IOSR Journal of Sports and Physical Education (IOSR-JSPE)
e-ISSN: 2347-6737, p-ISSN: 2347-6745, Volume 11, Issue 2, Series 1,(Mar. – Apr. 2024), PP 14-22
www.iosrjournals.org

Cricket's Analytical Revolution: Exploring the Cutting Edge of Data-Driven Insights

Priyanka Talukdar[1]

Abstract
Due to the advancement in sports analytics, availability ofdata, tools and techniques,researchers, analysts and sports authorities are now attracted towards analytical studies in sports. The field of sports is an arena where returns on investmentsare much greater now as compared to the yester years. Stiff competition is another factor which has promoted analytical investigations in sports.Cricket is a game thathas the second highest viewership in the Indian subcontinent. In fact, shorter versions of cricket, viz. Twenty20 and ODI have huge media coverage. The latest addition to this is the Twenty20 franchise cricket likethe Indian PremierLeague (IPL)of India, Big Bash League of Australiaetc.These leagues have escalated immense passion for cricket, tough competition among the teams and also investment of huge money for acquiring top players. In the current study, anattempt is made to disseminate information about the statistical and analytical research studies which have been conducted in cricket.
In any sports, performance is the focus and its improvement is thus a fundamental objective.Study on sports performance can beforindividuals and also over-all team based. Here, a review is done about different indices for measuring batting and bowling skills. The performance indicators in fielding, wicket keeping, etc., which are also key part of acricket match,are highlighted. Here, attempt is also made to review different studies based on optimum strategies for teams, modelling of cricket data, scheduling of a cricket match, theeffect of home-ground advantage, effect of toss, prediction of match outcomes,selection of a balanced playing eleven, and target rescheduling methods.
KeyWords:*Cricket Analytics, Performance Indicators, Statistical Methods, Batting and Bowling Indices*

Date of Submission: 14-04-2024 Date of Acceptance: 24-04-2024

I. Introduction

Due to the rapid progress in technology, there has been a staggering accumulation of data in all field of studies. To decipher this vast data landscape, the necessity for analysis, along with the use of modern analytical instruments and methodologies, has seen a significant surge. Analysts use these analytical tools to extract unrecognized patterns from the past dataset.Similarly, sports data analysis is also growing fast. In the ever-growing arena of sports, the incorporation of analytics has turned out to be a pivotal point, by transforming the way teams plan their strategies, players training, and fans involvement with the game. In the realm of sports, analytics hold a vital role in addressing challenges and competitions associated with every game. These include, but are not limited to, the assessment and ranking of players based on their unique skills, the formation of teams with a harmonious blend of these skills, and the ranking of these teams. They also aid in contract negotiations, the appraisal of sports enterprises and their prospective revenue sources, and the orchestration of both physical and mental training regimes.Moreover, they contribute to the formulation of strategies aimed at securing victories in games and tournaments, the evaluation of the efficacy of coaches and referees, and the medical and actuarial examination of sports injuries for health and insurance purposes. They also assist in the scrutiny of existing regulations and the identification of areas for potential improvement, the enhancement of equipment and technology, the allocation of awards, the preservation of historical records, and the calculation of odds for betting activities. From a business perspective, analytics has been instrumental for the optimization of ticket pricing, boosting fan engagement, and thereby increasing revenue generated from sports.Intrinsically linked to all these aspects is the clear statistical representation of both raw data and its derived insights, which is crucial for decision-makers to facilitate effective planning and execution. Additionally, the media and the general public have a pronounced interest in statistics that are presented in a visually appealing manner.

In fact, the first reference to the use of analytics in sports is found in the series of books entitled “The Bill James Baseball Abstract’ by George William James in the year 1977. James initiates the new branch called

[1]Assistant Professor, Department of Statistics, St. Xavier’s University, Kolkata- 700160, Email: stat.prt@gmail.com

'Sabermetrics' which deals with the scientific study of baseball data to investigate the factors behind victory and defeat of a baseball team. The term Sabermetrics is adopted from the 'Society for American Baseball Research'. This inspired the manager of a small Major League Baseball (MLB) team viz., Oakland Athletics, Billy Beane to use analytics for the first time. Billy Beane became interested to apply data-based approach for the purpose of team selection and determination of strength and specialization of the players who were ignored by the wealthy baseball leagues during previous player auctions. This ultimately brought a revolution in the history of baseball and that team of Billy Beane was able to secure 20 consecutive victories during the 2002 MLB season. The incredible result from the Oakland Athletics team became the subject matter of the book 'Moneyball: The Art of Winning Unfair Games' which was authored by Michael Lewis (2004). The Moneyball concept, which was first introduced by Billy Beane and gained widespread recognition through Michael Lewis's book and its subsequent movie version, has profoundly influenced how baseball teams assess and appreciate their players.

