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A Format-specific Bowling Performance Measure of Cricket

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Abstract

Batting and bowling are the prime skills of cricket. Cricket literature has seen a reasonable number of measures of bowling and batting performance. But with the different formats of cricket being played at the international level currently, it is not justified to have a unified measure of performance across all formats. Any performance measure in cricket shall include the existing popular performance statistics as its building block so that the refined measures are perceivable by ordinary followers of the game. This paper attempts to develop a format-specific bowling performance measure for limited-overs cricket. The measure is a weighted multiplicative aggregation of two popular bowling statistics, viz. the bowling average and the economy rate, after range and variance equalization. The proposed measure is implemented on a sample of top 20 bowlers, as per the recent International Cricket Council (ICC) rating, for two popular limited-overs formats of cricket. The study finds that the relative importance of the bowling average and the economy rate in the bowling performance measure varied across the formats of cricket.

Keywords: Cricket Analytics, Data Mining in Sports, Aggregation, Weighting, Composite Index.

AMS Classification: 62P99, 62R07.

1. Introduction

In cricket, the batsmen try to score runs against the balls bowled towards them by the bowlers of the opponent team. While the batsmen create the opportunity of scoring runs, the bowlers, on the other hand, try either to dismiss the batsmen or to restrict them from scoring runs. Cricket is played in three different formats at the international level: Test Match, One Day International (ODI), and Twenty20. While a Test match is an unlimited-overs match played over five days, ODI and Twenty20 are limited-overs cricket matches- with ODI innings lasting for 50 overs an innings and Twenty20, as the name indicates, lasts for 20 overs an innings. Traditionally, the performance of bowlers is measured by the bowling average and bowling strike rate, which are defined as follows:

$$\text{Bowling Average } (x) = \frac{\text{Runs conceded by the bowler in an innings or a series of innings}}{\text{Wickets dismissed by the bowler in that innings or that series of innings}}$$

$$\text{Bowling Strike Rate } (y) = \frac{\text{Balls bowled by the bowler in an innings or series of innings}}{\text{Wickets dismissed by the bowler in that innings or series of innings}}$$

Both x and y measure the ability of a bowler to dismiss the batsmen- the former in terms of runs conceded and the latter in terms of the number of balls the bowler has bowled. Also, both of them are negative measures i.e., a better bowler is characterized by smaller values of x or y. However, none of these measures quantifies the ability of a bowler to restrict the runs scored against his bowling by the batsmen. Traditionally, such a statistic was not very relevant to the Test match format of cricket but to the limited-overs cricket. The economy rate (z, say) is used for this purpose, which is the runs conceded by the bowler against the balls bowled. Mathematically,

$$\text{Economy Rate } (z) = \frac{\text{Runs conceded by the bowler in an innings or a series of innings}}{\text{Balls bowled by the bowler in that innings or that series of innings}}$$

Often z is multiplied by 6 to express it in terms of the average number of runs conceded by the bowler per over. z is again a negative measure like that of x and y.

A perfect bowling performance measure shall be a combination of the bowler's ability to take wickets and that of restricting the scoring of runs. This measure shall be a combination of the popular existing bowling statistic to be comprehensible by cricket fans. In addition to all these, the measure needs to be format-specific as the ability to take wickets and restricting the scoring of runs cannot be considered the same in both formats of limited-overs cricket.
Though the cricket literature has several measures of bowling performance that tried to combine both the wicket-taking ability and the capacity of restricting runs by the bowler, a simplified format-specific bowling performance measure was never on the agenda. This sets the motivation behind the current work. The paper tries to develop a limited over format-specific measure (different for ODI and Twenty20) of bowling performance, involving a combination of the available bowling statistics mentioned above.

The paper consists of six sections. While the first section tries to introduces the problem, the second section discusses the available measures of performance in cricket with special reference of bowling performance. The third section expresses the objective of the problem and the next section introduces the format-specific bowling performance measure. The penultimate section applies the formula to some top-performing bowlers of both the limited-overs format, followed by the concluding section where some areas of future research are also discussed.

2. Review of Literature

Cricketers to be successfully placed at the international level need to possess a high level of skill and precision in batting, bowling, and fielding. There is a huge body of literature that has addressed the issue of performance measurement of cricketers. Most of such measures are focused on batting and bowling only- which are the prime services of the game, and a few on the relatively lesser discussed skills of cricket like wicket-keeping or fielding.

Barr and Kantor (2004) combined two important batting matrices- the average and strike rate- as a measure of batting performance, where the relative importance of the two matrices can be controlled by the user. Basevi and Binoy (2007) defined another batting performance measure, but specific to Twenty20 cricket, that can take into account both average as well as strike rate. A Bayesian approach to replace not-out scores with conditional average scores for a suitable batting performance was defined by Damodaran (2006). Subsequently, Maini and Narayanan (2007) developed a batting performance measure that accounts for exposure-to-risk for all completed innings with adjustment from the not-out score of a batsman.

