

# IPL Team Performance Analysis: A Multi-Criteria Group Decision Approach in Fuzzy Environment

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**Abstract**— Now a day Cricket is one of the most popular sports around the world. Twenty-20 cricket is the most popular entertaining game in last eight to ten years among different formats of cricket. Indian Premier League (IPL) plays vital role to upturn the status of Twenty-20 cricket. This paper aims to analysis the team performances during first six sessions of IPL in the field of sports Data Mining. The proposed work deals with five different multi-criteria techniques and two group decision analysis in fuzzy environment to handle the imprecise and ambiguous data. The result shows that proposed model yields more realistic way to judge the team's performance and every time it produces the accurate performance appraisal.

**Index Terms**— Gaussian Fuzzy-AHP, Group Decision, Spearman Correlation coefficient, Kendall Correlation coefficient, Performance Appraisal Introduction.

## I. INTRODUCTION

In the early 70's Multi-Criteria Decision Analysis (MCDA) was introduced as a promising and important field in data mining for both quantitative and qualitative evaluation criteria together to take truthful decision. Kavita Devi et al [1] used MCDA as a tool to solve problems for selection from a limited number of alternatives, involves sorting and ranking. The inter-attribute and intra-attribute comparison of MCDA was proposed by [2]. Some of the commonly used MCDA techniques like Weighted Sum Method (WSM), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), Analytical Hierarchy Process (AHP), PROMETHEE, ELECTRE etc was described in [3]. AHP is a pair-wise comparison method that involves structuring multiple choice criteria into a hierarchy for assessing the relative importance of these criteria developed by Thomas L. Saaty in early 80's [4, 5]. TOPSIS, based on the idea that the chosen alternative should have the shortest distance from the positive ideal solution and on the other side the farthest distance of the

negative ideal was first developed by Hwang and Yoon [6]. Complex PROportional ASsessment (COPRAS) method, used for multi-criteria evaluation of both maximizing and minimizing criteria values was first developed by Kaklauskas in 1996 [7]. In 1998, [8] initiated a new technique known as VIKOR for determining the compromise solution for a problem with contrasting criteria to reach the final solution. Brans and Vincke [9] proposed a new technique named as Preference Ranking Organization METHod for Enrichment of Evaluations (PROMETHEE) at the beginning of the 1980s. Several MCDA provide different ranking for the same problem which is the major shortcomings of MCDA. Earlier we proposed a new mathematical model namely as Modified Group Decision Analysis (MGDA) [10] to overcome the main limitation of MCDA. Now in this paper we introduce Gaussian Fuzzy numbers to handle the uncertainty and ambiguous decision of expert opinion with five methods together to form a new model which is more accurate than the earlier MGDA technique.

People of India are fascinated with the game of cricket among all the games played in India. Twenty-20, the shorter format of cricket is the most popular entertainment sports in India. IPL was initiated in the year 2008 with 8 teams by the Board for Control of Cricket in India (BCCI) [11, 12]. IPL provides a great platform for every cricketers to fulfill their dreams. A graphical display for comparing the performances of bowlers, batsmen and all-rounders have been presented by Paul J.van.Staden [13]. The valuation of players in the IPL has been calculated by David Parker and et al. [14]. H.H. Lemmer proposed several techniques for assessing the performance of bowlers, batsmen [15, 16, 17]. Individual performance of the players and the overall performance of the teams are easily measured by our proposed methodology.

The paper is organized as follows: Section 2 focuses on the different terminologies that are used to judge the players and the dataset preparation for team performance analysis. Section 3 discusses about the techniques used and discussed the proposed methodology. Result and Discussion are carried out on section 4. In section 5 group decision techniques are discussed. Finally, section 6 concludes the paper.

## II. TERMINOLOGY USED & PREPARATION OF DATASET

At first we collect the original dataset from open source of information for the last six year of IPL starting from 2008 and ended with the year 2013. The table 1 displays single dataset of the teams for the starting year 2008.

Table 1. Dataset of the team in IPL for the year 2008.

