15.S50 - Poker Theory and Analytics

Basic Strategy
Basic Strategy

• Terminology – Position
• Pot Odds
• Implied Odds
• Fold Equity and Semi-Bluffing
Position Terminology

Middle Position
- MP1
- MP2
- MP3

Late Position
- CO
- BTN

Early Position
- UTG
- UTG+1
- UTG+2

Blinds
- BB
- SB
Position Terminology (6-handed)

Middle Position

UTG+1

UTG+2

UTG

UTG+1

Early Position

Blinds

Late Position

CO

BTN

SB

BB

D

Blinds

Early Position

Middle Position

Late Position
Position Basics

• In general, later position is preferred since you get more information before acting

• Playable hands are wider for later positions

• Blinds get a discount to see flops, but are in the worst position for every round thereafter

• Early position offers more opportunity for aggression, and is preferred in some low-M situations
  – e.g. in the “Game of Chicken” situation, first actor gets to “throw the steering wheel out the window”
Basic Strategy

• Terminology – Position
• Pot Odds
• Implied Odds
• Fold Equity
Why do odds come into play?

• Common situation is weak made hand vs drawing hand
  – i.e. pair or two pair on flop vs straight or flush draw
  – Or pocket pair vs anything else pre flop

• Drawer has to balance chance of hitting draw vs how much each addition card costs

• Made hand wants to
  – Bet enough for the drawer to not have a +EV call
  – Bet an amount that bad players might mistake as good odds
Pot Odds
Pot Odds

John_VH925 (UTG+1): $500       Blinds 20/40 + 10
Hero (MP1): $500

Pre Flop: ($140) Hero is MP1 with A♥ T♥
1 fold, John_VH925 raises to $120, Hero calls $120, 5 folds

Flop: ($380) 8♥ 3♥ K♣ (2 players)
John_VH925 bets $370 all in, Hero…

Should the hero call?
Pot Odds

- What is the maximum bet the hero should call?
Concept – Expected Value (EV)

- Expected Value is the probability-weighted average of possible results

- \( EV = \text{Win\%} \times \text{WinAmt} - \text{Lose\%} \times \text{LoseAmt} \)

- For example,
  - If Win\% = 25\% and you are facing a $60 bet into a pot of $100
  - \( EV = 25\% \times (100+60) - 75\% \times 30 = 17.5 \)

- In general, decision rules will be made based on Expected Value

- In Scenario A,
  - our Hero is facing a bet into a pot of $380
  - \( EV = \text{W\%} \times (380 + x) - \text{L\%} \times x \)
  - Calling threshold is at \( EV = 0 \)
Concept – Pot Odds

- Pot Odds are the relationship of the call amount to the size of the pot
- In general, a call will be +EV if Win% > CallAmt/(PotAfterCall)
- For example in our scenario,
  - If the bet were $100 into pot of $380
  - Pot Odds would be $100/$580, where $580 = (Pot + Bet + Call)
  - Hero’s call contributes ~17% of the pot
  - He can profitably call if Win% > 17% of the time
- Win% is based on “Outs” (cards that result in a win)
- Outs are 9 hearts to hit flush
- Win% = 1 – (40/49 * 39/48) ≈ 34%. This gives us the odds to call
- EV = 34% * $480 - $100 * 66% = $97.2
Concept – Pot Odds

34% Pot Odds
Pot Odds – Gordon's Rule of 2 or 4

- Phil Gordon
  - Fourth Place in 2001 WSOP ME
  - One WPT title
  - Win Two North American Bridge Championships
  - Head Referee World Series of Rock Paper Scissors
  - Author of *Phil Gordon's Little Green Book*

Pot Odds – Gordon's Rule of 2 or 4

- Phil Gordon
  - Author of *Phil Gordon's Little Green Book*

- Each Out is worth about 2% equity per card

- If you get to see both turn and river, use 4% per card

- For example, if have a low pair on the flop and are drawing to three-of-a-kind, you have 2 outs or about 4% to make your hand on each card.