Saikia *et al.* (2016) developed a linear measure that can quantify the all-round performance of a cricketer. Measuring the performance of wicket-keepers and fielders can be seen in the works of Lemmer (2011) and Saikia *et al.* (2012), respectively. Few other authors who attempt to combining the performance of the cricketers from different expertise like batting, bowling, fielding, and wicket-keeping into one index include the work of Lewis (2005), Gerber and Sharp (2006), Bhattacharjee *et al.* (2018).

Bowlers have a very crucial role in cricket, and their performance is often measured using various elementary measures of bowling performance that are discussed above (x, y, and z). Researchers are convinced of the need for an overall performance measure for bowlers, which might be crucial for evaluation of their effectiveness. Using such performance matrices, coaches and bowlers can identify their areas for improvement, leading to better strategies against batsmen. In consonance with that, Lemmer (2002) proposed the combined bowling rate (CBR), which is the harmonic mean of the bowling average, economy rate, and bowling strike rate. Later, several attempts were made by Lemmer (2005, 2006, 2007) 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. However, the bowling average (x), bowling strike rate (y) and economy rate (z) are having different units of measurement, and their combination in CBR does not seem reasonable. Bhattacharjee and Saikia (2012) showed how CBR fails the test of validity of index for quantifying bowling performance in case of a single innings of very few innings. They further developed a linearly aggregated weighted index to measure bowling performance combining x, y, and z after making them unit-free through normalization. Beaudoin and Swartz (2003) used the resource utilization table of Duckworth-Lewis to measure the bowling performance of cricketers.

However, in spite of several such bowling performance measures available, the search did not result in a single format-specific bowling performance measure. Different authors proposed the same bowling performance measure for all the formats of cricket viz., Test, ODI, and Twenty20. In Test matches since dismissal of batsmen is of utmost importance, so one can go only with the bowling average as a measure of bowling performance, but this is not the case with limited-overs cricket. Furthermore, the urgency of restricting runs and dismissing batsmen is expected to vary in the different formats of limited-overs cricket, and so the current researchers advocate the need for a format-specific bowling performance measure for limited-overs cricket. This acts as a motivation behind the current work.

3. Objective of the Study

The above discussion points out the absence of any format-specific bowling performance measure for limited-overs cricket in the host of several such measures visited in the available literature. Thus, the objective of the current research is to develop a format-specific bowling performance measure for limited-overs cricket (different for ODI and Twenty20) so that the players can be properly ranked in terms of their prowess in bowling. The proposed measure is to be designed in a way to comprehend both the wicket-taking skill and the ability of the bowler in restricting the scoring of runs. In addition to all these, the measure needs to have a parameter that can take care of the change in relative importance restricting of runs over dismissing a batsman between Twenty20 and ODI.

4. Methodology

As mentioned above, the bowling average (x), bowling strike rate (y), and economy rate (z) are the fundamental measures of bowling performance, but with different purpose. While x and y are the measures of the wicket-taking ability of a bowler, z measures the ability of a bowler to restrict runs scored by the opponent. As the agenda is to define a bowling performance measure that can combine both abilities, the current section initiates the process of defining the said measure.

4.1 Defining the Format-specific Bowling Performance Measure of Cricket

If r represents the runs conceded by a bowler in an innings (or a series of innings) in which he/she bowled b balls and dismissed w batsmen. Then the bowling average (x), bowling strike rate (y), and economy rate (z) can be redefined as

$$x = \frac{r}{w}, y = \frac{b}{w} \text{ and } z = \frac{r}{b}$$

Observation 1: The bowling strike rate (y) is not a unique measure but can be derived from the bowling average (x) and the economy rate (z).

The ratio of the bowling average and the economy rate is given by

$$\frac{\text{Bowling Average}}{Economy\ Rate} = \frac{x}{z} = \frac{r/w}{b/w} = \frac{r}{b} = y \text{ (bowling strike rate)}$$

Thus, the bowling strike rate shall not be considered as a separate measure. This is just another measure of the wicket-taking capability of the bowler, which is already addressed by the bowling average, though with a different perspective. Thus, the skill in restricting runs and the ability of dismissing batsmen by a bowler can be combined into the index through the bowling average (x) and the economy rate (z). Since an ideal bowler in limited-overs cricket needs to be good both in restricting runs and in dismissing the batsmen, the values of x and z (or their functions) shall be connected through multiplicative aggregation.