According to Fry and Ohlmann (2012), popularity and application of analytics has swiftly escalated as evident from the sports practitioners, trainers, coaches as well as the team management. Today, statistics sections are indispensable part of websites of important sports-bodies including the National Football League (NFL), Major League Baseball MLB), National Basketball Association (NBA),ESPNcricinfo.com (Perera, 2015). Moreover, quantitative studies on sports using different statistical methods and data mining techniques are emergent topics in different distinguished journals and societies. Swartz (2016) reveals that cricket ranks second in terms of the viewers or participants across the world. Clarke (1997) points out that cricket has the distinction of being the first sports to be used for explaining statistical concepts. Manage and Scariano (2013) highlights even though a vast scope for statistical analysis exists for cricket, yet comparatively less research has been made on cricket than baseball, soccer and basketball. However, after the introduction of limited overs edition of cricket, there is a paradigm change in the scenario. Popularity of cricket has been growing rapidly since last decade of twentieth century. There is a heavy increase of non-field cricket viewers via world-wide media coverage with the help of satellite technology and internet services. Very recently, it has accelerated further, particularly in Indian sub-continent after the introduction of league-based cricket like the Indian Premier League (IPL), Big Bash League and also due to the availability of mobile apps like Hotstar, SonyLIV Sports, Star Sports, SkySports, Cricbuzz, ESPNcricinfo etc.

Cricket boasts an impressive fan base of approximately three billion individuals, a statistic surpassed only by soccer and has a viewership of more than 2.3 billion enthusiasts. As per November, 2023 records, 108 nations are now currently the members of International Cricket Council (ICC). In the international arena, cricket is professionally contested in two primary formats: limited overs cricket and the test cricket. A Test cricket match between major cricket-playing nations customarily undergoes for a period of five days. Conversely, limited overs matches are structured to commence and conclude within the same day (or night). To illustrate, One Day International (ODI) matches are played for 50 overs per innings while Twenty20 International (T20I) matches are played for 20 overs per innings. The Twenty20 Internationals have the shortest duration among the three versions of international cricket, with matches generally lasting for a duration of three hours, thereby aligning the sport more closely with the temporal span of other sports like soccer.The game of cricket involves two teams of a batting and bowling lineup consisting of 11 players.Each team comes for batting and bowling in a session and is referred to as an innings. The main action happens on a 22-yard-long pitch with wickets consisting of three stumps and two bails at each end. Players are categorized as batsmen, bowlers, and a wicket-keeper. The bowling team positions all players on the field with one behind the wickets, one bowling, and others fielding as per the captain's arrangement. Two batsmen from the batting team alternate while one bats and the other waits. The batting team starts with 10 wickets. They aim to defend these wickets while scoring runs, whereas the bowling team strives to dismiss batsmen quickly and restrict runs. The team with the highest runs at the match's conclusion emerges as the winner.

The scope of research in cricket analytics are enormous and is evident from the following literature in this field.

II. Review of Literature

Performance Indicators in Cricket

Clarke (2007) finds that some indicators exist in each and every game that pointstowards the standard of performance of the players involved in that particular game. Peterson et al. (2008a) have emphasized on the importance of statistics for defining and forming essential game strategies in cricket.Many recent studies have also highlighted the importance of choosing essential key performance indicatorsfor developing real-time performance analysis systems. For defining different aspects of individual player performances, team performances or team-specific elements, different variables or group of action variables are used which are commonly referred to as performance indicators(Hughes and Bartlett, 2002). Moore et al. (2012)find that though performance indicators (PI) are essential tools for gauging the performance of players, teams etc., yeta smaller number of research studies are available for cricket than other sports.Currently, coaches utilize

performance indicators post-game to assess both individual performances (such as batting, bowling, and fielding) and overall team performance (Peterson et al., 2008a). Additionally, these serve crucial role in the development of team strategies and tactics, influenced by an understanding of the relative importance of team performance indicators (Peterson et al., 2008a).

The pioneering endeavor of cricket performance analysis is attributed to the seminal work of Elderton and Elderton (1909) which has shown the applicability of Cricket data analysis for elucidatingimportant statistical insights. In this work, the researchers have also emphasized the usefulness of standard deviation as a metric to gauge the performance of players. A study by Eldertonin 1927 reveals fitting exponential distribution to data obtained from Test cricket. Wood (1945, 1945a) has thrown light on another statistical tool called the coefficient of variation for assessing cricketer's performance. Building upon this foundation, Pollard (1977) and Clarke (1994) have also indicated the applicability of coefficient of variation for measuring the consistency of batsmen. These studies have gathered ball-by-ball data from Test cricket and Pollard (1977) makes a comparison of the fitting of two distributions viz., geometric distribution andnegative binomial distributionto the data obtained from cricket. Croucher (1979) also has delved into the player's performance analysis by fitting negative binomial distribution to model the runs scored by players.Schofield (1988)presents an alternative application of production functions in the realm of cricket and pinpoints the significance of bowlers in deciding the fate of any match.

Batting performance indicators

Traditionally, performance of a batsman is always measured with the help of batting average and strike rate. Batting average is computed by obtaining the ratio of runs scored by a batsman and the number of completed innings of a batsman (i.e., in which the batsman is dismissed). On the other hand, the total no. of runs scored by a batsman out of 'm' balls, where m=100, is referred to as the strike rate of a batsman. Apart from these traditional measures, a number of performance measures have been proposed by different researchers over time for analyzing the performance of batsmen in cricket.

