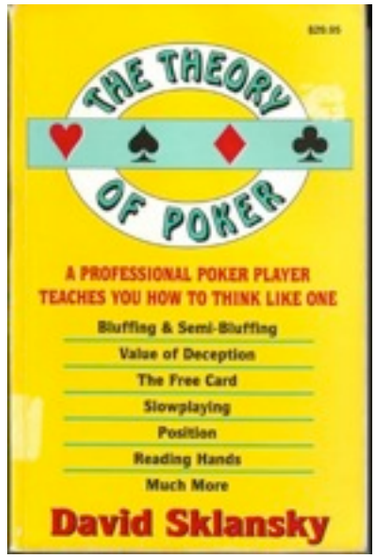
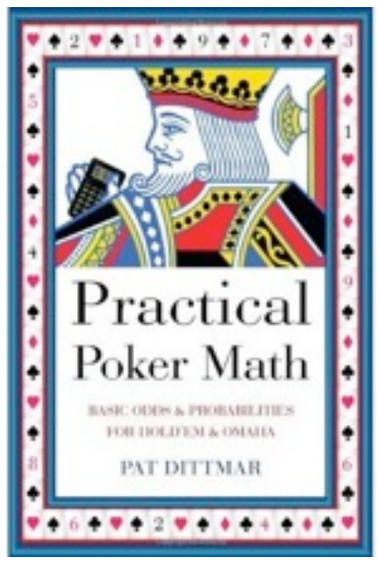


"The Theory of Poker"
by David Sklansky (1987)



"Practical Poker Math"
by Pat Dittmar (2008)

- www.pokerjunkie.com

Pot Odds

- How much you can win to the cost for playing

- Example:

  $30 : in pot
  $10 : to call
  * Pot odds are “4 to 1”

Pot Odds

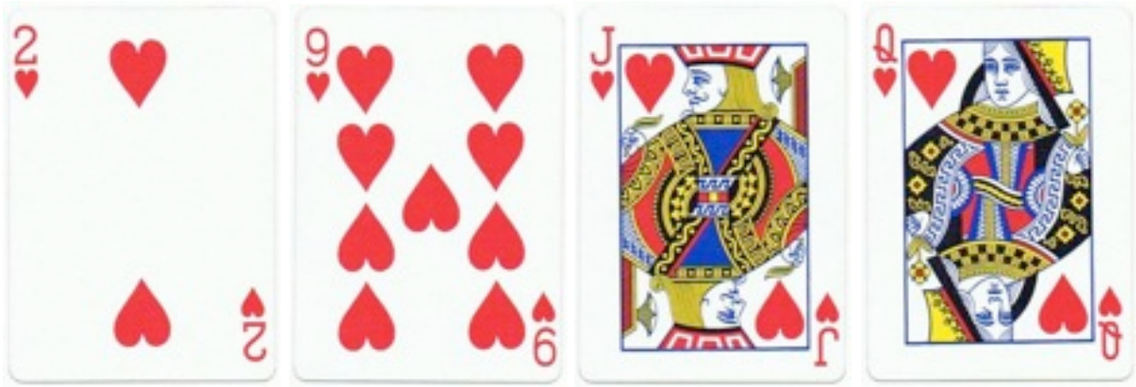
- Compare Pot Odds to your Winning Odds

- Example:

  If pot odds are “4 to 1”,
  - Call if your winning odds are better than “4 to 1” (20%)
  - Fold if your winning odds are worse than that.

Pot Odds with more cards to come

- One more card to come



Example:

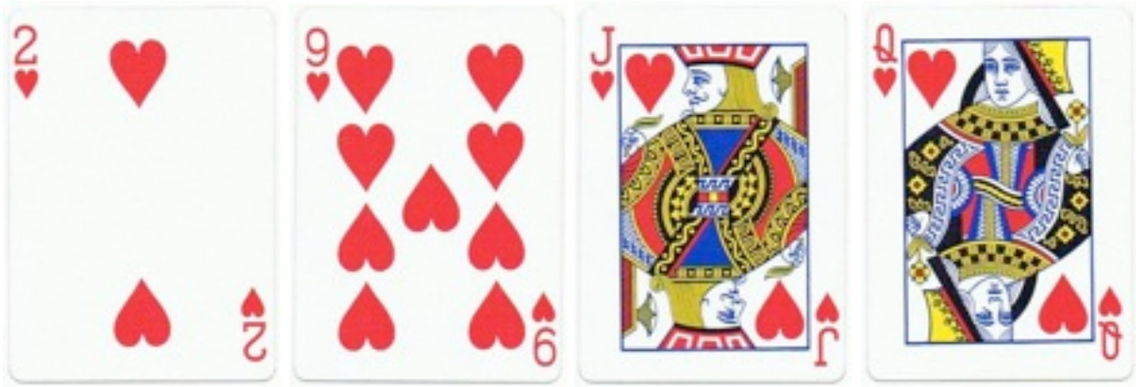
* Pot odds: 5 to 1

- If you're sure you can win with flush,
- The odds of making the flush are "4.22 to 1"

(9 of the 47 unseen cards)

Pot Odds with more cards to come

- One more card to come



Example:

* If pot odds are “3 to 1”

= FOLD

Effective Odds

- More than one card to come

Example:
In hold'em, you have four-flush after the flop.
* Pot odds: 3 to 1 ($20 in pot, $10 bet)

- Odds of making the flush (with two more cards)
: 1.8 to 1

= Call??