If one looks at the top 20 ODI bowers (as per the official ranking issued by the International Cricket Council (ICC) on September, 2024) in terms of their bowling average (x) and economy rate (z) then the ranges are [11.84, 57.55] and [0.49, 1.01] respectively. As the ranges of the two variables are so different, some range equalization treatment is necessary to give each of the variables a fair participation in the proposed measure. Thus, x' and z' are defined so that-

$$x' = \frac{x}{avg(x)} \text{ and } z' = \frac{z}{avg(z)}$$

Here, avg(x) is the arithmetic mean of the bowling average of the pool of all the bowlers who are considered for the study and similarly is avg(z). This transformation brings down the range of x' and z' to [0.41, 1.98] and [0.61, 1.25] which are in a comparable zone. Also, the transformation, termed as scale transformation on average value, has an advantage that an above average bowler in terms of the bowling average (or the economy rate) are converted to a value above unity and below average bowler less than unity. In a similar note, the ranges of bowling average and economy rate of the top 20 Twenty20 bowlers (as per official ranking of the ICC on September, 2024) are [11.84, 57.55] and [0.49, 1.01] respectively. Following the transformation the ranges squeeze to [0.41, 1.98] and [0.61, 1.25] which are again in a comparable environment.

However, the range equalization is not just enough. In the words of Iyengar and Sudarshan (1982), if a multiple number of parameters participate in an index, even if they are in a comparable range, it is necessary that the parameters have stability in their variance. This is necessary to check that the parameters with higher variance do not dominate the proceedings in the combined measure. For that purpose, given the data set β is to be identified such that-

$$Var(x') \cong Var[(z')^{\beta}]$$

Since, β appears as an index to the variable z' and stabilizes the variance with that of x', so β be termed as the variance stabilization index.

Once the values of x' and $(z')^{\beta}$ are obtained the next step is to determine the value of α, which is the relative importance that one wants to assign to the wicket-taking ability at the cost of the ability of restricting runs by the bowler. α is a real number that lies between 0 and 1. With increase in the value of α, the momentum of the proposed measure shifts towards the wicket-taking ability of the bowler, corresponding to a simultaneous decrease in the weight of the skill in restricting runs. The value of α is expected to be less in the case of Twenty20 cricket than in ODI as restricting runs is expected to be more important in Twenty20 than in ODI. Since the wicket-taking ability of a bowler is synonymous with the bowler's capacity of dismissing a batsman, α is termed the dismissal index. The word index is used as α appears in the power of x'. Thus, the ultimate format-specific bowling performance measure (BPM) is defined as,

$$BPM_{\alpha} = (x')^{\alpha}\left[(z')^{\beta}\right]^{(1-\alpha)} \tag{1a}$$

$$= \left[\frac{x}{Avg(x)}\right]^{\alpha}\left[\left\{\frac{z}{Avg(z)}\right\}^{\beta}\right]^{(1-\alpha)} \tag{1b}$$

As dismissal index (α) is the deterministic factor as to how much shall be the relative importance of the wicket-taking ability of the bowler, corresponding to the skill in restricting of runs, so BPM carries α in its suffix. The format-specific BPM is controlled by an appropriate value of α. The index 1 - α is the complementary of the dismissal index, and the value corresponds to the multiplicative weight one is attaching to the ability of the bowler in restricting runs. With $\alpha = 0$, the wicket-taking ability of the bowler gets no importance in BPM, and the performance of the bowler depends only on the ability to restricting runs. When α is in the other extreme, i.e. 1, the entire standing of the bowler, in BPM is authorized to the wicket-taking ability of the bowler. With $\alpha = 0.5$, equal importance is conferred to both x' and $(z')^{\beta}$. Observation 2 explains it better.

Observation 2: *BPM* gives the entire recognition of bowling performance to the scale transformed economy rate for the dismissal index, $\alpha = 0$ and shifts the entire recognition to the scale transformed bowling average for $\alpha = 1$, and for $\alpha = 0.5$, the contribution of the two participating parameters in the BPM is equally shared.

Putting $\alpha = 0$ in (1b) results in

$$BPM_0 = \left[\frac{x}{Avg(x)}\right]^{0}\left[\left\{\frac{z}{Avg(z)}\right\}^{\beta}\right]^{(1-0)} = \left[\frac{z}{Avg(z)}\right]^{\beta} = z'^{\beta} \tag{2}$$

with $\alpha = 1$ (1b) result to

$$BPM_1 = \left[\frac{x}{Avg(x)}\right]^{1}\left[\left\{\frac{z}{Avg(z)}\right\}^{\beta}\right]^{(1-1)} = \left[\frac{x}{Avg(x)}\right] = x' \tag{3}$$

and for $\alpha = 0.5$ (1b) result to

$$BPM_{0.5} = \left[\frac{x}{Avg(x)}\right]^{0.5}\left[\left\{\frac{z}{Avg(z)}\right\}^{\beta}\right]^{(1-0.5)} = \left[\frac{x}{Avg(x)}\right]^{0.5}\left[\left\{\frac{z}{Avg(z)}\right\}^{\beta}\right]^{0.5}$$
$$= x'^{0.5} z'^{0.5\beta} \qquad (4)$$

Thus, with the value of α moving from 0 to 1, the *BPM* gradually shifts its importance from the scaled and variance-stabilized economy rate $\left(z'^{\beta}\right)$to the scaled bowling average (x') of a given bowler. Like the bowling average (x) or economy rate (z), the *BPM* is also a negative measure, i.e. lower the value, the better is the bowler.

