

# A Naive Analytical Valuation of Chess Pieces

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## HOW DO WE LEARN CHESS?

The screenshot displays a chess game interface. On the left is a chessboard with a white knight highlighted on square d5 and a green arrow pointing to square e6. The board is labeled with ranks 1-8 and files a-h. The top of the board shows the player 'iDefend (1369)' and a timer of 0:51. On the right is a sidebar with tabs for 'Review', 'Analysis', 'Details', and 'Openings'. The 'Analysis' tab is active, showing a list of moves and their evaluations. The moves are: 1. d4 c6 2. e4 d5 3. f3 dxc4 4. e3 b5 5. a4 a6 6. axb5 cxb5 7. c3 d7 8. e5 e6 9. xd7 xd7 10. b3 cxb3 11. xb5 12. xb5. The evaluation for the move 12...xb5 is +6.52. Below the moves is a 'Game may have continued...' section with a sequence of moves: (39. g5 e6 40. d5+ e7 41. h5 e8 42. h6 e7 43. h7 +63.0). At the bottom of the sidebar is a 'Save' button and a 'Saved Analysis' section.

iDefend (1369) 0:51

Review Analysis Details Openings

Evaluation Lines Feedback depth=20 | Stockfish 14.1

**Nxb5 is a missed win** -0.13  
12... dxc6 13. c3 dxc6 14. d2 O-O Q

**Bxb5 is best** +6.52  
12... dxc6 13. c3 dxc6 14. d2 O-O 15. e2 fxb8 16. O-O e5 17. d5 ...  
-0.53 12... d7 13. e2 O-O 14. O-O dxc6 15. a3 fxb8 16. a4 d5 17. d5 ...  
+0.92 12... a5 13. a3 dxc6 14. d2 d7 15. d7 xe7 16. c3 O-O 17. O-...

1. d4 c6 2. e4 d5 3. f3 dxc4 4. e3 b5 5. a4 a6 6. axb5 cxb5 7. c3 d7 8. e5 e6 9. xd7 xd7 10. b3 cxb3 11. xb5 12. xb5

(12. xb5)

12... dxc6 13. c3 dxc6 14. d2 O-O 15. e2 fxb8 16. O-O e5 17. d5 ...  
12... d7 13. e2 O-O 14. O-O dxc6 15. a3 fxb8 16. a4 d5 17. d5 ...  
12... a5 13. a3 dxc6 14. d2 d7 15. d7 xe7 16. c3 O-O 17. O-...

Game may have continued...

(39. g5 e6 40. d5+ e7 41. h5 e8 42. h6 e7 43. h7 +63.0)

1-0

Save

Saved Analysis

0:51

- Memorize Openings
- Chess Puzzles
- Study End games
- Review Best Moves
- Practice, Practice, Practice



## RESEARCH PURPOSE

- Goal: Not to Reinvent the Wheel
  - Chess AI are getting significantly ahead of humans, and they probably won't stop anytime soon
- Look at chess from a learning perspective that is **not geared towards perfection** but rather understanding the individual pieces
  - How they differ among player levels and time intervals
- Can we create a new way to improve at chess?

## DATA OVERVIEW

### Data Overview

- 20,000 chess games from LiChess
- Features: time limit of game, ratings of players, script of game


### Data Segmentation

- Rating classes per players

### Examples:

1800-1999 : Class A

900-1200 : Novice

<i>Pieces and Point Value</i>		
<i>Pawn</i>		1
<i>Knight</i>		3
<i>Bishop</i>		3
<i>Rook</i>		5
<i>Queen</i>		9
<i>King</i>		<i>priceless</i>

# Chess Script

WHITE	BLACK
e4	e5
Nf3	Nc6
Bb5	Nf6
Nc3	Bc5
O-O	d5
exd5	Nxd5
Nxd5	Qxd5
Bxc6+	bxc6
c3	Q-O
Ng5	e4
d4 ?	exd3 (cp) !
Qf3	d2
Qxd5	dxc1=Q
Raxc1	cxd5
Kh1	Bb7
f4	Rfe8
Nh3	Rad8
g3	Be3
Rcd1	f6
Rfe1 ??	d4 ++

## SCRIPT ANALYSIS

### Pull Features per Piece

(Pawn, Knight, Bishop, Rook, Queen, King)

- The pieces it took (indicated by the "x" in the moves)
  - The value of the pieces it took
  - The list of the pieces it took
    - Used especially in Model 2 + 3
- The amount of times it moved
- The amount of checks it made

# **DIFFERENCES AMONG RATING CATEGORIES**



## PIECE MOVE TENDENCIES

### Percentage of Moves per Piece

On average, worse chess players used their queen more often, while not their rooks



On average, less experienced players moved their queen more often, while more experienced players moved their rooks more often.