- Other common examples include:
  - Flush Draw (9 outs) gives you odds of $9/47 \approx 18\% = 9*2\%$
  - Inside Straight Draw (4 outs) gives you odds of $4/47 \approx 8\% = 4*2\%$
Pot Odds – Gordon's Rule of 2 or 4

• Phil Gordon
  – Author of *Phil Gordon's Little Green Book*

• Each Out is worth about 2% equity per card

• If you get to see both turn and river, use 4% per card

• For example, if have a low pair on the flop and are drawing to three-of-a-kind, you have 2 outs or about 4% to make your hand on each card.

• Other common examples include:
  – Flush Draw (9 outs) gives you odds of 9/47 ≈ 18%
  – Inside Straight Draw (4 outs) gives you odds of 4/47 ≈ 8%
Concept – Pot Odds

- Breakeven is when EV = 0

- Bet is \( x \) into a pot of $380
- Chance of hitting flush is 9 Outs * 4% (since we get both cards)
- Win% \( \approx 36\% \)
- Exact Win% = \( 1 - (40/49 * 39/48) \approx 34\% \).

- \( EV = 34\% * (380 + x) - 66\% * x = 0 \) at \( x = 404 \)

- So the maximum bet we should call is $404

- Check with \( 404 / (404*2 + 380) \approx 0.34 \)
Solution Set

• Our Hero should call any bet **up to $404** and fold to anything larger
Practical Solution

John_VH925 (UTG+1): $500  Blinds 20/40 + 10
Hero (MP1): $500

Pre Flop: ($140) Hero is MP1 with A♥ T♥
1 fold, John_VH925 raises to $120, Hero calls $120, 5 folds

Flop: ($380) 8♥ 3♥ K♣ (2 players)
John_VH925 bets $370 all in, Hero…

Should the hero call?
Practical Solution

• In real time: Our Hero knows he will hit the flush about 36% of the time, so he can profitably call up to 36% of the new pot. In the case of a $370 bet, the Hero will decide to call since the new pot will be $380 + $370 + $370 = $1120 and his contribution is $370/1120 (33%), which is less than his chance of winning (36%)
More Examples

Villain (MP): $250  Blinds 20/40 + 10  Hero (BTN): $1000

Pre Flop: ($140) Hero is BTN with 6♦ 7♦  Villain raises to $90, Hero calls $90

Flop: ($320) 8♠ 5♥ K♣ (2 players)  Villain bets $150 all in,  Hero…
More Examples

1. What are we drawing to?
   – Straight (open-ended)

2. What are our outs?
   – Any 9, any 4 (8 cards total)

3. Chance of hitting draw?
   – $8 \times 4\% = 32\%$

4. Correct play?
   – Call, since call is 150 of 620 or 24%

5. EV of decision?
   – $32\% \times 470 - 68\% \times 150 = 48.4$
More Examples

Villain (MP): $3000  Blinds 100/200
Hero (BTN): $3000

Pre Flop: ($300) Hero is BTN with 5♦ 5♥
Villain raises to $400, 2 calls, Hero calls $400

Flop: ($1900) 5♣ A♣ 6♣ (2 players)
Villain bets $200, 2 folds, Hero…
More Examples

1. What are we drawing to?
   – Full House or 4-of-a-kind
2. What are our outs?
   – 3x A or 6, 1x 5 (7 cards total)
3. Chance of hitting draw?
   – 7 * 2% = 14%
4. Correct play?
   – Call, since call is 200 of 2300 or 9%
5. EV of decision?
   – 14% * 2100 - 86% * 200 = 122
More Examples

Villain (BB): $200  Blinds 100/200
Hero (SB): $1000

Pre Flop: ($300) Hero is SB with 5♣ 7♥
Hero…
More Examples

1. What are we drawing to?
   – Anything

2. Chance of hitting draw?
   – 57o vs ATC ≈ 40% [32o vs ATC ≈ 32%]

3. Correct play?
   – Call, since call is 100 of 400 or 25%

4. EV of decision?
   – \[40\% \times 300 - 60\% \times 100 = 60\]
Basic Strategy

• Terminology – Position
• Pot Odds
• Implied Odds
• Fold Equity
Implied Odds – Hand Rules

• We are trying to find the amount of chips we need to win after hitting our draw to make the bet we are facing a good call.

• We do this by figuring out what the pot would have to be after our call to make our \( x \)% chance of winning equal to the \( x \)% of the pot for the call.