Pos	Team	Mat	Won	Lost	Tied	N/R	Net RR	For	Against	Pts
1	<u>RR</u>	14	11	3	0	0	0.632	2245/261.1	2153/270.2	22
2	<u>KXIP</u>	14	10	4	0	0	0.509	2352/259.5	2271/265.5	20
3	<u>CSK</u>	14	8	6	0	0	-0.192	2241/264.2	2195/253.1	16
4	<u>DD</u>	14	7	6	0	1	0.342	2001/233.2	2031/246.4	15
5	<u>MI</u>	14	7	7	0	0	0.57	2080/249.1	2096/269.3	14
6	<u>KKR</u>	14	6	7	0	1	-0.147	1845/242.4	1718/221.4	13
7	<u>RCB</u>	14	4	10	0	0	-1.16	1983/272.4	2205/261.3	8
8	<u>DC</u>	14	2	12	0	0	-0.467	2229/270.0	2307/264.3	4
1 <sup>st</sup> Semi Final DD (87/10) vs RR (192/9)										
2 <sup>nd</sup> Semi Final CSK (116/1) vs KXIP (112/8)										
Final CSK (163/5) vs RR (164/7)										

Several multiple criteria are involved to judge a team's performance accurately and we consider the following multiple criteria for team performance analysis-

**Mat** – Total match played by a team in IPL from 2008 to 2013.

**Won** – (No. of matches won by a team) / (Total match played).

**Lost** – (No. of matches lost by a team) / (Total match played).

**For (RR)** – (Total runs made by a team / Total no. of overs taken to make the runs).

**Against (RR)** – (Total runs given by a team / Total no. of overs bowled).

**NRR** – For (RR) – Against (RR).

**Margin**–Team won by how many runs or by how many wickets in a winning match from the losing team.

**WM** – Total Margin / Total match played.

**AWAY** – Total match won in away condition / Total match played.

**Important match** – Quarter Final, Semi Final, Final matches are considered as important matches.

**IMP** – (Total win of important match) – (Total loss of important match).

With the above multiple criteria we prepared the overall team dataset from year 2008 to year 2013 is as follows in the table 2:

Table 2. Prepared Dataset from 2008 to 2013.

Team ID	Team	Mat	won	lost	NRR	WM	AWAY	IMP
1	CSK	100	0.59	0.39	0.45	2.28	0.32	4
2	DC/SRH	93	0.42	0.57	-0.16	1.37	0.29	-1
3	DD	92	0.46	0.52	-0.12	2.08	0.3	-4
4	KKR	91	0.46	0.51	-0.03	1.69	0.24	1
5	KXIP	89	0.49	0.51	-0.08	1.86	0.28	-1
6	MI	96	0.58	0.41	0.39	2.55	0.28	0
7	RCB	95	0.51	0.47	-0.06	2.1	0.29	-1
8	RR	92	0.53	0.45	0.11	2.4	0.26	2
9	PWI	46	0.3	0.7	-0.62	0.94	0.17	-6
10	KTK	14	0.29	0.64	-0.13	1.59	0.21	-6

## III. TECHNIQUES USED & PROPOSED METHODOLOGY

Some useful techniques are defined before we describe our proposed methodology for measuring the team performance. Analytical Hierarchy Process (AHP) is used to calculate the relative importance between the criterion

based on expert opinion with the help of Saaty's 9-point linear scale and the detailed steps of AHP was described in our previous work named as "Modified Group Decision Algorithm for Performance Appraisal of Indian Premier League Cricketers" [10]. Saaty's AHP method was modified by introducing the fuzzy analysis by

Chang's in 1992 [18] and the main drawback of Chang's extent analysis is that the degree of possibility of some criteria was zero. To overcome this limitation Hesham A and et. al. used Gaussian fuzzy number insist of triangular

fuzzy number [19] and we modified the steps of Hesham's Gaussian extent to calculate the relative importance between criteria with the help of the following flowchart:

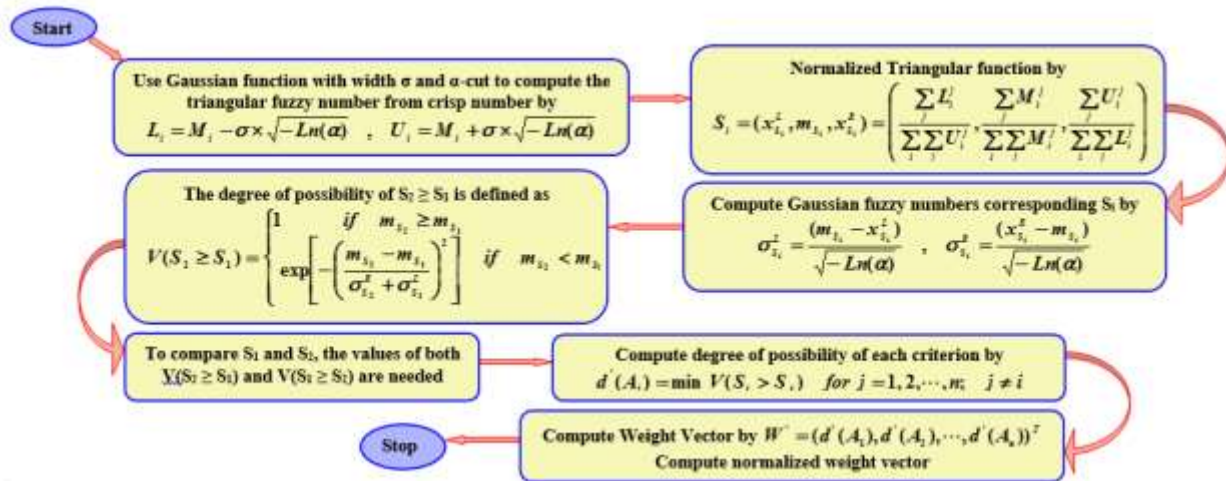


Fig. 1. Flowchart of Gaussian Fuzzy-AHP.

Several MCDM methods like WSM, TOPSIS, COPRAS, VIKOR and PROMETHEE are used in our proposed methodology. The detailed steps of WSM, TOPSIS, COPRAS, VIKOR are described in our previous

published research work named “Modified Group Decision Algorithm for Performance Appraisal of Indian Premier League Cricketers” [20]. The detailed steps of PROMETHEE are described by the following flowchart.

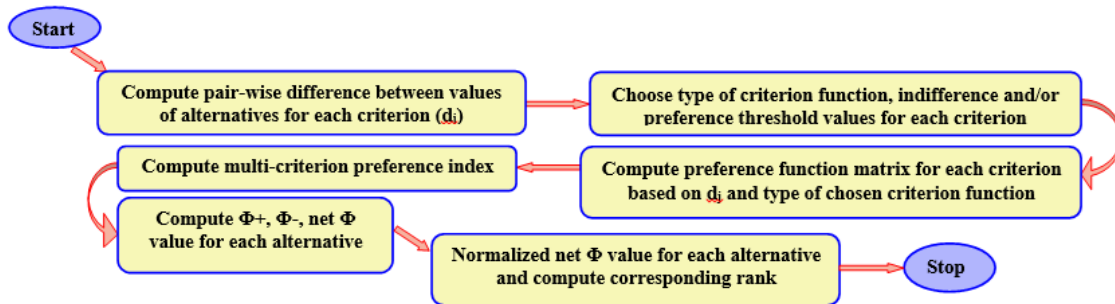


Fig. 2. Flowchart of PROMETHEE.

With the help of above techniques, Spearman and Kendall correlation and coefficient ranking method to calculate group decision multi criteria analysis we

propose a new technique which provides the accurate result in every case and our proposed methodology is described in the following flowchart:

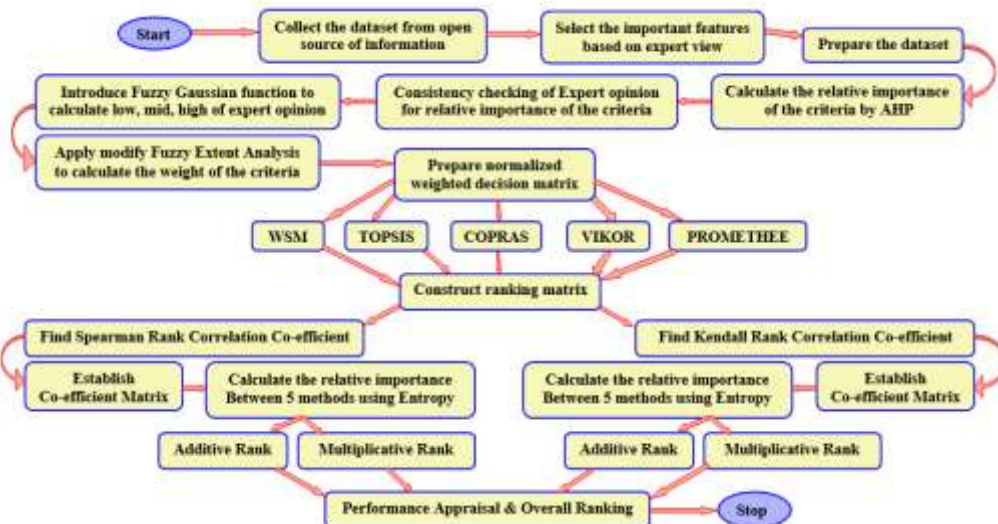


Fig. 3. Proposed Methodology.

