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PERFORMANCE MEASURES FOR WICKET KEEPERS IN CRICKET

Hermanus H. LEMMER
Department of Statistics, University of Johannesburg, Johannesburg, Republic of South Africa

ABSTRACT

A wicket keeper should not only perform well behind the wickets in terms of taking catches, executing stumpings and limiting the number of byes, but should also perform well as a batsman. The purpose of this study is to combine the dismissal rate (based on the number of catches and stumpings) and a measure of batting performance into measuring wicket-keeping performance. Measures are developed and applied to rank wicket keepers for test matches and for one-day internationals (ODIs) alike. The first two measures are for wicket keepers' test and one-day international careers, and then the necessary modifications are made to make the measures suitable for use after a short series of matches. The measures are easy to apply, which is in contrast to cumbersome methods found on the internet. In the case of test matches the ranking of wicket keepers is Adam Gilchrist, Brad Haddon and Kamran Akmal in the top three positions. In ODIs the ranking is Gilchrist, Haddon and Dhoni, with Boucher and Sangakkara alternating in the fourth and fifth positions.

Key words: Batting; Byes; Catches; Cricket; Dismissals; Sport; Stumpings.

INTRODUCTION

Many cricket performance measures have been proposed in the literature. Batting performance measures rely heavily on the traditional batting average. Various authors have defined measures, which take the average and also the strike rate into account, e.g., Croucher (2000), Barr and Kantor (2004), Basevi and Binoy (2007) and Barr *et al*. (2008). Barr and van den Honert (1998) defined a measure based on the average and a consistency measure. Lemmer (2004) went a step further by combining the strike rate with the former two. Kimber and Hansford (1993) used the product limit of the survivor function to find an estimator of the average, but Lemmer (2008a) showed that it behaves almost as badly as the batting average in the case of a high proportion of not out scores. Danaher (1989) also considered a product limit estimator, Damodaran (2006) a Bayesian type of estimator and Maini and Narayanan (2007) an estimator based on exposure-to-risk. The traditional bowling performance measures are the bowling average, the economy rate and the strike rate – cf. Kimber (1993).

Measures which combine two of the measures can be found in Barr and Kantor (2004), Croucher (2000) (who defined the batting index as the product of the average and the batting strike rate) and Basevi and Binoy (2007). Lemmer (2002) proposed a measure based on all three measures and gave a further refinement in Lemmer (2004). Other approaches can be found in Bairam *et al*. (1990), who used a production function approach to determine the best

batting and bowling strategy to maximise the probability of winning. Cohen (2002) used the strike rates of bowlers to calculate the probability of dismissing the opposing team. Gerber and Sharp (2006) defined batting, bowling, fielding, all-rounder and wicket keeper indices and used these for team selection purposes. Their measure of wicket-keeping ability is based on dismissal rates. Sharp *et al*. (2010) also used batting, bowling, all-rounder and wicket keeper indices. They combined the batting and bowling indices to obtain an all-rounder index. For wicket keepers they simply used their batting indices.

A list of criteria that can be used for the assessment of wicket keeper performances is given in Narayanan (2008). He defined the dismissal rate as the number of dismissals per match and stated that this is the most important of the wicket keeper measures. He defined the byes rate as the number of byes conceded per match. He mentioned that information on run-outs affecting missed catches and missed stumpings was not available in reliable form. Barry (2008) defined the byes rate as the number of byes conceded per 600 balls and mentioned that this is to some extent dependent on the bowlers and also on the country where the match was played. Samson (2007) used dismissals as a percentage of team dismissals, byes conceded per 100 balls kept and batting average as criteria to compare wicket keepers. Hemachandran (2009a) used the product of the dismissal rate, the team strike rate and the wicket keeper's percentage of dismissals per match to rank wicket keepers. Narayanan (2008) used an extensive points system to arrive at a final figure for each wicket keeper. From his discussion it is clear that it is very difficult, if not impossible, to take all the relevant factors into account. Each analyst has his own definitions of the respective criteria and each one combines/treats them in different ways.

In contrast to the many requirements of the experts, most cricket enthusiasts will agree that a good wicket keeper should be sharp behind the wickets and that he must also be a reasonably good batsman. In the present study it is shown how the two most important criteria, the batting performance measure (BP) and the dismissal rate (D), can be combined into a measure of wicket-keeping (WK) performance by using statistical techniques. This measure is easy to calculate and uses statistics that are readily available on the Internet. In order to combine these two measures into a single measure, it is necessary to standardise them by means of a procedure to be explained in the next section. The measure WK_1 can be very useful for selectors because it is an objective criterion based on player performances and it is easy to calculate. In the case of test matches, the byes rate is also included as a third criterion, but data on the latter is unfortunately not readily available in published statistics, so its inclusion is postponed to the final part of this paper.

