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# Prediction of the Winning Rate of Athlete Ma Long——Based on Probability Theory

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**Abstract.** Today, probability theory is becoming more and more useful in our daily life, and it is used more often in sports, especially in table tennis. As a well-known table tennis player from China, Ma Long is an experienced player in table tennis. The data from this study is mainly from @tingwalker who was famous for statistical table tennis data. This paper uses the probability theory to find the effects of the win rate of Ma Long as well as calculate the actual rate, including the effects we have to consider. It is more accurate than just considering the win rate of each competition or looking at the total winning rate of Ma Long. With the help of probability theory, the paper considers factors that affect Malone's winning rate, such as competition system, different players, independent events, and miss rate. Finally, it can be concluded that Ma Long's winning rate against Zhang Jike is as high as 78%~82%.

**Keywords:** Table tennis, probability theory, competition prediction.

## 1. Introduction

The paper attempts to forecast the outcome of each competition between Ma Long and the other competitors. It is obvious that each player has his or her main competitor who might win the championship. However, the players' physical state and combat mentality are different between different competitions. The competition system had a great influence on the players. For example, if the system is best-of-five, Player A has an 88% chance of winning. And if the system is five wins out of seven, then a player might have a 90% win rate. Different players also made a great difference. This paper wants to make a conclusion about the win rate of Ma Long when he suffered from different competitors and various competition systems. The probability theory is used to predict things that have some regularity but are not completely sure. The uncertainty of a player’s future makes me interested in predicting the winner of each game and overcoming the interference of opponents and the competition systems As we all know, probability theory makes use of random variables and probability distributions to assess uncertain situations mathematically.

## 2. Research method

The paper used conditional probability, which is defined as the likelihood of an event or outcome occurring, based on the occurrence of a previous event or outcome. A conditional probability is calculated by multiplying the probability of the preceding event by the updated probability of the succeeding, or conditional, event [1]. The data comes from @tingwalker. By using this calculating method, this paper is able to decide and make the probability of an event clearer.

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## 3. Results and analysis

First of all, let's consider the competition system. If Ma Long encounters a strong opponent player B robot. The win rate of Ma Long is only 0.4, while the Robot B is up to 0.6 [3]. At this point, how can Ma Long win the game more easily?

Let's divide into different competition system. The first one has two wins in three games.

We have two probabilities now. If Ma Long wins the first two rounds. (Let's consider the first probability as P(X) The win rate will be $P(X) = (0.4)^2 = 0.16$. Now we might think the probability is low. However, there is another probability is that, Ma wins the first round and the third round or he wins the second round and the third one. We will have $P(Y) = P(Y) = C_2^1 \times 0.4 \times 0.6 \times 0.4 = 0.192$. So the whole probability of Ma win the robot will be$P(W) = 0.16 + 0.192 = 0.352$.

Next, this paper considers another system. The system is three wins in five games.

This time, we have to consider more. Ma wins the first three rounds. The $P(X)=(0.4)^3=0.064$

Ma wins the second round and the third round and the fourth round. The probability will be $P(Y) = C_5^3 \times (0.4)^2 \times 0.6 \times 0.4 = 0.1152$.

Ma wins two rounds, the robot wins two rounds, and Ma wins the last round. The probability will be $P(Z) = C_4^2(0.4)^2 \times (0.6)^2 \times 0.4 = 0.1382$.

The whole probability will be $P(Total) = 0.0614 + 0.1152 + 0.1382 = 0.3174$.

It seems that the probability of the win rate becomes lower so what will happen if we use the four wins in seven games?

**Table 1.** The full record of the victory and defeat of Ma Long and Zhang Jike [2].

| The full record of the victory and defeat of Ma Long and Zhang jike | | | | |
|---|---|---|---|---|
| match | | Winner | | Total |
| | | Ma Long | Zhang Jike | |
| Total | Triumph | 38 | 14 | 52 |
| | Win rate | 73% | 27% | / |
| Three major competition | Olympic Games | 1 | 0 | 1 |
| | World Championships | 0 | 0 | 0 |
| | WorldCup | 0 | 1 | 1 |
| Tour Finals | An open tournament | 6 | 4 | 10 |
| | Finals | 4 | 0 | 4 |
| Asia Matches | Asian Games | 0 | 0 | 0 |
| | Asian Championship | 2 | 0 | 2 |
| | Asia Cup | 0 | 0 | 0 |
| Domestic Tournaments | National game | 2 | 0 | 2 |
| | National Championship | 2 | 0 | 2 |
| Other Tournaments | China Table Tennis Club Super League | 10 | 4 | 14 |
| | Direct Champion | 5 | 4 | 9 |
| | Exhibition game | 4 | 0 | 4 |
| | Qualifying game | 1 | 0 | 1 |
| | U18Tour Game | 0 | 1 | 1 |
| | U18Asian Youth Championship | 1 | 0 | 1 |

Now, we have more to consider: Ma wins the first four rounds and the probability will be $P(X) = (0.4)^4 = 0.0256$.

