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EVALUATING PERFORMANCES AT THE 2007 CRICKET WORLD CUP

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Summary: In this paper we apply the methodology of Barr and Kantor (Barr & Kantor, 2003) to evaluate the batting and bowling performances of the cricketers in the 2007 cricket world cup. The earlier Barr and Kantor paper developed criteria for evaluating the performance of batsmen and hinted at the extension of the methodology to bowling performances as well; here we extend the methodology to bowling in a parallel way and analyse both the batting and bowling performances of the participants in the 2007 Cricket World Cup and provide a ranking of performance for a set of given risk tolerance levels. The paper then goes on to select a World cricket team based on this analysis. The methodology provides some insights into the extraordinary dominance of the Australian team in this tournament in both batting and bowling and provides some pointers as to how teams might hope to match the Australians in the future, at least strategically. The analysis implies that to match the Australians in the batting department, batsmen would have to first accept a higher risk of dismissal in return for a faster scoring rate and to match them in the bowling department they would have to accept a higher risk of conceding more runs in return for improved chances of taking wickets.

1. Introduction

The 2007 Cricket World Cup was dominated by Australia in an unprecedented way with the Australian team winning every match with ease, including a

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disappointing final affected by the weather and hence determined, to some extent, by the Duckworth-Lewis (Duckworth-Lewis, 1998) system. Both the batting and bowling departments of the Australian team performed consistently at an extremely high level. Their batting was of such quality that Mike Hussey, who normally bats at number six for Australia and was rated as the number one, one-day batsman in the world before the World Cup, was rarely called upon to bat during the tournament. While the performance of each team at the world cup can be measured by that team's final position, it is not as straightforward to compare the performance of the individuals within each team. To this end we use the method of Barr and Kantor (2004) to compare the batsmen at the world cup and extend the methodology to the bowlers to provide a ranking of performance for a given risk tolerance level.

2. Overview

The methodology of Barr and Kantor (2004) considers a batsman's performance in the one-day cricket game in a two-dimensional sense by considering a "Risk-Return" analysis of a batsman's results that bears similarity to a risk-return analysis of financial assets; see Barr and Knight (1988). One dimension of measurement is the Strike Rate or the number of runs scored per ball; the other is an empirical measure of the probability (for any particular ball) of going out.

This approach allows one to define the profile and potential of a batsman playing in one-day cricket more comprehensively and with much greater subtlety than the calculation of a batting average alone. It goes on to demonstrate how the strike rate and the average may be effectively combined so as to reflect different attitudes to risk when different approaches to the

game are demanded by different circumstances. A criterion is then developed and demonstrated which combines the two measures and may be used to rank batsmen in any type of cricket. Although other approaches have been considered in the literature for modelling and describing one-day cricket performance, notably Clarke (1988) as well as Johnston, Clarke and Noble (1993) we believe the method of Barr and Kantor (2004) gives the most informative and subtle analysis of one-day cricket performance.

3. Definitions and an extension to Bowling

One crucial statistic for the batsman in the one-day limited overs game is the number of runs scored *per 100 balls faced* and is known as the *strike rate*. Since time is at a premium in the one-day game, particularly if weather may b e a factor, this measure has become the essential measure of achievement in the one-day game for a batsman.

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

However, the more a batsman attempts to increase the strike rate (the number of runs per 100 balls), the higher will be the batsman's probability of getting out. In cricket, as in most endeavours, any attempted improvement in the expected return (strike rate) will be associated with higher risk (the probability of being dismissed off any one ball).

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

In this paper we will give a graphical two-dimensional representation of the various batsmen's performance in the World Cup which we think is more subtle than any one-dimensional measure. However, this representation also captures

and explicitly includes the simple batting average, since:

$$\frac{Strike\ Rate}{Empirical\ Probability\ of\ getting\ out} = Batting\ Average$$

Hence, rays from the origin represent sets of batsmen with equal batting averages and any ray from the origin will thus represent loci of batsmen with the same batting average. Thus the two-dimensional (Strike Rate, P(out)) representation simultaneously captures three very important characteristics of a batsman's performance viz. Strike Rate, (Empirical) probability of getting out and Batting Average.

