A Criterion for Comparing and Selecting Batsmen in Limited Overs Cricket.

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Abstract

The batting average statistic has been used almost exclusively to assess the worth of a batsman. It reveals a great deal about the potential performance of batsmen in cricket played at the first class level. However, in the one-day game, strict limits to the number of balls bowled have introduced a very important additional dimension to performance. In the one-day game, it is clearly not good enough for a batsman to achieve a high batting average with a low strike rate. Runs scored slowly, even without the loss of wickets, will generally result in defeat rather than victory in the one-day game.

Assessing batting performance in the one-day game, therefore, requires the application of at least a two dimensional measurement approach because of the time dimension imposed on limited overs cricket. In this paper we use a new graphical representation with *Strike rate* on one axis and the *Probability of getting out* on the other, akin to the risk-return framework used in Portfolio Analysis, to obtain useful, direct and comparative insights into batting performance, particularly in the context of the one-day game. Within this two dimensional framework we develop a selection criterion for batsmen which combines the average and the strike rate. As an example of the application we apply this criterion to the batting performances of the 2003 World Cup. We demonstrate the strong and consistent performances of the Australian and Indian batsmen as well as providing a ranking of batting prowess for the top 20 run scorers in the tournament.

1. Introduction

American sports, most particularly baseball and football, have always been characterised by a high degree of statistical analysis and commentary. In contrast the originally English games of cricket, rugby and association football have not been subject to the same degree of detailed observation. Cricket, however, particularly the one-day game, lends itself to a more complete statistical analysis than is used at present.

In cricket the standard method of record has long been the number of runs scored by a batsmen per innings while for bowlers a record of Overs-Maidens-Runs-Wickets is still kept. Average runs per innings completed remains the principal criterion by which batsmen are rated in all classes of cricket while bowlers are compared by the average number of runs conceded per wicket taken.

In the first class version of cricket, which is played over three or four and in the case of international matches or Tests, five days, time spent batting was of secondary importance. Information about performance with a time dimension was referred to only on occasion. The length of time spent at the crease by a batsman was occasionally recorded but never as a matter of course. In the pre one-day-international era the time of an innings was, in fact, hardly ever kept as a matter of record, although mention was often made of it in the press. The more useful statistic, the number of balls faced was not mentioned; see for example the considerable set of press cutting in The Bradman Albums[1] or copies of the Wisden Cricket Almanac[2] (published annually from 1864 to the present) . Only in the last 20 years has it become established practice in test cricket to record the length of time a batsman spends at the wicket. An even more revealing statistic, the number of balls faced by a batsman, is only haphazardly recorded in test or first class cricket.

The advent and growing importance of the one-day International (ODI) limited overs game has brought a very different emphasis in the analysis of a batsman's contribution to the team's success or failure. Rather than runs scored, runs scored or conceded *per ball faced or delivered* has become the essential measure of achievement in the one-day game. Therefore average runs per innings has become a much less important estimate of a batsman's capabilities than the ability to score runs quickly. What is known as the ***strike rate***, runs scored per ball faced has become the primary focus of attention in the one-day limited overs game.

We propose below a method of examining a batsman's performance in the one-day cricket game two-dimensionally as an alternative to the largely one dimensional concern with runs per innings adopted conventionally. In a manner parallel to the standard assessment of the performance of financial assets, we will consider a "Risk-Return" analysis of a batsman's performance. In place of the "Return" on an asset, we will use the Strike Rate or the expected number of runs scored per ball. In place of the Risk of an asset, we will use the Probability (for any particular ball) of going out.

We will show that using this approach allows one to define the profile and potential of a batsman in one-day cricket more accurately and comprehensively than would be derived from the calculation of a batting average alone. We then suggest how the strike rate and the average may be combined in a way which may be useful in both test and one-day cricket. A criterion is then proposed which combines the two measures and may be used to rank batsmen in any type of cricket.

2. Statistics and Cricket.

The calculation of batting averages has received some attention in the statistical literature, most particularly from the perspective of the conditions under which the average represents an optimal estimator. Using a reliability and survival analysis approach Kimber et al.[3] note that if the underlying lifetimes (or scores) follow a geometric distribution then the maximum likelihood estimate of the population mean lifetime (or population mean score) is the average. Kimber et al. then go on to propose an alternative non-parametric estimator of the population batting mean which is robust to deviations from the geometric distribution.

The issue of a batsman's scores following a geometric distribution was first raised by Wood[4]. He found there to be considerable empirical support for this contention with the important implication that a batsman's chance of getting out was independent of the number of runs he had scored because of the memoryless property of the geometric distribution. Discussants of this paper at the time, indicated that cricketing lore would not support this position.

Cricket intuition and best practice is for the batsmen to play himself in. Initially, few risks with the bowling are taken while the character of the pitch, the quality of light and the opposition are assessed. As the innings progresses the batsmen typically gains confidence and a greater ascendancy over the bowlers. Runs gradually come more freely with time spent at the crease.