# MODEL I: TAKES + CHECKS MODEL

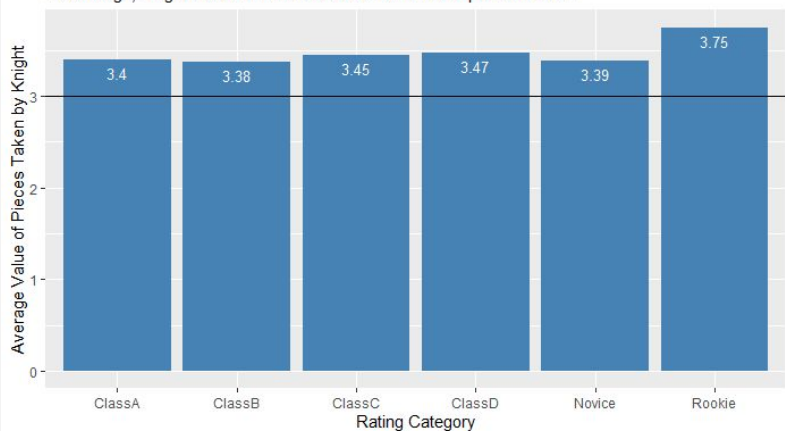
Think “Counting stats”





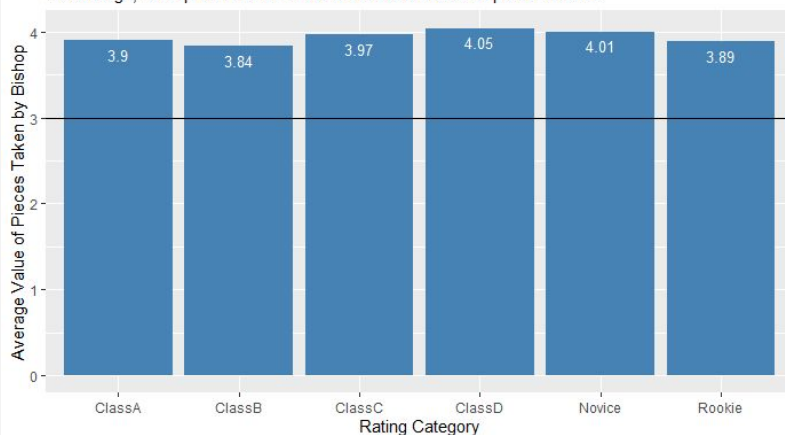
### Average Value of Pieces Taken by Knight