CONSTRUCTION OF THE MEASURE

The (unadjusted) dismissal rate D is defined as the number of dismissals (catches plus stumpings) divided by the number of matches in which the player stood as wicket keeper. This can be used to rank wicket keepers. But a wicket keeper's performance is obviously strongly dependent on the quality of his team's bowlers and it is important that this should be taken into account in the calculation of his performance. Hemachandran (2009a) used an interesting procedure to arrive at a measure to rank wicket keepers. He adjusted the dismissal rate by multiplying it by the team's strike rate and also the wicket keeper's dismissal

percentage (the percentage of the total number of wickets taken by the team that can be accounted for by the keeper).

TABLE 1: **WEIGHTS FOR BOWLERS IN TESTS AND ONE DAY INTERNATIONALS ACCORDING TO COUNTRY**

	TESTS					
Country	**CBP Home**	**CBP Away**	**nH**	**nA**	**WA**	**W**
Australia	7.419	6.141	459	447	6.788	1.049
England	6.364	6.487	445	490	6.428	0.994
India	6.253	5.969	400	501	6.095	0.942
N Zealand	6.654	6.051	347	397	6.332	0.979
Pakistan	6.147	6.371	292	467	6.285	0.972
S Africa	6.758	7.094	537	472	6.915	1.069
Sri Lanka	7.400	6.425	428	414	6.921	1.070
W Indies	6.815	6.321	419	475	6.553	1.013
Zim/BD	5.862	5.936	369	355	5.898	0.912
	ODIs					
Country	**CBP Home**	**CBP Away**	**nH**	**nA**	**WA**	**W**
Australia	9.431	9.371	390	624	9.394	1.007
England	10.600	9.212	210	303	9.780	1.048
India	9.298	8.368	467	966	8.671	0.929
N Zealand	11.138	9.483	528	840	10.122	1.085
Pakistan	8.795	9.119	246	841	9.046	0.969
S Africa	10.309	9.230	466	561	9.719	1.042
Sri Lanka	10.576	9.019	417	1089	9.450	1.013
W Indies	9.159	9.677	263	424	9.478	1.016
Zim/BD	8.395	8.269	258	454	8.315	0.891

nH: Total home matches; nA: Total away matches; WA: Weighted averages; W: Weights

In the present study the dismissal rate will be adjusted in a different way. In a recent study (Lemmer, 2007), the strength of each country's bowlers has been determined by calculating their current bowling performance measures (CBP) for home and away matches separately. Ideally, each dismissal should be quantified by taking into account the strength of the bowler who took the wicket. Unfortunately, this is not feasible. In the present study the dismissal rate is adjusted by dividing D by a weight that reflects the bowling strength of the wicket keeper's team. The procedure is firstly to calculate a weighted average between the CBP Home and CBP Away values in Table 1 of Lemmer (2007), based on the total number of home (nH) and away (nA) matches played by all players in the data set. The weighted averages (WA) are then transformed into weights (W). These are given in Table 1. For each country's wicket keeper, the dismissal rate is then defined as DR=D/W. For an Australian wicket keeper,

DR=D/1.049 for test matches and DR=D/1.007 for One Day Internationals (ODIs). The Australian bowlers have on average been stronger than the average strength of all the other bowlers. Therefore, the wicket keeper's dismissal rate D is scaled down to eliminate the undue advantage ascribed to his team's bowling strength.

In modern-day cricket it is expected that a wicket keeper should also be a good batsman. The batting performance measure BP developed in Lemmer (2004) will be used here. In order to combine DR and BP into a single measure, it is necessary to standardise the measures onto the same scale. This is done by using the batting and wicket keeper statistics of all the wicket keepers of the 10 test countries who had stood in at least 20 test matches since 1948 and whose strike rates SR were available, where SR denotes the number of runs scored per 100 balls faced. This way the largest available data set of wicket keepers is used to construct a measure of wicket keeper performance. The case of a small number of matches is considered in the next section. The method of standardisation of measures that are concentrated on the positive real line is similar to that of Lemmer (2004), and some details may be useful.

Let $x_1,\ldots,x_n$ denote the scores of a batsman in chronological order. The traditional average of a batsman is given by AVE= $\sum_{i=1}^{n} x_i$ /m where m denotes the number of out scores of the batsman. The exponentially weighted average of a batsman, in which recent scores have higher weights than scores back in time, is

$$\text{EWA}= \sum_{i=1}^{n} x_i (1-\alpha)^{n-i} \,/\, \sum_{i=1}^{n} (1-\alpha)^{n-i} \text{IND}(x_i \text{ an out score})$$

with α =0.04 and IND(.) the indicator function: IND(A)=1 if A is true and IND(A)=0 otherwise. The career consistency coefficient is defined by CC=AVE/SD where

$$\text{SD}^2 = \sum_{i=1}^{n} (x_i - \text{AVE})^2 \text{IND}(x_i \leq \text{AVE} \;\&\; x_i \text{ an out score})/(n-1).$$

SD is a truncated standard deviation, which increases only when the batsman was out with a score below his average.

