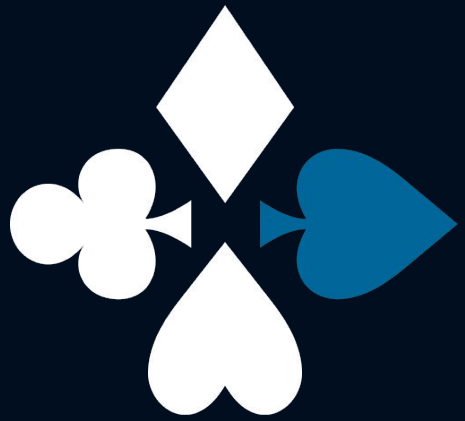

Pokerbots 2024

Lecture 2: Poker Theory

Sponsors


HRT


CITADEL
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Jane Street


jump trading


TREX
QUANT


SEVEN
EIGHT
CAPITAL, LP


SIG
SUSQUEHANNA

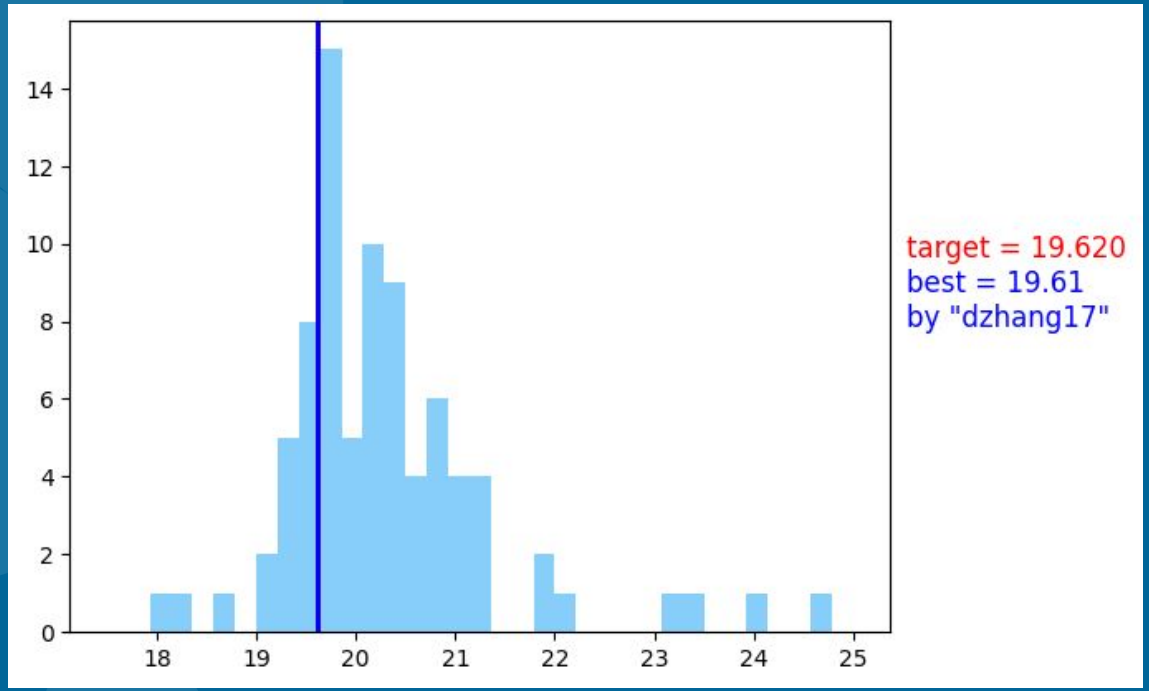

HAPCAPITAL


CTC
CHICAGO TRADING COMPANY


2σ
TWO SIGMA

Giveaways from last lecture!