4.2 Detecting Ideal Values of α for ODI and Twenty20

A fixed set of bowlers are considered (say, top 20 ODI or Twenty20 bowlers as per the ICC ranking), and their bowling average and economy rate based on data from their last 10 innings are computed. Now the BPM_{α} for the set of bowlers is computed with the dismissal index α, varying from 0 to 1, with a finite jump of 0.02 (say). For each value of α, one shall get a particular rank set of the bowlers under consideration. The bowlers' standing in terms of rank could shift when the value of α changes. Now, the following approach may be followed in determining the value of α.

Considering the ICC ranking of the bowlers as the gold standard, the Kendall (1938) distance of the rank set of the bowlers achieved based on the composite score computed using (1b) for each value of α is computed. The value of α (α', say) for which the corresponding rank set is having minimum Kendall distance with the ICC ranking may be considered the ultimate value of α for computing the BPM i.e., $BPM_{\alpha'}$. Let the rank set of the said pool of bowlers for a given value of α is τ_{α} and the rank set by ICC be τ_{ICC}; then the Kendall distance between the two rank sets τ_{α} and τ_{ICC} is defined as

$$K(\tau_{\alpha},\tau_{ICC}) = \left|\{(i,j): i<j, [\tau_{\alpha}(i)<\tau_{\alpha}(j)\wedge\tau_{ICC}(i)>\tau_{ICC}(j)]\vee[\tau_{\alpha}(i)>\tau_{\alpha}(j)\wedge\tau_{ICC}(i)<\tau_{ICC}(j)]\}\right| \quad (5)$$

where, $\tau_{\alpha}(i)$ and $\tau_{ICC}(j)$ are the ranking of the i^{th} and j^{th} bowler in the rank set τ_{α} and τ_{ICC} respectively. The expression in (5) is summarized as

$$K\left(\tau_{\alpha},\tau_{ICC}\right) = \sum_{\substack{(i,j)\in P \\ i<j}} K_{i,j}\left(\tau_{\alpha},\tau_{ICC}\right) \qquad (6)$$

where, P is the set of unordered pairs of all the distant subjects in the rank set τ_{α} and τ_{ICC} respectively, and

$K_{i,j}\left(\tau_{\alpha},\tau_{ICC}\right) = 0$ if the i^{th} and j^{th} subject are in the same order in both the rank set τ_{α} and τ_{ICC}

= 1, otherwise

Thus, the statistic $K(\tau_{\alpha}, \tau_{ICC})$ is a measure of the distance between the rank set τ_{α} and τ_{ICC} for the same set of batsmen. The value of α for which $K(\tau_{\alpha}, \tau_{ICC})$ is minimum is the ultimate value of α (which is termed as α'), for computing BPM.

5. Data, Computation and Result

To test the working of the *BPM*, the bowling average (x) and economy rate (z) of the top 20 ODI and Twenty20 bowlers as per the ICC rating as on September 28, 2024 are collected. The data of the same are placed in Appendix I of the paper. The data pertaining to x and z of the bowlers are based on their past 10 international matches computed separately for ODI and Twenty20 formats.

After converting the values of x and z to x' and z' the variance stabilization index (β) is determined using the hit and trial method. The values of β for ODI and Twenty20 are 1.9315 and 3.1117 respectively.

Figure 1 shows the ranks of the top 20 ODI bowlers based on the values of BPM_α for different values of α in the range of [0, 1] with a finite jump of 0.02. In the legend of the figure, the numbers against the players' names indicate the players' starting rank i.e., their ranks for α = 0, so that their changing positions in the graph can be identified. The graph shows a remarkable change in the ranks of a few bowlers as the relative importance of the bowling average increases over the economy rate with an increment in the value of α. For example, Mohammad Sami is ranked 17 for α = 0 in terms of BPM_α, when the entire standing of the measure is on economy rate, but as the importance of bowling average in the formula increases, his ranks start improving and ultimately reach the first position from α = 0.68 onwards. Some other noteworthy change in rank is of Rashid Khan (9^{th} to 18^{th}), Shaheen Afridi (19^{th} to 7^{th}). But some bowlers enjoyed robust ranking over the changing values of α, which include Bernard Scholtz (first to fourth), Matt Henry (18^{th} to 15^{th}) and Adam Zampa from seventh to third.