On average, Knights value of 3 is accurate to the value of pieces it takes



### Average Value of Pieces Taken by Bishop

On average, Bishop value of 3 is undervalued to the value of pieces it takes

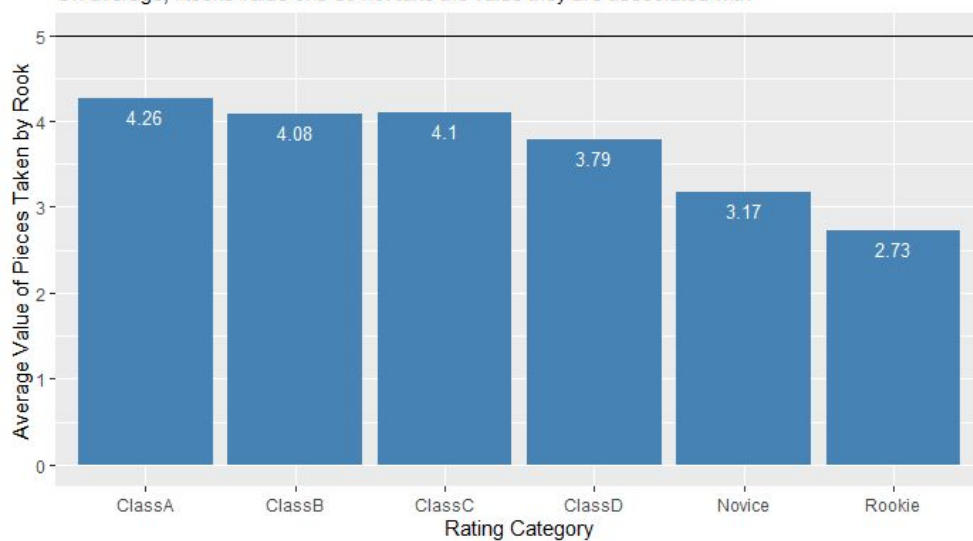


## VALUE OF PIECES TAKEN

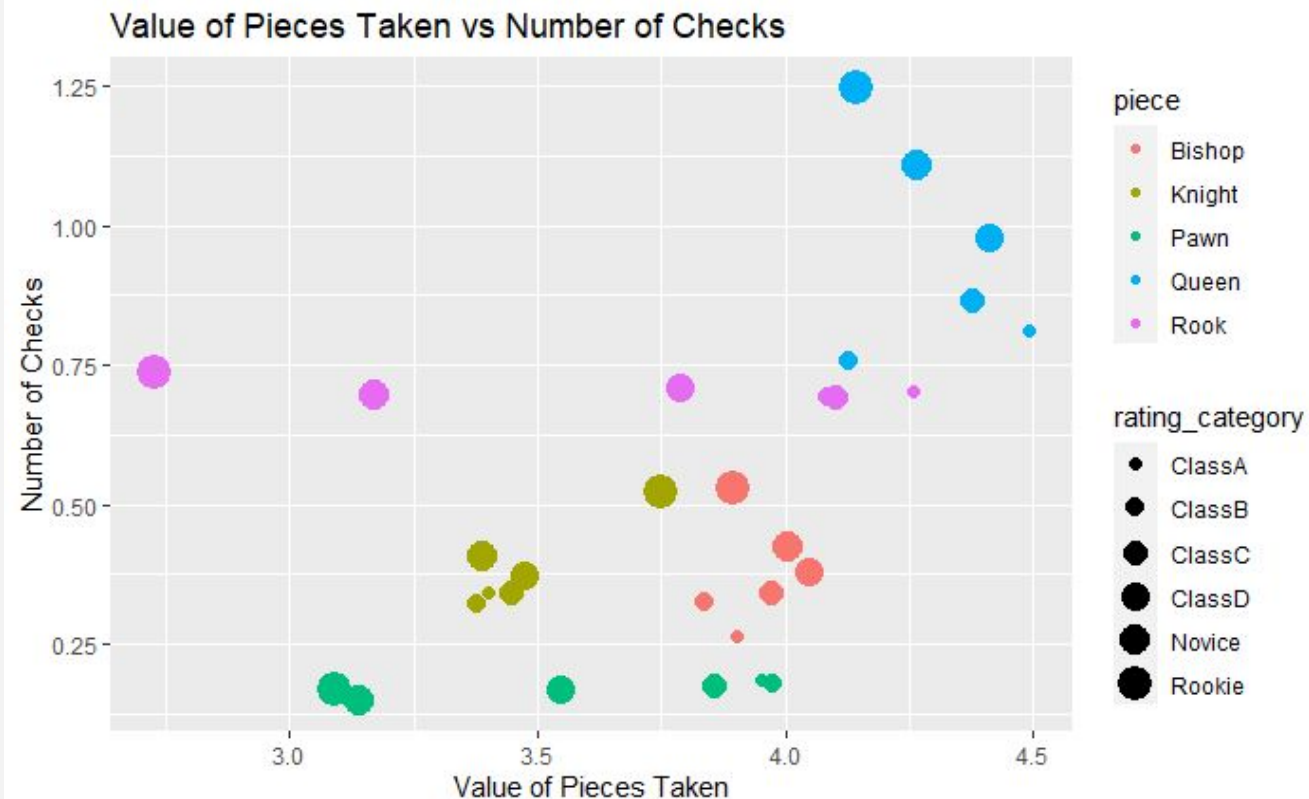
Via values of pieces taken,  
the knight slightly exceeds its value of 3,  
the bishop definitely exceeds its value of 3,  
but the rook subceeds its value of 5