Average Age Game:



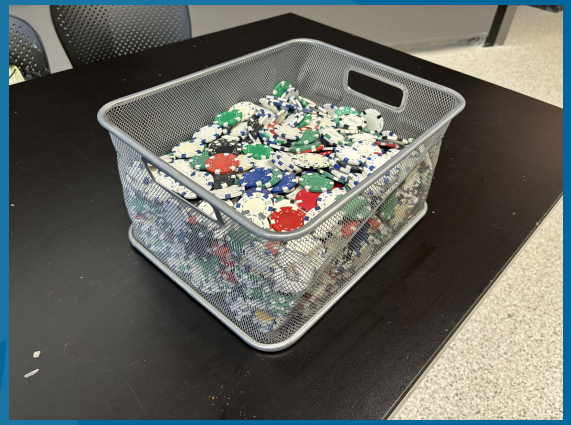
Raffle Winner: kerb “huafang”

Today's Giveaways!

Resume Raffle
pkr.bot/drop

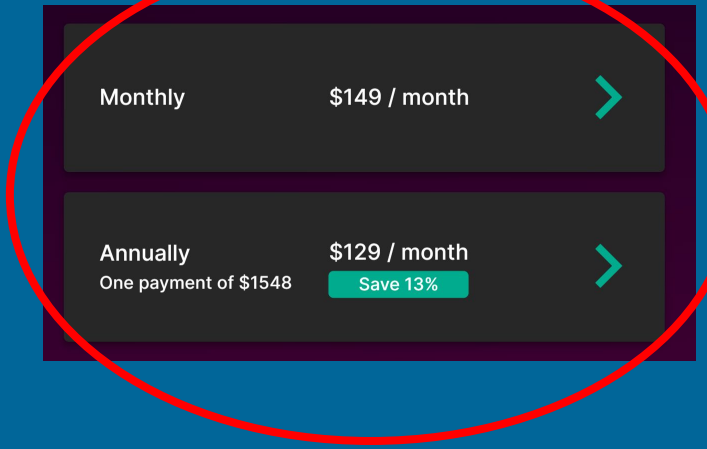
Chips Game: pkr.bot/chips

Guess the (integer) number of chips in the basket on the table in the front of the hall!



Hint: it took 10-20 minutes to count them

Prize:
One year's worth of GTO Wizard Elite Subscription



Engine Update: Piazza post @26

Find Teammates!
Piazza post @5

Poker Afternoon Study Break!
TODAY 3-5PM 2-131, 2-132

Week 1 bot deadline:
Friday Jan 12,
11:59 p.m.

Lecture Breakdown

- Poker Principles
- Hand Types
- Pot Odds
- Implied Odds
- Hand Ranges
- Auction and Variant Considerations

Poker Principles

Strength Principle

- Raising with Strong Hands
- Checking with Middling Hands
- Folding/Bluffing Weak Hands

Playing Styles

- Tight vs Loose
- Aggressive vs Passive
- Aim for Tight and Aggressive playing style

Purpose of Betting

- Value Betting → want weaker hands to call
- Bluffing → want stronger hands to fold
- Betting for Protection→ want drawing hands to draw at unfavorable odds