The notion therefore that the chances of going out to any ball are independent of time spent batting and runs scored, is therefore hard for cricketers to accept. Nevertheless, it should be appreciated that as batsmen grow in prowess while batting on, they also grow more confident and therefore willing to take risks with the bowling they would have been more circumspect with earlier in their innings. Their adoption of an increasingly risky approach thus tends to counter balance the increasing certainty stemming from the growing familiarity with the batting circumstances. The empirical evidence ties in exactly with this view; the extra ability to score more runs is being offset by the extra dangers of going out playing the wrong ball; see Kimber and Hansford, and Wood.

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$$Strike\ Rate = 100 * \frac{Runs\ Scored}{Balls\ \ Faced}$$

Generally, the more one tries to increase the strike rate (the number of runs per ball), the higher will be the probability of getting out. In cricket, as in financial markets, any improvement in expected returns (strike rate) will be associated with higher risk (the probability of being dismissed off any one ball).

$$\%P(out) = 100 * \frac{Number\ of\ times\ dismissed}{Balls\ Faced}$$

Winning strategies in one day cricket have been considered in a paper by Stephen R. Clarke[5] in which he shows how dynamic programming can be used to continually assess, as the match progresses, the required run rate (given the number of wickets that have fallen) which will maximise the chance of reaching a desired total. In a later paper with MI Johnstone et al.[6], Clarke measures the extent to which batsmen achieve these goals and proposes a method to rank their contribution in a particular match.

In this paper we offer a graphical 2-dimensional representation of a batsman's performance that we believe goes much further in capturing the multi--dimensional facets impinging on a batsman's performance and focuses on issues which have become critical in the one-day game. This representation also captures and explicitly includes the simple batting average.

3. Measuring Risk and Return in Cricket.

In Figure 1 below, we represent *Strike Rate* on the vertical axis and *Probability of getting out* on the horizontal axis. We may plot the characteristics of any batsman in this 2-dimensional space. A fixed vertical line represents a set of batsmen with the same chance of getting out but changing strike rate (increasing from bottom to top). A fixed horizontal represents a set of batsmen with the same strike rate but changing probability line (increasing from left to right).

It is important to note that because of the identity

$$\frac{Strike\ rate}{\Pr obability\ of\ getting\ out} = Batting\ Average\ ,$$

rays from the origin represent sets of batsmen with *equal batting averages*. Any ray from the origin thus represents loci of batsmen with the same batting averages and this 2-dimensional representation simultaneously captures 3 very important characteristics of a batsman's performance *viz* Strike Rate, Probability of getting out and Batting Average. Note that Batting Average, in addition to Strike rate and P(out), is a very important measure of a batsman's skill. Though, clearly, of paramount importance in the longer form of the game it remains important in the one-day game as an underlying measure of batting quality. As mentioned, any ray from the origin is a ray of fixed batting average. In the one-day game, for a given batting average, batsmen who lie further away from the origin become increasingly valuable to the team because of their ability to score quickly but maintain their average. These batting characteristics are clearly interdependent; if a batsmen of given skill attempts to raise his strike rate, he will generally move to a lower ray of batting average as he will have increased the P(out).

Figure 1 [here]

For stylised comparative purposes, we also include on the figure Geoff Boycott — arguably the dourest (though most reliable) of all post-war English batsmen and Viv Richards — indubitably one of the most exciting post-war West Indian batsmen who had the same average of 47 runs per dismissal for test and one-day cricket, respectively. Yet Viv Richards' strike rate in one-day internationals was nearly three times that of Boycott's test strike rate. Thus to maintain these averages Boycott must have had close to three times less chance of getting out on any particular ball. Clearly they were performing very different roles in very different cricketing contexts. We also plot Don Bradman, who never played one-day cricket but was perhaps the most talented batsman ever, with a test average of 99.94. In Figure 1, we plot Boycott, Richards and Bradman in *Strike Rate - Probability of getting out* space. For comparison, we plot Batsman B on the diagram who has the same strike rate as Boycott but a much higher chance of getting out and hence a lower average lying on ray OB. In addition, Batsman A on the diagram, who has the same chance of getting out as Richards but a lower strike rate and hence lower average. Since Boycott and Richards both have the same batting average, they will both lie on the same straight line OO' emanating from the origin.

This diagram has strong parallels to the geometric representation of the Risk-Return attributes of assets so frequently used in Financial Analysis; see Barr and Knight[7]. Rather than plotting return from an asset on the vertical axis we are plotting the return from a batsman. In place of the variability or riskiness of an asset normally plotted on the horizontal axis we are plotting the riskiness of a batsman, represented by his probability of getting out.

The parallels between these approaches are not, of course, complete. For example, a pivotal asset in financial analysis is that of the risk free asset but such a construct does not have any kind of empirically useable parallel in this analysis. In theory, it would be the strike rate of that batsman who was so risk averse that he never went out. Similarly, while optimal combinations of assets with attractive risk-return characteristics can be combined to form efficient frontiers in financial risk-return space, the batting characteristics of people cannot be combined.

Note that such a risk-return approach to the game of cricket is not limited to an analysis of batting. Bowling can be analysed in a parallel way with bowling strike rate (wickets/ball) on the vertical axis and runs per ball (economy rate) on the horizontal axis. In addition, the method of Duckworth and Lewis[8], which adjusts batting targets in rain affected one-day cricket matches, has implicit in it a risk-return trade off because it attempts to equalise the probability each team had of winning the match before the interruption to the probability of winning after the match is resumed.

