Review Article
Open Access
CrossMark

Visualizing bowling performance in cricket using contour plot

Abstract

Batting and bowling are widely considered to be the pivotal skills in cricket. Traditionally, cricket has relied on three distinct metrics to measure bowling performance: the bowling average, the bowler's strike rate, and the economy rate. While each of these measures attempts to quantify the performance of bowlers, their respective scopes are unique. Researchers have made several attempts to integrate these measures into a composite index to rank bowlers. However, the integration process inevitably results in the loss of the individual metrics' distinct natures. This paper endeavours to visualize the three measures in a two-dimensional plane using a contour plot. To better illustrate the proximity amongst bowlers concerning the three distinct measures, a few improvements to the plot are proposed. The proposed graphical extension utilizes the career statistics of bowlers across different eras and demonstrates how the style of bowling has evolved as the scoring patterns in cricket change. Additionally, an R program has been developed to facilitate the drawing of said graphical extension.

Keywords: cricket analytics, data mining in sports, statistical graphics, performance measurement, R programming

Volume 6 Issue 3 - 2023

Dibyojyoti Bhattacharjee,[1] Hemanta Saikia[2]
[1]Department of Statistics, Assam University, India
[2]Department of Basic Sciences and Humanities, Assam Agricultural University, India

Correspondence: Hemanta Saikia, Assistant Professor, Department of Basic Sciences and Humanities, College of Sericulture, Assam Agricultural University, India, Email h.saiki456@gmail.com

Received: September 12, 2023 | **Published:** September 26, 2023

Introduction

Cricket is a popular team sport that is played between two teams of 11 players each on a circular or oval field. The major action in a cricket match takes place in a 22-yard rectangular area in the middle of the field, called the pitch between the bowler and the batter. To dismiss the batter or prevent him/her from getting runs, the bowler throws the ball at the batter. On the other side, the batsman tries to hit the ball thrown towards him by the bowler all around the field to score runs. The bowler is supported by fielders (the other ten players of his team) to stop or catch the ball hit by the batter, either to restrict the batter from scoring or to dismiss him/her. For more details about the game of cricket and its rules, one may read Knight.[1] Thus, there are two prime skills of the game of cricket viz. batting and bowling. Traditionally bowling performance was measured by bowling average (BA) and bowling strike rate (BSR). If a bowler bowls 'b' balls and takes 'w' wickets and in the process concedes 'r' runs. Then, the BA and BSR are defined as follows:

$$\text{Bowling Average (BA)} = \frac{r}{w} \tag{1}$$

$$\text{Bowling Strike Rate (BSR)} = \frac{b}{w} \tag{2}$$

The bowling average gives the number of runs conceded by the bowler for getting a wicket on an aggregate, while the bowling strike rate gives the average number of deliveries that a bowler needs to bowl to take a wicket. Cricket is played in three different formats at the international level: Test cricket, One Day International (ODI) cricket, and Twenty20 cricket. Out of these, ODI and Twenty20 are limited-overs cricket, as the length of an innings is fixed in terms of the number of overs. ODIs are played for 50 overs per innings, and Twenty20, as the name suggests, is played for 20 overs per innings. In limited-overs cricket, the team that scores more runs in the limited number of overs wins the match. The batting side now feels compelled to score runs at a quicker pace because of the limited length of an innings in terms of the number of overs. A better bowler in limited-overs cricket will consume fewer runs and help his or her team.

Thus, with the popularity of limited overs cricket- another measure of bowling performance that has become more widely accepted for effective bowling is the economy rate.

$$\text{Economy Rate (ER)} = \frac{r}{b} \times 6 \tag{3}$$

All three of these measures stand out in their own right. While (1) and (2) quantify the frequency of wickets taken by the batsmen in terms of runs and balls, respectively, (3) is a metric that reveals a bowler's competence in limiting the number of runs that can be scored by his (or her) own bowling. Several authors like Lemmer,[2,3] Bhattacharjee and Saikia,[4] Shah,[5] Dey, Ghosh and Mondal,[6] Premkumar, Chakrabarty and Chowdhury[7] combined these measures into a single index to understand the relative position of bowlers. While this is an important exercise, such application comes at the cost of sacrificing the information that individual measures given in (1), (2) and (3) hold.

