

Some Issues in the Calculation of Batting Averages: Ranking (and Re-Ranking) the Top 50 Batsmen in Test Cricket, 1877-2006

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Abstract

Batsmen in cricket are invariably ranked according to their batting average. Such a ranking suffers from two defects. First, it does not take into account the consistency of scores across innings: a batsman might have a high career average but with low scores interspersed with high scores; another might have a lower average but with much less variation in his scores. Second, it pays no attention to the “value” of the player’s runs to the team: arguably, a century, when the total score is 600, has less value compared to a half-century in an innings total of, say, 200. The purpose of this paper is to suggest new ways of computing batting averages which, by addressing these deficiencies, complement the existing method and present a more complete picture of batsmen’s performance. Based on these “new” averages, the paper offers a “new” ranking of the top 50 batsmen in the history of Test Cricket.

Keywords: re-evaluation, inequality measures, consistency adjustment

1. Introduction

Professional cricket, despite being the subject of numerous books and articles, has not received the same degree of statistical scrutiny as related sports such as baseball.¹ As a result, batsmen in cricket are still predominantly judged, and ranked, by their unadjusted batting average. On this basis, as the first column of Table 1 shows, of the 50 players in the history of Test cricket with the highest batting averages - and who had played at least 20 Test innings - D.G. Bradman headed the ranking with an average of 99.94 and D.P. Jayawardene brought up the rear with an average of 47.86.² However, this method of ranking batsmen does not take into account the *consistency* of their scores: a batsman with a high career average might have low scores interspersed with high scores; another might have a lower average but with much less variation in his scores. The overall batting records of our top 50 batsmen shows that it is possible to compile a high average while, at the same time, displaying considerable inconsistency.³

In addressing the issue of *consistency*, the paper, borrows from the methods of inequality analysis, suggests a way of evaluating batsmen by combining the two criteria of career average and career consistency. The type of problem articulated above, with respect to batting scores, is well known in welfare economics and the analysis of inequality. Anand and Sen (1997), in a paper prepared for the 1995 *Human Development Report*, pointed out that a country's non-economic achievements were likely to be unequally distributed between subgroups of its population: for example, in terms of gender equality, which was the focus of their concern, the female literacy rate, or female life expectancy, was often lower than that for males. Sen (1998) showed that if μ is the mean level of achievement, and I the degree inequality in its distribution, then the level of social welfare, W , may be represented as

Table 1 Top 50 Batsmen in Test Cricket* : 1877- 2006**

Rank Based on average	Player	Average	Innings	Gini	Gini adjusted average*** : Average×(1-Gini)	Rank based on Gini adjusted average	Difference between col 1 and col 8 rank
1	Bradman, D.G	99.94	80	0.47	53.30	1	0
2	Pollock, R.G	60.97	41	0.49	30.98	13	-11
3	Headley, G.A.	60.83	40	0.52	29.14	21	-18
4	Sutcliffe, H	60.73	84	0.40	36.17	2	+2
5	Paynter, E	59.23	31	0.48	31.04	12	-7
6	Barrington, K.F	58.67	131	0.44	33.14	4	+2
7	Weekes, E.C	58.62	81	0.49	29.83	18	-11
8	Hammond, W.R	58.46	140	0.48	30.44	16	-8
9	Dravid, R.S	58.16	167	0.45	31.72	8	+1
10	Sobers, G.S	57.78	160	0.46	31.17	10	0
11	Ponting, R.T.	57.71	166	0.46	31.20	9	+2
12	Kallis, J.H	57.24	161	0.42	33.13	5	+7
13	Hobbs, J.C	56.95	102	0.44	32.17	7	+6
14	Walcott, C.L	56.69	74	0.46	30.63	15	-1
15	Hutton, L	56.67	138	0.46	30.33	17	-2
16	Tendulkar, S.R	55.80	209	0.50	27.89	27	-11
17	Tyldesley, G.E	55.00	20	0.41	32.47	6	+11
18	Davis, C.A.	54.21	29	0.39	33.33	3	+15
19	Kambli, V.G	54.20	21	0.60	21.92	49	-30
20	Hayden, M.L	54.17	141	0.48	28.06	25	-5
21	Chappell, G.S	53.87	151	0.48	28.14	24	-3
22	Nourse,A.D	53.82	62	0.45	29.72	19	+3
23	Sehwag, V	53.67	72	0.56	23.52	45	-22
24	Lara, B.C	53.38	216	0.56	23.67	44	-20
25	Miandad, J	52.57	189	0.47	27.87	28	-3
26	Inzamam U.H	51.72	177	0.48	27.02	29	-3
27	Ryder, J	51.63	32	0.45	28.24	23	+4
28	Flower, A	51.55	112	0.44	29.10	22	+6
29	Smith G.C	51.54	75	0.53	24.46	41	-12
30	Gavaskar, S.M	51.12	214	0.51	25.16	39	-9
31	Waugh, S.R	51.06	260	0.45	27.89	27	+4
32	Mohammad, Y	50.75	108	0.50	25.49	35	-3
33	Border, A.R	50.56	265	0.42	29.31	20	+13
34	Richards, I.V.A	50.24	182	0.50	25.13	40	-6
35	Gilchrist, A.C	50.18	116	0.47	26.76	30	+5
36	Compton, D.C.S	50.06	131	0.48	26.18	33	+3
37	Worrell, F.M.M	49.49	87	0.51	24.01	42	-5
38	Mead, C.P	49.38	26	0.52	23.52	46	-8
39	Bland, K.C.	49.09	39	0.37	31.11	11	+28
40	Mitchell, B	48.89	80	0.46	26.63	31	+9
41	Jackson, F.S	48.79	33	0.47	25.81	34	+7
42	Khan, Y	48.44	74	0.55	21.59	50	-8
43	Harvey, R.N	48.42	137	0.51	23.51	47	-4
44	Walters, D.S	48.26	125	0.47	25.48	36	+8
45	Ponsford, W.H	48.23	48	0.54	21.97	48	-3
46	McCabe, S.J	48.21	62	0.50	23.90	43	+3
47	Jardine, D.R	48.00	33	0.36	30.71	14	+33
48	Martyn, D.R	47.97	98	0.45	26.26	32	+16
49	Dexter, E.R	47.89	102	0.47	25.36	37	+12
50	Jayawardene, D.P.	47.86	123	0.47	25.29	38	+12

- Minimum of 20 innings; **Australia versus England, 15-19 March 1877, Melbourne; India versus England, 9-13 March 2006, Mohali ; *** Calculations with Gini to 5 decimal places.

$W = \mu(1-I)$: "this has the intuitive interpretation as the size of the pie (μ) corrected downwards by the extent of inequality ($I-I$)" (p. 129).⁴

In this paper we apply this notion of a trade-off between average and distribution by adjusting the average score of a batsman over a number of innings by the degree of inconsistency (or inequality) in his scores, thus obtaining a "consistency-adjusted" average score (CAA). We then contrast the ranking implied by the CAA scores with the more conventional ranking obtained through ("consistency-unadjusted") average (CUA) scores.⁵

The method of average-based ranking also pays no attention to the *value* of the player's runs to the team: arguably, a century, when the total score is 600, has less value compared to a half-century in an innings total of, say, 200. While, cricket has not fully established a batting role analogous to baseball's "pinch hitter", tactical and "needs-based" batting (the timing of an innings and the speed at which runs are accumulated) has always played a key role in team tactics and in the eventual result of the game (Brooks, Faff and Sokulsky, 2002).⁶ In such circumstances, batsmen may be required to chase quick runs and the consequent increased risk of dismissal may well damage their average. Lower order batsmen in our all time top 50, such as A.C. Gilchrist, were more likely to face this situation because they were more susceptible to a tactical re-ordering of the batting line up.⁷

Against this background, the purpose of this paper is to suggest new ways of computing batting averages which, by addressing these deficiencies, complement the existing method to present a more complete picture of batsmen's performance. Based on these "new" averages, this paper offers a "new" ranking of the top 50 batsmen in the history of Test Cricket.⁸ In order to allay the fears of the purists it should be made clear that the new ways of computing batting averages suggested in this paper are only generalisations of the traditional method.

Their advantage is that they provide different perspectives for judging batting excellence and highlight the sensitivity of sports rankings to the particular qualities that are being measured.

