Analysis of Badminton Technical Movement Scoring Rate in International Competitions with the Help of Computer

Chunli Zhou¹,², Yang Jie²

¹ZhaoTong University, Kunming, Yunnan, China, 657000
²Yunnan Normal University, Yunnan, China, 650500

*Corresponding author e-mail: mxnnana369@ztu.edu.cn

Abstract. The ideas and methods of probability theory are used to establish a badminton scoring rate and technical movement model in international competitions with the help of computer. The differences in scoring rates in international competitions are compared quantitatively. The coping strategies in international competitions are proposed to provide a scientific basis for badminton players in China to adapt to new rules and improve training levels. At the same time, this technical movement model is also applicable to other ball games such as volleyball and table tennis.

Keywords: New Rules, Technical Movement Model, Coping Strategies, Computer

1. Introduction

Badminton falls in the category of score games, which is played by the game (match). When one party reaches a specified number of points, the player wins [1, 2]. The way of scoring includes both his own offensive hit and the opponent’s mistake. Specifically, during the match, all the technical and tactical behaviors of the athletes focus on one point, one game, and one match. The game process is a relatively complicated system [3]. It is relatively difficult to evaluate and analyze the badminton game completely. The technique is the starting point of athletes' tactics, and it is also the main indicator of scoring. At the same time, athletes with various skills can both score and lose points. Hence, in this paper, focusing on the starting point of badminton game tactics and the technique of athletes with the highest rate, we analyzed the single technique of players. The smash is for the opponent to hit the ball to the backcourt or midfield area. The goal is to try to hit the ball as high as possible. The speed of smash is fast, and the force is tremendous. It is a crucial scoring method in badminton games and has been extensively and deeply studied. Different studies on the effect of smash experts and scholars also have their own ideas, tactics to smash around research undertaken are becoming increasingly mature and stable [4].

This paper will use the ideas and methods of probability theory to establish a badminton scoring rate and score to technical movement model in international competitions to improve the theoretical basis for scientific training.
2. Technical movement model of badminton scoring rate
This technical movement model is also applicable to other ball items such as volleyball and table tennis.

(1) Scoring rate in international matches
Let two players (pair) play in A and B. In the competition for any ball, the probability of A serving and winning is \( P_1 \), and the probability of the second serve and first win is \( P_2 \). In the following section, the scoring rate of 1 point for 1 score in international matches is discussed.

Assume \( A_i = \{ \text{In the competition for the i-th ball in the international competition, the first team won (thus 1 point)} \} \), Then

\[
P(A) = P(A_{i-1} + A_{i-1}) \\
= P(A)P(A_{i-1}) + P(A_{i-1})P(A_{i-1} - 1) \\
= P(A_{i-1})P_i + \left[ 1 - P(A_{i-1}) \right] P_2 \\
P(A) = P(A_{i-1})P_i + P_2
\]

Recursion (1) is applied repeatedly, and the following can be obtained

\[
P(A) = P(A_{i-1} (P_1 - P_2)) + P_2 \\
= \left[ P(A_{i-2}) (P_1 - P_2) + P_2 \right] (P_1 - P_2) + P_2 \\
= P(A_{i-2}) (P_1 - P_2)^2 + P_2 (P_1 - P_2) + P_2 \\
= \cdots \\
= P(A_i) (P_1 - P_2)^{i-1} + P_2 (P_1 - P_2)^{i-2} + \cdots + P_2 (P_1 - P_2) + P_2
\]

(2)

If the start is served early, then \( P(A_i) = P_1 \), available at this time

\[
P(A) = P_1 (P_1 - P_2)^{i-1} + \frac{P_2 \left[ 1 - (P_1 - P_2)^{i-1} \right]}{1 + P_2 - P_1}, i = 1, 2, 3, \ldots
\]

(3)

If the start is served by B, then \( P(A_i) = P_2 \), at this point

\[
P(A) = \frac{P_2 \left[ 1 - (P_1 - P_2)^{i-1} \right]}{1 + P_2 - P_1}, i = 1, 2, 3, \ldots
\]

(4)

Due to \( 0 \leq P_1, P_2 \leq 1 \), So when \( i \) is larger, \( |P_1 - P_2|^{i-1} \) and \( |P_1 - P_2|^i \) are both small, at this time (2) and (3) can be approximated as

\[
P(A) \approx \frac{P_2}{1 + P_2 - P_1}, i = 1, 2, 3, \ldots
\]

(5)

3. Statistical analysis of technique use
Sports technique itself does not have any subjective color, and athletes have different understandings and applications of sports techniques, which also lead to various technical styles of different athletes. According to the technical statistics of the four outstanding men's singles players in the world, we can see the characteristics of each player's competition: In all the skills of Li Zongwei, picking accounts
for 22.44%, the highest, followed by rubbing and releasing, accounting for 18.60%. The third place is blocking, accounting for 14.68%, and smashing accounts for 12.10%. For Axelsen, picking also accounts for the highest proportion (26.89%), followed by rubbing (18.86%), the third-place is smashing (16.59%), and blocking accounts for 13.86%. For Chen Long, picking accounts for 23.81%, followed by rubbing (20.98%), the third-place is smashing, up to 15.21%, and dropping also reaches 13.64% (04) For Lin Dan, picking accounts for 26.84%, followed by rubbing (16.24%), blocking (14.06%), and dropping (12.54%) is also higher than smashing (11.26%).