A graph is a visual tool that tries to reveal all the attributes of the data like central tendency, the spread of the data, the existence of outliers, and above all support relation between multiple data sets or variables, in contrast to statistical summaries. Most statistical summaries are, in a sense, data-reducing techniques and tend to eliminate information in the name of data summary.[8] Therefore, one can consider a visual tool that could be useful to compare and comprehend the bowlers' pattern based on the matrices (1), (2) and (3) discussed above. Visual displays of information have become an order of modern-day research. High-quality and sophisticated graphs and diagrams are used to communicate results in most of the research papers in scientific publications. In light of these considerations, this work attempts to improvise a graphical tool that can be used to compare bowlers based on various matrices mentioned in (1), (2) and (3) above across different eras.

Review of literature

Cricket is a sport that requires a high level of skill and precision. Bowlers play an essential role in the game and their performance is

often measured using various metrics. Some such elementary measures of bowling performance are discussed above. It may be noted that all those elementary measures defined in (1), (2) and (3) are negative in the sense that the lower the value the better the bowler. Researchers conceived of the need for an overall performance measure for bowlers, which might be crucial for evaluating their effectiveness on the field. Through such performance matrices, coaches and bowlers can identify areas for improvement and create performance-enhancing strategies. In response to the call Lemmer[2] introduced the combined bowling rate (CBR). In this measure, he combined the traditional bowling statistics, viz., bowling average, economy rate, and bowling strike rate, using the harmonic mean. Later, several attempts were made by Lemmer[3,9,10] to modify the proposed CBR for different formats of cricket by allocating suitable weights to the wickets dismissed by the bowler but in an objective manner. Bhattacharjee and Saikia[4] improvised over the measures defined by Lemmer by combining the elementary measures of bowling performance into a weighted linear combination. Beaudoin and Swartz[11] used the resource utilization table of Duckworth-Lewis to measure the bowling performance of cricketers.

Data visualization tools are now crucial in all phases of statistical study. They start with exploratory plots, assist in the different stages of analysis, and aid in the final presentation and communication of data.[12] Data needs to be visualized, whether it comes from a physical research experiment or any socioeconomic phenomenon, as it reveals all the minute details of the data.[13] Technology and computational power advancements have made visualization an essential component of data presentation and analysis in current times. Such techniques are now widely employed in our schools, government reports, newspapers, popular publications, television news, and sports coverage, in addition to scientific studies. Data visualization in sports has gained utmost popularity over the years, especially in sports reports appearing in relevant periodicals, on websites, and in television broadcasts. Some recent and excellent examples of data visualization related to cricket and football can be seen in Subramanian[14] and Tselova.[15] Perin et al.,[16] provide an extensive review of visualization in the arena of sports. Some attempts to visualize the performance of bowlers in cricket graphically are the works of Saikia et al.,[17] and Kimber.[18] Saikia et al.,[17] the researchers tried to find the most balanced bowler in the Indian Premier League of the 2018 season in terms of bowling strike rate, economy rate and bowling average using a trilinear plot. While Kimber[18] displayed all three parameters of bowlers in English First-Class cricket for the 1991 season using the augmented scatter plot, However, because of computational simplicity, it is now feasible to visualize the same set of data in many ways, leading to superior insights. Such displays are more informative and provide further details to the onlooker about the data vis-à-vis the performance of bowlers in this case.

This paper tries to develop a contour plot superimposed over a scatter diagram for the visualization of bowlers based on the three parameters discussed above. This shall help the observer understand and compare the performance of the bowlers and their appropriateness towards a specific format of cricket. A code in R programming for drawing the plot for a user-defined dataset shall also be provided.

About the Plot

A contour plot, also known as a contour map or a level plot, is a graphical representation of the variation of a function of two variables over a two-dimensional plane. In a contour plot, the independent variables are typically represented on the x and y axes, while the dependent variable (the function involving the two variables, i.e. f(x, y)) is represented by the contour lines. These contour lines connect points with equal function values, forming closed curves or lines of varying shapes. Here, taking the Bowling Average in (1) as 'x' and Bowling Strike Rate in (2) as 'y' we can express the Economy rate in (3) as $6\times\frac{(1)}{(2)}$ i.e.

$$\text{Economy Rate} = 6\times\frac{\text{Bowling Average}}{\text{Strike Rate}}$$

