

Statistical Mahjong Strategy

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Chapter 1

Head start riichi

1.1 Making judgements based on expected value

Let us first explain the use of data and expected values, since these are fundamental for understanding how data are applied during live play. First, why use data to guide live play at all? Well, when there are multiple choices to consider (for example, whether to riichi or dama, whether to push or fold against an opponent's riichi), the potential benefits and losses of each possible choice can be quantified, and the most advantageous choice can be made. It may be difficult to conceptualize this, so let us first consider rolling dice as an illustrative example.

Consider a game where the player gains or loses some amount of money y based on the outcome of a roll of a six sided die x . The rules of the game are as follows:

$$y = \begin{cases} 6000 \text{ ¥}, & x \in \{1, 2, 3, 4\} \\ -6000 \text{ ¥}, & x \in \{5, 6\} \end{cases} \quad (1.1)$$

Let us consider whether participating in this game will result in a net gain or loss under (1.1). If the expected value of the game is computed as shown in Figure 1.1, it can be seen that playing the game results in an expected gain of 2000 ¥. Thus under the rules (1.1), it is better to roll the dice than it is to not.

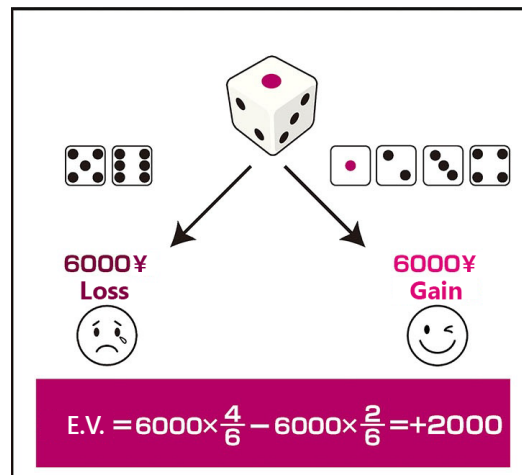


Figure 1.1

Let us now consider an example slightly more relevant to mahjong. A player must choose to participate in

one of two games. One follows the rules (1.2) and the other (1.3).

$$y = \begin{cases} -1500, & x \in \{1\} \\ 1500, & x \in \{2, 3, 4, 5, 6\} \end{cases} \quad (1.2)$$

$$y = \begin{cases} -2000, & x \in \{1, 2\} \\ 4000, & x \in \{3, 4, 5, 6\} \end{cases} \quad (1.3)$$

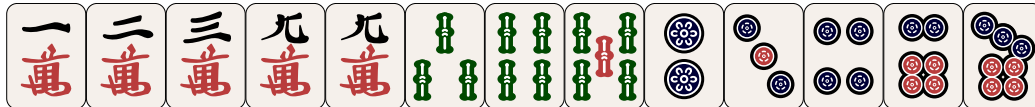
A situation like this might arise while playing mahjong, for example, when the player has a choice to declare riichi or stay dama. Which choice, then, should the player take?

The expected value of choosing (1.2) is 1000 ¥, and the expected value of choosing (1.3) is 2000 ¥. Thus the player should choose to play the game following (1.3). By making these considerations, it is possible to conclude which choices are the most advantageous when playing a game of dice.

Now let us consider a game of mahjong. It is east 1 and you are in the south seat. It is currently turn 5 no other players have called or declared riichi. Your own hand is closed ryanmen tenpai for pinfu nomi. To stay damaten or to declare riichi, which one should you choose? Many readers may already know the correct choice to make, but suppose that you did not have this knowledge beforehand. Can you confidently say which choice is correct? Now suppose that like with the game of dice, you know the probabilities of winning and the expected point gain upon winning. How confidently can you say which choice is correct now? Is it not easier to make your decision if you knew the probabilities of the outcomes upon declaring riichi or staying damaten and the respective expected point gains and losses?

Note that when computing expected point gains and losses from declaring riichi, in the case that a riichi hand is won, the 1000 point riichi bet is not factored into any calculations. However, when the riichi bet is not recovered, the 1000 points from the riichi bet are deducted from the point expected value. For example, the expected point gain for reaching ryuukyoku in riichi is 1000 points. When declaring riichi, 1000 points are placed as a riichi bet. The expected payment from other players at ryuukyoku is 2000 points. Combining $2000 - 1000$ gives the expected 1000 point gain. When unsure, any judgements about expected points at the end of the round should be made using the points available at the start of the round as a reference.

Why declaring riichi is correct with pinfu nomi



- When declaring riichi
 - 68% win rate, 3700 average point gain
 - 7% deal in rate, 6600 average point loss
 - 8% opponent tsumo rate, 2900 average point loss
 - 4% lateral movement (opponent deals in to another opponent) rate, 1000 average point loss
 - 13% ryuukyoku rate, 1000 average point gain
- When staying damaten
 - 85% win rate, 1100 average point gain
 - 4% deal in rate, 5600 average point loss
 - 5% opponent tsumo rate, 1900 average point loss
 - 6% lateral movement rate, 0 average point loss
 - 0% ryuukyoku rate, 2000 average point gain

In this case, the expected point gain when choosing to declare riichi is 1900 points, and the expected point gain when choosing to dama is 600 points. Thus, choosing to riichi will lead to a larger point gain on average and so declaring riichi is the correct choice. Like this, if the probabilities and expected point gains associated with some outcome are known, choices that lead to the best outcome can be made. Data is used to help oneself make the most advantageous decisions. Of course, the data used to make these decisions must be reliable; it is possible that the collected data do not accurately represent reality, leading to losses when the data predicts gains. This raises the question: what data can be considered reliable?

The data in this book is collected from tenhou houou level east-south game logs. Any game logs meeting the search criteria (in this case, logs in which pinfu nomi riichi have been declared on turn 5) are analysed for win rates, deal in rates, and their respective point gains and losses. The statistics above are the result of such analysis of game logs, or perhaps calculations done using the results of said analysis. For example, the point gain upon winning is calculated from game logs using ippatsu rate, tsumo rate, and ura dora rate. Likewise, the reported point loss upon dealing or upon opponent tsumo are averages obtained from analysis of game logs. To use the results of game log analysis means to estimate probabilities, averages, and expected values from a large number of situations that have occurred in actual play. Given that these data were collected from the results of actual play, they should be fairly reliable. Other ways of generating reliable data including modelling the decisions made by mahjong players and collecting statistics on win rates and the like from simulated play, but this requires the creation of rather accurate models, a difficult task.

1.1.1 Round balance

When rolling dice, the expected value used as the criterion for comparing different choices was the expected monetary payout. What then, should be the expected value that is used as a criterion for comparing choices when playing mahjong? In this book, the expected *round balance*, i.e. the expected change in points at the end of a round, is used. For example, if there is a 50% chance of winning a mangan (8000 point gain), 25% chance of dealing into a mangan (8000 point loss), and a 25% chance of an opponent tsumoing a mangan (2000 point loss) in a round, the round balance is

$$0.5 \cdot 8000 - 0.25 \cdot 8000 - 0.25 \cdot 2000 = 1500$$

and so the round balance is 1500 points. The scenario roughly modelled here is when two players, neither the dealer, are both in ryanmen tenpai for a mangan valued hand and pushing until one or the other wins. Although the point gain upon winning is 8000 points, the round balance in such a situation is only 1500 points. Evidently, a 1 vs. 1 mangan duel is not all that profitable.

Round balance can be calculated using (1.4).

$$\begin{aligned} (\text{round balance}) &= (\text{win rate})(\text{point gain upon win}) & (1.4) \\ &- (\text{deal in rate})(\text{point loss upon deal in}) \\ &- (\text{opponent tsumo rate})(\text{point loss upon opponent tsumo}) \\ &- (\text{lateral movement rate})(\text{point loss upon lateral movement}) \\ &+ (\text{ryuukyoku rate})(\text{point gain upon ryuukyoku}) \end{aligned}$$

With a few exceptions, (1.4) will be used in this book to compute round balances. However, with 10 parameters, (1.4) can be rather cumbersome to work with. For simplicity, (1.5) can be used instead.

Compared to (1.4), (1.5) is less accurate, but an estimate for the round balance can be calculated knowing just the win rate and point gain upon winning, and the calculations are easier. Even when errors occur, they are not all that large.

This book uses round balance to determine the merits of various strategies and choose the rational strategy. In other words, the strategy that yields the highest round balance will be chosen.

$$(\text{round balance}) = (\text{win rate})((\text{point gain upon win}) + 1500) - 1500 \quad (1.5)$$

The 1500 points used in this equation is the expected point loss when unable to win a hand. Depending on the situation, the expected point loss can vary between 1500 to 2000 points, but this variation is within statistical error, so there is no need to pay too much attention to it. The expected point loss was computed from the following holistic results from game log analysis:

- 12% deal in rate when not dealer, -5000 points upon deal in
- 26% opponent tsumo rate when not dealer, -2000 points upon opponent tsumo
- 24% lateral movement rate
- 16% ryuukyoku rate, -200 points upon ryuukyoku

1.1.2 Round balance and match score are correlated

This book uses round balance to judge the merits of various strategies, but some readers may wonder whether maximizing round balance has any relevance to maximizing match score (That is, the score at the end of a match after considering oka and uma). Although these two metrics are not entirely identical, round balance is more or less a correct metric to consider (Figure 1.2). Figure 1.2 shows the east 1 round balance of a non-dealer player, ranging from a 12000 point deal in to another non dealer player, to a 12000 point win, plotted against the expected match score in each respective case. From this graph, it becomes apparent that gains and losses from winning or dealing in can be viewed as indicators of match score instead of just point gains and losses. Let us take a look at

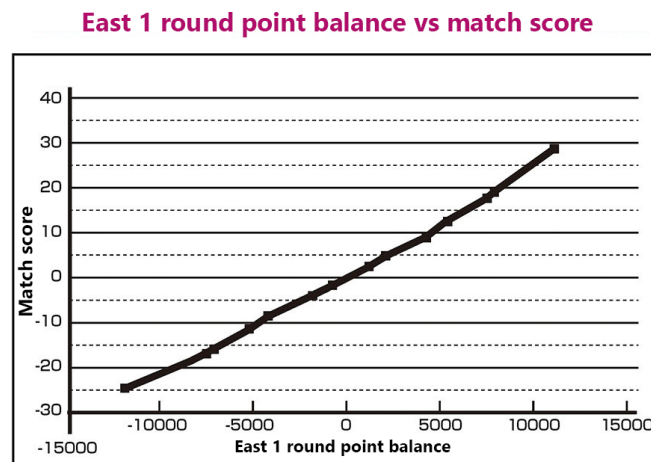


Figure 1.2

the numbers. Consider the case where 2000 points are won in the first round. In this case, the expected match score is 6.1 points after considering oka and uma. Of these 6.1 points, 2.0 result from the player's point standing during the match. The remaining 4.1 are from oka and uma. Additionally, the probability of placing first in such a situation is 29.6%. On the other hand, if a player deals into a mangan in the first round, the expected match score after accounting for oka and uma is -21 points, the probability of placing last is 46%, and the probability of placing first is 13%. Out of the -21 match end points, -8 result from the player's point standing during the match, and the remaining -13 points are due to oka and uma. Now then, please place a ruler on the line plotted in 1.2 (try to cover the the points corresponding to -8000 and 8000 points). Although the graph does not line up perfectly with the ruler, they do overlap to some extent. From this, it is apparent that match score can be estimated by round balance through the linear relationship between the two metrics. Phrased in terms of strategy, as long as it is not a duel between huge hands from the very start of the match, maximizing round balance will also tend to maximize match score.

Here the relation between round balance and match score will be explained. Suppose that in east 1 the player can has two options, one that leads to a 1000 point gain in round balance and one with a 0 point change in

round balance. The difference in average placement in the case of taking each of the choices is 0.07, a 2.7 point difference in match score. How much exactly is a 0.07 difference in expected placement? Let us illustrate this with the following example. The top level tenhoui players on tenhou have an expected placement of about 2.4, whereas a slightly above average houou player has an expected placement of about 2.47. A 1000 point difference in round balance may seem cheap, only having the value of one riichi stick, but it must be understood that a 1000 point is a very large difference when it comes to performance in mahjong.

1.1.3 A word of caution regarding the use of round balance

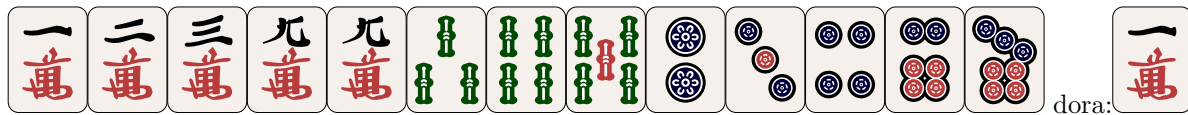
Lastly, a few points regarding the statistical error in round balance will be explained. Although game log analysis results reflect the outcomes of actual matches, the data are collected to represent rather general scenarios and any tabulated numbers will differ from those that may occur in an actual match. In that regard, the error in win rates tabulated in this book are around 5%, and the error in round balance is around 400 points ($5\% \times 8000$ points). Thus, when the difference in round point balance is less than 400 points, the optimal choice may be the opposite of what is suggested by the highest round balance. Knowing this, judgements such as “the round balance of this choice is 1000 points, so barring any extreme outliers making the choice with the highest round balance should be correct,” and “the difference in round balance between these two choices is only 100 points, so depending on the situation it may be possible that the choice with the lower round balance is correct. With the current situation, the option with the lower round balance should be chosen.” can be made.

Riichi/dama confirmed hand value	Turn 5		Turn 8		Turn 12		Points scored	
	Riichi	Dama	Riichi	Dama	Riichi	Dama	Riichi	Dama
Riichi nomi	1300		600		-100		2800	
Dama 1000 pt, Riichi 2000 pt	1900	600	1100	200	300	-300	3700	1100
Dama 1300pt, Riichi 2600 pt	2800	1000	1900	500	900	0	5000	1500
Dama 2000 pt, Riichi 3900 pt	3600	1600	2600	1000	1400	400	6300	2200
Dama 2600 pt, Riichi 5200 pt	4500	2300	3400	1600	1900	800	7600	3000
Dama 3900 pt, Riichi 7700 pt	5500	3400	4200	2600	2600	1600	9100	4300
Dama 5200 pt, Riichi 4 han	5600	4800	4300	3800	2600	2500	9200	6000
Dama 6400 pt, Riichi 4 han	5600	5600	4300	4500	2600	3000	9200	6900
Dama 7700 pt, Riichi 5 han	7000	6300	5500	5100	3500	3600	11300	7800
Dama 4 han, Riichi 5 han	7000	6500	5500	5300	3500	3700	11300	8000
Dama 5 han, Riichi 6 han	8300	7500	6500	6100	4300	4400	13100	9200
Dama 6 han, Riichi 7 han	9600	9900	7600	8200	5100	5900	15100	12000

Table 1.1: Head start ryanmen riichi/dama round balance. Round balance values are computed from game log analysis results tabulated in 1.2. Expected round balance values are rounded to the nearest 10.

1.2 Feel the value of ryanmen riichi

Suppose that it is east 1 and you are in the south seat. It is currently turn 8, and no other players have declared riichi. Your own hand, shown below, is ryanmen tenpai.



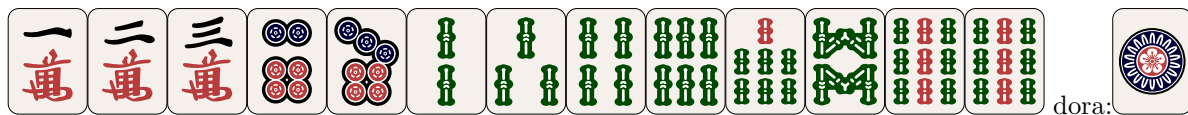
Should riichi be declared?

Reading any mahjong strategy book will say that with ryanmen tenpai riichi should be declared, and this may seem obvious to some readers. What then, is the basis for this statement? Or, phrased differently, how much more do you benefit from declaring riichi versus pushing the hand while remaining damaten?

Let us quantify how advantageous ryanmen riichi is (here, ryanmen also includes nobetan and other irregular multi-sided waits). Knowing this will let you confidently declare riichi without being tilted by bad luck and allow you make proper decisions in exceptional cases where riichi should not be declared.

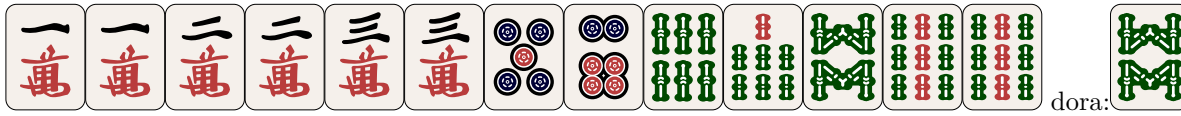
Table 1.1 shows expected round balance values for declaring head start riichi and staying damaten on turns 5, 8, and 12.

In the case of pinfu dora 1 ryanmen tenpai on turn 8, calling riichi has an expected round balance of 2600 points, whereas staying dama has an expected round balance of 1000 points. There is a large difference of 1600 points between calling riichi and staying dama. When converted to match score, this becomes a 4.3 point difference, and so it can be understood that there is a large difference between these two choices. Let us consider what to do in the case of some other hands. First, let us consider the case of pinfu nomi as below.



Calling riichi in this case results in an expected round balance of 1100 points, whereas staying dama results in an expected round balance of 200 points, a 900 point difference. When converted to match score, this is a 2.4 point difference.

What about the next hand?

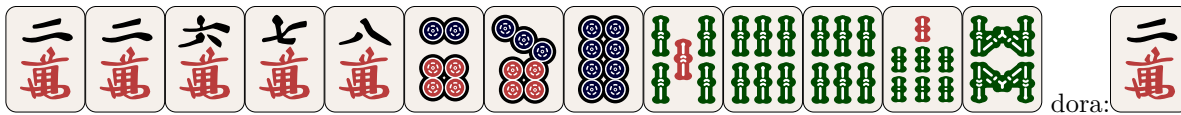


When damaten, this hand is worth 3900 points, whereas when calling riichi it is worth 7700 points. Riichi is better in this case as well. The expected round balance for declaring riichi is 4200 points and 2600 points for staying dama. The difference in round balance is 1600 points. When considered like this, the strength of declaring riichi for any ryanmen tenpai hand worth less than mangan can be understood.

1.2.1 Exceptional cases when damaten should be taken

Having said all this, riichi should not be declared 100% of the time. Next, let us consider some exceptional cases where damaten should be taken.

First is the case of confirmed haneman dama. For example, this hand.



The yaku are tanyao pinfu sanshoku doujun dora 2, a confirmed haneman. In this case, staying damaten has a higher round balance (8200 points) than declaring riichi (7600 points). In this case damaten should be taken.

Next, consider the case of a ryanmen damaten hand worth at least 5200 points with a confirmed yaku. For example, the hand shown below on turn 12.

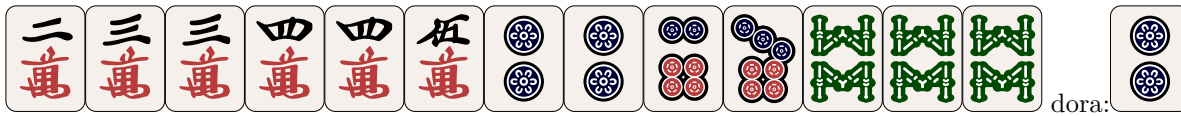
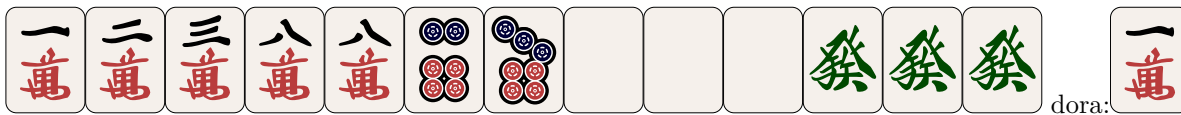


Table 1.1 shows that the expected difference in round balance between declaring riichi and staying damaten is not large. Let us choose to dama for the higher win rate.

Let us also consider the cases of midgame 6400 point damaten and 7700 point damaten. For example, the following hand.



When calling riichi in this case, the expected round balance is 4300 points, and when staying damaten, the expected round balance is 4500 points. Staying dama results in a higher expected round balance. Additionally, the expected round balance of calling riichi on turn 8 with a confirmed 7700 point hand is 5400 points, whereas staying dama gives an expected round balance of 5100 points, a difference of only a few hundred points. In cases like this, damaten is also an option.

Note that in the case where there is only a slight difference in expected round balance, specifically when there is less than a 400 point difference, depending on the situation in the round, the correct choice may differ from the choice with the higher round balance, so either choice can be fine. If win rate is more important, choose to stay damaten. Conversely, calling riichi due to a lack of points is also acceptable.

Lastly, cases where expected round value do not correspond directly with placement are considered. For example, it is all last and you are ryanmen tenpai with confirmed yaku. Winning any hand will let you place first. In this case, barring any exceptional circumstances, damaten should be taken to increase your win rate.

Several exceptions have been considered above, but as a general rule, head start riichi should be taken with ryanmen tenpai. Understand that in general you should riichi, and then consider the exceptions.

1.2.2 Why riichi is advantageous

Data used to compute expected round balances	Turn 5		Turn 8		Turn 12	
	Riichi	Dama	Riichi	Dama	Riichi	Dama
Win rate(%)	68	85	57	73	42	56
Tsumo rate upon win (%)	59	29	56	28	54	30
Ippatsu rate upon win (%)	13	0	16	0	23	0
Deal in rate (%)	7	4	11	8	15	13
Opponent tsumo rate (%)	8	5	11	8	13	13
Lateral movement rate (%)	4	6	7	10	10	14
Ryuukyoku rate (%)	13	0.2	14	1	20	3
Point loss upon deal in	6600	5600	6600	5600	6600	5600
Point loss upon opponent tsumo	2900	1900	2900	1900	2900	1900
Point gain upon ryuukyoku	1000	2000	1000	2000	1000	2000

Table 1.2: Head start ryanmen riichi/dama win rate data. The probabilities for damaten hands are extracted from hands where the final shape of the hand was tenpai but riichi was not called (this slightly skews the data in favor of damaten). Data for point loss upon dealing in/point loss upon opponent tsumo/point gain upon ryuukyoku are compiled from non-dealer head start riichi. Point values are rounded to the nearest 10.

It is apparent that calling riichi is advantageous with ryanmen tenpai. There are two reasons as to why this may be the case.

First, even if riichi is declared, the probability of winning the hand does not drop very much. Table 1.2 shows that declaring riichi on turn 8 has a win rate of 57% and staying damaten has a win rate of 73%, a difference of only 16%. Likewise, the difference in win rate between riichi on turn 5 and damaten is 17% and 15% on turn 12. In all cases, declaring riichi retains at least 70% of the win rate of staying damaten. Although declaring riichi makes other players more cautious, as should be clear from comparing riichi and dama tsumo rates, 40% to 50% of riichi wins are still by ron, so declaring riichi does not make it impossible to win by ron. Moreover, to declare riichi is to proclaim that you have a fairly high scoring hand, making it difficult for other players to counterattack. Consequently, your own chances of winning may actually increase. Considering the above, it can be concluded that declaring riichi does not lower your chances of winning by much.

The next reason why riichi should be declared is that doing so increases the value of your hand. For example, declaring riichi with a hand that would be worth 1000 points dama increases the value of your hand from 1100 (after accounting for tsumo) points to 3700 points. Declaring riichi with a hand worth 2000 points dama increases the value of your hand from 2200 points to 6300 points, and declaring riichi with a hand worth 3900 points dama increases the value from 4300 points to 9100 points. In all cases, the value of your hand is more than doubled. Like this, any hand worth less than 5200 points has its value at least doubled. This is another reason why declaring riichi is advantageous.

Thus we have seen the basis for head start riichi should be called with ryanmen tenpai. Even if you do encounter some bad luck, have the confidence to declare riichi.

Riichi/dama confirmed hand value	Turn 5		Turn 8		Turn 12		Points scored	
	Riichi	Dama	Riichi	Dama	Riichi	Dama	Riichi	Dama
Riichi nomi	500		-100		-600		2600	
Dama 1300pt, Riichi 2600 pt	1600	500	800	0	0	-500	4700	1500
Dama 2600 pt, Riichi 5200 pt	2900	1600	1900	900	800	100	7300	3000
Dama 5200 pt, Riichi 4 han	3800	3800	2700	2600	1400	1300	9000	6000
Dama 6400 pt, Riichi 4 han	3800	4500	2700	3100	1400	1700	9000	6900
Dama 4 han, Riichi 5 han	4800	5300	3500	3700	1900	2100	10900	8000
Dama 5 han, Riichi 6 han	5900	6100	4300	4400	2600	2600	12900	9200
Dama 6 han, Riichi 7 han	6900	8200	5200	6000	3100	3700	14800	12000

Table 1.3: Head start bad shape riichi/dama round balance. Round balance values are computed from data tabulated in Table 1.4. The points scored upon winning differ slightly from the corresponding values for ryanmen riichi due to some differences in ippatsu and tsumo rates.

1.3 Wipe away your fear of head start bad shape riichi

1.3.1 In general also call riichi with bad shapes

Here we consider head start riichi with bad shape tenpai (bad shapes are shanpon on number tiles, tanki on number tiles, kanchan, penchan).

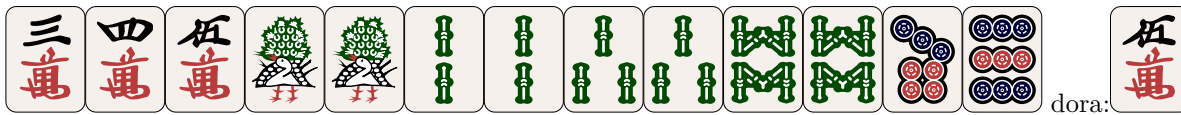
Consider the following hand.



Should we call riichi with this hand? If Totsugeki Touhoku’s arguments in *Scientific Mahjong* and the “kanchan insta riichi playstyle” popularized by Fukuchi Makoto are to be followed, then the answer would be to declare riichi. Just how advantageous is it to call riichi then?

The expected round balance for bad shape riichi and dama are tabulated in Table 1.3. With the hand in consideration (dama 1300 points, riichi 2600 points), the expected round balance when calling riichi is 800 points and 0 points when staying damaten. Thus riichi should be declared in this case.

In the following hand, which is better, riichi or dama?

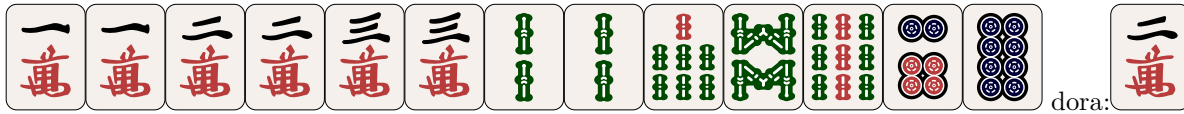


If in damaten, this hand is worth 2600 points and 5200 points if riichi is declared. In this case, declaring riichi results in an expected round balance of 1900 points and staying damaten results in an expected round balance of 900 points, a difference of 1000 points. Thus, with this hand riichi should also be declared.

1.3.2 Exceptions where damaten should be taken

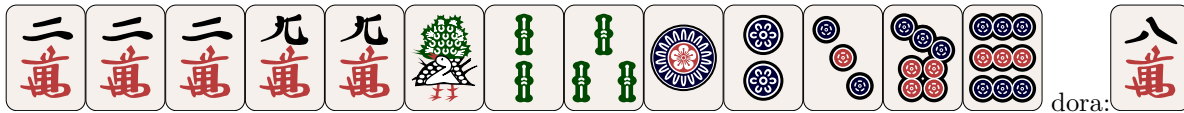
Having said this, there are more than a few cases where damaten should be taken when tenpai with a bad shape. Let us look at some specific cases where damaten should be taken.

First, a 5200 point hand with confirmed yaku. Specifically, a hand like this.



In this case, the expected round balance when calling riichi is 2700 points, and the expected round balance of staying damaten is 2600 points. The expected round balance is higher when calling riichi, but only by a slight 100 points. With this in mind, considerations like “I want to emphasize win rate over scoring more points,” and “my wait is even worse than usual” can be made, and it can be acceptable to stay damaten.

Lastly, how should a 1300 point bad shape hand without yaku, specifically a hand like



be considered? This is a troubling situation. When declaring riichi, the expected round balance is between -100 and 0 points, so it might not be the best hand to call riichi with. However, the expected -100 points from calling riichi is better than giving up on winning completely (expected round balance of -1500 points). Thus when waiting on suji, non-suji 1, 9, 2, 8, or other decent waits, riichi should be declared aiming to win. With bad shape waiting on non-suji 4, 5, or 6 late in the round, stay damaten and aim for keiten. If it is earlier than the mid game, breaking tenpai and waiting for improvement can also be considered.