Table 1.1: Batting performance indicators

Authors	Year	Significant contribution	Method
Wood	1945	Earliest statistical work in cricket and also computation of batting average	A batsman's total no. of runs without being dismissed is taken as completed innings
Kimberand Hansford	1993	Find an alternative method of calculation of batting average	Apply non-parametric approach by replacing not-out scores of a player in place of total runs scored by that player
Croucher	2000	Develops a new performance index called 'Batting Index'	Multiplying batting average and strike rate to get the 'batting index'
Beaudoin and Swartz	2003	Propose a new statistic and also show its application in ranking top 20 players during World Cup 2003	Dividing runs scored to Resource Utilized
Lemmer	2004, 2006, 2007	Proposes 'Batting Performance (BP)' and modifications of the indicator in subsequent papers	Combination of batting average, strike rate and consistency co-efficient
Gerber and Sharp	2006	Develop a batting performance statistic	Computed on the basis of no. of players with specific skills and expertise in the team
Damodaran	2006	Proposes an alternative approach of computation of batting average	Bayesian method
Borooah and Mangan	2010	Define an index using the consistent performance by a batsman and his individual contribution to the team's total run scored	Application of Gini Coefficient
Koulis, Muthukumarana and Briercliffe	2014	Analyze the individual batting performance by a respective batsman	A batsman-specific hidden Markov model
Manage and Scariano	2015	Combine multiple factors into one batting vector	Application of principal component analysis for the summarization of batting indices

Bowling performance indicators

The bowling average, the economy rate and the bowling average are performance indicators which are used to judge a bowler. The bowling strike rate is calculated by dividing the balls bowled by a specific bowler by the total wickets which are dismissed by the bowler. The economy rate indicates the total number of runs conceded out of k (k=6) number of balls bowled by a bowler. The bowling average represents the ratio of the average number of runs conceded by a specific bowler and wickets taken by that bowler. Definitely, these three measures are negative dimensional measure. That is, lower these measures, better would be the performance of that bowler. It is commonly mentioned that cricket is a batsman-friendly game. In fact, there is dearth of statistical investigations focused at the development of bowling performance indices as compared to the batting performance indices. Some of the existing bowling performance measures are mentioned in the table given below:

Table 1.2: Bowling performance indicators

Authors	Year	Significant contribution	Method
Lemmer	2002	DefinesCombined Bowling Rate (CBR)	Calculation of CBR is done through harmonic mean (HM) of bowling average, the economy rate and the bowling strike rate.
Lemmer	2005	Proposes Adjusted Combined Bowling Rate (CBR*)	Importance is given to exact match condition in which a bowler executes his bowling and also the weight of the wicket
Lemmer	2012	Improvement of the CBR* to $CBR^{\#}$	Considering adjusted runs scored as well as the weight (or importance) of the wickets as per their batting positions
Lemmer	2016	Proposes a new index CRM	Focused at the wicket-taking ability of any bowler
Bhattacharjee and Lemmer	2016	Propose Bowling Performance Indicator (BPI)	Based on the performance of the bowler in increasing or decreasing the Pressure Index value of the batting team.

Other performance indicators

In cricket, apart from batting and bowling, wicket-keeping and fielding are also important attributes and have significant impact for the fielding. Gerber and Sharp (2006) propose an index for measuring of fielding and wicket-keeping potentials of players. Suleman and Saeed (2009) put forward 'SS Index' based on the importance of the skills and expertise of players. This 'SS index' has been used by them to analyse the performance of a player in batting, bowling as well as wicket-keeping taking data from Twenty20 cricket matches. The pioneering study to measure the wicket-keeping performance has been attempted by Lemmer (2011) in case of Test cricket. In this study, Lemmer has combined two statistics viz., the batting performance as well as the dismissal rate of the wicket-keeper. Saikia, Bhattacharjee and Bhattacharjee (2012a) develop a new model for measuring wicket keeping, batting and bowling performance of players. Saikia, Bhattacharjee and Lemmer (2012b) define two fielding performance statistics which gives emphasis to the relative importance of each fielding activity and assign suitable weights for these activities.

Optimal strategies

Peterson et al. (2008a) mention that team strategy is apparent in every feature of the game of cricket like how quickly a team should chase a running total, aggressiveness of bowlers in seeking wickets versus restricting runs. On the determination of optimal strategies, different research studies have been developed by previous researchers.In a study on One-Day International matches, Clarke (1988) shows the application ofdynamic programming technique. They have attempted to find the optimal scoring rates at any point of the innings and have suggested possible batting strategies for winning a match. The estimation of first innings total runs, winning probability for a team batting second, etc. are undertaken. Johnston (1992) introduces a player rating system for rating the players, as well as, teams in case of ODI cricket, with the help of a dynamic programming model. Using the same method, batting strategies which should be adopted by teams towards the end of the innings are proposed by Clarke and Norman (1999). For the ODIs, optimal strategies are recommended by Preston and Thomas (2000) both for teams playing in first as well as second innings of a limited overs cricket match. They have shown the usage of dynamic programming and survival analysis models in their analysis. Further, Clarke and Norman (2003), Brooker and Hogan (2011) are similar studies in this direction which have tried to explore dynamic programming.