Effective Odds

- More than one card to come

Example:
In hold'em, you have four-flush after the flop.
- Odds of making the flush (with two more cards)
: 1.8 to 1

If you miss your hand: Lose $10(this) + $20(next)
If you make your hand: Win $30 + $20(next)
* Pot odds: 5 to 3 = 1.67 to 1

Effective Odds

- More than one card to come

Example:
In hold'em, you have four-flush after the flop.
- Odds of making the flush (with two more cards)
: 1.8 to 1

If you miss your hand: Lose $10(this) + $20(next)
If you make your hand: Win $50 + $20(opponent)
* Pot odds: 7 to 3 = 2.33 to 1

Implied Odds

- Based on the possibility of winning money in later betting rounds.
- Sometimes it's okay to make a call even if the pot is too small to give you the correct pot odds.
- Cannot be calculated with certainty.

Bluffing Frequency

- If you never bluff = Never call your bet
- If you always bluff = Always call
- Find Optimum Bluffing Frequency.

Bluffing Frequency

- T = Pot size
- B = Bet size
- p = The probability that you have the best hand
- b = Your bluff frequency

When opponent calls your bet,
- Wins (T+B) if you're on a bluff.
- Loses (B) if you have the best hand.

$$EV(opponent) = b(1-p)(T+B) - pB$$

Bluffing Frequency

- T = Pot size
- B = Bet size
- p = The probability that you have the best hand
- b = Your bluff frequency

Optimal strategy:

EV(opponent) = 0

$$b(1-p)(T+B) - pB = 0$$

$$b = (p/(1-p)) * (B/(T+B))$$

Bluffing Frequency

- Example:

- Bluffing frequencies for pot sized bets (B=T)

$$b = 1/2 * p/(1-p)$$

* if p = 2/3, then b = 1

Bluffing Frequency

- Example:

- Bluffing frequencies for pot sized bets (B=T)

p(%)	b(%)
0	0
10	6
20	12
30	21
40	33
50	50
60	75

Bluffing Frequency

- David Sklansky(Theory of Poker):

"Optimal bluffing strategy is to bluff in such a way that the chances against your bluffing equals his pot odds."

Bluffing Frequency

- David Sklansky:

"Optimal bluffing strategy is to bluff in such a way that the chances against your bluffing equals his pot odds."

* If you make pot-sized bet,

  = Bluff half as much as you bet.

Bluffing Frequency

- Example:

- Bluffing frequencies for pot sized bets (B=T)

p(%)	b(%)
0	0
10	6
20	12
30	21
40	33
50	50
60	75

Bet: 20 times / 100

Bluff:

*Sklansky: half of 20

= 10 times

*table: 12% of 80 times

= about 10 times

Bluff Equity

- Before folding, you should always consider bluffing.

- If you bluff equity is positive, you need to carry out the bluff.

Bluff Equity

- P = Pot size
- B = Bet size (your bluff bet)
- f = The probability that the opponent folds if you bet

When you bluff
- If opponent folds, you win P.
- If opponent calls, you lose your bet B.

So, expected value(EV) of your bluff is...

$$EV = fP - (1-f)B$$

Bluff Equity

- P = Pot size
- B = Bet size (your bluff bet)
- f = The probability that the opponent folds if you bet

- We want EV to be positive.

$$fP - (1-f)B > 0$$

$$f > B/(P+B)$$

Bluff Equity

- Example 1 - Pot sized bet
- P = B
  - f > 1/2

* If your opponent tends to fold more than 50% when you bet, a pot sized bluff earns you money.

Bluff Equity

- Example 2 - Smaller Bet
- P = 3B
  - f > 1/4

* If your opponent tends to fold more than 25% when you bet(usually calls your bet), a small bluff will earn you money.

Bluff Equity

- Example 3 - Bluff bet size limit and the opponent folding probability

$$B < P\frac{f}{1-f}$$

$$B_{max} = P\frac{f}{1-f} = P\frac{1}{\frac{1}{f}-1}$$

So bluff bet size increases as folding probability increases

Bluff Equity

- Limitations
  - Too simplified.
    - f is actually a function of B and P. And the function is hard to know.
    - Typically, bigger bets are harder to call.