The strike rate (SR) of the batsman is also important. In the construction of BP the measures EWA, CC and SR have been taken into account. For a large ODI data set the average values of CC and SR have been calculated. The batting performance measure was defined as:

$$\text{BP}=\text{EWA} \times (\text{CC}/1.8173) \times (\text{SR}/71.4286)^{0.43}.$$

The reason for the exponent 0.43 was that the strike rate component should not overshadow the consistency component and had to be standardised. Details of the standardisation can be found in Lemmer (2004:59) and the reader is advised to acquaint him-/herself with the contents of this paper. In Lemmer (2009) the parameters have been updated by using more recent player data. So the formula for ODIs used in the present study was:

$$\text{BP}=\text{EWA} \times (\text{CC}/1.8313) \times (\text{SR}/75.1745)^{0.50.}$$

The formula used for *test* matches was:

$$\text{BP}=\text{EWA} \times (\text{CC}/1.7771) \times (\text{SR}/50.4219)^{0.478}.$$

In order to study the performances of wicket keepers it is logical that only matches where they had stood as wicket keepers should be included. Their individual scores and dismissal figures were obtained from Cricket Archive (2010). Unfortunately, their strike rates were not

given, so career strike rates were obtained from Cricinfo (2010). These could not be obtained for players who had played up to about the 1970s, with the result that the number of wicket keepers who could be included (and had batted in at least 20 innings), was 29 in the case of test matches and 45 in ODIs. In the vast majority of cases the number of innings in which the player stood as wicket keeper was (almost) equal to the number of innings he played, so it was justified to use the career strike rates as best estimates of their wicket keeper strike rates. The careers of 24 of the 29 test players extended until after 2000, but only 10 beyond 2007. This was the motivation for the weights in Table 1 being based on the Lemmer (2007) CBP values rather than the adjusted values of Lemmer (2009).

Denote the batting performance measure of player i by BP_i and his dismissal rate by DR_i, i=1,…,p. In the case of test matches the average value of the BP_i was AVE(BP)=30.112 and the average dismissal rate was AVE(DR)=3.083. The construction of a joint wicket keeper measure requires that the batting and dismissal measures should be on the same scale. Let the batting index of player i be $c_{1i}=BP_i/AVE(BP)$, i=1,…,p. The initial dismissal index is defined by $c^0_{2i} = DR_i/AVE(DR)$, i=1,…,p. In order to ensure that the batting and dismissal indices are comparable, the scale adjustment of Lemmer (2004:59) was used (in a more sophisticated way) to transform the dismissal rates. Let $s_1=STD(c_{1i}$, i=1,…,p) where STD denotes the standard deviation, and $s_2 =STD(c^0_{2i}$, i=1,…,p). The adjusted dismissal indices are obtained iteratively in order to determine them as accurately as possible: Let $c'_{2i}=(c^0_{2i})^e$ where $e=s_1/s_2$ Let $s'_2=STD(c'_{2i}$, i=1,…,p) and $c''_{2i}=(c'_{2i})^e$ where $e=s_1/s'_2$. After a few iterations, for each i, the c'_{2i}, c''_{2i},… converge to a final value which is indicated by $c_{2i,}$ and the final value of the generic e was 2.292. Now the indices c_{1i} and c_{2i}, i=1,…,p are on the same scale and can be combined into a single wicket keeper measure. Let the measure be:

$$WK=(c_1)^{\beta}\ (c_2)^{1-\beta}=(BP/30.112)^{\beta} \times [(DR/3.083)^{2.292}]^{1-\beta},\ 0<\beta<1,$$

The requirement that a wicket keeper should perform well both as batsman and as wicket keeper motivates why the product is used. Obviously the choice of the value of β should be such that the batting requirement does not overshadow the wicket keeper requirement, so the value β =0.333 will be used. This is in agreement with the choice of Narayanan (2008), who allocated 40 points to wicket keeping (i.e. to DR) and 20 points to batting. Hence the measure WK for this situation becomes:

$$WK_1={c_1}^{0.333}{c_2}^{0.667}=(BP/30.112)^{0.333} \times [(DR/3.083)^{2.292}]^{0.667}.$$

Note that the constants in WK_1 have been calculated from career data of the largest available group of wicket keepers who qualified for the present study. In any application of WK_1 only BP and DR had to be calculated from player data. The constants remained the same. In Table 2 the wicket keepers used in this study are ranked according to WK_1. The number of matches played as wicket keeper is denoted by w, n is the number of innings batted, CT the number of catches taken and ST the number of stumpings performed.