3.1 Qualifications to the approach

When a batsman has completed a series of innings, but has never been out, the batting average, as normally defined, does not exist. In practice, where rankings of averages are required, the usual approach to handling such a case is simply to assume that the batsman has been out once and that the average is equal to the total number of runs scored across the innings played. In a parallel way, the probability of being out, as defined above, is not computable when a batsman has not been out over the series of innings considered. Both cases effectively amount to a “small sampling problem”; clearly, *a priori*, as the number of innings increases, the likelihood of the batsman eventually being out will increase. Although the situation does not directly arise in the example considered, we would suggest the rule that in cases where the batsman has not been out, he is considered to have been out once. This assumption, in particular, solves the problem where a lower order batsman, who may well bat on fewer occasions that his higher-order team members, has not been out in the series of matches considered and may have accumulated a significant number of runs. In addition, in the example below, as a way of getting around the small sample problem, we first ranked the batsmen according to their total number of runs scored. In this way we excluded the batsman who technically had a high average because he had only gone out a small number of times, but was a comparatively low run scorer.

Such an approach has implications for the analysis used to develop the diagrammatic representations. Specifically, we will henceforth assume in this analysis that P(out) >0 and this assumption will have ramifications for the analytical development that follows below.

4. A Selection criterion

There are essentially 2 factors that contributed to the suitability of a one-day batsman, namely the batting average (underlying quality) and, for any given batting average, the strike rate.

One may thus compute a criterion which blends the batting average represented by the gradient of the ray, namely, $\frac{y}{x}$ and the *rate* of scoring or strike rate, *y*.

One such criterion could be a weighted product of these two factors, namely

$$y^{\alpha}\left(\frac{y}{x}\right)^{1-\alpha} = \frac{y}{x^{1-\alpha}} \qquad (1)$$

where $0 \leq \alpha \leq 1$ is a measure of the balance between batting average and strike rate.

Note that it is appropriate to compute the product rather than the sum of these two factors since this product will imply that each factor makes a proportional, rather than additive, contribution to the criterion, which is a natural way of combining the two factors. In addition, by varying α from 0 through to 1 one may blend the importance of strike rate with the importance of average score. Hence, putting α=0 puts no emphasis on the speed of scoring and putting α=1 puts no emphasis on average score. These two extremes would correspond, on the one hand, to the timeless test match scenario where speed of scoring is immaterial and, on the other, to the last remaining overs of an ODI when speed of scoring is paramount and the loss of wickets is immaterial. An initial conjecture for the criterion is to put $\alpha = \frac{1}{2}$ and weight the two attributes equally. In this case of an equally weighted combination, we may note that plotting curves of the form

$$y = c\, x^{\frac{1}{2}} \qquad (2)$$

will yield criterion iso-quants of equal suitability as the constant c varies (given the equally weighted function).

Thus maximising equation (1), for some suitable α, is equivalent to selecting batsmen according to the highest isoquant on which they lie.

We illustrate these notions and a typical family of the isoquants in the case of $\alpha = \frac{1}{2}$ in Figure 2. Note that, as discussed above in 3.1, we assume in this model of human endeavour, that as a batsman decreases his risk, he must decrease his strike rate and that where the probability of dismissal approaches 0 the batsman would have a very low strike rate. When we apply these ideas in practice we may, in fact, want to exclude batsmen who have very low probabilities of getting out and low strike rates because, although they may be theoretically desirable, the rules of the one-day game with its 50 over limit will mean that such low-risk/low-strike rate batsmen will not be helpful to the team. We may, for example, have a case where there is a batsman with a low dismissal probability of 0.3% per ball and a strike rate of 10 or even 40 runs per 100 balls. Such a batsman will, however, be unlikely to help win a 300 ball per innings ODI match. In the stylised representation of the isoquants in Figure 2, therefore, which represent a typical example from an ODI match, we only include dismissal probabilities for 0.5% and above.

Figure 2 [here]

4.1 Some illustrations

For illustrative purposes, we consider the performance of the top 20 run scorers in the 2003 World Cup, held in South Africa. The tournament was run in 4 stages. Teams were first divided into two pools A and B. Pool A comprised Australia, England, Pakistan, India, Zimbabwe, Namibia and the Netherlands. Pool B comprised South Africa, Sri Lanka, West Indies, New Zealand, Kenya, Bangladesh and Canada. Each country within each pool played every other country in that pool (round robin system). Six countries were then selected from Pool A and Pool B on the basis of a points system to play another round robin series of matches. Again, on the basis of points, four teams were selected to play two knock-out semi-final matches. A final was then played. The details of all the results are given in Appendix 1.

The advantage of analysing the data from a single round robin type tournament such as the cricket World Cup are that each team plays all other teams at a predefined set of locations over a relatively short period of time. Hence there is some standardisation of the myriad of factors that go towards influencing the outcome of a cricket match and the performance of the players. Notwithstanding this, the sample remains relatively small in a statistical context and all results have to be treated with caution as they relate primarily to the conditions that pertained to the 2003 cricket World Cup.