1.3.3 Why riichi is advantageous

Data used to compute expected round balances	Turn 5		Turn 8		Turn 12	
	Riichi	Dama	Riichi	Dama	Riichi	Dama
Win rate(%)	53	73	43	58	31	40
Tsumo rate upon win (%)	48	29	46	30	44	34
Ippatsu rate upon win (%)	10	0	14	0	20	0
Deal in rate (%)	11	7	14	12	17	16
Opponent tsumo rate (%)	11	9	14	13	15	18
Lateral movement rate (%)	5	10	9	15	11	18
Ryuukyoku rate (%)	20	0.8	20	2	26	8
Chased rate (%)	22		22		16	
Mangan+ deal in rate (%)	3	1	3	2	3	2
Point loss upon deal in	6600	5600	6600	5600	6600	5600
Point loss upon opponent tsumo	2900	1900	2900	1900	2900	1900
Point gain upon ryuukyoku	1000	2000	1000	2000	1000	2000

Table 1.4: Head start bad shape riichi/dama win rates. Since confirmed yaku dama data was difficult to collect, 1 call bad shape tenpai was used instead. Data was collected from hands where the final shape was tenpai (consequently the data are slightly skewed in favor of damaten).

With bad shape tenpai, if calling riichi increases the value of the hand to 2 han or 3 han, riichi should be called. Let us consider why this is the case. The reason why declaring riichi with bad shape tenpai is advantageous is the same as why declaring riichi is advantageous with ryanmen tenpai. That is, calling riichi with any hand worth less than 5200 points greatly increases the value of the hand while not drastically decreasing win rate. The value increasing effect is essentially the same as in the case of ryanmen riichi, so let us see how much calling riichi with a bad shape decreases win rate.

Table 1.4 shows win rates and related statistics when calling riichi or staying damaten with a bad shape. The win rate when calling riichi (53% on turn 5, 43% on turn 8, 31% on turn 12) is lowered by 9%~20% when compared to the win rate when staying damaten (73% on turn 5, 58% on turn 8, 40% on turn 12). However,

when compared proportionally, the win rate when calling riichi preserves at least 70% of the damaten win rate. Evidently, calling riichi does not significantly lower win rate. This is the same as in the case of ryanmen riichi.

The reasons for calling riichi with a bad shape have been considered. However, even with this in mind, it may be scary to call riichi with a bad shape, especially when your own riichi is counterattacked by another riichi; it is reasonable to be scared of dealing into a mangan sized or more expensive hand in this case. Thus, let us examine how often you might get chased and how often you might deal into a mangan sized or more expensive hand. From Table 1.4, the probability of getting chased when declaring bad shape riichi is 22% on turn 5, 22% on turn 8, and 16% on turn 12. Getting chased while in bad shape riichi occurs roughly 1 out of every 5 to 6 cases—not a frequent occurrence. Additionally, the probability of dealing into a mangan after declaring riichi with a bad shape is 2.8% on turn 5, 3.1 % on turn 8, and 3.2% on turn 12, roughly once out of every 30~40 times.

Thus it is apparent that neither getting chased nor dealing into an expensive hand after riichi are all that likely, and, thinking in the long term, there is no reason to be afraid of these occurrences.

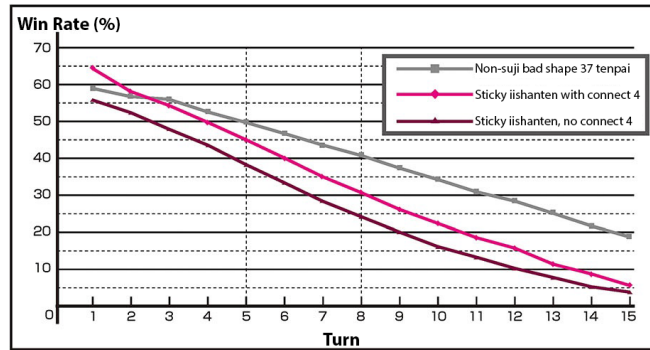


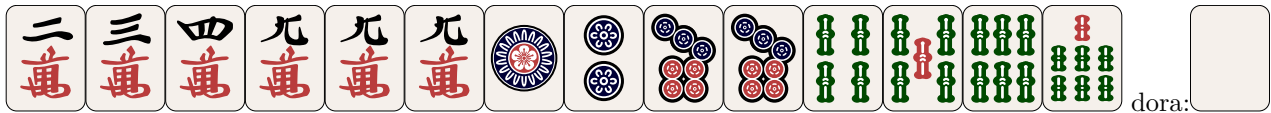
Figure 1.3: Sticky iishanten vs. head start bad shape riichi winrate

1.4 Break bad shape tenpai if tanyao is possible

1.4.1 Insta riichi when not expecting increases in hand value

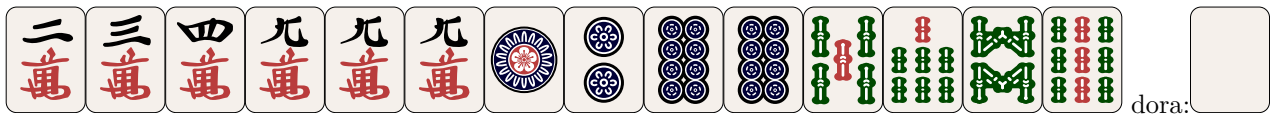
In section 1.3 it was said that riichi should instantly be called with bad shape tenpai—the so called “kanchan insta riichi playstyle.” However, this is not to say that it is good to riichi absolutely everything. The previous section had compared calling riichi and staying damaten. This time calling riichi and breaking tenpai will be compared.

Consider the following hand. It is currently turn 5 and you are in the south seat.



Cutting allows for penchan riichi nomi waiting on . Without ippatsu, ura , or tsumo, the hand is only worth 1300 points. On the other hand, the hand 4 tile connected shape, so waiting to draw any of to change to ryanmen tenpai is also an option. The question is, then, whether to discard to widen the hand for improvements. Figure 1.3 shows the win rate of hands in sticky iishanten versus those with bad shape riichi. On turn five, the win rate of bad shape riichi is 50%.

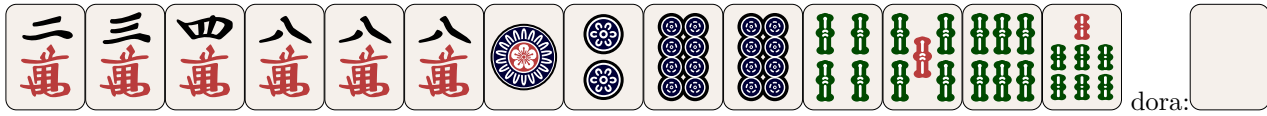
Let us estimate the win rate in the case of discarding . Sticky iishanten on turn 5 with a 4 tile connected shape has a win rate of 45%. If win rate is the only factor considered, bad shape riichi has better value. Thus, riichi should be called on this hand. Moreover, since it has been determined that head start bad shape riichi is better as early as on turn 5, the same is moreso true for declaring head start riichi on later turns. Of course, in a hand without a 4 tile connected shape, for example,



should be discarded and riichi declared.


1.4.2 Considerations when breaking tenpai to increase hand value

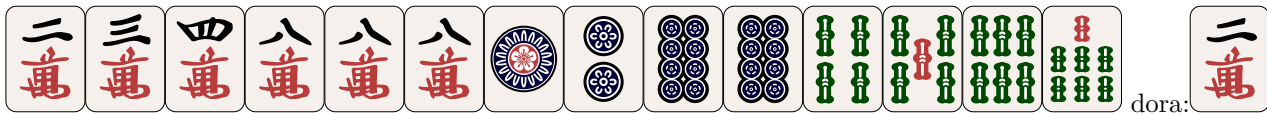
The discussion above was concerned solely with win rate, i.e. when possible increases in hand value are not expected. Consider now the following hand on turn 5.



The difference between the previous hand and the current hand is that when waiting for improvements, it is likely that the hand ends up incorporating tanyao and increasing in value. Winning a riichi nomi hand has an expected score of 2600 points, but this increases to 4700 points when winning with closed tanyao. Taking this into consideration, even if the win rate decreases, there is plenty of justification for breaking tenpai to wait for improvement.

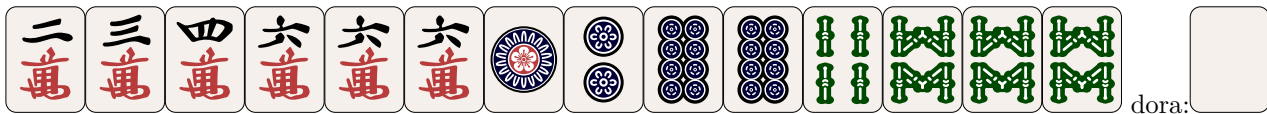
In light of these facts, striking a balance between win rate and hand value becomes important. An increase from 2600 points to 4600 points is a 1.8 times increase in score, but it is incorrect to consider alternative choices with 50-60% (roughly 1/1.8) the win rate of the original. Most rounds that are not won result in point loss due to dealing in or an opponent's tsumo. Simply comparing the expected point gain upon winning a hand ignores the effects of possible point losses upon losing.

To take into account the possibility of losing points, the expected point loss when not winning a hand will be assumed to be 1500 points, and the round balance of declaring riichi and breaking tenpai will be considered (1.4). In this case, the round balance when declaring riichi is 500 points, and the round balance when breaking tenpai is 1300 points. Therefore,  should be discarded to wait for improvement. Applying the same reasoning when it is turn 8, the round balance for declaring riichi is 100 points, and the round balance for breaking tenpai is 400 points. Thus even on turn 8, it is better to break tenpai to wait for improvement. Note that in this case the hand in question did not have any yaku other than riichi, but the same reasoning is correct even for a hand like the following.



The round balance is 1600 points for riichi + dora 1 and 2400 points for breaking tenpai on turn 5, and, respectively, 1000 points and 1200 points on turn 8. Thus, for hands including a 4 tile connected shape with the possibility for tanyao, breaking bad shape tenpai to wait for improvements is correct.

What then, should be done in the case where the hand does not include a 4 tile connected shape? Specifically, a hand like the following on turn 5.



In this case, the round balance for declaring riichi is 500 points and 900 points for breaking tenpai. In the early game, even without a 4 tile connected shape it is better to break tenpai for improvement if tanyao is likely. On turn 8, the round balance for declaring riichi is 100 points and 0 points for breaking tenpai. In the midgame or later, it may be better to make decisions based more on the current situation. Again, these considerations were made for a hand with no yaku other than riichi, but the same applies for a hand with dora 1 (on turn 5, declaring riichi has a round balance of 1600 points and breaking tenpai 1800; on turn 8, declaring riichi has a round balance of 1000 points and breaking tenpai 700). Thus, if tanyao can be incorporated, it is better to break bad shape tenpai in the early game even without a 4 tile connected shape.

1.4.3 Supplemental

Based on round balance calculations, the choices of declaring bad shape head start riichi and breaking tenpai have been compared, with the verdict being that it is beneficial to break tenpai early in the game if tanyao is

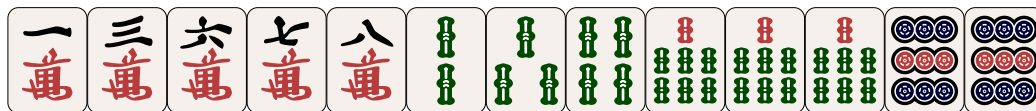
Turn 5~12 head start riichi win/tsumo rate	Overall		0 visible		1 visible		2 visible	
	win (%)	tsumo (%)	win (%)	tsumo (%)	win (%)	tsumo (%)	win (%)	tsumo (%)
Non suji 456	34	62	37	63	30	61	23	57
Non suji 37	40	51	43	52	36	49	28	46
Non suji 28	43	46	46	47	41	46	34	42
Half suji 456	36	52	40	53	32	52	24	48
Non suji 19	46	36			47	37	44	43
Suji 37	48	36	51	37	44	34	35	32
Suji 28	51	31	55	32	50	31	43	30
Full suji 456	47	33	51	34	42	33	36	31
Suji 19	57	24			58	24	56	25

Table 1.5: bad shape win rates by winning tile type and number of winning tiles

1.5 Bad shape riichi with 2 tiles visible should be called waiting on 1 or 9 if possible

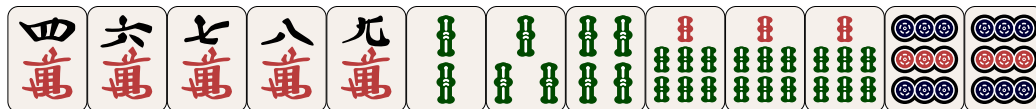
1.5.1 Only consider bad shape head start riichi with 2 tiles visible on 1 or 9

Until now, all bad shapes were treated identically. Although the two following hands are both considered bad shapes,



(is in your discards)

(a)



(b)

Figure 1.4: bad shapes

there probably is not anyone thinks that the win rates of these two hands are the same. In table 1.5 the win rates of bad shape riichi, accounting for the type of the winning tile and the number of winning tiles already visible, are listed (excluding shanpon).

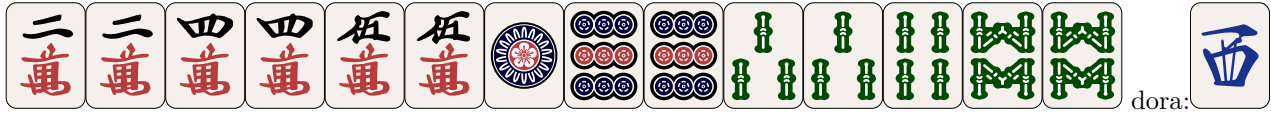
Consider the win rates of (1.4a) and (1.4b) when none of the tiles waited on are visible. (1.4a) is waiting on suji 28, which has a win rate is 55%. (1.4b) is non suji 456, which has a win rate of 37%. As expected, the type of wait makes a big difference win rate, with (1.4a) having an 18% higher winrate than (1.4b). Now, how does the number of visible winning tiles affect win rate? Using the same kanchan waits as before but now considering the case where 2 winning tiles are already visible, the win rate of (1.4a) becomes 43% and the win rate of (1.4b) drops to 23%.

Now that the effect of tile type on win rates is understood, let us consider the cases when declaring riichi on a bad shape with 2 winning tiles already visible gives a win rate greater than 40%. Table 1.5 gives suji 19 (56%), non suji 19 (44%), and suji 28 (43%). Other than these cases, try not to riichi bad shapes with 2 winning tiles already visible.

1.5.2 Non suji 19 tanki has a fighting chance

Even with 2 winning tiles visible, declaring riichi on non suji 19 tanki has a fighting chance. Let us try to explain why this is the case from the data.

Non suji 19 has a remarkably low tsumo rate, suggesting that such tiles are easily discarded by other players. A normal ryanmen riichi on turn 8 has a tsumo rate of 56% and bad shape riichi overall has a win rate of 46%. However, the tsumo rate for bad shape 19 riichi is 24% when the winning tile is suji 36% when the winning tile is not suji, both rather low. Regardless of suji or not, 19 tiles are easily discarded by other players. With chiitoi tenpai on 19 like in the following hand,



it is better to declare riichi immediately instead of waiting to draw an honor.

1.6.2 Head start ryanmen tenpai: answers

Question 1



discard and riichi

Closed ryanmen tenpai for tanyao. The round balance is 2800 points for riichi and 1000 points for dama, a large difference. Don't think and riichi.

Question 2



discard and riichi

Closed ryanmen tenpai for pinfu. The round balance 300 points for riichi and -300 points for dama. The difference is smaller, but pay it no mind and riichi. The winning tiles are middle tiles, but as long as fewer than 3 winning tiles are visible there is no need to pay any attention to it.

Question 3



discard and dama

One of the rare exceptions where head start ryanmen tenpai is kept in damaten. The hand is tenpai for tanyao sanankou. The round balance is 2600 points for riichi, lower than the 3000 points for dama. There is also the possibility for improvement to suuankou, so in this case keep calm and dama.

Question 4

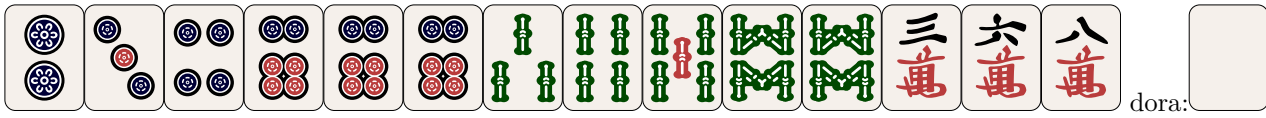


discard and riichi

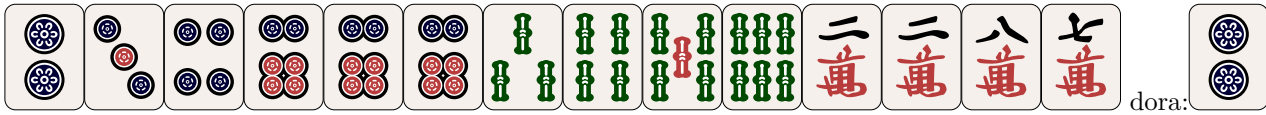
It is all last and winning any hand will place top. The current hand is ryanmen tenpai for riichi only, having a 57% win rate. Call riichi and end the match.

1.6.3 Head start bad shape tenpai

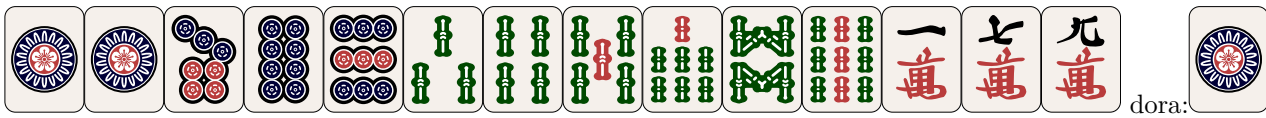
Question 1: non dealer, turn 5



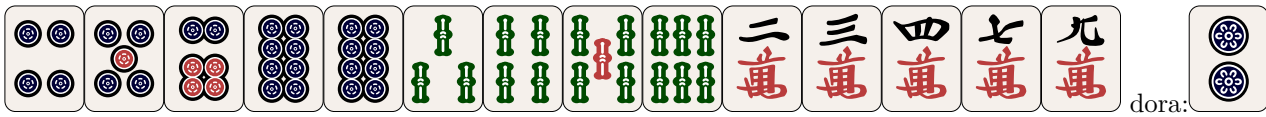
Question 2: non dealer, turn 12



Question 3: non dealer, turn 8



Question 4: non dealer, turn 5



1.6.4 Head start bad shape tenpai: answers

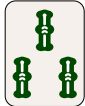
Question 1



discard and riichi

Closed kanchan tenpai for tanyao. This is a classic case where head start kanchan riichi should be declared. The round balance is 1600 points for riichi and 500 points for dama, a rather large difference. Chances for improvement are also scarce; don't think and call riichi.

Question 2



discard and riichi

Closed kanchan tenpai for tanyao dora 1. Also call riichi on this. The round balance is 800 points for riichi, higher than the 100 points for dama. Moreover, in the late game wait change is inadvisable even with a 4 tile connected shape.

Question 3





discard and dama

Closed kanchan tenpai for sanshoku dora 2. Round balance is 3500 points for riichi, less than the 3700 points for dama. Thus, damaten should be taken here to maximize win rate. Try not to rush blindly into riichi.

Question 4



discard

Discarding  and declaring riichi gives a hand worth 1300 points in confirmed value. Discarding  can improve the hand up to tanyao pinfu. Aim for improvement in value here.

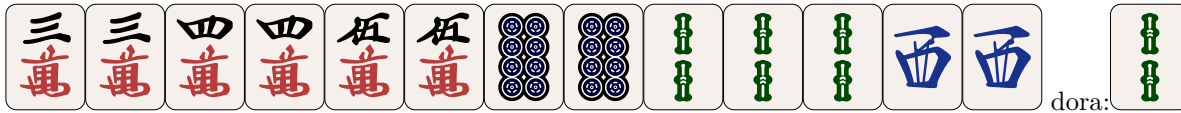
Riichi/dama confirmed hand value	Turn 5		Turn 8		Turn 12		Points scored	
	Riichi	Dama	Riichi	Dama	Riichi	Dama	Riichi	Dama
Riichi nomi	1100		400		-300		2600	
Dama 1300pt, Riichi 2600 pt	2400	700	1500	100	500	-400	4600	1500
Dama 2600 pt, Riichi 5200 pt	4200	1800	2900	1000	1500	200	7100	3000
Dama 5200 pt, Riichi 4 han	5400	4100	3900	2700	2300	1500	8900	6000
Dama 6400 pt, Riichi 4 han	5400	4800	3900	3200	2900	1900	8900	6900
Dama 4 han, Riichi 5 han	6600	5700	4900	3900	3000	2300	10700	8000
Dama 5 han, Riichi 6 han	8100	6600	6100	4600	3900	2800	12900	9200
Dama 6 han, Riichi 7 han	9300	8700	7000	6200	4500	4000	14600	12000

Table 1.6: Head start honor wait riichi/dama round balance. Round balance values are computed from data tabulated in Table 1.7.

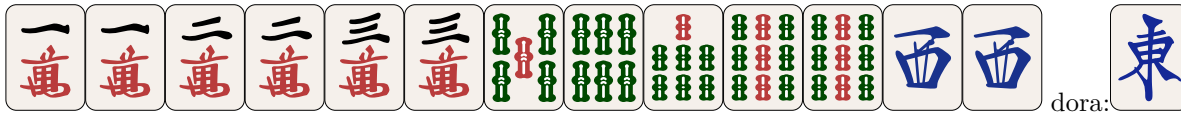
1.7 Riichi honor waits with impunity

1.7.1 Honor wait riichi is beneficial even for mangan class hands

Previously, riichi judgement for ryanmen and bad shape tenpai have been considered. Here honor waits are examined. Table 1.6 lists round balances for calling head start riichi and taking head start dama on turns 5, 8, and 12. The following hand is tenpai for an honor wait with iipeikou dora 3, and falls under the case of dama 4 han riichi 5 han in Table 1.6.

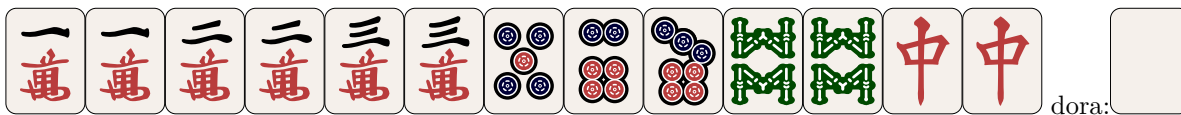


On turn 8, the round balance for this hand is 4900 points if riichi is declared and 3900 points if damaten is taken. Calling riichi results in a round balance 1000 points higher than that of staying damaten, so declaring riichi in this case is correct. Let us consider another example. For example, the following hand on turn 8.



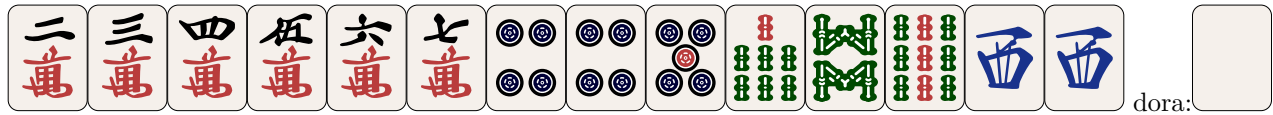
This hand is worth 1300 points in dama and 2600 points in riichi. In this case, the round balance is 100 points for dama and 1500 points for riichi, and so declaring riichi is correct.

Let us consider yet another example.

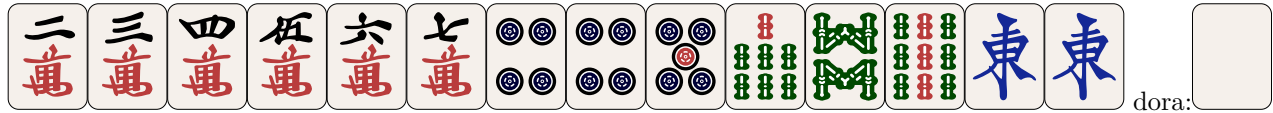


Choosing to dama results in 1300 points on yasume and 2600 points on takame, whereas declaring riichi results in 2600 points on yasume and 5200 on takame. The round balance will be taken to be the average of those of the takame and yasume. The round balance is then 550 points for dama $((100 + 1000)/2)$ and 2200 points for riichi $((1500 + 2900)/2)$. Thus, riichi should be declared in this case as well. With honor waits, call riichi as much as you want.

Let us consider another example. What should be done with the following hand (西 is a guest wind)?



In this case, calling riichi waiting on shanpon is riichi nomi, whereas calling riichi waiting on ryanmen also gives additional value with pinfu. Thus, in this case the ryanmen wait should be taken. Let us consider yet another example. You are dealer in east with the hand

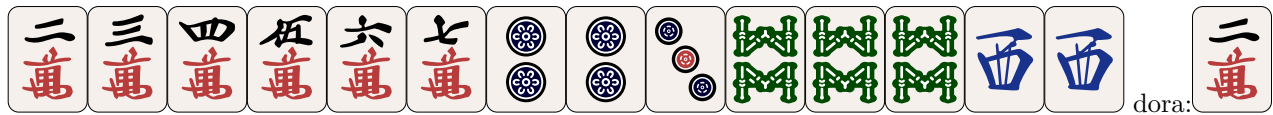


Since you are the dealer, the shanpon wait has a takame of double 東. It might seem difficult for others to discard 東 against the dealer, but in houou level tonpuu tables (based on analysis houou kuitan aka ari tonpuu tenhou logs), dealer tanki on 東 has a ron rate of 70%, not significantly different from ron rates of other honor tiles. Although suji tiles may be discarded before double 東, it is unlikely that an opponent would discard any random non suji tile over double 東 in the absence of any other safe tiles. Therefore, riichi should be declared waiting on shanpon in hopes for double 東 takame.

To conclude, when deciding between honor and ryanmen waits, if the honor in question is yakuhai, choose the honor wait, and when pinfu is possible, choose the ryanmen wait.

1.8.2 With all else equal, choose ryanmen

With a clear difference in value, it is best to choose the wait with the higher value. Now consider the case where choosing between honor wait and ryanmen makes no difference in value. For example, in the following case.



Regardless of whichever wait is chosen, the hand is riichi dora 1. Without ippatsu, ura dora, or tsumo, the hand is worth 2600 points. The round balance for head start ryanmen and honor wait riichi in various situations are tabulated in Table 1.8.

Riichi value/Turn + wait	Turn 5		Turn 8		Turn 12	
	Ryanmen	Honor	Ryanmen	Honor	Ryanmen	Honor
40 fu 1 han	1300	1100	600	400	-100	-300
30 fu 2 han	1900		1100		300	
40 fu 2 han	2800	2400	1900	1500	900	500
30 fu 3 han	3600		2600		1400	
40 fu 3 han	4500	4200	3400	2900	1900	1500
30 fu 4 han	5500		4200		2600	
40 fu 4 han	5600	5400	4300	3900	2600	2300
5 han	7000	6600	5500	4900	4500	4000
6 han	8300	8100	6500	6100	4300	3900
7 han	9600	9300	7600	7000	5100	4500

Table 1.8: Head start honor vs ryanmen riichi round balance

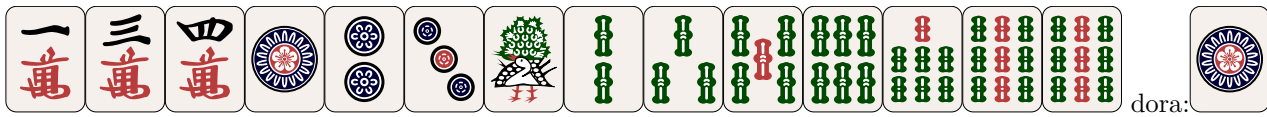
1.8. *WHEN DECIDING BETWEEN HONOR AND RYANMEN WAITS, CHOOSE WHICHEVER IS WORTH MORE POINTS?*

If a choice must be made, ryanmen should be the better choice. Although both choices have 2600 points in confirmed value, differences in tsumo rate lead to ryanmen riichi having the higher round balance. Specifically, the round balance is 1900 points for ryanmen riichi and 1500 points for shanpon riichi, and so ryanmen riichi is better.

All the discussion above was made considering head start riichi on turn 8, but as shown in Figure 1.6, the win rate of ryanmen and honor wait riichi are almost identical regardless of how early or late it is in the game. Regardless of the turn, with a yakuhai pair, take the shanpon riichi, and with pinfu, take the ryanmen riichi. If all else is equal, ryanmen riichi is ultimately favorable.

