Annals of Applied Sport Science, vol. 4, no. 1, pp. 39-47, Spring 2016
DOI: 10.7508/aass.2016.01.007

www.aassjournal.com
ISSN (Online)**: 2322 – 4479**
ISSN (Print)**: 2476–4981**

Original Article

www.AESAsport.com
Received: 18/11/2015
Accepted: 08/05/2016

Impact of Power Play Overs on the Outcome of Twenty20 Cricket Match

[1]Dibyojyoti Bhattacharjee, [2]Manish Pandey*, [3]Hemanta Saikia, [4]Unni Krishnan Radhakrishnan

[1]Department of Statistics, Assam University, Silchar, Assam, India. [2]Department of Statistics, Faculty of Guest, Cachar College, Silchar, Assam, India. [3]Department of Social Science, College of Sericulture, Assam Agricultural University, Jorhat, Assam, India. [4]Texas Cricket Academy, Texas, USA.

ABSTRACT

This study attempts to find if better performance in power play leads a team to victory in a Twenty20 match. Based on the methodology devised to do so, the study tries to measure the performance of both the teams during power play overs in terms of batting and bowling. The developed measure is called 'Prod' which is a product of the difference of batting and bowling performance of the teams during power play overs. The team with better performance in both the skills during power play is expected to win the match. But it would be difficult to predict the outcome of a match if the performance of a team is better in bowling and worse in batting and vice-versa. A total of 261 matches from different seasons of Indian Premier League (IPL) are considered for the study. The outcomes of 220 matches are predicted based on the performance of two teams in power play out of which 153 of them were correctly predicted. Remaining 41 matches could not be predicted as it is not clear which team performed better during power play. Thus, out of the matches where the dominance of a team was clear in the power play, 70 percent cases that team ultimately won the match in Twenty20 cricket.

KEY WORDS: ***Cricket, Performance Measure, Power Play, Prediction, Distribution Fitting, Sports.***

INTRODUCTION

Unlike other sports, there are different formats in the game of cricket at the international level *viz.* Test match, One-day and Twenty20. While Test match is an unlimited over match, One-day and Twenty20 matches have limited number of overs in each innings. In order to stop fielding captains from putting all their fielders on the boundary from the start of the batting side's innings, fielding restrictions are introduced in limited over matches (1). These rules restrict the fielding captain to keep nine fielders- including the bowler and wicket keeper- within a 30-yard circle (marked by a white line) of the batsman for a specific number of overs- first six, in the case of Twenty20 cricket. Though fielding restriction in limited overs cricket matches was introduced from 1996 world cup, the term 'power play' was introduced by the International Cricket Council in 2005 (2).

In a Twenty20 match played between two teams (say) A and B, Team A bats first for a maximum of 20 overs. In these 20 overs, Team A tries to score as many runs they can against the fielding of Team B. Team B tries to restrict

*. Corresponding Author:
Hemanta Saikia
E-mail: h.saikia456@gmail.com

the runs of Team A. At the end of the innings of Team A, a 'target' is set for Team B, which is one run more than the runs scored by Team A. This target is to be achieved by Team B within 20 overs of their batting without loosing all their wickets. The first six overs of any innings in a Twenty20 match are called the power play overs. In Twenty20 cricket, after the power play overs, a maximum of five fielders can be placed outside the fielding circle (3). As there are only two fielders outside the 30-yard circle during power play so the batsman is expected to play more attacking shots and excel the rate of scoring runs. Although it may appear self-evident that run scoring increases during power play, it is conceivable that aggressive batting leads to more wickets which in turn results in fewer runs (2). In a full length Twenty20 match, both the teams get the advantage of the six power play overs to excel the rate of scoring runs. In Twenty20 cricket, one over is equivalent to five percent of the total balls that the batting team is supposed to face. Thus, during power play, in a Twenty20 match, 30 percent of the balls (deliveries) available to the batting team are consumed. This study aims at finding the impact of power play in the outcome of Twenty20 cricket matches. Between two teams, Team A and Team B, the study tries to find out the expected winner of the match based on the performance of the two teams in their respective power play overs. In other words, based on the team performance of only 30 percent of both the innings of the match, the winner of the match is to be predicted.

