

DEA Analysis of Teams in the Indian Premier League

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Abstract

In this paper, Data Envelopment Analysis(DEA) was used to measure the efficiency of 8 cricket teams in the Indian Premier League considering their performance in 2015, 2018, and 2019. The input includes the money spent by each team in the player auctions held every year and the number of players bought by each team. The output includes the points earned by the franchises every season, the Net Run Rates (NRR), the number of matches won, team rankings, and the franchise revenue. After conducting the CCR-I model over these three seasons, we found that Chennai Super Kings (CSK) and Mumbai Indians(MI) have highly efficient operations mainly due to good performances and logical business models. It can be seen that efficiency is correlated to a certain extent with performance.

Introduction

The Indian Premier Tournament (IPL) is a professional men's Twenty20 cricket league in which ten teams compete from ten different cities across India. The BCCI (Board of Control for Cricket in India) established the league in 2007 with eight teams participating till 2022. The IPL is the most popular cricket league in the world, ranking sixth among all sports leagues in terms of average attendance in 2014. The 2015 IPL season provided Rs. 1,150 crore (US\$150 million) to India's GDP, according to the BCCI. With 31.57 million average impressions and a 23 percent increase in overall consumption over the 2019 season, the 2020 IPL season broke a tremendous viewership record.^[a]

IPL takes place every year between March and May and has a special slot in the ICC Future Tours Programme.. Each team in the league is owned by a franchise owner. There are typically three types of franchises, business franchise, product franchise and manufacturing franchise. The type that applied to

IPL is business franchise. Our paper focuses on analyzing 8 teams: Chennai Super Kings (CSK) is owned by India Cements, Mumbai Indians (MI) is owned by Reliance Industries Limited, Rajasthan Royals (RR) is jointly owned by Amisha Hathiramani, Manoj Badale, and Lachlan Murdoch. Delhi Capitals (DC) is jointly owned by the GMR Group and JSW Group, Royal Challengers Bangalore (RCB) is owned by United Spirits Limited, Kolkata Knight Riders (KKR) is owned by Red Chilies Entertainment and Mehta Group, Punjab Kings(KXIP) is jointly owned by Mohit Burman, Ness Wadia, Preity Zinta and Karan Paul. Sunrisers Hyderabad (SRH) is owned by the Sun Group. ^[b]

Eight teams play one another twice in a home and away format. Eventually, the top ranking teams of round robin league qualify for the play offs. From the league phase the highest ranking two teams play against each other, which is called the first qualifying match, the winner of this match goes to the IPL final and the loser gets a second chance to qualify for the IPL final by playing another match called second qualifier. From the league phase the 3rd and 4th team play against each other and the winner plays the loser of the first qualifying match. Eventually in the IPL final match the two winners from the second and the first qualifying match play the final and the winner receives the IPL trophy. The IPL auction is a gala event every year garnering a lot of enthusiasm among the worldwide cricket fans. Each of the eight teams is given a budget of Rs.85 crore to complete their squads with a maximum of 25 players including a maximum of 8 overseas players. Before the auction begins, the teams are given an opportunity to retain the players from last season. The budget that remains after the retention process is then spent in the auction. A team can retain a maximum of five players through a combination of pre-auction retention and 'Right To Match' (RTM) Cards. A maximum of three capped India players and two capped overseas players can be retained by each team. The RTM allows a player's previous team to match any winning bid for the player that they have just released. Often teams release a player with the intention of signing him back at a cheaper price using a 'Right To Match' card. The players that go under the hammer are first grouped by their specialty into categories of batsmen, all-rounder, wicketkeepers, fast bowlers and spinners who are auctioned separately. Players who sign up for the auction, set their base price, and are bought by the highest bidder. The unsold players go back and can be brought back in the final phase of the auctions if the franchises want them. Final unsold players at the auction are eligible to be signed up as replacement signings either before or during the tournament.

In this study, DEA was used to measure the overall efficiency of IPL teams over a 3 season period of 2015, 2018, and 2019. The 2017 and 2018 season has been excluded due to non uniformity in the teams during those two years. We use money spent in auctions and number of players bought every year as input which we will refer as 'investments' and points earned, net run rate, number of matches won, revenue and team rankings as outputs which we will refer as 'performance metrics'.

Literature Review

Many scholars have done research on the application of DEA. Sanjeet Singh (2011) used the DEA method to research the efficiency of cricket teams in the Indian Premier League in the 2009 season^[1]. E Thanassoulis, M Kortelainen, G Johnes & J Johnes (2017) used the DEA method to research the efficiency of higher education institutions^[2]. Based on general DEA research, some scholars use the improved DEA method to conduct research. Jui-Kou Shang, Wei-Ting Hung, Chang-Fang Lo & Fei-Ching Wang (2008) used the three-stage DEA method to analyze the efficiency of e-commerce and

hotel performance^[3]. Claudia Curi, Simone Gitto, Paolo Mancuso(2011) used the bootstrapped DEA method to research the efficiency of Italian airports.^[4]

Data Envelopment Analysis

Data Envelopment Analysis (DEA) is a method for analyzing the efficiency of different Decision Making Units (DMUs) by evaluating input and output that was first proposed by Charnes, Cooper, and Rhodes in 1978. A linear programming model stated as a ratio of output to input is known as DEA. In order to make future decisions, shareholders, managers, and investors need to know how efficient a company is. In operations management, DEA is used for benchmarking, where a set of measurements is chosen to compare the performance of manufacturing and service activities. The method is used for benchmarking in operations management and has a strong link to production theory in economics. The efficient DMUs, as defined by DEA, may not necessarily form a "production frontier," but rather a "best-practice frontier," when benchmarking. Police stations, hospitals, banks, schools, and university departments are examples of such units to which the DEA has been applied. It's worth noting that one of the benefits of DEA is that it can be used by non-profit organizations.

DEA aims to maximize service unit efficiency by comparing the performance of a group of DMUs. Units that achieve 100% efficiency are called relatively efficient units, and units that score below 100% are called inefficient units. ^[5]

The CCR model is one of the most common DEA models, named after Charnes, Cooper, and Rhodes. Compared with the BCC model, which assumes that the DMU is of variable returns to scale, the CCR model assumes that the DMU is of fixed returns to scale, which is used to measure the overall efficiency. We want to check if we can minimize the inputs of the given DMUs to achieve the sample level of outputs necessary. We consider on DMU to be the benchmark and the other inputs of other DMUs are then varied to achieve the output of the benchmarked DMU^[6]

In our project, DMUs are 8 cricket teams in the IPL 2019 season and here a non parametric tool like DEA would be more useful. $i = 1, 2, \dots, 8$ DMUs employ x_i input to produce y_z output. v_i and u_z are associated with inputs and outputs. By formalizing the efficiency expression, we can get

$$Efficiency = \frac{\sum_{z=1}^s u_z y_{iz}}{\sum_{j=1}^n v_j x_{ij}}$$

The specific DEA problem can be expressed as solving

$$max \frac{\sum_{z=1}^s u_z y_{oz}}{\sum_{j=1}^n v_j x_{oj}} \mid \sum_{z=1}^s u_z y_{iz} - \sum_{j=1}^n v_j x_{ij} \leq 0. \quad [7]$$

In the CCR model, this formula can also be written as a dual problem where w_i varies from 0 to 1 is the ratio of input_i and output_i to total input and output, θ varies from 0 to 1 is the efficiency score.

$$min(\theta) \mid \sum_{i=1}^8 w_i x_{ij} \leq \theta x_{oj}; \sum_{i=1}^8 w_i y_{iz} \geq y_{oz}; \sum_{i=1}^8 w_i = 1; w_i \geq 0.$$

In the input and output slacks format, CCR model can be expressed as

$$\min(\theta - \sum_{z=1}^s s_z^+ + \sum_{j=1}^n s_j^-) | \sum_{i=1}^8 w_i x_{ij} + s_j^- = \theta x_{oj}; \sum_{i=1}^8 w_i y_{iz} - s_z^+ = y_{oz};$$

$$w_i, s_j^-, s_z^+ \geq 0 \quad (8)(9)$$

After calculating the efficiency metrics of all teams over a 3 season period, the mean efficiency for each team was calculated over the 3 season period as the final efficiency score for each team.

Data

The data for this analysis was sourced from different reliable news sources and official IPL websites, cricket statistics websites such as CricBuzz and ESPNcricInfo were used thoroughly to gather the additional information. We have collected data for the 2015, 2018, and 2019 season for the purpose of this study. We have skipped the 2016 and 2017 season due to a two season suspension of two franchises in the league. Analyzing over the above mentioned 3 season makes the data more uniform and enables us to make a reasonable analysis

The two inputs that were fed into the analysis are the money spent by each team in the player auctions held every year and the number of players bought by each team. The IPL gives each team the same amount of money to spend each season so generally the money spent should not matter. However, the teams are free to release existing players and retain a few players in each year to gather additional purse money. The IPL had a purse of 82 crores in 2019 but teams like Chennai Super Kings and Mumbai Indians retained most of their old squad and ended up with less money to spend in the auction. Each time, the eight franchises were eligible to retain up to 4 players with a maximum of 3 Indians, 2 overseas players and 2 uncapped Indians. The number of retention varies per team so the total players bought by each team varies too hence these could be good parameters for inputs for the number of changes made by teams/season.

The output variables include the points earned by the franchises every season, the Net Run Rates (NRR), the number of matches won, team rankings, and the franchise revenue. The output variable of revenue indicates the team's financial success, including revenue from central sponsorship, central broadcasting, team sponsors, and revenue from other sources, such as gate receipts, merchandise sales, in-stadium advertising, prize money and so on.

The other variables relate to the team's onfield performance and measuring the number of matches won, the position they ended their season, the number of matches they won and the rate at which they scored runs. However factors such as revenue are directly related to the teams on field performance as teams which have won the most number of IPL titles have the highest revenue, Hence, such factors should be included in the efficiency calculation.^[10]

Pre-processing was also performed on the data, the money spent was calculated by analyzing the purse at the beginning of the auction minus the purse at the end of the auction while accounting for additional transfers. Player withdrawals were not accounted for in the data as reliable data on the replacements weren't available and the money spent would not vary much from the initial auction bids. . It should be

noted that several of the net run rate figures in this data were negative. To make the DMUs usable in the DEA model, an additional 1 has been added to the net run rate of all DMUs. Additionally, the team rankings have been reversed to enable increasing the output.^[11]

Data for the 2015 Season

| Teams | Money Spent | Players Bought | Points Earned | Revenue | Team Ranking | Matches Won | Net Run Rate |
|-------|-------------|----------------|---------------|---------|--------------|-------------|--------------|
| CSK | 0.533 | 8 | 18 | 20.8 | 7 | 10 | 2.709 |
| MI | 0.663 | 10 | 16 | 21.84 | 8 | 10 | 1.957 |
| RR | 0.273 | 6 | 16 | 12.13 | 5 | 7 | 2.062 |
| DC | 4.979 | 14 | 11 | 14.69 | 2 | 5 | 1.951 |
| RCB | 2.522 | 9 | 16 | 12.22 | 6 | 8 | 3.037 |
| KKR | 0.52 | 7 | 15 | 21.97 | 4 | 7 | 2.253 |
| KXIP | 0.442 | 3 | 6 | 16.9 | 1 | 3 | 0.564 |
| SRH | 1.521 | 10 | 14 | 13 | 3 | 7 | 2 |