TABLE 2: **RANKING ACCORDING TO WK_1 OF TEST MATCH WICKET KEEPERS**

Rank	Name	w	n	AVE	SR	BP	CT	ST	DR	c_1	c_2	WK_1
1	A Gilchrist	96	137	47.61	81.95	44.65	379	37	4.13	1.48	1.95	1.782
2	B Haddin	25	42	38.79	59.00	46.31	101	2	3.93	1.54	1.74	1.670
3	K Akmal	48	82	33.55	63.57	40.34	159	22	3.88	1.34	1.69	1.567
4	MS Dhoni	43	66	42.60	60.83	62.74	113	20	3.28	2.08	1.15	1.406
5	M Boucher	131	186	30.90	50.22	36.88	472	22	3.53	1.22	1.36	1.315
6	B McCullum	48	79	31.92	61.91	36.07	153	10	3.47	1.20	1.31	1.272
7	R Latif	37	57	28.77	47.42	28.89	119	11	3.62	0.96	1.44	1.259
8	G Jones	34	53	23.92	54.13	19.35	128	5	3.94	0.64	1.75	1.254
9	A Flower	55	100	53.71	45.07	61.44	142	9	3.01	2.04	0.95	1.223
10	R Jacobs	65	112	28.32	47.80	26.23	207	12	3.33	0.87	1.19	1.073
11	C Browne	20	30	16.13	40.02	11.20	79	2	4.00	0.37	1.81	1.070
12	A Stewart	82	145	34.92	48.66	36.22	227	14	2.96	1.20	0.91	0.998
13	D Richardson	42	64	24.27	41.93	18.70	150	2	3.39	0.62	1.24	0.985
14	K Sangakkara	48	81	40.48	55.53	43.72	124	20	2.80	1.45	0.80	0.980
15	A Parore	67	109	26.95	38.72	25.80	194	7	3.06	0.86	0.99	0.941
16	J Murray	31	41	23.05	54.97	20.49	98	3	3.22	0.68	1.10	0.939
17	I Healy	119	182	27.40	49.72	20.16	366	29	3.16	0.67	1.06	0.910
18	J Russel	54	86	27.10	35.86	20.12	153	12	3.07	0.67	0.99	0.871
19	D Ramdin	39	68	23.26	48.36	22.15	116	2	2.99	0.74	0.93	0.860
20	I Smith	63	88	25.56	63.17	23.78	168	8	2.85	0.79	0.84	0.821
21	P Jayawardene	30	40	30.71	52.63	36.84	61	20	2.52	1.22	0.63	0.788
22	P Patel	20	30	29.70	44.72	29.18	41	8	2.60	0.97	0.68	0.763
23	M Prior	27	44	40.11	63.44	38.73	63	2	2.42	1.29	0.58	0.752
24	T Taibu	24	46	29.60	40.93	28.46	48	4	2.38	0.95	0.55	0.659
25	M Khan	66	98	28.68	51.11	28.76	127	20	2.29	0.96	0.51	0.626
26	N Mongia	44	68	24.03	38.53	16.53	99	8	2.58	0.55	0.67	0.624
27	R Kaluwitharana	48	76	26.00	60.34	22.17	93	26	2.32	0.74	0.52	0.584
28	P Downton	30	48	19.63	29.33	11.73	70	5	2.52	0.39	0.63	0.535
29	K Mashud	44	84	19.04	34.06	15.60	78	9	2.17	0.52	0.45	0.469

w=No. matches as wicket keeper n=No. of innings batted SR=Strike rate BP=Bowling performance CT=No of catches
ST=No. of stumpings DR=Dismissal rate c_1=Batting index c_2=Dismissal index WK_1=Wicket-keeping performance

Gilchrist (rated 1st) had the 4th best batting performance and was 1st according to DR, which gave him the edge over Haddin, who was 4th according to DR and 3rd according to BP. Dhoni was 1st according to BP but only 11th according to DR. This put him behind Akmal, who was 6th according to BP and 5th according to DR. The dismissal rate is the major factor determining the WK measure, but the batting performance also plays a role. The choice of the value of β was arbitrary, but in line with that of Narayanan (2008). If β=0.40 is used, Flower goes 3 positions upward in the ranking due to his good BP value, Sangakkara also goes 3 positions up and Browne 2 down, but otherwise the ranking remains almost unchanged. (The user may choose his or her value for β.) WK_1 can now be used to measure a wicket keeper's career performance as wicket keeper in test matches, and also in first class and other unlimited overs matches.

The same procedure was used in the case of ODIs, and the formula of the wicket keeper performance measure was:

$$WK_2=c_1^{0.333}\,c_2^{0.667}=(BP/25.034)^{0.333} \times [(DR/1.165)^{2.180}]^{0.667}.$$

The ranking of ODI wicket keepers is given in Table 3. In order to limit the length of the table, only the top 32 wicket keepers are given. Gilchrist ranked 1st, although he was 2nd according to DR and 3rd according to BP. Haddin (2nd) was 1st according to DR but 7th according to BP. Dhoni (3rd) was 1st according to BP but 7th according to DR.