Review of Literature. Cricket is a data-rich sport. Therefore, it seems obvious that analytical work on cricket shall be attended by researchers interested in quantitative issues. One such area of cricket, where an enormous amount of analytics are involved comprises performance measurement of cricketers, especially in batting and bowling. Some studies are performed on optimal playing strategies in one-day international cricket with special focused on either batting strategies or on bowling strategies. The studies related to batting strategies are performed by the authors like Clarke (4), Clarke and Norman (5) and bowling strategies is performed by Preston and Thomas (6). Using multiple linear regression model, Allsopp and Clarke (7) tried to determine the relative batting and bowling strength of the teams in one-day cricket. Using relative batting and bowling strengths of teams along with parameters like home advantage, winning the toss and the establishment of a first-innings lead Allsopp and Clarke (7) explored how these factors affect outcomes of Test matches. A similar technique was applied by Bailey and Clarke (8) and tried to predict match outcome in one-day international cricket. Petersen *et al.* (9) found that bowlers had more impact than batsmen during Twenty20 matches. The bowlers by taking wickets are able to restrict the run rate of the batting team. But, in the paper, no discussion followed about the outcome of the matches based on the analysis of batting or bowling strategies. However, Douglas & Tam (10) suggest that batting strategies should mainly focus on scoring 4's and 6's with the power play overs. Silva, Manage and Swartz (2) investigates the impact of power play overs in one-day cricket and found that power play provides an advantage to the batting side and more wickets also fall during the power play. They also investigated individual batsman's and bowler's performance during power play. But none of the aforesaid studies has investigated whether the outcome of the match depends on the performance of the teams in power play overs in any form of limited over cricket.

Objective of the Study. The first six overs of any innings in a Twenty20 match are identified as power play overs. In those overs, only two fielders are allowed to field outside the 30-yard circle of the cricket field. This is an invitation to the batsman, to go for lofted shots over the heads of the fielders within the 30-yard circle, for high-scoring shots. In an attempt to score more runs, during the power play overs, through lofted shots the batsmen risk their wickets. In Twenty20, as each innings comprises of 20 overs, so power play overs comprises of 30 per cent of the bowling resources available to the batting team. The paper is set to study if the performance of a team in power play determines the outcome of the match. In other words, by comparing the performance of two teams in power play in a given match, can one predict the winner of the match?

MATERIALS AND METHODS

Suppose two teams Team A and Team B are playing a Twenty20 cricket match. Team A, is the team batting first and Team B tries to restrict the runs of Team A through bowling and fielding. Thus, the following terms are defined to measure the performance of Team A and Team B for that match.

- BP_PP_A = Batting Performance of Team A in power play
- CBR_B = Combined Bowling Rate (Bowling Performance) of Team B in power play
- R_PP_A = Runs scored by team A in power play
- R_T_A = Total runs scored by team A in the match
- RL_PP_A= Percentage of resources left to team A at the end of power play
- R_T_B = The target runs for team B to win the match = $R\_T_A + 1$
- W_A = Number of wickets lost by team A in power play

Now based on the above mentioned variables we define,

Bowling average of Team B in power play (BA_B) =

$$\frac{\text{Runs scored by Team A in Power play}}{\text{Wickets lost by Team A in power play}} = \frac{R\_PP_A}{W_A}$$

,

Economy rate of Team B in power play (ER_B) =

$$\frac{\text{Runs scored by Team A in Power play}}{6} = \frac{R\_PP_A}{6}$$

Bowling strike rate of Team B in power play (BSR_B) =

$$\frac{\text{No. of legal deliveries bowled by Team B in Power play}}{\text{Wickets lost by Team A in power play}} = \frac{36}{W_A}$$

Combining the terms BA_B, ER_B and BSR_B, Lemmer (11) defined a combined bowling rate to measure the performance of a bowler as

$$CBR = \frac{3R}{W + (B/6) + W \times \frac{R}{B}} \quad \text{… (a)}$$

where R is the runs conceded, B number of legal deliveries and W wickets taken by a bowler.