### Average Value of Pieces Taken by Rook

On average, Rooks value of 5 do not take the value they are associated with



## FIRST VALUATION



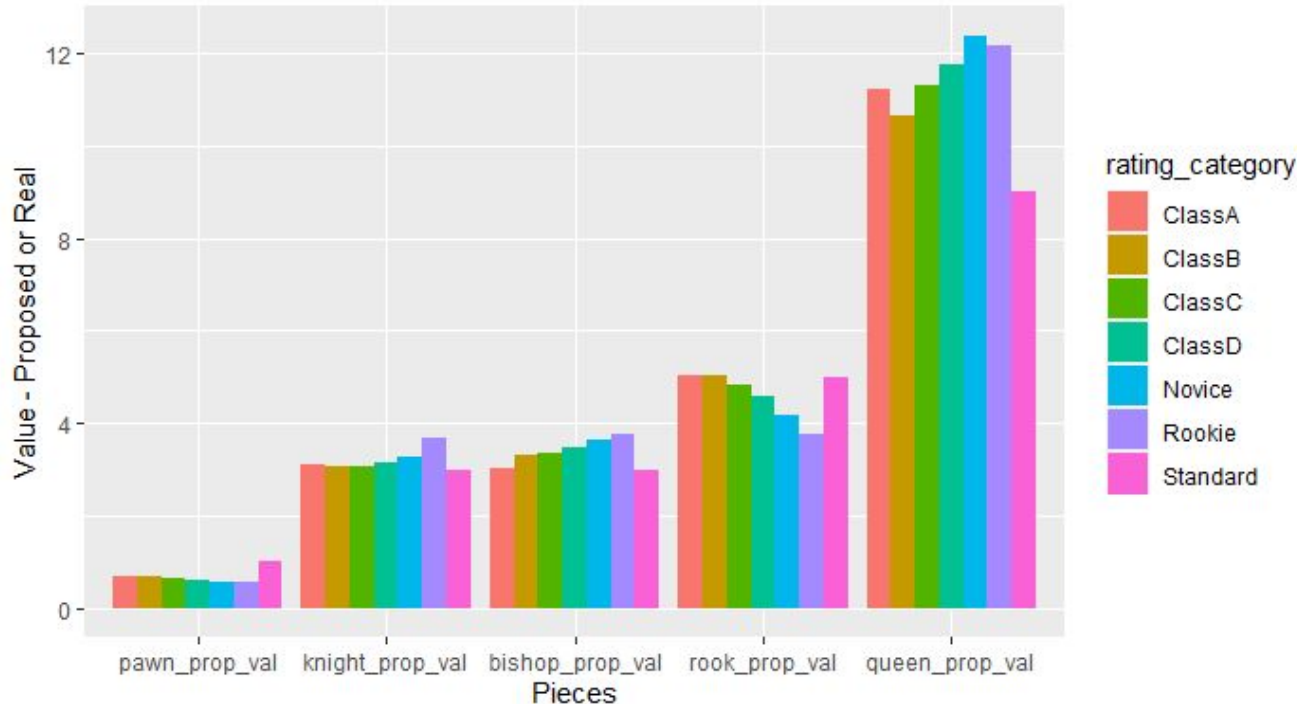
Different colors are different pieces

Smaller the circle, the better the player rating

## FIRST VALUATION

### First Valuations of Pieces for Every Level

Just using Value of Pieces Taken and Number of Checks, both proportional



Taking a proportion of the amount of checks and the value of pieces each piece took, and scaling it to 39 (the total value of typical pieces on a board, we get these proposed values for every level

Common trends:

- Pawn overvalued
- Bishop + Queen currently undervalued
- Rook appropriately valued for better players, not for worse