The formulae WK_1 and WK_2 can be used to measure wicket keeper career performances provided that the players had batted in a sufficiently large number of innings (at least 20) in order that BP can be relied upon. In the case of a small number of innings, or after a short series of matches, different formulae have to be used.

A SMALL NUMBER OF MATCHES PLAYED

In Lemmer (2008a) it was shown that batting performance measures based on the ordinary average AVE were not suitable in the presence of a moderate or large proportion of not-out scores. In the ODI formula of:

$$BP=EWA \times (CC/1.8313) \times (SR/75.1745)^{0.50}$$

certain modifications were required. Consider:

$$e_2=(sumout+2\times sumno)/n$$

and

$$e_6=(sumout+f_6\times sumno)/n \text{ with } f_6=2.2-0.01\times avno$$

where 'sumout' denotes the sum of the batsman's out scores, 'sumno' the sum of his not-out scores and 'avno' the average of his not-out scores. For Twenty20 matches Lemmer (2008b) recommended that EWA should be replaced by $e_{26}=(e_2+e_6)/2$ and that CC should be dropped because it can be very variable in a small number of scores.

TABLE 3: **RANKING ACCORDING TO WK_2 OF ODI WICKET KEEPERS**

Rank	Name	w	n	AVE	SR	BP	CT	ST	DR	c_1	c_2	WK_2
1	A Gilchrist	282	274	35.64	96.94	41.52	417	55	1.66	1.66	2.19	1.999
2	B Haddin	52	49	31.43	84.15	39.36	81	7	1.68	1.57	2.25	1.998
3	MS Dhoni	159	141	50.65	89.82	68.10	154	52	1.39	2.72	1.27	1.638
4	M Boucher	289	216	29.03	85.11	35.62	395	21	1.38	1.42	1.59	1.531
5	K Sangakkara	223	210	38.41	75.20	44.25	236	65	1.33	1.77	1.38	1.498
6	G Jones	49	41	24.70	78.21	27.24	68	4	1.40	1.09	1.66	1.443
7	M Prior	41	37	25.23	74.73	24.95	55	3	1.35	1.00	1.52	1.319
8	C Browne	46	32	17.29	70.33	19.31	59	9	1.46	0.77	1.69	1.299
9	D Ramdin	72	55	19.63	81.23	20.15	100	5	1.44	0.80	1.64	1.292
10	B McCullum	150	125	27.78	87.78	31.40	182	13	1.20	1.25	1.27	1.265
11	I Healy	168	120	21.00	83.84	21.12	194	39	1.38	0.84	1.47	1.222
12	M Khan	211	176	22.96	81.30	22.21	214	73	1.40	0.89	1.40	1.204
13	B Taylor	47	46	39.05	66.92	41.04	37	18	1.08	1.64	1.01	1.187
14	R Latif	166	117	19.42	76.39	21.24	182	38	1.37	0.85	1.34	1.148
15	R Dravid	73	64	44.23	71.17	38.64	71	13	1.24	1.54	0.97	1.134
16	D Richardson	122	77	19.73	66.87	18.45	148	17	1.30	0.74	1.38	1.120
17	R Jacobs	147	112	23.31	70.06	21.54	160	29	1.27	0.86	1.25	1.104
18	A Stewart	138	132	33.48	68.36	31.10	148	15	1.13	1.24	1.03	1.096
19	K Akmal	115	100	26.30	84.83	28.98	116	20	1.22	1.16	1.03	1.070
20	W Phillips	42	36	26.37	85.71	27.70	42	7	1.16	1.11	1.01	1.041
21	J Dujon	167	118	23.59	67.51	19.63	183	21	1.20	0.78	1.11	0.987
22	W Bari	51	26	17.00	51.27	18.84	52	10	1.25	0.75	1.11	0.973
23	S Yousuf	86	62	17.86	75.00	19.92	81	22	1.24	0.80	1.07	0.968
24	R Kaluwitharana	186	179	22.37	77.70	22.68	131	75	1.09	0.91	0.90	0.902
25	J Russell	40	31	17.63	66.30	16.54	41	6	1.12	0.66	1.03	0.888
26	T Taibu	108	95	28.74	65.63	28.38	97	15	1.16	1.13	0.78	0.884
27	B Kuruppu	31	29	22.79	51.66	21.53	26	8	1.08	0.86	0.88	0.875
28	D Mongia	140	96	20.19	68.90	21.29	110	44	1.18	0.85	0.88	0.872
29	C Read	36	24	17.65	73.17	14.35	41	2	1.14	0.57	1.05	0.857
30	J Murray	50	31	22.56	72.98	22.50	44	7	1.00	0.90	0.75	0.796
31	K Mashud	126	110	21.90	54.84	24.25	91	35	1.12	0.97	0.72	0.793
32	A Flower	186	183	34.59	74.59	38.50	133	32	1.00	1.54	0.56	0.781

w=No. matches as wicket keeper n=No. of innings batted SR=Strike rate BP=Bowling performance CT=No of catches
ST=No. of stumpings DR=Dismissal rate c_1=Batting index c_2=Dismissal index WK_2=Wicket-keeping performance