Modelling cricket data

Elderton and Elderton (1909) are the firstresearchers who have worked with cricket data.They have written a book entitled Primer of Statisticswhich is a pioneering attempt to explain statistical notionsutilising data from cricket. Here, application of standard deviation for analyzing batting performance has been shown by the authors.According to Swartz (2016), it is a difficult venture to model Test cricket data as nature of scoring runs usually varies for teams intending to seal a victory and those which strive to prevent a draw.Elderton and Wood (1945) and Wood (1945b) are the pioneering works in this direction. Drawing upon data from both Test cricket and the County Championship, Elderton and Wood (1945)depict the task of predicting individual scores

using a geometric distribution model. Wood (1945b) has dealt upon the use of co-efficient of variation to gauge the consistency of a player in scoring runs. Similar studies which dealt upon co-efficient of variation as a tool for analysing the performance of a player include Pollard (1977a) and Clarke (1994).Probably the earliest study conducted on modelling the runs scored by a partnership in case of County Cricket is undertaken by Pollard, Benjamin and Reep (1977b). Fortheir study, they make use of negative binomial distribution. To investigate instances of synergies Valero and Swartz (2012) have conducted a comparative analysis of a cricketer with their batting partners. This study makes use of a bivariate statistic obtained from batting average and strike rateof players with a common partner at the crease, aggregated over a sufficiently extensive sample of innings. They have generated a scatter plot based on this bivariate statistic, segmenting it into four quadrants in order to establish any discernible form of potential synergy between players. However, the scatter plot has not revealed any such patterns which suggests the existence of synergy among batting partners. Scarf, Shi and Akhtar (2011) try to model the performance by a batting partner using three statistical distributions, viz., geometric, negative binomial, and zero-inflated negative binomial using data from 197 Test matches.The study reveals that zero-inflated negative binomial distribution is the best fit among these three distributions for modelling the runs scored by a batting partnership.A similar investigation is conducted by Tan and Zhang (2001)by the use of exponential distribution forevaluating the performance of partnership applying Test cricket data.

Study of Team Performance

Since the popularity of the limited overs cricket matches have increased tremendously, quantitative analysis of team performance is also a task which has excited numerous researchers. Drawing an analogy between players and securities and the team as a portfolio, Damodaran (2006) employs principles of stochastic dominance for comparing batting performance of Indian batsmen over a period of 1989 to 2005 for ODI cricket. Swartz et al. (2006) delve into an extensive examination of optimal batting orders in one-day cricket for the first innings, utilizing available resources like wickets and balls remaining for each batsman and employing simulation methods to devise the best batting order, along with determining the probabilities of various outcomes. Borooah and Mangan (2010) adjust batting average scores of players concerning their team and batting consistency using the Gini coefficient and Sen's welfare index to rank players across different time periods.

Cricket Match Scheduling

In the realm of competitive sports, the challenge of match scheduling encompasses the determination of both dates and venues for the matches. Kendall et al. (2010) asserts that scheduling any sporting event poses a multifaceted problem, requiring careful consideration of logistical, economic, organizational, and fairness constraints among various decision-makers. Consequently, this subject has garnered significant attention from researchers across diverse disciplines. Over the years, researchers have employed various quantitative methods, including pure combinatorial approaches, optimization techniques like integer programming and constraint programming, metaheuristic methods, and hybrid methodologies, in pursuit of crafting well-balanced sports schedules. The optimization of sports schedules holds the potential to maximize revenue generation for sports organizations and enhance fan and media engagement. While a substantial body of literature exists on the scheduling of sports like soccer, baseball etc., exploration of this field in cricket remains relatively underexplored. Wright (1992) notably applied simulated annealing techniques to propose a schedule for the 1992-1995 English County matches, with further contributions in (1994, 2005). Armstrong and Willis (1993) utilized integer programming methods to formulate a schedule for the 1992 World Cup, while Willis and Terrill (1994) have utilised simulated annealing to schedule both national and as well as One Day International (ODI) cricket matches for the period spanning 1992-1993 in Australia.

Effect of Home Ground Advantage

Different researchers have investigated the effects of home team advantage in cricket, with Crowe and Middeldorp (1996) examining whether the leg before wicket (LBW) dismissals given by umpires to the Australian team against visiting teams are influenced by the home ground factor. Their study, employing a logistic regression model, reveals higher odds of LBW dismissals for visiting teams compared to the home team, Australia. Similarly, de Silva and Swartz (1998) analyze ODI matches using a logistic model, and conclude that the home team possesses a higher probability of winning matches when matches are being played by teams possessingsimilar strengths. Noteworthy contributions to the study of home ground advantage also come from Allsopp (2005), Morley and Thomas (2005), Bhaskar (2009), Saikia and Bhattacharjee (2010), among others.

Selection of a balanced playing XI

Team selection for a series of matches or a tournament poses a challenging decision-making task for selectors and team management, often relying on subjective judgments based on the captain's and coach's past

experiences and traditions. Numerous quantitative studies have contributed to the literature by offering insights into designing balanced teams. For instance, Gerber and Sharp (2006) utilize integer programming for choosing a batting lineup of 15 from a pool of 32 batsmen for South Africa's ODI team. The analytical hierarchical process is used by Kamble et al. (2011) for finding best playersas per their skills like batting, bowling, wicket-keeping and all-rounders. Lemmer (2013) has tackled the team selection problem using integer programming techniques. Other notable contributions to the field of team selection include works by Brettenny (2010), Ahmed, Deb, and Jindal (2013), Amin and Sharma (2014), and Davis, Perera, and Swartz (2015), etc.

Study of Team Performance

With the popularity and of limited overs matches, there's been a surge in quantitative analysis of team performance, intriguing numerous researchers. In order to investigate batting performance of One-Day International matches, Damodaran (2006)makes use of stochastic dominance rules by drawing an analogy between players as securities and the team as a portfolio. Swartz et al. (2006) delve into an extensive examination of optimal batting orders in one-day cricket for the first innings, utilizing available resources like wickets and balls remaining for each batsman and employing simulation methods to devise the best batting order, along with determining the probabilities of various outcomes. Borooah and Mangan (2010) adjust batting average scores of players concerning their team and batting consistency using the Gini coefficient and Sen's welfare index to rank players across different time periods. Saikia and Bhattacharjee (2011), on the other hand, utilize multinomial logistic regression and a naive Bayesian classification model to categorize the performance of all-rounders participating in the first three seasons of the IPL based on their strike rate and economy rate.