In the current context, the bowling performance of team B in power play following (a) shall be,

$$CBR_B = \frac{3R\_PP_A}{W_A + (6) + W_A \times \frac{R\_PP_A}{36}} \quad \text{… (b)}$$

As wickets fall, the batting team's wicket strength deteriorates and accordingly measured by the number of wickets that had fallen. Instead of just counting the number of wickets down, it is important to take into account the ability of the batsmen whose wickets had been taken. When top order batsmen lose their wickets, the strength of the team is weakened more than when lower order batsmen lose their wickets. In order to take this into account, the wicket weights shall be used in the CBR formula. This concept modifies the previous formula as in (c) using Lemmer (12) by

$$CBR_B{*} = \frac{3R\_PP_A}{W_A{*} + (6) + W_A{*} \times \frac{R\_PP_A}{36}} \quad \text{… (c)}$$

This term shall measure the bowling performance of the fielding team in power play (*i.e.* the bowling performance of Team B). In the same way, the bowling performance of Team A is

$$CBR_A{*} = \frac{3R\_PP_B}{W_B{*} + (6) + W_B{*} \times \frac{R\_PP_B}{36}} \quad \text{… (d)}$$

It is to be noted that CBR^* is a reverse measure. The smaller it is better is the bowling performance and *vice-versa*.

Table 1. Wicket weights as deduced in Lemmer (12)

Batting Position	1	2	3	4	5	6	7	8	9	10
Wicket weights	1.3	1.35	1.4	1.45	1.38	1.18	0.98	0.79	0.59	0.19

Batting Performance of Team in Power Play. The batting team's progress in power play depends on two factors, namely how rapidly the team scores runs and how well wickets are been preserved. It is customary to assess the scoring process by calculating the run rate from time to time, but in addition to that, the batting shall not loose much of its resources in terms of loss of wickets. The batting performance of Team A in power play is defined by,

$BP\_PP_A =$

$$\frac{\text{Runs scored in power play by team A}}{\text{Total runs scored by Team A in the Match}} \times \%\text{ of resources left after Power play}$$

$$= \frac{R\_PP_A}{R\_T_A} \times RL\_PP_A \qquad \ldots \text{(e)}$$

RL_PP_A is the percentage of resource left after power play of Team A. This term shall be determined from the Table of Duckworth and Lewis (DL) for Twenty20 matches. For example, if Team A scores 50 for 2 in 6 overs then the DL table shall tell us the percentage of resources left with the batting team at the end of power play is 71.4 %.

Table 2. Resource as per Duckworth-Lewis for Twenty 20 cricket at the end of power play

Wickets lost	0	1	2	3	4	5	6	7	8	9
Resource Left	75.4	73.7	71.4	68.0	63.4	56.9	47.7	35.2	20.8	8.3

However, the team batting second shall have a fixed target to attain. This is not available for the team batting first. So slight modification in the batting performance index of the team batting second (*i.e.* Team B) in this case shall be done.

$BP\_PP_B =$

$$\frac{\text{Runs scored in power play by team B}}{\text{Target runs for Team B in the Match}} \times \%\text{ of resources left after Power play}$$

$$= \frac{R\_PP_B}{R\_T_A + 1} \times RL\_PP_B \qquad \ldots \text{(f)}$$

Now, $D(Bat) = BP\_PP_A - BP\_PP_B$ is the difference of batting performance of the two teams in the power play. If D(Bat) is positive it means that the batting performance of Team A is better than the batting performance of Team B. But, if D(Bat) is negative it means Team B is better than Team A in batting.