2. Consistency Adjusted Averages and Certainty Scores

The Gini coefficient is one of the most popular methods for computing inequality in the distribution of outcomes. Its use in sports economics dates back to El-Hadiri and Quirk (1971) who argued that predictability of results (caused by strong team domination of the competition) impacted negatively upon spectator interest. Since then numerous studies have applied the Gini coefficient to measure the competitive balance (evenness of results) in a number of sporting competitions including the US sporting “cartels” of the National Hockey League (Richardson, 2000), Major League Baseball (Burger and Walters, 2003) and the National Football League (Larsen, Fenn and Spenner, 2006) as well as the Australian Football League (Booth, 2004). In this paper, we use the Gini coefficient in a different sense, by applying it to individual rather than the sports competition as a whole and use the results to illustrate consistency of individual performance rather than the evenness of a competition,

Applied to cricket, if N is the number of innings a batsman has played, of which M were “completed” (i.e. he was given out), R_i is the number of runs scored by a batsman in innings i

($i=1\dots N$), and $\mu = \sum_{i=1}^N R_i / M$ represents his (cricketing) “average” score, the Gini coefficient

associated with his scores is defined as:

$$G = \frac{1}{2N^2\mu} \sum_{i=1}^N \sum_{j=1}^N |R_i - R_j|$$

In other words, the Gini coefficient is computed as half the mean of the difference in scores between pairs of innings, divided by the average score (μ).⁹ So, $G=0.45$ implies that the

difference in scores between two innings chosen at random will be 90 percent of the average score: if $\mu=50$, this difference will be 45 runs.

Using the Gini values, the CAA scores for every batsmen were computed as $CAA = CUA \times (1-G)$. Suppose that batsmen are viewed as run producing machines of varying degrees of efficiency: every time a “batsman-machine” is started he/it would score, *with certainty*, the *same* number of runs before stopping. The CAA represents the “certainty score” of a batsman: a “Bradman-machine” would produce X runs ($CAA=X$) before stopping whereas, say, a less efficient “Jardine-machine” would produce Y runs ($CAA=Y$), $Y < X$.

The results for this exercise for the top 50 batsmen in Test cricket are shown in Table 1. The position of only two batsmen remains unchanged under both ranking criteria. D.G. Bradman retains his number 1 ranking and G.S. Sobers stays at number 10. As well, the rankings of some others are relatively insensitive to re-ordering under the consistency criteria, including R.S. Dravid (+1), H. Sutcliffe (+2), K.F. Barrington (+2), R.T. Ponting (+2), C.L. Walcott (-1), L. Hutton (-2), G. S.Chappell (-3), A.D. Nourse (+3), J. Miandad (-3), U.H. Inzaman (-3), Y. Mohammad (-3), D.C.S. Compton (-3) , W.H. Ponsford (-3) and S.J.McCabe (+3).

However, the rankings of others in the top 50 batsmen are highly sensitive to the introduction of consistency criteria. D.R. Jardine moves up 33 places to rank 14th. Other big improvers include K.C. Bland (+28), D.R. Martyn (+16), C.A. Davis (+15), A.R. Border (+ 13), E.R. Dexter (+12), D.P.M. Jaywardene (+12) and G.E. Tyldesley (+11). Those that drop down the rankings significantly are V.G. Kambli (-30), V. Sehwag (-22), B.C. Lara (-20), G.A. Headley (-18), G.W. Smith (-12), E. Weekes (-11) and R.G. Pollock (-11). A highlight of the results is the impact that the introduction of the consistency factor has on the ranking of R.G. Pollock. Regarded by many as a batting talent second only to D.G. Bradman and denied a

lengthy test career by the test ban on South Africa, he drops out of the top 10 under the CAA index to be rated at number 13.¹⁰

Although Test Match conditions vary from match to match, there are two general sets of circumstances which could affect a batsman's performance. First, his performance may be influenced by whether he is batting in the first or second innings: some batsmen are temperamentally better first innings players, scoring most heavily when the match is in an early stage; others are better second innings players, thriving in the latter stages of a match. Another partial explanation for differing performance between first innings and second innings batting performance (at least, implicitly) relates to the concept of Bayesian updating, whereby the batsmen (or team management) adjust their current response to the game on the basis of information gathered from the first innings performance of both teams.¹¹ While most batsmen come into a game with some expectations about the probability of winning (based on past results and current events such as injuries and recent form, weather and pitch conditions) there is little incentive for tactical batting in the first innings. The objective in the first innings is normally to score as many runs as possible and set the platform for tactical batting in the second innings.¹²

By contrast, in the second innings, probabilities about the likely results of the game are recalculated and the playing behaviour of the batsmen may be modified to fit these circumstances. For example, batsmen might be required to go for quick runs to force a result or they may be required to concentrate on survival rather than on normal scoring. As argued earlier, it is batsmen lower down the order or those with a proven ability to score runs quickly (the pinch hitter) or to occupy a crease safely during a difficult period (for example the "night watchmen") that are most likely to be effected by tactical batting.

It is in part for these reasons that 80% our top 50 batsmen score most heavily in the first innings. Table 2 shows the averages of the top 50 batsmen according to the innings in which they scored and Table 3 does the same according to whether their scores were compiled on domestic or foreign pitches. The first innings bias is particularly evident with V.G. Kambli (whose first innings average is 86% higher than his second innings average), V. Sehwag (66%), W.H. Ponsford (57%), F.W.W. Worrell (48%), S.W. Waugh (45%) and B.C. Lara (42%). The batsmen with the highest preference for the second innings are C.R. Davis (27%), A. Flower (15%), J. S. Kallis (14%) and A.R. Border (13%). At the top of the batting averages, D.G. Bradman, performed marginally better in the second innings (+7%) but again displayed a high degree of consistency of performance.

Another factor that may impact upon individual scores, and collectively, upon their average is whether a batsman is playing at home or overseas: some players make better tourists than others as evidenced by the fact that the home averages of some players are considerably higher than their average score on foreign pitches and, of course, vice-versa.¹³ Table 3 shows that some of the top 50 batsmen noticeably fared better abroad than at home (A.R. Border, R.S. Dravid, W. H. Hammond, J. Hobbs, V.G. Kambli and S.W. Waugh), while others did noticeably better at home (G.S. Sobers, D.R. Jardine, B.C. Lara, J. Miandad and C.W. Weekes). The reasons for this are complex and relate both to individual responses to changed physical conditions such as climate and facilities but also to psychological factors. It should be remembered that, unlike many other sporting contests, test cricket takes place over an extended time period with players often separated from family and other support groups for long periods.¹⁴

Table 2 1st and 2nd Innings Certainty Scores for the Top 50 Batsmen in Test Cricket: 1877- 2006

Rank Based on average	Player	Average	Innings	Average 1 st innings	Average 2 nd Innings	Certainty Score (CAA) 1 st Innings	Certainty Score (CAA) 2 nd Innings
1	Bradman, D.G	99.94	80	97.85	104.50	46.19	68.05
2	Pollock, R.G	60.97	41	64.61	55.0	26.96	37.82
3	Headley, G.A.	60.83	40	66.26	54.76	34.77	23.24
4	Sutcliffe, H	60.73	84	59.10	64.21	35.07	39.35
5	Paynter, E	59.23	31	62.00	51.71	28.71	34.99
6	Barrington, K.F	58.67	131	65.83	44.54	38.06	26.09
7	Weekes, E.C	58.62	81	71.44	36.64	37.85	20.42
8	Hammond, W.R	58.46	140	64.18	48.42	31.43	28.69
9	Dravid, R.S	58.16	167	62.37	51.00	32.10	31.08
10	Sobers, G.S	57.78	160	59.41	55.15	30.07	32.65
11	Ponting, R.T.	57.71	166	63.06	48.79	31.73	30.27
12	Kallis, J.H	57.24	161	54.78	62.23	27.87	42.77
13	Hobbs, J.C	56.95	102	63.56	46.11	35.58	27.77
14	Walcott, C.L	56.69	74	59.23	52.13	30.97	30.58
15	Hutton, L	56.67	138	66.28	42.16	34.40	25.46
16	Tendulkar, S.R	55.80	209	61.17	45.71	29.73	25.36
17	Tyldesley, G.E	55.00	20	60.31	41.20	36.60	25.59
18	Davis, C.A.	54.21	29	48.71	61.90	30.18	39.59
19	Kambli, V.G	54.20	21	69.13	9.40	31.94	5.21
20	Hayden, M.L	54.17	141	54.38	53.84	25.62	31.40
21	Chappell, G.S	53.87	151	58.53	46.38	28.69	27.18
22	Nourse, A.D	53.82	62	51.66	56.83	26.52	34.26
23	Sehwag, V	53.67	72	71.56	24.08	34.37	11.86
24	Lara, B.C	53.38	216	65.23	37.58	28.93	18.13
25	Miandad, J	52.57	189	57.05	43.11	28.67	26.28
26	Inzamam U.H	51.72	177	53.68	48.52	26.35	28.08
27	Ryder, J	51.63	32	57.06	43.73	31.18	25.17
28	Flower, A	51.55	112	48.66	56.34	26.97	33.31
29	Smith G.C	51.54	75	59.02	39.63	25.45	23.19
30	Gavaskar, S.M	51.12	214	50.90	51.47	23.70	27.41
31	Waugh, S.R	51.06	260	60.27	32.90	33.52	19.18
32	Mohammad, Y	50.75	108	60.32	36.98	30.63	19.86
33	Border, A.R	50.56	265	48.25	54.64	26.35	34.40
34	Richards, I.V.A	50.24	182	50.80	48.92	23.73	27.99
35	Gilchrist, A.C	50.18	116	55.17	37.71	30.20	19.94
36	Compton, D.C.S	50.06	131	50.49	49.26	23.86	30.00
37	Worrell, F.M.M	49.49	87	61.80	31.78	30.13	17.33
38	Mead, C.P	49.38	26	57.06	34.00	27.67	17.21
39	Bland, K.C.	49.09	39	36.95	68.69	20.54	49.83
40	Mitchell, B	48.89	80	43.26	57.03	21.27	34.73
41	Jackson, F.S	48.79	33	64.22	23.54	38.79	11.72
42	Khan, Y	48.44	74	54.83	39.7	24.73	18.12
43	Harvey, R.N	48.42	137	56.37	35.75	26.96	19.21
44	Walters, D.S	48.26	125	53.43	38.72	27.39	22.75
45	Ponsford, W.H	48.23	48	61.07	25.75	27.79	15.19
46	McCabe, S.J	48.21	62	48.26	48.11	21.74	27.91
47	Jardine, D.R	48.00	33	43.80	60.00	27.18	41.82
48	Martyn, D.R	47.97	98	47.46	48.97	24.80	29.08
49	Dexter, E.R	47.89	102	50.73	42.88	27.01	22.98
50	Jayawardene, D.P.	47.86	123	54.72	34.32	27.70	21.86