Figure 2 shows the ranks of the top 20 Twenty20 bowlers based on the values of BPM_α for different values of α in the range of [0, 1] with a finite jump of 0.02. The graph shows that the ranks of Rashid Khan are most robust. The bowler is always at the top, whatever the relative importance of bowling average over the economy rate. Moving only from the first position to the second throughout the transformation. The other case is that of Tim Southee, whose rank only varied between four and six in the entire journey. However, some bowlers showed remarkable changes in the rank as the momentum of the bowling average shifted. For example, Alzarri Joseph's rank shifted from 19^{th} (for α = 0) to 11^{th} (for α = 1). Similarly, Mitchell Santner's rank moved from seventh to 17^{th} and that of Arshdeep Singh from tenth to first.

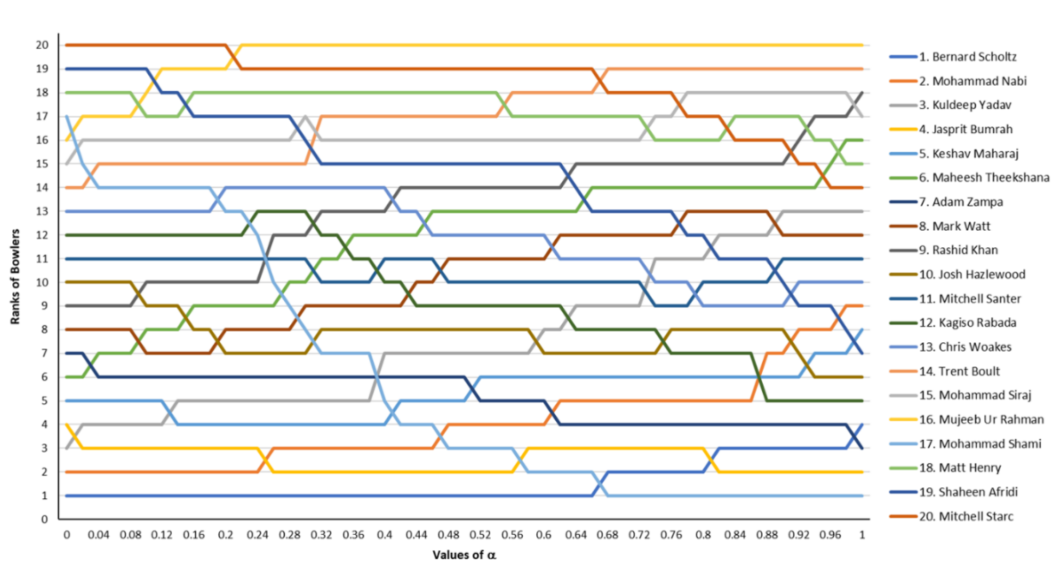

Figure 1: Ranks of the Top 20 ODI bowlers based on the values of BPM_α (for changing values of α from 0 to 1 with a jump of 0.02)

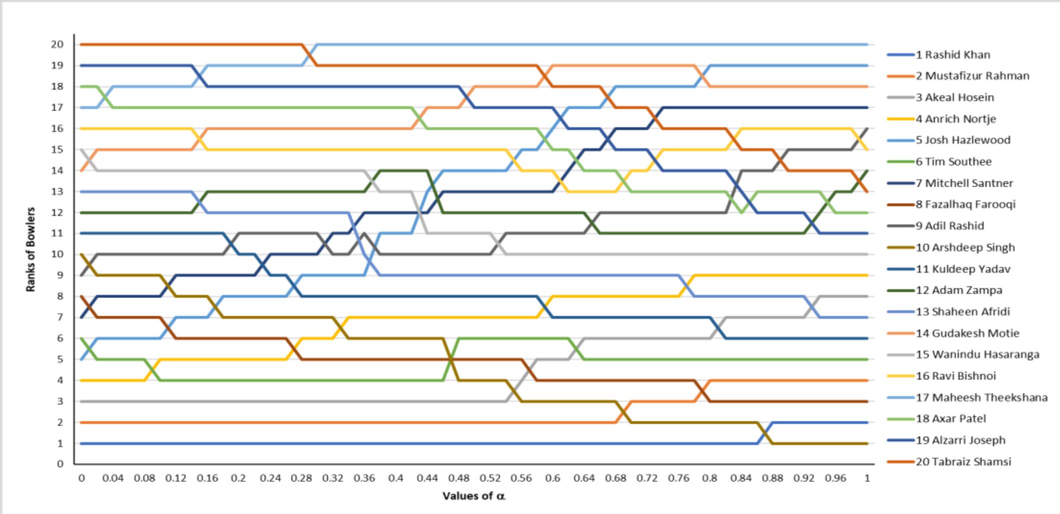

Figure 2: Ranks of the Top 20 Twenty20 bowlers based on the values of BPM_α (for changing values of α from 0 to 1 with a jump of 0.02)

Both the Figures 1 and 2 show that the ranks of the bowlers' change for both the formats of limited-overs cricket as the relative importance of bowling average increases over the economy rate. Also, the shift in rank changes in both directions. Thus, it is necessary to converge to a fixed value of α for BPM_α (which might be different for the different formats viz., ODI and Twenty20) so that the objective ranking of the players can be reached. Now, following the approach discussed in the methodology section (Section 4.2) the values of K for different values of α are computed separately for Twenty20 and ODI, and subsequently the objective value of α (that minimizes $K(\tau_\alpha, \tau_{ICC})$) is determined separately for the two formats.