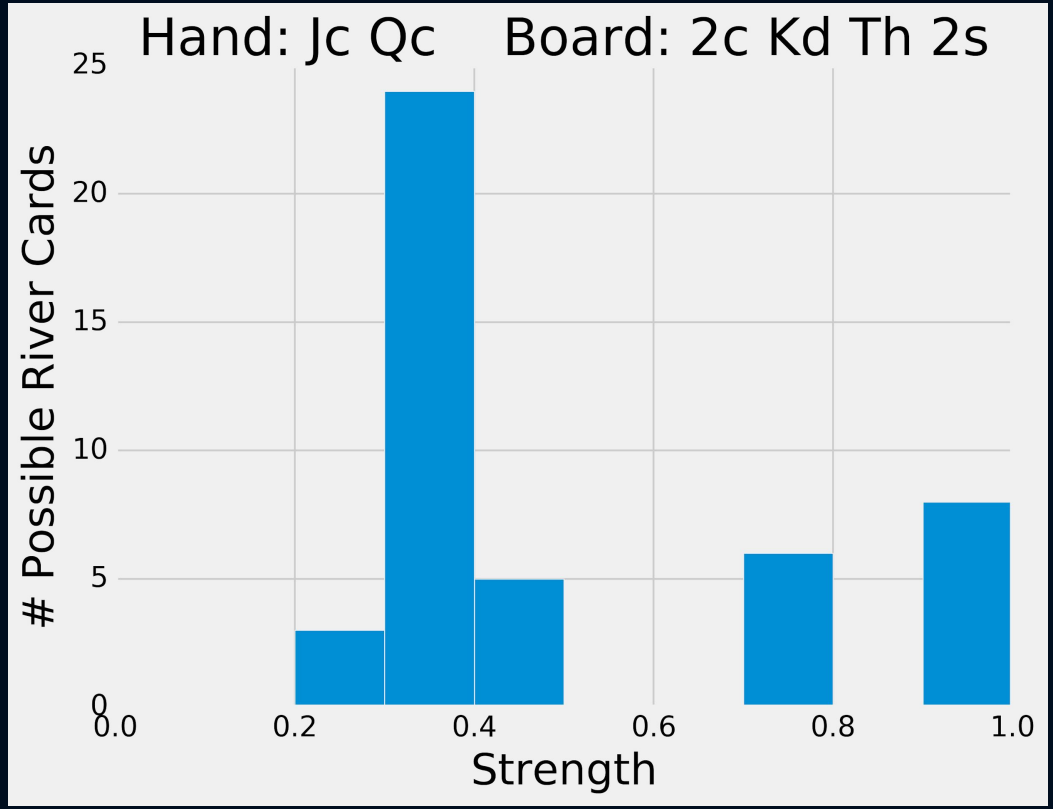
Deception

- Easy to read = Exploitable
- Never want to anything all the time
- A Big Reason to Incorporate Bluffs