Table 3 Home and Away Certainty Scores for the Top 50 Batsmen in Test Cricket:**1877 - 2006**

Rank Based on average	Player	Average	Innings	Average Home	Average Away	Certainty Score (CAA) Home	Certainty Score (CAA) Away
1	Bradman, D.G	99.94	80	98.23	102.85	54.09	52.69
2	Pollock, R.G	60.97	41	68.56	55.19	37.2	27.31
3	Headley, G.A.	60.83	40	77.56	47.45	37.54	23.91
4	Sutcliffe, H	60.73	84	64.60	56.31	42.01	29.63
5	Paynter, E	59.23	31	51.31	67.15	27.44	35.84
6	Barrington, K.F	58.67	131	50.71	69.18	26.91	42.53
7	Weekes, E.C	58.62	81	69.14	49.63	39.38	22.31
8	Hammond, W.R	58.46	140	50.07	66.32	26.40	34.65
9	Dravid, R.S	58.16	167	49.54	63.53	27.19	35.01
10	Sobers, G.S	57.78	160	66.80	50.73	37.76	26.37
11	Ponting, R.T.	57.71	166	62.91	51.48	34.64	27.42
12	Kallis, J.H	57.24	161	53.60	59.24	29.27	35.51
13	Hobbs, J.C	56.95	102	52.30	59.91	29.61	34.01
14	Walcott, C.L	56.69	74	69.84	40.47	42.38	18.89
15	Hutton, L	56.67	138	57.80	55.29	29.01	35.54
16	Tendulkar, S.R	55.80	209	59.71	53.66	30.53	26.80
17	Tyldesley, G.E	55.00	20	52.25	57.30	29.48	35.37
18	Davis, C.A.	54.21	29	66.56	29.5	44.02	15.75
19	Kambli, V.G	54.20	21	46.83	65.25	21.02	25.75
20	Hayden, M.L	54.17	141	63.77	44.42	33.99	23.22
21	Chappell, G.S	53.87	151	54.40	52.95	28.68	27.44
22	Nourse, A.D	53.82	62	51.85	55.59	29.48	30.23
23	Schwag, V	53.67	72	49.0	56.86	22.22	24.68
24	Lara, B.C	53.38	216	60.98	46.72	29.89	18.79
25	Miandad, J	52.57	189	64.09	44.93	36.74	22.54
26	Inzamam U.H	51.72	177	57.93	47.92	29.78	25.58
27	Ryder, J	51.63	32	49.35	58.14	26.34	35.13
28	Flower, A	51.55	112	51.81	51.27	30.27	28.16
29	Smith G.C	51.54	75	48.50	52.76	24.26	24.61
30	Gavaskar, S.M	51.12	214	52.43	50.20	25.49	24.99
31	Waugh, S.R	51.06	260	47.48	55.50	25.87	30.72
32	Mohammad, Y	50.75	108	56.44	46.80	29.96	22.71
33	Border, A.R	50.56	265	46.31	55.99	25.93	33.86
34	Richards, I.V.A	50.24	182	49.78	50.50	24.99	25.31
35	Gilchrist, A.C	50.18	116	47.88	52.78	26.83	27.04
36	Compton, D.C.S	50.06	131	60.05	36.88	33.06	18.41
37	Worrell, F.M.M	49.49	87	55.41	44.90	28.85	20.48
38	Mead, C.P	49.38	26	229.00	41.57	195.25	18.87
39	Bland, K.C.	49.09	39	39.53	56.63	24.24	37.91
40	Mitchell, B	48.89	80	47.39	49.86	29.62	25.25
41	Jackson, F.S	48.79	33	48.79	0.00	28.60	-
42	Khan, Y	48.44	74	51.78	46.94	22.90	21.16
43	Harvey, R.N	48.42	137	45.26	51.43	20.98	26.23
44	Walters, D.S	48.26	125	57.83	39.52	33.55	19.00
45	Ponsford, W.H	48.23	48	40.90	62.4	19.40	28.01
46	McCabe, S.J	48.21	62	42.43	54.63	20.76	28.06
47	Jardine, D.R	48.00	33	81.67	38.38	59.87	23.98
48	Martyn, D.R	47.97	98	49.25	46.85	30.18	22.94
49	Dexter, E.R	47.89	102	43.04	53.65	23.29	28.46
50	Jayawardene, D.P.	47.86	123	56.74	37.44	29.79	20.97

Following the earlier discussion, the first and second innings CAA are shown in the last columns of Table 2 and the home and away CAA are shown in the last columns of Table 3. Table 2 shows that, in its second innings, the “Bradman-machine” would have scored 68.05 runs compared to its first-innings output of 46.19 runs; when set to work on foreign pitches, it would have produced 52.69 runs compared to its domestic output of 54.09.

3. Measuring the Value of a Batsman to His Team

Batting averages measure the performance of players in an *absolute* sense, that is without reference to their team’s performance. However, given that cricket is a team game, an interesting question – and one that, to the best of our knowledge, has not been investigated – is how batsmen perform *relative* to other team members?¹⁵ An important aspect of relative performance is the contribution that individual batsmen make to their team’s total. In order to assess this, we computed for each batsman the total number of runs scored in all his innings as a *percentage* of the total number of runs scored by his team in these same innings.

These figures are shown in Table 4. In the Test Matches that D.G. Bradman played, one-fourth of the Australian team’s runs came from his bat; over their careers, G.A. Headley and B.C. Lara contributed, respectively, 22 and 19 percent to their team scores. So, from the perspective of value to their teams, Bradman, Headley, and Lara were the most “valuable” of the world’s top 50 Test batsmen; at the other end, D.J. Jardine (11 percent), A.C. Gilchrist (11 percent), and J. Ryder (12 percent) were the least valuable (to their teams) of the world’s top 50 Test batsmen.¹⁶ The ranking of the world’s top 50 Test batsmen, on the basis of their career value-to-team are very different from the ranking based on career averages. D.G. Bradman remains the best batsman on either criteria but B.C. Lara, who was ranked 24th on

Table 4 Contributions to Their Team Score by the Top 50 Batsmen in Test Cricket: 1877- 2006