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, (which constitutes an empirical measure of the probability of a wicket on any particular ball) and the number of runs conceded per ball (bowler's economy rate) on the horizontal axis.

$$Wickets\ per\ ball = \frac{Number\ of\ wickets\ taken}{Balls\ bowled}$$

$$Bowler's\ Economy\ Rate = \frac{Runs\ conceded}{Balls\ Bowled}$$

In a parallel way to the batting representation, any ray from the origin is a ray of constant number of wickets per run (intrinsic quality or (inverse of) bowler's average).

It is clear that the larger the sample considered, the more reliable will be the estimates. Thus in the case of batting it seems sensible to only include batsmen who have scored some reasonable number of runs and similarly, in the case of bowlers to only include bowlers who have taken some minimum number of wickets. Hence, in the analysis below, we first ranked the batsmen according to their total number of runs scored and the bowlers in terms of the number of

wickets taken. In this way we excluded batsmen who were comparatively low run scorers, and bowlers who picked up only a few wickets.

Moreover, in the analysis we consider only the test playing nations. There is such a divergence of skill between the front-line test playing nations and those who do not play test cricket that inclusion of the matches against the minnows of the cricket world might seriously distort the results.

4. The Selection criterion

There are essentially two factors that contribute to the suitability of a one-day batsman, namely the batting average (underlying quality) and, for any given batting average, the strike rate. Similarly there are two factors that contribute towards the suitability of a one-day bowler, namely the number of wickets per run scored (intrinsic quality) and for any given measure of this, the numbers of wickets taken per ball (bowler's strike rate).

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

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

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

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

It will generally be appropriate to compute the product, rather than the sum, of these two factors since this product will ensure that each factor makes a proportional, rather than additive, contribution to the criterion, which is the natural way of combining the two factors. In addition, by varying α from

0 through to 1, one may blend the importance of batting or bowling strike rate with the importance of average score or wickets taken per run. Hence, putting $\alpha = 0$ puts no emphasis on the speed of scoring or taking wickets, whilst putting $\alpha = 1$ puts no emphasis on average score or wickets taken per run. These two extremes could be seen as corresponding, on the one hand, to a timeless cricket match where speed of scoring is immaterial (or equivalently, where the rate of wicket taking was of less importance) and, on the other, to the last remaining overs of an ODI when the speed of scoring is paramount (or equivalently where the rate of taking wickets became increasingly important).

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 $y = cx^{\frac{1}{2}}$ will yield criterion iso-quants of equal suitability as the constant c varies (given the equally weighted function). Thus maximizing equation (1), for some suitable α, is equivalent to selecting batsmen or bowlers according to the highest isoquant on which they lie.

5. The 2007 World Cup

5.1 The tournament structure

We consider the performance of the top 20 run scorers in the 2007 World Cup held in the West Indies. The tournament was run in three stages. The 16 teams attending the World Cup were split into four groups of four teams, with each group being hosted by one particular venue. Each team in each group played against all the other members of their group and were allotted two points for a win, one for a tie and 0 points for a loss. The top two teams in each group then progressed to the Super Eight stage, carrying with them the points obtained against the other progressing member of their group. Thus,

for example, Australia, having beaten South Africa and everyone else in Group A, took two points through while South Africa, who lost to Australia but beat everyone else in Group A took no points through. The following table lists the venue and constituents of each group. The number in brackets is the ODI ranking of the side as of April 2005.

Group A	Group B (Trinidad &	Group C	Group D
(St. Kitts & Nevis)	Tobago)	(St. Lucia)	(Jamaica)
Australia (1)	Sri Lanka (2)	New Zealand (3)	Pakistan (4)
South Africa (5)	India (8)	England (7)	West Indies (6)
Scotland	Bangladesh (11)	Kenya (10)	Zimbabwe (9)
Netherlands	Bermuda	Canada	Ireland

Australia and South Africa, Sri Lanka and Bangladesh, New Zealand and England and West Indies and Ireland progressed to the Super Eight stage. Both India and Pakistan, who were expected to progress, suffered defeats to lower ranked sides, with Pakistan infamously losing to Ireland, and India succumbing to Bangladesh. The Super Eight stage was a round robin where each team played each of the other qualifying teams that they had not yet faced. The top four sides from this round progressed to the semi-finals, where the top placed team from the Super Eight stage played the fourth placed team and the second placed team faced the third placed team. The following table lists the constituents of the Super Eight Stage with their matches played (MP), matches

won (W), matches lost (L), points obtained (Pts) and net run rate (NRR) from the stage

