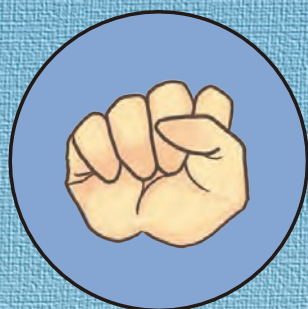# 銀河企画・数理科学セミナー

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Topic: An advanced game of rock-paper-scissors

Advanced game of rock-paper-scissors, Choki-Janken

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Introduction

Rock-paper-scissors (called JANKEN in Japan) is a kind of the hand game played between two or more people, in which each player forms one of three shapes with an outstretched hand at the same time. These shapes are named Goo (rock: a closed fist), Par (paper: a flat hand or five fingers extended), and Choki (Scissors: the index and middle fingers extended, forming a V sign).

A player who selected Goo will beat another player who has chosen Choki. As well, a player of Choki will beat a player of Par, and Par will beat Goo. If both players choose the same shape, the game is draw. If there are three or more players and all three shapes are appeared at the same time, the game is draw, too. This situation is called a deadlock.

Choki-Janken is the game that adds a new rule "Choki wins if deadlock occurs." to ordinary Janken. Simulations were conducted to determine the favorable ratio of giving three shapes, and the probability of draws, according to increase the number of players. The difference between Choki-Janken and ordinary Janken is the additional rule of Choki (scissors) victory. Choki-Janken is expected to reduce the draws. Then the following questions will come.

Question

1.　　In Janken, if only a certain type of hand shapes is put out, other players will notice and is easy to beat. So, it will be harder to lose by averaging the three shapes. And it will be best to put them out in the same ratio. In case of Choki-Janken, what will be the best ratio of the three shapes ?

Is it better to put a lot of Choki out ? When the number of players increases, how does the ratio of the most suitable hand-shape method change in Choki-Janken ?

2.　　If each player chooses the hand shapes probabilistically so as to win, how much is the degree of draws for Choki-Janken reduced ? In the case of ordinary Janken, if two or three players do, they will be draws at a rate of one third. If there are more than three, the ratio will be higher than one third. How much ?

Solution

So we use LINUX to simulate virtual players with learning method. By making such learning, the players bring the ratio of hand-shape patterns closer to the optimum. In general multi-player games, it should be noted that there is a scene they cooperate with each other. However, in this paper, the pattern in which the players cooperate with each other is not considered.

Conclusion

1.　No matter how many people do normal Janken, the theoretical value of the ratio of each hand-shape is one third. On the other hand, the ratio of Goo was 45% for 3 people and 60% for 5 people, and the result was that it was better to increase the ratio of putting out Goo as the number of players increased. This does not necessarily mean that Goo is easy to win, but it can be understood as an indication that Goo is the only way to restrain strong Choki. Also, as the number of players increases, the percentage of Par will decrease, but will never be zero. If you decide not to play Par, Goo would not lose. The change in the ratio due to the difference in the number of players is shown in Figure 1. In addition, each numerical value had fluctuation of about 1 %at each trial.

2.　The probability that the game will be a draw will increase gradually as the number of players increases, and will reach 88 % for 8 players in ordinary Janken. There is also variation in the final ratio of each hand-shape due to the decrease in the number of times the game is established (not draw). On the other hand, in the case of Choki-Janken, the number of draw was as low as 12% for 4 to 8 players. The change in draw ratio due to the difference in the number of players is shown in Figure 2.

References

[1]　　SHIBASAKI, Ginga："Choki-winner-Janken", Yonemitsu's expression lectures (20 May. 2017), Blog "Choki-Janken" (23 Jun. 2017).