## IV. RESULT &amp; DISCUSSION

After prepare the pay-off matrix we calculate the weights of the attribute by AHP. Then Gaussian fuzzy membership function is presented in [19] to overcome Saaty 9 point linear scale into fuzzy scale by considering original AHP decision input into low, mid, high decision and then we develop one modified technique of Chang's

extent analysis [18] to calculate more accurate importance relative between the attributes. The weights of the attribute calculating by AHP and Fuzzy-AHP

(FAHP) are shown in table 3 and ranking of different method are shown in table 4. The detailed result is shown in the appendix section.

Table 3. Attributes weight by AHP and Fuzzy-AHP.

	Mat	won	lost	NRR	WM	AWAY	IMP
AHP	0.067	0.259	0.214	0.157	0.128	0.076	0.100
FAHP	0.023	0.298	0.272	0.177	0.125	0.033	0.072

Table 4. Ranking of different method.

ID	Team	Prome -thee	Rank	WSM	Rank	Topsis	Rank	Copras	Rank	Vikor	Rank
1	CSK	0.343	1	3.2451	1	0.9776	1	-0.4733	1	0	1
2	DC /SRH	-0.0481	8	2.4997	6	0.4334	8	0.3544	9	0.5537	8
3	DD	-0.0111	7	2.3552	8	0.4632	7	0.3535	8	0.4047	6
4	KKR	0.0172	6	2.6547	4	0.5656	4	0.1689	4	0.4047	6
5	KXIP	0.0201	5	2.4873	7	0.5215	6	0.266	6	0.3156	5
6	MI	0.2753	2	2.8894	2	0.8793	2	-0.3487	2	0.0292	2
7	RCB	0.0629	4	2.6543	5	0.5485	5	0.2495	5	0.2374	4
8	RR	0.185	3	2.8684	3	0.7067	3	-0.0071	3	0.1445	3
9	PWI	-0.5066	10	0.9192	9	0.0138	10	1	10	1	9
10	KTK	-0.3377	9	0.3332	10	0.39	9	0.3468	7	1.0371	10

## V. GROUP DISCUSSION

Spearman Co-relation Co-efficient and Kendall Co-relation Co-efficient between the methods are shown in table 5:

Table 5. Correlation Coefficient Ranking by Spearman and Kendall

Spearman	Promethee	Wsm	Topsis	Copras	Vikor
PROM-ETHEE	1	0.8667	0.95	0.9	0.975
WSM	0.8667	1	0.9333	0.8333	0.8583
TOPSIS	0.95	0.9333	1	0.95	0.925
COPRAS	0.9	0.8333	0.95	1	0.825
VIKOR	0.975	0.8583	0.925	0.825	1
Kendall	Promethee	Wsm	Topsis	Copras	Vikor
PROM-ETHEE	1	0.7778	0.9111	0.8222	0.9556
WSM	0.7778	1	0.8667	0.7778	0.8222
TOPSIS	0.9111	0.8667	1	0.9111	0.8667
COPRAS	0.8222	0.7778	0.9111	1	0.7778
VIKOR	0.9111	0.7778	0.8222	0.7333	1

Calculate the relative closeness between the methods by entropy in both the correlation coefficient methods which is shown in the table 6.

Table 6. Relative Closeness between the methods

	PROM-ETHEE	WSM	TOPSIS	COPRAS	VIKOR
Spearman	0.2015	0.1980	0.2026	0.1983	0.1996
Kendall	0.2019	0.1979	0.2037	0.1987	0.1978

Calculate Additive & Multiplicative Ranking of the teams according Spearman and Kendall Correlation Coefficient are shown in the table 7:

Table 7. Additive and Multiplicative Ranking of the teams

Team ID	Team	Kendall		Spearman	
		Add. Rank	Mul. Rank	Add. Rank	Mul. Rank
1	CSK	1	1	1	1
2	DC/SRH	8	8	8	8
3	DD	7	7	7	7
4	KKR	5	5	5	5
5	KXIP	6	6	6	6
6	MI	2	2	2	2
7	RCB	4	4	4	4
8	RR	3	3	3	3
9	PWI	10	10	10	10
10	KTK	9	9	9	9

The ultimate ranking of the teams is same for additive ranking and multiplicative ranking in both Spearman and Kendall correlation coefficient which confirm the fruitfulness of our proposed method and this new model overcome the main drawbacks of MCDM method that different techniques provide different ranking for the same set of problems.

