Analysis of Basketball Game-Related Statistics: Exploring the Statistics that Discriminate Winning Teams and Efficient Players in the Basketball Africa League

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Abstract

Organizations are leveraging data to gain insights from analytics to improve performance of their employees and teams and in the long run generate revenue out of it. Due to limited basketball game-related statistics in African competition, teams are unaware of how they compare to other continental basketball teams and players. The purpose of this study is to evaluate the basketball game-related statistics in the newly formed league the basketball African league. This study sought to use multivariate linear discriminant analysis to identify the game-related statistics that discriminate between the teams that win in the Basketball Africa League from those that don't and to identify the most efficient players. The teams and players competing in the 2023 season were analyzed and five statistics, Assists, Field Goals Made, Two Point Field Goals Made, Defensive Rebounds and Blocked shots were found to discriminate winning teams from those that don't. A review of player efficiency rating identified the top players in the league.

Keywords: Analytics, Basketball, Global, Talent

1. INTRODUCTION

Basketball has become an increasingly global sport over the past few decades, with talented players emerging from various regions of the world. The international basketball Federation (FIBA) is a non-profit making organization with a mission to develop and promote basketball globally. There are over 450 million players basketball players worldwide according to FIBA (n.d.) estimates. This has led to the rise of international basketball competitions, such as FIBA basketball World Cup and the Olympic Games, which provide a platform for players from various countries to showcase their abilities and compete against the best teams. Despite the growing popularity and development of basketball worldwide, disparities in playing styles, coaching methodologies, and athletic performance still exist between regions.

While traditional basketball powerhouses, such as the United States and European nations, have long dominated international competitions, emerging regions are gradually making their presence felt on the global stage. Africa, an emerging region with enormous unrealized potential, is increasingly being highlighted for the growth and development of the sport note Means & Nauright (2007).

With a rich pool of athletic talent and a burgeoning interest in the sport, Africa has produced numerous accomplished basketball players such as Hakeem Olajuwon, Manute Bol and Serge Ibaka who have made significant

contributions to the National Basketball Associations (NBA) and other top-tier leagues around the world. However, African basketball teams have not yet consistently achieved the same level of success in international competitions, such as the FIBA Basketball World Cup and the Olympic Games. Out of the African teams – Egypt, Senegal, Angola - to represent the continent in FIBA World Cup 2014, Senegal made it to the round of 16 where they were eliminated according to Garrison (2014). In the FIBA Basketball World Cup 2019, none of the African teams made it to the second round despite Nigeria winning 2 of their 3 games. Nevertheless, African basketball is rapidly developing, with countries like Nigeria, Angola, and Tunisia making strides in recent years. The NBA has also [recognized the potential of the region, launching initiatives like the Basketball Africa League (BAL) to further develop the sport on the continent.

BAL is a professional basketball league in Africa, which was officially launched on May 16, 2021. The league is a collaboration of NBA and FIBA with a goal of developing and promoting basketball across Africa by providing a platform for talented African players to showcase their skill and compete at a high level as well as by the growth of local basketball infrastructure and fan engagement. The league features 12 clubs from across the continent which are placed in two conferences. Teams play regular season consisting of round robin competitions within each conference where the top teams from each conference advance to the BAL playoffs, ultimately leading to a championship game to decide the league's winner per BAL (n.d.). The league provides a high-level competitive platform with advanced analytics for African players and teams, which in turn generates valuable data and insights that can be analyzed to improve performance, coaching strategies, and player development.

Problem Statement
African basketball teams have not won or reached the semi-final stage of international competitions, despite numerous African players successfully participating in major European leagues and representing their countries at the national level. Performance indicators, which are action variables defining aspects of performance and relating to successful outcomes, can provide insights into team success. Given that FIBA-governed games are played under the same rules and with the same equipment worldwide, understanding the factors affecting African basketball teams' performance in international competitions is crucial. The research problem is

to identify and analyze the key factors and performance indicators that impact the success of African basketball teams in international competitions. This study aims to provide insights using club competitions that will enable African teams to achieve greater success, contributing to the continued growth and development of the sport on the continent.

