

Handicap of Othello Game

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Abstract: In the game of Go, it is known experientially that Black (=the first move) is advantageous. Thus, in the game of Go, White (=the defensive hand) has received a handicap for this compensation. There is Othello game well known as the Go. However, the handicap of White in Othello game has been hardly considered until now. This research considered quantitatively the handicap in Othello game from a viewpoint of points. As our conclusions of Othello game is the followings.

- The advantage of the defensive hand on board of 4×4 is -0.641 points on average.
- The advantage of the defensive hand on board of 4×6 is 0.778 points on average.

Keywords: Othello, handicap, handicap stones, first move advantage

1. Introduction

In the game of Go, how to put handicap has been discussed for a long time. Its handicap is given by means of compensation and handicap stones as known well.

It is known experientially that Black (= the first move) has a first move advantage. Thus, in the game Go, White (= the defensive hand) has received a handicap for this compensation. On a 19×19 goban, this predetermined compensation for Black's first move advantage, called "komi", means that White may receive somewhere on average of +6.5 points.

There are handicap stones as another handicap in the game of Go. The rank difference within a given amateur ranking system is one guide to how many handicap stones should be given to make the game a more equal contest. Generally, it is considered that one stone is 13-16 points in term of points, although this figure is not constant over levels.

There is a Reversi well known as the Go. Reversi is also called Othello game in general. It is thought to be given a handicap similar to the Go in Othello game. However, the discussion of quantitative handicap was not in the game of Othello such as in the game of Go.

This research considered quantitatively the handicap about a first move advantage and a handicap stones in the Othello game from a viewpoint of points.

Throughout this paper, we assume that the handicap for Black's first move advantage is compensation given to White. Therefore a negative handicap means a situation with an advantageous to White.

2. Method and Analysis

In the game of Othello, regular board is 8×8 , but in this research, we use some reduced boards such as 4×4 , 4×6 and so on.

In this experiment, players take a next move from all possible choice at random each other. Firstly, we enumerate all the situation that a game was finished, and count the number of results according to the difference of points of Black and White. Next, we add all the values (obtained for each point difference) of the product of a point difference (= Black's - White's) and the number of situations to become its point difference. Finally, we divide the values obtained above by the total number of situations. We assume this acquired value to be a handicap for White.

And the location with a handicap stone assumes the circumference of a board, see Fig.1.

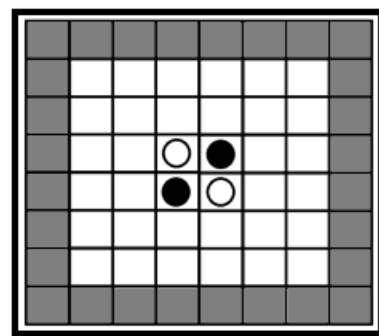


Figure.1: Location with a handicap stone

3. Results and Discussions

3.1 Board of 4 × 4

Fig.2 shows the number of situations of each point difference (Black's - White's) on 4 × 4 board.

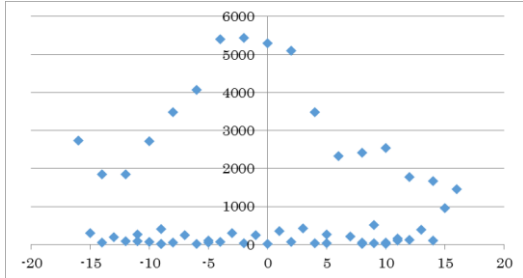


Figure.2: The number of situations of each point difference on 4 × 4 board

The advantage of Black is -0.642 points on average, which implies a first move disadvantage. Thus the handicap of White becomes -0.642. In fact, it has been found that white can certainly win on 4 × 4 board. Similarly, it has been found that White can win on 6 × 6 board [1]. Although the result of the 8 × 8 regular board has not been clear, many people believe that White can win. In this way, Othello game does not become clear whether the first move is advantageous.