• For example, if we have a flush draw (18% to hit), and we are facing a bet of $180 into a pot of $300, then our call represents \( \frac{180}{660} = 27\% \) of the pot (i.e. too expensive to call).

• This would be a good call if we contributed 18% of the pot, or \( \frac{180}{1000} \). So we need to find \( 1000 - 660 = 340 \) in dead money.

• The additional \( $340 \) after the draw makes our \( $180 \) bet worth 18% of a $1000 pot.
We need 18% for this to be a good call
We make our call 18% by adding $340 of dead money
Implied Odds Examples
Implied Odds Examples

Villain (MP): $3000  Blinds 25/50
Hero (BTN): $3000

Pre Flop: ($75) Hero is BTN with K♦ T♥
Villain raises to $150, 2 folds, Hero calls $150, 2 folds

Flop: ($375) T♣ A♥ 6♦ (2 players)
Villain bets $100, Hero…
Implied Odds Examples

1. What are we drawing to?
   – Two pair or 3-of-a-kind
2. What are our outs?
   – 3x K, 2x T (5 cards total)
3. Chance of hitting draw?
   – 5 * 2% = 10%
4. Pot odds?
   – $100 of $575, or about 17%, too expensive
5. Additional bets after draw to breakeven?
   – $100/10% = $1000 – $575 = $425 more
Implied Odds Examples
Implied Odds Examples

Villain (MP): $3000  Blinds 25/50
Hero (BTN): $3000

Pre Flop: ($75) Hero is BTN with K♣ Q♣
Villain raises to $100, 2 folds, Hero calls $100, 2 folds

Flop: ($275) T♣ J♣ 3♥ (2 players)
Villain bets $600, Hero…
Implied Odds Examples

1. What are we drawing to?
   – Straight or Flush

2. What are our outs?
   – Any A, any 9, 7 other ♠ (15 cards total)

3. Chance of hitting draw?
   – 15 * 2% = 30%

4. Pot odds?
   – $600 of $1475, or about 41%, too expensive

5. Additional bets after draw to break even?
   – $600/30% = $2000 – $1475 = $525 more
Drawing Formulas

• EV (Marginal Value of Any Decision)
  \[ x = \text{Win\%} \times \text{WinAmt} - \text{Lose\%} \times \text{LoseAmt} \]

• Rule of 2 or 4 (Chance of Hitting Draw)
  \[ x = 2\% \times \#\text{Outs} \times \#\text{FreeCards} \]

• Pot Odds (Decision Rule to Call Bet)
  \[ \text{Win\%} > \frac{\text{CallAmt}}{\text{Pot} + \text{BetAmt} + \text{CallAmt}} \]

• Implied Odds (Additional Chips After Draw Hits Needed to Call)
  \[ x = \left( \frac{\text{BetAmt}}{\text{Win\%}} \right) - \left( \text{Pot} + \text{BetAmt} + \text{CallAmt} \right) \]
Drawing Formulas (Example)

- **EV (Marginal Value of Decision)**
  - Calling a $150 bet into a $320 pot to have a 32% chance of winning
  - $48.4 = 32%*(320 + $150) - 68%*$150

- **Rule of 2 or 4 (Chance of Hitting Draw)**
  - You have 9 Outs to a Flush and get to see Turn (not River)
  - 18% = 2% * 9 * 1

- **Pot Odds (Decision Rule to Call Bet)**
  - You are facing a $370 all-in bet for a $380 pot with a flush draw
  - 36% > $370/($380 + $370 + $370) = TRUE

- **Implied Odds (Additional Chips After Draw Hits Needed to Call)**
  - $100 bet into pot of $375 with 2-pair/3-o-a-k draw on Turn
  - $425 = ($100 / 10%) - ($375 + $100 + $100)
Live Example
Live Example

• YouTube video:

  [https://youtube/Q1HkLjq-GGQ?t=23m24s](https://youtube/Q1HkLjq-GGQ?t=23m24s)
Live Example
Live Example

Hero (UTG): 22,450k  150k/300k Blinds + 50k
Tonking (SB): 6,775k

Pre Flop: (950k) Hero is UTG with A♣ J♣
Hero calls 300k, 7 folds, Tonking calls 150k, Sindelar checks

Flop: (1,400k) 7♣ 8♥ T♣ (3 players)
Tonking checks, Sindelar bets 500k, Hero raises to 1,750k, Tonking raises 4,525k to 6,275k all in, Sindelar folds

Hero...
Live Example

• What are we drawing to?
  – Flush, maybe straight

• What are our outs?
  – 2,3,4,5,6,8,9,Q,K of ♣ (9 cards) and maybe 9 of ♠, ♦, ♥ (3 cards)*50%
    – Count this as 10.5 outs

• Chance of hitting draw?
  – 10.5 * 4% = 42%

• Correct play?
  – Pot will be 1400k + 500k + 2*6,275k = 14,450k. Call amount is 4,525k or ≈ 31%. So call.