Data for the 2018 Season

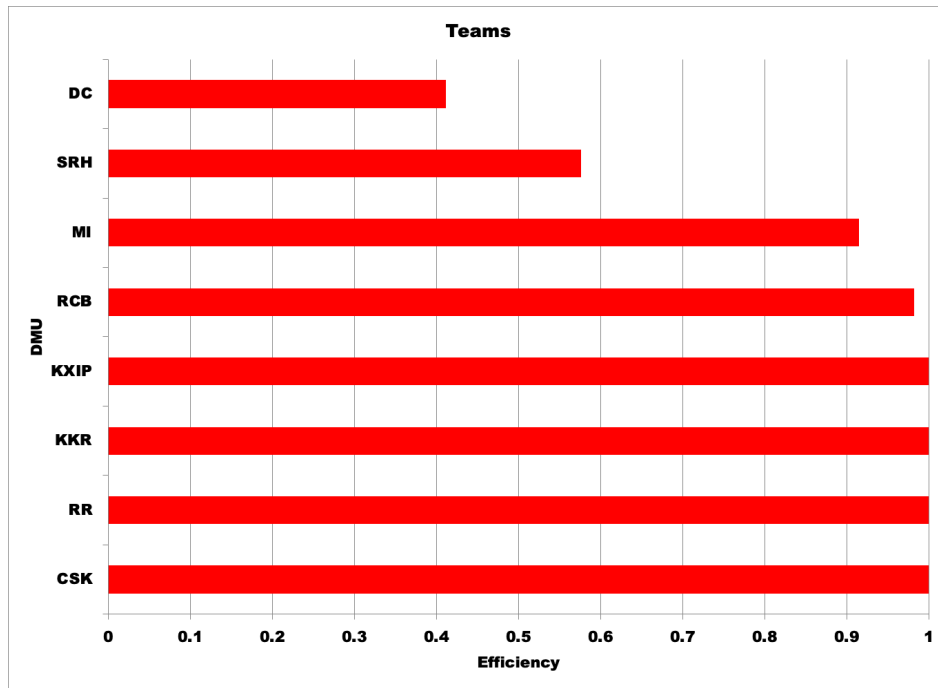
| Teams | Money Spent | Players Bought | Points Earned | Revenue | Team Ranking | Matches Won | Net Run Rate |
|-------|-------------|----------------|---------------|---------|--------------|-------------|--------------|
| CSK | 5.265 | 22 | 18 | 54.21 | 8 | 11 | 1.253 |
| MI | 6.0255 | 22 | 12 | 53.56 | 4 | 6 | 1.317 |
| RR | 8.5605 | 22 | 14 | 36.92 | 5 | 7 | 0.75 |
| DC | 5.902 | 22 | 10 | 43.55 | 1 | 5 | 0.778 |
| RCB | 6.3505 | 21 | 12 | 40.69 | 3 | 6 | 1.129 |
| KKR | 7.67 | 17 | 16 | 58.24 | 6 | 9 | 0.93 |
| KXIP | 8.762 | 20 | 12 | 49.01 | 2 | 6 | 0.498 |
| SRH | 7.5855 | 23 | 18 | 57.59 | 7 | 10 | 1.284 |

Data for the 2019 Season

| Teams | Money Spent | Players Bought | Points Earned | Revenue | Team Ranking | Matches Won | Net Run Rate |
|-------|-------------|----------------|---------------|---------|--------------|-------------|--------------|
| CSK | 0.676 | 2 | 18 | 46.41 | 7 | 10 | 1.131 |
| MI | 0.988 | 6 | 18 | 51.74 | 8 | 11 | 1.421 |
| RR | 1.794 | 9 | 11 | 26.78 | 2 | 5 | 0.551 |
| DC | 2.314 | 10 | 18 | 41.34 | 6 | 10 | 1.044 |
| RCB | 2.1255 | 9 | 11 | 26.91 | 1 | 5 | 0.393 |
| KKR | 1.1895 | 8 | 12 | 30.03 | 4 | 6 | 1.028 |
| KXIP | 4.225 | 13 | 12 | 27.95 | 3 | 6 | 0.749 |
| SRH | 0.572 | 3 | 12 | 31.72 | 5 | 6 | 1.577 |

Results and Analysis

2015



Efficiency Graph for Teams in 2015

| No. | DMU | Score | Rank |
|-----|------|--------|------|
| 1 | CSK | 1 | 1 |
| 3 | RR | 1 | 1 |
| 6 | KKR | 1 | 1 |
| 7 | KXIP | 1 | 1 |
| 5 | RCB | 0.9819 | 5 |
| 2 | MI | 0.915 | 6 |
| 8 | SRH | 0.5765 | 7 |
| 4 | DC | 0.411 | 8 |

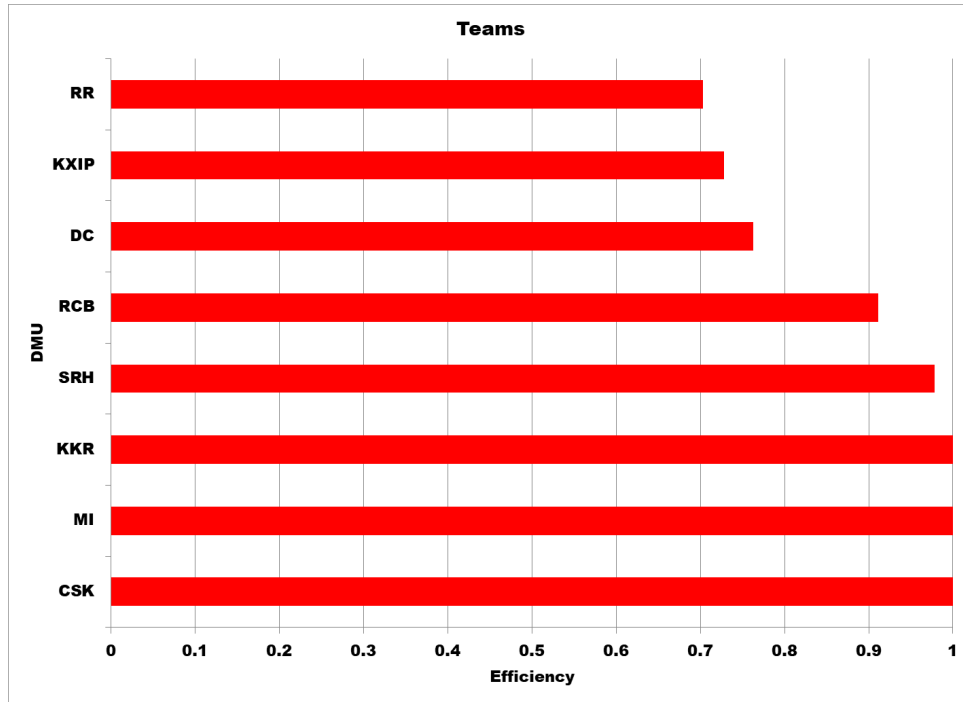
Efficiency Rank for Teams in 2015

Doing a CCR-I DEA Analysis of IPL teams in the 2015 season, a few things can be observed, 4 teams are found to be fully efficient namely CSK, RR, KKR, KXIP. Analyzing each of these teams individually, it can be seen that CSK is efficient due to their low money spending and great performance in the league. RR is efficient because they spent the least amount of money in the league while KKR had the highest revenues among all the teams. KXIP being fully efficient is surprising given that it was the worst performing team on field. Although it seems like an anomaly, it could be due to the fact that they also bought the fewest players. They are being efficient on a low performance - low investment scale.

RCB and MI were relatively almost efficient at 0.98 and 0.91 respectively, MI's efficiency could be due to a low spending, high performance - high revenue operation while RCB employed one with a very high Net Run Rate. SRH and DC were quite inefficient with DC having the worst efficiency at 0.41, they had the highest spending among all the teams and bought the most number of players and performed very poorly on the field whereas SRH had an unsuccessful campaign with a moderately high spending.

Overall, teams which spent the least amount of money and made least player changes were found to be efficient whereas teams with higher spending and high performance were found to have a good efficiency. This shows the model is more sensitive to the input variables. Teams with high spending and poor performance were generally rated to be inefficient which is along expected lines, poor performance directly translates to lower revenues which impacts the efficiency too.

2018



Efficiency Graph for Teams in 2018

| No. | DMU | Score | Rank |
|-----|------|--------|------|
| 1 | CSK | 1 | 1 |
| 2 | MI | 1 | 1 |
| 6 | KKR | 1 | 1 |
| 8 | SRH | 0.9785 | 4 |
| 5 | RCB | 0.9113 | 5 |
| 4 | DC | 0.7627 | 6 |
| 7 | KXIP | 0.7279 | 7 |
| 3 | RR | 0.7031 | 8 |

Efficiency Rank for Teams in 2018

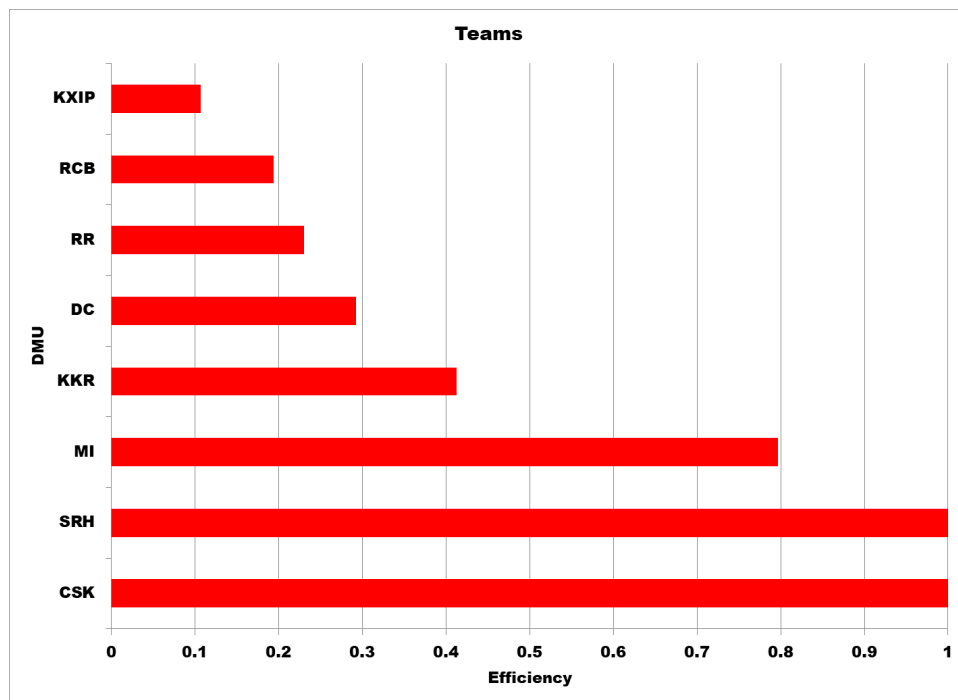
Through the CCR-I DEA analysis on teams in the 2018 season, three teams namely Chennai Super Kings, Mumbai Indians, and Kolkata Knight Riders were found to be efficient. This makes sense due to the fact that CSK had spent the least money during the auction and had very high revenue streams and ended up winning the league, MI and KKR too had extremely high revenues with KKR having the highest revenue in the league. KKR bought the least number of players in the auction which could be one reason it is efficient. Sunriser Hyderabad and RCB were relatively efficient, SRH's buying of more players and RCB's lower revenues meant they couldn't have 100% efficiency.

However, DC, KXIP were found to be inefficient with RR having the least efficiency of 0.70. DC's dip could be attributed to ending up last in the league which took their weight down, KXIP's high spending and bad performance on field can be attributed to their low efficiency. RR had the highest spending among all the teams and had the lowest revenues which meant it ended up being the most inefficient operation in the 201 season.

The major changes observed from 2015 are that KXIP and RR have become quite inefficient in their operations. KXIP and RR's prior low investment - low performance operations plan was not adhered to this year given their large spending which meant their spending and team changes went up but their performance remained poor. DC and CSK have maintained their inefficiency and efficiency respectively which shows there hasn't been any improvement or decline in their operations respectively.

The analysis seems to be consistent with all the patterns that were observed in the league with the historically efficient teams continuing to be efficient and the inefficient ones falling behind. Overall the efficiency metrics for the entire league seems to be high in 2018. This can be attributed to the fact that the 2018 season was the final season not to be impacted by COVID-19 and had the highest revenues for the IPL

2019



Efficiency Graph for Teams in 2019

| No. | DMU | Score | Rank |
|-----|------|--------|------|
| 1 | CSK | 1 | 1 |
| 8 | SRH | 1 | 1 |
| 2 | MI | 0.797 | 3 |
| 6 | KKR | 0.4128 | 4 |
| 4 | DC | 0.2921 | 5 |
| 3 | RR | 0.2303 | 6 |
| 5 | RCB | 0.1944 | 7 |
| 7 | KXIP | 0.1067 | 8 |

Efficiency Rank for Teams in 2019

The DEA analysis of the 2019 season shows that only two teams are fully efficient in their operation, SRH and CSK. CSK bought the least number of players in the auction and ended up topping the league stage. It is interesting to note SRH being efficient because they spent the least money among all the teams while just qualifying for the playoffs, the model has obviously put more weight on the inputs due to them being less in number. MI followed being moderately efficient this year, this because they won the league.

5 teams were very inefficient, rankwise: KKR, DC, RR, RCB, KXIP

Interpreting these results for each team as follows:

KKR: Spent moderate amounts of money and bought a moderate number of players but did not qualify for the playoffs.

DC: Spent a large amount of money in the auction and bought more players while not doing great in the league.