We first list the performance statistics of the batsmen in table 1, below, giving the innings played, number of times not out, the balls faced, the batting average, the strike rate, the P(out), the suitability criterion (1) ($\alpha = \frac{1}{2}$) with the corresponding ranking and the suitability criterion (1) ($\alpha = \frac{3}{4}$) with the corresponding ranking, and the difference in the rankings. As mentioned above, the criterion with $\alpha = \frac{1}{2}$ is an equal blend of ODI and first class batting prowess; as α increases ODI prowess in the form of strike rate becomes increasingly heavily weighted at the expense of the ability to consistently amass large scores. The rankings are fairly consistent for $\alpha = \frac{1}{2}$ and $\alpha = \frac{3}{4}$ as indicated in the column of ranking differences. Notable differences are in the case of Gilchrist who jumps 5 up the rankings because of his very high strike rate, Dravid who falls 8 positions because of his lowish strike rate (albeit reliable scoring) and Da Silva who moves up 4 because of a very good strike rate. Clearly, comparisons of this type are always somewhat flawed because of varying playing conditions and varying opposition, but by including players with the largest totals over a single tournament one attempts to average out these problems as far as possible. The three top ranked players in both flavours of the criterion considered, *viz*. Symonds, Gibbs and Styris were not the top ranked players coming into the tournament but performed outstandingly within the tournament. Symonds's average was particularly high because he was only out twice and he benefited from a score of 143 not out against Pakistan (the highest score by an Australian in a World Cup). Gibbs only played six matches as SA were eliminated in the preliminary rounds, but performed outstandingly in the matches he did play. Styris was not out twice and apart from Gilchrist had the highest strike rate in the tournament. Gilchrist had the extraordinary strike rate of 105.2 over the tournament but a high P(out) of 2.58, forcing his average down to 40.8. The strength and depth of Australian batting was demonstrated by the number of players they had in the top 10 ranking in both criteria, namely Symonds, Martyn, Ponting and Gilchrist. The analysis may be best captured pictorially where one is able to graphically appreciate the criterion at work. In Figure 3 below we plot the top 10 scorers in Strike Rate/ P(out) space.

Table 1 [here]

Figure 3 [here]

In Figure 3, two isoquants have been drawn in for the “top” two batsman according to the criterion with $\alpha = \frac{1}{2}$. Pictorially, it is seen that selection is a simple North-West type rule, and mimics the selection procedure in portfolio analysis.

5. Selecting batsmen for a (one-day) World XI

Taking into account the relative robustness of the selection procedure across the values of α considered, if we were to select batsmen for a (one-day) World eleven on the basis of this World Cup performance, our selection would probably narrow to Symonds, Gibbs, Martyn, Tendulkar, Ponting, Gilchrist, Attapatu and Ganguly. The Australians dominated in all departments but Figure 4 and the Table indicates the extraordinary depth of talent which the Australians were able to bring in batting alone. No other team approached their depth of talent.

6. Conclusion.

The batting average reveals a great deal about the potential performance for batsmen in cricket played at the first class level. However, in the one-day game, strict limits to the number of balls bowled have introduced a very important additional dimension to performance. In the one-day game, it is clearly not good enough for a batsman to achieve a high batting average with a low strike rate. Runs scored slowly, even without the loss of wickets, will generally result in defeat rather than victory in the one-day game.

Clearly, however, in the one-day game, although batting average maintains some importance a proper analysis of this form of cricket requires the application of at least a two dimensional measurement approach, because of the time dimension imposed on limited overs cricket. By using a graphical representation with Strike rate on one axis and the Probability of getting out on the other, one is able to gain useful direct and comparative insights into batting performance, particularly in the context of the one-day game. Then by combining the notion of batting average and strike rate within this two dimensional approach, one is able to obtain a selection criterion which is consistent with an intuitive selection approach. These insights highlight the skill and depth of the Australian batsmen who provided such a dominant platform for the team to win the 2003 cricket World Cup.

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APPENDIX 1

Results World Cup February 2003

Round Robin stage

South Africa v West Indies, Pool B
Cape Town (d/n), 9 Feb 2003 WI 278/5 [50]
SAf 275/9 [49] West Indies won by 3 runs

Zimbabwe v Namibia, Pool A
Harare, 10 Feb 2003 Zim 340/2 [50]
Nam 104/5 [25.1] Zimbabwe won by 86 runs (D/L method)

New Zealand v Sri Lanka, Pool B
Bloemfontein, 10 Feb 2003 SL 272/7 [50]
NZ 225 [45.3] Sri Lanka won by 47 runs

Australia v Pakistan, Pool A
Johannesburg, 11 Feb 2003 Aus 310/8 [50]
Pak 228 [44.3] Australia won by 82 runs

Bangladesh v Canada, Pool B
Durban (d/n), 11 Feb 2003 Can 180 [49.1]
Ban 120 [28] Canada won by 60 runs

India v Netherlands, Pool A
Paarl, 12 Feb 2003 Ind 204 [48.5]
NL 136 [48.1] India won by 68 runs

South Africa v Kenya, Pool B
Potchefstroom, 12 Feb 2003 Ken 140 [38]
SAf 142/0 [21.2] South Africa won by 10 wickets

Zimbabwe v England, Pool A
Harare, 13 Feb 2003 Zim
Eng Zimbabwe won by a walkover without a ball bowled

New Zealand v West Indies, Pool B
Port Elizabeth, 13 Feb 2003 NZ 241/7 [50]