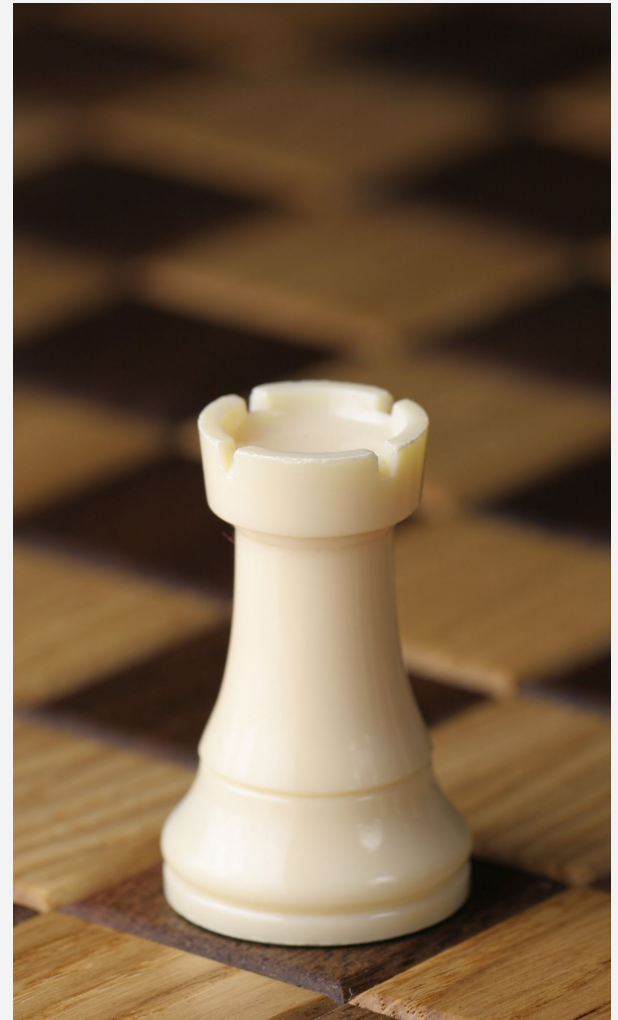
## FIRST VALUATION

Comparing the top(ish) rating category, the bottom(ish) rating category, and the standard values

	rating_category	pawn_prop_val	knight_prop_val	bishop_prop_val	rook_prop_val	queen_prop_val
1	ClassA	0.68	3.11	3.02	5.05	11.23
2	Novice	0.56	3.26	3.66	4.16	12.38
3	Standard	1.00	3.00	3.00	5.00	9.00

Overall, the standard values are **a lot closer to both then I initially thought** for how arbitrary these values are. The values are extremely close to the better pro players interestingly enough