General objectives
The goal of this project is to identify and analyze the key factors and performance indicators that impact the success of African basketball teams in international competitions. This study aims to provide insights that will enable African teams to achieve greater success, contributing to the continued growth and development of the sport on the continent.

Specific Research Objectives
1. To review the performance indicators that are associated with successful outcomes in international basketball competitions.
2. To analyze the performance of African basketball teams in BAL that impact their success in the international competitions.
3. To develop recommendations and strategies to enhance performance of African basketball teams in international competitions.

Scope and Limitations
This research is limited to basketball teams that participated in the Basketball Africa League which are governed by FIBA rules. The research focuses only on box-score data drawn from the scorer's table.

Significance of the Study
The study aims to provide insights for stakeholders of African teams in order to prepare the teams and players for international basketball games. Coaching staffs can fine-tune these profiles to develop more team-specific models and, conversely, use the results to monitor and rebuild team formation under the dynamics of the game and competition stages. The insights would be useful for players and coaches of national teams preparing for international competitions.

2. LITERATURE REVIEW

Overview of Basketball Game-Related Statistics
Historically, Basketball coaching intervention has been based on arbitrary assessments of player and team performance. However, Sampaio et al. (2004) point out that visual observations can be unreliable and inaccurate. To overcome this

challenge, coaches often rely on quantitative analysis and performance evaluation, particularly through game-related statistics, to analyze game events with more reliable and precise data.

Researchers have shown that coaches are not the only stakeholders who benefit from quantitative analytics. In Aggio's (2015) study, fans and contract negotiators benefit from quantitative analysis of the game. Fans are actively engaged and have in-depth sports conversation when they have team and player game-related statistics. They are able to choose their favorite players based on technical and athletic qualities that massively contribute to team performance. On the other hand, contract negotiators use numbers and statistics to ascertain player market value which helps in the negotiation of lucrative player contracts and basketball teams are able to build their roster within their budget caps.

In every basketball game, game-related statistics are written by the table officials through notational analysis. The scorer, a table official, records the actions that happen during the game in a box score sheet alongside the timer and the shot clock operator. A box score is a thorough breakdown of a game's outcomes. It identifies a player's position and if the player starts as described by Page et al. (2007).Basketball statistics, including minutes played, total points, field goal percentage, three-point shooting %, rebounds, free throw percentage, assists, steals, and blocked shots, are broken out in depth in a box score per MasterClass (2021). Additionally, the box score has details of all the players in the game including the designated coaching staff of the home team and away team. Apart from the score of the individual players, fouls are also recorded. Mandić et al. (2019) state that the box score forms the primary source of basketball game-related statistics for researchers.

Skinner & Guy's (2015) review of methods for using player tracking data in basketball to learn player skill and predict team performance, indicate that box score misses subtle characteristics of value such as the ability to create solid screens and make high-caliber non-assists passes rotate efficiently on defense which traditionally evaluated by intuition of an experience coach or an analyst. In light of this, Advanced statistics in basketball rely a lot on sophisticated technology such as cameras. The number of points scored by a professional basketball player is frequently used to judge them, however scoring only conveys part of the tale according to *Basketball Stat Guide* (2021). Oliver (2003) one of the key pioneers in the field

of basketball analytics, an author who wrote the book "Basketball on paper", introduces the concept of the "four factors" of basketball success which are significant piece of a winning basketball strategy that could be measure and tracked using advanced statistical analysis are shooting, turnovers, rebound and free throws.

Possessions play a critical role in assessing team's efficiency and effectiveness on both offense and defense on a per-possession basis note Kubatko et al. (2007). A possession begins when one team obtains control of the basketball and ends when that team relinquishes control. Offensive, defensive rating, turnover percentage and pace of the games are statistics drawn from possession-based statistics. Offensive and defensive rating measure how many points a team scores or allows per 100 possessions. Pace measures the number of possessions a team has per game. The turnover percentage represents how often a team turns the ball over per possession. Sports analysts compare teams that play at different tempos and account for the differences in the number of possessions each team has during a game. Kubatko et al. (2007) point out that analysts get a more accurate picture of a team's performance than just looking at raw totals.