Similarly, $D(Bowl) = CBR_B^* - CBR_A^*$ is the difference in the bowling performance of the two teams in the power play. Since CBR^* is a reverse measure so $CBR_B^* - CBR_A^*$ is considered instead of $CBR_A^* - CBR_B^*$. If D(Bowl) is positive it means that the bowling performance of Team A is better than the bowling performance of Team B. But, if D(Bowl) is negative it means Team B is better than Team A in bowling. We define now the following statistic

$$Prod = D(Bat) \times D(Bowl) \qquad \ldots \text{(g)}$$

The value of the 'Prod' can be positive or negative or zero in the following fashion (Table 3).

In this process, one cannot consider the matches where the value of 'Prod' is negative at least for the time being. But one can expect results of the matches, with positive 'Prod' values. One may compare the expected result of such matches with the actual result and see how far they are correct. This shall help us to conclude what the impact of power play is, in the outcome of the match (only for those matches with positive Prod values).

Table 3. Nature of 'Prod' values and expected results

No.	Value of Prod	D(Bat)	D(Bowl)	Comment	Expected Result
(i)	Positive	Positive	Positive	Team A is better performer in power play than team B both in bowling and batting	Team A shall win
		Negative	Negative	Team A is poor performer in power play than team B both in bowling and batting	Team B shall win
(ii)	Negative	Positive	Negative	Team A is better performer in power play than team B while batting but while bowling Team B is better	Difficult to conclude who shall win
		Negative	Positive	Team B is better performer in power play than team A while batting but while bowling Team A is better	
(iii)	Zero	Zero	Zero	Both the teams performed equally in both batting and bowling in power play	Difficult to reach a conclusion about the winner of the match

Now, certain special cases under (ii) may be considered. It may so happen that, D(Bat) is slightly less than zero but D(Bowl) is significantly greater than zero, accordingly 'Prod' value is negative. But the corresponding values of D(Bat) and D(Bowl) indicate that Team B 's batting performance is little better than that of Team A in the power play overs, but Team B's performance in bowling is much poor compared to the bowling performance in Team A in power play. In such a case, it can be expected that Team A shall win for a highly superior performance in bowling compared to a very marginal inferior performance in batting. Similarly, it may also happen that D(Bat) is slightly more than zero but D(Bowl) is significantly less than zero accordingly the 'Prod' value is negative. But the corresponding values of D(Bat) and D(Bowl) indicate that Team A's batting performance is little better than that of Team B in power play, but Team A's performance in bowling is much poor compared to the bowling performance in Team B during power play. In such a case, it can be expected that Team A shall loose for a highly inferior performance in bowling compared to a very marginal better batting performance. Thus, it is necessary to identify the threshold values of marginally and significantly better batting and bowling performances of teams, identifying the distributional pattern of D(Bat) and D(Bowl). This issue shall be considered in the subsequent section of the paper.

RESULTS

To study the impact of power play on the outcome of Tewnty20 matches all the complete matches of four previous seasons of Indian Premier League (IPL) were considered. The IPL is a franchise based cricket tournament organized by Board of Cricket Control in India played between generally eight teams named after Indian cities or states. But the teams are formed by competitive bidding amongst the franchisees from domestic and international players. The seasons of IPL considered for the study are 2012, 2013, 2014 and 2015. The total number of Twenty20 matches played during the four seasons is 261. The break up is being 72, 75, 60 and 54 in the seasons 2012, 2013, 2014 and 2015 respectively. The details of the match information, score etc. necessary for computation is collected from tournament pages of the website www.espncricinfo.com for the respective seasons. Based on the methodology discussed in the previous section calculations are done and the compiled result is provided in Table 4 below.

The table shows that out of 261 matches, the outcome of 220 matches are predicted based on the performance of two teams in power play only and 41 of them cannot be predicted. Out of these 220 matches, the outcome of 153 matches is correctly predicted. Thus, the accuracy of prediction is 69.5 percent for the matches in which prediction is possible.