Riichi value/Turn + wait	Turn 5		Turn 8		Turn 12	
	Ryanmen	Honor	Ryanmen	Honor	Ryanmen	Honor
40 fu 1 han	1300	500	600	-100	-100	-600
30 fu 2 han	1900		1100		300	
40 fu 2 han	2800	1600	1900	800	900	0
30 fu 3 han	3600		2600		1400	
40 fu 3 han	4500	2900	3400	1900	1900	800
30 fu 4 han	5500		4200		2600	
40 fu 4 han	5600	3800	4300	2700	2600	1400
5 han	7000	4800	5500	3500	4500	1900
6 han	8300	5900	6500	4300	4300	2600
7 han	9600	6900	7600	5200	5100	3100

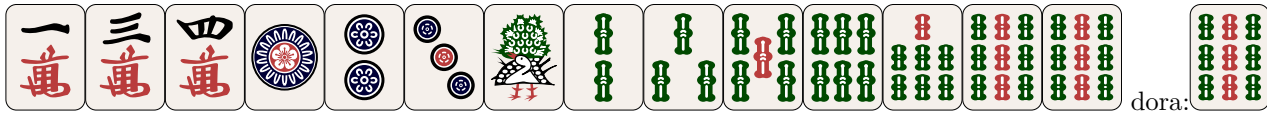
Table 1.9: Head start ryanmen vs bad shape riichi round balance



Compared to the previous example, the hand above has one additional han in value. What should be done in this case?

Discarding 25000 is bad shape riichi sanshoku dora 1, resulting in 40 fu 4 han of value and a round balance of 2700 points. On the other hand, discarding 25000 is ryanmen riichi pinfu dora 1, resulting in 30 fu 3 han of value and a round balance of 2600 points. As the round balances for the two cases are almost identical, either choice is acceptable.

Let us consider yet another example. What should be done in this case?



The hand above has 2 han more than the first example. Discarding 25000 is bad shape riichi sanshoku dora 2, resulting in 40 fu 5 han in value and a round balance of 3500 points. On the other hand, discarding 25000 is ryanmen riichi pinfu dora 2, resulting in 30 fu 4 han in value and a round balance of 4200 points. In this case, discarding 25000 for ryanmen riichi is better.

The previous discussion had compared pinfu ryanmen with bad shape sanshoku. As a general rule, if a hand has one han other than pinfu, choose the ryanmen wait, otherwise choose bad shape sanshoku. This rule likewise holds for bad shape ittsumu. Try to apply this rule whenever possible in actual play.



1.9.3 When pinfu is not possible

Let us now consider the case where pinfu is not possible with the ryanmen wait. For example, the following hand with ryanmen riichi nomi or bad shape riichi sanshoku.



The round balance for the two choices with varying amounts of dora is listed below.



1. No dora

- 600 points for discarding 
- 1900 points for discarding 

2. 1 dora

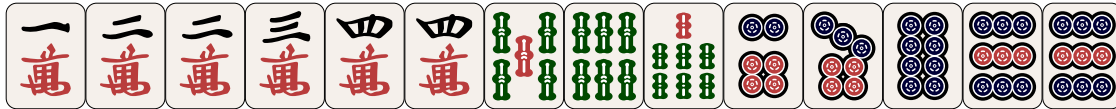
- 1900 points for discarding 
- 2700 points for discarding  (dama round balance is 2600 points)

3. 2 dora

- 3400 points for discarding 
- 3500 points for discarding  (dama round balance is 3700 points)



Thus, with one or fewer dora, choosing bad shape sanshoku is correct. The difference is more subtle with 2 dora. If the choosing the ryanmen wait result in less than 3900 points in confirmed value, take bad shape sanshoku instead.

Next, let us compare riichi pinfu and bad shape riichi iipeikou. Specifically, a hand like the following.



The round balance for the two choices with varying amounts of dora is listed below.

1. No dora


- 1100 points for discarding 
- 800 points for discarding 

2. 1 dora

- 2600 points for discarding 
- 1900 points for discarding  (dama round balance is 2600 points)

3. 2 dora

- 4200 points for discarding 
- 2600 points for discarding  (dama round balance is 2600 points)

The round balance for ryanmen riichi is higher in all cases, so  should be discarded for riichi.

1.10.2 Chiitai dora 2 is a shortcut to haneman

Let us try to explain these results using data and logic. The first reason is that even if you declare riichi, your opponents cannot effectively deny you your winning tile. The fraction of hands won by ron from turns 6 to 10 is 73~77% for dama and 68% for riichi. Regardless of riichi or dama, your winning tile is easily discarded by other players. For this reason, the win rate of riichi is increased, making it more beneficial to riichi.

Next, declaring riichi delays opponents' counterattacks and reduces the chance of successful counterattacks. It is easy to imagine that declaring riichi changes the behaviour of other players. In the usual case of a head start ryanmen riichi, opponents are less likely to counterattack, but are also less likely to discard any winning tiles. However, in this case, declaring riichi delays opponent counterattacks, but winning tiles are not necessarily less likely to be discarded, and so declaring riichi becomes more beneficial.

Lastly, ippatsu, ura dora, and tsumo are rather likely to occur. Upon winning, ippatsu has a 20% chance of occurring, landing ura dora has a 20% chance of occurring, and tsumo has a 30% chance of occurring. The probability of none of these occurring is $0.8 \times 0.8 \times 0.7 = 45\%$. Expect that declaring riichi will result in at least a haneman half the time. As evidence, the expected point gain when winning such a riichi on turn 8 is 10500 points. It is incorrect to think that declaring riichi in this case only increases the value of the hand by 1600 points. In reality, there is a 55% chance of the hand becoming haneman.

With this, the reasons why riichi is beneficial have been considered. Note that, although these results show that honor wait riichi is difficult to play around, the same can be said for 19 wait riichi. Declare riichi aggressively to suppress other players and rake in the points.

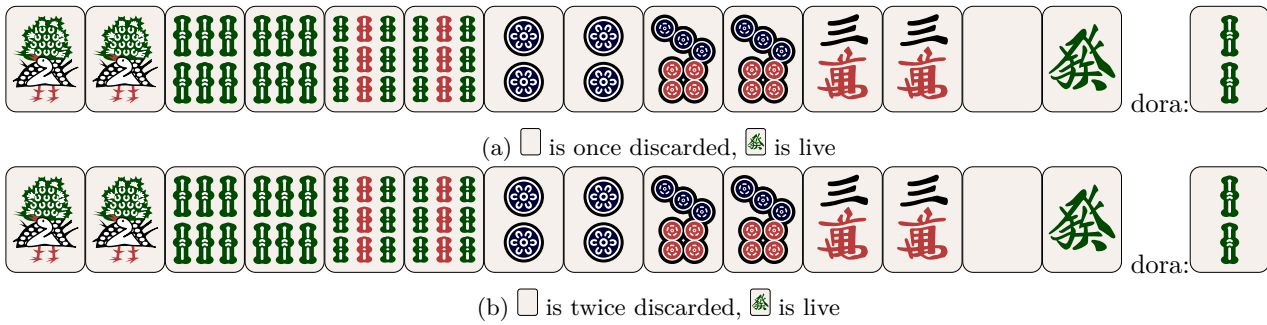


Figure 1.10

1.11 Choose once discarded honors for honor wait tanki

1.11.1 Once discarded honors are superior

When tenpai for chiiroi, there are often cases where a choice has to be made as to which tile to wait on.

In 1.10a, the choice is between a once discarded honor tile and a live honor tile, whereas in 1.10b the choice is between a hell wait (twice discarded) honor tile and a live honor tile. Let us consider how the win rate of honor tanki riichi depends on the number of tiles already discarded to decide what to wait on.

Figure 1.11 shows the dependence honor wait riichi win rate on the number of winning tiles already discarded. Let us now consider the win rate from turns 8 to 12. On turn 8, the win rate is 49% when waiting on a live tile, 58% when waiting on a tile once discarded, and 48% when waiting on a tile twice discarded. Respectively the win rates are 31%, 45%, and 40% on turn 12. From these data, it can be concluded that it is best to choose once discarded tiles for honor tanki. Additionally, excluding riichi declared in the early game, it is disadvantageous to declare riichi waiting on a live tile, thinking that more tiles are available to win on. Therefore, riichi should be declared discarding 緑 from 1.10a.

Next, let us compare live tile tanki waits and hell waits. In the early game, the win rate of live tile tanki is higher. In the mid game, the difference in win rate between the two becomes small (if a choice must be made, prioritize the number of available winning tiles and choose the live tile tanki). On turn 11 and later, the win rate of hell wait tanki becomes higher than live tile tanki. Thus, in the late game, riichi should be declared discarding 緑 from 1.10b, whereas in the early game it is better to declare riichi and discard \square .

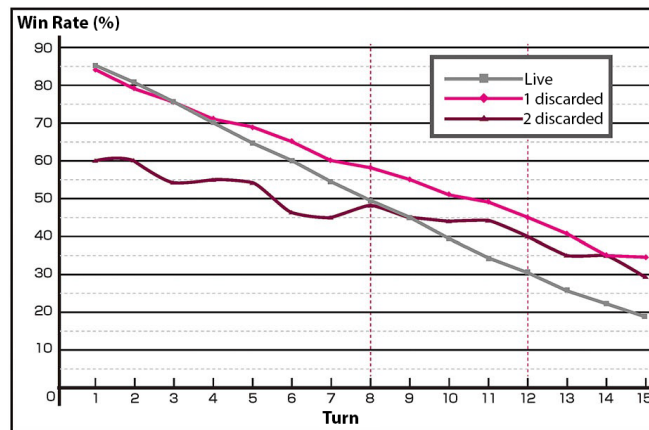


Figure 1.11: Head start honor tanki riichi win rates

Tiles discarded/Turn	Turn 8		Turn 12	
	Ron rate	Ron fraction	Ron rate	Ron fraction
0	33%	66%	18%	59%
1	42%	73%	32%	71%
2	36%	74%	30%	75%

Table 1.10: Head start honor tanki riichi data

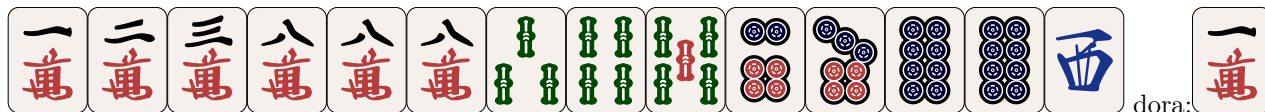
1.11.2 Live honors are unlikely to be in the wall

Now let us try to explain the superior win rate of once discarded honors from game logs.

First, the later it gets in the round, the less likely that live honor tiles will be in the wall. For example, on turn 8, the probability of drawing a winning tile from the wall is 3.3% for a live honor and 3.2% for a once discarded honor, almost identical (the probability for a twice discarded honor is 1.7%). Respectively, on turn 12, the probabilities are 3.4%, 4.0% (and 2.3%); it becomes more likely to draw the once discarded honor.

Next, once discarded honors are more easily discarded by other players than live honors. Table 1.10 shows data regarding win rates and ron probability for honor wait tanki depending on how many tiles have already been discarded. On both turn 8 and turn 12, the ron rate for tanki wait on once discarded honors is higher than that of tanki wait on live honors. As result of these two factors, the win rate for once discarded honor tanki becomes higher than the win rate of live tile tanki in the mid game. Moreover, the win rate for hell wait tanki becomes higher than the win rate of live tile tanki in the late game.

The results of these analyses can also be applied elsewhere; for example, the following hand on turn 12.



If is once discarded, there is plenty of reason to riichi waiting on tanki. Otherwise, if is live, choose the wait without hesitation.

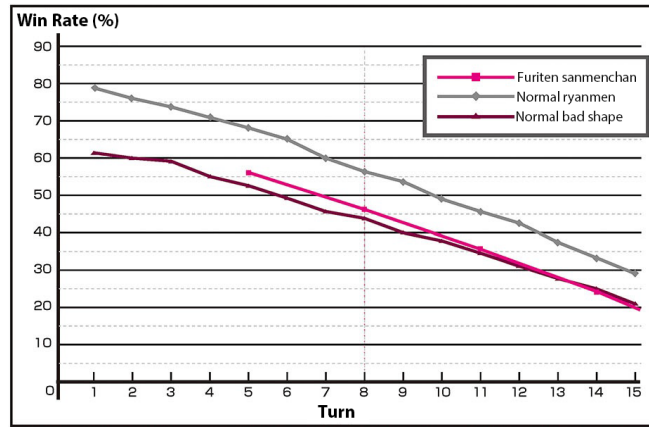


Figure 1.12: Head start furiten sanmenchan riichi win rates

Hand value	Furiten riichi	Normal
40 fu 1han	3200	2800
30 fu 2 han	5800	5000
30 fu 3 han	6800	6300
40 fu 3 han	8400	7600
30 fu 4 han	9800	9100

Table 1.11: Furiten riichi average hand value

1.12 Choose to riichi furiten sanmenchan over bad shape

1.12.1 Furiten sanmenchan riichi and bad shape riichi have similar win rates

When playing mahjong, there are times when the final wait is furiten. The frustrating situation of discarding from penchan and drawing the following turn may also occur. In situations like these, it may also be possible to choose a wait without furiten. For example, by keeping in the following hand.

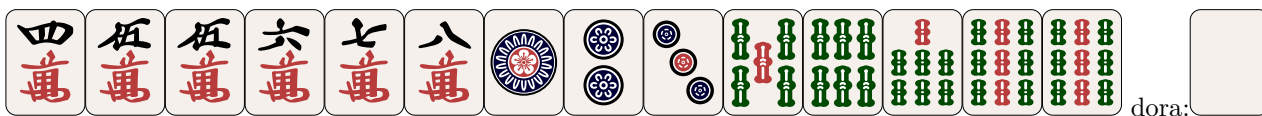


() has previously been discarded from this hand)

Now then, how often does furiten riichi win? In this section the win rate of furiten riichi will be examined to make a judgement on whether to take furiten riichi or not.

Figure 1.12 shows the win rate of furiten sanmenchan riichi. On turn 8, the win rate of furiten sanmenchan riichi is 46%, and the win rate of bad shape riichi is 43%. The win rate of furiten sanmenchan riichi is 3% higher. Moreover, since furiten riichi confirms tsumo, the value of furiten sanmenchan riichi is higher, moreso if choosing the sanmenchan wait allows for pinfu (the expected point gain upon winning a hand in furiten riichi is listed in table 1.11). Thus, in the example above, should be discarded and riichi declared.

Let us consider another example. This time the choice is between furiten sanmenchan and ryanmen (has previously been discarded from the hand).



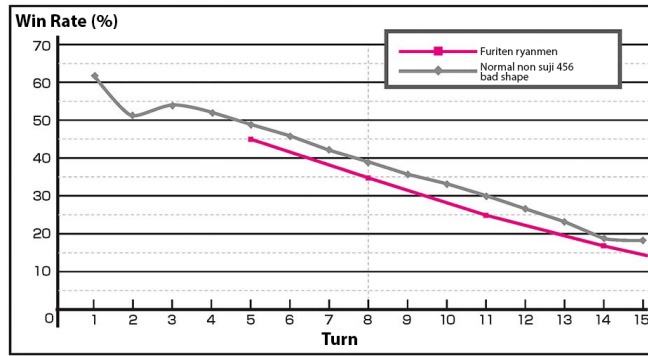
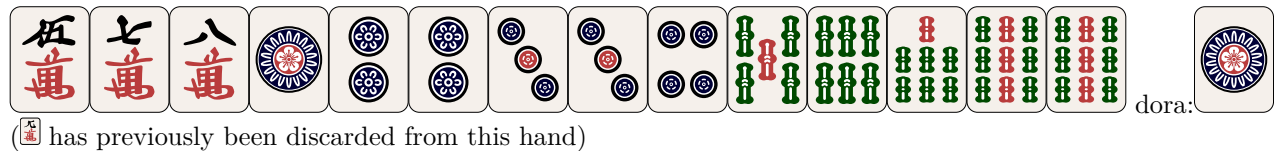


Figure 1.13: Head start furiten ryanmen riichi win rates

On turn 8, ryanmen riichi has a win rate of 57%, whereas furiten sanmenchan riichi has a win rate of 46%, a difference of about 10%. Although furiten riichi is worth more, the increase in value is not dramatic. Thus, in this case should be discarded and riichi declared. As a general rule, furiten riichi should be chosen over bad shape riichi, and ryanmen should be chosen over furiten sanmenchan.

1.12.2 Comparing furiten ryanmen riichi and furiten bad shape riichi

Here furiten ryanmen riichi and bad shape riichi are compared. Specifically, in a hand like the following.

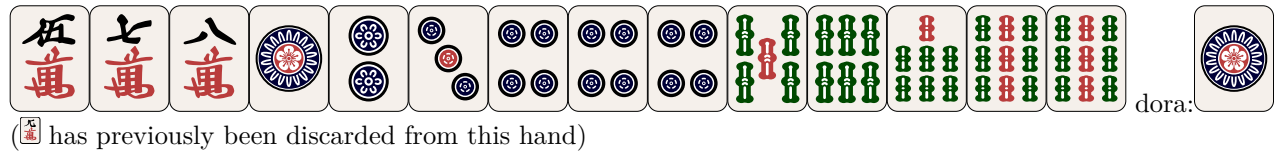


Discarding results in a half suji 456 kanchan wait, whereas discarding results in a furiten ryanmen wait. Which wait should be chosen?

Figure 1.13 shows the win rate of furiten ryanmen riichi and half suji 456 bad shape riichi. On turn 8, kanchan riichi has a win rate of 39%, whereas furiten ryanmen riichi has a win rate of 34%; the win rate for kanchan riichi is higher. Considering just the win rates, it may seem better to discard and declare riichi.

However, in this case, the furiten ryanmen riichi also comes with pinfu. Computing the round balances results in 1000 points for discard riichi and 1300 points for discard riichi, and so discarding is better.

Now let us consider the case where pinfu is not possible. Specifically, consider a hand like the following.




The round balance for either choice is 1000 points. Either choice is acceptable in this case.

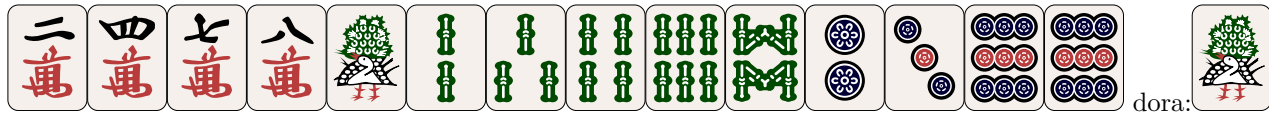
1.12.3 Supplemental


Lastly, let us consider what can be concluded from these results.





First, when a hand contains a furiten sanmenchan shape () after having previously discarded from the hand), it is unnecessary to keep a tile around to enable a bad shape final wait (in this case). Even if the

furiten sanmenchan shape does not complete, declaring riichi waiting on the furiten sanmenchan is still the better choice. Keep a more useful tile (e.g. safe tile or a tile in a complex shape) instead of holding on to .

Additionally, in a hand such as the following,



 has previously been discarded from this hand)

that is 2 shanten or higher, there may be a choice between keeping a furiten ryanmen shape or a kanchan shape, but in this case it is better to keep the furiten ryanmen shape () and discard the kanchan shape (). Furiten ryanmen riichi and kanchan riichi are comparable in win rate and value, so keep the shape that is more likely to complete.

ryanmen > furiten sanmenchan > bad shape = furiten ryanmen

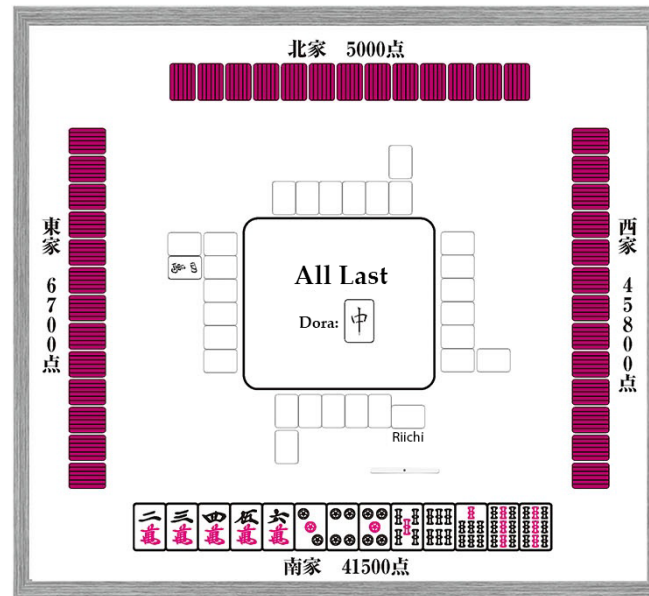


Figure 1.14

Ura count	Probability
0	69.2
1	24.8
2	4.1
3+	1.9

Table 1.12: Ura dora rate (%)



1.13 Bet on ura 1 over tsumo

1.13.1 Choosing between ura 1 and tsumo for sanmenchan riichi

Consider the situation depicted in figure 1.14. At the start of all last, there was a 3300 point difference between you and the first place player. Without a direct hit a 3900 point hand is required to overtake first, with tsumo 700/1300, and with a direct hit a 2000 points hand is required. Additionally, a mangan deal in to anyone does not change placement. Considering just this the current state of the game is a favorable one. In the case of 30/10/-10/-30 uma split, there is an equivalent of 40000 points between placing first and placing second, making first place desirable.

In this situation, you have declared head start riichi with a pinfu only hand on turn 6. Tsumo or a direct hit will place you first. Without a direct hit either ipatsu or ura 1 is required. On turn 8 the dealer discards your winning tile. Ura 1 is required to overtake first if you ron, otherwise tsumo is required if you decline ron (and the hand becomes furiten for the rest of the round). Should ron be declared here?

First, let us consider how often hands land ura dora. Table 1.12 shows the ura dora rate for a mentsu hand (not chiitoe or kokushi). In the case of a normal mentsu hand, the probability of having one or more ura dora is 31%. In other words, declaring ron gives a 31% of taking first. On the other hand, let us consider the win rate when declining ron in hopes of tsumo. Doing so will put the hand in permanent furiten, so it is sufficient to consider the win rate of furiten sanmenchan. Figure 1.15 shows that, on turn 8, furiten sanmenchan riichi has a win rate of 46%. In other words, declining ron in hopes of tsumo gives a 46% chance of taking first. In this case, ron should be declined.

Next, let us consider the case when it is late in the round. The situation depicted in 1.14 had  discarded on turn 8, but suppose that  was instead discarded on turn 11. The probability of landing ura dora and taking

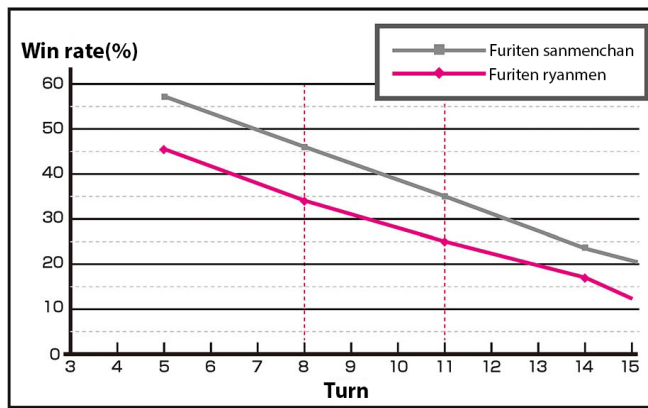


Figure 1.15: Head start furiten riichi win rates

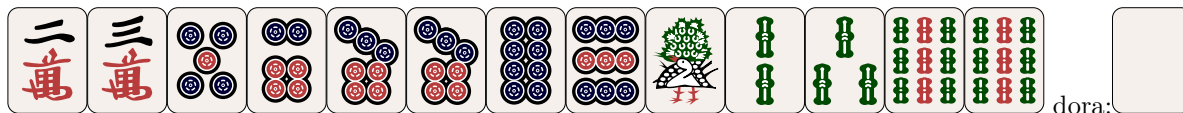
Ura count	Probability
0	50
1	31.1
2	10.8
3+	8.1

Table 1.13: Ura dora rate with 1 kan call(%)

first is 31%. On the other hand, the probability of placing top after declining ron is equivalent to the win rate of a furiten sanmenchan on turn 11—35%. The two options have similar rates of success, and either choice is acceptable if only considering the probability of placing first. However, declaring ron confirms a win, so it is better to declare ron and hope for ura dora in this case.

1.13.2 Ura 1 versus tsumo cutoff in the case of ryanmen

Having considered sanmenchan, what then should be done in the case of ryanmen? Specifically, suppose that the point situation is the same as in 1.14 and your hand is the following.



In this case, the probability of landing ura dora after ron and taking first is 31%. Figure 1.15 shows that the win rate for furiten ryanmen on turn 8 is 35%. The probability of placing first does not differ by much between the two choices, so aim to maximize round balance and declare ron.

Incidentally, if 三萬 is discarded on turn 11, the probability of placing first by declining ron and hoping for tsumo is 25%; declaring ron is clearly the better choice here.

To conclude, declaring ron is better than hoping for tsumo in terms of round balance, so barring a large difference between the success rate of landing ura and tsumo, ron should be declared. Specifically, when in the early game or when in the mid game with sanmenchan, bet on tsumo. Otherwise, in the mid game with ryanmen, or in the late game, declare ron and hope for ura dora.

With one kan call two tiles can become ura dora. A normal mentsu hand in this case has a 50% chance of landing ura dora (Table 1.13). Thus, unless waiting on sanmenchan in the early game, declare ron and hope for ura dora.

Note that the previous discussion had assumed that no opponents were tenpai. In the event of oikake riichi or an opponent making three calls, take the ron and hope for ura dora.

The choice between hoping for *ura dora* and hoping for *tsumo* is not one that arises frequently. It may be uncomfortable to do so, but have faith and hope for *ura*.

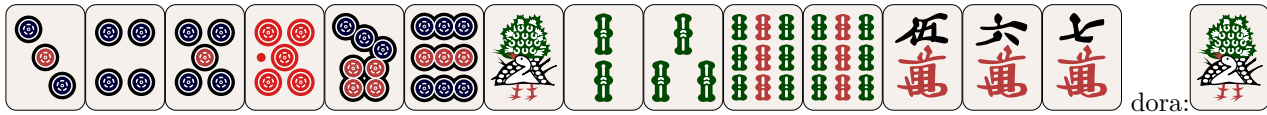
	suji 28 wait					non suji 28 wait
	overall	suji trap overall	aka suji trap	non-aka suji trap	no suji trap	overall
Win rate (%)	55	54	57	54	57	46
Tsumo rate(%)	32	34	34	34	29	47

Table 1.14: Head start suji 28 riichi win rates with 0 tiles visible (turns 5~12)

1.14 Do not hesitate to declare suji trap riichi

1.14.1 Are players cautious of suji traps?

Consider the following hand. or can be discarded for suji trap riichi (where the winning tile is suji to the riichi declaration tile).



How often would such a riichi win?

In *Winning Mahjong With Statistics* (統計で勝つ麻雀), suji trapped tiles are said to not be any safer than their non suji equivalents from the perspective of betaori. Some players may even think that “if this tile was not suji to the riichi tile I would have pushed it, but since it is I’ll just fold here.”

With this in mind, is declaring suji trap riichi with the hand above really a good idea? Let us then consider the win rate of suji trap riichi.

1.14.2 Suji trap 28 riichi win rate is plenty high

Table 1.14 shows the win rate for suji trap 28 bad shape head start riichi with 0 winning tiles visible.

First, the overall win rate of bad shape head start riichi waiting on suji 28 is 55%, similar to ryanmen riichi win rates. Evidently, this is a pretty good wait.

Next, let us consider the win rate of suji trap 28 riichi. The suji trap can be aka suji trap or non aka suji trap, so the two cases will be examined separately. The win rate is 57% for aka suji trap riichi and 54% for non aka suji trap riichi. Incidentally, the win rate for non trapped (the winning tile is suji to a tile other than the riichi declaration tile) is 57%.

The win rate of non aka suji trap riichi is indeed lower. However, the win rate of aka suji trap riichi and non trapped suji 28 riichi is only 3% higher—not particularly large. Moreover, compared to the win rate of a normal non suji 28 bad shape riichi of 46%, the win rate of non aka suji trap riichi is quite a bit higher. Thus, it does not become impossible to win a 28 kanchan wait just because the wait is suji to the riichi tile.

Additionally, although the win of aka suji trap is higher, the value of the hand decreases by 1 han. Thus, should be discarded in this case and riichi declared.

1.14.3 Suji trap 37 riichi win rate is plenty high

Next, let us consider suji trap 37 riichi. For example, what is the win rate if riichi is declared discarding from the hand below?