Thus for ODIs it is recommended that

$$BP_{26}=e_{26}\times(SR/75.1745)^{0.50}$$

should be used. For test matches Lemmer (2008a) defined

$$e_8=(\text{sumout}+f_8\times\text{sumno})/n \text{ where } f_8=2.2-0.01\times\text{avno}+0.15\times p_0$$

with p_0 the proportion of not-out scores. Using the reasoning of Lemmer (2008b) that led to e_{26}, let $e_{28}=(e_2+e_8)/2$, then the measure for test matches becomes

$$BP_{28}=e_{28}\times(SR/50.4219)^{0.478}.$$

TABLE 4: **RANKING ACCORDING TO WKS_1 OF TEST MATCH WICKET KEEPERS**

Rank	Name	n	p_0	AVE	e_{28}	BP_{28}	DR	c_1	c_2	WKS_1
1	A Gilchrist	137	0.146	47.61	48.18	60.78	4.13	1.95	1.73	1.800
2	B Haddin	42	0.095	38.79	38.48	41.48	3.93	1.33	1.57	1.488
3	K Akmal	82	0.073	33.55	34.72	38.79	3.88	1.25	1.54	1.434
4	G Jones	53	0.076	23.92	23.60	24.41	3.94	0.78	1.58	1.251
5	MS Dhoni	66	0.136	42.60	43.86	47.97	3.28	1.54	1.12	1.249
6	B McCullum	79	0.051	31.92	31.89	35.18	3.47	1.13	1.25	1.207
7	M Boucher	186	0.118	30.90	30.49	30.43	3.53	0.98	1.29	1.174
8	R Latif	57	0.158	28.77	28.08	27.27	3.62	0.88	1.35	1.168
9	A Flower	100	0.180	53.71	54.31	51.47	3.01	1.65	0.96	1.148
10	C Browne	30	0.200	16.13	17.05	15.27	4.00	0.49	1.63	1.091
11	R Jacobs	112	0.188	28.32	30.69	29.92	3.33	0.96	1.15	1.085
12	D Richardson	64	0.125	24.27	25.17	23.04	3.39	0.74	1.19	1.017
13	I Healy	182	0.126	27.40	28.89	28.70	3.16	0.92	1.05	1.005
14	J Murray	41	0.098	23.05	24.82	25.87	3.22	0.83	1.08	0.991
15	A Stewart	145	0.103	34.92	35.97	35.36	2.96	1.14	0.93	0.991
16	K Sangakkara	81	0.049	40.48	41.10	43.04	2.80	1.38	0.84	0.990
17	J Russel	86	0.186	27.10	27.79	23.61	3.07	0.76	1.00	0.909
18	A Parore	109	0.156	26.95	26.52	23.37	3.06	0.75	0.99	0.902
19	I Smith	88	0.193	25.56	25.39	28.28	2.85	0.91	0.87	0.880
20	D Ramdin	68	0.103	23.26	23.57	23.11	2.99	0.74	0.94	0.871
21	M Prior	44	0.159	40.11	41.15	45.93	2.42	1.48	0.64	0.843
22	P Jayawardene	40	0.15	30.71	32.84	33.52	2.52	1.08	0.69	0.798
23	P Patel	30	0.233	29.70	28.41	26.83	2.60	0.86	0.73	0.770
24	N Mongia	68	0.118	24.03	23.70	20.84	2.58	0.67	0.72	0.701
25	T Taibu	46	0.065	29.60	31.09	28.14	2.38	0.90	0.61	0.699
26	R Kaluwitharana	76	0.053	26.00	26.85	29.25	2.32	0.94	0.59	0.686
27	M Khan	98	0.082	28.68	29.24	29.43	2.29	0.95	0.57	0.678
28	P Downton	48	0.167	19.63	18.99	14.66	2.52	0.47	0.68	0.604
29	K Mashud	84	0.119	19.04	19.98	16.57	2.17	0.53	0.52	0.522

n=No. of innings batted p_0= proportion not-out scores e_{28}= Estimated average of batsman
BP_{28}= batting performance in a test series WKS_1=Wicketkeeper performance tests
DR=Dismissal rate c_1=Batting index c_2=Dismissal index