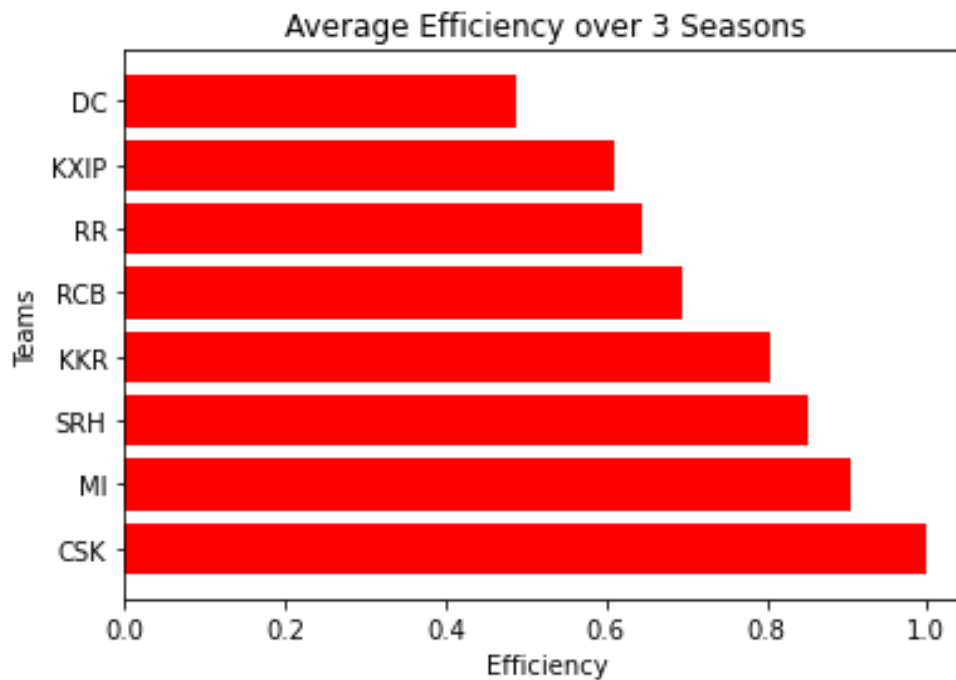
RR: Spent moderate amounts of money and bought more players while having a very poor performance.

RCB: Spent quite a lot of money in the auction while ending up last in the league.

KXIP: Decline can be attributed to it spending the highest amount of money in the league.

Overall, it can be seen that the trend is along expected lines with SRH growing to be fully efficient compared to the last year while CSK continuing their efficient operations. MI and KKR seem to have taken a hit in their efficiency while the other teams have been historically inefficient. KXIP, RR and DC have maintained their position of being inefficient.

Overall Analysis



| No. | DMU | Score | Rank |
|-----|------|----------|------|
| 1 | CSK | 1 | 1 |
| 2 | MI | 0.904 | 2 |
| 8 | SRH | 0.851667 | 3 |
| 6 | KKR | 0.804267 | 4 |
| 5 | RCB | 0.695867 | 5 |
| 3 | RR | 0.644467 | 6 |
| 7 | KXIP | 0.611533 | 7 |
| 4 | DC | 0.4886 | 8 |

Average Efficiency Rank for Teams in 2015, 2018& 2019

Calculating the average of the efficiency scores for the three teams over the 3 year period, it was found that CSK was the team with the highest efficiency of 1. This was expected since CSK was efficient throughout all the seasons which is because they had the least spending and least changes while having great performances on the field. Mumbai Indians too came close to a great efficiency of 0.9 which is due to their high spending, less changes and high performance operations.

SRH has slowly and steadily improved their efficiency over the 3 seasons by increasing their performance output while decreasing the number of changes in their team. KKR's efficiency has decreased over the 3 seasons despite having a low spending profile, this could be due to their fluctuating performances. RCB has been pretty constant in their efficiency being below average in all 3 seasons, this could be due to the fact that RCB have not come up with a viable model to place their business on and their performance has generally been below average despite high spendings and investment.

RR and KXIP had the most surprising metrics over the 3 season period with both teams having full efficiencies in 2015 to both having the worst efficiencies in the latter two seasons. The reason for this is that they are confused about their approach to the franchise sports business. Both teams initially had a low investment - low performance efficiency strategy which worked well for their business in the initial season but then they decided to increase spending and team changes while not changing their low performance at all. This led to a high investment - low performance strategy which turned out to be disastrous for them.

DC has been constantly at the bottom of the efficiency scale due to the constant changes in their team roster every year while having no improvements in any of the performance metrics. There has been a marginal increase in their efficiency of late which however, does not affect their overall efficiency. They need a major overhaul in their operations.

It can be seen that generally efficiency is correlated with performances with teams having better performances having higher efficiency over a given period, this is expected as better performances translate to higher revenues and increased operational flexibility. However, there are anomalies every year where teams not performing well too have higher efficiencies. However, this is not sustainable over the long term as was observed.

Recommendations

1. **Franchises have high efficiencies due to the fact that they first focus on having high performance metrics (Output Variables) while keeping their investments (Input Variables) generally constant. Teams like CSK and MI have had a high performance strategy with a constant investment scheme. This is a great strategy to adopt for other teams.**
2. **Franchises need to figure out their exact business/strategy model for a certain period of time and stick to it for the given duration. RR and KXIP have been prone to not sticking to their business models and switching from a low investment - low performance model to a high investment - low performance model which is not ideal for sports franchises.**
3. **Teams like SRH have shown that making definitive investment(input) decisions in order to overhaul their team for the long term does help. This can be seen through their slow and steady rise over the years. Short Term changes are unlikely to help but mid tier teams like KKR and RCB should have a long term performance oriented growth plan with high investments.**
4. **It is always good to have low overheads, invest less but invest smart. Large investments do not necessarily translate to high performance. CSK is an example of this, they have kept their investments low constantly without making many changes. Other teams wanting low exposure to risk should adopt this strategy.**
5. **Better performance leads to higher revenues which encourages teams to increase unnecessary investments. Teams should resist the urge to do this as it might impact their overall business model and hurt them in case performance metrics diminish in the future.**

Conclusion

Through this study, the DEA Analysis of teams in the Indian Premier League was performed using a CCR- I Model over 3 seasons. The average of the efficiencies of all the 3 seasons was calculated to get the final efficiency. Results showed that Chennai Super Kings and Mumbai Indians were among the most efficient teams in the league thanks to their well planned business models while Delhi Capitals and Punjab Kings had the least efficient operations in the league, this was due to their below average performances and bad decision making. The results were along the lines of expected lines and public perception. Recommendations were made to the inefficient teams in order to improve their business models and efficiency metrics with some teams having some difficult decisions due in the immediate future.

Acknowledgements

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- [b]** <https://www.cricbuzz.com/>

Appendix

Model = CCR-I

Workbook Name = \\engin-labs.m.storage.umich.edu\hegde\windat.v2\Documents\output 2015.xlsx

| | | | | Slack | Slack | Slack | Slack | Slack | Slack | Slack |
|-----|------|--------|------|----------|------------|------------|---------|----------|-----------|--------------|
| No. | DMU | Score | Rank | Money Sp | Players Bc | Points Ear | Revenue | Team Ran | Matches W | Net Run Rate |
| 1 | CSK | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | MI | 0.915 | 6 | 0 | 0 | 4.645 | 1.867 | 0 | 1.425 | 1.142 |
| 3 | RR | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | DC | 0.411 | 8 | 1.673 | 0 | 2.144 | 0 | 3.016 | 2.154 | 0 |
| 5 | RCB | 0.9819 | 5 | 2.074 | 0 | 7.565 | 5.646 | 1.364 | 2.31 | 0 |
| 6 | KKR | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | KXIP | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | SRH | 0.5765 | 7 | 0.545 | 0 | 0 | 0.559 | 1.941 | 0 | 0.204 |

| | Score | Rank | Money Sp | Players Bc | Points Ear | Revenue | Team Ran | Matches W | Net Run Rate |
|---------|--------|--------|----------|------------|------------|---------|----------|-----------|--------------|
| Average | 0.8606 | 3.75 | 0.5365 | 0 | 1.7942 | 1.009 | 0.7901 | 0.7361 | 0.1682 |
| Max | 1 | 8 | 2.074 | 0 | 7.565 | 5.646 | 3.016 | 2.31 | 1.142 |
| Min | 0.411 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| St Dev | 0.2325 | 3.0589 | 0.8531 | 0 | 2.8697 | 1.9832 | 1.179 | 1.0469 | 0.3999 |

Model = CCR-I

Workbook Name = \\engin-labs.m.storage.umich.edu\hegde\windat.v2\Documents\output 2015.xlsx

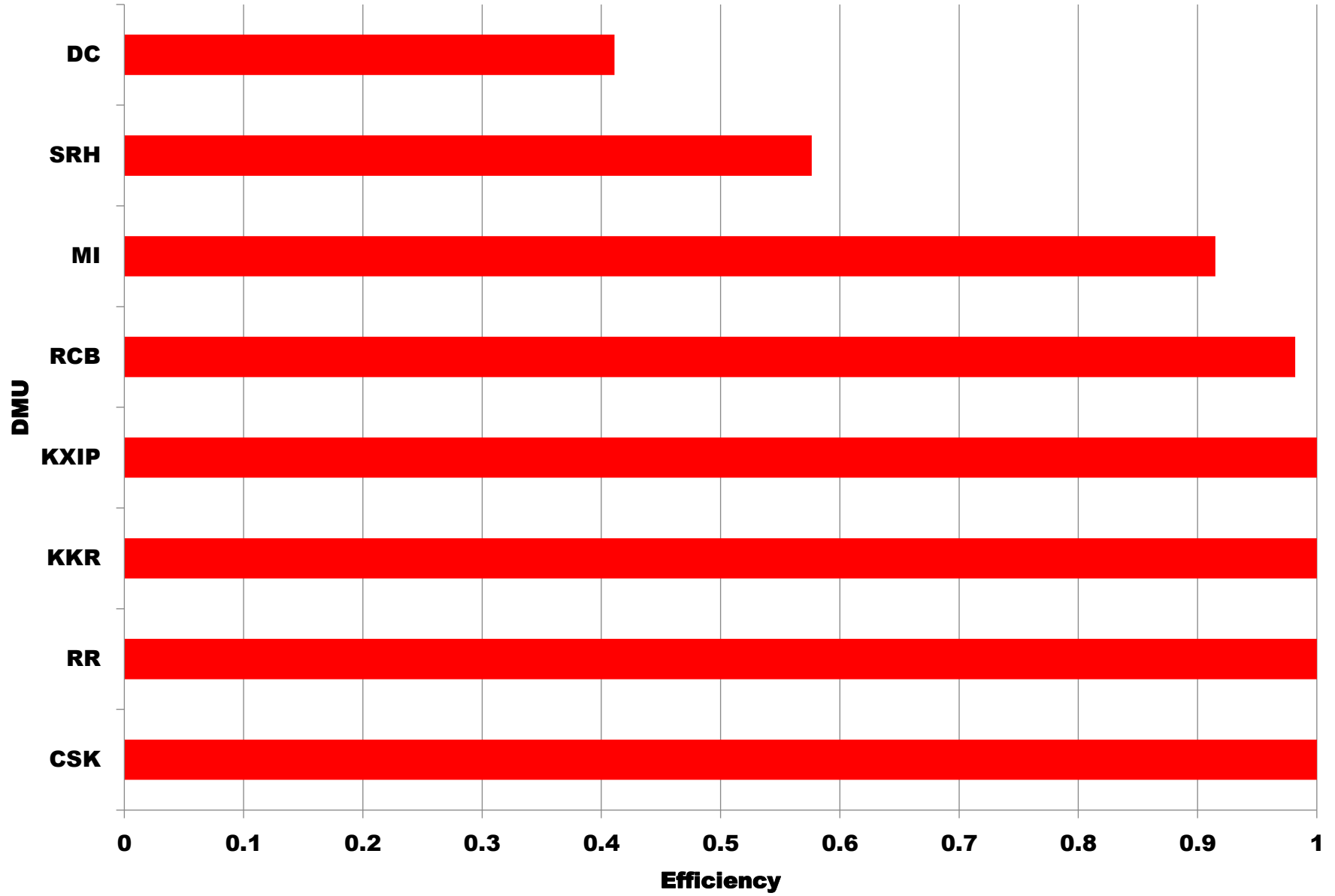
| No. | DMU | Score | Rank | Money Spent | | | Players Bought | | | Points Earned | | |
|-----|------|--------|------|-------------|------------|----------|----------------|------------|----------|---------------|------------|----------|
| | | | | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) |
| 1 | CSK | 1 | 1 | 0.533 | 0.533 | 0 | 8 | 8 | 0 | 18 | 18 | 0 |
| 2 | MI | 0.915 | 6 | 0.663 | 0.606616 | -8.504 | 10 | 9.14956 | -8.504 | 16 | 20.64516 | 29.032 |
| 3 | RR | 1 | 1 | 0.273 | 0.273 | 0 | 6 | 6 | 0 | 16 | 16 | 0 |
| 4 | DC | 0.411 | 8 | 4.979 | 0.373468 | -92.499 | 14 | 5.754538 | -58.896 | 11 | 13.14353 | 19.487 |
| 5 | RCB | 0.9819 | 5 | 2.522 | 0.402086 | -84.057 | 9 | 8.837051 | -1.811 | 16 | 23.56547 | 47.284 |
| 6 | KKR | 1 | 1 | 0.52 | 0.52 | 0 | 7 | 7 | 0 | 15 | 15 | 0 |
| 7 | KXIP | 1 | 1 | 0.442 | 0.442 | 0 | 3 | 3 | 0 | 6 | 6 | 0 |
| 8 | SRH | 0.5765 | 7 | 1.521 | 0.331882 | -78.18 | 10 | 5.764706 | -42.353 | 14 | 14 | 0 |