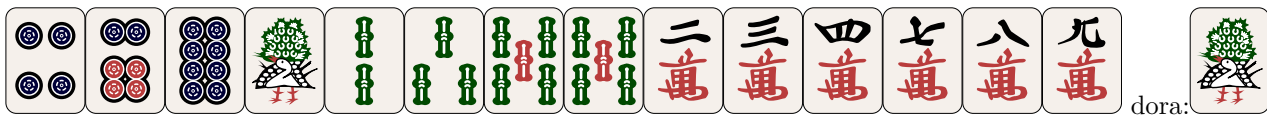


Table 1.15 shows that the win rate is 50% for suji trap 37 riichi and 53% for non trapped suji 37 riichi, a difference of only 3%. Additionally, the win rate of non suji 37 bad shape riichi is 43%. Compared to this, the

	suji 37 wait			non suji 37 wait
	overall	suji trap	no suji trap	overall
Win rate (%)	51	50	53	43
Tsumo rate (%)	36	39	34	52

Table 1.15: Head start suji 37 riichi win rates with 0 tiles visible (turns 5~12)

win rate of suji trap 37 riichi is quite a bit higher. Thus, suji should also be declared in the case of suji trap 37 without hesitation.

It is true that other players are more cautious about discarding riichi to the suji tile—the tsumo rate increases for suji trap bad shape. However, a precipitous drop in win rate does not occur. Have confidence and declare suji trap riichi.

Chapter 2

Push/fold

2.1 Understand what is at risk when dealing in

2.1.1 Be cautious of riichi, honitsu, toitoi, dora pon

This chapter will examine push/fold judgement. Specifically, whether to push or fold a tenpai hand against an opponent's riichi. Before discussing any specific criteria for pushing or folding, let us first consider the what is at risk when dealing in.

Table 2.1 shows the expected point gain upon winning in several different situations. Knowing the expected point gain upon ron allows us to know the expected point loss upon dealing in, and knowing the expected point gain upon winning by tsumo allows us to understand the expected point loss upon opponent tsumo.

Let us consider a few specific point values. Without ippatsu, average value of a riichi hand is 5300 points upon ron (when dealing in this much will be lost), roughly 40 fu 3 han. The probability that a given riichi hand is worth more than 7700 points is 36%. For riichi + ippatsu, the average value 7600 points upon ron, essentially a mangan (the probability of the hand being worth more than 7700 points is 66%). It is clear that dealing in to ippatsu will hurt quite a bit. With riichi there are no doubts that a hand is tenpai, so it is important to have countermeasures for riichi. The tsumo rate serves as an indicator of how cautious players are of a given hand. For riichi the tsumo rate is 49%, much higher than the overall 39% for all hands. Evidently, declaring riichi makes other players much more cautious of dealing in.

Next, the average value of a non dealer honitsu hand is 6600 points upon ron, higher than that of riichi without ippatsu. Since it is easy to identify honitsu from an opponent's discard and it is possible to estimate when a honitsu hand is tenpai, it is important to have countermeasures for honitsu hands as well.

For toitoi, the average value upon ron is 7300 points, higher than both honitsu and toitoi, and so it is best to also be cautious of toitoi. However, despite the average value of toitoi hands being higher than that of honitsu, the tsumo rate of toitoi is still only 35%, so being cautious may be difficult.

In contrast to the previous hands, the average value of open tanyao is 3200 points upon ron and the average

Yaku	Average hand value		Tsumo rate
	tsumo	ron	
Overall	5800	4300	39
Riichi + Ippatsu	9400	7600	49
Riichi (no ippatsu)	7000	5300	49
Honitsu (open)	7200	6600	37
Toitoi (open)	8900	7300	35
Tanyao (open)	3700	3200	34
Yakuhai (no honitsu)	3400	2800	32

Table 2.1: Average non dealer hand value for common yaku. Points from honba and riichi sticks are not included.

Yaku	Average hand value		Tsumo rate
	tsumo	ron	
Overall	8600	6400	43
Riichi + Ippatsu	13700	10900	53
Riichi (no ippatsu)	10000	7500	54
Honitsu (open)	10400	9600	41
Toitoe (open)	12900	10500	38
Tanyao (open)	5300	4700	36
Yakuhai (no honitsu)	5300	4500	36

Table 2.2: Average dealer hand value for common yaku.

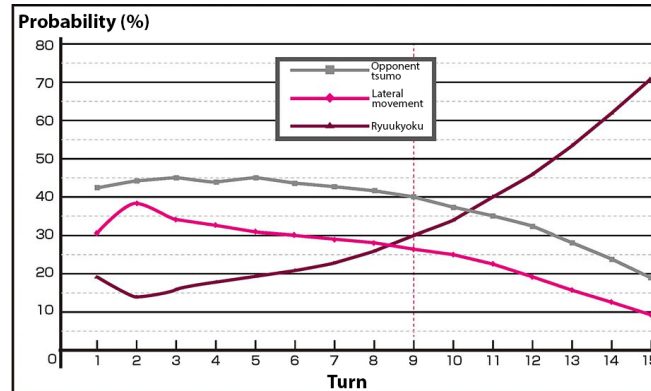


Figure 2.1: Data for betaori against one riichi. The criteria for betaori are having shanten of 3 or higher when a tile is discarded and having 4 or more safe tiles against the opponent in riichi. The probabilities for opponent tsumo, lateral movement, and ryuukyoku do not sum to 100% due to the slight chance of dealing in despite betaori. This case will be treated as lateral movement when calculating round balances.

value of yakuhai when not combined with honitsu or toitoe is 2800 upon ron, both lower than riichi, honitsu, and toitoe. Thus, there is no reason to be afraid of these hands in the absence of dora pon or other special circumstances. The tsumo rate for open tanyao and yakuhai is less than 35% for both. Evidently, these hands draw less caution from other players than riichi or honitsu.

The corresponding data for dealer is shown in table 2.2. As evident from the higher tsumo rate for dealer hands, players tend to be more cautious towards the dealer, but the trends across the common yaku unchanged.

2.1.2 The cost of betaori

Next, let us estimate the round balance when employing betaori against riichi. For simplicity, the deal in rate when choosing to betaori will be assumed to be 0. Figure ?? shows the probabilities of opponent tsumo, lateral movement, and ryuukyoku when betaori against one opponent in riichi.

As the average turns to head start riichi is 8.5, consider the data for turn 9. There is a 40% chance of opponent tsumo, 27% chance of lateral movement, and 30% chance of ryuukyoku. In most cases, betaori results in point loss—only about one out of every four attempts at betaori succeeds in preventing any point loss.

Having understood these data, let us estimate the round balance when choosing to betaori. The average hand value of non dealer riichi + tsumo is 7000 points. As a non dealer, the point loss upon opponent tsumo is then 1800 points. Additionally, from game log analyses, the average point loss when noten at, ryuukoyku is 1200 points. Thus, the round balance when choosing to betaori on turn 9 is -1100 points. The decision to push or fold against non dealer riichi as a non dealer is made depending on whether the round balance of pushing is greater than -1100 points or not. Note that the decision is not based on whether the round balance for pushing or folding is positive or negative.

Next, let us estimate the round balance of betaori against the dealer as non dealer. The average hand value of dealer riichi + tsumo is 10000 points, resulting in a loss of 3400 points, and the round balance of betaori in this case becomes -1700 . The decision to push or fold, then, will be made depending on whether or not pushing a hand will have a round balance that exceeds -1700 points. Lastly, let us estimate the round balance of dealer betaori against non dealer riichi. The average hand value of non dealer riichi + tsumo is 7000 points, resulting in a loss of 3500 points, and so the round balance in this case is -1700 points. Pushing or folding is then decided based on whether or not the round balance for pushing exceeds -1700 points. With these data in mind, let us proceed to discuss push/fold judgement.

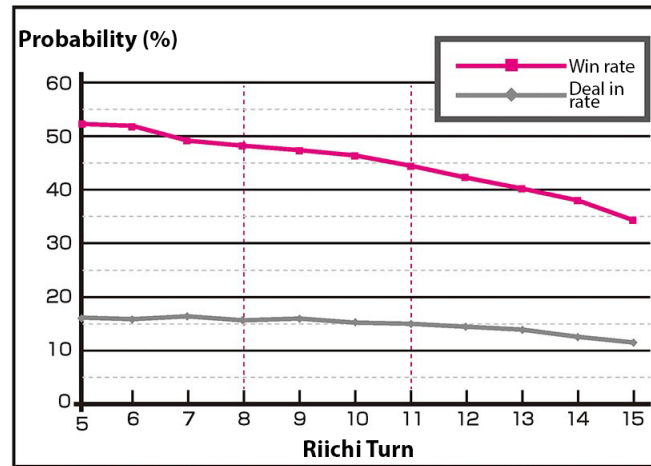


Figure 2.2: Win rate and deal in rate of oikake ryanmen riichi discarding a safe tile. Due to concerns that oikake riichi declared discarding a safe tile might not have enough data, cases where oikake riichi was declared cutting any tile that did not deal in were included in the data used for this plot.

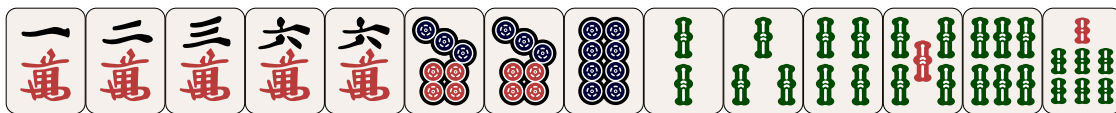
2.2 Do not hesitate to chase with ryanmen tenpai



2.2.1 Chasing with ryanmen tenpai has a fighting chance

The previous section had considered the round balance of betaori. This section the specifics of pushing and folding will be examined through the respective round balances of each choice. Let us first consider push/fold judgement in the case of oikake ryanmen tenpai. To start, let us consider just how often oikake ryanmen riichi wins and how often it deals in. Figure 2.2 shows statistics for win rate and deal in rate for oikake ryanmen riichi declared discarding a safe tile collected from game logs.

From 2.2, the win rate of chasing in this case is 49% and the deal in rate is 16%. On average, oikake riichi is declared on turn 11, with a 44% win rate and 15% deal in rate. Evidently, with ryanmen tenpai and a safe tile to discard, oikake riichi can be declared rather aggressively.

However, it is more likely in reality that an unsafe tile must be discarded to call oikake riichi. Let us also examine the win rate and deal in rate in this case. Suppose that the following hand has reached tenpai on turn on turn 11, but an opponent has already declared riichi.



The unsafe tile  must be discarded to declare riichi. Let us calculate the win rate of discarding  and declaring oikake riichi using previous data. On turn 11, non suji 37 has a danger level (the probability of dealing in when discarding the tile) of 10%, so win rate calculations will be done assuming a 10% danger level tile will be discarded for riichi.

The results of these calculations are shown in figure 2.3. On turn 11, there is a 40% win rate and 24% deal in rate, more than good enough to put up a fight for. Additionally, the probability of dealing in upon declaring riichi and the probability of dealing in after declaring riichi are similar (10% upon declaring riichi and 14% after). Evidently, the deal in rate is not all that high if the riichi declaration tile passes.

2.2.2 In general, push against non dealer riichi

Let us then examine round balances and create some specific rules for pushing and folding. Table 2.3 shows the round balances for declaring oikake riichi from ryanmen tenpai. The data used to calculate these round balances

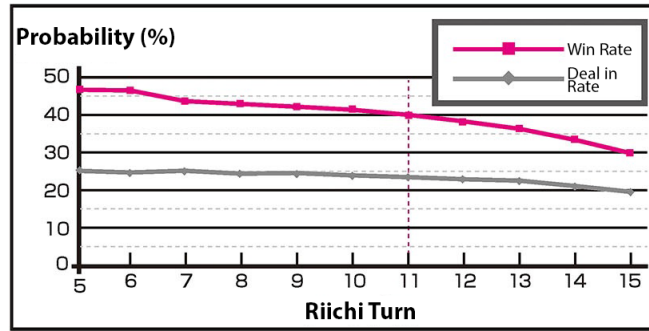



Figure 2.3: Win rate and deal in rate of oikake ryanmen riichi discarding a 10 % danger level tile

Riichi value/Turn	Turn 8		Turn 11		Turn 14		Average points
	safe tile	10% tile	safe tile	10% tile	safe tile	10% tile	
40 fu 1 han	200	-400	100	-500	100	-500	3900
30 fu 2 han	700	100	500	-100	500	-100	4900
40 fu 2 han	1300	600	1100	400	900	300	6100
30 fu 3 han	1900	1200	1700	1000	1400	800	7500
40 fu 3 han	2400	1600	2100	1400	1800	1100	8500
30 fu 4 han	3200	2300	2800	2000	2400	1700	10100
40 fu 4 han	3200	2400	2900	2000	2500	1700	10200

Table 2.3: Non dealer oikake ryanmen riichi vs non dealer riichi round balance. Average points takes into account the opponent's riichi bet. Average ryuukyoku point gain is 300 points. 10% tile data are for the case where a 10% danger level tile is discarded for riichi.

are shown in table 2.4.

First, let us consider the round balance for declaring riichi in the scenario proposed with the previous hand. The hand is worth 30 fu 2 han. In this situation (turn 11, 30 fu 2 han, 10% danger level tile) the round balance is -100 points. At first glance, a round balance of -100 points may suggest that both folding and pushing are acceptable, but the round balance of choosing to betaori is -1100 points; there is a 1000 point difference between choosing to push and choosing to fold. Thus,  should be discarded and riichi declared with the previous hand.

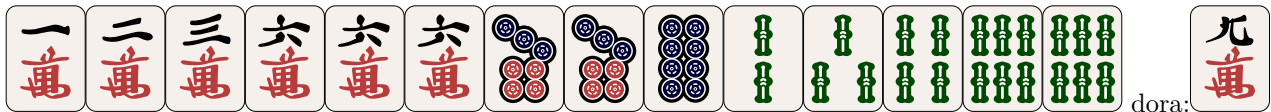
Let us consider another example.

Data used to compute round balances	Turn 8		Turn 11		Turn 14	
Riichi tile danger level	safe tile	10% tile	safe tile	10% tile	safe tile	10% tile
Win rate (%)	49	44	44	40	38	34
Tsumo rate upon win (%)	43	43	42	42	40	40
Ippatsu rate upon win (%)	27	27	30	30	36	36
Deal in rate (%)	16	24	15	24	13	21
Opponent tsumo rate (%)	22	20	22	19	20	18
Lateral movement rate (%)	10	9	11	10	10	9
Riichi bet lost rate (%)	48	43	45	43	43	38
Ryuukyoku rate (%)	3	3	8	7	19	18

Table 2.4: Oikake ryanmen riichi data. 10% tile refers to 10 % danger level tiles

Riichi value/Turn	Turn 8		Turn 11		Turn 14		Average points
	safe tile	10% tile	safe tile	10% tile	safe tile	10% tile	
40 fu 1 han	-500	-1500	-600	-1300	-500	-1200	3900
30 fu 2 han	0	-800	-200	-900	-100	-900	4900
40 fu 2 han	600	-300	400	-400	300	-500	6100
30 fu 3 han	1200	400	1000	100	800	0	7500
40 fu 3 han	1700	800	1400	500	1200	400	8500
30 fu 4 han	2500	1500	2100	1200	1800	900	10100
40 fu 4 han	2500	1500	2200	1200	1900	900	10200

Table 2.5: Non dealer oikake ryanmen riichi vs dealer riichi round balance

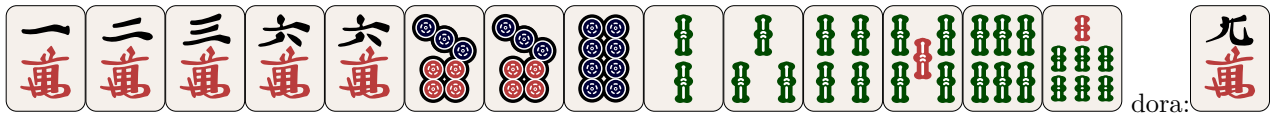


This hand is riichi only. Is pushing correct in this case? From Table 2.3 (40 fu 1 han, turn 11, 10% danger tile), the round balance for pushing is -500 points, 600 points more than the round balance for choosing to betaori. Thus in this case riichi should also be declared. Some may think, “wait, isn’t a riichi nomi hand worth only 1300 points?” However, with ippatsu (roughly 30% chance), ura dora, tsumo, and the opponent’s riichi bet, the average point gain upon winning for riichi nomi is 3900, a rather significant amount. Therefore, barring any special circumstances, oikake riichi should be declared against non dealer riichi if in ryanmen tenpai. Fear not the deal in and declare riichi aggressively.

2.2.3 In general, also push against dealer riichi

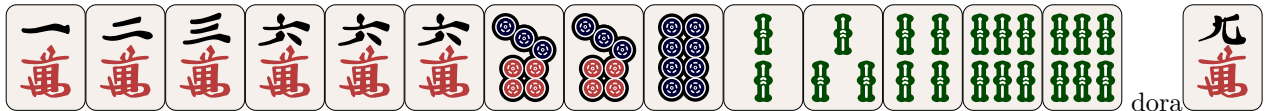
Now then, what should be done when facing dealer riichi? Round balances for specific cases are listed in table 2.5.

First, suppose tenpai has been reached as non dealer on turn 11 with the following hand.



This hand is riichi + pinfu. Considering that the opponent is dealer and that dealing in results in a roughly 1.4 times larger point loss than dealing into a non dealer opponent, it may seem scary to deal in. However, the round balance for declaring riichi in this case is -900 points, 800 points higher than that of choosing to betaori (the opponent is the dealer, so the round balance for betaori is -1700 points). Thus, riichi should be declared in this case.

What about, a riichi nomi hand then? For example, the following hand.



The round balance for pushing in this case is -1300 points (turn 11, 10% danger level, 40 fu 1 han), 400 points higher than that of choosing to betaori. Thus, riichi should also be declared in this case. Indeed, it is painful to deal in to dealer riichi, but betaori is correct only in cases such as riichi nomi having to discard non suji 456, riichi nomi having to discard no suji 2837 when dora or at risk of ippatsu.

To conclude, against one other riichi as non dealer, it is worth fighting with ryanmen riichi when the value of your own riichi is worth at least a third of that of your opponent’s riichi (5300 for non dealer, 7500 for dealer).

Riichi value/Turn	Turn 8		Turn 11		Turn 14		Average points
	safe tile	10% tile	safe tile	10% tile	safe tile	10% tile	
40 fu 1 han	500	-100	300	-200	300	-300	5300
30 fu 2 han	1200	600	1000	400	800	200	6800
40 fu 2 han	2100	1400	1800	1100	1500	800	8600
30 fu 3 han	3100	2300	2700	1900	2300	1500	10700
40 fu 3 han	3800	2900	3400	2500	2900	2100	12200
30 fu 4 han	5000	4000	4500	3500	3800	2900	14700
40 fu 4 han	5100	4100	4500	3500	3900	2900	14800

Table 2.6: Dealer oikake ryanmen riichi vs non dealer riichi round balance

Riichi value (-1 han if dama)	Turn 8		Turn 11		Turn 14		Dama average points
	riichi	dama	riichi	dama	riichi	dama	
40 fu 1 han	-400		-500		-500		
30 fu 2 han	100	-600	-100	-600	-100	-500	2600
40 fu 2 han	600	-500	400	-500	300	-300	3600
30 fu 3 han	1200	-200	1000	-200	800	-100	4200
40 fu 3 han	1600	200	1400	200	1100	200	5400
30 fu 4 han	2300	800	2000	600	1700	600	7300
40 fu 4 han	2400	1200	2000	1000	700	900	8800

Table 2.7: Oikake riichi vs oikake dama round balance. Danger level of tile discarded for riichi assumed to be 10%.

When in ryanmen tenpai against another riichi, declare oikake riichi aggressively even with many safe tiles.

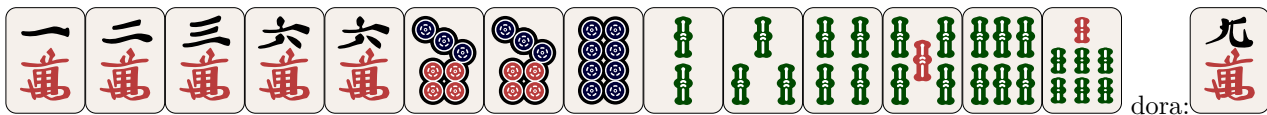
Additionally, even less thought should be put into declaring riichi as dealer. Table 2.6 shows the round balance for chasing as dealer.

As dealer, the average point gain upon winning is higher and the point loss when choosing to betaori larger, it is best to declare riichi aggressively. Moreover, the round balance calculations here were done assuming betaori is always successful, and even then it is better to riichi; if it is uncertain whether betaori will be successful or not it is even better to riichi.

2.2.4 Riichi versus dama

Before, the choice between oikake riichi and betaori was considered. On the other hand, there may be cases where a hand already has a yaku and a choice can be made between oikake riichi and damaten. Here the choice between oikake riichi and dama will be compared. Often a dama hand will be pushed against riichi with no intention of folding, so the corresponding deal in and win rate statistics for riichi will be used in round balance calculations.

Table 2.7 shows the round balance for nondealer oikake riichi and dama. The round balance for riichi exceeds that of dama in all cases. For example, consider the following hand on turn 11.



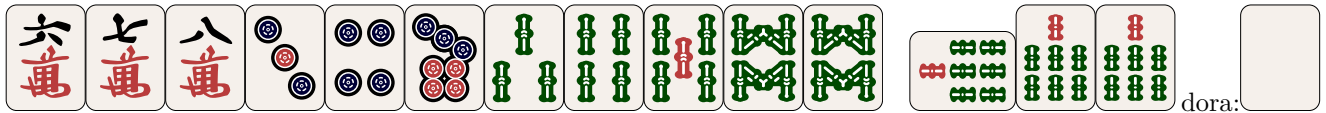
The round balance is -100 points for riichi and -600 points for dama, 500 points higher in the case of riichi. Riichi should thus be declared to earn more points. It is clear that there is no reason to worry about dama. Riichi aggressively.

The round balance for pushing a tenpai open hand against riichi is shown in table 2.8. Generally it is also correct to push with open hands.

Player	Opponent	Value	Turn 8		Turn 11		Turn 14		Average points	Betaori
			safe	10%	safe	10%	safe	10%		
Non dealer	Non dealer	30 fu 1 han	-200	-700	-200	-700	0	-500	2000	-1100
Non dealer	Non dealer	30 fu 2 han	300	-300	200	-300	400	-200	3000	-1100
Non dealer	Non dealer	30 fu 3 han	1200	500	1100	400	1100	400	4900	-1100
Non dealer	Non dealer	30 fu 4 han	3000	2200	2800	2000	2500	1700	8700	-1100
Non dealer	Dealer	30 fu 1 han	-900	-1600	-900	-1500	-600	-1300	2000	-1700
Non dealer	Dealer	30 fu 2 han	-400	-1100	-400	-1100	-200	-1000	3000	-1700
Non dealer	Dealer	30 fu 3 han	500	-300	400	-400	500	-300	4900	-1700
Non dealer	Dealer	30 fu 4 han	2300	1300	2100	1100	1900	1000	8700	-1700
Dealer	Non dealer	30 fu 1 han	-600	-1100	-600	-1000	-400	-800	2500	-1700
Dealer	Non dealer	30 fu 2 han	-100	-600	-100	-600	0	-500	3900	-1700
Dealer	Non dealer	30 fu 3 han	800	200	700	100	700	100	6800	-1700
Dealer	Non dealer	30 fu 4 han	2700	1900	2400	1600	2200	1400	12700	-1700

Table 2.8: Open ryanmen tenpai vs riichi push/fold round balance. Win rates used to calculate these results are taken from riichi win rate statistics.

For example, the round balance for pushing the following hand against riichi is -700 points.



Even a 1000 point hand puts up a good fight. With ryanmen tenpai, push aggressively even if the hand is open.

2.2.5 How to use the round balance tables (autism)

Lastly is a supplement on how to use the round balance tables. First, the tables list the round balance in the cases of discarding a 10% danger level tile and a safe tile. However, non suji 2837 and safe tiles are not the only tiles that may be discarded to call riichi. Additionally, there may be cases where declaring riichi deals into ippatsu or dora must be discarded to fight. In these cases, the round balance can be computed with (2.1).

$$\begin{aligned} \text{round balance when discarding 5\% tile} &= (\text{round balance when discarding safe tile} \\ &\quad + \text{round balance when discarding 10\% tile})/2 \end{aligned} \quad (2.1a)$$

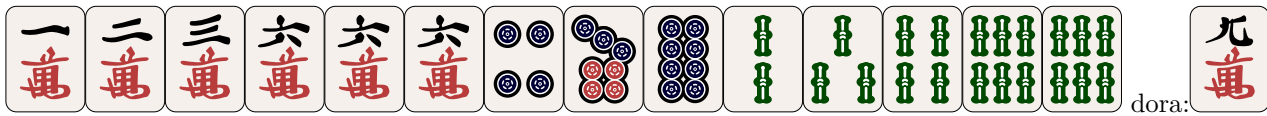
$$\begin{aligned} \text{round balance when discarding 15\% tile} &= \text{round balance when discarding 10\% tile} \\ &\quad - (\text{round balance when discarding safe tile} \\ &\quad - \text{round balance when discarding 10\% tile})/2 \end{aligned} \quad (2.1b)$$

$$\begin{aligned} \text{round balance if chasing on ippatsu turn} &= \text{round balance without opponent ippatsu} \\ &\quad - (\text{ippatsu deal in point loss} - \text{non ippatsu deal in point loss})^1 \\ &\quad \times \text{danger level of tile discarded} \end{aligned} \quad (2.1c)$$

The round balance when chasing and discarding a 5% danger level tile, specifically suji 2837, can be computed with (2.1a), and the round balance when declaring chasing and discarding a 15% danger level tile, specifically non suji 456, can be computed (2.1b).

For example, suppose that the following hand has reached tenpai on turn 11, but the dealer has already declared riichi more than 2 turns ago.

¹point difference is 2300 for non dealer and 3400 for dealer



Using (2.1b), the round balance for discarding 二 and declaring riichi is

$$-1300 - \frac{1}{2}(-600 - (1300)) = -1650$$

fairly close to the -1700 points for betaori, a hand not worth pushing aggressively.

The round balance for pushing on the ippatsu turn can be calculated with the following steps. When the opponent is not the dealer, dealing in to ippatsu increases the expected point loss from 5300 to 7600. Thus when discarding a 10% danger level tile for riichi, deducting 230 points, 10% of the 2300 point difference between the point loss for ippatsu and no ippatsu deal in, from the round balance for pushing in the case of no ippatsu yields the round balance in the case where dealing in results in ippatsu. Similarly, if the opponent is the dealer, dealing in to ippatsu increases the expected point loss from 7500 to 10900. Deducting 340 points, 10% of the 3400 point difference, from the round balance when not at risk of ippatsu results in the round balance. The same process can be applied for when the tile discarded for riichi is dora.

Like this, round balance values that were not listed in the tables can also be calculated. Don't stop at merely memorizing the basic rules; learn to use the data as needed in response to different situations.

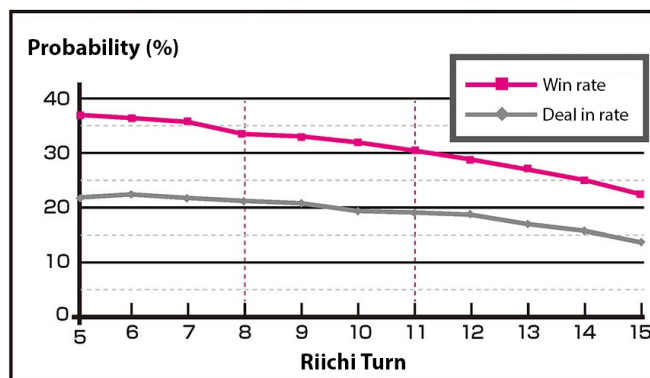


Figure 2.4: Win rate and deal in rate of oikake bad shape riichi discarding a safe tile

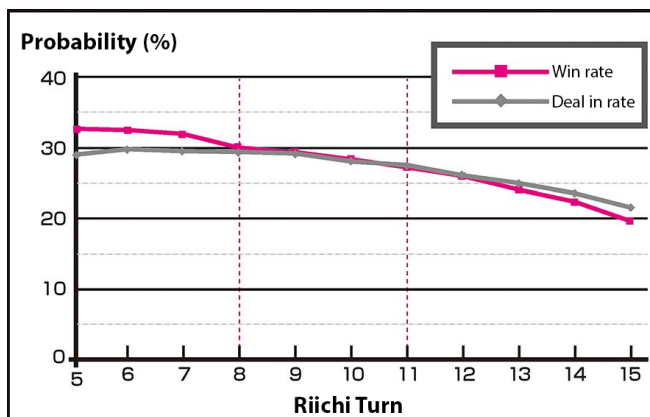


Figure 2.5: Win rate and deal in rate of oikake bad shape riichi discarding a 10% danger level tile

2.3 Even with bad shape tenpai, chasing is okay with 1 dora

2.3.1 Win rate with bad shape tenpai drops significantly

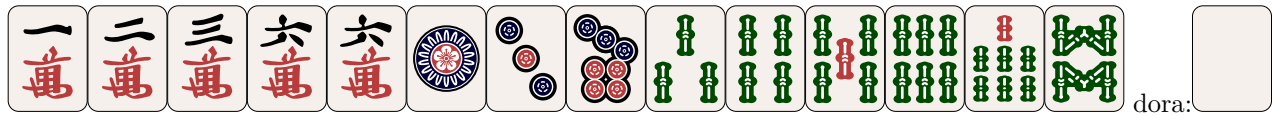
The previous section had discussed push/fold judgement with oikake ryanmen riichi. This section concerns push/fold judgement with oikake bad shape riichi. First, let us examine how often oikake bad shape riichi wins and how often it deals in. Figure 2.4 shows the probabilities for these two cases, computed using data collected from game logs.