WI 221 [49.4] New Zealand won by 20 runs

Bangladesh v Sri Lanka, Pool B
Pietermaritzburg, 14 Feb 2003 Ban 124 [31.1]
SL 126/0 [21.1] Sri Lanka won by 10 wickets

Australia v India, Pool A
Centurion, 15 Feb 2003 Ind 125 [41.4]
Aus 128/1 [22.2] Australia won by 9 wickets

Canada v Kenya, Pool B
Cape Town (d/n), 15 Feb 2003 Can 197 [49]
Ken 198/6 [48.3] Kenya won by 4 wickets

England v Netherlands, Pool A
East London, 16 Feb 2003 NL 142/9 [50]
Eng 144/4 [23.2] England won by 6 wickets

Namibia v Pakistan, Pool A
Kimberley, 16 Feb 2003 Pak 255/9 [50]
Nam 84 [17.4] Pakistan won by 171 runs

South Africa v New Zealand, Pool B
Johannesburg, 16 Feb 2003 SAf 306/6 [50]
NZ 229/1 [36.5] New Zealand won by 9 wickets (D/L method)

Bangladesh v West Indies, Pool B
Benoni, 18 Feb 2003 WI 244/9 [50]
Ban 32/2 [8.1] No result

Canada v Sri Lanka, Pool B
Paarl, 19 Feb 2003 Can 36 [18.4]
SL 37/1 [4.4] Sri Lanka won by 9 wickets

England v Namibia, Pool A
Port Elizabeth, 19 Feb 2003 Eng 272 [50]
Nam 217/9 [50] England won by 55 runs

Zimbabwe v India, Pool A

Harare, 19 Feb 2003 Ind 255/7 [50]
Zim 172 [44.4] India won by 83 runs

Australia v Netherlands, Pool A
Potchefstroom, 20 Feb 2003 Aus 170/2 [36]
NL 122 [30.2] Australia won by 75 runs (D/L Method)

Kenya v New Zealand, Pool B
Nairobi, 21 Feb 2003 Ken
NZ Kenya won by a walkover without a ball bowled

South Africa v Bangladesh, Pool B
Bloemfontein, 22 Feb 2003 Ban 108 [35.1]
SAf 109/0 [12] South Africa won by 10 wickets

England v Pakistan, Pool A
Cape Town (d/n), 22 Feb 2003 Eng 246/8 [50]
Pak 134 [31] England won by 112 runs

Canada v West Indies, Pool B
Centurion, 23 Feb 2003 Can 202 [42.5]
WI 206/3 [20.3] West Indies won by 7 wickets

India v Namibia, Pool A
Pietermaritzburg, 23 Feb 2003 Ind 311/2 [50]
Nam 130 [42.3] India won by 181 runs

Zimbabwe v Australia, Pool A
Bulawayo, 24 Feb 2003 Zim 246/9 [50]
Aus 248/3 [47.3] Australia won by 7 wickets

Kenya v Sri Lanka, Pool B
Nairobi, 24 Feb 2003 Ken 210/9 [50]
SL 157 [45] Kenya won by 53 runs

Netherlands v Pakistan, Pool A
Paarl, 25 Feb 2003 Pak 253/9 [50]
NL 156 [39.3] Pakistan won by 97 runs

Bangladesh v New Zealand, Pool B
Kimberley, 26 Feb 2003 Ban 198/7 [50]
NZ 199/3 [33.3] New Zealand won by 7 wickets

England v India, Pool A
Durban (d/n), 26 Feb 2003 Ind 250/9 [50]
Eng 168 [45.3] India won by 82 runs

Australia v Namibia, Pool A
Potchefstroom, 27 Feb 2003 Aus 301/6 [50]
Nam 45 [14] Australia won by 256 runs

South Africa v Canada, Pool B
East London, 27 Feb 2003 SAf 254/8 [50]
Can 136/5 [50] South Africa won by 118 runs

Zimbabwe v Netherlands, Pool A
Bulawayo, 28 Feb 2003 Zim 301/8 [50]
NL 202/9 [50] Zimbabwe won by 99 runs

Sri Lanka v West Indies, Pool B
Cape Town (d/n), 28 Feb 2003 SL 228/6 [50]
WI 222/9 [50] Sri Lanka won by 6 runs

March 2003
Bangladesh v Kenya, Pool B
Johannesburg, 1 Mar 2003 Ken 217/7 [50]
Ban 185 [47.2] Kenya won by 32 runs

India v Pakistan, Pool A
Centurion, 1 Mar 2003 Pak 273/7 [50]
Ind 276/4 [45.4] India won by 6 wickets

Australia v England, Pool A
Port Elizabeth, 2 Mar 2003 Eng 204/8 [50]
Aus 208/8 [49.4] Australia won by 2 wickets

Canada v New Zealand, Pool B
Benoni, 3 Mar 2003 Can 196 [47]
NZ 197/5 [23] New Zealand won by 5 wickets

Namibia v Netherlands, Pool A
Bloemfontein, 3 Mar 2003 NL 314/4 [50]
Nam 250 [46.5] Netherlands won by 64 runs

South Africa v Sri Lanka, Pool B
Durban (d/n), 3 Mar 2003 SL 268/9 [50]
SAf 229/6 [45] Match tied (D/L method)