[2]　　SHIBASAKI, Ginga："Choki-Janken", Mathematical Science Seminar Report, February 2019, Galaxy Plan Inc. (20 Feb. 2019).
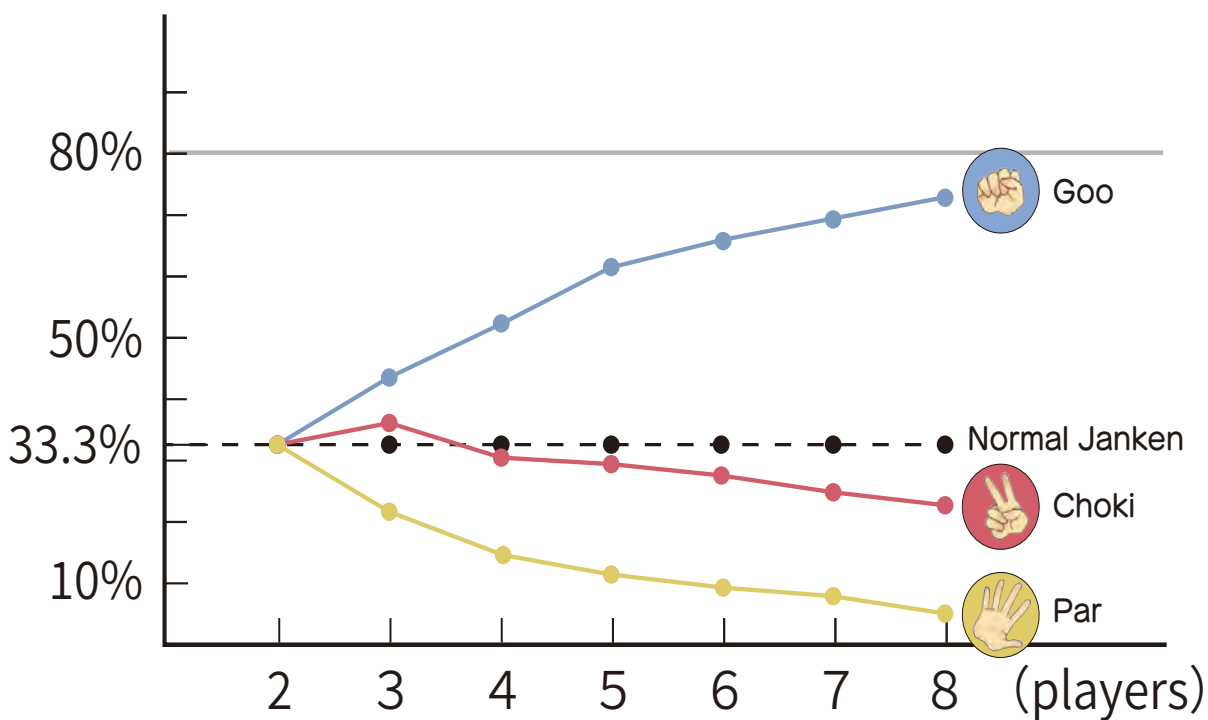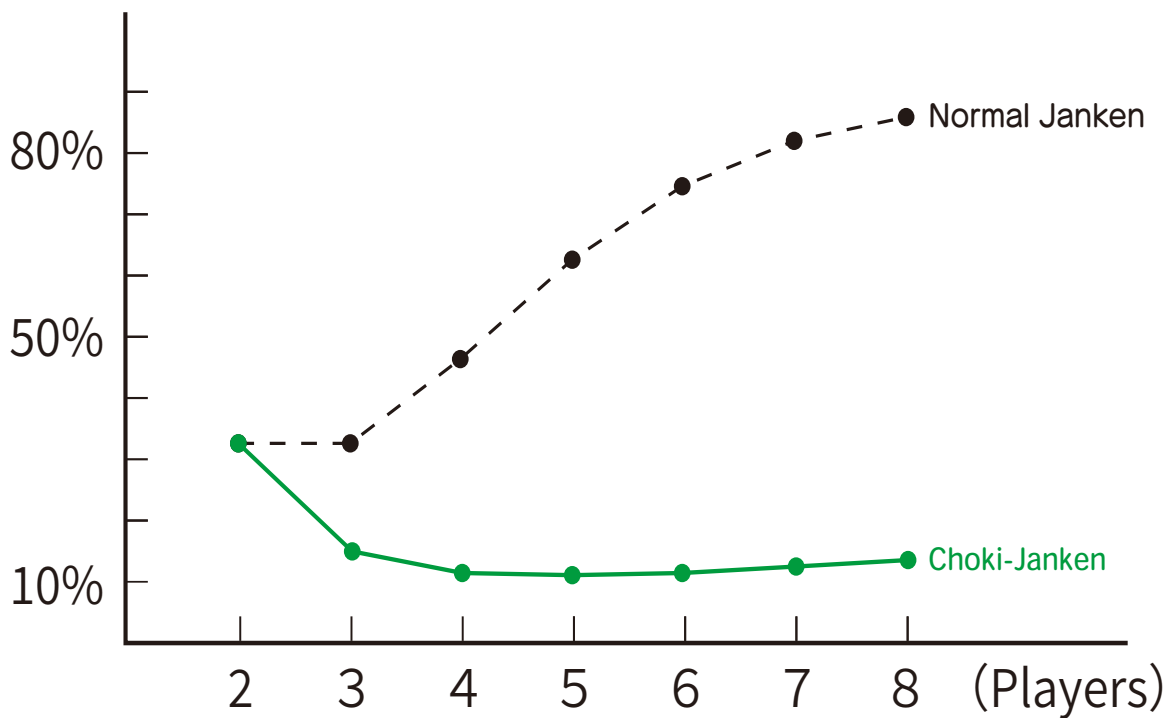
Fig.1 Changes in ratio due to the number of players

Fig.2 Probability of draws

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