On turn 8, oikake bad shape riichi has a 33% win rate and a 21% deal in rate. On turn 11, the win rate is 31% and the deal in rate is 19%. From these data, it seems that chasing with every bad shape tenpai is inadvisable. This is for the case of declaring riichi discarding a safe tile. As with the case of oikake ryanmen riichi, let us also consider the win rate when declaring riichi discarding a non suij tile. Figure 2.5 shows the win rate of oikake bad shape riichi assuming a 10% danger level tile was discarded, computed using the same data as before. On turn 8, the win rate is 30%, the deal in rate is 29%. On turn 11, the win rate is 28% and the deal in rate is 27%. About one out of every four attempts will result in a win, and the deal in rate is about the same as the win rate. Evidently, oikake bad shape riichi does not win very often. Keep this in mind.

2.3.2 2 han is barely worth pushing, 3 han is definitely worth pushing

Now that the win rate of oikake bad shape riichi is known, let us consider the round balance specifics and determine the criteria for pushing and folding. Table 2.9 shows the round balance for chasing with bad shape tenpai under various circumstances. These results are tabulated assuming that the first riichi occurred two or

Lastly, consider this hand.

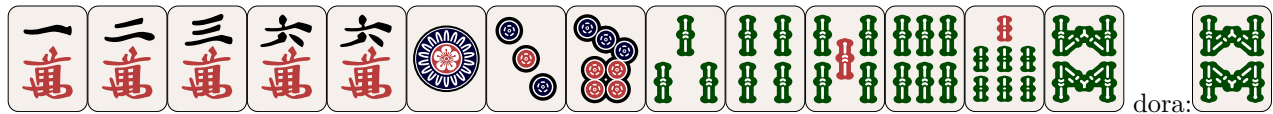


Now this hand is worth 1 han. Chasing in this case has a round balance of -1300 points, which is 200 points lower than the round balance for choosing to betaori. In this case it is best to quietly retreat.

To conclude, in general, with 1 han fold, with 2 han maybe push, with 3 han definitely push.

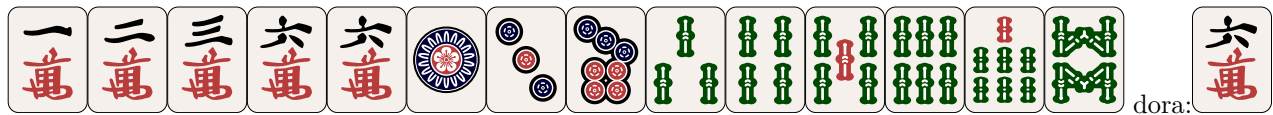
2.3.3 Against dealer riichi, 2 han is also barely worth pushing

Now let us consider the case of dealer riichi. The dealer has declared riichi and your hand is the following. Should you push?



The round balance for this case (nondealer vs dealer, 40 fu 2 han, turn 11, 10% danger level tile discarded for riichi) is -1600 points for chasing and -1700 points for betaori. The round balance for chasing is 100 points higher, so it is barely worth chasing in this case. However, there is only a 100 point difference, the correct decision may change depending on the exact situation of the game. With a good lead, it is better to betaori and not take unnecessary risks.

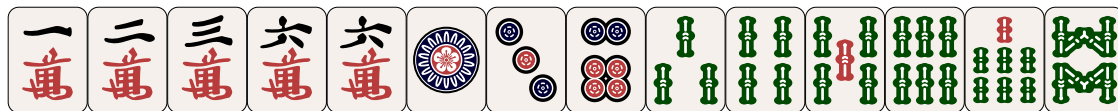
Next, what about the case of 2 dora?



This hand is worth 3 han. The round balance in this case is -900 points for chasing and -1700 points for betaori, 800 points higher for chasing. Thus, in this case it is best to push aggressively.

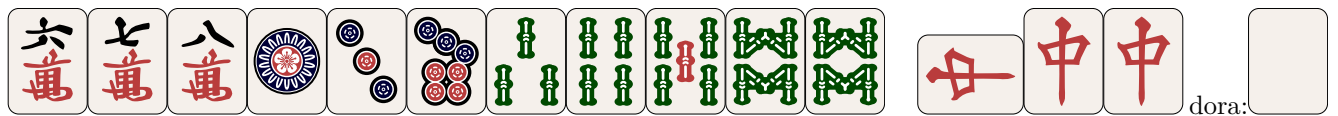
To conclude, against one other riichi as non dealer, it is worth fighting when your own hand is at least 2/3 the value of your opponent's. The win rate of bad shape riichi is indeed not very high, but it is best to be aggressive and try and win if a hand has 3 or more han.

As the dealer, excluding hands like



i.e. non suji 456 must be discarded for riichi nomi, it is generally correct to chase; there is no need to think too much.

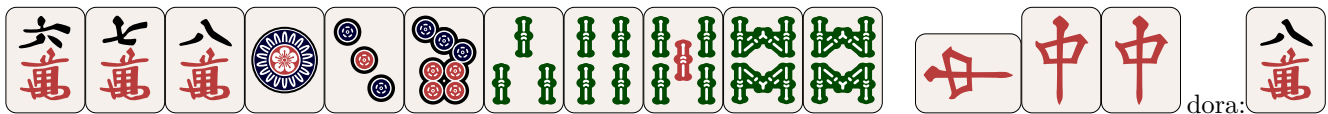
The round balance for open bad shape tenpai is shown in table 2.11. In short, on turn 11, fold with a 1 han hand, for example,



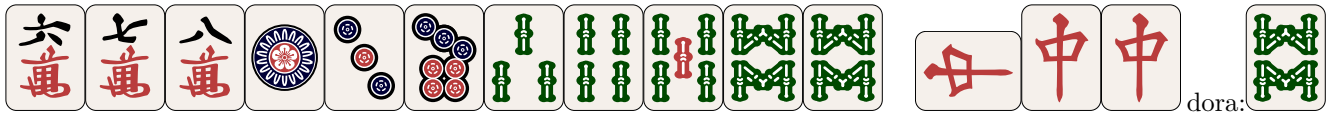
push against non dealer with a 2 han hand, for example,

Player	Opponent	Value	Turn 8		Turn 11		Turn 14		Average points	Betaori
			safe	10%	safe	10%	safe	10%		
Non dealer	Non dealer	30 fu 1 han	-800	-1300	-700	-1100	-400	-900	2000	-1100
Non dealer	Non dealer	30 fu 2 han	-500	-1000	-400	-800	-100	-700	3000	-1100
Non dealer	Non dealer	30 fu 3 han	100	-400	200	-300	300	-200	4900	-1100
Non dealer	Non dealer	30 fu 4 han	1400	700	1400	700	1300	600	8700	-1100
Non dealer	Dealer	30 fu 1 han	-1700	-2300	-1500	-2100	-1100	-1700	2000	-1700
Non dealer	Dealer	30 fu 2 han	-1400	-2000	-1200	-1800	-800	-1500	3000	-1700
Non dealer	Dealer	30 fu 3 han	-700	-1400	-600	-1300	-400	-1100	4900	-1700
Non dealer	Dealer	30 fu 4 han	500	-300	600	-200	600	-200	8700	-1700
Dealer	Non dealer	30 fu 1 han	-1300	-1700	-1100	-1500	-800	-1200	2500	-1700
Dealer	Non dealer	30 fu 2 han	-900	-1400	-800	-1200	-500	-1000	3900	-1700
Dealer	Non dealer	30 fu 3 han	-300	-800	-200	-700	0	-600	6800	-1700
Dealer	Non dealer	30 fu 4 han	1000	300	1000	300	900	300	12700	-1700

Table 2.11: Open bad shape tenpai vs riichi push/fold round balance



and push even against dealer with a 3 han hand, for example,



2.3.4 Supplement

Some may think that results recommend pushing too often. This is a common point of discussion between researchers. For example, the round balance results suggest that against non dealer riichi, discarding a safe tile and declaring 1300 point riichi is good to fight with, and that discarding a 10% tile and declaring 2600 point riichi is good to fight with. The reason that these choices have rather high round balances is that despite these hands only having 1300 and 2600 points in confirmed value, the expected point gain upon winning is actually rather high. For example, even with a 1300 point hand, after accounting for ippatsu, ura dora, tsumo, and the opponent's riichi stick, the expected point gain upon winning is 3800 points. With a 2600 point hand, the expected point gain upon winning is 5900 points. In particular, the average point gain upon winning a 2600 point hand is comparable to that of non dealer riichi. Therefore, judging 1300 and 2600 point hands by their confirmed value for pushing and folding leads to inaccurate decisions.

Additionally, some may think to first dama with a 1300 or 2600 point hand and retreat if a dangerous tile is drawn. However, even when choosing to dama, the point gains over declaring riichi are insignificant (according to NISI research). Thus, instead of half heartedly choosing to dama, it is better to aim to increase your own points and declare riichi.

On the other hand, these round balance calculations are based on expected values. When the difference between round balances for pushing and folding is small, and when there are foreseeable deviations from expected values, it is also acceptable to adjust push/fold judgement to prioritize the situation of the game. For example, with a 2 han bad shape hand, the specific situation of the match becomes important when considering whether to push or fold. After having mastered the general rules, account for the situation of the game when making the decision to push or fold.

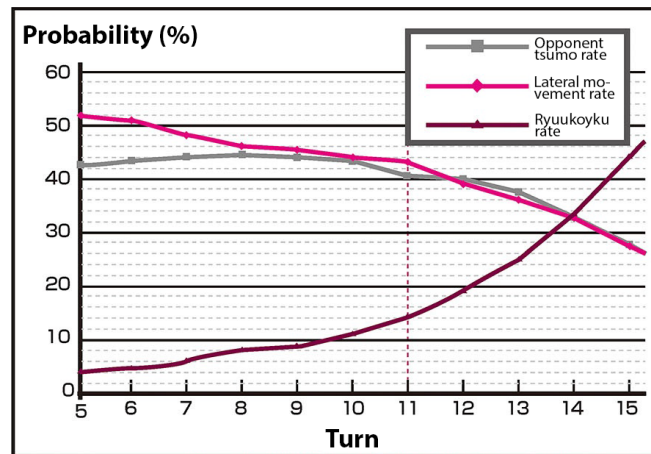


Figure 2.6: Data for betaori against two riichi. The percentages don't sum to 100% because there is a slight chance of dealing while betaori. The probability of dealing in is considered as probability of lateral movement in round balance calculations.

2.4 Against two riichi, pray for lateral movement

2.4.1 With two riichi, lateral movement rate is rather high

Now push/fold judgement against two opponents in riichi will be considered. First the round balance of betaori will be examined. Data for opponent tsumo rate, lateral movement rate, and ryuukyoku rate as a function of turn are shown in figure 2.6.

Let us consider the specific case of turn 11. There is a 41% chance of opponent tsumo, 43% chance of lateral movement, and 14% chance of ryuukyoku. About 40% of the time lateral movement occurs and point loss can be avoided. When choosing to betaori against one opponent riichi, the rate of opponent tsumo is 22%. The probability of avoiding point loss is therefore higher when betaori against two opponent riichi. This is because with two opponents in riichi, both will continuously discard dangerous tiles, and the probability that one will get hit by the other is high, as opposed to when only one opponent is in riichi, where opponent tsumo and ryuukyoku are more likely.

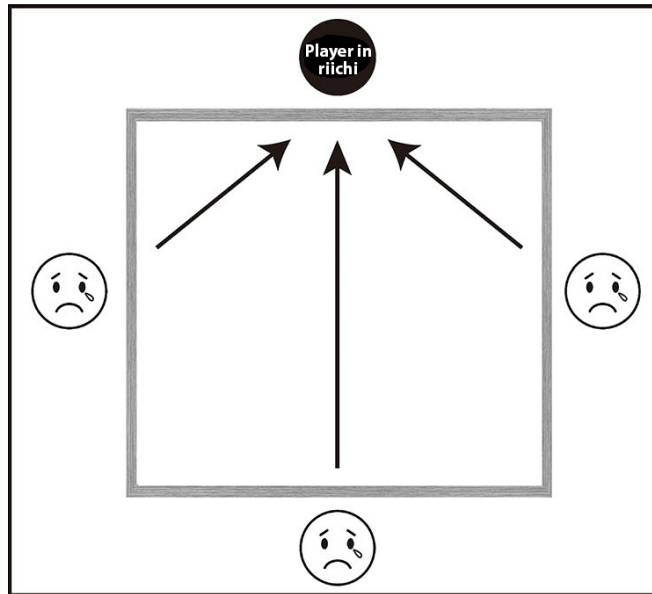
Next, let us compute the round balance for betaori against two non dealer riichi. The average point loss upon opponent tsumo is -1800 points, and the average point loss upon ryuukyoku is -1600 points (these data are collected from game logs). The round balance is then -1000 points, similar to the round balance of betaori against a single opponent. Evidently, the round balance for successfully folding is similar regardless of whether folding against one riichi or two.

Additionally, the round balance for betaori when both the dealer and another non dealer have declared riichi is -1300 points, higher than the round balance when only the dealer has declared riichi. Since either the dealer or a non dealer can win, the average point loss upon opponent tsumo drops from 3400 points to 2600 points.

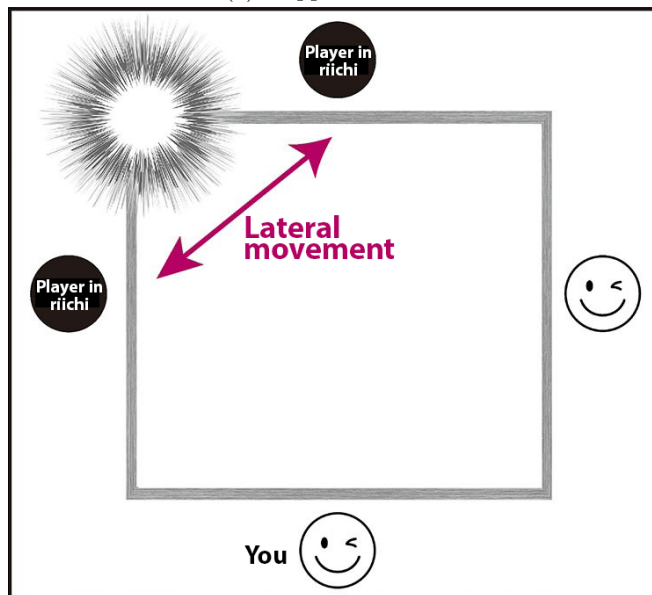
As dealer, betaori against two non dealer riichi has a round balance of -1700 points, again similar to the round balance of betaori against one nondealer as dealer.

Thus the round balance for betaori against two riichi is similar to the round balance for betaori against one riichi. However, pushing an iishanten hand requires discarding dangerous tiles against not one but two players, doubling the risk of dealing in. Against two riichi, it is safer to not try to counterattack from iishanten. Wait for lateral movement when one of the players falls.

With this, the round balance for betaori against two opponents in riichi has been made clear. In the next section the round balance for pushing against two opponents in riichi will be examined and the criteria for pushing and folding will be set.



(a) 1 opponent riichi



(b) 2 opponent riichi

2.5.2 Oikake ryanmen tenpai: answers

Question 1



discard and riichi

Riichi + pinfu ryanmen tenpai. The round balance is 100 points for chasing and -1100 points for betaori, 1200 points higher in the case of chasing. Declare riichi at the speed of sound. Riichi should be declared even if was instead non suji (-200 point round balance).

Question 2



discard and riichi

Riichi + pinfu ryanmen tenpai. The round balance is -200 points for chasing and -1700 points for betaori, 1500 points higher in the case of chasing. Thus, don't worry and declare riichi. Damaten is another choice, but the deal in rate for riichi is 15% and if won the average point gain is 4900. Fear not and advance.

Question 3

Betaori

Ryanmen tenpai for riichi nomi. Caution is necessary when trying to pass a non suji middle tile against dealer riichi. In this case applying (2.1b) gives a round of -1650 points, not much different from the round balance of choosing to betaori. Thus, don't risk it and choose to betaori here.

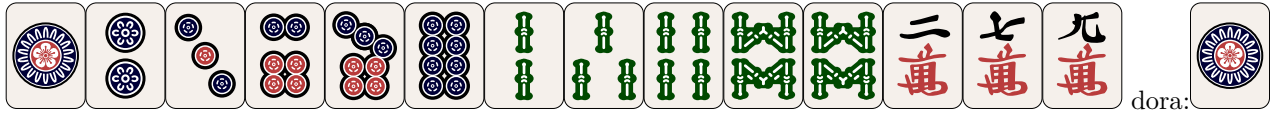
Question 4

Betaori

nomi ryanmen tenpai. Calculating the round balance (deduct 340 points for the normal round balance of -1500 points when facing dealer riichi) gives -1850 points, lower than the round balance of betaori. Discard the safe tile and betaori.

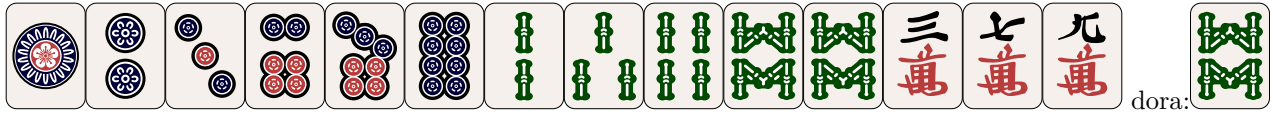
2.5.3 Oikake bad shape tenpai

Question 1: non dealer, turn 8, first riichi is from non dealer



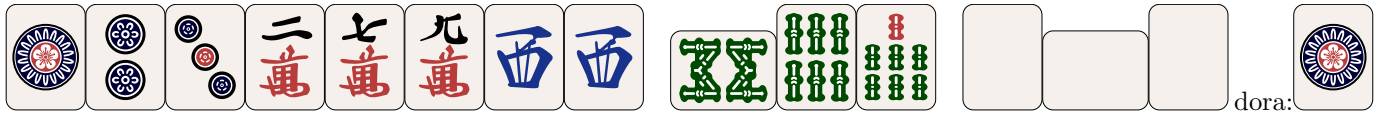
(First riichi was declared at least 2 turns ago, 西 is non suji)

Question 2: non dealer, turn 11, first riichi is from non dealer



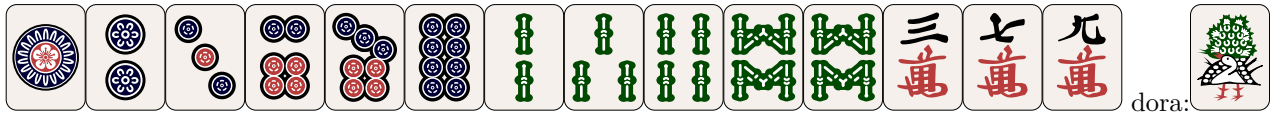
(Dealing in results in ippatsu, 西 is non suji)

Question 3: non dealer, turn 11, first riichi is from non dealer



(First riichi was declared at least 2 turns ago, 西 is safe, 西 is non suji)

Question 4: non dealer, turn 8, first riichi is from dealer



(First riichi was declared at least 2 turns ago, 西 and 西 are safe, 西 is non suji)

2.5.4 Oikake bad shape tenpai: answers

Question 1



discard and riichi

Dora 1 kanchan tenpai. The round balance is -700 points for chasing and -1100 points for betaori, 400 points higher in the case of chasing. Choose to riichi in this case. The hand has no other yaku and few improvements, so damaten has no benefits.

Question 2



discard and riichi

Dora 2 kanchan tenpai. Discarding can deal into ippatsu, but the round balance in this case is -230 points (deduct 230 points from the normal round balance of 0 points), 800 points higher than the round balance for betaori. Declare riichi here. Riichi even if was instead (-650 point round balance).

Question 3



discard

dora 1 kanchan tenpai. Discarding has a round balance of -800 points, so push. However, if a dangerous middle tile is drawn in the late game, don't risk it and fold with .

Question 4



discard

Kanchan tenpai for riichi nomi. Declaring riichi discarding the safe tile has a round balance of -1800 points, lower than the -1700 points for betaori by 100 points. Discard the safe tile and declare riichi if or become ryanmen for riichi + pinfu. Betaori if any dangerous tiles are drawn before that can happen.

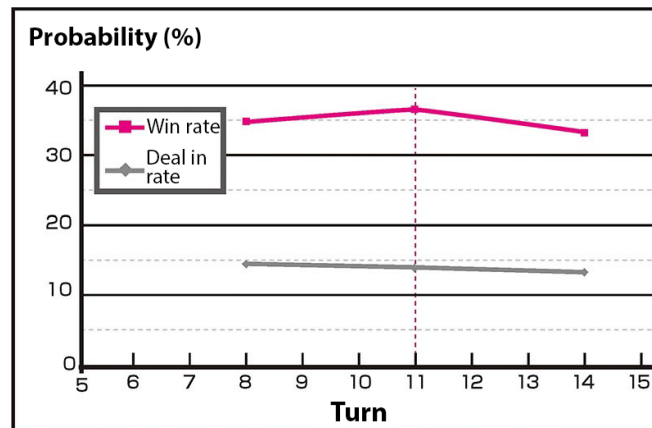


Figure 2.8: Win rate of oikake ryanmen riichi discarding a safe tile against two existing riichi. Data are computed as averages for every three turns due to insufficient sample size.

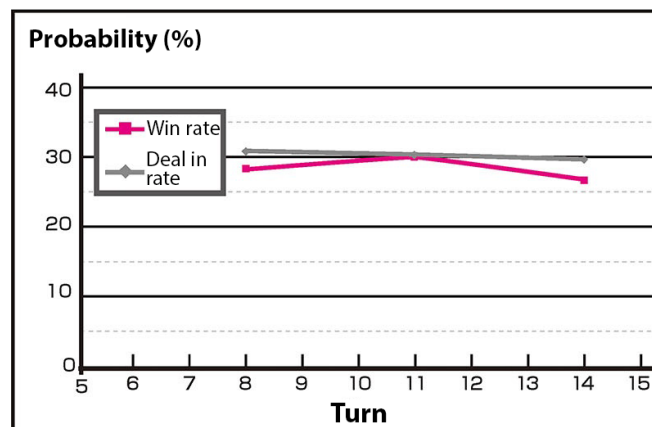


Figure 2.9: Win rate of oikake ryanmen riichi discarding a 10% danger level tile against two existing riichi

2.6 With good shape tenpai against two riichi, close your eyes and jump in

2.6.1 The win rate of good shape tenpai against two riichi is fairly high

In the previous section the round balance of betaori against two riichi was examined. Now let us examine the round balance for chasing against two riichi.

First, let us consider how often chasing with ryanmen tenpai can win. Figure 2.8 shows the win rate and deal in rate for declaring oikake ryanmen riichi discarding a safe tile against both existing riichi. Let us consider the data for turn 11. The win rate is 37% and the deal in rate is 14%. For comparison, chasing a single riichi has a win rate of 44% and a deal in rate of 15%; the deal in rate does not change by much and the win rate drops. The deal in rate remaining unchanged since there are three players including yourself being forced to tsumogiri, increasing the lateral movement rate. The win rate decreases since there are three players in tenpai. Nonetheless, with a more than 33% win rate, ryanmen tenpai has a fighting chance even against two dueling players.

However, cases where a safe tile against both opponents can be discarded for riichi may be rare, so let us compute the win rate and deal in rate when discarding a 10% danger level tile against both opponents. Figure 2.9 shows the win rate and deal in rate when declaring oikake ryanmen riichi discarding a 10% danger level tile against both opponents. Considering turn 11 as before, the win rate is 30% and the deal in rate is 30%; the win rate and deal in rate are comparable. In this case, the probability of dealing in with the riichi declaration tile

Riichi value/Turn	Turn 8		Turn 11		Turn 14		Average points
	safe tile	10% tile	safe tile	10% tile	safe tile	10% tile	
40 fu 1 han	-100	-1100	100	-900	0	-1000	5000
30 fu 2 han	300	-700	500	-600	300	-800	6100
40 fu 2 han	700	-400	900	-300	700	-500	7200
30 fu 3 han	1300	0	1500	200	1200	0	8800
40 fu 3 han	1500	200	1800	400	1400	200	9500
30 fu 4 han	2100	700	2400	900	2000	600	11100
40 fu 4 han	2100	700	2400	900	2000	600	11200

Table 2.12: Non dealer oikake ryanmen riichi vs two non dealer riichi round balance. Round balance values are computed from data tabulated in Table 2.13. Point loss upon opponent tsumo or deal in is the average of the values for the two opponents in riichi. Ryuukyoku point gain is 0 points after accounting for riichi bet.




Data used to compute round balances	Turn 8		Turn 11		Turn 14	
Riichi tile danger level	safe tile	10% tile	safe tile	10% tile	safe tile	10% tile
Win rate (%)	35	29	37	30	33	27
Tsumo rate upon win (%)	28	28	28	28	28	28
Ippatsu rate upon win (%)	41	41	44	44	49	49
Deal in rate (%)	15	31	14	30	13	30
Opponent tsumo rate (%)	24	19	23	19	24	19
Lateral movement rate (%)	24	19	22	18	21	17
Riichi bet lost rate (%)	62	50	59	48	58	47
Ryuukyoku rate (%)	2	2	4	4	9	7

Table 2.13: Oikake ryanmen riichi against two riichi data

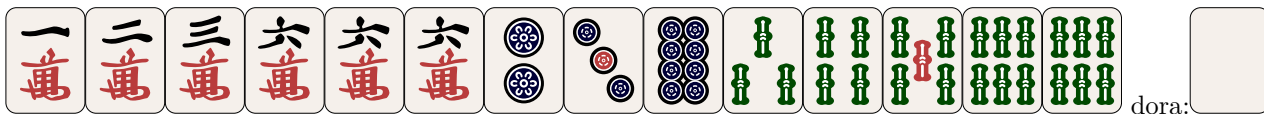
is 19%. When discarding non suji, the greatest danger occurs right when riichi is declared. With a hand worth pushing, discarding non suji may be scary, but if it passes then there is a fighting chance.






2.6.2 Generally, push against two riichi with ryanmen tenpai

Next, let us consider the specifics of pushing and folding against two riichi. Table 2.12 shows round balances for chasing by discarding a safe tile and chasing by discarding a 10% danger level tile. Should the hand shown in figure 2.10 be pushed?

If  is a safe tile, declaring riichi is 30 fu 2 han with a round balance of 500 points, 1500 points higher than the round balance for betaori. Thus, in this case riichi should be declared. What if neither  nor  have been discarded by either opponent in riichi? In this case, the round balance is -600 points, 400 points higher than the round balance for betaori. In this case riichi should also be declared. Importantly, the round balance is 1100 points lower than for the case of discarding a safe tile. Against two riichi, the round balance for chasing changes dramatically depending on what must be discarded for riichi.

Let us consider another example. What should be done with this hand?