The comparison shows that the four athletes' use of techniques in the game is mainly for picking and rubbing, but the technical ratio afterward is different. The ball, Axelsen, and Chen Long are more skilled in using the ball than blocking the ball. Li Zongwei and Lin Dan are similar in age and figure, and their use of technique is similar. As tall athletes, Chen Long and Chen Long have statistically similar technical styles.

Table 1 shows that the four athletes have different choices of serve techniques: Axelsen's serve characteristics are more prominent, the proportion of balls before serving the net accounted for 81.12%, the lowest among the four outstanding players; The percentage of field balls is also as high as 18.88%, the highest among the four athletes. The characteristics of Chen Long's serving are also quite unique. The proportion before serving the net is as high as 99.18%, which is the highest among the four athletes. And the two players Li Zongwei and Lin Dan's serve showed similar characteristics, Li Zongwei's smash near the net accounted for 91.25%, Lin Dan's smash near the net accounted for 91.91%.

| Before posting | After field |
|----------------|-------------|
| frequency      | percentage(%) | frequency | percentage(%) |
| Li Zongwei     | 240 91.25    | 23        | 8.75        |
| Anselon        | 202 81.12    | 447       | 18.88       |
| Chen Long      | 242 99.18    | 2         | 0.82        |
| Lin Dan        | 250 91.91    | 22        | 8.09        |

4. Coping strategies in international competitions

In response to the characteristics of the new rules, Chinese badminton players and coaches are working hard to develop a new set of technical and tactical methods to improve their technical and tactical capabilities and strive for the initiative on the field.

The most noticeable change of the new rules is that the game time has been shortened, but only 11 minutes of technical suspension is allowed in each game. There is also a break of no more than 60 seconds. The new rule inhibits many players who used to wipe sweat and drink water to control the game time and take the opportunity to rest and adjust their own rhythm. It is strictly prohibited in the new rules. Therefore, after a game, the rest time is reduced, and physical strength becomes highly essential. At this point, young players undoubtedly have an advantage. Especially in women's singles, the competition time is not only shortened but prolonged. Therefore, the usual training should meet the new rules and strengthen targeted training, instead of relying on experience alone. We should improve the players' physical fitness so that they can withstand the opponent's attack under the condition of considerable strength.

Attention is the ability to concentrate fully on a specific goal and not be distracted by other thoughts. It is also the ability to focus instantaneously, use the attention at any time, at will, and at random, and quickly distract attention. The new rules lead to the accelerated pace of the match, and the scores will change instantly. Athletes cannot get sloppy, and they have to keep highly focused. Otherwise, the judgment will be inaccurate, the start will be slow, and the movement will not be in place, which will affect the batting skills and anti-interference ability, such as external stimuli from opponents, referees, spectators, coaches, and changes in the environment. Meanwhile, it is necessary to adjust the incentives inherent in the athletes in time, such as self-doubt, anxiety, fatigue, and other
factors. Otherwise, they can lose if they are careless. It is difficult to come back after losing a few points. Especially for athletes who are slow to enter, they should adjust their attention in time and focus on any changes that occur on the field. In a fierce competition, in addition to the athletes' excellent skills and tactics, attention during the match is also a critical factor in winning. Attention training is an issue worthy of attention by athletes and coaches. Individual differences should be used to find the training that suits their concentration. They directly affect the improvement of the technical level of badminton players and their performance in the game.

In the match against Axelsen, Li Zongwei created 27.36% of the ball by rubbing, followed by blocking the ball, reaching 21.70%. It indicates that Li Zongwei often uses rubbing and blocking to create a chance of smash. Li Zongwei has high movement speed, with better techniques near the net, who often uses high-speed movement to seize the high point, make a high-quality rubbing, force Axelsen to serve the high ball, and win offensive opportunities for himself. It indicates that Li Zongwei's technical and tactical strategy of creating a ball against Axelsen: the technique of controlling the opponent's movement near the net to connect with the technique of the next bat, thus creating a chance to smash by blocking is also the main feature of Li Zongwei against Axelsen, i.e., the implementation of defensive counterattack tactics. On the one hand, it indicates that the effect of Axelsen's attack on Li Zongwei is not apparent. It also suggests that Li Zongwei has a better outcome of blocking the ball against Axelsen and can create opportunities for his own counterattack.

![Figure 1. Li Zongwei's technical characteristics of creating kills against three other athletes.](image)

5. Conclusion
The rally point system in international games makes the matches more accidental and unpredictable. The probability thinking method is an effective method to study the statistical law of random phenomenon and make the objective scientific judgment on the possibility of a random phenomenon. Hence, research on related scientific methods is full of theoretical and practical significance. In international competitions, we should focus on improving the technical and tactical capabilities of athletes, stabilizing their mentality on the playing court, improving their physical fitness, strengthening their attention training, striving to help Chinese badminton players create new glory in matches of new rules through scientific training.

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