Rank Based on average	Player	Average	Innings	Percentage Career Contribution to Team Score	Rank based on Career Contribution to Team Score	Difference between column 1 and column 5 ranks
1	Bradman, D.G.	99.94	80	24.97	1	0
2	Pollock, R.G.	60.97	41	16.60	17	-14
3	Headley, G.A.	60.83	40	21.65	2	+1
4	Sutcliffe, H	60.73	84	17.21	8	-4
5	Paynter, E	59.23	31	14.29	42	-37
6	Barrington, K.F.	58.67	131	17.01	11	-5
7	Weekes, E.C.	58.62	81	17.79	7	0
8	Hammond, W.R.	58.46	140	17.00	12	-5
9	Dravid, R.S.	58.16	167	16.64	15	-6
10	Sobers, G.S.	57.78	160	15.78	23	-13
11	Ponting, R.T.	57.71	166	14.46	40	-29
12	Kallis, J.H.	57.24	161	15.07	31	-19
13	Hobbs, J.C.	56.95	102	18.25	6	+7
14	Walcott, C.L.	56.69	74	16.09	20	-6
15	Hutton, L	56.67	138	18.36	5	+10
16	Tendulkar, S.R.	55.80	209	15.86	22	-6
17	Tyldesley, G.E.	55.00	20	16.79	13	+4
18	Davis, CA	54.21	29	15.68	25	-7
19	Kambli, V.G.	54.20	21	13.94	43	-24
20	Hayden, M.L.	54.17	141	15.17	29	-9
21	Chappell, G.S.	53.87	151	15.71	24	-3
22	Nourse, A.D.	53.82	62	18.42	4	+18
23	Sehwag, V	53.67	72	15.98	21	+2
24	Lara, B.C.	53.38	216	19.08	3	+21
25	Miandad, J	52.57	189	16.36	19	+6
26	Inzamam U.H.	51.72	177	15.30	27	-1
27	Ryder, J	51.63	32	11.85	48	-21
28	Flower, A	51.55	112	17.05	10	+18
29	Smith G.C.	51.54	75	14.72	35	-6
30	Gavaskar, S.M.	51.12	214	16.67	14	+16
31	Waugh, S.R.	51.06	260	12.88	46	-15
32	Mohammad, Y	50.75	108	14.81	34	-2
33	Border, A.R.	50.56	265	14.44	41	-8
34	Richards, I.V.A.	50.24	182	15.03	32	+2
35	Gilchrist, A.C.	50.18	116	11.35	49	-14
36	Compton, D.C.S.	50.06	131	15.63	26	+10
37	Worrell, F.M.M.	49.49	87	15.11	30	+7
38	Mead, C.P.	49.38	26	15.22	28	+10
39	Bland, K.C.	49.09	39	14.64	37	+2
40	Mitchell, B	48.89	80	17.17	9	+31
41	Jackson, F.S.	48.79	33	16.46	18	+23
42	Khan, Y	48.44	74	14.94	33	+9
43	Harvey, R.N.	48.42	137	16.61	16	+27
44	Walters, D.S.	48.26	125	14.63	38	+6
45	Ponsford, W.H.	48.23	48	13.32	45	0
46	McCabe, S.J.	48.21	62	13.56	44	+2
47	Jardine, D.R.	48.00	33	11.11	50	-3
48	Martyn, D.R.	47.97	98	12.04	47	+1
49	Dexter, E.R.	47.89	102	14.48	39	+10
50	Jayawardene, D.P.	47.86	123	14.66	36	+14

the basis of average, moves to third spot (just behind G.A.Headley) in terms of value-to-team; at the other end of the spectrum, E. Paynter, who occupied 5th place on the basis of his average, drops to the 42nd spot on the basis of his “value-to-team”.¹⁷

Another way of assessing the value of a batsman to his team is to ask how many additional runs a batsman would make if the rest of the team made *another* 100 runs. In order to answer this question we estimated, for every top 50 Test Match batsman, the regression equation:

$$R_i = \alpha S_i + \varepsilon_i$$

where: R_i is the score of the batsman and S_i are the runs scored by the other team members (strictly, team score less batsman’s score) in the i^{th} innings ($i=1 \dots N$). If $\hat{\alpha}$ is the estimate of α , then, on average, for every additional 100 runs scored by the other team members in an innings, the batsman in question would score another $\hat{\alpha}$ runs.

Table 5 shows the values of $\hat{\alpha}$ for the various batsmen. Again the top three batsmen are D.G. Bradman, G.A. Headley, and B.C. Lara: for every 100 additional runs scored by his team mates, Bradman would score another 31 runs; Headley and Lara would score another 20 runs for every 100 additional runs scored by their team mates. At the other end of the scale, the least valuable batsmen to their teams were J. Ryder, D.J. Jardine, and S.M. McCabe (less than 12 runs for every 100 additional runs scored by their team mates).

The preceding analysis raises a more general question: should the runs made by a batsman in his different innings be valued differently? Arguably, a century, when the team score is 600, has less value compared to a half-century in an innings total of, say, 200. But this raises a further question. If runs made in different innings are to be evaluated differently, how should this differential valuation be carried out? We now turn to this issue.

Table 5 The Relation Between Individual and Rest of Team Scores for the Top 50 Batsmen in Test Cricket: 1877- 2006

Rank Based on average	Player	Average	Innings	$\hat{\alpha}^*$	Rank based on $\hat{\alpha}$	Rank based on Career Contribution to Team Score
1	Bradman, D.G.	99.94	80	30.9	1	1
2	Pollock, R.G.	60.97	41	17.2	18	17
3	Headley, G.A.	60.83	40	20.3	2	2
4	Sutcliffe, H	60.73	84	16.8	22	8
5	Paynter, E	59.23	31	12.7	45	42
6	Barrington, K.F.	58.67	131	18.6	9	11
7	Weekes, E.C.	58.62	81	18.5	10	7
8	Hammond, W.R.	58.46	140	16.8	21	12
9	Dravid, R.S.	58.16	167	17.9	12	15
10	Sobers, G.S.	57.78	160	17.1	19	23
11	Ponting, R.T.	57.71	166	14.4	41	40
12	Kallis, J.H.	57.24	161	15.6	28	31
13	Hobbs, J.C.	56.95	102	19.1	6	6
14	Walcott, C.L.	56.69	74	16.0	26	20
15	Hutton, L	56.67	138	18.6	7	5
16	Tendulkar, S.R.	55.80	209	16.6	23	22
17	Tyldesley, G.E.	55.00	20	17.6	14	13
18	Davis, CA	54.21	29	17.5	15	25
19	Kambli, V.G.	54.20	21	14.5	37	43
20	Hayden, M.L.	54.17	141	14.4	39	29
21	Chappell, G.S.	53.87	151	16.1	25	24
22	Nourse, A.D.	53.82	62	19.9	4	4
23	Sehwag, V	53.67	72	14.3	42	21
24	Lara, B.C.	53.38	216	20.1	3	3
25	Miandad, J	52.57	189	18.1	11	19
26	Inzamam U.H.	51.72	177	16.1	24	27
27	Ryder, J	51.63	32	10.6	50	48
28	Flower, A	51.55	112	18.6	8	10
29	Smith G.C.	51.54	75	14.4	38	35
30	Gavaskar, S.M.	51.12	214	16.9	20	14
31	Waugh, S.R.	51.06	260	13.6	43	46
32	Mohammad, Y	50.75	108	15.2	32	34
33	Border, A.R.	50.56	265	15.1	34	41
34	Richards, I.V.A.	50.24	182	15.1	33	32
35	Gilchrist, A.C.	50.18	116	11.6	47	49
36	Compton, D.C.S.	50.06	131	15.4	31	26
37	Worrell, F.M.M.	49.49	87	17.2	17	30
38	Mead, C.P.	49.38	26	14.8	35	28
39	Bland, K.C.	49.09	39	13.2	44	37
40	Mitchell, B	48.89	80	17.2	16	9
41	Jackson, F.S.	48.79	33	19.3	5	18
42	Khan, Y	48.44	74	15.8	27	33
43	Harvey, R.N.	48.42	137	17.7	13	16
44	Walters, D.S.	48.26	125	15.5	29	38
45	Ponsford, W.H.	48.23	48	14.4	40	45
46	McCabe, S.J.	48.21	62	11.6	48	44
47	Jardine, D.R.	48.00	33	10.7	49	50
48	Martyn, D.R.	47.97	98	12.1	46	47
49	Dexter, E.R.	47.89	102	15.5	30	39
50	Jayawardene, D.P.	47.86	123	14.6	36	36

*For every 100 runs scored by rest of team, batsman would score $\hat{\alpha}$ runs

Suppose a batsman plays N innings (indexed, $(i=1..N)$). If $C = \sum_{i=1}^N R_i$ is his career total of runs,

his career average is $\mu = C/M$, where $M (\leq N)$ is the number of his “completed” innings.

We define a batsman’s *value adjusted average*, denoted Ω , as:

$$\Omega = \mu + \theta$$

where θ is the amount by which his career average is adjusted (either positively or negatively) to reflect his value to the team: we refer to θ as his *value added adjustment*.

Let v_i represent the value (per run) associated with the runs R_i scored in innings i ($i=1..N$). Hereafter, v_i is referred to as the *unit value* associated with the i^{th} innings.¹⁸ Then the *value added adjustment*, θ , is defined as the weighted sum of the runs scored in the various innings, the weights being the unit values associated with the innings:

$$\theta = (\sum_{i=1}^N v_i R_i) / M$$

If T_i denotes the team score in the i^{th} innings of a batsman’s career, $p_i = R_i / T_i$ is his proportionate contribution to the team score, $0 \leq p_i \leq 1$. Suppose that z represents a

“threshold” contribution on the basis of which we define: $v_i = \frac{p_i - z}{z}$

The unit-values, v_i , defined above place the value of runs in the context of “team contribution”. They are such that: $v_i > 0$ if $p_i > z$, $v_i < 0$ if $p_i < z$, and $v_i = 0$ if $p_i = z$. In other words, if the batsman’s contribution to the team score in any innings exceeds/ is less than/ equals the threshold contribution, then the unit value attached to the runs made in that innings is positive/negative/zero respectively. In order to make the results comparable across

the batsmen, we chose the *same* threshold, z , for *all* the batsmen. For example, z was taken as the average value of the p_i for Bradman: $z = \sum_{i=1}^N p_i / N = 0.2182$ ¹⁹.