Hand Types

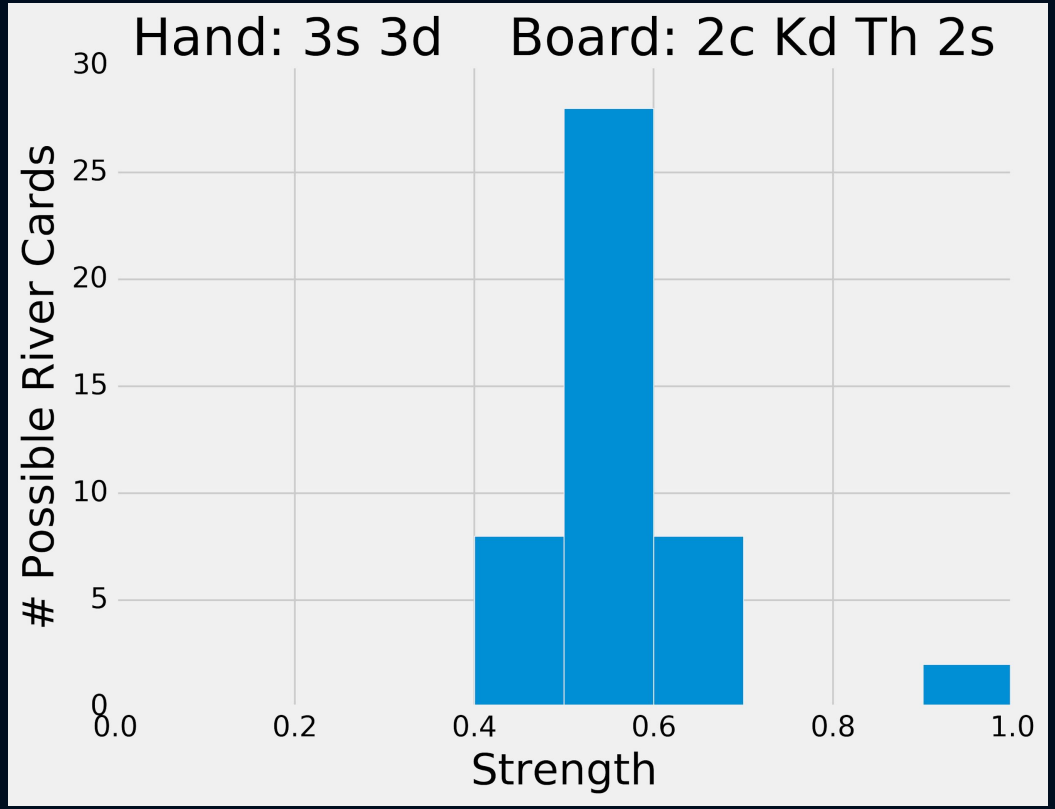
Drawing hand

Drawing hand



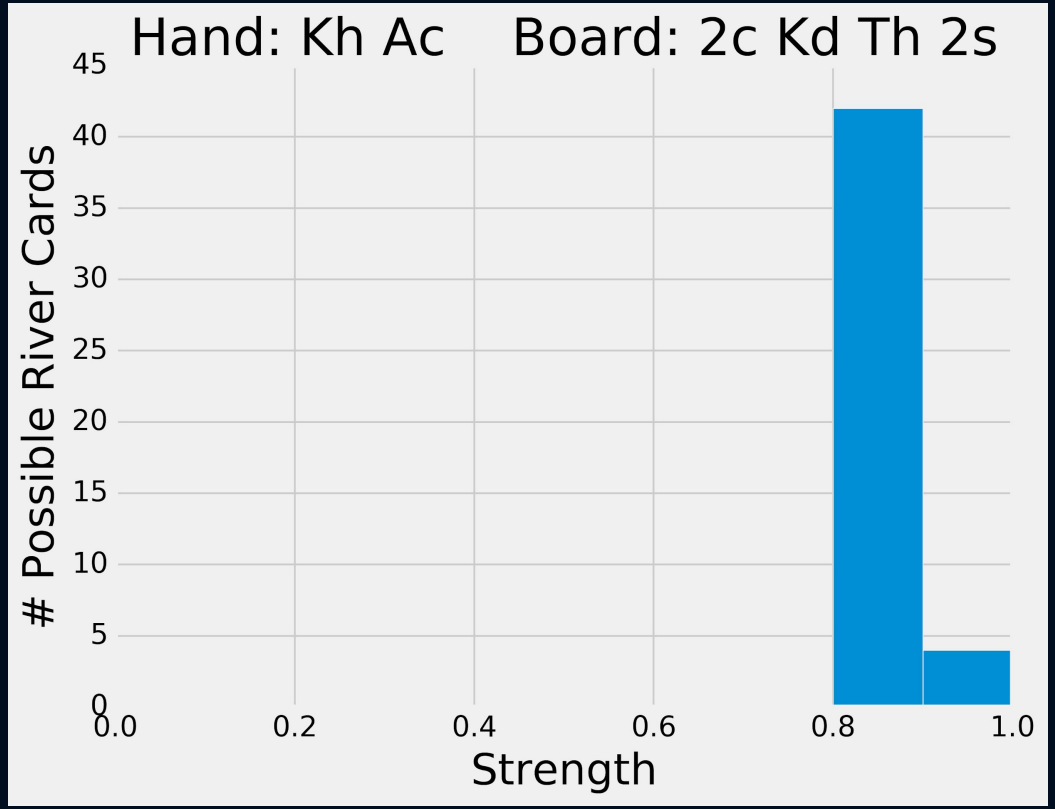
Low pair

Low pair


Hand: 3s 3d
Board: 2c Kd Th 2s
Possible River Cards
30
25
20
15
10
5
0
0.0
0.2
0.4
0.6
0.8
1.0
Strength

Made hand

Made hand


Hand: Kh Ac
Board: 2c Kd Th 2s
Possible River Cards
45
40
35
30
25
20
15
10
5
0
0.0
0.2
0.4
0.6
0.8
1.0
Strength

“The nuts”

“The nuts”


Hand: 2h 2d
Board: 2c Kd Th 2s
Possible River Cards
50
40
30
20
10
0
0.0
0.2
0.4
0.6
0.8
1.0
Strength

Board Types/Textures

Dry Board Texture

How would you feel about your hand strength here?

Wet Board Texture

What about here?