Table 4. Compiled results of different IPL seasons

Season	Correct Prediction	Wrong Prediction	Prediction Unable	Total matches
2012	40	20	12	72
2013	42	20	13	75
2014	35	16	9	60
2015	36	11	7	54
Total	153	67	41	261

Next, an attempt is made to use the concept of distribution theory to predict the winner of some more matches in which the previous model is unable to predict the winner. In other words, an attempt is made if some matches under No. (ii) of Table 3 can be predicted. In some of the matches, under No. (ii), it may so happen that, D(Bat) is slightly less than zero but D(Bowl) is significantly greater than zero accordingly 'Prod' value is negative. But the corresponding values of D(Bat) and D(Bowl) indicate that Team B 's batting performance is little better than that of Team A in the power play. However, Team B's performance in bowling is much poor compared to the bowling performance in Team A in the power play. In such a case, it can be expected that Team A shall win for a highly superior performance in bowling compared to a very marginal inferior performance in batting. Similarly, it may also happen that D(Bat) is slightly more than zero but D(Bowl) is significantly less than zero accordingly the 'Prod' value is negative. But the corresponding values of D(Bat) and D(Bowl) indicate that Team A's batting performance is little better than that of Team B in the power play. However, Team A's performance in bowling is much poor compared to the bowling performance of Team B in the power play. In such a case, it can be expected that Team A shall loose for a highly inferior performance in bowling compared to a very marginal better batting performance. Thus, it is necessary to identify the threshold values of marginally better and significantly better batting and bowling performances of teams. Accordingly, the distributional pattern of D(Bat) and D(Bowl) are identified. D(Bat) follows normal distribution with mean 0 and standard deviation 7.339 and D(Bowl) follows normal distribution with mean 0 and standard deviation 10.13. The 45th to 55th percentile of D(Bat) and D(Bowl) indicates marginally better/poorer performance of one team compared to the other. Similarly, the values of D(Bat) (or D(Bowl)) lying above the 75th percentile indicates significantly better batting (or bowling) performance of Team A compared to Team B. Likewise, the values of D(Bat) (or D(Bowl)) lying below the 25th percentile indicates significantly poorer batting (or bowling) performance of Team A compared to Team B. Identification of these threshold values helps to predict the outcome of some of the matches which falls under case (ii), based on power play results.

Table 5. Threshold values of D(Bat) and D(Bowl)

	25^{th} Percentile	45^{th}Percentile	55^{th}Percentile	75^{th}Percentile
D(Bat)	-6.8326	-1.2729	1.2729	6.8326
D(Bowl)	-4.99	-0.9298	0.9298	4.99

For example, in the 52nd match of IPL 2012 between Pune Warriors India (Team A) and Rajasthan Royals (Team B), the values of D(Bat) and D(Bowl) are 0.2675 and -7.1307 respectively. Thus, the corresponding 'Prod' value is negative, taking to (ii) of Table 3, making predicting the winner of the match difficult based on the results of power play overs. The values D(Bat) and D(Bowl) in comparison with the threshold values in Table 4, indicates that Pune Warriors'(PWI) batting performance is little better than that of Rajasthan Royals (RR) in power play, but PWI's performance in bowling is significantly poor compared to the bowling performance of RR in power play. Thus, PWI is expected to loose for a highly inferior performance in bowling compared to a very marginal better batting performance.