This hand is riichi nomi. If  is a safe tile, the round balance for chasing is 100 points. If neither  nor  have been discarded by either opponent, the round balance for chasing is -900 points. Thus, if  is safe against both opponents in riichi then riichi should be declared. Otherwise if non suji  must be discarded, the round balance is only 100 points higher than that of betaori, only marginally better. Thus, in the case of pushing non suji, if

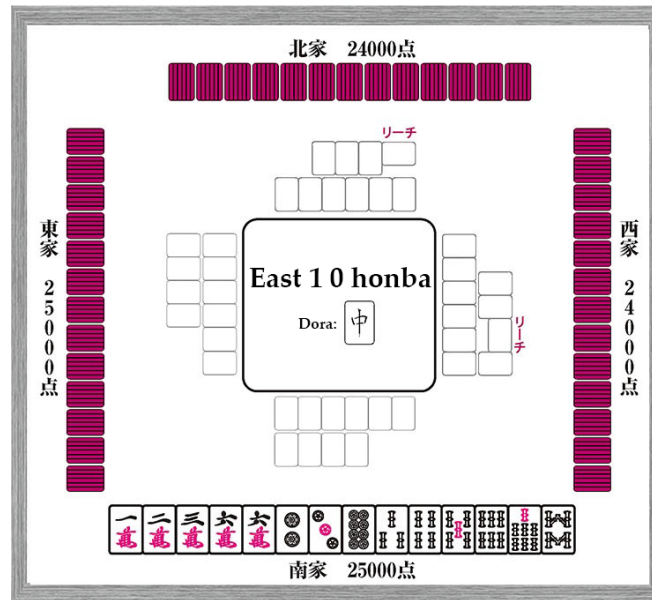


Figure 2.10

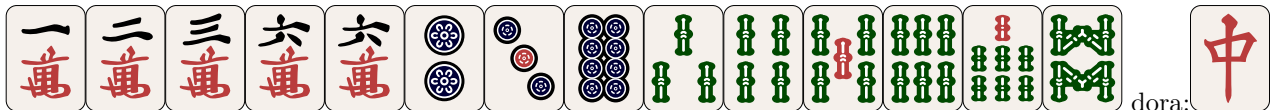
Riichi value/Turn	Turn 8		Turn 11		Turn 14		Average points
	safe tile	10% tile	safe tile	10% tile	safe tile	10% tile	
40 fu 1 han	-400	-1500	-200	-1400	-400	-1500	5000
30 fu 2 han	0	-1200	200	-1100	0	-1200	6100
40 fu 2 han	400	-900	600	-700	300	-900	7200
30 fu 3 han	900	-500	1200	-300	900	-500	8800
40 fu 3 han	1200	-300	1400	-100	1100	-300	9500
30 fu 4 han	1700	200	2000	400	1600	100	11100
40 fu 4 han	1800	200	2100	500	1700	100	11200

Table 2.14: Non dealer oikake ryanmen riichi vs dealer and nondealer riichi round balance

all else equal, choose to riichi, but that is not to say that riichi should always be declared. 中 is more dangerous than usual. When it is late in the round, when you have good lead, or when it is difficult to recover from a deal in, etc. is better to betaori.

To conclude, when a safe tile can be discarded for riichi, a 1 han hand is worth pushing, and when a non suji tile must be discarded for riichi, 2 han makes a hand worth pushing. Since there are two riichi sticks and a 45% chance of ippatsu, even riichi nomi is worth 5000 points on average.

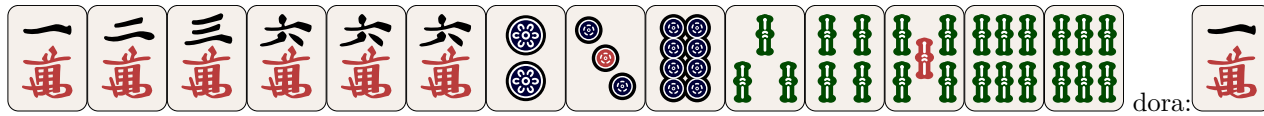
Now, what should be done when one of the two opponents in riichi is the dealer? Round balances for pushing against two opponents where one is the dealer are listed in table 2.14. As expected, the round balances are slightly worse than when chasing against two nondealer riichi. For example, with pinfu tenpai on turn 11, specifically something like



discarding non suji 中 and chasing has a round balance of -1100 points. The round balance for betaori is -1300 points, so this is not a hand to call riichi aggressively with. On the other hand, with 40 fu 2 han, confirmed 2600 points, specifically,

Riichi value/Turn	Turn 8		Turn 11		Turn 14		Average points
	safe tile	10% tile	safe tile	10% tile	safe tile	10% tile	
40 fu 1 han	100	-1000	-300	-800	100	-1000	5000
30 fu 2 han	600	-500	900	-300	600	-500	6100
40 fu 2 han	1200	0	1500	200	1200	-100	7200
30 fu 3 han	2000	600	2300	900	1900	500	8800
40 fu 3 han	2400	1000	2800	1200	2300	800	9500
30 fu 4 han	3300	1700	3700	2000	3100	1500	11100
40 fu 4 han	3300	1700	3700	2000	3100	1500	11200

Table 2.15: Dealer oikake ryanmen riichi vs two nondealer riichi round balance



discarding has a round balance of -700 points. This hand is good to call riichi aggressively with. As such, pushing against both the dealer and another non dealer in riichi requires at least 2600 points in confirmed value.

Lastly, the round balance of pushing as the dealer against two other riichi is listed in table 2.15.

To conclude, as a non dealer, having a hand worth 80% of the opponents' is enough to justify discarding non suji against both opponents to chase. It may feel scary to declare riichi against two opponents in riichi, but fear not dealing in and counterattack.

2.6.3 With an open hand

Next, what should be done with an open hand? Round balances for pushing an open hand are listed in 2.16.

First, let us consider pushing ryanmen tenpai as a non dealer against two non dealer riichi. For example, the following hand.



Let us first consider when the hand has no dora. Discarding non suji against both riichi has a round balance of -1000 points, the same as the -1000 point round balance for betaori. In this case, push or fold depending on the situation of the game. Next, suppose that is dora. The round balance for pushing non suji against both riichi is -700 points. Thus, with one dora, it is worth pushing non suji terminals. Lastly, let us consider when is dora, making the hand worth 3900 points. Discarding pushing non suji has a round balance of -100 points. With 3900 points, the hand is rather good for pushing. To conclude, 1 han is borderline, 2 han is just barely worth pushing, and 3 han is worth pushing. Analogously, for pushing against the dealer and another non dealer, fold with 1 han, 2 han is borderline, and 3 han is worth pushing. As the dealer, 1 han is worth pushing, and 2 han is easily worth pushing. Evidently, ryanmen tenpai is worth pushing to some extent even with an open hand. It is true that open hands cannot score ura dora, tsumo, or ippatsu, but this is somewhat compensated for by not losing the 1000 point riichi bet when failing to win.

2.6.4 Riichi vs dama

As with the case of pushing against a single opponent in riichi, let us compare the choices of riichi and dama. One one hand, choosing to dama lowers the value of the hand, but preserves the choice to fold if a dangerous tile

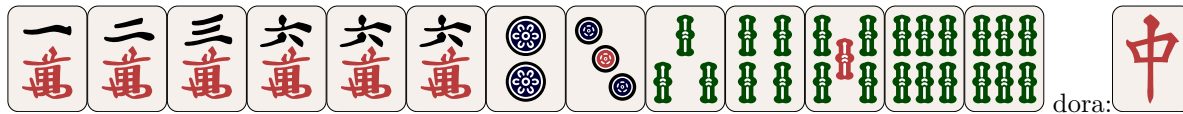
2.6.5 How to adjust round balances (autism)

Lastly, the way to compute round balances for the cases not previously discussed in this section will be covered. Only data for discarding a safe tile against both riichi and discarding a 10% danger level tile against both riichi have been listed, but the round balance for other cases can also be computed. First, the round balance for discarding a tile that is suji against both riichi (danger level 5%) can be computed by equation (2.2a), and the round balance for discarding a non suji middle tile against both riichi (danger level 15%) can be computed by (2.2b).

$$\begin{aligned} \text{round balance when discarding 5\% tile vs both riichi} &= (\text{round balance when discarding safe tile} \\ &\quad + \text{round balance when discarding 10\% tile})/2 \end{aligned} \quad (2.2a)$$

$$\begin{aligned} \text{round balance when discarding 15\% tile vs both riichi} &= \text{round balance when discarding 10\% tile} \\ &\quad - (\text{round balance when discarding safe tile} \\ &\quad - \text{round balance when discarding 10\% tile})/2 \end{aligned} \quad (2.2b)$$

For example, consider the following tenpai hand as a non dealer against two non dealer riichi on turn 11.



Pushing safe tile (中) against both riichi has a round balance of 100 points, and pushing non suji (中) has a round balance of -900 points. Discarding suji (中) (danger level 5%) has a round balance of

$$\frac{100 + (-900)}{2} = -400$$

On the other hand, discarding non suji (中) (danger level 15%) against both riichi has a round balance of

$$\frac{-900 - (100 - (-900))}{2} = -1400$$

In this case, the round balance is 400 points lower than that of betaori, so don't risk it and retreat. Like this, the round balance for tiles with danger levels other than 10% can be estimated.

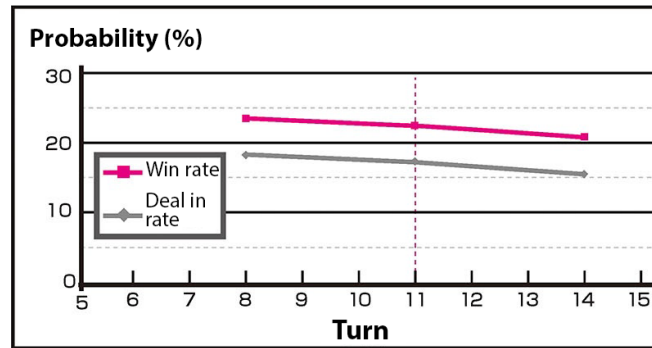


Figure 2.11: Win rate of oikake bad shape riichi discarding a safe tile against two existing riichi. Data are computed as averages for every three turns due to insufficient sample size.

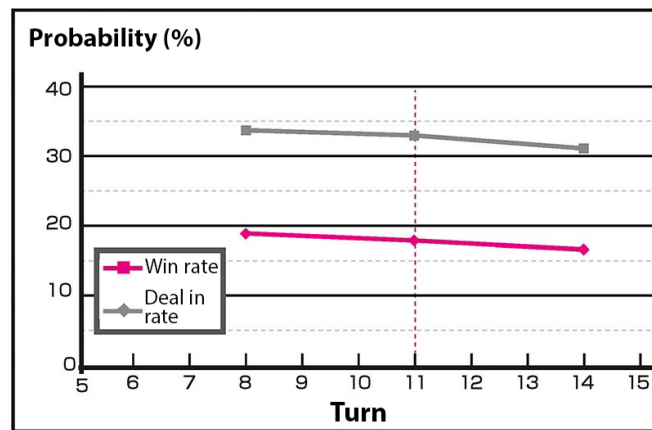


Figure 2.12: Win rate of oikake bad shape riichi discarding a 10% danger level tile against two existing riichi

2.7 Fold against with bad shape tenpai against two riichi

2.7.1 Bad shape tenpai against two riichi is rough

The previous section had examined push/fold judgement with ryanmen tenpai against two other riichi. Now push/fold judgement with bad shape tenpai against two riichi will be examined.

Let us first consider how often pushing with bad shape tenpai against two riichi can win. Figure 2.11 shows the win rate and deal in rate when declaring oikake bad shape riichi discarding a safe tile against both riichi, computed from game log analysis. The win rate is 22% and the deal in rate is 18%. For comparison, the win rate for discarding a safe tile to chase with ryanmen tenpai is 37% and the deal in rate is 14%. The win rate of oikake bad shape riichi drops dramatically compared to oikake ryanmen riichi. Considering that these results are just for discarding a safe tile, it is clear that chasing against two riichi with bad shape tenpai is a difficult fight.

Next, let us consider the win rate when discarding a non suji tile to chase. Figure 2.12 shows the win rate and deal in rate when declaring oikake bad shape riichi discarding a 10% danger level tile against both riichi, computed using the same data as was used for 2.11. In this case, the win rate is 18% and the deal in rate is 33%. The deal in rate is 1.8 times higher than the win rate. The deal in rate is higher than the win rate since there is a 19% of dealing in with the riichi declaration tile, but dealing in 1 out of every 3 attempts is still surprisingly high.

Player	Opponents	Value	Turn 8		Turn 11		Turn 14		Average points	Betaori
			safe	10%	safe	10%	safe	10%		
Non dealer	non dealer non dealer	40 fu 1 han	-1100	-1900	-800	-1800	-700	-1700	4900	-1000
Non dealer	non dealer non dealer	40 fu 2 han	-600	-1500	-300	-1400	-200	-1300	7100	-1000
Non dealer	non dealer non dealer	40 fu 3 han	0	-1000	200	-1000	300	-900	9400	-1000
Non dealer	non dealer non dealer	40 fu 4 han	400	-700	600	-700	600	-600	11200	-1000
Non dealer	non dealer dealer	40 fu 1 han	-1500	-2400	-1200	-2400	-1000	-2200	4900	-1300
Non dealer	non dealer dealer	40 fu 2 han	-1000	-2000	-1200	-2400	-1000	-2200	7100	-1300
Non dealer	non dealer dealer	40 fu 3 han	-400	-1600	-200	-1600	-100	-1400	9400	-1300
Non dealer	non dealer dealer	40 fu 4 han	0	-1200	200	-1200	300	-1100	11200	-1300
Dealer	non dealer non dealer	40 fu 1 han	-1200	-2000	-900	-1900	-700	-1700	6400	-1700
Dealer	non dealer non dealer	40 fu 2 han	-400	-1400	-200	-1300	0	-1200	9600	-1700
Dealer	non dealer non dealer	40 fu 3 han	400	-700	600	-700	700	-600	13100	-1700
Dealer	non dealer non dealer	40 fu 4 han	1000	-200	1200	-200	1200	-200	15800	-1700

Table 2.17: Oikake bad shape riichi vs two riichi round balance

Data used to compute round balances	Turn 8		Turn 11		Turn 14	
	safe tile	10% tile	safe tile	10% tile	safe tile	10% tile
Riichi tile danger level						
Win rate (%)	23	19	22	18	21	17
Tsumo rate upon win (%)	27	27	30	30	26	26
Ippatsu rate upon win (%)	41	41	37	37	46	46
Deal in rate (%)	19	34	18	33	15	31
Opponent tsumo rate (%)	28	23	27	22	24	19
Lateral movement rate (%)	25	21	25	20	24	19
Riichi bet lost rate (%)	72	59	50	56	44	51
Ryuukyoku rate (%)	5	3	8	7	16	14

Table 2.18: Oikake bad shape riichi against two riichi data

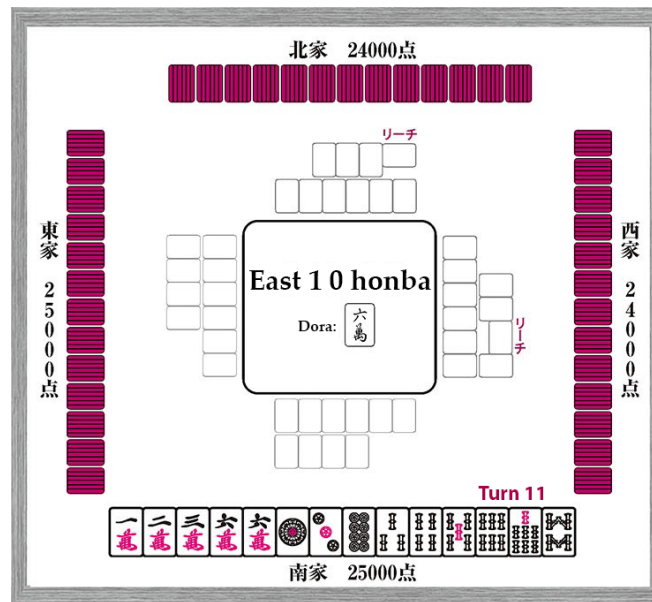


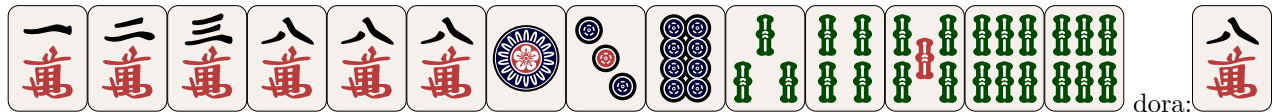
Figure 2.13

2.7.2 4 han is needed to challenge two riichi with bad shape tenpai

Knowing how often bad shape tenpai can win against two other riichi, now we consider when it is worth pushing such a hand. Table 2.17 shows round balances for chasing with bad shape tenpai. The data used for computing the round balances are listed in table 2.18.

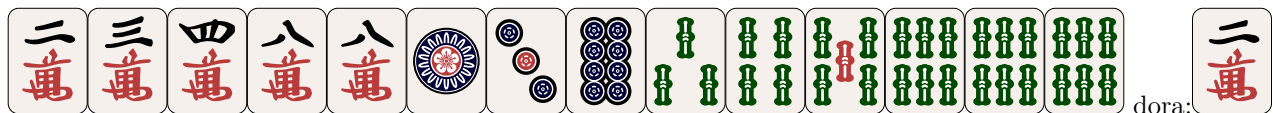
Let us consider the specifics of pushing/folding. First, suppose you have the hand shown in figure 2.13, bad shape tenpai worth 5200 points (40 fu 3 han) with riichi. 六萬 is neither safe nor suji and must be discarded for riichi. Pushing on turn 11 has a round balance of -1000 points, the same as the -1000 points when choosing to betaori; pushing and folding are equal in value here. A tough situation to be in.

Let us consider another example. The dealer and another non dealer have already declared riichi, and your own hand is dora 3. 六萬 is neither safe nor suji against the two riichi.



This hand is mangan. In this case, pushing has a round balance of -1200 points, about the same as the -1300 points when choosing to betaori. It is not clearly advantageous to fight with bad shape tenpai against two riichi even with mangan.

What about when you are the dealer then? For example, when your hand is dora 1.



This hand is worth 2 han, 3900 points as the dealer. In this case the round balance is -1300 points for pushing. The round balance for betaori is -1700 points, so as the dealer a 2 han hand is enough to be worth pushing.

To conclude, as non dealer with bad shape tenpai, 1.7 times the value of the opponents' hand is required for non suji to be worth pushing against two riichi. With bad shape tenpai as the dealer, a 2 han hand is sufficient for pushing non suji against two riichi. As a non dealer against two non dealers, 4 han is required. Against the

Player	Opponents	Value	Turn 8		Turn 11		Turn 14		Average points	Betaori
			safe	10%	safe	10%	safe	10%		
Non dealer	non dealer non dealer	30 fu 1 han	-800	-1600	-700	-1500	-500	-1400	3000	-1000
Non dealer	non dealer non dealer	30 fu 2 han	-500	-1400	-400	-1400	-200	-1200	4000	-1000
Non dealer	non dealer non dealer	30 fu 3 han	-100	-1100	0	-1000	100	-900	5900	-1000
Non dealer	non dealer non dealer	30 fu 4 han	800	-300	800	-300	900	-200	9700	-1000
Non dealer	non dealer dealer	30 fu 1 han	-500	-1200	-2200	-1100	-2100	-800	-1900	-1300
Non dealer	non dealer dealer	30 fu 2 han	-900	-2000	-800	-1900	-600	-1700	4000	-1300
Non dealer	non dealer dealer	30 fu 3 han	-500	-1600	-400	-1600	-200	-1400	5900	-1300
Non dealer	non dealer dealer	30 fu 4 han	400	-900	400	-900	600	-700	9700	-1300
Dealer	non dealer non dealer	30 fu 1 han	-1100	-1900	-1000	-1800	-700	-1600	3500	-1700
Dealer	non dealer non dealer	30 fu 2 han	-800	-1600	-700	-1500	-400	-1300	4900	-1700
Dealer	non dealer non dealer	30 fu 3 han	-100	-1100	0	-1000	200	-900	7800	-1700
Dealer	non dealer non dealer	30 fu 4 han	1300	0	1300	0	1400	100	13600	-1700

Table 2.19: Open bad shape tenpai vs two riichi round balance. Win rates used to compute these results are taken from riichi win rate statistics.

Turn 11, vs 2 non dealer	Safe tile		10% tile		Average points
	riichi	dama	riichi	dama	
dama 1 han, riichi 2 han	-300	-500	-1400	-1400	3500
dama 2 han, riichi 3 han	200	-200	-1000	-1200	5000
dama 3 han, riichi 4 han	600	500	-700	-600	8000

Table 2.20: Bad shape riichi and dama round balance against two riichi. Win rates used to compute these results are taken from riichi win rate statistics. Average points for dama assumes 28% tsumo rate.

dealer and another non dealer, 5 han is required. Keep this in mind.

The previous discussion was considering non suji 2837, so pushing middle tiles is difficult to justify even if the conditions are assumed to be the same as pushing non suji 2837. Do not try to push thinking that “my hand is expensive and my flow is good.” Calmly retreat if the numbers are not in your favor.

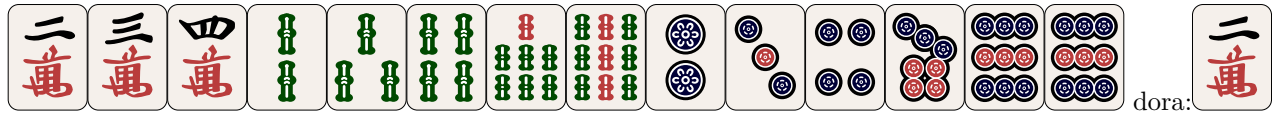
Additionally, round balances for pushing bad shape open tenpai against two riichi are shown in table 2.19. To push a 10% danger level tile against both riichi, 3 han is required as dealer and 4 han is required as non dealer. If these conditions are not fulfilled and the hand has no safe tiles, it is acceptable to tentatively push. However, many tiles will be revealed to be safe with two opponents in riichi, so taking unnecessary risks is forbidden.



Again, these decisions rely heavily on the point situation. In cases where pushing is slightly advantageous by round balance, decisions such as “I have lots of points so I can fold” are important.

2.7.3 Riichi vs dama

The previous discussion was about the choice between pushing non suji for riichi and betaori. However, in cases where a choice can be made between riichi and betaori, there is also the choice between riichi and dama. Thus, let us compare the choice between riichi and dama using the data for non dealer on turn 11.

For example, consider this sanshoku dora 1 hand.



This hand is 3 han with dama, 4 han with riichi.  is non suji, so the danger level is 10%. The round balance for pushing a dama hand is shown in table 2.20. The round balance is -600 points for dama and -700 points for riichi, about the same for both. Thus, discarding  and choosing to dama until folding when a dangerous middle tile is drawn is a perfectly acceptable choice. There are many cases where it is better to dama when the hand already has yaku. In particular, this is a strong choice when your own points are high.

Round/Points	14000~ 16000	24000~ 26000	34000~ 36000	44000~ 46000
East 1	1.13	1.15	0.98	0.74
East 2	1.19	1.13	0.93	0.75
East 3	1.25	1.13	0.86	0.72
East 4	1.32	1.15	0.85	0.68
South 1	1.36	1.17	0.79	0.64
South 2	1.46	1.19	0.72	0.61

Table 2.21: Win utility separated by round and current points. If curious about the definition of win utility, search for the author’s blog page (現代麻雀理論 和了価値指標).

2.8 Rely on round balances in east round

2.8.1 The balance between point gains and losses does not deviate much in east round

Until now, differences between round balances were used when considering push/fold judgement. However, it goes without saying that maximizing round balance does not always maximize match score. In this section, the balance between point gains and losses will be examined, and how exactly push/fold judgement based on round balances should be applied.

First, let us quantify the balance between point gains and point losses. Table 2.21 shows the *utility* for winning a hand, a measure for the balance between winning and dealing in. For a concrete picture, imagine dividing the match score increase from winning a 8000 point hand by the match score decrease from dealing in to a 8000 point hand. If this number is 1.0, then winning and dealing in are balanced. If this number is greater than 1.0, then the utility of winning increases, and if less than 1.0, the utility of winning decreases.

Let us consider some of the specific values in table 2.21. In east 1 with 24000~26000 points, the utility of winning is 1.15. As non dealer in east 1, the match score increase from winning a 8000 point hand is 1.15 times the match score decrease from dealing in to a 8000 point hand.

Let us consider another example. The utility of winning in east 4 with 44000~46000 points is 0.68. This means that with 45000 points in east 4, the match score increase from winning a 8000 point hand is 0.68 times the match score decrease when dealing in to a 8000 point hand.

Overall, the more points you have, the utility of winning decreases, and the fewer points you have, the utility of winning increases. This is because when you have many points, winning more points will not change your placement, and can only increase the current number of points you have. Conversely, when dead last, even though dealing into a yakuman will decrease your current points, it will not change your placement and thus does not affect oka/uma.

Again, the utility of winning with 24000~26000 points in east is 1.13~1.15. Even when close to the starting points, the gain in utility from winning overcomes the loss in utility from dealing in. This is due to oka being applied (25000 starting points, 30000 minimum points to win), i.e. there is special value to being first, so even when close to the starting points the utility of earning points is increased.

A glance at the east round entries in table 2.21 shows that the utility for winning in east round falls between 0.7~1.3. When having between 15000 points and 45000 points in east, the gain when winning is between 0.7 to 1.3 times that of the loss when dealing in. In other words, excluding when at the risk of busting with fewer than 10000 points, the utility of winning in east 1 only varies by $\pm 30\%$.

30% may seem like a large number. However, it is not 1.5 times or 0.5 times. Having 45000 points in east does not occur too frequently, but even in such a situation the gain when winning is 70% that of the loss when dealing in. Moreover, the utility of winning with 34000~36000 points in east is 0.85 ~ 0.98, pretty close to 1.0, and the utility of winning with 24000~26000 points is 1.13~1.15, less than a 0.2 difference from 1.0. With this in mind, it can be concluded that the balance between point gains and losses does not deviate much in east round. This point has been stated as “do not look at the point indicator in east round” by Ishii Kazuma in his book *How to Achieve 70% Deviation in Mahjong* (麻雀偏差値 70 へのメソッド, Takeshobo). Perhaps these data explain why.

2.8.2 Changes to push/fold judgement based on win utility

Criterion for non dealer oikake ryanmen riichi against one riichi:

$$\begin{aligned} & \text{(normal) your points} > \frac{\text{opponent points}}{3} \\ \rightarrow & \text{(adjusted) your points} > \frac{\text{opponent points}}{3(\text{utility})} \end{aligned} \quad (2.3a)$$

Criterion for non dealer oikake bad shape riichi against one riichi:

$$\begin{aligned} & \text{(normal) your points} > \frac{2(\text{opponent points})}{3} \\ \rightarrow & \text{(adjusted) your points} > \frac{2(\text{opponent points})}{3(\text{utility})} \end{aligned} \quad (2.3b)$$

Having said all this, it may be difficult to understand what this means without considering some concrete examples of how the rules for pushing and folding change. Thus, let us consider how much the rules for pushing and folding change when the utility of winning is 0.7 and 1.3. The utility of a 8000 point change and the utility of a 4000 point change (closer to 1.0) are different, but for the sake of simplicity they will be assumed to be the same.

In section 2.2 it was said that “it is worth fighting with ryanmen riichi if your hand has one third of the value of your opponent’s.” Using (2.3a) gives the adjusted criterion; if your own hand is worth more than the value of your opponent’s hand divided by three times the utility, then it is worth fighting. Supposing that the opponent’s average hand value is 6000 points, let us consider how much these criteria change. When the utility is 1.0, the requisite points is 2000, when the utility 1.3, the requisite points 1500, and when the utility 0.7, the requisite points 2900. The deviation is at most 1000 points. 1000 points may seem like a lot, but unless the hand is worth mangan or more, one han creates a 2000 point difference. With this in mind, it is difficult to call 1000 points a huge difference.

Next, let us apply the same reasoning to pushing bad shape riichi against one other riichi. In section 2.3 it was said that “it is worth fighting with bad shape riichi if your hand has two thirds the value of your opponent’s.” Assuming that the opponent’s average hand value is 6000 points, when the utility is 1.0, the requisite points is 4000, when the utility 0.7, the requisite points 5700. The deviation is at most 2000 points. With this in mind, when your own points are high in east, increase the han requirements for pushing bad shape tenpai by 1. On the other hand, it can also be said that the point situation will not change push/fold criteria by 2 han or more.

Having a 0.7 utility of winning does not occur without having 45000 points. Considering that the change to push/fold criteria in this case changes by at most 1 han, it is better to not be overly sensitive about the point situation in east round. It is true that in some borderline situations, specifically riichi nomi ryanmen and 2600 point bad shape, it may be better to fold with many points where normally it is better to push, but these situations do not occur all that often. Additionally, points also factor in to the calculation of match score. If you only have a slight lead, excluding some extraordinary cases, it is better to push.

2.8.3 Win utility in tenhou ranked matches

The discussion in this book assumes 25000 starting points, 30000 minimum points to win, and 30/10/-10/-30 uma. Here a system like tenhou ranked matches will be examined, where firstly, only ranked points and not point sticks are important, and secondly, there is a huge penalty for placing last. Table 2.22 shows the utility of winning in tenhou 7 dan ranked. Two trends are that, first, the utility values are generally smaller, and secondly, the utility values deviate more from 1.0. The reason for the first trend being the large penalty for being last, and the reason for the second being that point sticks do not factor into ranked points calculation.