By using the same test and ODI data sets as before, the parameters to be used in the construction of WKS (the measure for short series) are calculated by using the same

procedure as for WK. It was found that for a small number of test matches the wicket keeper measure WKS should be

$$WKS_1=c_1^{0.333}c_2^{0.667}=(BP_{28}/31.121)^{0.333}\times[(DR/3.083)^{1.872}]^{0.667}$$

and for ODIs

$$WKS_2=c_1^{0.333}c_2^{0.667}=(BP_{26}/23.456)^{0.333}\times[(DR/1.165)^{2.280}]^{0.667}.$$

TABLE 5: **RANKING ACCORDING TO WKS_2 OF ODI WICKET KEEPERS**

Rank	Name	n	p_0	AVE	e_{26}	BP_{26}	DR	c_1	c_2	WKS_2
1	A Gilchrist	274	0.037	35.64	35.99	40.87	1.66	1.74	2.25	2.067
2	B Haddin	49	0.102	31.43	30.97	32.76	1.68	1.40	2.31	1.952
3	MS Dhoni	141	0.255	50.65	49.24	64.89	1.39	2.77	1.51	1.845
4	K Sangakkara	210	0.100	38.41	38.17	38.18	1.33	1.63	1.36	1.444
5	M Boucher	216	0.259	29.03	28.24	30.05	1.38	1.28	1.48	1.408
6	R Dravid	64	0.188	44.23	44.14	42.94	1.24	1.83	1.15	1.342
7	M Khan	176	0.233	22.96	22.86	23.77	1.40	1.01	1.53	1.333
8	G Jones	41	0.195	24.70	21.58	22.01	1.40	0.94	1.53	1.298
9	D Ramdin	55	0.255	19.63	18.04	18.76	1.44	0.80	1.61	1.276
10	M Prior	37	0.189	25.23	24.22	24.15	1.35	1.03	1.40	1.263
11	C Browne	32	0.250	17.29	17.31	16.74	1.46	0.71	1.66	1.254
12	I Healy	120	0.300	21.00	20.16	21.29	1.38	0.91	1.47	1.250
13	R Latif	117	0.248	19.42	18.19	18.34	1.37	0.78	1.44	1.175
14	B McCullum	125	0.168	27.78	28.84	31.16	1.20	1.33	1.07	1.148
15	K Akmal	100	0.130	26.30	26.84	28.52	1.22	1.22	1.11	1.145
16	R Jacobs	112	0.286	23.31	22.36	21.58	1.27	0.92	1.21	1.104
17	W Phillips	36	0.167	26.37	27.16	29.00	1.16	1.24	0.99	1.065
18	T Taibu	95	0.190	28.74	29.94	27.98	1.16	1.19	1.00	1.059
19	A Stewart	132	0.091	33.48	33.70	32.14	1.13	1.37	0.93	1.056
20	D Richardson	77	0.429	19.73	17.24	16.26	1.30	0.69	1.28	1.044
21	B Taylor	46	0.174	39.05	39.99	37.73	1.08	1.61	0.84	1.043
22	J Dujon	118	0.305	23.59	22.12	20.96	1.20	0.89	1.08	1.011
23	S Yousuf	62	0.307	17.86	14.97	14.95	1.24	0.64	1.14	0.941
24	D Mongia	96	0.344	20.19	17.68	16.93	1.18	0.72	1.04	0.919
25	R Kaluwitharana	179	0.078	22.37	23.07	23.46	1.09	1.00	0.87	0.909
26	A Flower	183	0.077	34.59	35.52	35.38	1.00	1.51	0.70	0.903
27	C Read	24	0.292	17.65	18.15	17.90	1.14	0.76	0.95	0.884
28	K Mashud	110	0.246	21.90	22.46	19.18	1.12	0.82	0.92	0.884
29	B Kuruppu	29	0.035	22.79	23.62	19.58	1.08	0.83	0.85	0.843
30	J Russell	31	0.226	17.63	17.66	16.59	1.12	0.71	0.92	0.841
31	W Bari	26	0.500	17.00	11.63	9.60	1.25	0.41	1.18	0.831
32	J Murray	31	0.194	22.56	20.10	19.80	1.00	0.84	0.71	0.754

n=No. of innings batted p_0=proportion not-out scores e_{28}= Estimated average of batsman
BP_{26}= Batting performance in ODI series DR=Dismissal rate
c_1=Batting index c_2=Dismissal index WKS_2 = Wicket keeper performance ODIs

By using large data sets the parameters could be calculated accurately, but the measures WKS_1 and WKS_2 are specifically designed for use after a (short) series of matches. Note that the ranking according to WKS may differ from that according to WK because the consistency coefficient is not present in WKS, not-out scores are better dealt with in WKS and BP_{28} (or BP_{26}) does not include a weighting of scores as in BP. Therefore, the values of BP and BP_{28} (or BP_{26}) of a player cannot be expected to be the same. The ranking of test players according to WKS_1 is given in Table 4 for illustrative purposes only. Their ranking in Table 2 is more reliable because it includes CC and the weighting of scores. Table 5 gives the ranking for ODIs.