Table 6 shows the values of μ , θ , and Ω for the top 50 batsmen. In terms of θ , the value added adjustment, the top three batsmen were D.G. Bradman ($\theta = 65.36$), G.A. Headley ($\theta = 43.81$), and B.C. Lara ($\theta = 29.37$) and the lowest ranked three batsmen were D.J. Jardine ($\theta = -7.61$), D.S. Martyn ($\theta = -3.15$), and A.C. Gilchrist ($\theta = -1.91$). The value adjusted average, Ω , is obtained by adding the value added adjustment, θ to the conventional average, μ . On the basis of the value adjusted average, Ω , the top three batsmen were: D.G. Bradman ($\Omega = 165.30$), G.A. Headley ($\Omega = 104.64$), and C.W. Weekes ($\Omega = 87.54$). B.C. Lara, who was third on the θ ranking, is fifth on the Ω ranking ($\Omega = 82.75$); R.G. Pollock, who was seventh on the θ ranking, is fourth on the Ω ranking ($\Omega = 84.98$). At the other end of spectrum, D.J. Jardine ($\Omega = 40.39$), D.S. Martyn ($\Omega = 44.81$), and A.C. Gilchrist ($\Omega = 48.27$) continued to occupy the last three places.

4. Conclusions

This paper suggested two ways by which the assessment of batsmen – traditionally based on their career average score – may be extended: first, by taking account of their career consistency and, second, by taking account of their career contribution. In proposing these extensions, one of our aims was to eliminate any element of subjectivity from the new measures. For example, a particular innings by a batsman may have had special value to his team because it was played in difficult circumstances – for example, E. Paynter’s innings of 83 in the Brisbane Test of 1932-33. Other examples of such “great” innings will be readily

Table 6 Ranking by Average, Value-Adjusted Average, and Value-Added Adjustment of the Top 50 Batsmen in Test Cricket: 1877- 2006

Rank Based on average	Player	Average	Value added adjustment (θ)	Value adjusted average (Ω)	Rank based on Ω	Rank based on θ	Rank based on Career Contribution to Team Score
1	Bradman, D.G.	99.94	65.36	165.30	1	1	1
2	Pollock, R.G.	60.97	24.00	84.98	4	7	17
3	Headley, G.A.	60.83	43.81	104.64	2	2	2
4	Sutcliffe, H	60.73	15.05	75.78	9	16	8
5	Paynter, E	59.23	13.20	72.43	11	25	42
6	Barrington, K.F.	58.67	11.70	70.37	14	27	11
7	Weekes, E.C.	58.62	28.93	87.54	3	4	7
8	Hammond, W.R.	58.46	22.90	81.36	6	8	12
9	Dravid, R.S.	58.16	13.07	71.23	12	26	15
10	Sobers, G.S.	57.78	11.55	69.33	20	28	23
11	Ponting, R.T.	57.71	10.55	68.27	23	34	40
12	Kallis, J.H.	57.24	8.53	65.78	27	40	31
13	Hobbs, J.C.	56.95	17.74	74.69	10	11	6
14	Walcott, C.L.	56.69	13.23	69.92	17	24	20
15	Hutton, L	56.67	24.14	80.81	7	6	5
16	Tendulkar, S.R.	55.80	14.32	70.12	16	18	22
17	Tyldesley, G.E.	55.00	10.83	65.83	26	32	13
18	Davis, CA	54.21	2.95	57.16	40	46	25
19	Kambli, V.G.	54.20	15.35	69.66	19	15	43
20	Hayden, M.L.	54.17	15.62	69.79	18	14	29
21	Chappell, G.S.	53.87	13.74	67.60	24	22	24
22	Nourse, A.D.	53.82	16.85	70.67	13	13	4
23	Sehwag, V	53.67	25.50	79.17	8	5	21
24	Lara, B.C.	53.38	29.37	82.75	5	3	3
25	Miandad, J	52.57	10.74	63.31	28	33	19
26	Inzamam U.H.	51.72	9.82	61.54	33	37	27
27	Ryder, J	51.63	5.29	56.92	41	43	48
28	Flower, A	51.55	14.98	66.53	25	17	10
29	Smith G.C.	51.54	18.75	70.29	15	10	35
30	Gavaskar, S.M.	51.12	17.59	68.71	22	12	14
31	Waugh, S.R.	51.06	0.98	52.04	47	47	46
32	Mohammad, Y	50.75	9.96	60.71	36	36	34
33	Border, A.R.	50.56	4.54	55.10	43	44	41
34	Richards, I.V.A.	50.24	11.13	61.36	34	30	32
35	Gilchrist, A.C.	50.18	-1.91	48.27	48	48	49
36	Compton, D.C.S.	50.06	11.19	61.25	35	29	26
37	Worrell, F.M.M.	49.49	10.00	59.49	38	35	30
38	Mead, C.P.	49.38	13.66	63.03	29	23	28
39	Bland, K.C.	49.09	20.15	69.24	21	9	37
40	Mitchell, B	48.89	14.09	62.98	30	20	9
41	Jackson, F.S.	48.79	10.84	59.64	37	31	18
42	Khan, Y	48.44	9.52	57.95	39	38	33
43	Harvey, R.N.	48.42	13.93	62.35	32	21	16
44	Walters, D.S.	48.26	6.53	54.79	45	42	38
45	Ponsford, W.H.	48.23	8.58	56.81	42	39	45
46	McCabe, S.J.	48.21	14.24	62.45	31	19	44
47	Jardine, D.R.	48.00	-7.61	40.39	50	50	50
48	Martyn, D.R.	47.97	-3.15	44.81	49	49	47
49	Dexter, E.R.	47.89	4.20	52.09	46	45	39
50	Jayawardene, D.P.	47.86	6.96	54.82	44	41	36

recalled by other cricketing enthusiasts. We did not make any attempt to adjust for such special circumstances for, to do so, would have been to inject an element of subjectivity into the assessment.

Nor did we, in arriving at our assessment of the world's top 50 batsmen, make any attempt to allow for the quality of the opposition against which they played. Arguably, there has never been a fiercer bowling attack than D. J. Jardine's body-line team and, in this context, S.M. McCabe's 187 at Sydney December 1932 – hailed by Bradman as the greatest innings he had ever seen – must mock at his lowly position in the rankings (46th out of 50). Equally, runs scored against the West Indian bowling quartet of Holding, Garner, Marshall, and Roberts must have special significance compared to centuries compiled against Bangladesh or Zimbabwe.

In any celestial judgement of batsmen these, and many more criteria, will all be used to arrive at St. Peter's ranking of batsmen. But, till then, this paper offers a modest proposal for refining rankings based on batting averages. In so doing, one awe-inspiring fact stands out: whatever, the criterion used for ranking batsmen, Sir Donald Bradman is always *numero uno*.

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Table 1 Top 50 Batsmen in Test Cricket* : 1877- 2006**

Rank Based on average	Player	Average	Innings	Gini	Gini adjusted average*** : Average×(1-Gini)	Rank based on Gini adjusted average	Difference between col 1 and col 8 rank
1	Bradman, D.G	99.94	80	0.47	53.30	1	0
2	Pollock, R.G	60.97	41	0.49	30.98	13	-11
3	Headley, G.A.	60.83	40	0.52	29.14	21	-18
4	Sutcliffe, H	60.73	84	0.40	36.17	2	+2
5	Paynter, E	59.23	31	0.48	31.04	12	-7
6	Barrington, K.F	58.67	131	0.44	33.14	4	+2
7	Weekes, E.C	58.62	81	0.49	29.83	18	-11
8	Hammond, W.R	58.46	140	0.48	30.44	16	-8
9	Dravid, R.S	58.16	167	0.45	31.72	8	+1
10	Sobers, G.S	57.78	160	0.46	31.17	10	0
11	Ponting, R.T.	57.71	166	0.46	31.20	9	+2
12	Kallis, J.H	57.24	161	0.42	33.13	5	+7
13	Hobbs, J.C	56.95	102	0.44	32.17	7	+6
14	Walcott, C.L	56.69	74	0.46	30.63	15	-1
15	Hutton, L	56.67	138	0.46	30.33	17	-2
16	Tendulkar, S.R	55.80	209	0.50	27.89	27	-11
17	Tyldesley, G.E	55.00	20	0.41	32.47	6	+11
18	Davis, C.A.	54.21	29	0.39	33.33	3	+15
19	Kambli, V.G	54.20	21	0.60	21.92	49	-30
20	Hayden, M.L	54.17	141	0.48	28.06	25	-5
21	Chappell, G.S	53.87	151	0.48	28.14	24	-3
22	Nourse,A.D	53.82	62	0.45	29.72	19	+3
23	Sehwag, V	53.67	72	0.56	23.52	45	-22
24	Lara, B.C	53.38	216	0.56	23.67	44	-20
25	Miandad, J	52.57	189	0.47	27.87	28	-3
26	Inzamam U.H	51.72	177	0.48	27.02	29	-3
27	Ryder, J	51.63	32	0.45	28.24	23	+4
28	Flower, A	51.55	112	0.44	29.10	22	+6
29	Smith G.C	51.54	75	0.53	24.46	41	-12
30	Gavaskar, S.M	51.12	214	0.51	25.16	39	-9
31	Waugh, S.R	51.06	260	0.45	27.89	27	+4
32	Mohammad, Y	50.75	108	0.50	25.49	35	-3
33	Border, A.R	50.56	265	0.42	29.31	20	+13
34	Richards, I.V.A	50.24	182	0.50	25.13	40	-6
35	Gilchrist, A.C	50.18	116	0.47	26.76	30	+5
36	Compton, D.C.S	50.06	131	0.48	26.18	33	+3
37	Worrell, F.M.M	49.49	87	0.51	24.01	42	-5
38	Mead, C.P	49.38	26	0.52	23.52	46	-8
39	Bland, K.C.	49.09	39	0.37	31.11	11	+28
40	Mitchell, B	48.89	80	0.46	26.63	31	+9
41	Jackson, F.S	48.79	33	0.47	25.81	34	+7
42	Khan, Y	48.44	74	0.55	21.59	50	-8
43	Harvey, R.N	48.42	137	0.51	23.51	47	-4
44	Walters, D.S	48.26	125	0.47	25.48	36	+8
45	Ponsford, W.H	48.23	48	0.54	21.97	48	-3
46	McCabe, S.J	48.21	62	0.50	23.90	43	+3
47	Jardine, D.R	48.00	33	0.36	30.71	14	+33
48	Martyn, D.R	47.97	98	0.45	26.26	32	+16
49	Dexter, E.R	47.89	102	0.47	25.36	37	+12
50	Jayawardene, D.P.	47.86	123	0.47	25.29	38	+12