• EV of Decision?
  – EV = 42% * 9925k – 58% * 4,525k = 1544k
Drawing – Be careful about

• Drawing to a hand that might not win at showdown
  – i.e. a Q-high or lower flush
  – Or the low end of a straight
  – Or a flush/straight on a paired board

• Assuming you will get to see turn and river for one bet
  – This very rarely happens unless the aggressor is all-in
  – A lot of players will bet on flop with a draw to get this

• Overestimating how easy it is to extract additional chips
  – Flush draws hitting on turn/river are very easy to spot
  – Straight draws are less easy, hitting sets is difficult to see

• Betting too little and letting other players make +EV calls
  – Most flop, turn bets should be around half to 2/3rds of the pot
Basic Strategy

• Terminology – Position
• Pot Odds
• Implied Odds
• Fold Equity and Semi-Bluffing
Fold Equity
Fold Equity

Turkito694 (UTG): $2098.00  Blinds $5/$10
Hero (CO): $990.00

Pre Flop: ($15.00) Hero is CO with 6♠ 7♠

River: ($350.00) A♦ 5♥ 8♦ Q♠ 2♦ (2 players)
Turkito694 checks
Hero bets $150…

How often does this bluff have to work to be profitable?
Concept – Fold Equity

• Fold Equity is the value a player gains from the likelihood that the other player will fold to his bet, assuming a call will result in a loss

• Fold Equity = Current Pot * Fold% - Bet * (1-Fold%)
  – If SD-Win% = 0

• Fold Equity = Current Pot * Fold% + (1-Fold%) * EV-if-Called
  – If SD-Win% > 0

• SD Value = (1-Fold%) * EV-if-Called

• **Bluffing** is a bet that is +EV because Fold Equity > 0
• **Semi-bluffing** is a bet that is +EV with negative Fold Equity offset by sufficiently high Showdown-Win%
Fold Equity

River: ($350.00) A♦ 5♥ 8♦ Q♠ 2♦ (2 players)
Turkito694 checks
Hero bets $150…

How often does this bluff have to work to be profitable?

Bet is 150 into pot of 350. Showdown-Win% = 0.

EV = 350 * Fold% - 150 * (1 - Fold%)

EV > 0 when Fold% > 150/(350+150) = 30%

Check with EV = 30% * 350 – 70% * 150 = 0

This seems +EV, given that Hero is representing a flush
Fold Equity

Turkito694 (UTG): $2098.00  Blinds $5/$10
Hero (CO): $990.00

Pre Flop: ($15.00) Hero is CO with 6♠ 7♠

River: ($350.00) A♦ 5♥ 8♦ Q♠ 2♦ (2 players)
Turkito694 checks
Hero bets $150…

How often does this bluff have to work to be profitable?
Semi-Bluffing – Impact of Win%

• Using our example:
  – BetAmt = 150
  – Pot = 350
  – \( \text{Fold\%} = \frac{-2 \times \text{BetAmt} \times \text{Win\%} + \text{BetAmt} - \text{Pot} \times \text{Win\%}}{-2 \times \text{BetAmt} \times \text{Win\%} + \text{BetAmt} - \text{Pot} \times \text{Win\%} + \text{Pot}} \)
  – \( \text{Fold\%} = \frac{(13 \times \text{Win\%} - 3)}{(13 \times \text{Win\%} - 10)} \)
Semi-Bluffing – Impact of Win% 

BetAmt = 150    Pot = 350
Fold% = (13Win% - 3) / (13Win% - 10)
Semi-Bluffing – Impact of Win% 

BetAmt = 150  
Pot = 350  
Fold% = \( \frac{(13\text{Win\%} - 3)}{(13\text{Win\%} - 10)} \)