| | Score | Rank | Money Spent | | | Players Bought | | | Points Earned | | |
|---------|--------|--------|-------------|------------|----------|----------------|------------|----------|---------------|------------|----------|
| | | | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) |
| Average | 0.8606 | 3.75 | 1.4316 | 0.4353 | -32.905 | 8.375 | 6.6882 | -13.9455 | 14 | 15.7943 | 11.9754 |
| Max | 1 | 8 | 4.979 | 0.6066 | 0 | 14 | 9.1496 | 0 | 18 | 23.5655 | 47.284 |
| Min | 0.411 | 1 | 0.273 | 0.273 | -92.499 | 3 | 3 | -58.896 | 6 | 6 | 0 |
| St Dev | 0.2325 | 3.0589 | 1.6183 | 0.1122 | 43.3329 | 3.2486 | 2.0105 | 23.245 | 3.8173 | 5.2866 | 18.1702 |

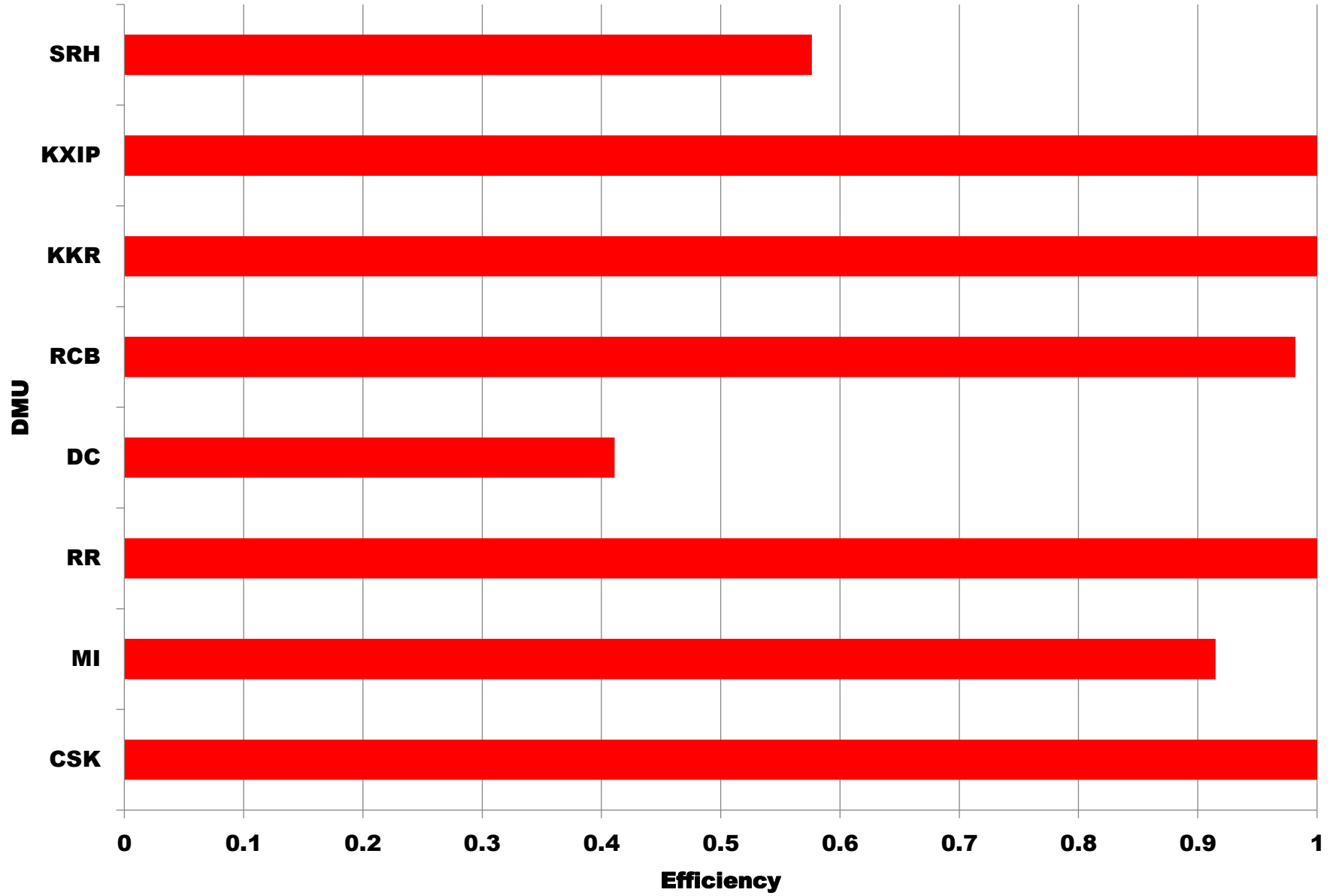
| Revenue | | | Team Ranking | | | Matches Won | | | Net Run Rate | | |
|---------|------------|----------|--------------|------------|----------|-------------|------------|----------|--------------|------------|----------|
| Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) |
| 20.8 | 20.8 | 0 | 7 | 7 | 0 | 10 | 10 | 0 | 2.709 | 2.709 | 0 |
| 21.84 | 23.70745 | 8.551 | 8 | 8 | 0 | 10 | 11.42522 | 14.252 | 1.957 | 3.098979 | 58.354 |
| 12.13 | 12.13 | 0 | 5 | 5 | 0 | 7 | 7 | 0 | 2.062 | 2.062 | 0 |
| 14.69 | 14.69 | 0 | 2 | 5.015639 | 150.782 | 5 | 7.154009 | 43.08 | 1.951 | 1.951 | 0 |
| 12.22 | 17.86557 | 46.199 | 6 | 7.36421 | 22.737 | 8 | 10.30989 | 28.874 | 3.037 | 3.037 | 0 |
| 21.97 | 21.97 | 0 | 4 | 4 | 0 | 7 | 7 | 0 | 2.253 | 2.253 | 0 |
| 16.9 | 16.9 | 0 | 1 | 1 | 0 | 3 | 3 | 0 | 0.564 | 0.564 | 0 |
| 13 | 13.55941 | 4.303 | 3 | 4.941176 | 64.706 | 7 | 7 | 0 | 1.761 | 1.964529 | 11.558 |

| Revenue | | | Team Ranking | | | Matches Won | | | Net Run Rate | | |
|---------|------------|----------|--------------|------------|----------|-------------|------------|----------|--------------|------------|----------|
| Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) |
| 16.6938 | 17.7028 | 7.3816 | 4.5 | 5.2901 | 29.7781 | 7.125 | 7.8611 | 10.7758 | 2.0368 | 2.2049 | 8.739 |
| 21.97 | 23.7074 | 46.199 | 8 | 8 | 150.782 | 10 | 11.4252 | 43.08 | 3.037 | 3.099 | 58.354 |
| 12.13 | 12.13 | 0 | 1 | 1 | 0 | 3 | 3 | 0 | 0.564 | 0.564 | 0 |
| 4.3049 | 4.1718 | 15.9914 | 2.4495 | 2.2335 | 53.9115 | 2.3566 | 2.6627 | 16.7493 | 0.7328 | 0.8092 | 20.4514 |

Teams



Teams



Model = CCR-I

Workbook Name = \\engin-labs.m.storage.umich.edu\hegde\windat.v2\Documents\output 2015.xlsx

| No. | DMU | Score | Rank |
|-----|------|--------|------|
| 1 | CSK | 1 | 1 |
| 3 | RR | 1 | 1 |
| 6 | KKR | 1 | 1 |
| 7 | KXIP | 1 | 1 |
| 5 | RCB | 0.9819 | 5 |
| 2 | MI | 0.915 | 6 |
| 8 | SRH | 0.5765 | 7 |
| 4 | DC | 0.411 | 8 |

Model = CCR-I

Workbook Name = \\engin-labs.m.storage.umich.edu\hegde\windat.v2\Documents\output 2015.xlsx

| No. | DMU | Score | Rank | | v(1)*Money | v(2)*Players Bought | u(1)*Point | u(2)*Reve | u(3)*Team | u(4)*Match | u(5)*Net R |
|-----|------|--------|------|--|------------|---------------------|------------|-----------|-----------|------------|------------|
| 1 | CSK | 1 | 1 | | 0.54525 | 0.45475 | 0 | 0.71655 | 0.28345 | 0 | 0 |
| 2 | MI | 0.915 | 6 | | 0.14956 | 0.85044 | 0 | 0 | 0.914956 | 0 | 0 |
| 3 | RR | 1 | 1 | | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 4 | DC | 0.411 | 8 | | 0 | 1 | 0 | 2.53E-02 | 0 | 0 | 0.38572 |
| 5 | RCB | 0.9819 | 5 | | 0 | 1 | 0 | 0 | 0 | 0 | 0.981895 |
| 6 | KKR | 1 | 1 | | 0 | 1 | 0.232222 | 0.276528 | 2.14E-02 | 0 | 0.469863 |
| 7 | KXIP | 1 | 1 | | 0 | 1 | 0 | 0.616528 | 0 | 0 | 0.383472 |
| 8 | SRH | 0.5765 | 7 | | 0 | 1 | 0.164706 | 0 | 0 | 0.411765 | 0 |

Model = CCR-I

Workbook Name = \\engin-labs.m.storage.umich.edu\hegde\windat.v2\Documents\output 2015.xlsx

| No. | DMU | Score | Rank | | v(1) | v(2) | | u(1) | u(2) | u(3) | u(4) | u(5) |
|-----|------|--------|------|--|----------|----------|--|----------|----------|----------|----------|----------|
| 1 | CSK | 1 | 1 | | 1.022982 | 5.68E-02 | | 0 | 3.44E-02 | 4.05E-02 | 0 | 0 |
| 2 | MI | 0.915 | 6 | | 0.225581 | 8.50E-02 | | 0 | 0 | 0.11437 | 0 | 0 |
| 3 | RR | 1 | 1 | | 3.663004 | 0 | | 6.25E-02 | 0 | 0 | 0 | 0 |
| 4 | DC | 0.411 | 8 | | 0 | 7.14E-02 | | 0 | 1.72E-03 | 0 | 0 | 0.197704 |
| 5 | RCB | 0.9819 | 5 | | 0 | 0.111111 | | 0 | 0 | 0 | 0 | 0.323311 |
| 6 | KKR | 1 | 1 | | 0 | 0.142857 | | 0.015481 | 1.26E-02 | 5.35E-03 | 0 | 0.20855 |
| 7 | KXIP | 1 | 1 | | 0 | 0.333333 | | 0 | 3.65E-02 | 0 | 0 | 0.679914 |
| 8 | SRH | 0.5765 | 7 | | 0 | 1.00E-01 | | 1.18E-02 | 0 | 0 | 0.058824 | 0 |

Model = CCR-I

Workbook Name = \\engin-labs.m.storage.umich.edu\hegde\windat.v2\Documents\output 2015.xlsx

| No. | DMU | Score | Rank | | Reference(Lambda) | | |
|-----|------|--------|------|------|-------------------|----|-------|
| 1 | CSK | 1 | 1 | CSK | 1 | | |
| 2 | MI | 0.915 | 6 | CSK | 1.126 | RR | 0.023 |
| 3 | RR | 1 | 1 | RR | 1 | | |
| 4 | DC | 0.411 | 8 | CSK | 0.661 | RR | 0.078 |
| 5 | RCB | 0.9819 | 5 | RR | 1.473 | | |
| 6 | KKR | 1 | 1 | KKR | 1 | | |
| 7 | KXIP | 1 | 1 | KXIP | 1 | | |
| 8 | SRH | 0.5765 | 7 | CSK | 0.412 | RR | 0.412 |

| | |
|---------|--------|
| Average | 0.8606 |
| Max | 1 |
| Min | 0.411 |
| St Dev | 0.2325 |