General formula for estimating possessions for a team t ($POSS\_t$) is:

$$(1) \quad POSS_t = (FGM_t + \lambda FTM_t) + \alpha\left[(FGA_t - FGM_t) + \lambda(FTA_t - FTM_t) - OREB_t\right]$$
$$+ (1-\alpha)DREB_o + TO_t,$$

where FGA_t is field goal attempts for team t,
        FGM_t is field goals made for team t,
        FTA_t is free throw attempts for team t,
        FTM_t is free throws made for team t,
        $OREB_t$ is offensive rebounds for team t,
        $DREB_t$ is defensive rebounds for opponent o,
        TO_t is turnovers for team t,[4]
        λ is the fraction of free throws that end possessions,[5] and

Basketball games played in high-tech arenas use automated player detection and tracking to gather advanced statistics. Player-tracking data offer rich information about team and player performance on the court. There are three categories of player-tracking data as reviewed by Terner & Franks (2021): player tracking, ball tracking and data from wearable devices.

Regional Basketball analysis
Basketball is one of the most popular sports in the world. Teams in the International Basketball Federation (FIBA) compete in international competitions such as FIBA world cup, FIBA Continental Cups and Olympic Basketball Tournament. International competitions governed by FIBA ensure games are played by the same rules and equipment regardless of the

location in the world. However, Researchers have shown regional differences in player and teams performance profiles. Ibáñez et al. (2018) study shows each continent had a specific performance profile based on the basketball game-related statistics among the continental championship for men held in 2015 which was characterized as follows: African teams had high number of free throws, rebounds, steals and fouls; American teams had a high number of field goals attempts; Asian teams had a high number of possessions and low number of assists; European teams had a high number of assists and a low number of possessions.

Europe
European basketball is more tactical compared to the NBA based on the study done by Mandić et al. (2019) after comparing the trend in the NBA and Euroleague between the year 2000 and 2017 based on a longer positional and tactical offence. Consequently, Özmen (2016) showed the relative significance of several variables in more competitive stages of the Euroleague season, particularly shooting percentages, assists and turnovers, defensive rebounds, and fouls committed, differentiated playoff games.

In Madarame's (2018) study which analyzed game-related statistics from the continental championship for women held in 2017 showed that European teams had high homogeneity and had the least mean point difference between the winning and losing teams in the European championship. Another study by Zhai et al. (2020) that focused on regional differences in game-style considering playing position in the FIBA female continental basketball competitions showed European guards are cautious due to low number of steals but performed well in ball handling, moving observations, communication, passing and avoiding turnovers. This was further confirmed by Ibáñez et al.'s (2018) study on technical-tactical performance of the continental Basketball championship.

Africa
Several studies indicate that African teams have a defensive playing style. African teams in the Afrobasket championship recorded the highest difference in offensive rebounds and steals in the continental basketball championships played in the 2015 featuring American, European and Asian teams per Ibáñez et al. (2018). In Zhai et al.'s (2020) study, they found that forwards in the African teams preferred making 2-point shots compared to European forwards. African forwards often played in a traditional manner and lacked versatility, making it challenging for them to

space the floor and occupy defenses effectively. However, they made up for this by being energetic and active in isolation, resulting in more physical contact and ultimately more opportunities to shoot free throws.

3. RESEARCH QUESTIONS

The three research questions covered in the study include:
1. Which game related statistics discriminate between winning and losing in the Basketball Africa League.
2. Who are the most efficient players in the Basketball Africa League?
3. How do players' statistics in the Basketball Africa League contribute to the game statistics that discriminate between winning and losing games?