Breakeven Fold%

(W\%, F\%)  
(16\%, 12\%)
Semi-Bluffing – Impact of Win%

BetAmt = 150  Pot = 350
Fold% = \frac{(13\text{Win\%} - 3)}{(13\text{Win\%} - 10)}

Breakeven
Fold%  (0\%, 30\%)
(W\%, F\%)

SD-Value = 0
F\% = \frac{150}{(150+350)}
F\% = 0.30
Semi-Bluffing – Impact of Win%

BetAmt = 150   Pot = 350
Fold% = (13Win% - 3) / (13Win% - 10)

Breakeven Win% ≈ 0.23

(W%, F%) (23%, 0%)
Semi-Bluffing – Impact of Win%

BetAmt = 150  
Pot = 350  
Fold% = (13Win% - 3) / (13Win% - 10)

Breakeven  
Fold%  
(W%, F%)

(W%, F%)

(23%, 0%)

(0%, 30%)
Sensitivity to Bet Size – Impact of Win%

- A pot sized bet would mean a 1% increase in Win% leads to a 1.5% decrease in breakeven Fold%.

\[
\lim_{\text{Bet} \to \infty} \frac{\partial F\%}{\partial W\%} = 2
\]

- A higher bet increases the sensitivity, but it is bound by the interval (1,2).

\[
\lim_{\text{Bet} \to \text{Pot}} \frac{\partial F\%}{\partial W\%} = 1.5
\]

\[
\lim_{\text{Bet} \to 0} \frac{\partial F\%}{\partial W\%} = 1
\]
Fold Equity – Real Time

• When SDValue = 0
  – F% needed = bet / (pot + bet)
  – Pot sized bet needs to win 50% of time
  – Scales approximately linearly down to zero
    • i.e. a half pot size bet needs to win about 25% of the time
    • actual fold rate needed is .5 / 1.5 = 33%

• When SDValue > 0
  – This is difficult to develop quick rules
  – In general, your value is much higher if you have a real draw
  – A good assumption is your SD-Win% decreases the Fold% 1.5x to 1
  – Preflop is basically always semi-bluffing
Live Example
Fold Equity Examples

Villain (MP): $3000 Blinds 25/50
Hero (BTN): $3000

Pre Flop: ($75) Hero is BTN with T♦ 5♠
Villain raises to $150, 2 folds, Hero calls $150, 2 folds

River: ($375) 4♣ 8♥ 9♦ 6♥ 6♦ (2 players)
Villain checks, Hero bets $250…
Fold Equity Examples

1. Bluff or semi-bluff?
   – Bluff

2. What is our Showdown Win%?
   – 0

3. What is our breakeven Fold%?
   – $250 / $625 = 40%

4. Is this a good bet if Villain calls 25% of the time?
   – Yes, 75% > 40%

5. What is our Fold Equity if Villain calls 25%?
   – $375 * 75% - $250 * 25% = 218.75
Live Example
Fold Equity Examples

Villain (MP): $800         Blinds 25/50
Hero (BTN): $1500

Pre Flop: ($75) Hero is BTN with 9♥ T♥
Villain raises to $150, 2 folds, Hero calls $150, 2 folds

Turn: ($775) 4♣ 8♠ 7♦ 2♥ (2 players)
Villain checks, Hero bets $450 ...
Fold Equity Examples

1. Bluff or semi-bluff?
   – Semi-bluff, SD Win% = 16%

2. What is our Showdown Value if Villain calls 80%?
   – 80% * \[16\% * \$1225 - 84\% * \$450\] = -$145.6

3. What is our breakeven Fold%?
   – $450 / $1225 = 37\% - 16\%*1.5 = 13\%

4. Is this a good bet if Villain calls 80% of the time?
   – Yes, 20% > 13%

5. What is our Fold Equity if Villain calls 80%?
   – $775*.20 + .80*(16\%*$1225 - 84\%*$450) = 9.4
Live Example

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Live Example

• YouTube video:


  https://youtu.be/Q1HkLjq-GGQ?t=30m5s
Live Example
Live Example

Jacobson (MP2): 22,000k  
Hero (CO): 18,000k  
150k/300k Blind + 50k

Pre Flop: (950k) Hero is CO with A♣ Q♥  
4 folds, Jacobson raises to 650k, 1 fold, Hero raises to 1,425k, 3 folds, A♥ exposed, Jacobson calls 775k

Flop: (3,800k) K♦ J♥ 3♣ (2 players)  
Jacobson checks, Hero bets 1,800k

Is this a good bet?
Live Example

Pre Flop: (950k) Hero is CO with A♣ Q♥

Flop: (3,800k) K♦ J♥ 3♣ (2 players)
Jacobson checks, Hero bets 1,800k

Is this a good bet?