Workbook Name = \\engin-labs.r Workbook Name = \\engin-labs.m.storage.umich.edu\hegde\windat.v2\Documents\output 2015.xlsx

Data File = \\engin-labs.m.storage.umich.edu\hegde\windat.v2\Documents\2015 Data.xlsxSheet1

DEA model = DEA-Solver LV8.0/ CCR(CCR-I)

Problem = Teams

No. of DMUs = 8

Returns to Scale = Constant ($0 \leq \text{Sum of Lambda} < \text{Infinity}$)

No. of Input items = 2

Input(1) = Money Spent

Input(2) = Players Bought

No. of Output items = 5

Output(1) = Points Earned

Output(2) = Revenue

Output(3) = Team Ranking

Output(4) = Matches Won

Output(5) = Net Run Rate

Statistics on Input/Output Data

| | Money Sp | Players Bc | Points Ear | Revenue | Team Ran | Matches W | Net Run Rate |
|---------|----------|------------|------------|----------|----------|-----------|--------------|
| Max | 4.979 | 14 | 18 | 21.97 | 8 | 10 | 3.037 |
| Min | 0.273 | 3 | 6 | 12.13 | 1 | 3 | 0.564 |
| Average | 1.431625 | 8.375 | 14 | 16.69375 | 4.5 | 7.125 | 2.03675 |
| SD | 1.513767 | 3.038811 | 3.570714 | 4.026903 | 2.291288 | 2.204399 | 0.685435 |

Correlation

| | Money Sp | Players Bc | Points Ear | Revenue | Team Ran | Matches W | Net Run Rate |
|------------|----------|------------|------------|----------|----------|-----------|--------------|
| Money Sp | 1 | 0.793283 | -0.20593 | -0.40372 | -0.32303 | -0.264 | 0.174695 |
| Players Bc | 0.793283 | 1 | 0.264959 | -0.11003 | 0.134644 | 0.272905 | 0.412389 |
| Points Ear | -0.20593 | 0.264959 | 1 | 0.158913 | 0.855585 | 0.92107 | 0.85986 |
| Revenue | -0.40372 | -0.11003 | 0.158913 | 1 | 0.35867 | 0.372684 | -0.00962 |
| Team Ran | -0.32303 | 0.134644 | 0.855585 | 0.35867 | 1 | 0.952798 | 0.683608 |
| Matches W | -0.264 | 0.272905 | 0.92107 | 0.372684 | 0.952798 | 1 | 0.731338 |
| Net Run R | 0.174695 | 0.412389 | 0.85986 | -0.00962 | 0.683608 | 0.731338 | 1 |

No. of Efficient DMUs = 4
No. of Inefficient DMUs = 4

[CCR-I] LP started at 04-26-2022 16:22:50
Finished at 04-26-2022 16:22:51
Elapsed time = 1 seconds

| Teams | (I)Money Spent | (I)Players Bought | (O)Points Earned | (O)Revenue | (O)Team Ranking |
|--------------|-----------------------|--------------------------|-------------------------|-------------------|------------------------|
| CSK | 0.533 | 8 | 18 | 20.8 | 7 |
| MI | 0.663 | 10 | 16 | 21.84 | 8 |
| RR | 0.273 | 6 | 16 | 12.13 | 5 |
| DC | 4.979 | 14 | 11 | 14.69 | 2 |
| RCB | 2.522 | 9 | 16 | 12.22 | 6 |
| KKR | 0.52 | 7 | 15 | 21.97 | 4 |
| KXIP | 0.442 | 3 | 6 | 16.9 | 1 |
| SRH | 1.521 | 10 | 14 | 13 | 3 |

| (O)Matches Won | (O)Net Run Rate |
|-----------------------|------------------------|
| 10 | 2.709 |
| 10 | 1.957 |
| 7 | 2.062 |
| 5 | 1.951 |
| 8 | 3.037 |
| 7 | 2.253 |
| 3 | 0.564 |
| 7 | 2 |

Model = CCR-I

Workbook Name = \\engin-labs.m.storage.umich.edu\hegde\windat.v2\Documents\output 2018.xlsx

| | | | | Slack | Slack | Slack | Slack | Slack | Slack | Slack |
|-----|------|--------|------|----------|------------|------------|---------|----------|-----------|--------------|
| No. | DMU | Score | Rank | Money Sp | Players Bc | Points Ear | Revenue | Team Ran | Matches W | Net Run Rate |
| 1 | CSK | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | MI | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | RR | 0.7031 | 8 | 0 | 0 | 0 | 11.711 | 0.507 | 1.055 | 0.106 |
| 4 | DC | 0.7627 | 6 | 0 | 0 | 4.01 | 0 | 5.077 | 3.457 | 0.172 |
| 5 | RCB | 0.9113 | 5 | 0.744 | 0 | 0 | 6.071 | 1.52 | 0.52 | 0 |
| 6 | KKR | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | KXIP | 0.7279 | 7 | 0 | 0 | 1.591 | 0 | 3.148 | 1.681 | 0.3 |
| 8 | SRH | 0.9785 | 4 | 1.461 | 0 | 0 | 0 | 0.695 | 0.74 | 0 |

| | Score | Rank | Money Sp | Players Bc | Points Ear | Revenue | Team Ran | Matches W | Net Run Rate |
|---------|--------|--------|----------|------------|------------|---------|----------|-----------|--------------|
| Average | 0.8854 | 4.125 | 0.2756 | 0 | 0.7001 | 2.2228 | 1.3684 | 0.9316 | 0.0722 |
| Max | 1 | 8 | 1.461 | 0 | 4.01 | 11.711 | 5.077 | 3.457 | 0.3 |
| Min | 0.7031 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| St Dev | 0.1319 | 2.8504 | 0.5451 | 0 | 1.4486 | 4.3831 | 1.8422 | 1.1811 | 0.1128 |

Model = CCR-I

Workbook Name = \\engin-labs.m.storage.umich.edu\hegde\windat.v2\Documents\output 2018.xlsx

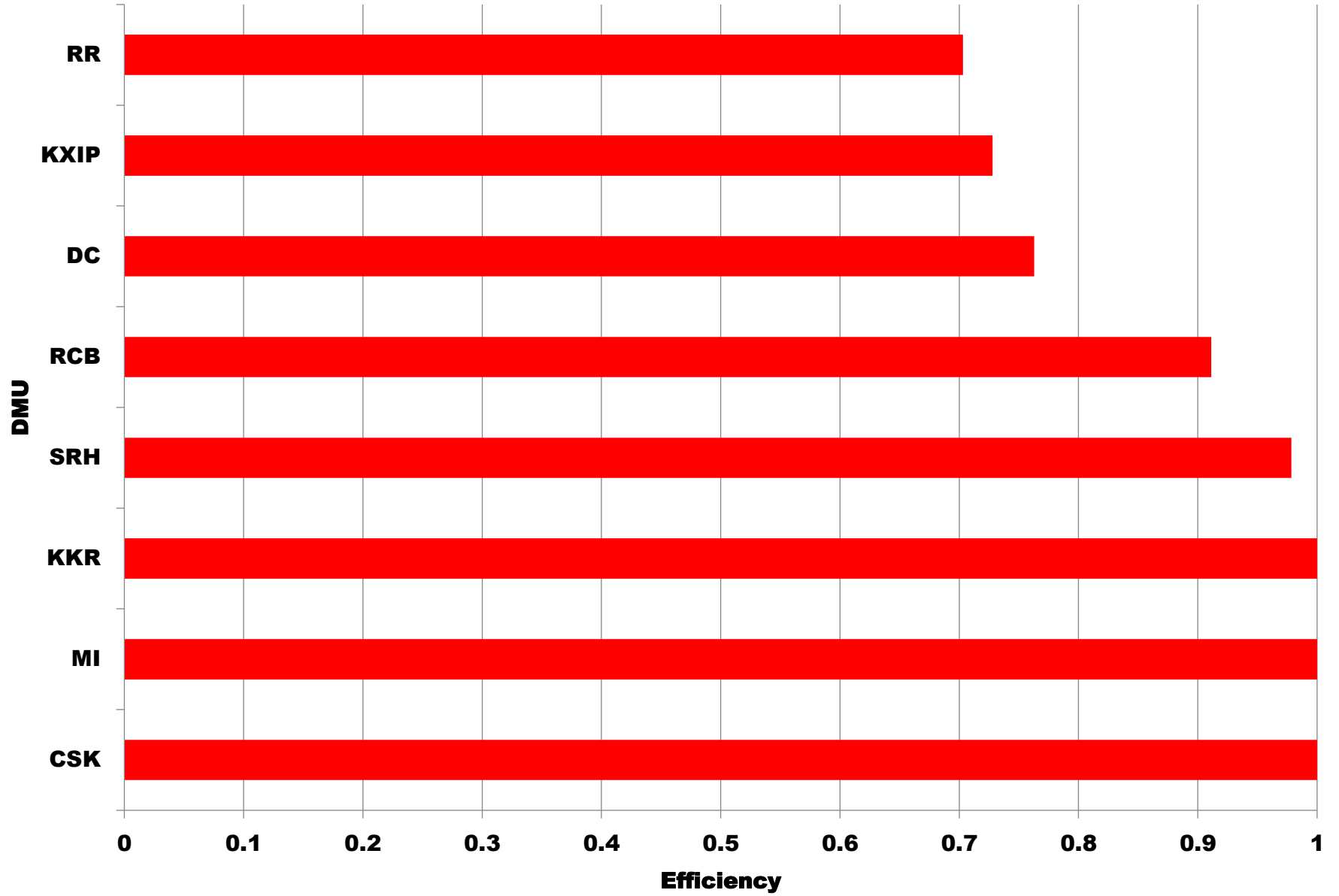
| No. | DMU | Score | Rank | Money Spent | | | Players Bought | | | Points Earned | | |
|-----|------|--------|------|-------------|------------|----------|----------------|------------|----------|---------------|------------|----------|
| | | | | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) |
| 1 | CSK | 1 | 1 | 5.265 | 5.265 | 0 | 22 | 22 | 0 | 18 | 18 | 0 |
| 2 | MI | 1 | 1 | 6.0255 | 6.0255 | 0 | 22 | 22 | 0 | 12 | 12 | 0 |
| 3 | RR | 0.7031 | 8 | 8.5605 | 6.018468 | -29.695 | 22 | 15.46712 | -29.695 | 14 | 14 | 0 |
| 4 | DC | 0.7627 | 6 | 5.902 | 4.501292 | -23.733 | 22 | 16.77879 | -23.733 | 10 | 14.01015 | 40.101 |
| 5 | RCB | 0.9113 | 5 | 6.3505 | 5.043672 | -20.578 | 21 | 19.13772 | -8.868 | 12 | 12 | 0 |
| 6 | KKR | 1 | 1 | 7.67 | 7.67 | 0 | 17 | 17 | 0 | 16 | 16 | 0 |
| 7 | KXIP | 0.7279 | 7 | 8.762 | 6.37789 | -27.21 | 20 | 14.55807 | -27.21 | 12 | 13.59119 | 13.26 |
| 8 | SRH | 0.9785 | 4 | 7.5855 | 5.961151 | -21.414 | 23 | 22.50477 | -2.153 | 18 | 18 | 0 |

| | Score | Rank | Money Spent | | | Players Bought | | | Points Earned | | |
|---------|--------|--------|-------------|------------|----------|----------------|------------|----------|---------------|------------|----------|
| | | | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) |
| Average | 0.8854 | 4.125 | 7.0151 | 5.8579 | -15.3288 | 21.125 | 18.6808 | -11.4574 | 14 | 14.7002 | 6.6701 |
| Max | 1 | 8 | 8.762 | 7.67 | 0 | 23 | 22.5048 | 0 | 18 | 18 | 40.101 |
| Min | 0.7031 | 1 | 5.265 | 4.5013 | -29.695 | 17 | 14.5581 | -29.695 | 10 | 12 | 0 |
| St Dev | 0.1319 | 2.8504 | 1.3048 | 0.9617 | 13.0257 | 1.8851 | 3.1765 | 13.1938 | 3.0237 | 2.3978 | 14.2828 |