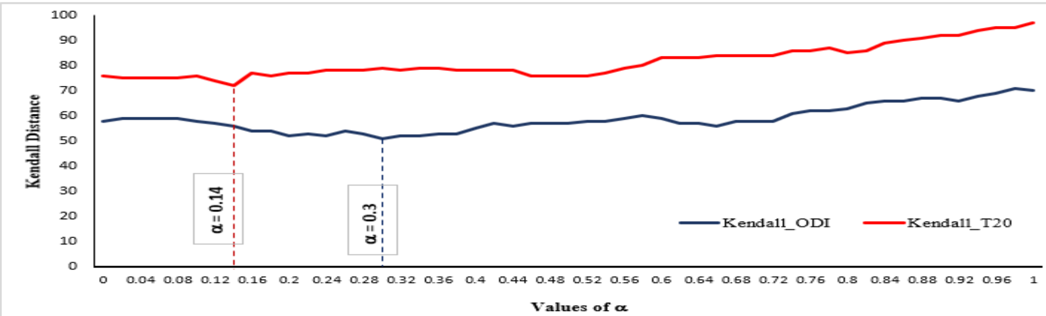

Figure 3: Graph showing the Kendall Distance between ICC ranking of top 20 bowlers with that of BPM_α for the ODI and Twenty20 formats (for changing values of α)

From Figure 3, it is seen that the value of α for which the Kendall distance attains the minimum position is not the same for ODI and Twenty20. The minimum Kendall's distance is obtained for $\alpha = 0.14$ in the case of Twenty20 cricket and $\alpha = 0.3$ in the case of ODI cricket. Thus, in each of the limited-overs cricket, restricting runs counts more than dismissing a batsman. Also, as expected, the economy rate gets more importance in Twenty20 than in ODI. Thus, with the objective value of α, the refined measure of bowling performance is given by

$$BPM_{0.14} = \left[\frac{x}{Avg(x)}\right]^{0.14} \left[\left\{\frac{z}{Avg(z)}\right\}^{3.1117}\right]^{0.86} \text{ for Twenty20} \quad (7a)$$

$$BPM_{0.3} = \left[\frac{x}{Avg(x)}\right]^{0.3} \left[\left\{\frac{z}{Avg(z)}\right\}^{1.9315}\right]^{0.7} \text{ for ODI} \quad (7b)$$

Based on (7a) and (7b) the performance of the top twenty bowlers, i.e., *BPM* for both Twenty20 and ODI, is computed and laid down in Figure 4(a) and 4(b), respectively. The computations show that Rashid Khan, Mustafizur Rahman, and Akeal Hosein are the top three position holders both in Twenty20 and also in ODI. The last of the twenty positions are attained by Tabraiz Samsi and Maheesh Theekshana in Twenty20 and ODI respectively.

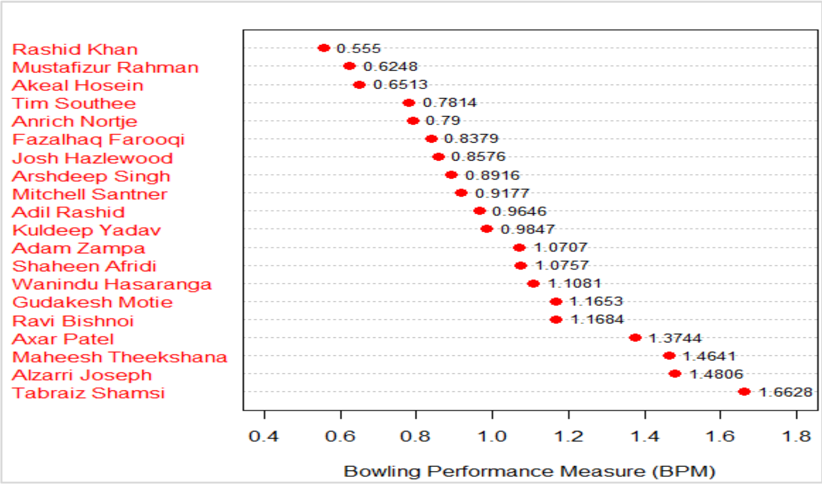

Figure 4(a): Dot plot to display the bowling performance score of top twenty Twenty20 bowlers of international cricket

Since *BPM* is a negative measure (smaller the value, better is the bowler), as per the computation, Rashid Khan, Mustafizur Rahman and Akeal Hosein attain the top three Twenty20 bowlers. Similarly, the top three bowlers for the ODI format are also captured by the same three bowlers.