Prediction of Match Outcome

Prediction of cricket match outcomes remains a captivating field within Cricket Analytics, with various authors contributing to its enrichment. For computing a team’s probability of winning a match over its opponent in case of One-Day Internationals and Teset cricket, Allsopp and Clarke (2004) employ multinomial logistic regression considering multiple factors. Bailey and Clarke (2006) state that match outcomes are influenced by factors such as home ground advantage, past performance, venue familiarity, and current form. In their study, they utilize multiple linear regression to data collected from 2200 ODI matches for the purpose of determination of a team’s total runs and also, it’s margin of victory. Lemmer (2012) employs a logistic regression model to predict the outcomes of knock-out stage matches during the ICC World Cup 2011. Davis, Perera, and Swartz (2015) develop a simulator for the Twenty20 version of cricket, applying estimation techniques and hierarchical empirical Bayes methods, and conclude that batting outcome probabilities are contingent upon the variables inputted into the simulator.

Target Resetting Methods

Adverse weather conditions can totally spoil the playing conditions in case of a cricket match. When a limited overs match experiences an interruption, with both teams having completed a certain number of overs, the probability of winning the match can vary between the teams. Consequently, one team may find itself in a favourable position following the interruption, while the other may face an unfavourable situation.Preston and Thomas (2002) observe that prolonged interruptions in limited overs matches can significantly alter the probabilities of winning, contingent upon the timing and point of interruption. Ignoring such interruptions can not only compromise the integrity of the contest but also diminish the excitement of the game. Therefore, a fair target-resetting method, commonly referred to as the 'rain rule', typically establishes a reasonable target for the team batting second, thereby ensuring equitable opportunities for both teams to win. Various methods have been utilized to determine the rescheduled target in limited overs cricket, including the Average Run Rate (ARR) method, the Most Productive Overs (MPO) method, the Discounted Most Productive Overs (DMPO) method, the Parabola (PARAB) method, the World Cup 1996 (WC96) method, and the Clark Curves (CLARK) method.

In the pursuit of quantitative solutions to address interruptions in limited overs cricket, English statisticians Duckworth and Lewis (1998, 2004) have introduced a method famously known as the Duckworth-Lewis (D-L) method, later updated to the Duckworth-Lewis-Stern (DLS) method. The DLS method operates on the principle that a team's capacity to score runs while batting relies on optimizing two primary resources: batting resources, represented by the ten wickets available, and the total number of overs allotted to the team. Hence, a batting team faces the strategic dilemma of choosing between conservative batting to preserve wickets, potentially yielding insufficient runs, or aggressive batting, risking wicket loss. In the event of an interruption, targets are recalibrated to establish a fair and equitable goal based on the percentage of available resources at the time of interruption. This method, widely endorsed by the International Cricket Council and other cricket governing bodies, is now well accepted for its application in interrupted limited overs cricket matches.

In addition to the aforementioned contributions, notable works by Clarke (1998), Christos (1998), Jayadevan (2002), and Carter and Guthrie (2004) have further enriched the field of cricket analytics.

Additionally, McHale and Asif (2013) have made significant strides in this area. Furthermore, de Silva, Pond, and Swartz (2001) applied the Duckworth-Lewis (DL) method to estimate the magnitude of victory in ODI cricket matches. Perera and Swartz (2013) explored the applicability of the Duckworth-Lewis-Stern (DLS) method in Twenty20 cricket, noting differences in scoring patterns compared to ODI cricket. They also introduced a novel method to determine resource tables tailored specifically for the Twenty20 format of the game.

Determination of Optimal Strategies

Over the years, numerous studies have been conducted by various authors to determine optimal strategies in cricket. Clarke (1988) applied dynamic programming techniques to calculate optimal scoring rates for teams at any stage of an ODI match, proposing potential batting strategies for securing victory. The author also estimated the total runs required by a team batting first and the winning probability for a team batting second. Johnston (1992) introduced a player rating system for ODI cricket using a dynamic programming model. Clarke and Norman (1999) put forth batting strategies for teams to maximize total runs scored towards the end of innings, employing dynamic programming models. Preston and Thomas (2000) utilize dynamic programming alongside survival analysis models to craft optimal batting strategies for teams participating in both innings of a limited overs cricket match. They have determined ideal run rates which should be maintained by teams playing while batting during both innings of a limited overs cricket match.Applying dynamic programming, Clarke and Norman (2003) have suggested that instead of picking a tail-ender batsmen during the end of play of a match as the NightWatchmen, the team should try to send the next batsmen in the batting line-up for securing an optimal score.In a study related to ODI cricket, Monte Carlo methods have been used by Brooker and Hogan (2011) for finding the distribution of the ground condition with the help of data obtained from only the first innings score and the final outcome of a match. Silva, Perera, Davis, and Swartz (2016) have suggested important strategies which can be incorporated by teams while playing a Twenty20 match. They observe that changing the batting and the bowling orders are significant and wickets loosing has less impact in Twenty20 format than in the longer formats.