Kenya v West Indies, Pool B
Kimberley, 4 Mar 2003 WI 246/7 [50]
Ken 104 [35.5] West Indies won by 142 runs

Zimbabwe v Pakistan, Pool A
Bulawayo, 4 Mar 2003 Pak 73/3 [14]
Zim No result

Super Six Stage

Australia v Sri Lanka
Centurion, 7 Mar 2003 Aus 319/5 [50]
SL 223 [47.4] Australia won by 96 runs

India v Kenya
Cape Town (d/n), 7 Mar 2003 Ken 225/6 [50]
Ind 226/4 [47.5] India won by 6 wickets

New Zealand v Zimbabwe
Bloemfontein, 8 Mar 2003 Zim 252/7 [50]
NZ 253/4 [47.2] New Zealand won by 6 wickets

India v Sri Lanka
Johannesburg, 10 Mar 2003 Ind 292/6 [50]
SL 109 [23] India won by 183 runs

Australia v New Zealand
Port Elizabeth, 11 Mar 2003 Aus 208/9 [50]
NZ 112 [30.1] Australia won by 96 runs

Kenya v Zimbabwe

Bloemfontein, 12 Mar 2003 Zim 133 [44.1]
Ken 135/3 [26] Kenya won by 7 wickets

India v New Zealand
Centurion, 14 Mar 2003 NZ 146 [45.1]
Ind 150/3 [40.4] India won by 7 wickets

Australia v Kenya
Durban (d/n), 15 Mar 2003 Ken 174/8 [50]
Aus 178/5 [31.2] Australia won by 5 wickets

Sri Lanka v Zimbabwe
East London, 15 Mar 2003 SL 256/5 [50]
Zim 182 [41.5] Sri Lanka won by 74 runs

Semi-final (knock-out) Stage

Australia v Sri Lanka, 1st Semi Final
Port Elizabeth, 18 Mar 2003 Aus 212/7 [50]
SL 123/7 [38.1] Australia won by 48 runs (D/L Method)

India v Kenya, 2nd Semi Final
Durban (d/n), 20 Mar 2003 Ind 270/4 [50]
Ken 179 [46.2] India won by 91 runs

Finals

Australia v India, Final
Johannesburg, 23 Mar 2003 Aus 359/2 [50]
Ind 234 [39.2] Australia won by 125 runs