According our new model it is very much clear that in all six years of IPL, the performance of CSK is very decent and consistent and after that the performance of MI is good. The overall performance of DC/SRH is not at all up to the mark although DC/SRH won the IPL cup in 2009. RCB still not win the title but its performance is very much consistent and they done well from the starting of IPL.

## VI CONCLUSION

This article offers emerging idea in the field of multi criteria decision analysis in fuzzy environment by integrating few multi criteria techniques in a single model. This proposed work eliminate the main drawback of multi-criteria decision analysis that is different multi criteria methods provide different ranking for the same problem with same multiple attributes and same multiple alternatives although same decision maker.

Cricket team performance measurement is done with this new model to get the precise result every time. Fuzzy membership handles the uncertainty and improper judgment of any linear scale pair-wise comparison between alternatives or attributes.

In every step of this mathematical model we check the accuracy in terms of consistency checking or correlation between intermediate methods or calculate the overall additive or multiplicative ranking. In this model both Spearman and Kendall correlation coefficient methods are used to find the relative closeness between the different MCDM methods and the result of this work shows that the new model is scientifically and mathematically error free and produce precise outcome in every time.

This new model helps the decision maker to make their error free decision in very systematic way irrespective of any specific field of multi criteria.

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APPENDIX

Table 8. AHP Pair-wise comparison table

Criteria	Mat	won	lost	NRR	WM	AWAY	IMP	W
MAT	1.000	0.250	0.333	0.500	0.500	1.000	0.500	0.0666
WON	4.000	1.000	1.000	2.000	2.000	3.000	3.000	0.2586
LOST	3.000	1.000	1.000	1.000	2.000	3.000	2.000	0.2135
NRR	2.000	0.500	1.000	1.000	1.000	2.000	2.000	0.1569
WM	2.000	0.500	0.500	1.000	1.000	2.000	1.000	0.1280
Away	1.000	0.333	0.333	0.500	0.500	1.000	1.000	0.0764
IMP	2.000	0.333	0.500	0.500	1.000	1.000	1.000	0.1000

Table 9. FAHP (Normalized Triangular Function with Gaussian Fuzzy Number)

$\alpha = 0.1, =0.25$	LOW	MID	HIGH	LOW	MID	HIGH	Si- L	Si- R
MAT	1.428	4.083	6.739	0.018	0.066	0.157	0.032	0.060
WON	13.345	16.000	18.655	0.166	0.260	0.434	0.062	0.115
LOST	10.345	13.000	15.655	0.129	0.211	0.364	0.054	0.101
NRR	6.845	9.500	12.155	0.085	0.154	0.283	0.045	0.085
WM	5.345	8.000	10.655	0.067	0.130	0.248	0.042	0.078
Away	2.011	4.667	7.322	0.025	0.076	0.170	0.033	0.062
IMP	3.678	6.333	8.989	0.046	0.103	0.209	0.038	0.070
Sum	42.995	61.583	80.172					

Table 10. FAHP (Degree of Possibility with weight Calculation)

	Mat	won	lost	NRR	WM	AWAY	IMP	MIN	FAHP	AHP	Weight
MAT	1.000	0.078	0.197	0.496	0.674	0.990	0.868	0.078	0.023	0.556	0.027
WON	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.298	0.599	0.370
LOST	1.000	0.914	1.000	1.000	1.000	1.000	1.000	0.914	0.272	0.556	0.314
NRR	1.000	0.594	0.846	1.000	1.000	1.000	1.000	0.594	0.177	0.545	0.200
WM	1.000	0.419	0.684	0.962	1.000	1.000	1.000	0.419	0.125	0.036	0.009
Away	1.000	0.110	0.259	0.588	0.763	1.000	0.929	0.110	0.033	0.036	0.003
IMP	1.000	0.241	0.467	0.820	0.943	1.000	1.000	0.241	0.072	0.521	0.078

Table 11. Spearman Correlation coefficient calculation

Team	P-rank	W-rank	T-rank	C-rank	V-rank	P-W	P-T	P-C	P-V	W-T	W-C	W-V	T-C	T-V	C-V
CSK	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
DC/SRH	8	6	8	9	8	4	0	1	0	4	9	4	1	0	1
DD	7	8	7	8	6	1	0	1	1	1	0	4	1	1	4
KKR	6	4	4	4	6	4	4	4	0	0	0	4	0	4	4
KXIP	5	7	6	6	5	4	1	1	0	1	1	4	0	1	1
MI	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0
RCB	4	5	5	5	4	1	1	1	0	0	0	1	0	1	1
RR	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0
PWI	10	9	10	10	9	1	0	0	1	1	1	0	0	1	1
KTK	9	10	9	7	10	1	0	4	1	1	9	0	4	1	9
					SUM	16	6	12	3	8	20	17	6	9	21
					Spearman coefficient	0.87	0.95	0.9	0.98	0.93	0.83	0.86	0.95	0.93	0.83