III. Concluding Remarks

As the present paper is a review of cricket analytics, there is little scope to make any concluding remarks. Anyway, this effort of the author might be fruitful if this articleis treated as a nomenclature for any enthusiastic researcher in cricket. It seems relevant to mention further that,there are many other areas in which research on the game of cricket is going on. Some of these include biomechanical analysis for preventive injury ,improving bowling lengths, devising auction and draft strategies by considering player performance metrics, requirements andfan engagement using social media and associated tools, etc.

References

[1] Ahmed, F., Deb, K., And Jindal, A. (2013). Multi-Objective Optimization And Decision-Making Approaches To Cricket Team Selection. Applied Soft Computing, 13(1), 402-414.

[2] Allsopp, P.E. And Clarke, S.R. (2004). Rating Teams AndAnalysing Outcomes In One-Day And Test Cricket. Journal Of The Royal Statistical Society, Series A, 167, 657-667.

[3] Allsopp, P. (2005). Measuring Team Performance And Modelling The Home Advantage Effect In Cricket [Ph.D. Thesis, Swinburne University Of Technology, Melbourne, Australia].

[4] Amin, G. R., And Sharma, S. K. (2014). Cricket Team Selection Using Data Envelopment Analysis. European Journal Of Sport Science, 14(1), S369-S376.

[5] Armstrong, J And Willis, R J (1993). Scheduling The Cricket World Cup: A Case Study. The Journal Of The Operational Research Society, 44(11), 1067-1072.

[6] Bailey, M., And Clarke, S. R. (2006). Predicting The Match Outcome In One Day International Cricket Matches, While The Game Is In Progress. Journal Of Sports Science And Medicine, 5(4), 480–487.

[7] Beaudoin, D., & Swartz, T. (2003). The Best Batsmen And Bowlers In One-Day Cricket. South African Statistical Journal, 37, 203–222.

[8] Bhaskar, V. (2009). Rational Adversaries? Evidence From Randomised Trials In One Day Cricket. The Economic Journal, 119(534), 1-23.

[9] Bhattacharjee, D. And Lemmer, H.H. (2016). Quantifying The Pressure on The Teams Batting Or Bowling In The Second Innings Of Limited Overs Cricket Matches. International Journal of Sports Science And Coaching, 11(5), 683-692.

[10] Borooah, V. K., And Mangan, J. E. (2010). The "Bradman Class": An Exploration Of Some Issues In The Evaluation Of Batsmen For Test Matches, 1877–2006. Journal Of Quantitative Analysis In Sports, 6(3), 1-19.

[11] Brettenny, W. (2010). Integer Optimisationof The Selection Of A Fantasy League Cricket Team [Master's Dissertation, Nelson Mandela Metropolitan University]. Retrieved July 17, 2018 From Http://Dspace.Nmmu.Ac.Za:8080/Jspui/Bitstream/10948/…/Warren%20brettenny.Pdf.

[12] Brooker, S. And Hogan, S. (2011). A Method for Inferring Batting Conditions InOdi Cricket From Historical Data. (Technical Report No. 44/2011). Department Of Economics and Finance College Of Business And Economics. University Of Canterbury.

[13] Carter, M., And Guthrie, G. (2004). Cricket Interruptus: Fairness And Incentive in Limited Overs Cricket Matches. Journal Of The Operational Research Society, 55(8), 822-829.

[14] Christos, G. A. (1998). It's Just Not Cricket. In N. De Mestre And K. Kumar (Eds.), Mathematics And Computers In Sport (Pp. 181-188). Queensland: Bond University.

[15] Clarke, S. R. (1988). Dynamic Programming In One-Day Cricket-Optimal Scoring Rates. Journal Of The Operational Research Society, 39(4), 331-337.

[16] Clarke, S. R. (1994). Variability Of Scores And Consistency In Sport. In N. De Mestre (Ed.), Proceedings Of The Second Australian Conference On Mathematics And Computers In Sport (Pp. 69–81). Australia.

[17] Clarke, S.R. (1997). Performance Modelling In Sports [Ph.D. Thesis, Swinburne University Of Technology]. Retrieved August 20, 2018 FromHttps://Researchbank.Swinburne.Edu.Au/File/D1af29b1-43d3-47b6-95a0-986ad39bf890/1/Stephen%20r%20clarke%20thesis.Pdf

[18] Clarke, S. R., And Norman, J. M. (1999). To Run Or Not? Some Dynamic Programming Models In Cricket. Journal Of The Operational Research Society, 50(5), 536-545.

[19] Clarke, S. R., And Norman, J. M. (2003). Dynamic Programming In Cricket: Choosing A Night Watchman. Journal Of The Operational Research Society, 54(8), 838-845.

[20] Clarke, S. R. (2007). Studying Variability In Statistics Via Performance Measures In Sport. Bulletin Of The International Statistical Institute 56th Session, Lisbon.

[21] Croucher, J. S. (1979). The Battle For The Ashes A Statistical Analysis Of Post War Australia–England Cricket. In Proceedings Of The 4th National Conference Of The Australian Society Of Operations Research (Pp. 48–58), Sydney: Sydney University Of Technology.

[22] Croucher, J. S. (2000). Players Ratings In One-Day Cricket. Proceedings Of The Fifth Australian Conference On Mathematics And Computers In Sport (Pp. 95-106). Sydney: Sydney University Of Technology.

[23] Crowe, S. M., And Middeldorp, J. (1996). A Comparison Of Leg Before Wicket Rates Between Australians And Their Visiting Teams For Test Cricket Series Played In Australia, 1977–94. Journal Of The Royal Statistical Society: Series D (The Statistician), 45(2), 255-262.