Figures & Tables

Figure 1

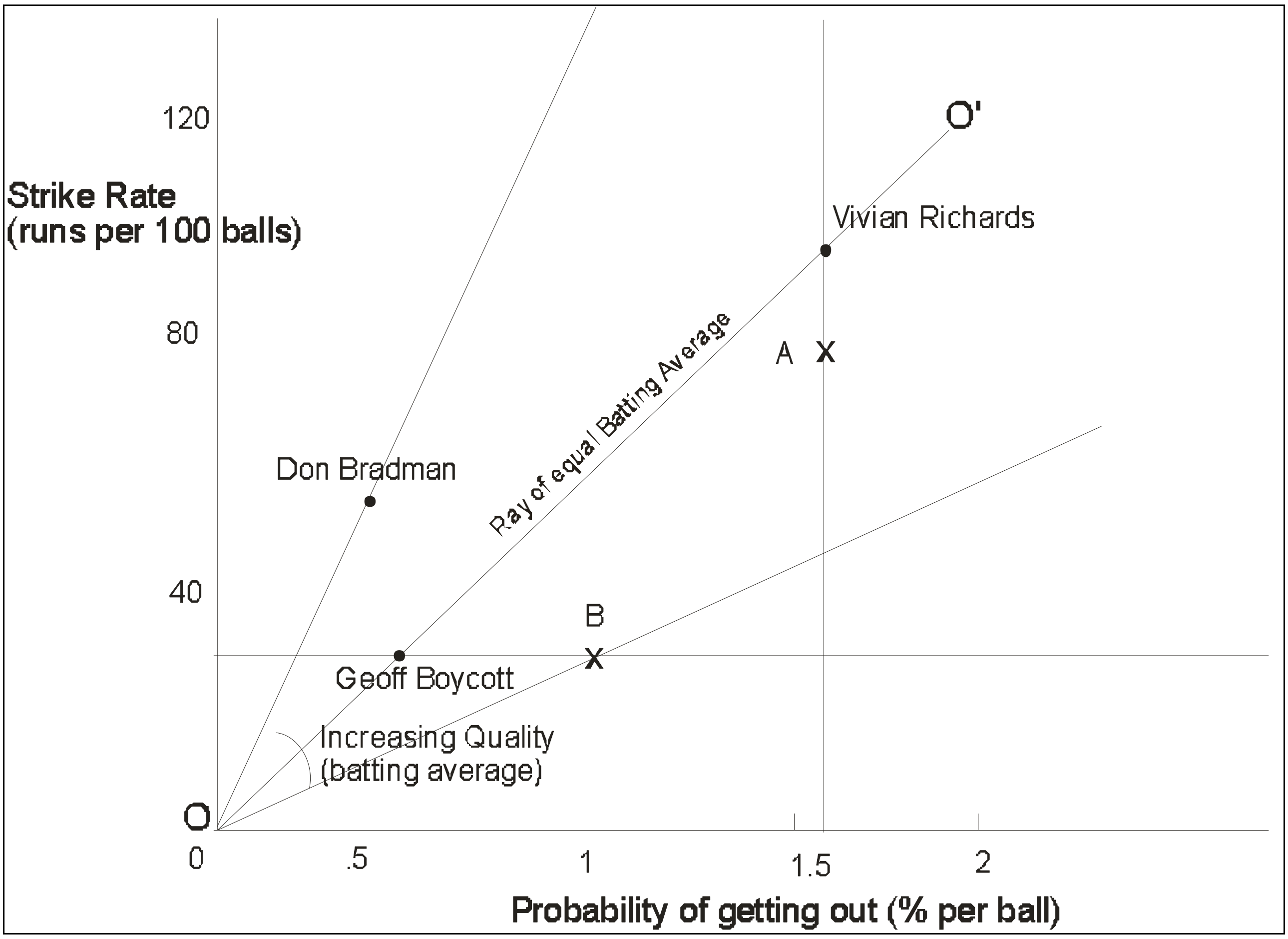

Figure 2

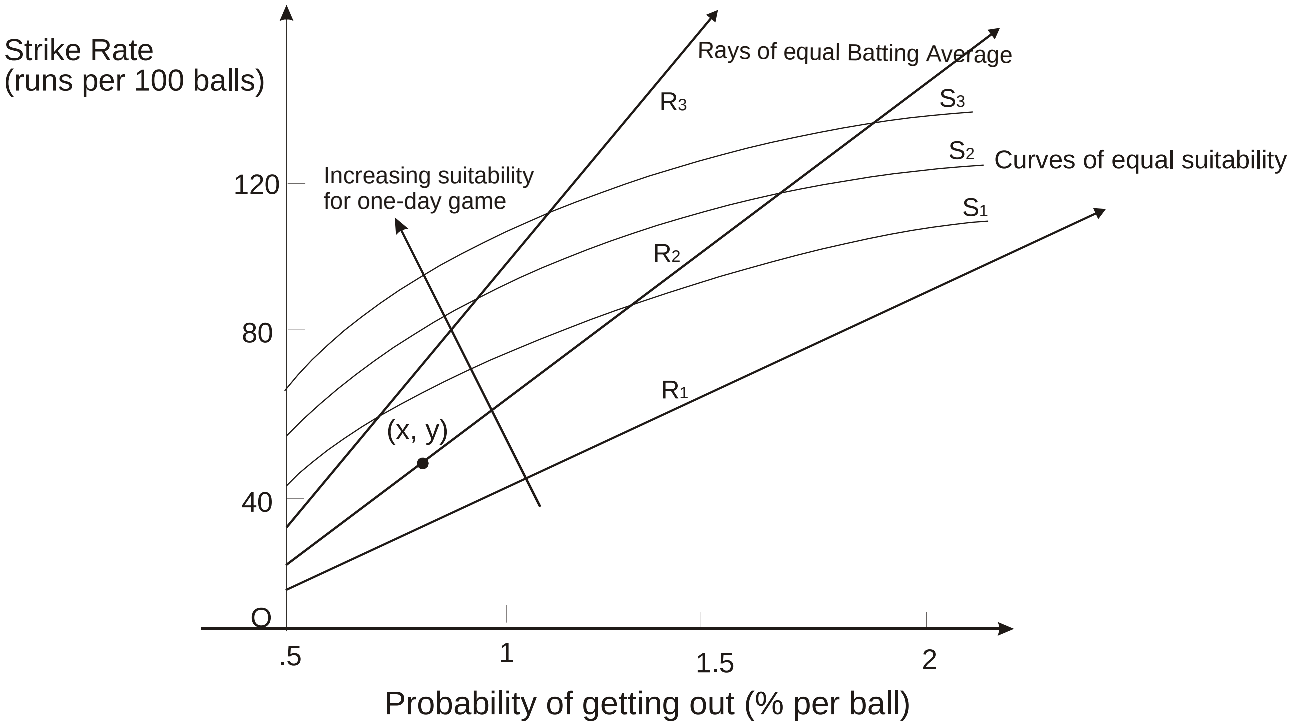
Strike Rate
(runs per 100 balls)
Rays of equal Batting Average
R3
R2
R1
S3
S2
S1
Curves of equal suitability
Increasing suitability
for one-day game
(x, y)
120
80
40
O
.5
1
1.5
2
Probability of getting out (% per ball)