Thus,

$$\text{Economy Rate} = f(x,y) = 6\times\frac{x}{y} \quad (4)$$

Thus, a contour plot can be drawn with the (Bowling Average, Strike Rate, and Economy Rate) of a set of bowlers as (x, y and f(x, y)) necessary for drawing it. However, the contour plot looks incongruous when one wants to compare bowlers concerning the three performance measures of bowlers as mentioned above. The exact positioning of the bowlers in the plot area shall depict more information about the bowlers in terms of Bowling Average, Strike Rate and Economy Rate. If a scatter plot of the bowlers based on (Bowling Average (x) and strike Rate (y)) is superimposed over the contour plot with identical axes and a transparent background, then the relative position of the bowlers based on the three parameters can be visualized. For identification of the players, the dots in the graph need to be labeled with the names of the corresponding players or their identification codes. Currently, no package provides the option of drawing such a plot. However, a code can be developed in the R package for drawing a contour plot with a superimposed scatter plot. The code is appended to Appendix I of the paper.

The data set

The data for drawing the plot is collected from the website espncricinfo.com.[1] It pertains to information about the top 33 ODI bowlers of all time measured in terms of their career strike rate. To ensure that the selected bowlers have played a significant amount of cricket at the international level, players who bowled more than 100 overs and played in 30 or more matches were considered. This has led to the selection of 33 bowlers from different cricket-playing nations and across different eras. The Bowling Average, Strike Rate and Economy Rate of the selected bowlers, along with the period in which they played for their country in ODIs, are provided in Table 1.

The plot

This plot, as discussed in the "About the Plot" section, is an extension of the contour plot and is a scatter plot of (Bowling Average (x) and strike Rate (y)) of the 33 bowlers superimposed over a contour plot of (Bowling Average, Strike Rate and Economy Rate). The measures of Bowling Average, Strike Rate and Economy Rate are the career figures of the selected bowlers. As none of the packages directly allow the drawing of this type of superimposed contour plot, it is programmed in the R-package. The code for the same is provided in Appendix I of the paper, and the graph is displayed in Figure 1. To classify the bowlers in terms of bowling average and strike rate two grid lines are provided perpendicular to the x-axis and y-axis, respectively. All three measures of bowling performance are negative (i.e., the lower the value, the better it is). So, from Figure 1, it can be seen that Rashid Khan, SE Bond, AA Donald, Saqlain Mushtaq, Saeed Ajmal, BAW Mendis, and MA Starc are better compared to the other bowlers in terms of Bowling Strike Rate and Bowling Average.

[1]https://stats.espncricinfo.com/ci/engine/stats/index.html?class=2;filter=advanced;orderby=bowling_strike_rate;template=results;type=bowling (Assessed on 28th May, 2023).

Citation: Bhattacharjee D, Saikia H. Visualizing bowling performance in cricket using contour plot. *MOJ Sports Med.* 2023;6(3):97–100.
DOI: 10.15406/mojsm.2023.06.00148

Out of these bowlers, the Economy Rates of Rashid Khan, SE Bond, AA Donald, Saqlain Mushtaq and Saeed Ajmal are in the range of [4, 4.5]. It is further observed that most modern bowlers have a higher economy rate than the bowlers of yesteryear; this has happened as modern-day cricket has become more scoring. As the 80s and 90s batsmen were more conscious of losing their wickets, the bowlers of that era had to wait longer to get wickets. This is evident from the figure, as most of the bowlers who ruled the cricket world during that period are positioned in the upper half of the graph, with more crowding at the top left.

Table 1 Bowling average, strike rate and economy rate of 33 international cricketers in ODI