- Minimum of 20 innings; **Australia versus England, 15-19 March 1877, Melbourne; India versus England, 9-13 March 2006, Mohali ; *** Calculations with Gini to 5 decimal places.

Table 2 1st and 2nd Innings Certainty Scores for the Top 50 Batsmen in Test Cricket: 1877- 2006

Rank Based on average	Player	Average	Innings	Average 1 st innings	Average 2 nd Innings	Certainty Score (CAA) 1 st Innings	Certainty Score (CAA) 2 nd Innings
1	Bradman, D.G	99.94	80	97.85	104.50	46.19	68.05
2	Pollock, R.G	60.97	41	64.61	55.0	26.96	37.82
3	Headley, G.A.	60.83	40	66.26	54.76	34.77	23.24
4	Sutcliffe, H	60.73	84	59.10	64.21	35.07	39.35
5	Paynter, E	59.23	31	62.00	51.71	28.71	34.99
6	Barrington, K.F	58.67	131	65.83	44.54	38.06	26.09
7	Weekes, E.C	58.62	81	71.44	36.64	37.85	20.42
8	Hammond, W.R	58.46	140	64.18	48.42	31.43	28.69
9	Dravid, R.S	58.16	167	62.37	51.00	32.10	31.08
10	Sobers, G.S	57.78	160	59.41	55.15	30.07	32.65
11	Ponting, R.T.	57.71	166	63.06	48.79	31.73	30.27
12	Kallis, J.H	57.24	161	54.78	62.23	27.87	42.77
13	Hobbs, J.C	56.95	102	63.56	46.11	35.58	27.77
14	Walcott, C.L	56.69	74	59.23	52.13	30.97	30.58
15	Hutton, L	56.67	138	66.28	42.16	34.40	25.46
16	Tendulkar, S.R	55.80	209	61.17	45.71	29.73	25.36
17	Tyldesley, G.E	55.00	20	60.31	41.20	36.60	25.59
18	Davis, C.A.	54.21	29	48.71	61.90	30.18	39.59
19	Kambli, V.G	54.20	21	69.13	9.40	31.94	5.21
20	Hayden, M.L	54.17	141	54.38	53.84	25.62	31.40
21	Chappell, G.S	53.87	151	58.53	46.38	28.69	27.18
22	Nourse, A.D	53.82	62	51.66	56.83	26.52	34.26
23	Sehwag, V	53.67	72	71.56	24.08	34.37	11.86
24	Lara, B.C	53.38	216	65.23	37.58	28.93	18.13
25	Miandad, J	52.57	189	57.05	43.11	28.67	26.28
26	Inzamam U.H	51.72	177	53.68	48.52	26.35	28.08
27	Ryder, J	51.63	32	57.06	43.73	31.18	25.17
28	Flower, A	51.55	112	48.66	56.34	26.97	33.31
29	Smith G.C	51.54	75	59.02	39.63	25.45	23.19
30	Gavaskar, S.M	51.12	214	50.90	51.47	23.70	27.41
31	Waugh, S.R	51.06	260	60.27	32.90	33.52	19.18
32	Mohammad, Y	50.75	108	60.32	36.98	30.63	19.86
33	Border, A.R	50.56	265	48.25	54.64	26.35	34.40
34	Richards, I.V.A	50.24	182	50.80	48.92	23.73	27.99
35	Gilchrist, A.C	50.18	116	55.17	37.71	30.20	19.94
36	Compton, D.C.S	50.06	131	50.49	49.26	23.86	30.00
37	Worrell, F.M.M	49.49	87	61.80	31.78	30.13	17.33
38	Mead, C.P	49.38	26	57.06	34.00	27.67	17.21
39	Bland, K.C.	49.09	39	36.95	68.69	20.54	49.83
40	Mitchell, B	48.89	80	43.26	57.03	21.27	34.73
41	Jackson, F.S	48.79	33	64.22	23.54	38.79	11.72
42	Khan, Y	48.44	74	54.83	39.7	24.73	18.12
43	Harvey, R.N	48.42	137	56.37	35.75	26.96	19.21
44	Walters, D.S	48.26	125	53.43	38.72	27.39	22.75
45	Ponsford, W.H	48.23	48	61.07	25.75	27.79	15.19
46	McCabe, S.J	48.21	62	48.26	48.11	21.74	27.91
47	Jardine, D.R	48.00	33	43.80	60.00	27.18	41.82
48	Martyn, D.R	47.97	98	47.46	48.97	24.80	29.08
49	Dexter, E.R	47.89	102	50.73	42.88	27.01	22.98
50	Jayawardene, D.P.	47.86	123	54.72	34.32	27.70	21.86

Table 3 Home and Away Certainty Scores for the Top 50 Batsmen in Test Cricket:**1877 - 2006**

Rank Based on average	Player	Average	Innings	Average Home	Average Away	Certainty Score (CAA) Home	Certainty Score (CAA) Away
1	Bradman, D.G	99.94	80	98.23	102.85	54.09	52.69
2	Pollock, R.G	60.97	41	68.56	55.19	37.2	27.31
3	Headley, G.A.	60.83	40	77.56	47.45	37.54	23.91
4	Sutcliffe, H	60.73	84	64.60	56.31	42.01	29.63
5	Paynter, E	59.23	31	51.31	67.15	27.44	35.84
6	Barrington, K.F	58.67	131	50.71	69.18	26.91	42.53
7	Weekes, E.C	58.62	81	69.14	49.63	39.38	22.31
8	Hammond, W.R	58.46	140	50.07	66.32	26.40	34.65
9	Dravid, R.S	58.16	167	49.54	63.53	27.19	35.01
10	Sobers, G.S	57.78	160	66.80	50.73	37.76	26.37
11	Ponting, R.T.	57.71	166	62.91	51.48	34.64	27.42
12	Kallis, J.H	57.24	161	53.60	59.24	29.27	35.51
13	Hobbs, J.C	56.95	102	52.30	59.91	29.61	34.01
14	Walcott, C.L	56.69	74	69.84	40.47	42.38	18.89
15	Hutton, L	56.67	138	57.80	55.29	29.01	35.54
16	Tendulkar, S.R	55.80	209	59.71	53.66	30.53	26.80
17	Tyldesley, G.E	55.00	20	52.25	57.30	29.48	35.37
18	Davis, C.A.	54.21	29	66.56	29.5	44.02	15.75
19	Kambli, V.G	54.20	21	46.83	65.25	21.02	25.75
20	Hayden, M.L	54.17	141	63.77	44.42	33.99	23.22
21	Chappell, G.S	53.87	151	54.40	52.95	28.68	27.44
22	Nourse,A.D	53.82	62	51.85	55.59	29.48	30.23
23	Sehwag, V	53.67	72	49.0	56.86	22.22	24.68
24	Lara, B.C	53.38	216	60.98	46.72	29.89	18.79
25	Miandad, J	52.57	189	64.09	44.93	36.74	22.54
26	Inzamam U.H	51.72	177	57.93	47.92	29.78	25.58
27	Ryder, J	51.63	32	49.35	58.14	26.34	35.13
28	Flower, A	51.55	112	51.81	51.27	30.27	28.16
29	Smith G.C	51.54	75	48.50	52.76	24.26	24.61
30	Gavaskar, S.M	51.12	214	52.43	50.20	25.49	24.99
31	Waugh, S.R	51.06	260	47.48	55.50	25.87	30.72
32	Mohammad, Y	50.75	108	56.44	46.80	29.96	22.71
33	Border, A.R	50.56	265	46.31	55.99	25.93	33.86
34	Richards, I.V.A	50.24	182	49.78	50.50	24.99	25.31
35	Gilchrist, A.C	50.18	116	47.88	52.78	26.83	27.04
36	Compton, D.C.S	50.06	131	60.05	36.88	33.06	18.41
37	Worrell, F.M.M	49.49	87	55.41	44.90	28.85	20.48
38	Mead, C.P	49.38	26	229.00	41.57	195.25	18.87
39	Bland, K.C.	49.09	39	39.53	56.63	24.24	37.91
40	Mitchell, B	48.89	80	47.39	49.86	29.62	25.25
41	Jackson, F.S	48.79	33	48.79	0.00	28.60	-
42	Khan, Y	48.44	74	51.78	46.94	22.90	21.16
43	Harvey, R.N	48.42	137	45.26	51.43	20.98	26.23
44	Walters, D.S	48.26	125	57.83	39.52	33.55	19.00
45	Ponsford, W.H	48.23	48	40.90	62.4	19.40	28.01
46	McCabe, S.J	48.21	62	42.43	54.63	20.76	28.06
47	Jardine, D.R	48.00	33	81.67	38.38	59.87	23.98
48	Martyn, D.R	47.97	98	49.25	46.85	30.18	22.94
49	Dexter, E.R	47.89	102	43.04	53.65	23.29	28.46
50	Jayawardene, D.P.	47.86	123	56.74	37.44	29.79	20.97