Pot Odds and Outs

Defining *p*

- At any point in the game there exists some fixed probability of winning (*p*)
- *In reality p* is often hard to explicitly calculate, but can reasonably estimate

Expected Value

- Expected Value - how many chips we expect to win/lose on average
- EV of calling a bet - $p \cdot \text{pot\_total} - (1 - p) \cdot \text{continue\_cost}$

>0?

=0?

<0?

Solving for *p*

- $p \geq \text{continue\_cost} / (\text{pot\_total} + \text{continue\_cost})$
- RHS of the Equation is called the “pot odds”

- Pot Odds serve as a cutoff for when we should call

Exercise

40

40

Exercise

50?

40

Example pot odds

- pot_total = 90
- continue_cost = 10
- pot odds = 10 / (90 + 10) = 0.1
- If $p \geq 0.1$, we should call!

How do we know what p is?

Estimating *p* by Counting Outs

Out = A card that would complete our hand or make us significantly stronger

Idea: If we count our outs, we can estimate the probability of finding cards we need
We can use this to estimate our probability of winning (p)

Strategy:

- Count the number of cards that complete our hand *(outs)*
- Multiply this number by 2 *(52 cards gives ~2% chance of getting a specific card)*
- If we have two cards left to see, multiply by 2
- This number is our probability estimate! *(as a percent)*

Exercise

50?

40

Counting Outs

- Any Ace or Nine gives us a straight (8 outs)
- Probability of winning is 8*2 = 16%
- Pot_odds = 0.1

Probability of winning > pot_odds → We should Call!!!

Reverse pot odds

- If we overbet relative to the size of the pot, then we give our opponent the opportunity to exploit pot odds
- If they have a bad hand, we win a little
- If they have “the nuts,” we lose a lot

Example: the all-in bot

- Our opponent goes all-in on the preflop (deterministic!)
- We can check-fold, letting our opponent collect the blinds, until we are dealt a high pair to crush them and win big

Implied and Reverse Implied Odds

Implied Odds

- The amount of money you expect to win on later streets if you hit one of your outs
- Enables us to call when we don't have the right pot odds
- Mostly important when calling with a drawing hand

Updated *p*

- Pot odds cutoff: we should stay in the game if

$$p \geq \text{continue\_cost} / (\text{pot\_total} + \text{continue\_cost})$$

- Implied odds cutoff: we should stay in the game if

$$p \geq \text{continue\_cost} / (\text{pot\_total} + \text{continue\_cost} + \text{amount\_you\_expect\_to\_win})$$

- Sometimes you need to factor in calling on the Run

Updated *p*

- Pot odds cutoff: we should stay in the game if

$$p \geq \text{continue\_cost} / (\text{pot\_total} + \text{continue\_cost})$$

- Implied odds cutoff: we should stay in the game if

$$p \geq \text{continue\_cost} / (\text{pot\_total} + \text{continue\_cost} + \text{amount\_you\_expect\_to\_win})$$

- Sometimes you need to factor in calling on the Run

Exercise

40

40

Exercise

60?

40

Pot odds revisited

- pot_total = 100
- continue_cost = 20
- pot odds = 20 / (100 + 20) = 0.167
- probability of completing the hand is 8 * 2 = 16%
- From counting outs, p = 0.16

Pot odds tell us to fold!

Implied Odds

- Assumption: our opponent been always betting, and will continue to bet ¼ pot
- pot_total = 100, continue_cost = 20, next_bet = ¼ * (120) = 30
- pot odds = 20 / (100 + 20 + 30) = 0.133
- From counting outs, p = 0.16

Implied odds tell us to call!

Reverse Implied Odds

- This is the amount you could expect to lose after hitting your draw
- Balances out implied odds, and together they provide a better estimate of your true pot odds
- Warns us to be careful when we're not drawing to "the nuts"

Exercise

40

40

Exercise

60?

40

Exercise

60

60

Exercise

90?

60

Exercise

90?

60

Exercise

90

90

Exercise

90

90

Ranges

Ranges

- We know the pot odds when faced with any bet
- If we can estimate *p* better than our opponent, then we will make money on average
- What affects *p*?