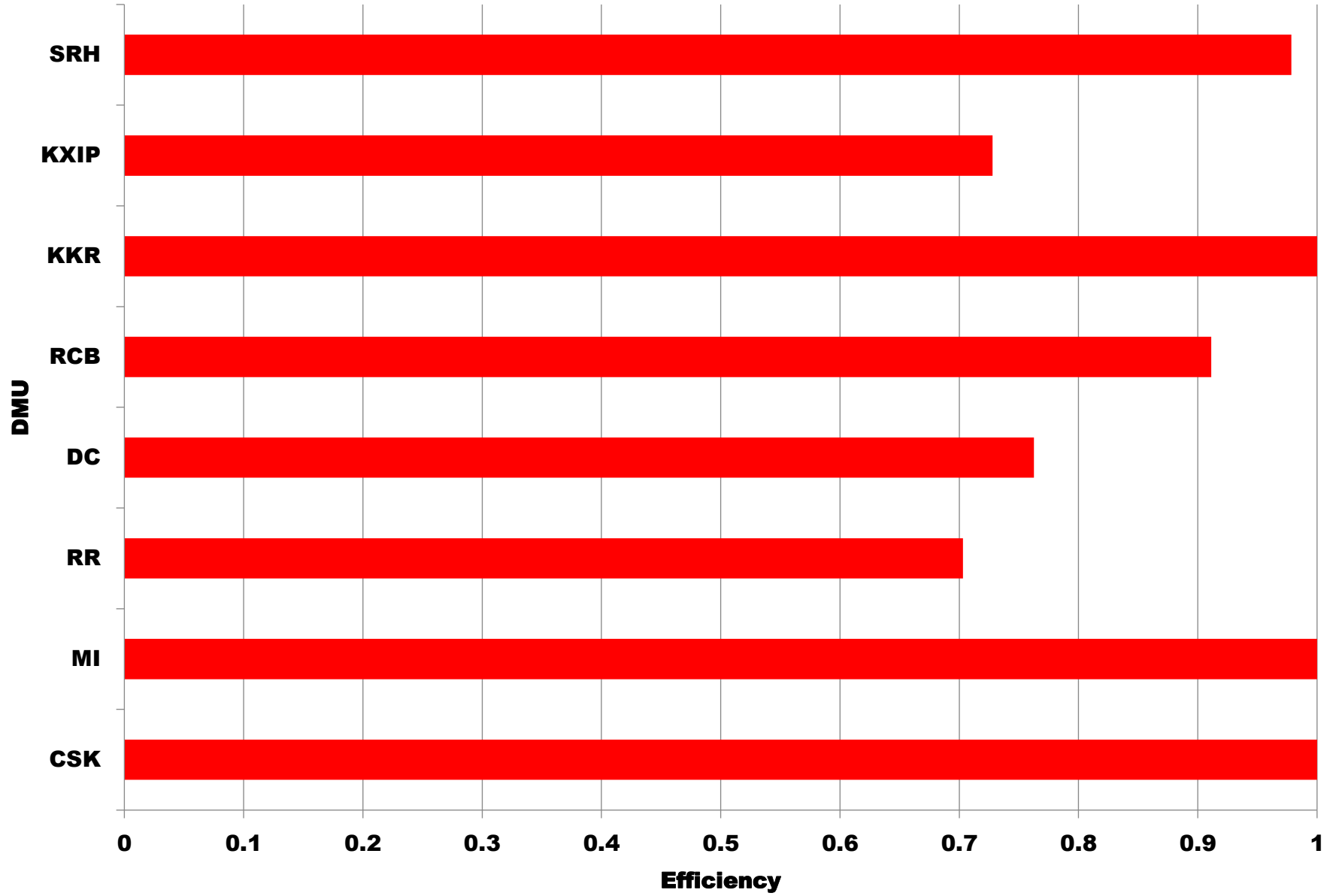
| Revenue | | | Team Ranking | | | Matches Won | | | Net Run Rate | | |
|---------|------------|----------|--------------|------------|----------|-------------|------------|----------|--------------|------------|----------|
| Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) |
| 54.21 | 54.21 | 0 | 8 | 8 | 0 | 11 | 11 | 0 | 1.253 | 1.253 | 0 |
| 53.56 | 53.56 | 0 | 4 | 4 | 0 | 6 | 6 | 0 | 1.317 | 1.317 | 0 |
| 36.92 | 48.63065 | 31.719 | 5 | 5.507444 | 10.149 | 7 | 8.055211 | 15.074 | 0.75 | 0.856331 | 14.178 |
| 43.55 | 43.55 | 0 | 1 | 6.076853 | 507.685 | 5 | 8.456842 | 69.137 | 0.778 | 0.950472 | 22.169 |
| 40.69 | 46.76078 | 14.92 | 3 | 4.520415 | 50.681 | 6 | 6.520415 | 8.674 | 1.129 | 1.129 | 0 |
| 58.24 | 58.24 | 0 | 6 | 6 | 0 | 9 | 9 | 0 | 0.93 | 0.93 | 0 |
| 49.01 | 49.01 | 0 | 2 | 5.147752 | 157.388 | 6 | 7.680785 | 28.013 | 0.498 | 0.798433 | 60.328 |
| 57.59 | 57.59 | 0 | 7 | 7.695085 | 9.93 | 10 | 10.74017 | 7.402 | 1.284 | 1.284 | 0 |

| Revenue | | | Team Ranking | | | Matches Won | | | Net Run Rate | | |
|---------|------------|----------|--------------|------------|----------|-------------|------------|----------|--------------|------------|----------|
| Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) |
| 49.2212 | 51.4439 | 5.8299 | 4.5 | 5.8684 | 91.9791 | 7.5 | 8.4317 | 16.0375 | 0.9924 | 1.0648 | 12.0844 |
| 58.24 | 58.24 | 31.719 | 8 | 8 | 507.685 | 11 | 11 | 69.137 | 1.317 | 1.317 | 60.328 |
| 36.92 | 43.55 | 0 | 1 | 4 | 0 | 5 | 6 | 0 | 0.498 | 0.7984 | 0 |
| 8.0303 | 5.2668 | 11.6913 | 2.4495 | 1.4091 | 176.313 | 2.2039 | 1.7937 | 23.4956 | 0.3 | 0.2059 | 21.2593 |

Teams



Teams



Model = CCR-I

Workbook Name = \\engin-labs.m.storage.umich.edu\hegde\windat.v2\Documents\output 2018.xlsx

| No. | DMU | Score | Rank |
|-----|------|--------|------|
| 1 | CSK | 1 | 1 |
| 2 | MI | 1 | 1 |
| 6 | KKR | 1 | 1 |
| 8 | SRH | 0.9785 | 4 |
| 5 | RCB | 0.9113 | 5 |
| 4 | DC | 0.7627 | 6 |
| 7 | KXIP | 0.7279 | 7 |
| 3 | RR | 0.7031 | 8 |

Model = CCR-I

Workbook Name = \\engin-labs.m.storage.umich.edu\hegde\windat.v2\Documents\output 2018.xlsx

| No. | DMU | Score | Rank | | v(1)*Money | v(2)*Players Bought | u(1)*Point | u(2)*Reve | u(3)*Team | u(4)*Matc | u(5)*Net R |
|-----|------|--------|------|--|-------------|----------------------|-------------|------------|------------|------------|-------------|
| 1 | CSK | 1 | 1 | | 0.353613 | 0.646387 | 0 | 0 | 0 | 0 | 1 |
| 2 | MI | 1 | 1 | | 0 | 1 | 8.86E-02 | 0 | 0 | 0 | 0.911419 |
| 3 | RR | 0.7031 | 8 | | 0.249574 | 0.750426 | 0.703051 | 0 | 0 | 0 | 0 |
| 4 | DC | 0.7627 | 6 | | 0.469229 | 0.530771 | 0 | 0.762672 | 0 | 0 | 0 |
| 5 | RCB | 0.9113 | 5 | | 0 | 1 | 9.28E-02 | 0 | 0 | 0 | 0.81852 |
| 6 | KKR | 1 | 1 | | 0 | 1 | 0 | 9.74E-02 | 0.902577 | 0 | 0 |
| 7 | KXIP | 0.7279 | 7 | | 0.590783 | 0.409217 | 0 | 0.727903 | 0 | 0 | 0 |
| 8 | SRH | 0.9785 | 4 | | 0 | 1 | 0.121481 | 3.64E-02 | 0 | 0 | 0.820636 |

Model = CCR-I

Workbook Name = \\engin-labs.m.storage.umich.edu\hegde\windat.v2\Documents\output 2018.xlsx

| No. | DMU | Score | Rank | | v(1) | v(2) | | u(1) | u(2) | u(3) | u(4) | u(5) |
|-----|------|--------|------|--|----------|----------|--|----------|----------|----------|-------|----------|
| 1 | CSK | 1 | 1 | | 6.72E-02 | 2.94E-02 | | 0 | 0 | 0 | 0 | 0.798085 |
| 2 | MI | 1 | 1 | | 0 | 4.55E-02 | | 7.38E-03 | 0 | 0 | 0 | 0.692042 |
| 3 | RR | 0.7031 | 8 | | 2.92E-02 | 3.41E-02 | | 5.02E-02 | 0 | 0 | 0 | 0 |
| 4 | DC | 0.7627 | 6 | | 7.95E-02 | 2.41E-02 | | 0 | 1.75E-02 | 0 | 0 | 0 |
| 5 | RCB | 0.9113 | 5 | | 0 | 4.76E-02 | | 7.73E-03 | 0 | 0 | 0 | 0.724996 |
| 6 | KKR | 1 | 1 | | 0 | 5.88E-02 | | 0 | 1.67E-03 | 0.150429 | 0 | 0 |
| 7 | KXIP | 0.7279 | 7 | | 6.74E-02 | 2.05E-02 | | 0 | 1.49E-02 | 0 | 0 | 0 |
| 8 | SRH | 0.9785 | 4 | | 0 | 4.35E-02 | | 6.75E-03 | 6.31E-04 | 0 | 0 | 0.639124 |

Model = CCR-I

Workbook Name = \\engin-labs.m.storage.umich.edu\hegde\windat.v2\Documents\output 2018.xlsx

| No. | DMU | Score | Rank | | Reference(Lambda) | | | |
|-----|------|--------|------|-----|-------------------|-----|-------|-----------|
| 1 | CSK | 1 | 1 | CSK | 1 | | | |
| 2 | MI | 1 | 1 | MI | 1 | | | |
| 3 | RR | 0.7031 | 8 | CSK | 0.206 | KKR | 0.643 | |
| 4 | DC | 0.7627 | 6 | CSK | 0.658 | KKR | 0.135 | |
| 5 | RCB | 0.9113 | 5 | CSK | 0.26 | MI | 0.61 | |
| 6 | KKR | 1 | 1 | KKR | 1 | | | |
| 7 | KXIP | 0.7279 | 7 | CSK | 0.041 | KKR | 0.804 | |
| 8 | SRH | 0.9785 | 4 | CSK | 0.802 | MI | 0.116 | KKR 0.135 |

| | |
|---------|--------|
| Average | 0.8854 |
| Max | 1 |
| Min | 0.7031 |
| St Dev | 0.1319 |

Workbook Name = \\engin-labs.r Workbook Name = \\engin-labs.m.storage.umich.edu\hegde\windat.v2\Documents\output 2018.xlsx

Data File = \\engin-labs.m.storage.umich.edu\hegde\windat.v2\Documents\Data 2018.xlsxSheet1

DEA model = DEA-Solver LV8.0/ CCR(CCR-I)

Problem = Teams

No. of DMUs = 8

Returns to Scale = Constant ($0 \leq \text{Sum of Lambda} < \text{Infinity}$)

No. of Input items = 2

Input(1) = Money Spent

Input(2) = Players Bought

No. of Output items = 5

Output(1) = Points Earned

Output(2) = Revenue

Output(3) = Team Ranking

Output(4) = Matches Won

Output(5) = Net Run Rate

Statistics on Input/Output Data

| | Money Sp | Players Bc | Points Ear | Revenue | Team Ran | Matches W | Net Run Rate |
|---------|----------|------------|------------|----------|----------|-----------|--------------|
| Max | 8.762 | 23 | 18 | 58.24 | 8 | 11 | 1.317 |
| Min | 5.265 | 17 | 10 | 36.92 | 1 | 5 | 0.498 |
| Average | 7.015125 | 21.125 | 14 | 49.22125 | 4.5 | 7.5 | 0.992375 |
| SD | 1.220503 | 1.763342 | 2.828427 | 7.511632 | 2.291288 | 2.061553 | 0.280628 |