# MODEL 2: LOG ODDS



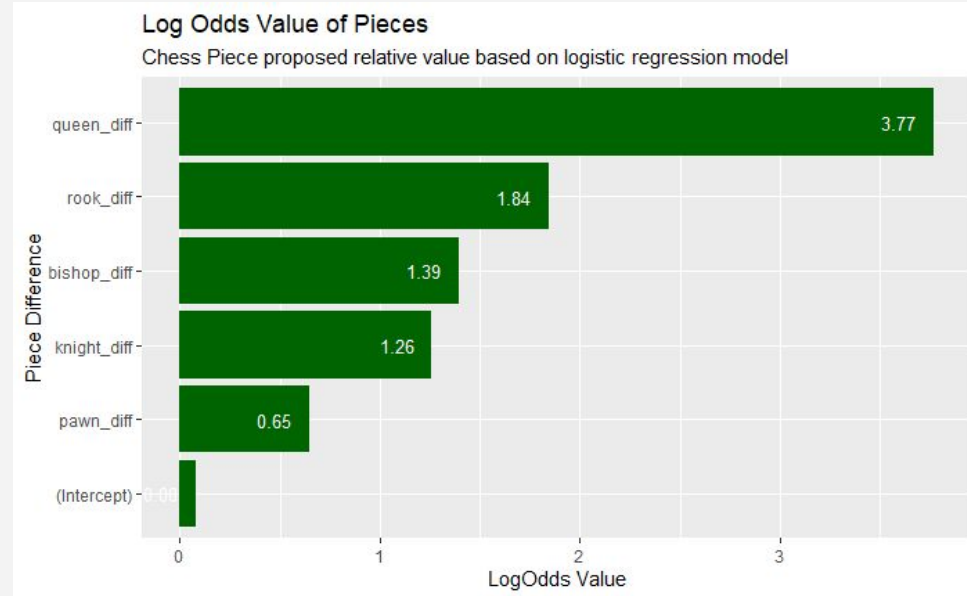
## LOGISTIC REGRESSION

### Formula

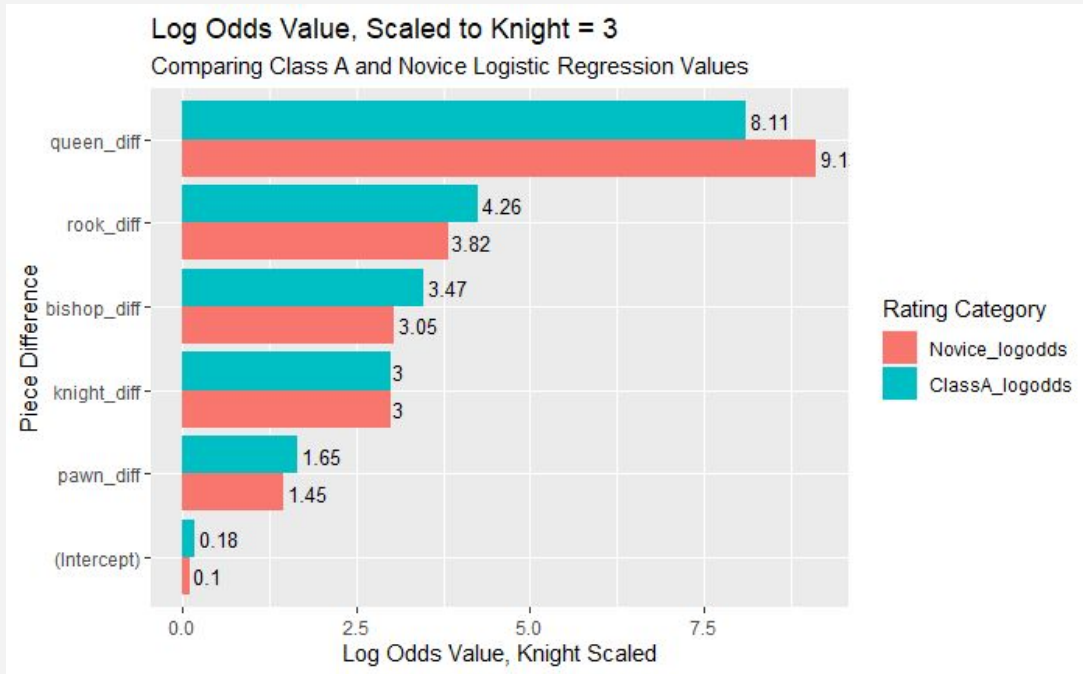
- Correlate the win of a game to the pieces remaining on the board
- $\text{winner} \sim \text{bishop\_rem} + \text{knight\_rem} + \text{pawn\_rem} + \text{queen\_rem} + \text{rook\_rem}$

### LogOdds

- Coefficients of Logistic Model turned positive



## COMPARE RATING CATEGORIES - SCALED TO KNIGHT = 3



- For worse players, there persists the overvalue of the Queen for nearly everything else
  - Queen: +1
  - Rook: -0.4
  - Bishop: -0.4
  - Pawn: -0.2

# **MODEL 3: TREES OF SUCCESS**





**CONCLUSION,  
FUTURE PURPOSE**



### Conclusion

- Values differ among player rating categories
- Overuse of the queen at lower levels
- Underuse of pieces, especially the rook at lower levels

### Combining Predictions

- Weighted average of models, based on personal confidence / rating of the models
- Predictions for each rating category and different time intervals

### Future Parts

- Including pairs of pieces into my analysis (i.e. 2 bishops vs 2 knights, 1 queen vs 1 rook and 1 knight)

# Creating a Program for Everyone to Use to Get Better

A System which:

1. Takes in all your personal games (via scripts)
2. Analyzes games on a piece by piece basis, and segments it based on a variety of metrics
3. Provides recommendations of ways to improve with such pieces, such as an opening that gets a rook more involved or a less vulnerable queen