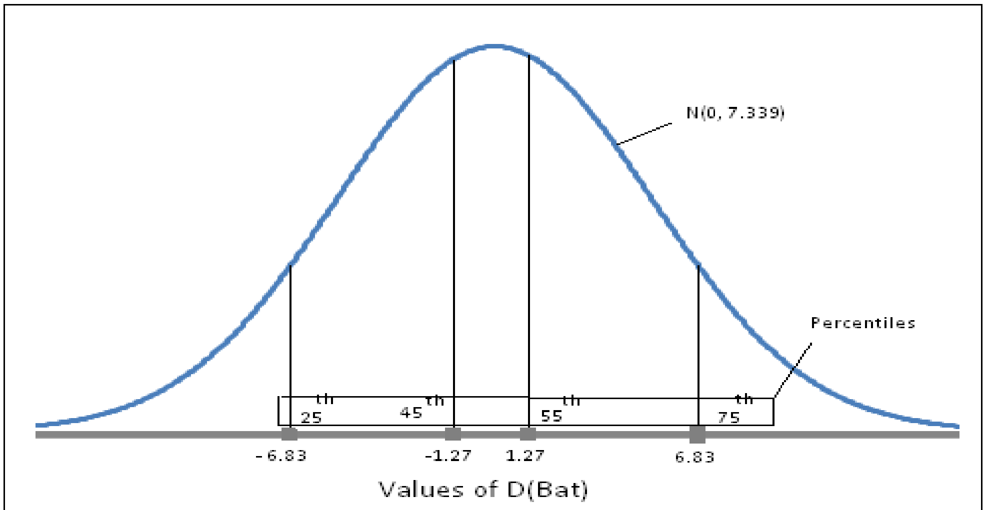

Figure 1. Density function of D(Bat) along with relevant percentiles

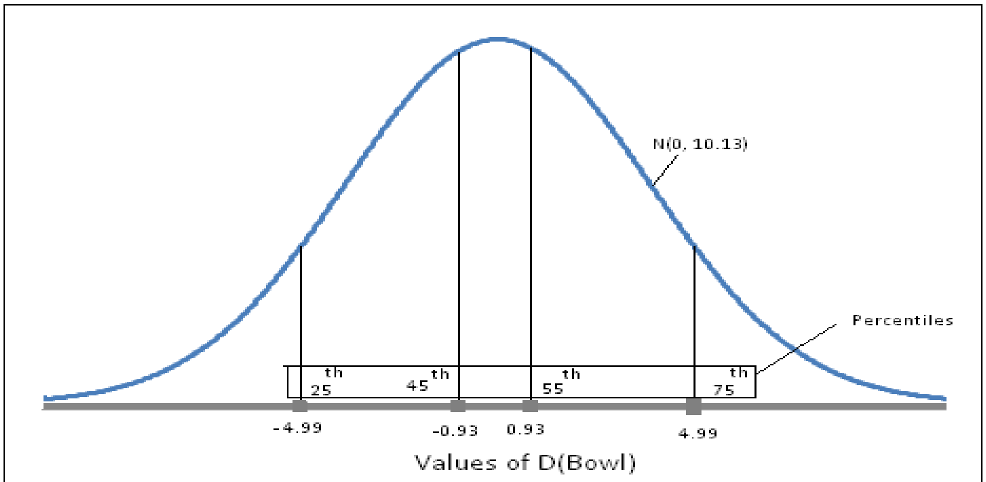

Figure 2. Density function of D(Bowl) along with relevant percentiles

Following this exercise, seven more matches which earlier could not be considered for prediction are now predicted. Out of these, three of them could be correctly predicted and the remaining lead to wrong prediction (details can be seen in column 10 of Appendix I). After this exercise, predictions of 227 matches are made based on the performance of the two teams based on power play overs only. Out of which 156 are correctly predicted. Thus, better team performance in power play was responsible for the victory of the team in 68.7 percent matches. However, in 34 matches (41□7) it was not clear which team performed better during the power play overs and hence no prediction could be made.

DISCUSSION

An interesting situation may develop in the computation in case a Twenty20 match gets truncated because of bad weather conditions. Such a match may get affected in a number of ways. Either the start of the match may be delayed leading to a reduction of an equal number of overs in both the innings. In such a case the power play overs of each team are also reduced, but shall be equal in number in both the innings. Or, bad weather conditions may disturb the progress of the match sometimes when the first innings is in progress. This may lead to reduction of overs only in the second innings of the match. In such a case, the team batting second, Team B in this case, shall be given a revised target obtained by the application of the Duckworth-Lewis method. The power play overs shall also be of unequal numbers in the two innings. In both the cases minor modifications are proposed in the formulae (c), (d), (e) and (f), as follows in chronological order:

$$CBR_B{*} = \frac{3R\_PP_A}{W_A{*} + \text{No. of Power play overs} + W_A{*} \times \dfrac{R\_PP_A}{\text{No. of legal deliveries in power play}}}$$

$$CBR_A{*} = \frac{3R\_PP_B}{W_B{*} + \text{No. of Power play overs} + W_B{*} \times \dfrac{R\_PP_B}{\text{No. of legal deliveries in power play}}}$$

$$\text{BP\_PP}_A = \frac{\text{Runs scored in power play by team A}}{\text{Total runs scored by Team A in the Match}} \times \%\ \text{of resources left after Power play}$$

$$\text{BP\_PP}_B = \frac{\text{Runs scored in power play by team B}}{\text{Revised Target for Team B as per DL method}} \times \%\ \text{of resources left after Power play}$$

The other calculations shall follow in the usual manner.