First, let us consider the range of values for the utility. In east round, the utility ranges from 0.4 to 1.3. The lower bound is 0.4, much lower than the lower bound of 0.7 for normal rules. Additionally, the utility for 34000~36000 points in east round ranges from 0.56 (in east 4) to 0.68 (in east 1). Even in east 1, this is lower than

Round/Points	14000~ 16000	24000~ 26000	34000~ 36000	44000~ 46000
East 1	0.96	1.02	0.68	0.48
East 2	1.11	0.98	0.64	0.47
East 3	1.19	0.91	0.57	0.44
East 4	1.31	0.86	0.56	0.40
South 1	1.40	0.8	0.51	0.35
South 2	1.57	0.71	0.45	0.30

Table 2.22: Win utility separated by round and current points. Tenhou ranked (houou table, 7 dan) points are 90 points for first, 45 points for second, 0 points for third, and -135 points for fourth. Point sticks are not considered at all.

the 0.7 lower bound for normal rules. Thus it is difficult to say that you should not look at the point indicator in east round when playing by tenhou ranked rules.

As before, let us consider how much push/fold judgement should be adjusted with a utility of 0.5. In the case of oikake ryanmen riichi against one other riichi, assuming that the opponent's average hand value is 6000 points, the requisite 2000 points increases to 4000 points. In other words, a 1 han difference. With 40000 points in east round, the han criteria for pushing with ryanmen tenpai should be increased by 1.

Next, let us consider the case of oikake bad shape riichi. If the opponent's hand is worth 6000 points, the requisite points with a utility of 1 is 4000. When the utility is 0.5, the requisite points is 8000 ($4000 / 0.5$), an increase of 4000 points. A 40 fu 3 han riichi is worth 8500 points on average (accounting for ippatsu, tsumo ura, and the opponent's riichi stick), so 3 han is worth pushing. Thus, in ranked matches, it may be good to only push mangan sized bad shape hands when leading by a good amount. Incidentally, with 45000 points in east 4, the utility of winning is 0.4, and the threshold for pushing is 10000 points. Only with a mangan is it worth pushing.

To conclude, since point sticks do not count towards ranked points and placing last has a large penalty in tenhou ranked, there is more of a drive to fold even when near 25000 points when compared to normal rules. Chasing with ryanmen tenpai is not too stressful, but chasing with bad shape requires more careful judgement than normal when playing ranked.

Chapter 3

Betaori and wait reading




3.1 Master the basics of betaori






3.1.1 Understand the deal in rates of different tiles









This chapter will discuss the danger levels of different tiles when betaori against riichi (the probability of dealing in with a tile, units of %). It is unnecessary to memorize the exact deal in rates, but it is good to have a general sense of how often specific tiles will deal in. Knowing the danger level of a tile is useful not only when betaori, but also important for understanding how often pushing a tile will result in a deal in.

Let us imagine this scenario. It is turn 9, and an opponent declares head start riichi with the discards shown in figure 3.1, and you have chosen to fold hard. What should you discard first?

First to discard are safe tiles. Dealing in is impossible with a safe tile, so the danger level is 0. Next are thrice discarded honors. These can only deal in to kokushi, and effectively have a deal in rate of 0 as with safe tiles. Following these are twice discarded honors, which can only deal in to tanki or kokushi and have a danger level of 0.2~0.3%. These can essentially be regarded as safe tiles. Start by discarding these three types of tiles.

The next category includes double suji  (middle tiles where both suji tiles have become safe), suji , and once discarded honors. With respect to the discards in figure 3.1, these are . The danger level of these tiles is about 2%, fairly safe.

Next are suji , suji , and live honors. With respect to the discards in figure 3.1, these are . The danger level of these tiles are 4~6%. Within these four types of tiles, suji  and live guest winds are safer, and suji  and live yakuhai are more dangerous. Dealing in with these tiles will occur roughly once out of every twenty times. If these tiles are actually the safest tiles to discard, don't feel bad about dealing in.

Following, the next safest tiles are non suji , non suji , non suji , and half suji  (middle tiles where one of the suji have been discarded), with a danger level of 7~10%. In order of decreasing safety,  is the safest, followed by half suji , suji , and suji  is the most dangerous. This ordering is useful when you really want to fold but have neither safe tiles nor suji, so please remember this.


Lastly are non suji , with a deal in rate of 13%. About one out of every eight times one of these tiles is discarded will result in dealing in.



Figure 3.1

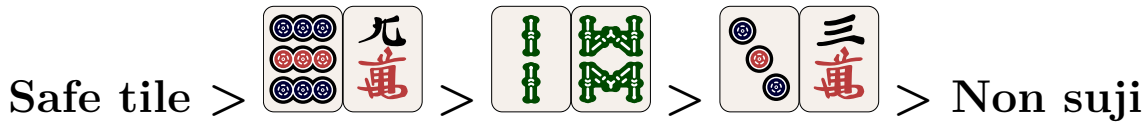


Figure 3.2: Safety level of tiles against the riichi declared in figure 3.1

Turn	Passed suji	Non suji 5	Non suji 46	Non suji 37	Non suji 28	Non suji 19	Half suji 5	Half suji 46A	Half suji 46B	Suji 37	Suji 28	Suji 19	Full suji 5	Full suji 46
1	1.0	5.7	5.7	5.8	4.7	3.4	2.5	2.5	3.1	5.6	3.8	1.8		
2	1.7	6.6	6.9	6.3	5.2	4.0	3.5	3.5	4.1	5.3	3.5	1.9	0.8	2.6
3	2.5	7.7	8.0	6.7	5.8	4.6	4.3	4.1	4.9	5.2	3.6	1.8	1.6	2.0
4	3.2	8.5	8.9	7.1	6.2	5.1	4.8	4.7	5.6	5.2	3.8	1.7	1.6	2.0
5	4.0	9.4	9.7	7.5	6.7	5.5	5.3	5.1	6.0	5.3	3.7	1.7	1.7	2.0
6	4.8	10.2	10.5	7.9	7.1	5.9	5.8	5.6	6.4	5.2	3.7	1.7	1.8	2.0
7	5.6	11.0	11.3	8.4	7.5	6.3	6.3	6.1	6.8	5.3	3.7	1.7	2.0	2.1
8	6.3	11.9	12.2	8.9	8.0	6.8	6.9	6.6	7.4	5.3	3.8	1.7	2.1	2.2
9	7.1	12.8	13.1	9.5	8.6	7.4	7.4	7.2	7.9	5.5	3.9	1.8	2.2	2.3
10	7.8	13.8	14.1	10.1	9.2	8.0	8.0	7.8	8.5	5.6	4.0	1.9	2.4	2.4
11	8.5	14.9	15.1	10.8	9.9	8.7	8.7	8.5	9.2	5.7	4.2	2.0	2.5	2.6
12	9.2	16.0	16.3	11.6	10.6	9.4	9.4	9.2	9.9	6.0	4.4	2.2	2.7	2.7
13	9.8	17.2	17.5	12.4	11.4	10.2	10.2	10.0	10.6	6.2	4.6	2.4	3.0	3.0
14	10.5	18.5	18.8	13.3	12.3	11.1	11.0	10.9	11.4	6.6	4.9	2.7	3.2	3.1
15	11.1	19.9	20.1	14.3	13.3	12.0	11.9	11.8	12.3	7.0	5.3	3.0	3.4	3.4
16	11.6	21.3	21.7	15.4	14.3	13.1	12.9	12.8	13.3	7.4	5.7	3.3	3.7	3.6
17	12.2	22.9	23.2	16.6	15.4	14.2	14.0	13.8	14.4	8.0	6.1	3.6	3.9	3.9
18	12.7	24.7	24.9	17.9	16.7	15.4	15.2	15.0	15.6	8.5	6.6	4.0	4.3	4.2
19	13.3	27.5	27.8	20.4	19.1	17.8	17.5	17.5	17.5	9.8	7.4	5.0	5.1	5.1

Table 3.1: Danger level of number tiles by turn. Half suji A refers to 46 that is half suji by 19. Half suji B refers to 46 that is half suji by 37.

This is roughly the order of tile safety; please remember them. Adjustments can be made based on the discards of the opponent in riichi, but in general the order will be like this. For tile safety on different turns, see tables 3.1 and 3.2.

3.1.2 Danger level by turn










The previous discussion was for tiles discarded on turn 9. Now let us see whether these trends change depending on the turn.

First, let us consider the late game, specifically the data for turn 15. The ordering of danger levels does not change much from that of turn 9. However, non suji 37 has a 20% danger level and non suji 46 has a 13% danger level. Additionally, on turn 18, non suji 37 has a 25% danger level, non suji 46 has a 17% danger level, suji 37 has a 7% danger level. These values are about double of those for turn 9. Since more tiles become safe in the late game, the danger level of the remaining unsafe tiles increases relative to the danger level of tiles in the mid game.

Next, let us consider the danger level of tiles in the early game. On turn 5, the danger levels of suji 37, non suji 37, half suji 46 are 5%, closer than in the mid game and late game. This is since ryanmen or better waits are less common for early riichi (turn 1 riichi has 32% chance of being good shape, turn 4 riichi has 56% of being good shape, overall there is a 62% chance), and so the danger level of non suji 37 decreases. If a choice has to be made between suji 37 and non suji 37 in the early game, take into consideration the concepts discussed in the following sections and the number of tiles in the hand to make a decision.



Turn	Passed suji	Yakuhai live	Yakuhai 1 visible	Yakuhai 2 visible	Guest wind live	Guest wind 1 visible	Guest wind 2 visible
1	1.0	2.1	1.2	0.5	2.4	1.4	1.2
2	1.7	2.3	1.2	0.5	2.7	1.3	0.4
3	2.5	2.4	1.2	0.3	2.6	1.2	0.3
4	3.2	2.6	1.1	0.2	2.6	1.2	0.2
5	4.0	2.9	1.2	0.2	2.8	1.2	0.2
6	4.8	3.2	1.3	0.2	2.9	1.3	0.2
7	5.6	3.6	1.4	0.2	3.2	1.4	0.2
8	6.3	4.0	1.6	0.2	3.5	1.6	0.2
9	7.1	4.6	1.9	0.3	4.0	1.8	0.2
10	7.8	5.3	2.2	0.3	4.6	2.1	0.3
11	8.5	6.0	2.6	0.4	5.1	2.5	0.3
12	9.2	6.8	3.1	0.4	5.9	3.0	0.4
13	9.8	7.8	3.7	0.5	6.6	3.7	0.5
14	10.5	8.8	4.4	0.7	7.4	4.4	0.6
15	11.1	9.9	5.2	0.8	8.4	5.3	0.8
16	11.6	11.2	6.2	1.0	9.4	6.5	0.9
17	12.2	12.4	7.3	1.3	10.5	7.7	1.2
18	12.7	13.9	8.5	1.7	11.8	9.4	1.6
19	13.3	18.1	12.1	2.8	14.7	12.6	2.1




Table 3.2: Danger level of honor tiles by turn





Lastly, let us examine the danger level of tiles on turn 1. These danger levels are for discarding tiles against double riichi. First, suji  has a danger level (6%) higher than that of half suji  and non suji  (3%), so half suji  and non suji  should be discarded before suji . Moreover, the danger level of non suji  and non suji  are similar (6%). Evidently,  is relatively more dangerous in the early game.

3.1.3 Points to note when betaori

Lastly, let us discuss a few important things to note when betaori.

First, if choosing to betaori, commit to betaori. Thoughts like “ is a safe tile so I’ll discard  suji” will backfire 4% of the time. When choosing to betaori, discard safe tiles even if it means breaking up sets. It is important to be thorough here.

Next, there may be cases where choices must be made between different safe tiles. When betaori, there may be times where the safety of tiles has to be considered beyond the just next turn; other opponents may counterattack after the first has declared riichi. For example, after an opponent has declared riichi, there is a 17% chance that another opponent will chase. Taking this into consideration, when choosing between safe tiles to discard, discard first the tiles that are currently safe but most likely to become dangerous in the future. For example, if both  and  are safe, discard  first. When the dora becomes gebutsu, it is also important to start by discarding the dora.

When lacking both safe tiles and suji, consider whether discarding a tile will make other tiles safer. For example, with a pair, passing one tile will buy another turn. If the opponent in riichi has discarded  and you have  in your hand, discarding  will buy another turn if it passes and make  suji and thus less dangerous. When lacking safe tiles, it is important to think about ways to create new safe tiles.

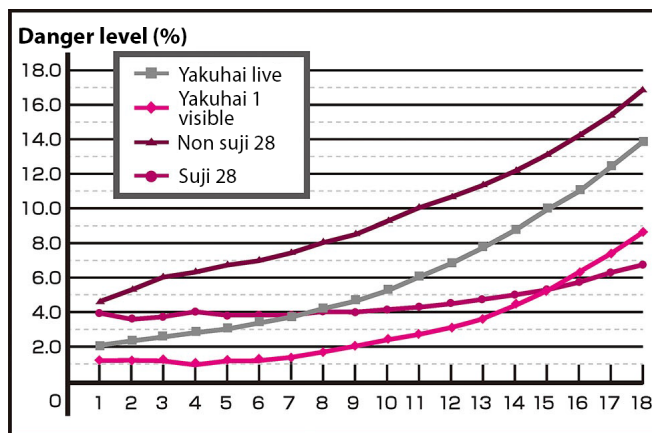


Figure 3.3: Danger level of honor tiles by turn

3.2 Live honors are rather dangerous in the late game

3.2.1 The danger level ranking for honors changes in the late game

In the previous section tiles were ranked in order of safety. The ranking itself can be found anywhere, but it is good to understand things like how often these tiles deal in under normal circumstances and how much the probability of dealing in with and change.

This section will consider honor tiles. In the previous section, it was said that 2 times and 3 times discarded honors were basically safe, 1 time discarded honors are comparable to suji in safety, and live honors are comparable to suji in safety. This is good enough for the mid game, but let us see how things are outside the mid game.

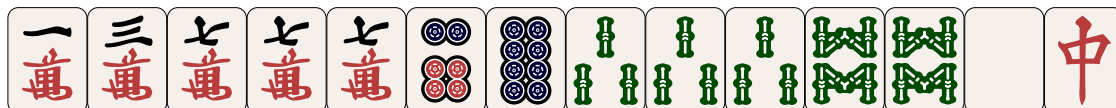
Figure 3.3 shows the deal in rate of once discarded yakuhei as a function of the turn. On turn 1 (double riichi), the danger level of live yakuhei is 2% and the danger level of once discarded yakuhei is 1%, safer than suji . Double riichi has a high chance of being chiitoi (12%, overall chiitoi is 3.5% of all riichi), so it may seem that honors are likely to deal in, but the danger level of honors is not particularly high relative to other tiles. Try not to care too much if discarding an honor deals in to double riichi.

Next, let us consider the danger level on turn 5. The danger level of live honors is 3% and the danger level of once discarded honors is 1%, safer than suji . In the early game, choose to discard live honors over suji without hesitation.

Now let us consider the data for turns later than 9. On turn 15, the danger level of live honors is 10%, and the danger level of once discarded honors is 5%. Once discarded honors are as dangerous as suji , and live honors are more dangerous than suji . Try not to carelessly toss live honors.

Lastly, let us consider the data for turn 18. The danger level of live honors is 14% and the danger level of once discarded honors is 9%, both more dangerous than suji . Moreover, the danger level of live honors approaches that of non suji . In the late game, choose to discard suji over live honors.

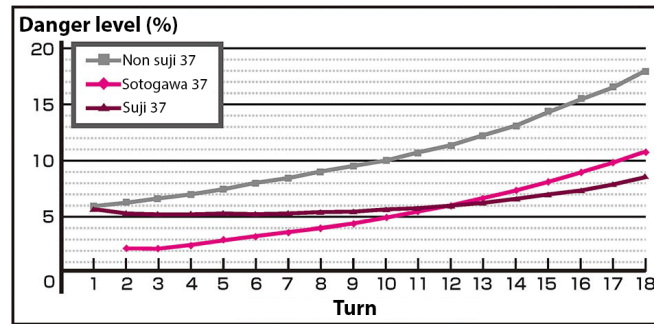
For example, with the following hand,



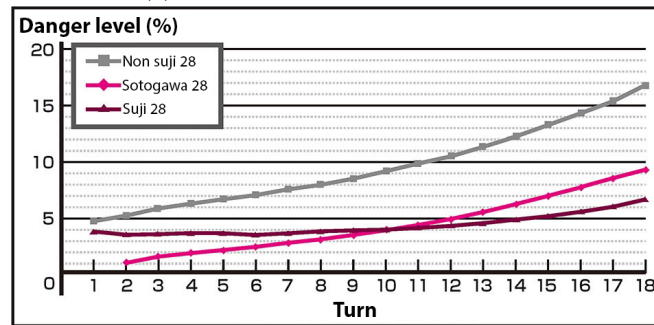
(Turn 18, is suji, is live, is once discarded)

the danger level is 9% for and 14% for is 14%, both more dangerous than that of (7%). Discard in situations like this.

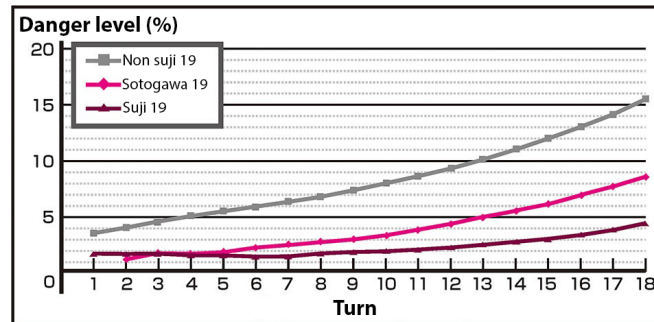
To conclude, in the late game, live honors and once discarded honors are both more dangerous than suji ⑧. Keep this in mind.



(a) Danger level of sotogawa 37 tiles









(b) Danger level of sotogawa 28 tiles



(c) Danger level of sotogawa 19 tiles

Figure 3.5

non sotogawa tiles on turn 9.

First, non sotogawa  has a 8.5% danger level and non suji  has an overall danger level of 7.4%, an increase of 1%. Next, non sotogawa  has a 9.5% danger level and non suji  has an overall danger level of 8.6%, again a 1% increase. Non sotogawa  has a danger level of 9.9%, and non suji  has an overall danger level of 9.5%, not that much of an increase. Evidently, the danger level of non sotogawa tiles in the same suit does not increase by much. The round balances used for push/fold judgement used overall danger levels, but pushing non sotogawa tiles will not cause a huge change in round balances.

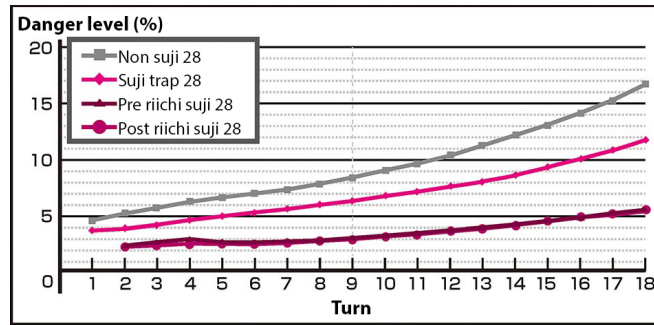
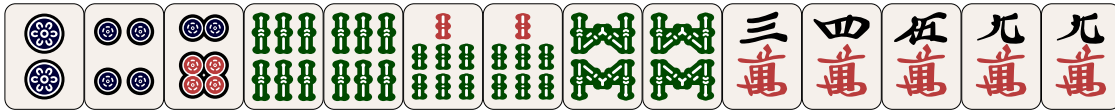


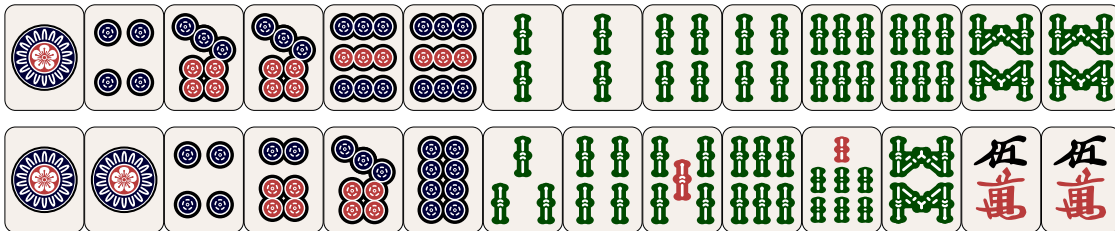
Figure 3.7: Danger level of suji trap 19 tiles



If the value is the same, it is common to discard or instead of or .

3.4.2 Suji trap 19 tiles are not dangerous

The reason why suji trap 2837 tiles are dangerous is due to the possibility of ryankan, so if ryankan is not possible, then suji trap tiles might not be so dangerous. To see if this is true, let us consider the data for suji trap 19, shown in figure 3.7. On turn 9, suji trap has a 1.9% danger level, not too different from post and pre suji trap. Therefore, if ryankan is not possible, suji trap tiles are not dangerous, and suji trap 19 tiles are not scary. Additionally, as shown in the following hands, there are few shapes that involve both and , so such suji traps are rare.



Lastly, let us confirm the danger level of full suji trap. Full suji has a 2.2% danger level, which increases slightly to 3% when suji trap. It may be good to be slightly cautious of middle tile full suji trap.

3.4.3 Pre and post riichi suji trap

It is often said that “post riichi suji” is safe, so let us see if this is the case. Regular suji trap 2837 becomes more dangerous, so these data will be excluded when comparing pre and post suji danger levels.

First, on turn 9, pre riichi suji has a 4.9% danger level, and post riichi suji has a 4.4% danger level. Post riichi suji is slightly safer, but not by a large amount. For , pre riichi suji has a 3.1% danger level, and post riichi suji has essentially the same 3.1% danger level. Lastly, pre riichi suji has a 2.2% danger level, and post riichi suji is safer with a 1.4% danger level.

To conclude, post riichi suji is safer than pre riichi suji. Apply this information when choosing between different suji to discard.







Riichi tile/wait	Non suji 5	Non suji 4(6)	Non suji 3(7)	Non suji 2(8)	Non suji 1(9)	Half suji 5	Half suji 4(6)A	Half suji 4(6)B	Suji 3(7)	Suji 2(8)	Suji 1(9)	Full suji 5	Full suji 4(6)
Overall	12.8	13.1	9.5	8.6	7.4	7.4	7.2	7.9	5.5	3.9	1.8	2.2	1.6
1(9)	11.9		8.8	10.5		6.8	7.6		6.3	7.2		1.3	2.8
2(8)		12.5	7.4		9.6	7.2	7.0	9.4	3.5		5.5	3.0	3.9
3(7)	11.1	11.8		6.5	8.4	6.8	6.1	7.0		2.9	3.3	2.4	1.3
4(6)	11.4		6.2	7.9		6.3			3.2	3.0	1.9	1.7	
5		11.0	8.2		7.6		5.1	7.7	3.9	6.2	1.8		1.3
Aka 5		8.6	4.6		10.0		0.8	9.9	5.0	5.0	1.8		1.1
6(4)	11.4	10.4		8.7	6.8	6.3	5.1	6.1	8.4	3.5	1.5	1.7	1.6
7(3)	11.1		9.2	7.8	5.9	6.8		7.9	4.1	3.1	1.4	2.4	3.7
8(2)		12.0	8.4	7.5	7.0	7.2	6.2	7.2	4.1	2.9	1.7	3.0	1.3
9(1)	11.9	11.5	8.2	8.2	7.0	6.8	6.0	7.8	4.5	3.2	1.7	1.3	1.8
Honor	13.5	13.8	9.3	8.5	7.7	7.5	7.1	8.3	3.7	2.4	1.8	1.6	1.4


















Table 3.3: Danger level of tiles in the same suit as the riichi declaration tile (turn 9, %). Half suji A refers to 4(6) that is half suji by 1(9). Half suji B refers to 4(6) that is half suji by 7(3).

3.5 Be wary of riichi with waiting on adjacent

3.5.1 Tiles close to the riichi tile are not necessarily more dangerous











In this section the danger level of tiles depending on what the riichi declaration tile was will be examined; the danger level of tiles close to the riichi declaration tile will be inspected to determine which tiles are safer or more dangerous than usual.








Table 3.3 shows the danger level of tiles in the same suit as the riichi declaration tile (for example, the danger level of  for riichi declared discarding  on turn 9. Let us consider some specific cases. The danger level of non suji  against riichi declared with  is 12%, and the danger level of suji  against riichi declared with  is 3%.

Let us consider the danger level of tiles close to the riichi declaration tile. It is cumbersome to look at the cases at once, so let us first consider non suji . The danger level of non suji  is 11.4% if riichi is declared with , not a large change from the overall danger level of 11.4% for non suji . Likewise, the danger level of non suji  if riichi is declared with  is 12.5%, with  11.8%, with  11%, and with  10.4%. In each case the danger level is not more than the overall danger level of 13.1% for non suji . Moreover, the danger level of  if riichi is declared with  is 8.8%, with  7.4%, with  6.2%, and with  8.2%, none of which exceed the overall danger level of 9.5% for non suji . For non suji , being close to the riichi declaration tile does not necessarily make them more dangerous than usual. Perhaps with other information tiles close to the riichi tile become more dangerous than usual, but what is important is that additional information.

3.5.2 Cases where danger level does increase

There are, however, cases where tiles close to the riichi tile do become more dangerous, so let us cover them properly.

First,  against riichi declared with . In this case, the danger level of  is 10.5% if  is non suji and 7.2% if  is suji. In particular, the danger level of non suji  here exceeds the overall danger level of non suji . Additionally, the danger level of suji  is comparable to the overall danger level of non suji 19. It is not a good idea to discard suji  against riichi declared with  just because it is suji.

Additionally,  is also rather dangerous against riichi declared with . If  is non suji it has a 9.6% danger level and if it is suji it has a 5.5% danger level. Against riichi declared with , try to avoid discarding  carelessly just because it is a terminal. Against riichi declared with ,  likewise becomes dangerous with an 8.4% danger

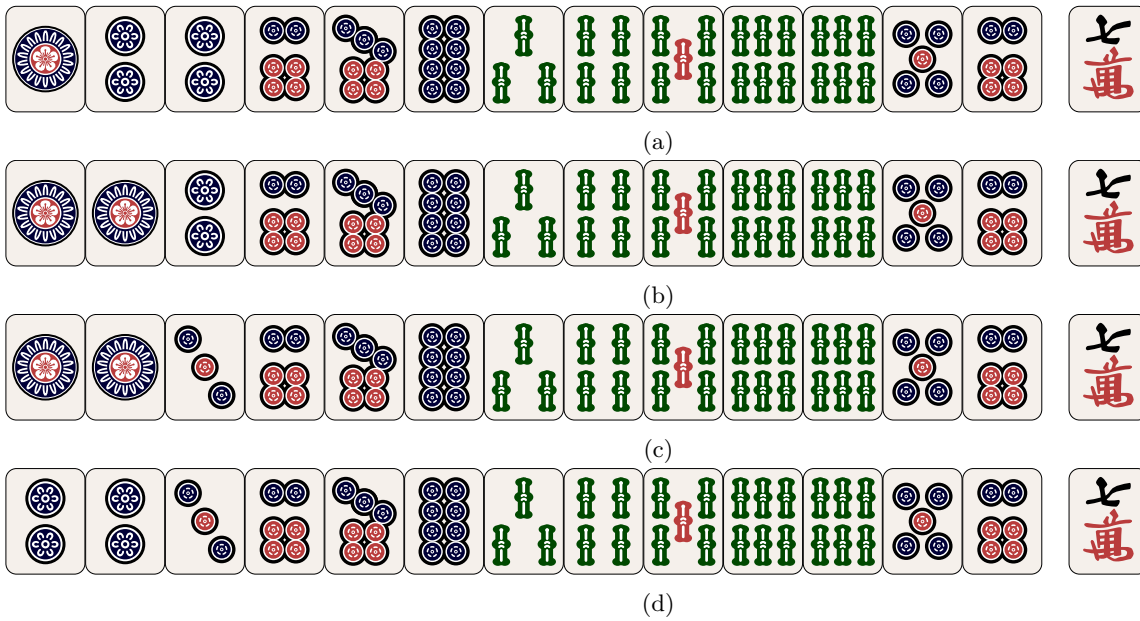


Figure 3.8

level if not suji and 3.3% danger level if suji.

Let us consider why in these cases tiles close to the riichi tile become dangerous. The hands 3.8a, 3.8b, 3.8c contain complex joints $\begin{matrix} \text{1} \\ \text{2} \\ \text{3} \end{matrix}$, $\begin{matrix} \text{1} \\ \text{2} \\ \text{3} \end{matrix}$, $\begin{matrix} \text{1} \\ \text{2} \\ \text{3} \end{matrix}$. These complex joints are more difficult to complete than ryanmen and commonly remain uncompleted until tenpai, upon which the shanpon wait may be taken.