Team	MP	W	L	Pts	NRR
AUS	7	7	0	14	2.4
SRI	7	5	2	10	1.48
NZL	7	5	2	10	0.25
RSA	7	4	3	8	0.31
ENG	7	3	4	6	–0.39
WIN	7	2	5	4	–0.57
BAN	7	1	6	2	–1.51
IRE	7	1	6	2	–1.73

Australia, Sri Lanka, New Zealand and South Africa progressed to the semi-finals with Sri Lanka beating New Zealand by 81 runs in Jamaica on 24 April and Australia defeating South Africa by 7 wickets on 25 April in St. Lucia. The final was played between Australia and Sri Lanka in Barbados on 28 April with Australia reclaiming the trophy in a bizarre light-affected ending to the match.

The advantage of analysing the data from such a tournament is that each of the top teams played each of the other top teams at least once 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 2007 cricket World Cup.

5.2 An Analysis of the 2007 World Cup performances - Batting

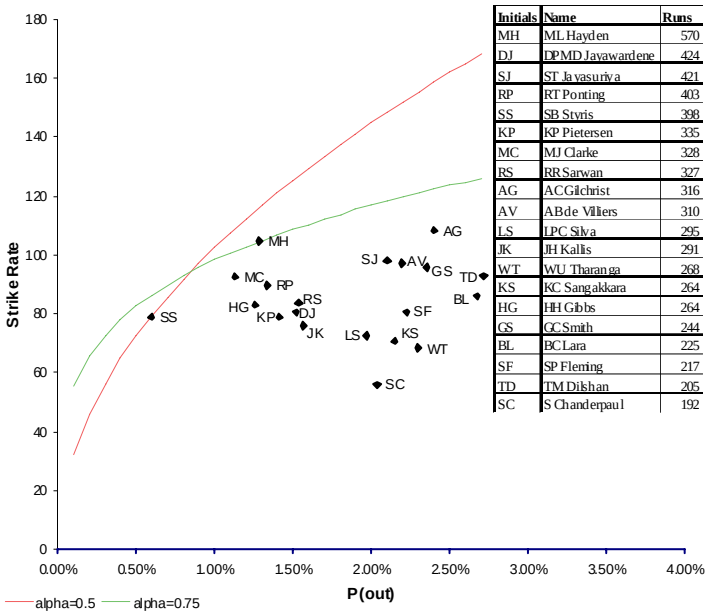
We first list the performance statistics of the batsmen in Tables 1 and 2, below; Table 1 gives the results for all the matches while Table 2 excluded matches with non-Test playing nations. The rationale for Table 2 is that the competition was of some sub-minimum strength and excludes outlying performances against weak opposition. We give the innings played, number of times not out, the balls faced, the batting average, the strike rate, the (empirical estimate of) P(out), the suitability criterion (1) $\left(\alpha = \frac{1}{2}\right)$ with the corresponding ranking and the suitability criterion (1) $\left(\alpha = \frac{3}{4}\right)$ 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.

Table 1. Results for the top 20 run-scoring batsmen for all the matches played.