If SD-Win% = 0, the bet is +EV at F%>1800/(3800+1800) = 33%

If only the inside straight draw is good, Win% = 8%, making the breakeven Fold% closer to 21%
Live Example

Pre Flop: (950k) Hero is CO with A♣ Q♥
Flop: (3,800k) K♦ J♥ 3♣ (2 players)
Jacobson checks, Hero bets 1,800k

Is this a good bet?

If we assume any T wins (4 card) and any A wins sometimes (2 cards * .5) then chance to make draw is about 5 * 2 = 10%

Full solution is
EV = 3800 * F% - [90% * 1800 * (1-F%)] + [10% * (1-F%) * 5600] = 0 at F% = 21.8%

This is profitable if the Villain folds more than 22% of the time.
Live Example (Result)
Bluffing Formulas

- **Fold% (Minimum Fold Rate if SDWin% = 0)**
  \[ x = \frac{\text{BetAmt}}{\text{Pot} + \text{BetAmt}} \]

- **Fold Equity (EV of Bluff, assuming SDWin% = 0)**
  \[ x = \text{Fold}% \times \text{Pot} - (1-\text{Fold}% \times \text{BetAmt} \]

- **Showdown-Value (EV Contribution of Being Called)**
  \[ x = (1-\text{Fold}% \times (\text{Win}% \times \text{WinAmt} - \text{Lose}% \times \text{LoseAmt}) \]

- **Fold Equity (EV of Semi-Bluff, if SDWin% > 0)**
  \[ x = \text{Fold}% \times \text{Pot} + (1-\text{Fold}% \times (\text{Win}% \times \text{WinAmt} - \text{Lose}% \times \text{LoseAmt}) \]

- **Semi-Bluff Fold% (Quick Rule for Breakeven Semi-Bluff Fold%)**
  \[ x = \frac{\text{BetAmt}}{\text{Pot} + \text{BetAmt}} - 1.5 \times \text{Win}% \]
Bluffing Formulas (Example)

- **Fold% (Minimum Fold Rate if SDWin% = 0)**
  - Making a $150 bluff into a $350 pot
  - \(30\% = \frac{150}{350 + 150}\)

- **Fold Equity (EV of Bluff, assuming SDWin% = 0)**
  - Making a $250 bluff into a pot of $625 against a 25% call rate
  - \(\$218.75 = 75\% \times 625 - (1-75\%) \times 250\)

- **Showdown-Value (EV Contribution of Being Called)**
  - Making a $450 bluff into a pot of $775 with a 16% WinRate against an 80% call rate
  - \(-\$145.6 = (1-20\%) \times (16\% \times 1225 - 84\% \times 450)\)

- **Fold Equity (EV of Semi-Bluff, if SDWin% > 0)**
  - \(\$9.4 = 20\% \times 1225 + (1-20\%) \times (16\% \times 1225 - 84\% \times 450)\)

- **Semi-Bluff Fold% (Quick Rule for Breakeven Semi-Bluff Fold%)**
  - \(13\% = \frac{450}{775 + 450} - 1.5 \times 16\%\)
Bluffing – Be careful about

• Betting too little on a bluff
  – If you had a real hand, you wouldn’t bet 1/3rd of the pot
  • Or at least you shouldn’t, but we’ll get to that
  – Bet enough to make a draw -EV

• Betting too much on a bluff
  – Pot overbets are basically never a good idea (unless you are pot committed on a normal sized bet)
  – If you are short-stacked, don’t bluff an amount that would require you to call a raise (i.e. you would have the odds to call a raise)

• Being afraid of being caught bluffing or showing down bad cards
  – This is really common, especially live

• Semi-bluffing when a free card is offered

• Bluffing calling stations

[Image]
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