Table 4 Contributions to Their Team Score by the Top 50 Batsmen in Test Cricket: 1877- 2006

Rank Based on average	Player	Average	Innings	Percentage Career Contribution to Team Score	Rank based on Career Contribution to Team Score	Difference between column 1 and column 5 ranks
1	Bradman, D.G.	99.94	80	24.97	1	0
2	Pollock, R.G.	60.97	41	16.60	17	-14
3	Headley, G.A.	60.83	40	21.65	2	+1
4	Sutcliffe, H	60.73	84	17.21	8	-4
5	Paynter, E	59.23	31	14.29	42	-37
6	Barrington, K.F.	58.67	131	17.01	11	-5
7	Weekes, E.C.	58.62	81	17.79	7	0
8	Hammond, W.R.	58.46	140	17.00	12	-5
9	Dravid, R.S.	58.16	167	16.64	15	-6
10	Sobers, G.S.	57.78	160	15.78	23	-13
11	Ponting, R.T.	57.71	166	14.46	40	-29
12	Kallis, J.H.	57.24	161	15.07	31	-19
13	Hobbs, J.C.	56.95	102	18.25	6	+7
14	Walcott, C.L.	56.69	74	16.09	20	-6
15	Hutton, L	56.67	138	18.36	5	+10
16	Tendulkar, S.R.	55.80	209	15.86	22	-6
17	Tyldesley, G.E.	55.00	20	16.79	13	+4
18	Davis, CA	54.21	29	15.68	25	-7
19	Kambli, V.G.	54.20	21	13.94	43	-24
20	Hayden, M.L.	54.17	141	15.17	29	-9
21	Chappell, G.S.	53.87	151	15.71	24	-3
22	Nourse, A.D.	53.82	62	18.42	4	+18
23	Sehwag, V	53.67	72	15.98	21	+2
24	Lara, B.C.	53.38	216	19.08	3	+21
25	Miandad, J	52.57	189	16.36	19	+6
26	Inzamam U.H.	51.72	177	15.30	27	-1
27	Ryder, J	51.63	32	11.85	48	-21
28	Flower, A	51.55	112	17.05	10	+18
29	Smith G.C.	51.54	75	14.72	35	-6
30	Gavaskar, S.M.	51.12	214	16.67	14	+16
31	Waugh, S.R.	51.06	260	12.88	46	-15
32	Mohammad, Y	50.75	108	14.81	34	-2
33	Border, A.R.	50.56	265	14.44	41	-8
34	Richards, I.V.A.	50.24	182	15.03	32	+2
35	Gilchrist, A.C.	50.18	116	11.35	49	-14
36	Compton, D.C.S.	50.06	131	15.63	26	+10
37	Worrell, F.M.M.	49.49	87	15.11	30	+7
38	Mead, C.P.	49.38	26	15.22	28	+10
39	Bland, K.C.	49.09	39	14.64	37	+2
40	Mitchell, B	48.89	80	17.17	9	+31
41	Jackson, F.S.	48.79	33	16.46	18	+23
42	Khan, Y	48.44	74	14.94	33	+9
43	Harvey, R.N.	48.42	137	16.61	16	+27
44	Walters, D.S.	48.26	125	14.63	38	+6
45	Ponsford, W.H.	48.23	48	13.32	45	0
46	McCabe, S.J.	48.21	62	13.56	44	+2
47	Jardine, D.R.	48.00	33	11.11	50	-3
48	Martyn, D.R.	47.97	98	12.04	47	+1
49	Dexter, E.R.	47.89	102	14.48	39	+10
50	Jayawardene, D.P.	47.86	123	14.66	36	+14

Table 5 The Relation Between Individual and Rest of Team Scores for the Top 50 Batsmen in Test Cricket: 1877- 2006

Rank Based on average	Player	Average	Innings	$\hat{\alpha}^*$	Rank based on $\hat{\alpha}$	Rank based on Career Contribution to Team Score
1	Bradman, D.G.	99.94	80	30.9	1	1
2	Pollock, R.G.	60.97	41	17.2	18	17
3	Headley, G.A.	60.83	40	20.3	2	2
4	Sutcliffe, H	60.73	84	16.8	22	8
5	Paynter, E	59.23	31	12.7	45	42
6	Barrington, K.F.	58.67	131	18.6	9	11
7	Weekes, E.C.	58.62	81	18.5	10	7
8	Hammond, W.R.	58.46	140	16.8	21	12
9	Dravid, R.S.	58.16	167	17.9	12	15
10	Sobers, G.S.	57.78	160	17.1	19	23
11	Ponting, R.T.	57.71	166	14.4	41	40
12	Kallis, J.H.	57.24	161	15.6	28	31
13	Hobbs, J.C.	56.95	102	19.1	6	6
14	Walcott, C.L.	56.69	74	16.0	26	20
15	Hutton, L	56.67	138	18.6	7	5
16	Tendulkar, S.R.	55.80	209	16.6	23	22
17	Tyldesley, G.E.	55.00	20	17.6	14	13
18	Davis, CA	54.21	29	17.5	15	25
19	Kambli, V.G.	54.20	21	14.5	37	43
20	Hayden, M.L.	54.17	141	14.4	39	29
21	Chappell, G.S.	53.87	151	16.1	25	24
22	Nourse, A.D.	53.82	62	19.9	4	4
23	Sehwag, V	53.67	72	14.3	42	21
24	Lara, B.C.	53.38	216	20.1	3	3
25	Miandad, J	52.57	189	18.1	11	19
26	Inzamam U.H.	51.72	177	16.1	24	27
27	Ryder, J	51.63	32	10.6	50	48
28	Flower, A	51.55	112	18.6	8	10
29	Smith G.C.	51.54	75	14.4	38	35
30	Gavaskar, S.M.	51.12	214	16.9	20	14
31	Waugh, S.R.	51.06	260	13.6	43	46
32	Mohammad, Y	50.75	108	15.2	32	34
33	Border, A.R.	50.56	265	15.1	34	41
34	Richards, I.V.A.	50.24	182	15.1	33	32
35	Gilchrist, A.C.	50.18	116	11.6	47	49
36	Compton, D.C.S.	50.06	131	15.4	31	26
37	Worrell, F.M.M.	49.49	87	17.2	17	30
38	Mead, C.P.	49.38	26	14.8	35	28
39	Bland, K.C.	49.09	39	13.2	44	37
40	Mitchell, B	48.89	80	17.2	16	9
41	Jackson, F.S.	48.79	33	19.3	5	18
42	Khan, Y	48.44	74	15.8	27	33
43	Harvey, R.N.	48.42	137	17.7	13	16
44	Walters, D.S.	48.26	125	15.5	29	38
45	Ponsford, W.H.	48.23	48	14.4	40	45
46	McCabe, S.J.	48.21	62	11.6	48	44
47	Jardine, D.R.	48.00	33	10.7	49	50
48	Martyn, D.R.	47.97	98	12.1	46	47
49	Dexter, E.R.	47.89	102	15.5	30	39
50	Jayawardene, D.P.	47.86	123	14.6	36	36

*For every 100 runs scored by rest of team, batsman would score $\hat{\alpha}$ runs