Correlation

| | Money Sp | Players Bc | Points Ear | Revenue | Team Ran | Matches W | Net Run Rate |
|------------|----------|------------|------------|----------|----------|-----------|--------------|
| Money Sp | 1 | -0.32137 | 0.031068 | -0.13282 | -0.086 | -0.09171 | -0.63584 |
| Players Bc | -0.32137 | 1 | 0 | -0.26208 | 0.046407 | -0.01719 | 0.367698 |
| Points Ear | 0.031068 | 0 | 1 | 0.605758 | 0.964396 | 0.986117 | 0.473709 |
| Revenue | -0.13282 | -0.26208 | 0.605758 | 1 | 0.557519 | 0.636437 | 0.457951 |
| Team Ran | -0.086 | 0.046407 | 0.964396 | 0.557519 | 1 | 0.952661 | 0.592049 |
| Matches W | -0.09171 | -0.01719 | 0.986117 | 0.636437 | 0.952661 | 1 | 0.487118 |
| Net Run R | -0.63584 | 0.367698 | 0.473709 | 0.457951 | 0.592049 | 0.487118 | 1 |

No. of Efficient DMUs = 3
No. of Inefficient DMUs = 5

[CCR-I] LP started at 04-26-2022 16:23:46
Finished at 04-26-2022 16:23:47
Elapsed time = 1 seconds

| Teams | (I)Money Spent | (I)Players Bought | (O)Points Earned | (O)Revenue | (O)Team Ranking | (O)Matches Won |
|--------------|-----------------------|--------------------------|-------------------------|-------------------|------------------------|-----------------------|
| CSK | 5.265 | 22 | 18 | 54.21 | 8 | 11 |
| MI | 6.0255 | 22 | 12 | 53.56 | 4 | 6 |
| RR | 8.5605 | 22 | 14 | 36.92 | 5 | 7 |
| DC | 5.902 | 22 | 10 | 43.55 | 1 | 5 |
| RCB | 6.3505 | 21 | 12 | 40.69 | 3 | 6 |
| KKR | 7.67 | 17 | 16 | 58.24 | 6 | 9 |
| KXIP | 8.762 | 20 | 12 | 49.01 | 2 | 6 |
| SRH | 7.5855 | 23 | 18 | 57.59 | 7 | 10 |

(O)Net Run Rate

| |
|-------|
| 1.253 |
| 1.317 |
| 0.75 |
| 0.778 |
| 1.129 |
| 0.93 |
| 0.498 |
| 1.284 |

Model = CCR-I

Workbook Name = C:\Users\hegde\Downloads\output 2019.xlsx

| | | | | Slack | Slack | Slack | Slack | Slack | Slack | Slack |
|-----|------|--------|------|----------|------------|------------|---------|----------|-----------|--------------|
| No. | DMU | Score | Rank | Money Sp | Players Bc | Points Ear | Revenue | Team Ran | Matches W | Net Run Rate |
| 1 | CSK | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | MI | 0.797 | 3 | 0 | 2.234 | 2.428 | 1.061 | 0 | 0.238 | 0 |
| 3 | RR | 0.2303 | 6 | 0 | 0.85 | 0 | 1.582 | 2.278 | 1.111 | 0.14 |
| 4 | DC | 0.2921 | 5 | 0 | 0.921 | 0 | 5.07 | 1 | 0 | 0.087 |
| 5 | RCB | 0.1944 | 7 | 0 | 0.527 | 0 | 1.452 | 3.278 | 1.111 | 0.298 |
| 6 | KKR | 0.4128 | 4 | 0 | 1.414 | 0 | 1.17 | 0.778 | 0.445 | 0 |
| 7 | KXIP | 0.1067 | 8 | 0 | 0.053 | 0 | 2.99 | 1.667 | 0.667 | 0.005 |
| 8 | SRH | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | Score | Rank | Money Sp | Players Bc | Points Ear | Revenue | Team Ran | Matches W | Net Run Rate |
|---------|--------|--------|----------|------------|------------|---------|----------|-----------|--------------|
| Average | 0.5042 | 4.375 | 0 | 0.7499 | 0.3035 | 1.6656 | 1.1251 | 0.4465 | 0.0662 |
| Max | 1 | 8 | 0 | 2.234 | 2.428 | 5.07 | 3.278 | 1.111 | 0.298 |
| Min | 0.1067 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| St Dev | 0.3703 | 2.6152 | 0 | 0.7877 | 0.8584 | 1.6714 | 1.2066 | 0.4741 | 0.1075 |

Model = CCR-I

Workbook Name = C:\Users\hegde\Downloads\output 2019.xlsx

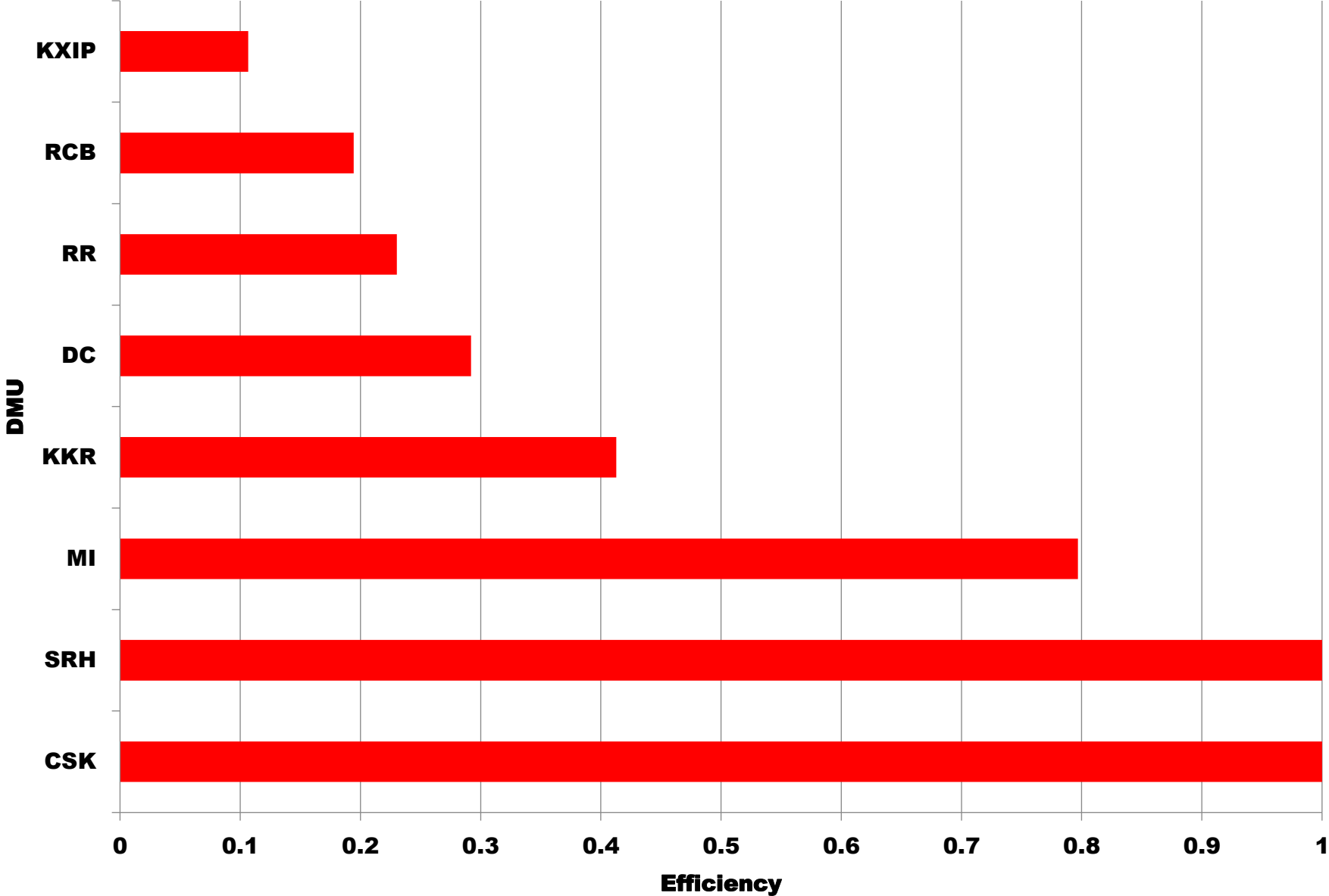
| No. | DMU | Score | Rank | Money Spent | | | Players Bought | | | Points Earned | | |
|-----|------|--------|------|-------------|------------|----------|----------------|------------|----------|---------------|------------|----------|
| | | | | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) |
| 1 | CSK | 1 | 1 | 0.676 | 0.676 | 0 | 2 | 2 | 0 | 18 | 18 | 0 |
| 2 | MI | 0.797 | 3 | 0.988 | 0.787456 | -20.298 | 6 | 2.548105 | -57.532 | 18 | 20.42831 | 13.491 |
| 3 | RR | 0.2303 | 6 | 1.794 | 0.413111 | -76.973 | 9 | 1.222222 | -86.42 | 11 | 11 | 0 |
| 4 | DC | 0.2921 | 5 | 2.314 | 0.676 | -70.787 | 10 | 2 | -80 | 18 | 18 | 0 |
| 5 | RCB | 0.1944 | 7 | 2.1255 | 0.413111 | -80.564 | 9 | 1.222222 | -86.42 | 11 | 11 | 0 |
| 6 | KKR | 0.4128 | 4 | 1.1895 | 0.491062 | -58.717 | 8 | 1.888214 | -76.397 | 12 | 12 | 0 |
| 7 | KXIP | 0.1067 | 8 | 4.225 | 0.450667 | -89.333 | 13 | 1.333333 | -89.744 | 12 | 12 | 0 |
| 8 | SRH | 1 | 1 | 0.572 | 0.572 | 0 | 3 | 3 | 0 | 12 | 12 | 0 |

| | Score | Rank | Money Spent | | | Players Bought | | | Points Earned | | |
|---------|--------|--------|-------------|------------|----------|----------------|------------|----------|---------------|------------|----------|
| | | | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) |
| Average | 0.5042 | 4.375 | 1.7355 | 0.5599 | -49.584 | 7.5 | 1.9018 | -59.5641 | 14 | 14.3035 | 1.6864 |
| Max | 1 | 8 | 4.225 | 0.7875 | 0 | 13 | 3 | 0 | 18 | 20.4283 | 13.491 |
| Min | 0.1067 | 1 | 0.572 | 0.4131 | -89.333 | 2 | 1.2222 | -89.744 | 11 | 11 | 0 |
| St Dev | 0.3703 | 2.6152 | 1.1965 | 0.1407 | 37.0284 | 3.6645 | 0.6425 | 38.0867 | 3.3381 | 3.8282 | 4.7698 |