Factors of win probability

- Bluffing
- Betting style
- Board and Hole cards
- *Ranges*

Our opponent's *range* is the distribution of hands we expect them to hold

Which ranges are good?

- Tight-aggressive
- Fold early and often to mitigate losses
- Bet and win when you have a good hand!

Variant Specific Considerations

Auction Bids and Pot Odds

- Extra card has highest impact on wet boards
- Increased strength of drawing hands (suited connectors)
- Can bid for value and/or for protection
- Auction alters preflop ranges
- High auction bids can lead to reverse pot odds scenarios

Coding reference-lecture-2 bot

Goals

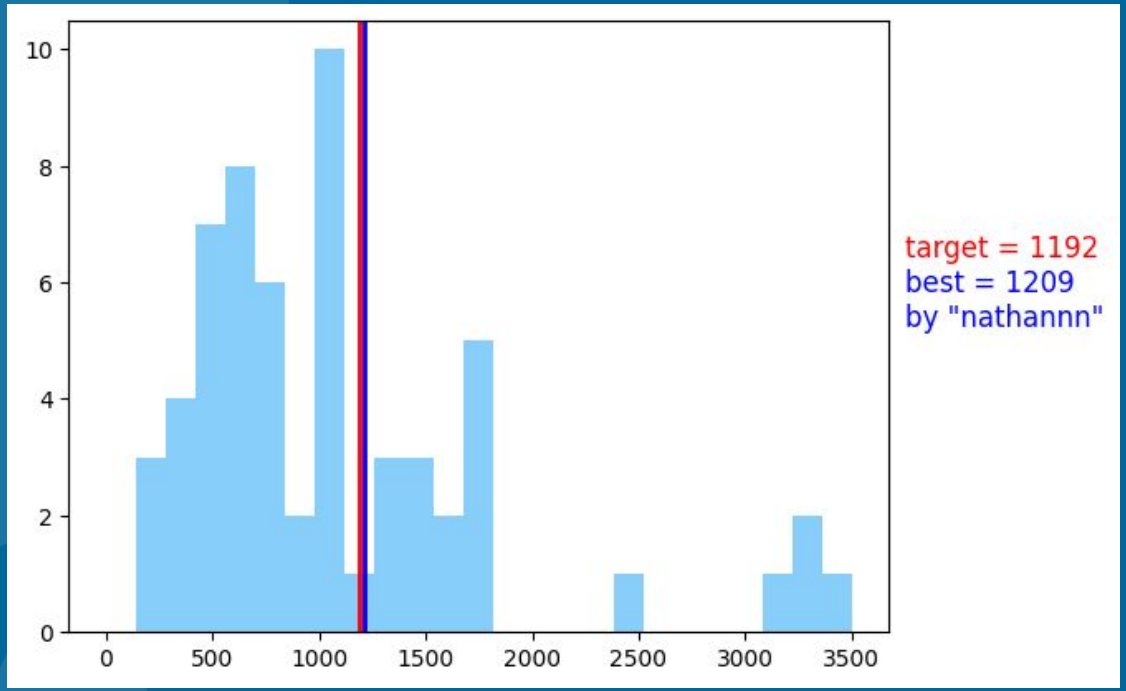
- Improve our betting strategy
- Implement pot odds
- Incorporate randomness
- Monte Carlo simulation for card strength estimation *(p)*

Monte Carlo Simulation

- Helps us estimate values by using randomness and sampling
- Simulates a process many times to see what happens on average
- We can estimate our hand strength by simulating poker games many times
- The proportion of wins from the simulations is our win probability!

Giveaway Winner

Chips Game:


target = 1192
best = 1209
by "nathannn"
0
2
4
6
8
10
0
500
1000
1500
2000
2500
3000
3500

Resume Raffle Winner: Leo Yao

Thanks for watching!

Slides/notes will be posted on **pkr.bot/resources**

Make sure to check **pkr.bot/piazza** for updates

Lecture recording at **pkr.bot/lecture-2-recording**