Name	Country	Total	Innings	Not	Average	Balls	Strike	P(out)	Criterion	Rank	Criterion	Rank	Rank
		runs		out		faced	rate		$\alpha = 0.5$	$\alpha = 0.5$	$\alpha = 0.75$	$\alpha = 0.75$	diff.
M.L. Hayden	Aus	659	10	1	73.2	652	101.1	1.38%	86.03	2	93.24	1	1
D.P.M.D. Jayawardene	SL	548	11	2	60.9	644	85.1	1.40%	71.98	7	78.26	11	-4
R.T. Ponting	Aus	539	9	1	67.4	565	95.4	1.42%	80.16	5	87.45	3	2
S.B. Styris	NZ	499	9	3	83.2	598	83.4	1.00%	83.30	3	83.37	6	-3
J.H. Kallis	SA	485	9	3	80.8	578	83.9	1.04%	82.36	4	83.13	7	-3
S.T. Jayasuriya	SL	467	11	1	46.7	475	98.3	2.11%	67.76	10	81.62	8	2
A.C. Gilchrist	Aus	453	11	1	45.3	436	103.9	2.29%	68.60	9	84.42	5	4
K.P. Pietersen	Eng	444	9	1	55.5	548	81.0	1.46%	67.06	11	73.71	12	-1
G.C. Smith	SA	443	10	1	49.2	424	104.5	2.12%	71.71	8	86.56	4	4
M.J. Clarke	Aus	436	9	4	87.2	459	95.0	1.09%	91.00	1	92.97	2	-1
R.R. Sarwan	WI	375	9	1	46.9	481	78.0	1.66%	60.45	13	68.65	14	-1
A.B. de Villiers	SA	372	10	0	37.2	369	100.8	2.71%	61.24	12	78.57	10	2
S.P. Fleming	NZ	353	10	1	39.2	409	86.3	2.20%	58.18	16	70.86	13	3
L.P.C. Silva	SL	350	10	2	43.8	452	77.4	1.77%	58.20	15	67.13	15	0
K.C. Sangakkara	SL	350	11	1	35.0	465	75.3	2.15%	51.32	17	62.15	17	0
H.H. Gibbs	SA	342	8	2	57.0	373	91.7	1.61%	72.29	6	81.41	9	-3
S. Chanderpaul	WI	315	9	1	39.4	517	60.9	1.55%	48.97	19	54.62	19	0
W.U. Tharanga	SL	298	11	0	27.1	446	66.8	2.47%	42.54	20	53.31	20	0
P.G. Fulton	NZ	297	8	0	37.1	424	70.0	1.89%	50.99	18	59.76	18	0
P.D. Collingwood	Eng	276	9	3	46.0	368	75.0	1.63%	58.74	14	66.37	16	-2

Table 2. Results for the top 20 run-scoring batsmen for all the matches played

Name	Country	Total runs	Innings	Not out	Average	Balls faced	Strike rate	P(out)	Criterion $\alpha = 0.5$	Rank $\alpha = 0.5$	Criterion $\alpha = 0.75$	Rank $\alpha = 0.75$	Rank diff.
M.L. Hayden	Aus	570	8	1	81.4	545	104.6	1.28%	92.28	2	98.24	1	1
D.P.M.D. Jayawardene	SL	424	9	1	53.0	527	80.5	1.52%	65.30	11	72.48	11	0
S.T. Jayasuriya	SL	421	9	0	46.8	429	98.1	2.10%	67.75	7	81.54	6	1
R.T. Ponting	Aus	403	7	1	67.2	450	89.6	1.33%	77.56	4	83.34	5	-1
S.B. Styris	NZ	398	6	3	132.7	504	79.0	0.60%	102.35	1	89.90	2	-1
K.P. Pietersen	Eng	335	6	0	55.8	425	78.8	1.41%	66.34	9	72.31	12	-3
M.J. Clarke	Aus	328	7	3	82.0	354	92.7	1.13%	87.17	3	89.87	3	0
R.R. Sarwan	WI	327	7	1	54.5	391	83.6	1.53%	67.51	8	75.14	10	-2
A.C. Gilchrist	Aus	316	8	1	45.1	292	108.2	2.40%	69.90	6	86.97	4	2
A.B. de Villiers	SA	310	7	0	44.3	319	97.2	2.19%	65.60	10	79.84	7	3
L.P.C. Silva	SL	295	9	1	36.9	407	72.5	1.97%	51.70	17	61.21	17	0
J.H. Kallis	SA	291	7	1	48.5	383	76.0	1.57%	60.70	13	67.91	14	-1
W.U. Tharanga	SL	268	9	0	29.8	392	68.4	2.30%	45.12	19	55.54	19	0
H.H. Gibbs	SA	264	6	2	66.0	318	83.0	1.26%	74.02	5	78.39	8	-3
K.C. Sangakkara	SL	264	9	1	33.0	373	70.8	2.14%	48.33	18	58.49	18	0
G.C. Smith	SA	244	7	1	40.7	255	95.7	2.35%	62.38	12	77.26	9	3
B.C. Lara	WI	225	7	0	32.1	262	85.9	2.67%	52.54	16	67.17	15	1
S.P. Fleming	NZ	217	7	1	36.2	270	80.4	2.22%	53.91	15	65.83	16	-1
T.M. Dilshan	SL	205	8	2	34.2	221	92.8	2.71%	56.30	14	72.26	13	1
S. Chanderpaul	WI	192	7	0	27.4	344	55.8	2.03%	39.13	20	46.73	20	0