[24] Damodaran, U. (2006). Stochastic Dominance And Analysis Of Odi Batting Performance: The Indian Cricket Team, 1989-2005. Journal Of Sports Science And Medicine, 5(4), 503-508.

[25] Davis, J., Perera, H., And Swartz, T. B. (2015). A Simulator For Twenty20 Cricket. Australian And New Zealand Journal Of Statistics, 57(1), 55-71.

[26] De Silva, B. M., & Swartz, T. B. (1998). Winning The Coin Toss And The Home Team Advantage In One-Day International Cricket Matches. Department Of Statistics And Operations Research, Royal Melbourne Institute Of Technology.

[27] De Silva, B. M., Pond, G. R., And Swartz, T. B. (2001). Estimating The Magnitude Of Victory In One-Day Cricket. Australian And New Zealand Journal Of Statistics, 43(3), 259-268.

[28] Duckworth, F. C., And Lewis, A. J. (1998). A Fair Method For Resetting The Target In Interrupted One-Day Cricket Matches. Journal Of The Operational Research Society, 49(3), 220-227.

[29] Duckworth, F. C., And Lewis, A. J. (2004). A Successful Operational Research Intervention In One-Day Cricket. Journal Of The Operational Research Society, 55(7), 749-759.

[30] Elderton, W. P., And Elderton, E. M. (1909). Primer Of Statistics. London: A. And C. Black.

[31] Elderton, W. P. (1927). Frequency Curves And Correlation. London: Layton.

[32] Fry, M. J., And Ohlmann, J. W. (2012). Introduction To The Special Issue On Analytics In Sports, Part I: General Sports Applications. Interfaces, 42(2), 105–108.

[33] Gerber, H., And Sharp, G. D. (2006). Selecting A Limited Overs Cricket Squad Using An Integer Programming Model. South African Journal For Research In Sport, Physical Education And Recreation, 28(2), 81-90.

[34] Hughes, M.D. And Bartlett, R.M. (2002). The Use Of Performance Indicators In Performance Analysis. Journal Of Sports Sciences, 20 (10), 739 – 754.

[35] Jayadevan, V. (2002). A New Method For The Computation Of Target Scores In Interrupted, Limited-Over Cricket Matches. Current Science, 83(5), 577-586.

[36] Johnston, M. I. (1992). Assessing Team And Player Performance In One-Day Cricket Using Dynamic Programming [Master's Thesis, Swinburne University, Australia].

[37] Kamble, A.G., Venkata Rao, R., Kale, A.V., And Samant, S.P. (2011). Selection Of Cricket Players Using Analytical Hierarchy Process. International Journal Of Sports Science And Engineering, 5(4), 207-212.

[38] Kendall, G., Knust, S., Ribeiro, C. C., And Urrutia, S. (2010). Scheduling In Sports: An Annotated Bibliography. Computers And Operations Research, 37(1), 1-19.

[39] Kimber, A. C., And Hansford, A. R. (1993). A Statistical Analysis Of Batting In Cricket. Journal Of The Royal Statistical Society: Series A (Statistics In Society), 156(3), 443-455.

[40] Koulis, T., Muthukumarana, S., And Briercliffe, C. D. (2014). A Bayesian Stochastic Model For Batting Performance Evaluation In One-Day Cricket. Journal Of Quantitative Analysis In Sports, 10(1), 1-13.

[41] Lemmer, H. H. (2002). The Combined Bowling Rate As A Measure Of Bowling Performance In Cricket. South African Journal For Research In Sport, Physical Education And Recreation, 24(2), 37-44.

[42] Lemmer, H. H. (2004). A Measure For The Batting Performance Of Cricket Players. South African Journal For Research In Sport, Physical Education And Recreation, 26(1), 55-64.

[43] Lemmer, H. H. (2005). 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, 27(1), 75-87.

[44] Lemmer, H. H. (2006). A Measure Of The Current Bowling Performance In Cricket. South African Journal For Research In Sport, Physical Education And Recreation, 28(2), 91–103.

[45] Lemmer, H. (2007). The Allocation Of Weights In The Calculation Of Batting And Bowling Performance Measures. South African Journal For Research In Sport, Physical Education And Recreation, 29(2), 75–85.

[46] Lemmer, H. H. (2011). Performance Measures For Wicket Keepers In Cricket. South African Journal For Research In Sport, Physical Education And Recreation, 33(3), 89-102.

[47] Lemmer, H. H. (2012). Individual Match Approach To Bowling Performance Measures In Cricket. South African Journal For Research In Sport, Physical Education And Recreation, 34(2), 95-103.

[48] Lemmer, H. H. (2013). Team Selection After A Short Cricket Series. European Journal Of Sport Science, 13(2), 200-206.

[49] Lemmer, Lemmer, H. H. (2016). Wicket Taking Ability Of Bowlers. International Journal Of Sports Science And Coaching, 11(2), 231–236.

[50] Lewis, M. (2004). Moneyball: The Art Of Winning An Unfair Game. Ww Norton And Company

[51] Manage, A. B., And Scariano, S. M. (2013). An Introductory Application Of Principal Components To Cricket Data. Journal Of Statistics Education, 21(3).