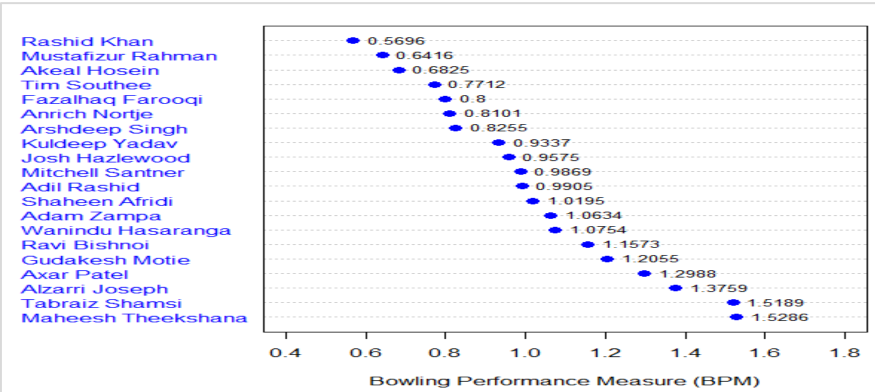

Figure 4(b): Dot plot to display the bowling performance score of top twenty ODI bowlers of international cricket

6. Discussion and Conclusion

The paper basically aims at combining two most convincing and conceivable measures of bowling performance, viz. bowling average (ability of bowler to take wickets) and economy rate (bowler's capacity of restricting the scoring of runs), into a single metric called Bowling Performance Measure (BPM). The main difference between other measures of bowling performance and the current measure is that here the range and variance equalization is done for the participating sub-indicators i.e., bowling average and economy rate. In addition to all these, the measure is made format-specific with different values of the dismissal index (α) for ODI and Twenty20 cricket. This shall make the BPM sensitive to change in the format of limited-overs cricket as it has adaptability from ODI to Twenty20 based on the value of the dismissal index (α). In the case of ODI, the dismissal of the batsman is given 30 percent importance, with a complementary importance of 70 percent to the economy rate. The situation further swings in favour of the economy rate i.e. to the extent of 86 percent in case of Twenty20 cricket. This additional importance to economy rate seems to be natural, as in the format of limited-overs cricket, restricting runs by the bowlers is always the priority. The value of the dismissal index in BPM, is obtained by comparing the performance of the bowlers with their corresponding ICC ranking, providing an objective justification for the same.

In spite of all these, one limitation of the method is that the dismissal index (α) and the variance stabilization index (β) are endogenous, i.e., computed from the bowling average and the economy rate of the pool of bowlers considered in the study. So, with change in the value of the bowling average or economy rate of any of the bowlers under consideration, the values of α and β might change. To obtain a pair of values of (α, β) that can be universally used, one can think of considering a large pool of bowlers and replicate the same exercise. The pair of values of (α, β) thus obtained can be used universally in the formula of BPM. The other solution to the issue concerning the computation of the pair (α, β) is to develop a computer program in any high-level language that considers as input the bowling average and economy rate of a pool of bowlers and produces as output the BPM corresponding to each of the bowlers along with their ranks, following the exact computation of the pair of indices (α, β).

The method, though not void of technicalities, can be perceived by cricket fans as a derived measure of bowling performance based on economy rate and bowling average, both of which are basic cricketing measures the fans are aware of. Thus, the *BPM* stands ahead of the other measures of bowling performance for two reasons: (*i*) it is easily perceivable by the fans (*ii*) the measure is sensitive to the format of limited-overs cricket viz. ODI and Twenty20.

Reference

[1] A. J. Lewis (2005). Towards fairer measures of player performance in One Day cricket. Journal of the Operational Research Society, 56:804–815.

[2] Barr, G. D. I. and Kantor, B. S. (2004). A criterion for comparing and selecting Batsmen in limited-overs Cricket, Journal of the Operational Research Society, Vol. 55, pp. 1266-1274.

[3] Basevi, T. and Binoy, G., (2007). The world's best Twenty20 players. [online] ESPNCricinfo. Available at: https://www.ESPNCricinfo.com/story/the-world-s-best-twenty20-players-311962 .

[4] Beaudoin, D. J. and Swartz, T. (2003). The best batsmen and bowlers in One Day cricket. South African Statistical Journal. 7(2):203–222.

[5] Bhattacharjee, D. and Saiki, H. (2012). A fairer metric for the performance measurement of bowlers in cricket. Gurukul Business Review. 8: pp. 1– 5.