For handicap stones, we display the location of the handicap stones as Fig.3.

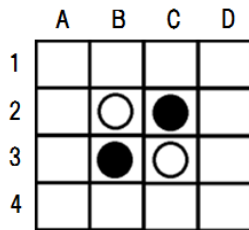


Figure.3: 4 × 4 board

The handicaps for White due to the color and location of a handicap stones are followings. (See Table.1.)

Table. 1: Handicap stones of 4 × 4 board

	Black stone	White stone
A1	+6.000	- 3.796
B1	- 0.689	+1.540
C1	- 2.322	+1.991
D1	+0.929	- 6.773

3.2 Board of 4 × 6

Fig.4 shows the number of situations of each point difference (Black's - White's) on 4 × 6 board.

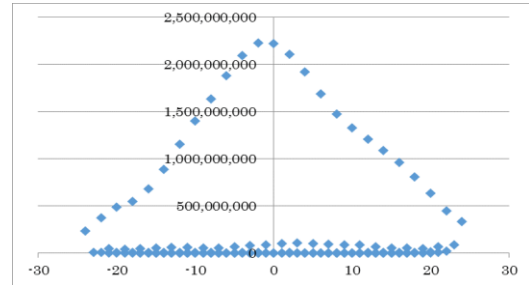


Figure.4: The number of situations of each point difference on 4 × 6 board

The handicap of White becomes +0.778 points, which implies a first move advantage.

According to an exhaustive search of 4 × 6 board, we found that Black can win. The fact that the value of the handicap for White of 4 × 6 board is positive is consistent with this result.

For handicap stones, we display the location of the handicap stones as Fig.5.

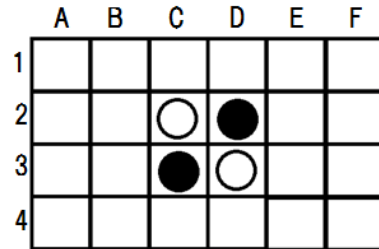


Figure.5: 4 × 6 board

The handicaps for White due to the color and location of a handicap stones are followings. (See Table.2.)

Table. 2: Handicap stones of 4 × 6 board

	Black stone	White stone
A1	+5.112	- 3.742
A2	- 0.119	+1.812
A3	+0.223	+1.934
A4	+5.080	- 2.878
B1	- 1.057	+2.267
C1	+1.740	- 0.381
D1	+2.118	+0.135
E1	- 0.564	+3.255

4. Conclusion

In this research, we tried to measure the handicap in Othello game quantitatively. By choosing a situation at random from all possible choice, we can estimate the handicaps for White (=the defensive hand) of 4 × 4 and

4×6 boards at -0.642 and $+0.778$, respectively. Sign of the handicap is decided whether the first move is advantageous. Unlike the game of Go that an advantage of the first move is confirmed empirically, the Othello game does not become clear whether the first move is advantageous. However, our results of handicap are consistent with results with an exhaustive search. This indicates that the evaluation method that we proposed is effective.

Moreover, since the defensive hand was believed to be advantageous in the game of Othello, it is a very interesting result that advantage and disadvantage of the first move is determined depending on the board. We have the following conjecture.

Conjecture: Suppose that $m, n \in \mathbb{N} = \{1, 2, 3, \dots\}$. For a given $2m \times 2n$ board in the game of Othello, we get the followings.

- (1) Assume that $m=1$ or $n=1$, the game draw.
- (2) Assume that $m, n \geq 2$ and $n+m$ is odd number, the first move is advantageous.
- (3) Assume that $m, n \geq 2$ and $n+m$ is even number, the first move is disadvantageous.

For handicap stones, we found that the side that is placed in the corner is advantageous. However, we were not able to find the law except in the corner. To find the rules of general, experiments with a large board is required.

Reference

- [1] Joel Feinstein (1993), Perfect Play in 6×6 Othello from two alternative starting positions, <http://www.feinst.demon.co.uk/Othello/6x6sol.html>
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