4. METHODS

All 38 matches in the 2023 edition of the Basketball Africa League were analyzed. Data was downloaded by screen scraping box score results from Flashscore, a popular website for tracking up to date sports leagues statistics. The following game related statistics were gathered: MatchID (Match), Player Name (Player), Team Name (Team), Points (PTS), Rebounds (REB), Assists (AST), Minutes Played (MIN), Field Goals Made (FGM), Field Goal Attempts (FGA), Two Point Field Goals Made (2PM), Two Point Field Goal Attempts (2PA), Three Point Field Goals Made (3PM), Three Point Field Goal Attempts (3PA), Free Throws Made (FTM), Free Throw Attempts (FTA), Plus/Minus(+/-), Offensive Rebounds (OR), Defensive Rebounds (DR), Personal Fouls (PF), Steals (ST), Turnovers (TO) and Blocked Shots (BS). Afterwards the variables were normalized according to game ball possessions and multiplied by 100 similarly to Sampaio and Janeira (2003). This is necessary due to game rhythm contamination, meaning that there are some fast paced, and slow-paced teams in the competition, so teams don't have an equal number of possessions and corresponding game statistics.

Statistical Analysis
All analyzed games were divided into two groups based on the final score differences whereby final score differences equal or below 12 points (balanced games) were analyzed separately, and the other games were analyzed separately (unbalanced games).

Data were expressed as mean and standard deviation, with pairwise comparisons determined using percentage of mean difference and effect

size statistics (Cohen's d) with 95% confidence interval.

A t-test for independent samples was carried out in order to do a first examination of the existing differences between the groups of variables that discriminate between both groups.

For the individual player efficiency analysis, the Player Efficiency Ratio (PER) calculation was used. The PER seeks to add up all of a basketball player's positive accomplishments (such as points, assists, and rebounds), subtract the negative accomplishments (such as turnovers, missed shots, and missed free throws), and return a rating of a player's performance."

5. RESULTS

Descriptive statistics of all the match variables analyzed for balanced games are shown in Table 1 below. Statistics for unbalanced and all matches are shown in the appendix.

	Balanced Games			
	Winner		Loser	
Statistic	mean	SD	mean	SD
2PA	62.44	12.74	60.64	11.05
2PM	32.72	6.23	26.95	4.73
3PA	41.18	9.19	43.32	9.28
3PM	12.39	6.22	12.82	5.11
AST	30.20	8.83	24.65	6.20
BS	6.68	3.78	3.10	2.25
DR	45.18	6.25	39.64	8.97
FGA	103.61	8.31	103.96	8.68
FGM	45.11	5.56	39.77	5.26
FTA	36.18	13.54	35.14	13.34
FTM	25.80	10.38	23.86	9.64
OR	15.43	6.92	16.02	6.04
PF	32.18	7.78	30.97	8.21
PTS	128.40	21.40	116.22	16.86
REB	60.61	7.80	55.66	11.97
ST	12.93	4.30	11.76	4.02
TO	26.29	5.59	26.12	5.67

Table 1: Match Statistics for Balanced BAL

Games

The match variables that discriminate between winning and losing games in the Basketball Africa League were derived from the independent samples t-test and are shown in Table 2 below. Winning teams had a statistically significant difference from losing teams ($p <= 0.05$) in Assists (AST), Field Goals Made (FGM), Two Point Field Goals Made (2PM), Defensive Rebounds (DR) and Blocked Shots (BS).

Balanced Games		
Statistic	t-statistic	p-value (0.05)
AST	2.1822	0.0369
FGM	2.9579	0.0056
2PM	3.1288	0.0038
DR	2.1494	0.0397
BS	3.4524	0.0018

Table 2: Discriminant Match Variables for BAL Wins and Losses

A cluster analysis of player attributes, using k-means clustering, and how they align with statistics discriminating winning from losing was carried out and the top fifteen rated players based on PER and the clusters they belong to are listed in Table 3.