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Or Ma wins first three rounds and wins the fifth round. The probability will be $P(Y) = (0.4)^3 \times 0.6 \times 0.4 = 0.0614$

Ma wins three rounds and the sixth one. The probability$P(Z) = (0.4)^3 \times (0.6)^2 \times 0.4 = 0.0922$

The last situation is that Ma wins three rounds and wins the seventh one. The probability will be $P(A) = (0.4)^3 \times (0.6)^3 \times 0.4 = 0.1106$.

$P(Whole) = 0.0256 + 0.0614 + 0.1106 = 0.2898$.

From here we can get the conclusion. If Ma have more games to attend with the robot, the win rate will become lower and lower. We can find the importance of the sports game to have more games for the players. As the player we are weaker have larger probability to win when the number of games is very small. When the number of games become larger, the stronger player will be more likely to win the game. Instead of letting the weaker player win it by luckiness.

Table 1 presents the win percentage of Ma Long vs. Zhang jike. It can be observed that the win rate of Ma Long is up to 73%. We can multiply the win rate of the competition system and the win rate of different players he met. Then Ma Long's more accurate win rate against other competitors can be obtained. It is obvious that using the probability theory helps get more accurate number compared to just looking at the historical win rate.

Another contributing factor is independent events. The definition of independent events is that A and B are said to be independent if the probability of one event A occurring is not affected by the occurrence of another event B [4]. If Malone's hit rate is 0.9 and Zhang's is 0.8, what is the ball's total hit rate? $P(Total) = P(0.9 \cup 0.8) = 0.9 + 0.8 - 0.9 \times 0.8 = 0.98$.

According to formula we can draw the conclusion that if the hit rate is higher the amount of time the players need to defeat their competitors is also higher. It seems that the competition system is becoming more and more important. The player who is younger and has better endurance will win the game which lasts a long time and require to a huge amount of energy to win. We can investigate the endurance of each player before they have the competition. Injury and mentality will also have an influence here, which require the coaching staff to make changes that can't be calculated by the probability theory.

Then we should consider the missing rate.

f Malone hits the ball hard, Zhang's conceding percentage is 0.3. If Malone keeps hitting the ball with great power, Zhang's turnover rate will keep going up.

**Table 2.** Table tennis competition between Ma Long VS. Zhang jike [5].

| Ma | Zhang jike |
|---|---|
| 14 | 12 |
| 11 | 5 |
| 11 | 4 |
| 11 | 4 |

First time:$P(M_1) = 0.3$ Second time: $P(M_2) = 0.3 + 0.3 \times (1 - 0.3) = 0.51$

Third time:$P(M_3) = 0.3 + 0.3 \times (1 - 0.3) + 0.3 \times (1 - 0.3) \times (1 - 0.3) = 0.657$.[6]

From the data, it can be seen that the longer the horse hits the ball hard, the more likely Zhang is to make mistakes. The numbers will continue to increase as the batting time increases. If the numbers are getting bigger and bigger, the final number will get closer and closer to 1. That's why players choose to keep hitting the ball harder, as the batting average gets bigger and bigger, eventually approaching 1, the higher the odds of winning.

Also, the player must consider his missing rate when he hit the ball at this strength. If his missing rate will be greater than 0.3. Obviously, he will not use this attacking method or practice more during his daily exercises.

In the end, it can be argued that strong players are more eager to choose a format that has more games and will not end in a short time. When he encounters another player with a lower winning percentage

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than him, the actual winning percentage must be higher than what is shown in the historical winning percentage. Since Malone has consistently higher hit and miss percentages than his competitors, he's more likely to choose to hit the ball with a lot of power. The decisions he and the coaching staff made became very important when they faced different competitors.

## 4. Conclusion

This paper uses the method of probability theory to predict the winning rate of the athlete Ma Long in different scenarios. The final win rate is from 78% to 82%. In regulation games, when Ma Long suffers a loss to a competitor whose win rate for each round is 0.4, the win rate for Ma will be 0.2898. Ma's win rate will increase as the number of rounds in each game increases. What's more, the hitting and missing rates were also greatly influenced. When Ma reaches a higher hitting rate than his competitors, the hitting rate will be 0.98, which means the competitor is less likely to hit the ball. The tactical strategy leads to different choices for Ma. When the missing rate for Ma when he keeps hitting the ball hard is more than 0.3, he will not choose to use the strategy of hitting the ball hard, which makes it difficult for Zhang to hit the ball. Instead, Ma can choose the high missing rate strategy for Zhang. The data in this paper is limited, and it is hoped that future research can expand the scope of the data sample and obtain more accurate research results.

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