Table 12. Kendall Correlation coefficient calculation

Team	P-rank	W-rank	T-rank	C-rank	V-rank	W-P	T-P	C-P	V-P
CSK	1	1	1	1	1	9	9	9	9
MI	2	2	2	2	2	8	8	8	8
RR	3	3	3	3	3	7	7	7	7
RCB	4	5	5	5	4	5	5	5	6
KXIP	5	7	6	6	5	3	4	4	5
KKR	6	4	4	4	6	4	4	4	3
DD	7	8	7	8	6	2	3	2	3
DC/SRH	8	6	8	9	8	2	2	1	2
KTK	9	10	9	7	10	0	1	1	0
PWI	10	9	10	10	9	0	0	0	0
					SUM	40	43	41	43
						KENDELL coefficient			
						0.7778	0.9111	0.8222	0.9111
Team	P-rank	W-rank	T-rank	C-rank	V-rank	P-W	T-W	C-W	V-W
CSK	1	1	1	1	1	9	9	9	9
MI	2	2	2	2	2	8	8	8	8
RR	3	3	3	3	3	7	7	7	7
KKR	6	4	4	4	6	4	6	6	3
RCB	4	5	5	5	4	5	5	5	5
DC/SRH	8	6	8	9	8	2	2	1	2
KXIP	5	7	6	6	5	3	3	3	3
DD	7	8	7	8	6	2	2	1	2
PWI	10	9	10	10	9	0	0	0	1
KTK	9	10	9	7	10	0	0	0	0
					SUM	40	42	40	40
						KENDELL coefficient			
						0.7778	0.8667	0.7778	0.7778
Team	P-rank	W-rank	T-rank	C-rank	V-rank	P-T	W-T	C-T	V-T
CSK	1	1	1	1	1	9	9	9	9
MI	2	2	2	2	2	8	8	8	8
RR	3	3	3	3	3	7	7	7	7
KKR	6	4	4	4	6	4	6	6	3
RCB	4	5	5	5	4	5	5	5	5
KXIP	5	7	6	6	5	4	3	4	4
DD	7	8	7	8	6	3	2	2	3
DC/SRH	8	6	8	9	8	2	2	1	2
KTK	9	10	9	7	10	1	0	1	0
PWI	10	9	10	10	9	0	0	0	0
					SUM	43	42	43	41
						KENDELL coefficient			
						0.9111	0.8667	0.9111	0.8222
Team	P-rank	W-rank	T-rank	C-rank	V-rank	P-C	W-C	T-C	V-C
CSK	1	1	1	1	1	9	9	9	9
MI	2	2	2	2	2	8	8	8	8
RR	3	3	3	3	3	7	7	7	7
KKR	6	4	4	4	6	4	6	6	3
RCB	4	5	5	5	4	5	5	5	5
KXIP	5	7	6	6	5	4	3	4	4
KTK	9	10	9	7	10	1	0	1	0
DD	7	8	7	8	6	2	1	2	2
DC/SRH	8	6	8	9	8	1	1	1	1
PWI	10	9	10	10	9	0	0	0	0
					SUM	41	40	43	39
						KENDELL coefficient			
						0.8222	0.7778	0.9111	0.7333
Team	P-rank	W-rank	T-rank	C-rank	V-rank	P-V	W-V	T-V	C-V
CSK	1	1	1	1	1	9	9	9	9
MI	2	2	2	2	2	8	8	8	8
RR	3	3	3	3	3	7	7	7	7
RCB	4	5	5	5	4	6	5	5	5
KXIP	5	7	6	6	5	5	3	4	4
KKR	6	4	4	4	6	4	4	4	4
DD	7	8	7	8	6	3	2	3	2
DC/SRH	8	6	8	9	8	2	2	2	1
PWI	10	9	10	10	9	0	1	0	0
KTK	9	10	9	7	10	0	0	0	0
					SUM	44	41	42	40
						KENDELL coefficient			
						0.9556	0.8222	0.8667	0.7778

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