Ranking by Player Efficiency Rating*					
No.	Player	PER	Games Played	Team	Cluster
1	Diarra A.	30.97	8	STA	3
2	Boissy J.	25.62	8	DOU	2
3	Pedro J.	25.20	8	PET	3
4	Jones F.	23.47	5	CIT	2
5	Miller D.	23.13	5	SLA	2
6	Kra U.	22.81	6	ABI	4
7	Saleh E. A.	21.39	7	ALA	1
8	Young N.	20.70	6	FER	2
9	Mordi J.	20.26	5	KWA	1
10	Morais C.	20.15	8	PET	1
11	Omot N.**	20.08	8	ALA	2
12	Thomas C.	19.81	6	REG	2
13	Randle J.	19.16	5	USM	2
14	Oraby O.	17.12	8	ALA	3
15	Hollis D.	17.05	8	PET	3

Table 3: BAL Player Efficiency Ratings

*Players must have averaged a minimum of 10 min per game to be included.
**Omot was voted as the most valuable player in the 2023 BAL season.

Five clusters were selected based on the interpretation of the k-means chart in the appendices and in line with the number of players in a basketball game. The emerging clusters five distinct group of players: Star Players (they had the highest number of AST, FGM and 2PM, and second highest DR and BS),Defensive Players (they had the highest DR and BS), Offensive Players (they had the second highest AST, FGM and 2PM). There were two clusters with lower match statistics, identified as reserves in Table 4 that follows.

The 162 players in the BAL are distributed somewhat evenly in the clusters identified, with the largest groups being cluster 0 (N=52) and cluster 4 (N=4). All the match statistics available in the box score were used to determine the clusters but only the match statistics which have been identified as discriminating winning from losing matches are included for comparison of the clusters as well as further analysis. The Player Efficiency ratings align with the clusters identified.

Cluster	N	AST	FGM	2PM	DR	BS	Possible Role
0	52	0.39	0.37	0.25	0.55	0.03	Reserve
1	28	2.78	3.38	1.89	2.83	0.16	Offensive Presence
2	22	**3.49**	**5.88**	**4.21**	3.89	0.17	Star Player
3	17	1.33	3.31	3.1	**4.38**	**0.99**	Defensive Presence
4	43	0.88	1.63	1.25	1.89	0.25	Reserve

Table 4: BAL Player Clusters

6. DISCUSSION

The aim of this study was to identify match related statistics that discriminate between winning and losing games in the Basketball Africa League, identify players that excel and how they impact their teams' results. In balanced games the results show that winning teams have on average more Assists (AST) 30.20 ± 8.83 vs. 24.65 ± 6.20, Field Goals Made (FGM) 45.11 ± 5.56 vs. 39.77 ± 5.26, Two Point Field Goals Made (2PM) 32.72 ± 6.23 vs. 26.95 ± 4.73, Defensive Rebounds (DR) 45.18 ± 6.25 vs. 39.64 ± 8.97 and Blocked Shots 6.68 ± 3.78 vs. 3.10 ± 2.25. These results are in line with previous studies on factors that discriminate between winning and losing in basketball in other leagues. It also highlights the value of offensive tactics (field goals made and assists) as well as defensive ones (defensive rebounds and blocked shots).
In reviewing the Player Efficiency Ratio of players in the Basketball Africa League the levels of efficiency drop significantly after the 20th ranked player. This may indicate a need for more depth on teams, as well as additional investment in player development and coaching to ensure that players are more efficient irrespective of the outcome of the match.

7. CONCLUSION

These results are significant to basketball stakeholders in particular but would also be of interest to any organization seeking to leverage data to improve the performance of the individuals and teams in their organization. One key area to look into is the composition of team rosters, and the clusters that each of their players belong to. While it may be more obvious to identify star players with well above average statistics, identifying which role players are

needed and how to develop and allocate time to them in matches can be aided by use of the clusters identified in this study. Data and information can play a significant role in identifying factors that result in higher or lower performance as well as in identifying individuals that make a significant contribution to the performance of the team or organization in the short term or long term. Future studies can focus on other advanced statistics such as usage rate, and the extent to which teams utilize players in different clusters to implement their game plan.