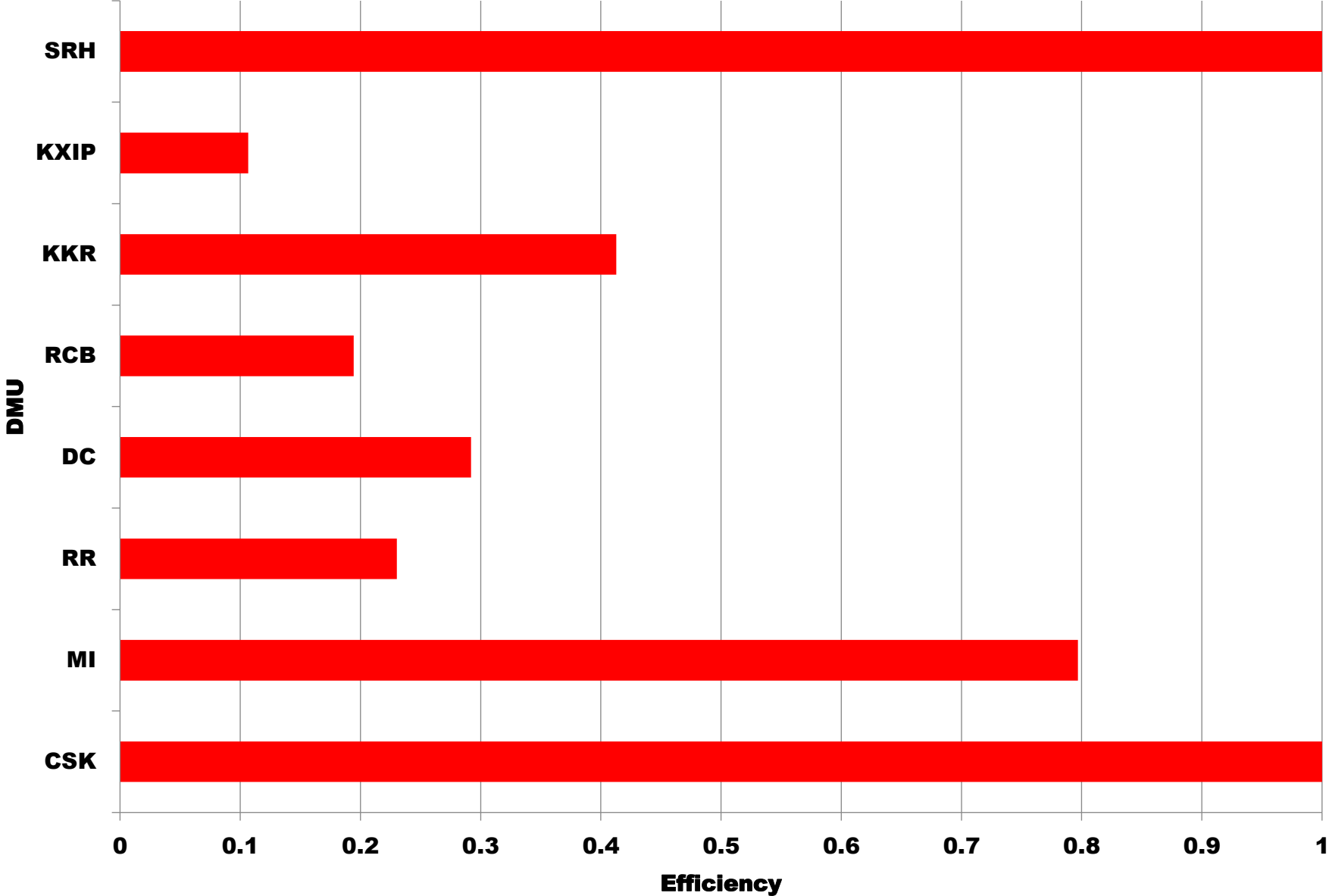
| Revenue | | | Team Ranking | | | Matches Won | | | Net Run Rate | | |
|---------|------------|----------|--------------|------------|----------|-------------|------------|----------|--------------|------------|----------|
| Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) |
| 46.41 | 46.41 | 0 | 7 | 7 | 0 | 10 | 10 | 0 | 1.131 | 1.131 | 0 |
| 51.74 | 52.80122 | 2.051 | 8 | 8 | 0 | 11 | 11.23774 | 2.161 | 1.421 | 1.421 | 0 |
| 26.78 | 28.36167 | 5.906 | 2 | 4.277778 | 113.889 | 5 | 6.111111 | 22.222 | 0.551 | 0.691167 | 25.439 |
| 41.34 | 46.41 | 12.264 | 6 | 7 | 16.667 | 10 | 10 | 0 | 1.044 | 1.131 | 8.333 |
| 26.91 | 28.36167 | 5.395 | 1 | 4.277778 | 327.778 | 5 | 6.111111 | 22.222 | 0.393 | 0.691167 | 75.869 |
| 30.03 | 31.19968 | 3.895 | 4 | 4.777643 | 19.441 | 6 | 6.444714 | 7.412 | 1.028 | 1.028 | 0 |
| 27.95 | 30.94 | 10.698 | 3 | 4.666667 | 55.556 | 6 | 6.666667 | 11.111 | 0.749 | 0.754 | 0.668 |
| 31.72 | 31.72 | 0 | 5 | 5 | 0 | 6 | 6 | 0 | 1.577 | 1.577 | 0 |

| Revenue | | | Team Ranking | | | Matches Won | | | Net Run Rate | | |
|---------|------------|----------|--------------|------------|----------|-------------|------------|----------|--------------|------------|----------|
| Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) | Data | Projection | Diff.(%) |
| 35.36 | 37.0255 | 5.0261 | 4.5 | 5.625 | 66.6664 | 7.375 | 7.8214 | 8.141 | 0.9867 | 1.053 | 13.7886 |
| 51.74 | 52.8012 | 12.264 | 8 | 8 | 327.778 | 11 | 11.2377 | 22.222 | 1.577 | 1.577 | 75.869 |
| 26.78 | 28.3617 | 0 | 1 | 4.2778 | 0 | 5 | 6 | 0 | 0.393 | 0.6912 | 0 |
| 9.7669 | 9.8144 | 4.5689 | 2.4495 | 1.4677 | 112.5015 | 2.5036 | 2.1896 | 9.5655 | 0.4074 | 0.3325 | 26.5979 |

Teams



Teams



Model = CCR-I

Workbook Name = C:\Users\hegde\Downloads\output 2019.xlsx

| No. | DMU | Score | Rank |
|-----|------|--------|------|
| 1 | CSK | 1 | 1 |
| 8 | SRH | 1 | 1 |
| 2 | MI | 0.797 | 3 |
| 6 | KKR | 0.4128 | 4 |
| 4 | DC | 0.2921 | 5 |
| 3 | RR | 0.2303 | 6 |
| 5 | RCB | 0.1944 | 7 |
| 7 | KXIP | 0.1067 | 8 |

| No. | DMU | Score | Rank |
|-----|------|--------|------|
| 1 | CSK | 1 | 1 |
| 8 | SRH | 1 | 1 |
| 2 | MI | 0.797 | 3 |
| 6 | KKR | 0.4128 | 4 |
| 4 | DC | 0.2921 | 5 |
| 3 | RR | 0.2303 | 6 |
| 5 | RCB | 0.1944 | 7 |
| 7 | KXIP | 0.1067 | 8 |

Model = CCR-I

Workbook Name = C:\Users\hegde\Downloads\output 2019.xlsx

| No. | DMU | Score | Rank | | v(1)*Money | v(2)*Players Bought | u(1)*Point | u(2)*Revenue | u(3)*Team | u(4)*Match | u(5)*Net F |
|-----|------|--------|------|--|-------------|----------------------|-------------|---------------|------------|-------------|-------------|
| 1 | CSK | 1 | 1 | | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 2 | MI | 0.797 | 3 | | 1 | 0 | 0 | 0 | 0.630328 | 0 | 0.166693 |
| 3 | RR | 0.2303 | 6 | | 1 | 0 | 0.230274 | 0 | 0 | 0 | 0 |
| 4 | DC | 0.2921 | 5 | | 1 | 0 | 0.292135 | 0 | 0 | 0 | 0 |
| 5 | RCB | 0.1944 | 7 | | 1 | 0 | 0.194359 | 0 | 0 | 0 | 0 |
| 6 | KKR | 0.4128 | 4 | | 1 | 0 | 0.285419 | 0 | 0 | 0 | 0.127412 |
| 7 | KXIP | 0.1067 | 8 | | 1 | 0 | 0.106667 | 0 | 0 | 0 | 0 |
| 8 | SRH | 1 | 1 | | 1 | 0 | 0 | 0 | 0.680467 | 0 | 0.319533 |

Model = CCR-I

Workbook Name = C:\Users\hegde\Downloads\output 2019.xlsx

| No. | DMU | Score | Rank | | v(1) | v(2) | | u(1) | u(2) | u(3) | u(4) | u(5) |
|-----|------|--------|------|--|----------|-------|--|----------|-------|----------|-------|----------|
| 1 | CSK | 1 | 1 | | 0 | 0.5 | | 0 | 0 | 0 | 0 | 0.884173 |
| 2 | MI | 0.797 | 3 | | 1.012146 | 0 | | 0 | 0 | 7.88E-02 | 0 | 0.117307 |
| 3 | RR | 0.2303 | 6 | | 0.557414 | 0 | | 2.09E-02 | 0 | 0 | 0 | 0 |
| 4 | DC | 0.2921 | 5 | | 0.432152 | 0 | | 1.62E-02 | 0 | 0 | 0 | 0 |
| 5 | RCB | 0.1944 | 7 | | 0.470478 | 0 | | 1.77E-02 | 0 | 0 | 0 | 0 |
| 6 | KKR | 0.4128 | 4 | | 0.840689 | 0 | | 2.38E-02 | 0 | 0 | 0 | 0.123941 |
| 7 | KXIP | 0.1067 | 8 | | 0.236686 | 0 | | 8.89E-03 | 0 | 0 | 0 | 0 |
| 8 | SRH | 1 | 1 | | 1.748252 | 0 | | 0 | 0 | 0.136093 | 0 | 0.202621 |

Model = CCR-I

Workbook Name = C:\Users\hegde\Downloads\output 2019.xlsx

| No. | DMU | Score | Rank | | Reference(Lambda) | | |
|-----|------|--------|------|-----|-------------------|-----|-------|
| 1 | CSK | 1 | 1 | CSK | 1 | | |
| 2 | MI | 0.797 | 3 | CSK | 1.024 | SRH | 0.167 |
| 3 | RR | 0.2303 | 6 | CSK | 0.611 | | |
| 4 | DC | 0.2921 | 5 | CSK | 1 | | |
| 5 | RCB | 0.1944 | 7 | CSK | 0.611 | | |
| 6 | KKR | 0.4128 | 4 | CSK | 0.445 | SRH | 0.333 |
| 7 | KXIP | 0.1067 | 8 | CSK | 0.667 | | |
| 8 | SRH | 1 | 1 | SRH | 1 | | |

| | |
|---------|--------|
| Average | 0.5042 |
| Max | 1 |
| Min | 0.1067 |
| St Dev | 0.3703 |

Workbook Name = C:\Users\hegde\Downloads\output 2019.xlsx

Data File = C:\Users\hegde\Downloads\dea-2019.xlsx

DEA model = DEA-Solver LV8.0/ CCR(CCR-I)

Problem = Teams

No. of DMUs = 8

Returns to Scale = Constant (0 =< Sum of Lambda < Infinity)

No. of Input items = 2

Input(1) = Money Spent

Input(2) = Players Bought

No. of Output items = 5

Output(1) = Points Earned

Output(2) = Revenue

Output(3) = Team Ranking

Output(4) = Matches Won

Output(5) = Net Run Rate

Statistics on Input/Output Data

| | Money Sp | Players Bc | Points Ear | Revenue | Team Ran | Matches W | Net Run Rate |
|---------|----------|------------|------------|----------|----------|-----------|--------------|
| Max | 4.225 | 13 | 18 | 51.74 | 8 | 11 | 1.577 |
| Min | 0.572 | 2 | 11 | 26.78 | 1 | 5 | 0.393 |
| Average | 1.7355 | 7.5 | 14 | 35.36 | 4.5 | 7.375 | 0.98675 |
| SD | 1.119204 | 3.427827 | 3.122499 | 9.136143 | 2.291288 | 2.341874 | 0.381067 |

Correlation

| | Money Sp | Players Bc | Points Ear | Revenue | Team Ran | Matches W | Net Run Rate |
|------------|----------|------------|------------|----------|----------|-----------|--------------|
| Money Sp | 1 | 0.903263 | -0.27969 | -0.43509 | -0.48508 | -0.29139 | -0.58692 |
| Players Bc | 0.903263 | 1 | -0.35036 | -0.49087 | -0.55703 | -0.35036 | -0.64967 |
| Points Ear | -0.27969 | -0.35036 | 1 | 0.952981 | 0.891042 | 0.991453 | 0.508874 |
| Revenue | -0.43509 | -0.49087 | 0.952981 | 1 | 0.936954 | 0.975956 | 0.617503 |
| Team Ran | -0.48508 | -0.55703 | 0.891042 | 0.936954 | 1 | 0.920161 | 0.825331 |
| Matches W | -0.29139 | -0.35036 | 0.991453 | 0.975956 | 0.920161 | 1 | 0.561225 |
| Net Run R | -0.58692 | -0.64967 | 0.508874 | 0.617503 | 0.825331 | 0.561225 | 1 |

No. of Efficient DMUs = 2
No. of Inefficient DMUs = 6

[CCR-I] LP started at 04-23-2022 21:29:29
Finished at 04-23-2022 21:29:30
Elapsed time = 1 seconds

| Teams | (I)Money Spent | (I)Players Bought | (O)Points Earned | (O)Revenue | (O)Team Ranking |
|--------------|-----------------------|--------------------------|-------------------------|-------------------|------------------------|
| CSK | 0.676 | 2 | 18 | 46.41 | 7 |
| MI | 0.988 | 6 | 18 | 51.74 | 8 |
| RR | 1.794 | 9 | 11 | 26.78 | 2 |
| DC | 2.314 | 10 | 18 | 41.34 | 6 |
| RCB | 2.1255 | 9 | 11 | 26.91 | 1 |
| KKR | 1.1895 | 8 | 12 | 30.03 | 4 |
| KXIP | 4.225 | 13 | 12 | 27.95 | 3 |
| SRH | 0.572 | 3 | 12 | 31.72 | 5 |

| (O)Matches Won | (O)Net Run Rate |
|-----------------------|------------------------|
| 10 | 1.131 |
| 11 | 1.421 |
| 5 | 0.551 |
| 10 | 1.044 |
| 5 | 0.393 |
| 6 | 1.028 |
| 6 | 0.749 |
| 6 | 1.577 |