[52] Mchale, I. G., And Asif, M. (2013). A Modified Duckworth–Lewis Method For Adjusting Targets In Interrupted Limited Overs Cricket. European Journal Of Operational Research, 225(2), 353-362.

[53] Moore, A., Turner, J. D., & Johnstone, A. J. (2012). A Preliminary Analysis Of Team Performance In English First-Class Twenty-Twenty (T20) Cricket. International Journal Of Performance Analysis In Sport, 12(1), 188-207.

[54] Morley, B., And Thomas, D. (2005). An Investigation Of Home Advantage And Other Factors Affecting Outcomes In English One-Day Cricket Matches. Journal Of Sports Sciences, 23(3), 261-268.

[55] Perera, H. P., & Swartz, T. B. (2013). Resource Estimation In T20 Cricket. Ima Journal Of Management Mathematics, 24(3), 337-347.

[56] Perera, G. H. P. (2015). Cricket Analytics (Doctoral Dissertation, Department Of Statistics And Actuarial Science). Retrieved January 5, 2019 Fromhttp://Summit.Sfu.Ca/System/Files/Iritems1/16247/Etd9381_Gperera.Pdf

[57] Perera, H. P., & Swartz, T. B. (2013). Resource Estimation In T20 Cricket. Ima Journal Of Management Mathematics, 24(3), 337-347.

[58] Pollard, R. (1977a). Cricket And Statistics. In S.P. LadanyAnd R.E. Machol (Eds.), Optimal Strategies In Sports (Pp. 129-130). North Holland: Amsterdam.

[59] Pollard, R., Benjamin, B., And Reep, C. (1977b). Sport And The Negative Binomial Distribution. Optimal Strategies In Sports, 188-195.

[60] Preston, I., And Thomas, J. (2000). Batting Strategy In Limited Overs Cricket. Journal Of The Royal Statistical Society: Series D (The Statistician), 49(1), 95-106.

[61] Preston, I., And Thomas, J. (2002). Rain Rules For Limited Overs Cricket And Probabilities Of Victory. Journal Of The Royal Statistical Society: Series D (The Statistician), 51(2), 189-202.

[62] Saikia, H., And Bhattacharjee, D. (2010). On The Effect Of Home Team Advantage And Winning The Toss In The Outcome In T20 International Cricket Matches. Assam University Journal Of Science And Technology, 6(2), 88-93.

[63] Saikia, H., Bhattacharjee, D., And Bhattacharjee, A. (2012a). Is Ipl Responsible For Cricketers' Performance In Twenty20 World Cup. International Journal Of Sports Science And Engineering, 6(2), 96-110.

[64] Saikia, H., Bhattacharjee, D., And Lemmer, H. (2012b). A Double Weighted Tool To Measure The Fielding Performance In Cricket. International Journal Of Sports Science And Coaching, 7(4), 699–713.

[65] Scarf, P., Shi, X., And Akhtar, S. (2011). On The Distribution Of Runs Scored And Batting Strategy In Test Cricket. Journal Of The Royal Statistical Society: Series A (Statistics In Society), 174(2), 471-497.

[66] Schofield, J. A. (1988). Production Functions In The Sports Industry: An Empirical Analysis Of Professional Cricket. Applied Economics, 20(2), 177–193.

[67] Silva, R. M., Perera, H., Davis, J., & Swartz, T. B. (2016). Tactics For Twenty20 Cricket. South African Statistical Journal, 50(2), 261-271.

[68] Suleman, M. T., & Saeed, M. A. (2009). Option On Human Performance: A Case Study Of Indian Premier League. Retrieved December 21, 2009, From Http://Papers.Ssrn.Com/Sol3/…/Ssrn_Id1474093_Code1208558.Pdf.

[69] Swartz, T. B., Gill, P. S., Beaudoin, D., And De Silva, B. M. (2006). Optimal Batting Orders In One-Day Cricket. Computers And Operations Research, 33(7), 1939-1950.

[70] Swartz, T. B. (2016). Research Directions In Cricket. In Jh Albert, Me Glickman, Tb Swartz And Rh Koning (Eds.), Handbook Of Statistical Methods And Analysis In Sports, Chapman & Hall/Crc: Boca Raton.

[71] Tan, A. And Zhang, D. (2001). Distribution Of Batting Scores And Opening Wicket Partnerships In Cricket. Mathematical Spectrum, 34(1), 13-17.

[72] Valero, J. And Swartz, T.B. (2012). An Investigation Of Synergy Between Batsmen In Opening Partnerships. Sri Lankan Journal Of Applied Statistics, 13, 87–98.

[73] Willis, R. J., And Terrill, B. J. (1994). Scheduling The Australian State Cricket Season Using Simulated Annealing. Journal Of The Operational Research Society, 45(3), 276-280.

[74] Wood, G. H. (1945). Cricket Scores And Geometric Progression. JournalOf Royal Statistical Society, Series A (Statistics In Society), 108, 12-22.

[75] Wood, G. H. (1945a). What Do You Mean By Consistency? The Cricketer Annual. 22-28.

[76] Wright, M. (1992). A Fair Allocation Of County Cricket Opponents. Journal Of The Operational Research Society, 43(3), 195-201.

[77] Wright, M. (1994). Timetabling County Cricket Fixtures Using A Form Of Tabu Search. Journal Of The Operational Research Society, 45(7), 758-770.

[78] Wright, M. B. (2005). Scheduling Fixtures For New Zealand Cricket. Ima Journal Of Management Mathematics, 16(2), 99-112.