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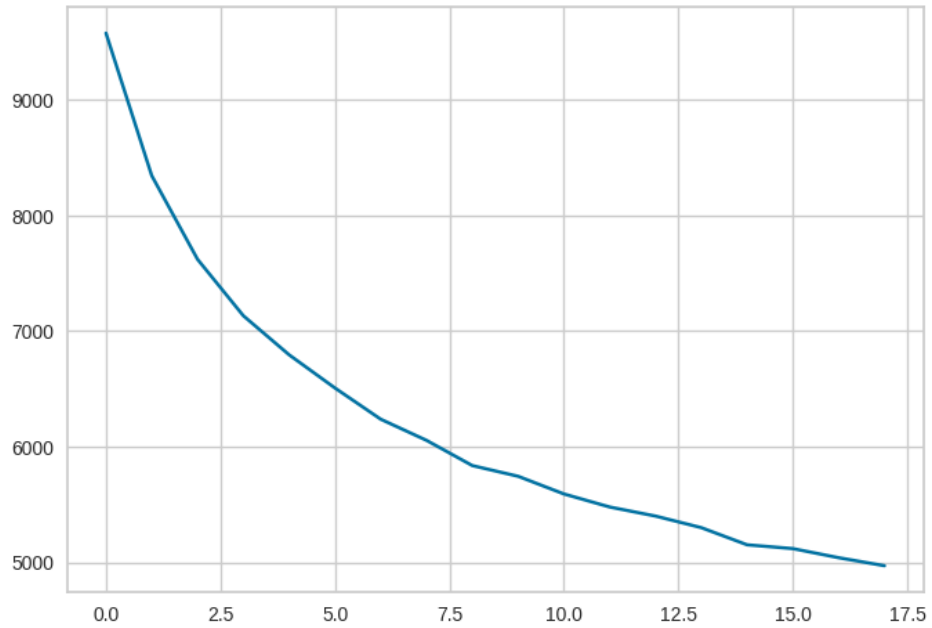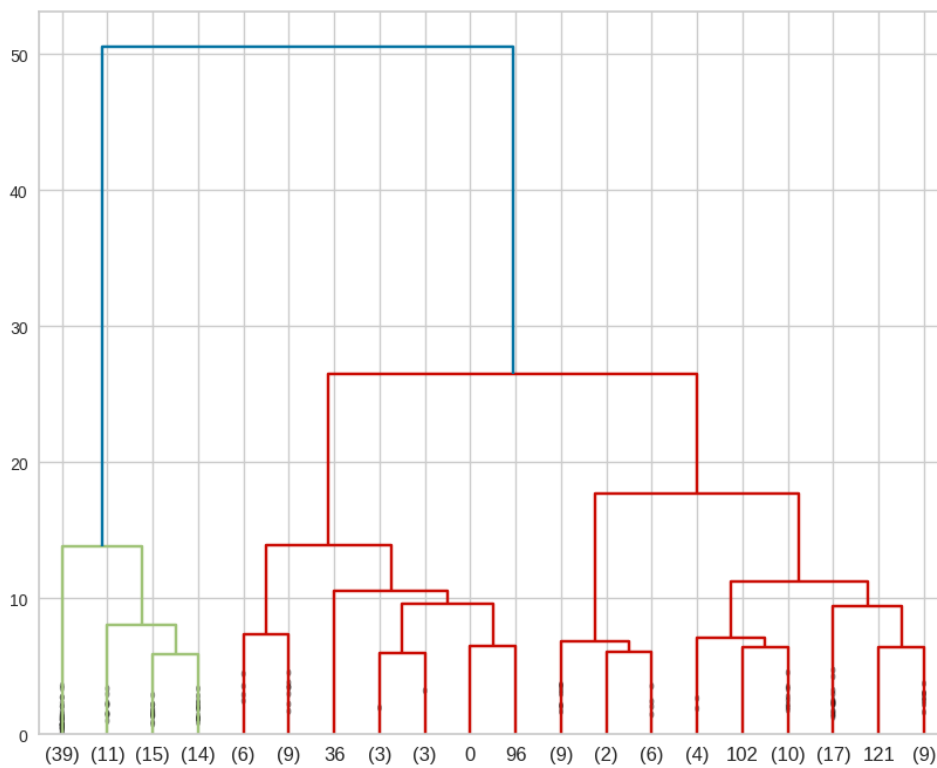