Player	Country	Period in International Cricket	Economy rate	Bowling average	Bowling strike rate
MA Starc	Australia	2010/11 to present	5.08	22.22	26.2
Rashid Khan	Afghanistan	2015/16 to present	4.16	18.65	26.8
BAW Mendis	Sri Lanka	2007/8 to 2015/16	4.8	21.86	27.3
Mustafizur Rahman	Bangladesh	2015 to present	5.09	23.32	27.4
TA Boult	New Zealand	2012 to 2022	4.93	23.97	29.1
SE Bond	New Zealand	2001/2 to 2009/10	4.28	20.88	29.2
B Lee	Australia	1999 to 2012	4.76	23.36	29.4
Saqlain Mushtaq	Pakistan	1995/96 to 2003/4	4.29	21.78	30.4
Waqar Younis	Pakistan	1989/90 to 2002/3	4.68	23.84	30.5
CJ McKay	Australia	2009/10 to 2013/14	4.78	24.37	30.5
AR Cusack	Ireland	2008 to 2015	4.63	23.96	31
AA Donald	South Africa	1991/92 to 2002/3	4.15	21.78	31.4
JJ Bumrah	India	2015/16 to present	4.63	24.3	31.4
C Pringle	New Zealand	1990 to 1994/5	4.45	23.87	32.1
Saeed Ajmal	Pakistan	2008 to 2015	4.18	22.72	32.6
M Ntini	South Africa	1997/98 to 2008/9	4.53	24.65	32.6
NW Bracken	Australia	2000/1 to 2009	4.41	24.36	33
A Flintoff	England	1998/99 to 2008/9	4.39	24.38	33.2
BP Patterson	West Indies	1985/86 to 1992/93	4.33	24.51	33.8
GD McGrath	Australia	1993/94 to 2006/7	3.88	22.02	34
CG Rackemann	Australia	1982/83 to 1990/91	3.94	22.35	34
DK Lillee	Australia	1972 to 1983	3.58	20.82	34.8
M Muralidaran	Sri Lanka	1993 to 2010/11	3.93	23.08	35.2
Mujeeb Ur Rahman	Afghanistan	2017/18 to present	3.97	23.43	35.3
Wasim Akram	Pakistan	1984/85 to 2002/3	3.89	23.52	36.2
J Garner	West Indies	1976/77 to 1986/87	3.09	18.84	36.5
CJ McDermott	Australia	1984/85 to 1995/96	4.03	24.71	36.7
TM Alderman	Australia	1981 to 1990/91	3.65	23.36	38.3
MA Holding	West Indies	1976 to 1986/87	3.32	21.36	38.5
RJ Hadlee	New Zealand	1973 to 1990	3.3	21.56	39.1
SM Pollock	South Africa	1995/96 to 2007/08	3.67	24.5	39.9
CEL Ambrose	West Indies	1987/88 to 2000	3.48	24.12	41.5
RGD Willis	England	1973 to 1984	3.28	24.6	44.9

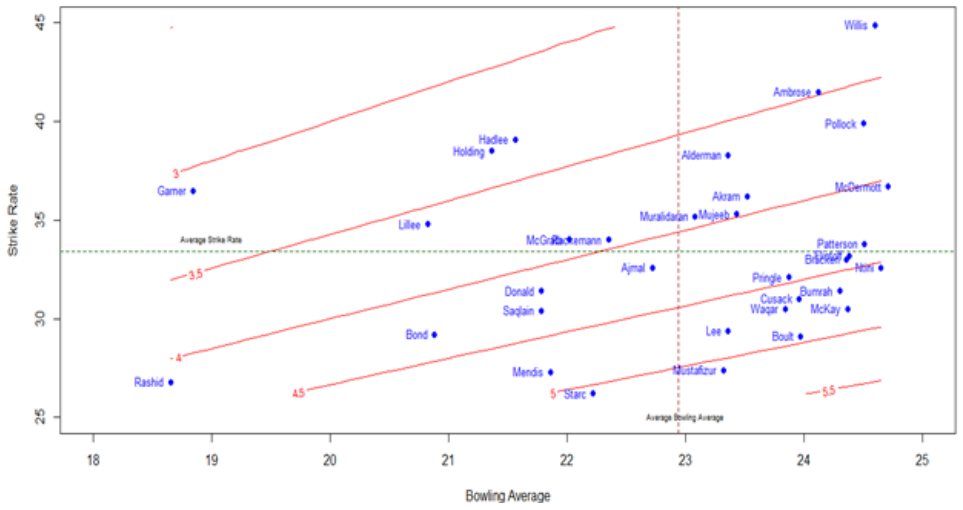

Figure 1 The superimposed scatter plot over the contour plot displaying the performance of ODI bowlers in terms of bowling average, strike rate and economy rate.

Citation: Bhattacharjee D, Saikia H. Visualizing bowling performance in cricket using contour plot. *MOJ Sports Med.* 2023;6(3):97–100. DOI: 10.15406/mojsm.2023.06.00148

Conclusion

The paper attempts to represent the three measures of bowling performance, viz., bowling average, bowling strike rate, and economy rate, in the same graph. Here a scatter diagram is used to plot the values of the bowling average and strike rate of some great ODI bowlers across different eras, and the contours are used to represent their economy rate. Both the contour and the scatter plot are superimposed over each other so that all three performance statistics of a host of bowlers can be visualized in the same graph. The points are labeled with the bowlers' names so that it is possible to compare a bowler's performance to that of his peers according to any of the bowling performance statistics. The current researchers have also provided an R code that would enable widespread usage of this display in research papers, magazines, and periodicals where three variables are to be represented in a two-dimensional plane.