CONCLUSION

The study tried to understand the impact of power play overs of Twenty20 cricket matches on the ultimate result of the match. An attempt is made to find out if better performance in power play leads a team to victory in a given match. A methodology is accordingly devised. The methodology first finds out the performance of both the teams during the power play overs both in batting and in bowling. The team better in performance in both the skills during the power play is expected to win the match and vice-versa. The prediction based on performance in power play overs is not possible in those matches, in which a team is better in batting but worse in bowling than its opponent or vice-versa. To test the model, complete Twenty20 matches of four seasons of Indian Premier League from 2012 to 2015 are considered. Out of 227 matches for which better power play team could be identified, in 156 matches the dominance of the better power play performing team continued until the end. This shows that the power play overs, though occupy only 30 percent of a Twenty20 match actually dominate the outcome of matches in 68.7 percent cases, provided a team is ahead of its opponent in both batting and bowling.

APPLICABLE REMARKS

- Based on past data from the Indian Premier League of the yesteryears, the study tells that the team that outplays its opponent in power play generally has more chance of winning the match.
- This finding is important in designing the strategy of Twenty20 cricket matches. Now, the team can arrange its batting order or shuffle their bowlers in such a way that they can attack their opponent in the power play overs.
- Instead of risking their resources in the power play overs team can set up a strategy so that reasonable but steady progress can be made during the power play overs.

REFERENCES

1. Knight J. Cricket For Dummies. 2nd ed: John Wiley & Sons; 2013. 352 p.
2. Silva RM, Manage ABW, Swartz TB. A study of the powerplay in one-day cricket. European Journal of Operational Research. 2015;244(3):931-8.
3. The free encyclopedia. Twenty20 Cricket: Wikipedia; 2015. Available from: https://en.wikipedia.org/wiki/Twenty20.
4. Clarke SR. Dynamic Programming in One-Day Cricket-Optimal Scoring Rates. The Journal of the Operational Research Society. 1988;39(4):331-7.
5. Clarke SR, Norman JM. To Run or Not?: Some Dynamic Programming Models in Cricket. The Journal of the Operational Research Society. 1999;50(5):536-45.
6. Preston I, Thomas J. Batting Strategy in Limited Overs Cricket. Journal of the Royal Statistical Society Series D (The Statistician). 2000;49(1):95-106.
7. Allsopp PE, Clarke SR. Rating Teams and Analysing Outcomes in One-Day and Test Cricket. Journal of the Royal Statistical Society Series A (Statistics in Society). 2004;167(4):657-67.
8. Bailey M, Clarke SR. Predicting the match outcome in one day international cricket matches, while the game is in progress. Journal of sports science & medicine. 2006;5(4):480-7.
9. Petersen C, Pyne DB, Portus MR, Cordy J, Dawson B. Analysis of performance at the 2007 Cricket World Cup. International Journal of Performance Analysis in Sport. 2008;8(1):1-8.
10. Douglas JM, Tam N. Analysis of team performances at the ICC World Twenty20 Cup 2009. International Journal of Performance Analysis in Sport. 2010;10(1):47-53.
11. Lemmer HH. The combined bowling rate as a measure of bowling performance in cricket. South African Journal for Research in Sport, Physical Education and Recreation. 2002;24(2):37-44.
12. Lemmer HH. A method for the comparison of the bowling performances of bowlers in a match or a series of matches. South African Journal for Research in Sport, Physical Education and Recreation. 2006;27(1):75-85.