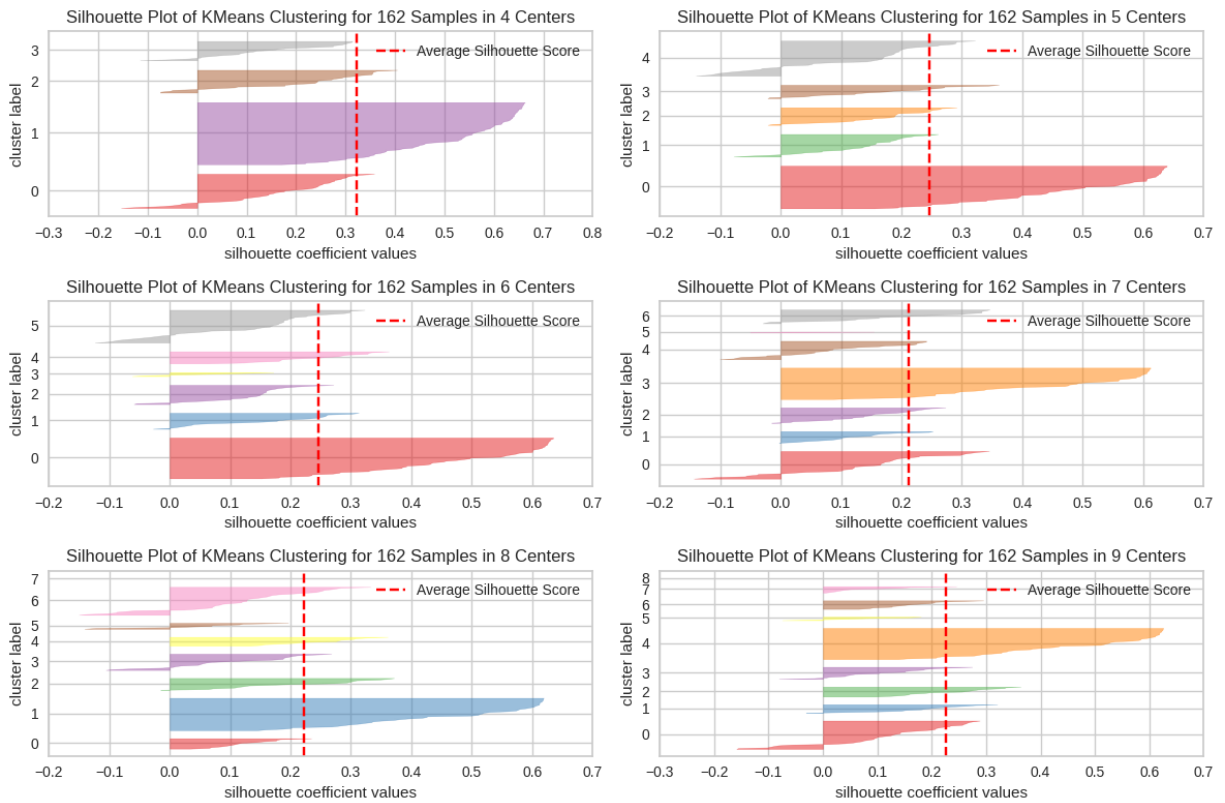
Appendices and Annexures

Figure 1 – K-means chart

Figure 2 – Dendrogram

Figure 3 – K-means clustering