[6] Damodaran, U. (2006). Stochastic dominance and analysis of ODI batting performance: the Indian cricket team, 1989-2005, Journal of Sports Science and Medicine, Vol. 5, No. 4, pp. 503-508

[7] Dibyojyoti, B., Hermanus, H. L., Hemanta, S. and Diganta, M. (2018). Measuring performance of batting partners in limited-overs cricket. South African Journal for Research in Sport, Physical Education and Recreation, 40(3):1–12.

[8] Hannah, G. and Gary, D. S. (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.

[9] Hemanta, S., Dibyojyoti, B. and Hermanus, H. L. (2012). A double weighted tool to measure the fielding performance in cricket. International Journal of Sports Science & Coaching, 7(4):699–713.

[10] Hermanus, H. L. (2011). Performance measures for wicket keepers in cricket. South African Journal for Research in Sport, Physical Education and Recreation, 33(3): 89–102.

[11] ICC (2024a). Men's ODI Bowling rankings | www.icc-cricket.com. https://www.icc-cricket.com/rankings/bowling/mens/odi [Assessed on 28 September, 2024]

[12] ICC (2024b). Men's T20I Bowling rankings | www.icc-Cricket.com. https://www.icc-cricket.com/rankings/bowling/mens/t20i [Assessed on 28 September, 2024]

[13] Iyengar, N. S. and Sudarshan, P. (1982). A method of classifying regions from multivariate data. Economic and Political Weekly, 2047-2052.

[14] Lemmer, 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.

[15] Lemmer, 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: 91–103.

[16] 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.

[17] Lemmer, 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.

[18] Maini, S. and Narayanan, S. (2007). The flaw in batting averages, The Actuary, May-07, pp. 30-31.

[19] Saikia, H., Bhattacharjee D. and Radhakrishnan U. K. (2016). A New Model for Player Selection in Cricket, International Journal of Performance Analysis in Sport, 16:1, 373-388.

Appendix I: Bowling Average and Economy Rate of top 20 ODI and Twenty20 bowlers as per ICC Ranking as on 30th September, 2024

Twenty20				One Day Internationals (ODI)			
Player	Country	Bowling Average	Economy Rate	Player	Country	Bowling Average	Economy Rate
Adam Zampa	Australia	18.8667	1.1792	Adam Zampa	Australia	21.8333	0.7751
Adil Rashid	England	20.3333	1.1296	Bernard Scholtz	Namibia	22.0000	0.4914
Akeal Hosein	West Indies	15.3077	0.9900	Chris Woakes	England	27.3846	0.8476
Alzarri Joseph	West Indies	18.2500	1.3333	Jasprit Bumrah	India	18.7778	0.6884
Anrich Nortje	South Africa	16.5333	1.0598	Josh Hazlewood	Australia	26.2667	0.7896
Arshdeep Singh	India	10.7727	1.1340	Kagiso Rabada	South Africa	25.3125	0.8368
Axar Patel	India	18.5385	1.2957	Keshav Maharaj	South Africa	26.6923	0.6968
Fazalhaq Farooqi	Afghanistan	11.9474	1.1019	Kuldeep Yadav	India	31.6000	0.6870
Gudakesh Motie	West Indies	25.5556	1.1979	Maheesh Theekshana	Sri Lanka	34.1000	0.7715
Josh Hazlewood	Australia	28.3333	1.0625	Mark Watt	Scotland	30.6154	0.7758
Kuldeep Yadav	India	13.5263	1.1629	Matt Henry	New Zealand	33.6429	0.9652
Maheesh Theekshana	Sri Lanka	33.7500	1.2857	Mitchell Santer	New Zealand	28.0625	0.8076
Mitchell Santner	New Zealand	24.8000	1.0973	Mitchell Starc	Australia	33.0000	1.0115
Mustafizur Rahman	Bangladesh	13.1765	0.9825	Mohammad Nabi	Afghanistan	27.3333	0.6457
Rashid Khan	Afghanistan	11.6667	0.9459	Mohammad Shami	India	11.8438	0.9428
Ravi Bishnoi	India	20.2857	1.2137	Mohammad Siraj	India	34.5000	0.9324
Shaheen Afridi	Pakistan	14.7368	1.1966	Mujeeb Ur Rahman	Afghanistan	57.5556	0.9401
Tabraiz Shamsi	South Africa	18.6875	1.3907	Rashid Khan	Afghanistan	34.6923	0.7789
Tim Southee	New Zealand	13.3158	1.0675	Shaheen Afridi	Pakistan	26.6500	0.9870
Wanindu Hasaranga	Sri Lanka	17.2500	1.2000	Trent Boult	New Zealand	36.0000	0.9231

Note: The economy rate and bowling average of the players are computed based on the performance in their most recent twenty international matches. The data for the same is collected from the website ESPNcricinfo.com