Initials	Name	Runs
MH	ML Hayden	570
DJ	DPMD Jayawardene	424
SJ	ST Jayasuriya	421
RP	RT Ponting	403
SS	SB Styris	398
KP	KP Pietersen	335
MC	MJ Clarke	328
RS	RR Sarwan	327
AG	ACGilchrist	316
AV	ABde Villiers	310
LS	LPC Silva	295
JK	JH Kallis	291
WT	WU Tharanga	268
KS	KC Sangakkara	264
HG	HH Gibbs	264
GS	GC Smith	244
BL	BC Lara	225
SF	SP Fleming	217
TD	TM Dilshan	205
SC	S Chanderpaul	192

Figure 1. The two-dimensional plot for batting (in the case where only matches between test-playing nations are considered)

In the figure above, two isoquants have been drawn in for the "top" batsmen according to the criterion with $\alpha = \frac{1}{2}$ and $\alpha = \frac{3}{4}$ respectively. Pictorially, it is seen that selection is a simple North-West type rule.

Of the top 20 scorers amongst the test-playing nation matches, Adam Gilchrist had the highest Strike Rate and Scott Styris had the lowest empirical probability of going out. As discussed above, an appropriate criterion would combine a high strike rate with a low empirical probability of going out according to a suitable alpha. Using an alpha of 0.5 Styris, Hayden and Clark would be adjudged the best (in that order); however, particularly given the

high scores that are now common in one-day internationals it would not be unreasonable to place strike rate as more important than average. Hence an alpha of 0.75 may be more appropriate; this, in fact, would yield the same batsmen, but in the order Hayden, Styris and Clark. In Table 3 below we show the top rated batsman for different alphas. Only three batsmen qualify to be rated as the best for any given alpha value. Of these Scott Styris is shown to have been the best defensive batsman while Adam Gilchrist has been the most aggressive. Matthew Hayden has managed to protect his wicket while being aggressive and is the top rated batsman for the remaining alpha values.

Table 3. Top batsman for different alphas

Alpha	Best batsman
0.000–0.635	S.B. Styris
0.635–0.945	M.L. Hayden
0.945–1.000	A.C. Gilchrist

5.3 An Analysis of the 2007 World Cup performances - Bowling

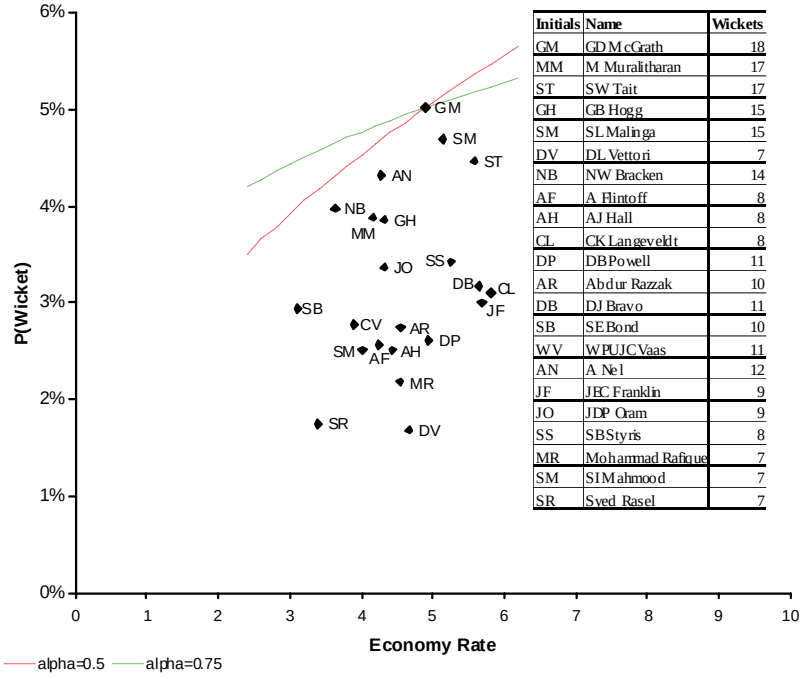
A parallel analysis is carried out for the bowlers in the World Cup team.