Lastly, if $\begin{matrix} \text{1} \\ \text{2} \end{matrix}$ was discarded by an opponent prior to riichi and riichi is declared with $\begin{matrix} \text{1} \\ \text{2} \end{matrix}$, $\begin{matrix} \text{1} \\ \text{2} \end{matrix}$ becomes dangerous. Specifically, the danger level increases to 9.4% from the overall 7.9% for half suji B. In this case, the complex joint $\begin{matrix} \text{1} \\ \text{2} \\ \text{3} \end{matrix}$ is not difficult to complete, but from a hand like 3.8d, the $\begin{matrix} \text{1} \\ \text{2} \\ \text{3} \end{matrix}$ shape is commonly kept until tenpai, upon which $\begin{matrix} \text{1} \\ \text{2} \end{matrix}$ is discarded for the ryanmen wait. Try to apply this information when identifying dangerous tiles.

3.5.3 Suji becomes safer against riichi declared with honor tiles










Lastly, let us see whether riichi declared with an honor tile reveals any information. The data for non suji tiles do not show any big differences, but the danger level of suji $\begin{matrix} \text{1} \\ \text{2} \end{matrix}$ and suji $\begin{matrix} \text{1} \\ \text{2} \end{matrix}$ drop by at least 1%. This is because honors are commonly kept as safe tiles, and keeping safe tiles is more likely to be done with hands full of good shapes, increasing the likelihood of a ryanmen wait. Consequently, the probability of a suji wait decreases. This effect is large enough to change the order of tile safety, but try to keep this in mind.










Discard/Wait	Non suji 4(6)	Non suji 3(7)	Non suji 1(9)	Half suji 4(6)A	Half suji 4(6)B	Suji 3(7)	Suji 2(8)	Suji 1(9)	Full suji 4(6)
Overall	13.1	9.5	7.4	7.2	7.9	5.5	3.9	1.8	1.6
Pre riichi 5	11.5	5.5	10.4	2.9	9.8	3.7	3.1	2.1	0.9
Pre riichi aka 5	8.8	3.1	11.0	0.2	8.6	4.4	2.6	2.3	0.3
Pre riichi 5 & 1(9)		4.3		2.9		1.5	1.6		1.0
Riichi 5	11.0	8.2	7.6	5.1	7.7	3.9	6.2	1.8	1.3
Riichi aka 5	8.6	4.6	10.0	0.8	9.9	5.0	5.0	1.8	1.1












Table 3.4: Danger level of tiles in the same suit as a discarded 5 (turn 9, %). Half suji A refers to 46 that is half suji by 19. Half suji B refers to 46 that is half suji by 37. 5 has been discarded, so non suji 5, half suji 5, full suji 5, non suji 2(8) deal in are impossible.

3.6 Pay attention to discard




















3.6.1 Danger levels when is discarded


















In this section the danger level of tiles in the same suit as a discarded  will be considered. Table 3.4 shows the danger level of tiles in the same suit when  is discarded under various circumstances. For example, the row for pre riichi 5 shows the danger level of tiles  through  if  was discarded before riichi was declared ( included). Pre riichi aka 5 shows the corresponding data if  was discarded before riichi was declared. Pre riichi 5 & 1(9) shows the danger level of tiles in the same suit when both  and  have been discarded.





Let us consider some actual numbers. The danger level of  against riichi where  was discarded before riichi is 3.1%. This is just the danger level of pre riichi suji . If  was discarded prior to riichi, the danger level of  is 2.6%. Suji  becomes safer if  was discarded, as discarding  early from  is uncommon.












Next, let us consider when  is discarded to declare riichi.  has a 6.2% danger level against riichi declared with . This is the suji trap  danger level. If riichi is declared with , the danger level of  is 5.0%. This is aka suji trap. Suji  also becomes safer if  is discarded in this case, since the chance of discarding  from  for riichi increases, but  is still more dangerous than usual, so be careful.

3.6.2 discard makes safer and more dangerous

Let us now discuss the most important points from these data. Particular emphasis will be put on non suji . First, let us consider the danger level of non suji  and half suji  when  has been discarded. The danger level of non suji  is 5.5% if  was discarded before riichi and 3.1% if  was discarded before riichi. The danger level of half suji  is 2.9% if  was discarded before riichi and 0.2% if  was discarded before riichi, safer than a regular non suji tile. In particular, if  was discarded, non suji  and half suji  become safer than suji . The reason why  becomes safer is that even when fixing  into ryanmen, it is uncommon to discard , so a  wait is unlikely if  is discarded.

Conversely, there are also tiles that become more dangerous. Here, non suji  and half suji  when  has been discarded will be considered. The danger level of non suji  is 10.4% if  was discarded before riichi and 11.0% if  was discarded before riichi. The danger level of half suji  is 9.8% if  was discarded before riichi and 8.6% if  was discarded before riichi. Additionally, if  is discarded for riichi, the danger level of non suji  is 10.0% and the danger level of half suji  is 9.9%. In all cases, the danger level is higher than that of regular non suji  and half suji . Be cautious of non suji  if  has been discarded; it is dangerous to carelessly discard it just because  is a terminal.

Lastly, some interesting data. If both  and  were discarded before riichi, suji  and suji  have danger




levels of 1.5%, comparable to suji 19 in safety. This is since if  and  have been discarded early, it is unlikely that the hand contains shapes like , , , ,  (otherwise it is unlikely that both  and  will have been discarded early), so the danger levels of suji  and suji  decrease.












	Non suji 5	Non suji 4(6)	Non suji 3(7)	Non suji 2(8)	Non suji 1(9)	Half suji 5	Half suji 4(6)A	Half suji 4(6)B	Suji 3(7)	Suji 2(8)	Suji 1(9)	Full suji 5	Full suji 4(6)
Overall	12.8	13.1	9.5	8.6	7.4	7.4	7.2	7.9	5.5	3.9	1.8	2.2	2.3
3 visible	13.7	14.1	9.9	8.4	6.9	7.9	7.9	8.7	4.8	2.5	0.2	1.3	1.6
Anko	14.8	15.5	11.4	9.7	7.6	8.6	8.8	9.9	6.4	3.9	0.4	1.6	2.2
Suji to 3 visible	13.6	13.3	10.6	9.4	8.1	7.4	7.2	8.0	6.0	4.3	2.0	2.3	2.4
Anko suji	14.9	14.9	11.4	10.5	9.2	9.3	8.9	9.5	5.7	4.9	1.8	1.9	2.1
Neither	12.7	13.0	9.4	8.6	7.5	7.4	7.1	7.9	5.3	3.9	2.3	2.2	2.2

Table 3.5: Danger level of anko suji tiles (turn 9, %)

3.7 Don't be overly concerned about anko suji






3.7.1 Anko suji becomes more dangerous within the same danger class






In this section the danger level of anko suji and anko tiles will be examined. For example, with ,  and  are anko suji. It is said that “anko suji is dangerous,” but let us see how dangerous anko suji is, or perhaps how often discarding an anko during betaori will deal in. Table 3.5 shows the danger level of anko suji tiles by type.

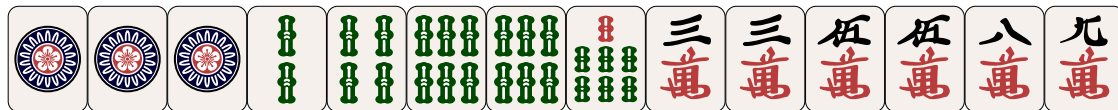
As for why anko suji is more dangerous, when having an anko of  in the hand, opponents are unable to draw , so it becomes more likely for opponents to reach tenpai with  or  waiting on  or . Accordingly, let us see just how much more dangerous non suji tiles become when they are anko suji. First, with an anko of  or , the danger level of non suji  is 14.9%, 2% higher than the overall danger level of 12.8%. With , the danger level of non suji  becomes 10.5%, also 2% higher than the overall danger level of 8.6%. Examining the other data shows that the danger level of anko suji is 1.5%~2% higher than normal. In other words, anko suji form a dangerous class within non suji tiles. Therefore, when avoid discarding anko suji when betaori.

On the other hand, anko suji only become more dangerous by 1.5%~2%. Given this, the difference in round balances when using anko suji danger levels for calculations results in a less than 200 point difference. Thus, there is no need to make considerations such as “if this tile was a regular non suji tile I would push, but since it is anko suji I will fold’.







3.7.2 Discarding 1928 anko is effective

Here the danger level of anko tiles will be considered. Let us start by examining suji . With an anko of , the danger level of suji  is 0.4%. Here  can only deal into kokushi and tanki, so it is okay treat suji  as a safe tile here.

Next, let us consider non suji . With an anko of , the danger level of non suji  is 7.6%. Compared to the overall danger level of 7.4% for non suji 19, the danger level of anko  does not increase significantly. Perhaps this is because with 3 copies of , there is no possibility of opponents waiting on shanpon. When betaori but lacking safe tiles and suji with a hand like the following,



discard the  suji and try to buy 3 turns.

Let us also consider non suji . With an anko of , the danger level of non suji  is 9.7%, only 1% higher than the overall danger level of 8.6%. Thus, discarding  anko can also be effective. On the other hand, the danger level of anko  is 11.4%, 2% higher than the overall danger level of non suji 37 and an entire 4% higher than the danger level of non suji 19. In this case, if there are other tiles like a  pair, it may be good to

discard those instead of the anko. Try to apply this information when making more detailed judgements during betaori.

	Non suji 5	Non suji 4(6)	Non suji 3(7)	Non suji 2(8)	Non suji 1(9)	Half suji 5	Half suji 4(6)A	Half suji 4(6)B	Suji 3(7)	Suji 2(8)	Suji 1(9)	Full suji 5	Full suji 4(6)
Overall	12.8	13.1	9.5	8.6	7.4	7.4	7.2	7.9	5.5	3.9	1.8	2.2	2.3
No chance	8.4	8.1	3.4	2.0	1.8	1.6	1.4	1.8	4.8	3.1	2.4	1.9	1.9
Non sotogawa 1 chance	10.6	10.7	6.7	6.5	6.1	4.4	4.1	4.7	5.5	4.1	2.4	2.0	2.1
Non sotogawa 1 chance by self	10.3	10.3	6.5	5.7	4.3	4.6	4.4	5.1	5.6	3.7	1.8	1.9	2.1
Non sotogawa 1 chance by other	10.5	10.5	6.8	6.6	6.6	4.3	3.9	4.5	5.3	4.3	2.7	1.9	2.1
Non sotogawa 2× 1 chance	9.2	9.3	5.0	5.0	4.8	3.0	2.7	3.0	5.2	3.8	3.0	1.6	1.6
Non sotogawa 2× 2 chance	11.4	11.6	7.7	7.8	7.5	5.5	5.2	6.0	5.4	4.3	2.2	2.0	2.0
Neither no chance nor 1 chance	13.7	14.3	10.0	9.2	8.2	7.9	7.6	8.8	5.5	4.0	1.7	2.3	2.4

Table 3.6: Danger level of one chance and related tiles (turn 9, %). One chance by self refers to one chance tiles where all 3 kabe tiles are in your own hand. One chance by other refers to one chance tiles where none of the 3 kabe tiles are in your own hand. 2× one chance refers to tiles for which 3 copies of both the tile 1 away and the tile 2 away are visible. 2× two chance refers to tiles for which 2 copies of both the tile 1 away and the tile 2 away are visible. The data for non suji/full suji 456 include all cases where there is kabe on at least one side. For half suji 456, the kabe needs to be on the side opposite to the suji tile that was discarded.

3.8 Understand the slight differences in safety of one chance

3.8.1 One chance is more dangerous than suji but safer than non suji 19
























In this section the danger level of one chance tiles (3 copy kabe) will be considered. An example of one chance is  when 3 copies of  are visible. In case, there is only 1 copy of  left, so the probability that the opponent in riichi has  decreases, and the probability of waiting on  ryanmen is lower than usual. Thus,  is still safer when it is suji and ryanmen is not possible, but one chance does makes  safer than usual. This conclusion is reasonable and does not seem unnatural, so let us see specifically what the danger levels are and determine which is more dangerous between non suji one chance  and regular non suji .

Table 3.6 shows the danger level of one chance and no chance tiles on turn 9. Additionally, for 192837 tiles that have become one chance, it is possible that the opponent in riichi will have discarded the kabe tile before riichi. In this case, the one chance tile is also sotogawa, decreasing its danger level as discussed in section 3.3, so here the cases where the one chance tile is not sotogawa will be examined. Additionally, full suji/non suji 456 is one chance if it is one chance on either side, for example non suji  when 3 copies of any of    are visible. For half suji 456, 3 copies of either the tile 1 away or the tile 2 away on the side opposite to the suji tile that was discarded must be visible, for example  half suji by  when 3 copies of any of   are visible. One chance tiles are also categorized by how the kabe tiles are distributed; the data for when you hold 3 copies (anko) of the kabe tiles (one chance by self) and when you hold none of the kabe tiles (one chance by other) are shown separately.

Looking at the overall danger level of non suji one chance tiles, non suji one chance  has a 6.7% danger level, safer than non suji 37 overall. This trend is observed for non suji , non suji , half suji , suggesting that the original reasoning is accurate.

Next, let us compare the danger levels of non suji one chance  and non suji 19. Non suji one chance  has a

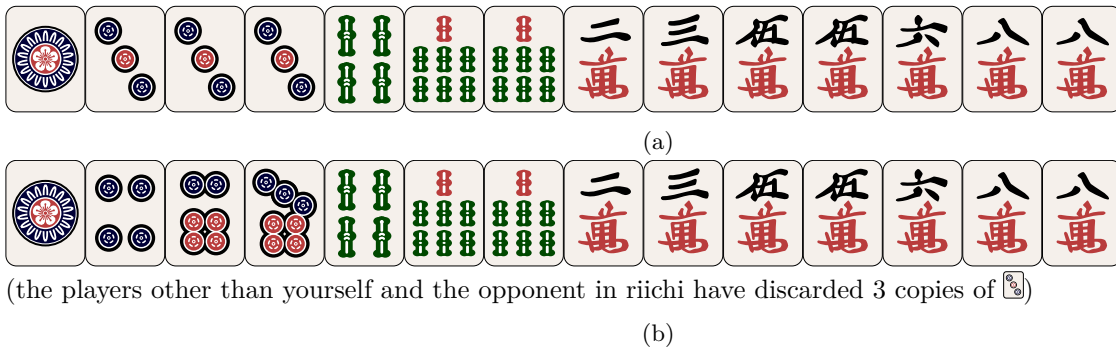


Figure 3.9

6.7% danger level, and non suji 19 has a 7.4% danger level. The difference in danger levels is less than 1%, so it is entirely possible that with other information the best tile to discard may change, but if a choice must be made blindly, 10000 seems better.

Continuing, let us compare the danger level between different types of one chance tiles. Half suji one chance 10000 has a 4.4% danger level, safer than suji 37. Players tend to avoid bad waits on middle tiles, so if ryanmen is unlikely, the danger level of half suji 10000 drops drastically. Rely on half suji 10000 or half suji 10000 if they become one chance.

Lastly, let us consider the difference in danger level between one chance tiles when 3 copies of the kabe tile are in your own hand as in 3.9a, and when your own hand contributes no copies to the 3 visible kabe tiles (but the opponent in riichi has not discarded any copies of the kabe tile). In 3.9a, one chance by self 10000 has a 4.3% danger level, whereas in 3.9b, one chance by other 10000 has a 6.6% danger level. When 3 copies of the kabe tile are in your own hand, 10000 becomes safer, but when none of the kabe tiles are in your own hand, 10000 does not become all that safe. When 3 copies of 10000 are discarded by the two opponents not in riichi, it is less likely that they have the remaining copy of 10000, meaning that the opponent in riichi is more likely to have the last copy.

Other than 10000 (non suji 2836, half suji 456), however, the danger level is not changed much by how the kabe tiles are distributed. Other than 19 tiles, there is no need to pay attention to where the kabe tiles are.

3.8.2 Double one chance tiles are similar in safety to suji

Here the danger level of tiles for which 3 copies are visible for 2 different types of kabe tiles (double one chance) and tiles for which 2 copies are visible for 2 different types of kabe tiles (double two chance, e.g. 10000 when two copies of both 10000 and 10000 are visible) will be considered. Comparing tiles of the same type, the overall ranking in increasing danger level is suji, double one chance, one chance, followed by double two chance. In particular, half suji double one chance 10000 and 10000 are safer than suji 10000. Treat half suji double one chance 10000 and 10000 as if they were suji.

Additionally, non suji double two chance 10000, 10000, 10000 are more dangerous than non suji 19 are overall, but half suji double two chance 10000 and 10000 are safer than non suji 19 are overall. It may be helpful to recognize double two chance as a factor that decreases the danger level of half suji 456. Try to apply this information when trying to get betaori but lacking safe tiles and suji.

	Non suji 5	Non suji 4(6)	Non suji 3(7)	Non suji 2(8)	Non suji 1(9)	Half suji 5	Half suji 4(6)A	Half suji 4(6)B	Suji 3(7)	Suji 2(8)	Suji 1(9)	Full suji 5	Full suji 4(6)
Overall	12.8	13.1	9.5	8.6	7.4	7.4	7.2	7.9	5.5	3.9	1.8	2.2	2.3
4 → 2(6 → 8)			3.9			10.3			1.9		4.2	1.3	
5 → 2(5 → 8)		10.1	4.0		11.3		2.5	8.4	2.6		4.6		0.6
6 → 2(4 → 8)		11.3			11.2	3.6	4.6	8.5	3.6		5.0	1.1	1.6
4 → 3(6 → 7)	13.1			5.6		7.3				1.7	2.4	1.0	
5 → 3(5 → 7)		11.4			11.3		3.2	9.0		3.2	2.9		0.8
6 → 3(4 → 7)	8.2	8.9		7.3	8.7	4.5	3.1	6.8		2.2	3.6	0.7	0.8
2 → 4(8 → 6)			6.4			7.4			0.9		1.2	1.7	
2 → 5(8 → 5)		5.6	4.8		2.3		3.9	2.3	0.8		1.7		0.7
2 → 6(8 → 4)		7.0			3.1	4.9	4.7	2.8	1.5		1.6	1.5	0.8

Table 3.7: Danger level of tiles by discard sequence (turn 9, %)

3.9 Deduce danger levels of tiles from discard order

Until now, sotogawa, anko suji, etc. have all focused on one factor contributing to the danger level of a tile. In this section, two factors will be considered, that is the effect of a fixed discard order on the danger level of a tile. The author would like to investigate this topic further; more detailed analyses will come in the future, so think of this section as an introduction to the topic. It is often said that $\text{♠} \rightarrow \text{♠}$ discard followed by $\text{♠} \rightarrow \text{♠}$ discard makes ♠ dangerous. Indeed, discarding ♠ before riichi makes ♠ more dangerous, and declaring riichi with ♠ makes ♠ more dangerous. What happens then, if these two are combined, that is, ♠ is discarded and then riichi is declared with ♠ ? Table 3.7 shows the danger level of tiles in the same suit as two tiles from the same suit that were discarded before riichi following a particular order (e.g. $\text{♠} \rightarrow \text{♠}$).

First, let us consider what makes non suji ♠ dangerous. ♠ has a 11.3% danger level when $\text{♠} \rightarrow \text{♠}$ is discarded, a 11.2% danger level when $\text{♠} \rightarrow \text{♠}$ is discarded, and a 11.3% danger level when $\text{♠} \rightarrow \text{♠}$ is discarded. The danger level of ♠ has indeed increased from the cases where ♠ was discarded before riichi and riichi declared with ♠ were considered alone, but how much of an increase is it really? It might also seem that there is less of an increase than expected. Maybe a larger increase in danger level is not observed since these data include cases where riichi is not declared with ♠ . The fact that suji ♠ has a 5.5% danger level when riichi is declared with ♠ but only a 4.2% danger level against riichi having previously discarded $\text{♠} \rightarrow \text{♠}$ suggests that this is the case. Accordingly, it may be best to limit conclusions from these data to statements such as “the danger level of non suji ♠ does not exceed 11%.”

On the other hand, when the discard order is reversed, specifically $\text{♠} \rightarrow \text{♠}$ and $\text{♠} \rightarrow \text{♠}$, the danger level of non suji ♠ decrease to 2.3% and 4.1%, respectively. When ♠ is discarded early but ♠ or ♠ is discarded the turn before, there is no need to view ♠ as dangerous.

Let us consider some other data. When $\text{♠} \rightarrow \text{♠}$ is discarded, the danger level of half suji ♠ is 10%, higher the usual 9.5% danger level of non suji ♠ . It is best to be cautious of ♠ when $\text{♠} \rightarrow \text{♠}$ has been discarded.

A few important cases were discussed here, but for the interested reader other scenarios are listed in table 3.7 as well. These data may be useful for developing rules for wait reading.

	Non suji 5	Non suji 4(6)	Non suji 3(7)	Non suji 2(8)	Non suji 1(9)	Half suji 5	Half suji 4(6)A	Half suji 4(6)B	Suji 3(7)	Suji 2(8)	Suji 1(9)	Full suji 5	Full suji 4(6)
Overall	12.8	13.1	9.5	8.6	7.4	7.4	7.2	7.9	5.5	3.9	1.8	2.2	2.3
Dora	14.9	15.0	12.1	10.3	8.9	9.7	8.9	10.4	8.0	5.5	3.5	4.1	4.1
Dora indicator	13.8	14.4	11.2	9.5	6.9	8.1	8.0	8.9	6.4	3.9	0.5	1.6	1.9
Neither	12.7	13.0	9.3	8.5	7.3	7.3	7.1	7.8	5.3	3.8	1.7	2.1	2.2

(a) Danger level of dora number tiles (turn 9, %)

	Yakuhai			Guest wind		
	Live	1 visible	2 visible	Live	1 visible	2 visible
Overall	4.6	1.9	0.3	4.0	1.8	0.2
Dora	5.2	2.9	1.1	5.1	3.0	0.8
Dora indicator		2.1	0.2		1.5	0.2
Neither	4.5	1.8	0.2	3.8	1.7	0.2

(b) Danger level of dora honor tiles (turn 9, %)

Table 3.8







	Dora ron		Non dora ron		Dora tsumo		Non dora tsumo	
	Dealer	Non dealer	Dealer	Non dealer	Dealer	Non dealer	Dealer	Non dealer
Overall	11700	8000	8000	5600	13800	9500	10600	7400
Non suji 456	11600	7800	8300	5800	13700	9500	10700	7500
Non suji 37	10800	7500	7800	5600	13300	9100	10400	7400
Non suji 28	11200	7500	7600	5400	13300	9200	10100	7100
Non suji 19	11500	7700	7600	5300	13700	9300	10000	6900
Half suji 456	11600	8100	8500	6000	14200	9700	11100	7800
Suji 37	10300	7500	7800	5600	13100	9300	10700	7500
Suji 28	11100	8100	7900	5600	13800	9800	10500	7600
Suji 19	13600	9200	8200	5800	16600	11500	11300	8200
Full suji 456	12000	8800	8700	6200	14400	10500	11800	8300
Yakuhai	14500	9600	9800	6700	17400	11600	13100	8800
Guest wind	13300	9200	7900	5600	16200	10800	11000	7700

Table 3.9: Average point gain upon ron/tsumo for riichi waiting on dora/non dora

3.10 Prepare yourself when discarding dora

3.10.1 Deal in rate is higher for dora

Lastly, some topics regarding dora will be discussed. Dealing in with the dora increases the opponent's hand value by 1 han. For this reason, waiting on the dora or tiles near the dora is not uncommon. In this section, the danger level of the dora and the losses when dealing in with dora will be considered.



Tables 3.8a and 3.8b show the danger level of dora tiles. First, dora non suji  has a 14.9% danger level, 2% higher than the overall 12.8% danger level of non suji . Dora non suji  has a 10.3% danger level, 1.7% higher than the overall 8.6% danger level of non suji . Additionally, dora suji  has a 5.5% danger level, 1.6% higher than the overall 3.9% danger level of suji . In all cases, the danger level of a tile is higher than usual when it is dora.

	Danger level	Point loss upon deal in	Expected point loss
Dora non suji 5	14.9	7800	1170
Dora half suji 5	9.7	8100	790
Dora non suji 2(8)	10.3	7500	770
Non dora non suji 5	12.7	5800	740
Dora live yakuhai	5.2	9600	500
Non dora non suji 2(8)	8.5	5400	460
Non dora half suji 5	7.3	6000	440
Dora suji 2(8)	5.5	8100	440
Dora full suji 5	4.1	8800	360
Non dora live yakuhai	4.5	6700	300
Dora 1 visible yakuhai	2.9	9600	280
Non dora suji 2(8)	3.8	5600	210
Non dora full suji 5	2.1	6200	130
Non dora 1 visible yakuhai	1.8	6700	120
Dora 2 visible yakuhai	1.1	9600	100
Non dora 2 visible yakuhai	0.2	6700	20

Table 3.10: Tile safety accounting for point losses. Expected point loss is computed by multiplying danger level (%) by point loss upon deal in.


3.10.2 Dealing in with dora increases point loss by 40%

Next, how much does dealing in with dora increase point loss by? When discussing push/fold judgement, dealing in with dora was treated the same way as dealing in to ippatsu, but let us specifically separate the expected point gain upon win by winning tile. Table 3.9 shows the average point gain upon win for riichi. The point gain upon win is the same as the point loss upon dealing in, so these data can be used to estimate how many points will be lost when dealing in. The average points for non dealer ron is 5600 points when winning on non dora, which increases to 8000 points if the winning tile is dora (the inconsistency with table 2.1 is due to the data being separated for ippatsu and non ippatsu in table 2.1 but not in table 3.9); there is a 2400 point increase when dealing in with dora, roughly a 40% increase when expressed as percentages. Considering this, treating dealing in with dora the same was as dealing in to ippatsu is not all that inaccurate.

When discarding suji , yakuhai, or a guest wind, however, the difference between point losses when dealing in with dora and dealing in with non dora is about 3000 points. The point loss when dealing in with these tiles is at least 9000 points, more than a mangan. This increase is because waits involving these tiles can only be shanpon or tanki, confirming that the hand has at least one other dora. Moreover, such waits often come from hands like riichi chiitoe dora 2, or riichi yakuhai dora 3, or riichi ura 3. In situations where you are safe barring a mangan deal in, avoid discarding dora suji , dora yakuhai, or dora guest wind.

3.10.3 Tile safety rules accounting for point losses

With information on both the deal in rate and point loss upon dealing in, let us now rank the safety of tiles taking both into consideration. Ranking every tile results in a rather long list, so for simplicity, only 258 tiles and yakuhai will be compared. Table 3.10 lists these tiles in decreasing order of expected point loss upon being discarded. With this table the risk when discarding dora can be evaluated.

Let us consider then the risk when discarding dora. First, the expected point loss when discarding dora 2 visible yakuhai is comparable to that of discarding non dora 1 visible yakuhai, both about 100 points. Likewise, the expected point loss when discarding dora 1 visible yakuhai is similar to that of discarding non dora live yakuhai, both about 300 points. Discarding dora live yakuhai has an expected point loss similar to that of discarding non dora non suji . Think this as dora 2 visible is non dora 1 visible, dora 1 visible is non dora 0 visible, and dora 0 visible is non suji.

Next, let us consider the values for number tiles. Discarding dora full suji  has an expected point loss of 360

points, lower than the 460 of discarding non dora ④ but higher than the 210 points of discarding non dora suji ④ . Discarding dora suji ④ has an expected point loss of 440 points, comparable to the 440 points of discarding half suji non dora ④ . Moreover, discarding non suji dora ④ has a similar expected point loss to that of discarding non dora non suji ④ , both about 800 points. Think of this as dora full suji ④ is somewhere between suji and non suji, dora suji ④ is non dora non suji ④ , dora non suji ④ is non dora non suji ④ .

Considering these points, there are not many situations during betaori where dora must be discarded. Put simply, it is okay to not discard dora unless it is a safe tile.

3.10.4 On wait reading

When compiling this data, the author had felt that “there is information that can be read from just the opponent in riichi’s discards alone.” It is true that it is best for players who have not mastered the basics of betaori to first learn to betaori according to the safety ranking and not make any poor attempts at reading. However, once these basics have been mastered, please try to gradually apply the principles of wait reading written in this book.

Moreover, if this much can be read against riichi, then even more information should be readable from open hands. In the case of riichi, the only exposed information is from the opponent’s discards, but in the case of an open hand, this information is accompanied by information from other exposed tiles, increasing the accuracy of reads. Currently data for open hands have not been collected, but further investigation of this topic will surely result in the development of more effective reading methods.