Table 6 Ranking by Average, Value-Adjusted Average, and Value-Added Adjustment of the Top 50 Batsmen in Test Cricket: 1877- 2006

Rank Based on average	Player	Average	Value added adjustment (θ)	Value adjusted average (Ω)	Rank based on Ω	Rank based on θ	Rank based on Career Contribution to Team Score
1	Bradman, D.G.	99.94	65.36	165.30	1	1	1
2	Pollock, R.G.	60.97	24.00	84.98	4	7	17
3	Headley, G.A.	60.83	43.81	104.64	2	2	2
4	Sutcliffe, H	60.73	15.05	75.78	9	16	8
5	Paynter, E	59.23	13.20	72.43	11	25	42
6	Barrington, K.F.	58.67	11.70	70.37	14	27	11
7	Weekes, E.C.	58.62	28.93	87.54	3	4	7
8	Hammond, W.R.	58.46	22.90	81.36	6	8	12
9	Dravid, R.S.	58.16	13.07	71.23	12	26	15
10	Sobers, G.S.	57.78	11.55	69.33	20	28	23
11	Ponting, R.T.	57.71	10.55	68.27	23	34	40
12	Kallis, J.H.	57.24	8.53	65.78	27	40	31
13	Hobbs, J.C.	56.95	17.74	74.69	10	11	6
14	Walcott, C.L.	56.69	13.23	69.92	17	24	20
15	Hutton, L	56.67	24.14	80.81	7	6	5
16	Tendulkar, S.R.	55.80	14.32	70.12	16	18	22
17	Tyldesley, G.E.	55.00	10.83	65.83	26	32	13
18	Davis, CA	54.21	2.95	57.16	40	46	25
19	Kambli, V.G.	54.20	15.35	69.66	19	15	43
20	Hayden, M.L.	54.17	15.62	69.79	18	14	29
21	Chappell, G.S.	53.87	13.74	67.60	24	22	24
22	Nourse, A.D.	53.82	16.85	70.67	13	13	4
23	Sehwag, V	53.67	25.50	79.17	8	5	21
24	Lara, B.C.	53.38	29.37	82.75	5	3	3
25	Miandad, J	52.57	10.74	63.31	28	33	19
26	Inzamam U.H.	51.72	9.82	61.54	33	37	27
27	Ryder, J	51.63	5.29	56.92	41	43	48
28	Flower, A	51.55	14.98	66.53	25	17	10
29	Smith G.C.	51.54	18.75	70.29	15	10	35
30	Gavaskar, S.M.	51.12	17.59	68.71	22	12	14
31	Waugh, S.R.	51.06	0.98	52.04	47	47	46
32	Mohammad, Y	50.75	9.96	60.71	36	36	34
33	Border, A.R.	50.56	4.54	55.10	43	44	41
34	Richards, I.V.A.	50.24	11.13	61.36	34	30	32
35	Gilchrist, A.C.	50.18	-1.91	48.27	48	48	49
36	Compton, D.C.S.	50.06	11.19	61.25	35	29	26
37	Worrell, F.M.M.	49.49	10.00	59.49	38	35	30
38	Mead, C.P.	49.38	13.66	63.03	29	23	28
39	Bland, K.C.	49.09	20.15	69.24	21	9	37
40	Mitchell, B	48.89	14.09	62.98	30	20	9
41	Jackson, F.S.	48.79	10.84	59.64	37	31	18
42	Khan, Y	48.44	9.52	57.95	39	38	33
43	Harvey, R.N.	48.42	13.93	62.35	32	21	16
44	Walters, D.S.	48.26	6.53	54.79	45	42	38
45	Ponsford, W.H.	48.23	8.58	56.81	42	39	45
46	McCabe, S.J.	48.21	14.24	62.45	31	19	44
47	Jardine, D.R.	48.00	-7.61	40.39	50	50	50
48	Martyn, D.R.	47.97	-3.15	44.81	49	49	47
49	Dexter, E.R.	47.89	4.20	52.09	46	45	39
50	Jayawardene, D.P.	47.86	6.96	54.82	44	41	36

NOTES

¹ Notable exceptions to this include articles by Preston and Thomas (2002) and Brooks, Faff and Sokulsky (2002)

² For all players who had played at least 20 innings in all Test Matches up to, and including, 13 March 2006 (India versus England, Mohali). The criterion of a minimum of 20 test innings is used by the authoritative cricketing website, www.cricinfo.com, in compiling Test averages.

³ A case in point is the batting performance of V.G Kambli. He played in 17 test matches (21 separate innings) for India between the years 1992/93 to 1995/96 and compiled an impressive batting average of 54.20. He had two large innings, 224 in the first innings of the third test versus England at Wankhede in 1992/93 and 227 in the first test, versus Zimbabwe at Dehli (Feroz) in 1993/94. However, his batting, on an innings by innings basis, showed a high degree of inconsistency. He scored below his average in 70% of his innings, had a batting score standard deviation of 68.97 and scored below 20 in 50% of his innings.

⁴ Pursuing this line of reasoning, Anand and Sen (1997) argued that a country's achievement with respect to a particular outcome should not be judged exclusively by its mean level of achievement (for example, by the average literacy rate for a country) but rather by the mean level *adjusted to take account of inter-group or inter-personal differences in achievements*. Anand and Sen (1997) compared Honduras (with an average literacy rate of 75%, distributed between men and women as 78%, 73%) with China (with an average literacy rate of 80%, distributed between men and women as 92%, 68%) and asked which country should be regarded as having the "better" achievement with regard to literacy: China with a higher overall rate or Honduras with greater gender equality?

⁵ In this sense we are observing consistency of output (scores) and implicitly assuming this is entirely determined by the personal characteristics of the player (Rushall, B. S and Sherman, C. A. (1987). Later in the paper we consider other factors that may influence individual performance such as team needs and managerial tactics

⁶ The pinch hitter in baseball is a player, often not a first choice player, but through qualities of temperament is often called upon during crisis situations or when a home run or base hit is required quickly to turn the direction of the game. The role is extending into cricket through circumstances now occurring in one-day cricket and particularly the 20-20 version of cricket. See, Krautmann (1990) and Chatterjee, Campbell and Wiseman (1994)

⁷ The issue of the relationship between team needs and individual performance is highlighted in Brooks, Faff and Sokulsky (2002) in which their ordered response model of test cricket performance is less predictive in matches that were rain affected or involved a final innings run chase.

⁸ One implication from this type of exercise, not pursued in this paper, is the adoption of new or augmented criteria which could lead to some players being omitted from the top 50 and others being added

⁹ Note that the “average” score in cricket, which computed over *all completed* innings, is different from the mean score which is computed over *all* innings whether completed or not. The formulation of the Gini used here – modified to fit cricketing conventions - is slightly different from the conventional formulation which uses the mean in the denominator

¹⁰ Including Bradman himself, see Perry (2002)

¹¹ See, Yang and Swartz (2004) for the use of a two-stage Bayesian model in predicting behaviour in Major League Baseball,

¹² For example, of the 1789 tests where both innings were completed by the host country, the first innings score exceeded the second innings score in 1221 occasions,

¹³ The notable exception here is the Hon. F.S. Jackson who never played test cricket outside of the UK

¹⁴ For a discussion of the issues that arise see Waugh (2006) and for more general discussion on the role of psychological factors in sport see Syer and Connolly (1984) and Rushall (1995).

¹⁵ The issue of quantifying the significance of individual performance within a team sport environment has always proven problematic. Clearly, the individual performance is, in some ways, dependent upon interaction with other members of the team. This is particularly true in football codes but even in the essentially individualistic pursuit of test cricket batting, batting “partnerships” have proven to be influential. As well, it can be argued that players benefit from the performance of others, particularly when these players have already built the innings. See, Kahn and Lawrence (1993)

¹⁶ A.C. Gilchrist is a special case. He is essentially a lower order Batsmen (number 7) in 5 day cricket and, as such, is more subject to the vagaries of “needs batting”, early declarations and unreliable batting partners than the other 49 batsmen who all bat at number 6 (S.W. Waugh) or above. The strength of the Australian “tail” normally starting with A.C. Gilchrist is credited with giving the team a competitive edge in recent years.

¹⁷ It needs emphasising, particularly in the case of Paynter, that value-to-team is defined in terms of a batsman’s contribution to the team score over his career: nobody who recalls the Brisbane Test of the infamous 1932-33

“bodyline” tour, when Paynter, after the spending the night in hospital, came in to make 83, can have any doubt as to his value to his side in that Test Match.

¹⁸ If $v_j > v_k$, then the R_j runs scored in innings j would be valued more highly than the R_k runs scored in innings k

¹⁹ In one sense the choice of D.G. Bradman as the default standard is arbitrary but is justified in much the same way as best outcome in Data Envelope Analysis (DEA) is used to rank the efficiency of all other parts of the Decision Making Unit (DMU) and is often used in analysis of the efficiency of sporting teams by comparing the most successful team with the others in the competition, see (Haas (2004))