Table 4. Results for the top 20 wicket-taking bowlers for all the matches played

Name	Country	Wkts	Runs	Mat	Ave	Overs	Wickets/	Economy	Criterion	Rank	Criterion	Rank	Rank
							ball	rate	$\alpha = 0.5$	$\alpha = 0.5$	$\alpha = 0.75$	$\alpha = 0.75$	diff.
G.D. McGrath	Aus	26	357	11	13.7	80.5	5.36%	4.41	0.063	1	0.058	1	0
M. Muralitharan	SL	23	351	10	15.3	84.4	4.53%	4.14	0.055	3	0.050	3	0
S.W. Tait	Aus	23	467	11	20.3	84.3	4.54%	5.52	0.047	6	0.046	5	1
G.B. Hogg	Aus	21	332	11	15.8	82.5	4.23%	4.00	0.052	4	0.047	4	0
S.L. Malinga	SL	18	284	8	15.8	58.2	5.14%	4.86	0.057	2	0.054	2	0
N.W. Bracken	Aus	16	258	10	16.1	71.4	3.72%	3.60	0.048	5	0.042	6	-1
D.L. Vettori	NZ	16	447	10	27.9	97.4	2.73%	4.57	0.031	19	0.029	20	-1
A. Flintoff	Eng	14	298	8	21.3	69	3.38%	4.31	0.040	9	0.037	9	0
C.K. Langeveldt	SA	14	361	8	25.8	66	3.54%	5.46	0.037	10	0.036	10	0
A.J. Hall	SA	14	335	9	23.9	76	3.07%	4.40	0.036	11	0.033	13	-2
D.B. Powell	WI	14	385	9	27.5	85	2.75%	4.52	0.032	18	0.029	17	1
S.E. Bond	NZ	13	213	8	16.4	69.4	3.11%	3.05	0.044	8	0.037	8	0
D.J. Bravo	WI	13	361	9	27.8	64.5	3.34%	5.56	0.035	15	0.034	12	3
W.P.U.J.C. Vaas	SL	13	286	10	22.0	77.4	2.79%	3.68	0.036	12	0.032	14	-2
Abdur Razzak	Ban	13	344	9	26.5	73.4	2.94%	4.66	0.033	16	0.031	16	0
A. Nel	SA	12	217	6	18.1	52.2	3.82%	4.14	0.046	7	0.042	7	0
W.B. Rankin	Ire	12	324	9	27.0	59.2	3.37%	5.46	0.035	13	0.035	11	2
J.E.C. Franklin	NZ	11	331	9	30.1	65.2	2.81%	5.06	0.031	20	0.029	19	1
W.K. McCallan	Ire	10	233	9	23.3	58.4	2.84%	3.97	0.035	14	0.031	15	-1
J.D.P. Oram	NZ	10	252	9	25.2	62.3	2.67%	4.03	0.033	17	0.029	18	-1

Table 5. Results for the top 20 wicket-taking bowlers for the matches played between test-playing nations

Name	Country	Wkts	Runs	Mat	Ave	Overs	Wickets/	Economy	Criterion	Rank	Criterion	Rank	Rank
							ball	rate	$\alpha = 0.5$	$\alpha = 0.5$	$\alpha = 0.75$	$\alpha = 0.75$	diff.
G.D. McGrath	Aus	18	293	8	16.3	59.9	5.01%	4.90	0.055	1	0.053	1	0
M. Muralitharan	SL	17	304	8	17.9	73	3.88%	4.16	0.047	5	0.043	6	-1
S.W. Tait	Aus	17	354	8	20.8	63.3	4.46%	5.57	0.046	6	0.045	4	2
S.L. Malinga	SL	15	274	7	18.3	53.2	4.69%	5.14	0.051	4	0.049	2	2
G.B. Hogg	Aus	15	280	8	18.7	64.5	3.86%	4.32	0.045	7	0.042	7	0
N.W. Bracken	Aus	14	213	8	15.2	58.4	3.98%	3.63	0.051	3	0.045	5	-2
A. Nel	SA	12	198	5	16.5	46.2	4.32%	4.27	0.051	2	0.047	3	-1
W.P.U.J.C. Vaas	SL	11	257	8	23.4	66	2.78%	3.89	0.034	11	0.031	13	-2
D.J. Bravo	WI	11	326	8	29.6	57.5	3.17%	5.64	0.033	12	0.032	11	1
D.B. Powell	WI	11	346	7	31.5	70	3.62%	4.94	0.029	19	0.027	19	0
S.E. Bond	NZ	10	176	6	17.6	56.4	2.94%	3.11	0.041	8	0.035	10	-2
Abdur Razzak	Ban	10	276	7	27.6	60.4	2.75%	4.55	0.032	13	0.029	15	-2
J.D.P. Oram	NZ	9	192	6	21.3	44.3	3.37%	4.31	0.040	9	0.037	8	1
J.E.C. Franklin	NZ	9	284	7	31.6	50	3.00%	5.68	0.031	15	0.030	14	1
S.B. Styris	NZ	8	205	8	25.6	39	3.42%	5.26	0.037	10	0.035	9	1
C.K. Langeveldt	SA	8	250	5	31.3	43	3.10%	5.81	0.031	14	0.031	12	2
A. Flintoff	Eng	8	220	6	27.5	51.5	2.57%	4.24	0.031	17	0.028	17	0
A.J. Hall	SA	8	235	6	29.4	53	2.52%	4.43	0.029	18	0.027	20	-2
S.I. Mahmood	Eng	7	186	4	26.6	46.2	2.52%	4.01	0.031	16	0.028	18	-2
S.T. Jayasuriya	SL	7	302	9	43.1	36.5	3.17%	8.20	0.027	20	0.029	16	4
Mohammad Rafique	Ban	7	242	7	34.6	53.2	2.19%	4.54	0.025	21	0.023	21	0
Syed Rasel	Ban	7	225	6	32.1	66.2	1.76%	3.39	0.023	22	0.020	22	0
D.L. Vettori	NZ	7	322	7	46.0	69	1.69%	4.67	0.019	23	0.018	23	0