In conclusion, performance measures for bowlers in cricket using the graphical tools discussed above are essential for evaluating individual performances as well as team strategies. Without these exercises, it would be difficult to assess the effectiveness of different bowling tactics or identify areas for improvement. Therefore, these metrics must continue to be visualized and refined to enhance and fine-tune the quality of players in this sport and beyond.

Appendix

R code for drawing contour plot with superimposed scattered diagram

```
data = read.csv("BOWLER_CONTOUR.csv",header = TRUE)

attach(data)

xgrid = seq(min(Avg),max(Avg),0.3)

ygrid = seq(min(SR),max(SR),0.3)

data.fit=expand.grid(Avg1 = xgrid,SR1 = ygrid)

# Computation of Economy Rate from Bowling Average and Strike Rate

Econ1=6*data.fit$Avg1/data.fit$SR1

mat=matrix(Econ1,nrow=length(xgrid))

contour(x=xgrid,y=ygrid,z=mat,xlab="Bowling Average",ylab="

Strike Rate",xlim=c(18,25),ylim=c(25,45),lwd=1.5,labcex = 0.8,col=heat.colors(1))

points(Avg,SR) # Superimposing the scatterplot over the Contour

# Printing the name of bowlers in the scatter plot

text(Avg,SR, labels = Player, col="blue", adj = 0.5,pos = 2, cex = 0.8)

# Getting guided lines on average values to create quadrants in the plot

abline(v=mean(Avg),col="darkred", lty=2)

abline(h=mean(SR),col="darkgreen", lty=2)
```

Acknowledgments

None.

Conflicts of interest

The author declares that there are no conflicts of interest.

Funding

None.

References

1. Knight J. Cricket for Dummies. West Sussex, England: John Wiley and Sons Ltd; 2006.
2. Lemmer H. 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.
3. Lemmer H. 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*. 2005;27:91–103.
4. Bhattacharjee D, Saikia H. A fairer metric for the performance measurement of bowlers in cricket. *Gurukul Business Review*. 2012;8:1–5.
5. Shah P. New performance measure in Cricket. *IOSR Journal of Sports and Physical Education*. 2017;04:28–30.
6. Dey PK, Ghosh DN, Mondal AC. An MCDM approach for evaluating bowlers' performance in IPL. *Journal of Emerging Trends in Computing and Information Sciences*. 2011;2(11):563–573.
7. Premkumar P, Chakrabarty JB, Chowdhury S. Key performance indicators for factor score based ranking in One-Day International cricket. *IIMB Management Review*. 2020;32(1):85–95.
8. Bhattacharjee D. Some aspects of statistical graphics. (Unpublished doctoral dissertation). India: Gauhati University; 2005.
9. Lemmer H. A measure of the current bowling performance in cricket. *South African Journal for Research in Sport, Physical Education and Recreation*. 2006;28(2):91–103.
10. Lemmer H. The allocation of weights in the calculation of batting and bowling performance measures. *South African Journal for Research in Sport, Physical Education and Recreation*. 2007;29(2):75–85.
11. Beaudoin DJ, Swartz T. The best batsmen and bowlers in one-day cricket. *South African Statistical Journal*. 2003;7(2):203–222.
12. Bhattacharjee D, Das KK. Statistical Graphics for Everyone. New Delhi: South Asian Publishers Pvt. Ltd; 2007.
13. Bhattacharjee D. Moving bubbles: an example of dynamic visualization. Dey TK, Nag A, Editors. Contemporary Trends of Research in Physical Sciences. 1st ed. Department of Physics, Silchar: Guru Charan College; 2012;111–116.
14. Subramanian D. Exploring Indian Premier League with interactive visualizations. *Towards data science*. 2019.
15. Tselova, S. Seven creative data visualization ideas for your World Cup coverage. *Flourish studio*. 2022.
16. Perin C, Vuillemot R, Stolper C, et al. State of the art of sports data visualization. *Computer Graphics Forum*. 2018;37(3).
17. Saikia H, Bhattacharjee D, Mukherjee D. Cricket performance management: mathematical formulation and analytics. 2020.
18. Kimber A. A graphical display for comparing bowlers in cricket. *Teaching Statistics*. 1993;15(3): 84–86.