The reason why measures based on AVE can be unreliable is clearly illustrated by comparing the values of AVE and e_{26} in cases where p_0 is large. In all cases where $p_0>0.300$, the value of AVE was larger than that of e_{26}. Bari had $p_0=0.500$, AVE=17.00 and the more accurate measure $e_{26}=11.63$. If a very small number of matches had been played, the difference between AVE and e_{26} can be very large. This illustrates why WKS_2 rather than WK_2 should be used after a series of matches (e.g. a World Cup Series).

BYES CONCEDED AS A THIRD FACTOR

Hemachandran (2009b) worked out how to get the number of byes for a wicket keeper and gave the byes per 1000 balls faced by 51 wicket keepers in test matches. This further statistic can be incorporated into the measure WK by standardising BY=number of byes conceded per 1000 balls faced. The byes index is denoted by c_3. Obviously the BP and DR indices c_1 and c_2 are the same as in Table 2. Using the points scheme of Narayanan (2008), who allocated 5 points to byes conceded, 40 to dismissals and 20 to batting performance, the weight of BP becomes 0.308, that of DR 0.615 and that of BY 0.077. The last seems to be very low, but is probably justified because the concession of byes depends not only on the wicket keeper, but also very much on the bowler and the pitch conditions. The measure now becomes

$$WK_3=(BP/30.112)^{0.308}\times[(DR/3.083)^{2.292}]^{0.615}\times[(1/0.174BY)^{1.190}]^{0.077}$$

where BY appears in the denominator because large values of BY indicate bad performances. The exponent 1.190 was computed in the same manner as before in order to bring BY in line with BP and DR. After ranking the wicket keepers according to WK_3 (not shown here) it follows that, despite the fact that Haddin had the 2nd worst BY value (11.54), he retained his 2nd position. The introduction of BY did not have a great effect on the rankings compared to their rankings in Table 2. Sangakkara went down 2 positions from 14th to 16th due to his large value of BY=9.09. Richardson went from 13th to 12th position due to his excellent value BY=3.31 (the best of all). For the rest there was only one switch.

In case of a small number of scores BP_{28} is used instead of BP. The formula now becomes:

$$WKS_3=(BP_{28}/31.121)^{0.308}\times[(DR/3.083)^{1.872}]^{0.615}\times[(1/0.174BY)^{0.982}]^{0.077}.$$

From the ranking according to WKS_3, Flower went from the 9th to the 7th position compared to his position in Table 4; and Mongia went 2 positions down. There were 2 switches between pairs of wicket keepers, but otherwise the rankings remained the same.

The results have shown that the use of BY had a little effect on the rankings. Even with a very large value of BY=12.95, Prior retained his rating. Haddin also retained his position in both cases. For career performances in test matches the measure WK_1 can be used (or WK_3 if byes statistics are available). For a small or moderate number of matches more reliable results are obtained by using WKS_1 (or WKS_3 if BY is available). Unfortunately, in the case of ODIs, byes statistics could not be obtained and therefore BY could not be included in the formulae.

From the rankings it is clear that Gilchrist, Haddin and Akmal were the top wicket keepers in test matches and Gilchrist, Haddin and Dhoni top in ODIs. Gilchrist retired in 2008 and Haddin has already shown that he was a worthy successor.

CONCLUSION

The inclusion of byes into WK and WKS, in order to obtain a more comprehensive measure, was interesting, but it is doubtful whether it is worth the effort using the extended measures WK_3 and WKS_3. Narayanan (2008) used a points system to combine various criteria in order to rank wicket keepers. His method put Gilchrist first and Boucher second, but the 10 players he considered did not include many of those considered in the present study. The methods used by Narayanan (2008) and others on the Internet are cumbersome and it is unlikely that other people will use them. It may be idealistic to say that all kinds of factors should be incorporated into the measures, but if such data is not readily available, this is simply not feasible. The measures proposed in this paper can readily be used because their formulae can easily be programmed and the necessary statistics are available on the Internet.

In each application it is important to select the appropriate measure and compare players by using this measure. The WK measures are suitable for career data sets and the WKS measures for smaller data sets. In the case of Twenty20 matches the formulae for ODIs (both are limited overs matches) may be used until enough such data become available to develop measures for this type of cricket.

The measures developed here are objective criteria and should be useful for selectors, but obviously other factors should also be taken into account in deciding which wicket keeper would be the best choice for the expected circumstances. The most important results of this study are the rankings of test and ODI wicket keepers presented in Tables 2 and 3.

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Prof. Hermanus H. LEMMER: Department of Statistics, University of Johannesburg, Johannesburg Republic of South Africa. Tel.: +27 (0)11 6783031, Fax.: +27 (0)11 6784413, Cell: 073 1661934, E-mail: hoffiel@uj.ac.za

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