Initials	Name	Wickets
GM	GD McGrath	18
MM	M Muralitharan	17
ST	SW Tait	17
GH	GB Hogg	15
SM	SL Malinga	15
DV	DL Vettori	7
NB	NW Bracken	14
AF	A Flintoff	8
AH	AJ Hall	8
CL	CK Langeveldt	8
DP	DB Powell	11
AR	Abdur Razzak	10
DB	DJ Bravo	11
SB	SE Bond	10
WV	WPUJC Vaas	11
AN	A Nel	12
JF	JEC Franklin	9
JO	JDP Oram	9
SS	SB Styris	8
MR	Mohammad Rafique	7
SM	SI Mahmood	7
SR	Syed Rasel	7

Figure 2. The two-dimensional plot for bowling (in the case where only matches between test-playing nations are considered)

In Figure 2 above, in a parallel way to that for batting, two isoquants have been drawn in for the "top" bowlers according to the criterion with $\alpha = \frac{1}{2}$ and $\alpha = \frac{3}{4}$ respectively. Pictorially, it is seen that selection is a simple North-West type rule.

Of the top 20 wicket takers amongst the test-playing nation matches, Glen McGrath took the highest number of wickets per ball and Shane Bond conceded the lowest number of runs per ball. As discussed above, an appropriate criterion would combine a high number of wickets per ball with

a low number of runs per ball according to a suitable alpha. Using an alpha of 0.5 McGrath, Nel and Bracken would be adjudged the best in that order; again, however, in a parallel way to the batting analysis, because of the importance of having bowlers who can strike quickly in the one-day game it may be more reasonable to consider that wickets per ball is more important than bowling average. On this basis, an alpha of 0.75 may be more appropriate; this would yield McGrath, Malinga and Nel. The extent of McGrath's dominance relative to the other bowlers is shown below. McGrath is not the top-rated bowler for only the most conservative alpha values, for which another Australian, Bracken, is top rated.

Table 6. Top bowler for different alpha values

Alpha	Best bowler
0.000–0.226	N.W. Bracken
0.226–1.000	G.D. McGrath

6. Selecting a team 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 a team for a one-day World eleven on the basis of the 2007 World Cup performance, our selection would probably look something like Styris, Hayden, Clarke, Ponting, Gibbs, Gilchrist, McGrath, Bracken, Nel, Malinga, Tait. It is extraordinary the extent to which the Australians dominated the tournament and this is reflected in the number of Australians in a world team. The Australians dominated in all departments indicating the extraordinary depth of talent which the Australians were able to bring in both batting and bowling.

7. Conclusion

This paper shows how the methods of Barr and Kantor (2004), which were established for the assessment of batting performance, can be easily extended to the analysis of bowling performance. Using these tools of analysis, the performance of the teams competing in the 2007 World Cup were analysed from both a bowling and batting perspective. The analysis demonstrates the extraordinary talent of an Australian team which dominated the tournament and justifiably won it comfortably.

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