Table 1

Name	Country	Total Runs	Innings	Not Out	Batting Average	Balls Faced	Strike Rate	P(out) %	Criterion $(\alpha = \frac{1}{2})$	Rank $(\alpha = \frac{1}{2})$	Criterion $(\alpha = \frac{3}{4})$	Rank $(\alpha = \frac{3}{4})$	Rank Diffs
SR Tendulkar	IND	673	11	0	61.2	754	89.3	1.46	73.90	4	81.21	5	-1
SC Ganguly	IND	465	11	3	58.1	565	82.3	1.42	69.16	6	75.45	9	-3
RT Ponting	AUS	415	10	2	51.9	472	87.9	1.69	67.53	8	77.06	7	1
AC Gilchrist	AUS	408	10	0	40.8	388	105.2	2.58	65.50	9	82.99	4	5
HH Gibbs	RSA	384	6	2	96.0	381	100.8	1.05	98.36	2	99.56	2	0
MS Atapattu	SL	382	10	3	54.6	452	84.5	1.55	67.91	7	75.76	8	-1
A Flower	ZIM	332	7	0	47.4	459	72.3	1.53	58.57	13	65.09	15	-2
ML Hayden	AUS	328	11	1	32.8	410	80.0	2.44	51.22	18	64.02	18	0
A Symonds	AUS	326	5	3	163.0	360	90.6	0.56	121.49	1	104.88	1	0
DR Martyn	AUS	323	8	3	64.6	395	81.8	1.27	72.68	5	77.09	6	-1
SP Fleming	NZ	321	8	1	45.9	374	85.8	1.87	62.73	12	73.37	11	1
ST Jayasuriya	SL	321	10	2	40.1	420	76.4	1.90	55.37	15	65.05	16	-1
R Dravid	IND	318	10	5	63.6	496	64.1	1.01	63.85	11	63.98	19	-8
V Sehwag	IND	299	11	0	27.2	345	86.7	3.19	48.53	19	64.85	17	2
CB Wishart	ZIM	293	7	1	48.8	343	85.4	1.75	64.59	10	74.28	10	0
SB Styris	NZ	268	7	2	53.6	263	101.9	1.90	73.90	3	86.78	3	0
PA de Silva	SL	267	8	0	33.4	299	89.3	2.68	54.59	16	69.82	12	4
RD Shah	KENYA	265	9	0	29.4	438	60.5	2.05	42.21	20	50.53	20	0
BC Lara	WI	248	6	0	41.3	306	81.0	1.96	57.88	14	68.49	13	1
Y Singh	IND	240	10	3	34.3	281	85.4	2.49	54.11	17	67.98	14	3

Data Souce: Cricinfo database at www.cricket.org

Figure 3

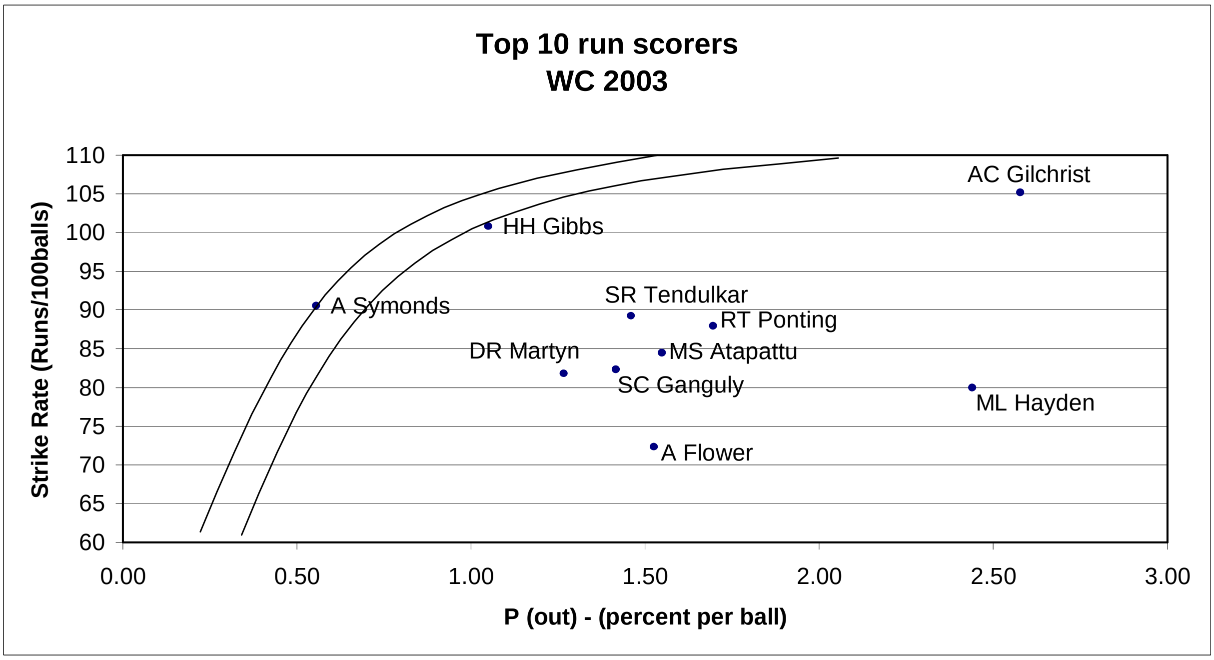
Top 10 run scorers
WC 2003
Strike Rate (Runs/100balls)
110
105
100
95
90
85
80
75
70
65
60
0.00
0.50
1.00
1.50
2.00
2.50
3.00
P (out) - (percent per ball)
AC Gilchrist
HH Gibbs
A Symonds
SR Tendulkar
RT Ponting
DR Martyn
MS Atapattu
SC Ganguly
ML Hayden
A Flower

Figure captions and Table headings

Figure1

Positioning Batsmen in Strike rate / Probability (out) space

Figure 2

Combining Strike rate and Batting Average to form Curves of equal Suitability

Figure 3

Plotting the Performance of the top 10 run scorers in the 2003 World Cup

Table 1 – Top 20 run scorers in 2003 Cricket World Cup