

ADS1001 Semester 1 2023

Final project report

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Part 1: Description of the project:

This project focuses on the comprehensive data analysis of statistics and figures collected over a nine-year period, spanning from the 2012 AFL season to the 2021 AFL season. The AFL (Australian Football League) consists of 18 teams, competing in Australian Rules football, a fast-paced and physically demanding sport that involves elements such as kicking, handballing, marking, and tackling. The collected information was organised into three distinct datasets.

The first dataset, named 'games,' (Figure 1) contains detailed information about the matches that took place. Each row in this dataset corresponds to a unique game, identified by a gameld. It includes data such as the year of the match, venue, start time, attendance figures, home team, home team score, and rainfall during the game. By thoroughly examining this data, patterns, comparisons, and insights can be derived, enabling a better understanding of the factors that influence the outcome of a match.

The second dataset, known as 'statistics,' (Figure 2) provides comprehensive information about player performance throughout the 2012-2021 period. It includes player names, team affiliations, game numbers, and various statistical measures like disposals, goals scored, and marks taken. This dataset allows for an in-depth analysis of individual player performance and trends over the years.

The final dataset, 'players,' (Figure 3) provides valuable insights into individual players, featuring data such as player names, height, weight, position, and origin. This dataset enables the exploration of factors like physical attributes, playing positions, and player backgrounds within the league.

Armed with this extensive dataset, the research group delved deeper into understanding how each game is influenced by both internal and external variables. Each member of the group investigated a specific variable, such as rainfall, start time, venue, season period, COVID-19 impact, and player and team statistics, and analysed its effect on the game's outcome or its frequency of occurrence.

By conducting this comprehensive analysis, the group aimed to uncover significant correlations and trends, shedding light on the intricate dynamics of the game and

providing valuable insights for team strategies, player scouting, and overall understanding of the sport.

Part 2 Details of preprocessing and manipulation of data in Python

Since the data set is completely clean, very little pre-processing was required. However, it was necessary to add a few different columns to the initial data. Eric used the `np.where()` function to create a column for which team won or lost using the `homeTeamScore` and `awayTeamScore` columns so win percentages could be calculated using the `value_counts()` function.

The data was then grouped depending on the question being answered. To investigate the effect of rainfall, games were grouped into either having rainfall or not having rainfall, the amount of rainfall was not considered. When looking at attendance, the data was grouped by 10 000 people. Given the COVID-19 pandemic in the 2020 and 2021 seasons, games between certain dates were separated as attendance for some of these games were nil, which removes the effect of the crowd altogether. The start times of the games were simply grouped together based on their exact values. Finally, to investigate whether the point in the season had an influence on performance, the round column values were changed into integers or a 'finals' value so that they could be easily divided. Final values were often removed in the analysis as there were insufficient data points to make valid conclusions. Once the season was divided into the start, middle and end, data frames can be created to calculate the win percentage of each team.

While most of the data used was exclusively from the 'games' data set, the modelling done involved the 'players' and 'stats' data sets, which needed to be merged. This process involved removing the finals games and finished with one data set containing all the information about each individual player. The data could then be separated by team where appropriate and totalled, then heat maps could be created to determine links between different statistics.

Regarding the creation of the model to predict a player's position, variables had to be chosen based on comparing the medians and variation of position's statistics by looking at their box plots. From there trial and error was used to find the best model.

Part 3 Summary of exploratory data analysis and any significant conclusions

Exploratory data analysis on Venue:

Exploratory data analysis was achieved through the investigation of how the different AFL venues affected each team's performances. This impact was measured through the differing win rates of each team at the most relevant venues. Bar charts for the venues were used to show the win rates of each team at that venue. However, it would have been unnecessary to include a bar chart for every single venue, because as shown in Fig 19, there are 23 venues. Therefore, electing to only include the bar charts for the 3 most popular venues, being the MCG (Fig 16), Docklands (Fig 17) and Adelaide Oval (Fig 18). Together, these 3 bar charts were able to represent the change in win rate for each team across the venues, as each team's win rate is shown at an away venue. Thus, the comparison between the win rates of a relevant team such as Adelaide, shows that at their home venue (Adelaide Oval) they had a win rate of 59%, and at the most popular away venue (MCG) they had a win rate of 41%. It is therefore safe to conclude that overall, if the venue is a team's home ground, then they will win more games than if they were away.

Exploratory data analysis on Season Period:

Regarding the investigation of season period, the graph (Figure 9) indicates the win percentage of each team across 3 different parts of the season, start (first 8 rounds), middle (rounds 9-14) and end (15-22). Finals were omitted as not all teams have made finals and there are so few games that it is difficult to draw conclusions.

The most obvious thing that this graph indicates is the overall win rates of each team. It is clear that Geelong is winning the most games and are also extremely consistent across the season. This indicates that they are a team with good depth as players change teams over the 9 years and players also get injured then come back, but Geelong have managed to overcome these challenges and consistently achieve a 70+% win rate.

On the flip side, the Gold Coast Suns are usually performing the poorest. At the start of the season, they were not even averaging a 40% win rate and this only dropped in the later parts of the season. It is likely that this team is inexperienced or struggles to bond together and play as a team. Another explanation for their statistics is key players are consistently getting injured early in the season or they are very easy to shut down.

Overall, there are not many large differences in win rate across the season. In general, teams with a high win rate are performing across the season and teams who are performing poorly have a low win rate all year round, as one would expect.

Brisbane, Hawthorn and Richmond all consistently improve throughout the season while Collingwood, Melbourne and Port Adelaide all tend to finish a season poorly.

Exploratory data analysis on Start Time:

The exploratory data analysis of the start time on the other hand, revealed interesting patterns in the AFL games data. The frequency of home wins and losses varies depending on the start time, suggesting that game time may influence team performance. Additionally, the analysis shows that attendance fluctuates across different start times, indicating potential preferences among fans. Furthermore, scoring patterns by AFL teams also exhibit variations based on the start time. These findings highlight the importance of considering game time when analysing AFL games and suggest that it may have an impact on team performance, fan engagement, and scoring dynamics.

Exploratory data analysis on Rainfall:

Exploratory analysis with the variable rainfall in the dataset was done through investigating how the presence of rain affected each teams performances, measured through their changes in winrate in the presence of rain. This involved using stacked bar charts of the teams win rates in order to visually represent the data (Fig 13) but deciding that the stacked bar charts were still unsatisfactory as a way of comparing the wins and losses with and without rain visually I added another bar chart with the % increase and decrease in winrate while rain was present (Fig 14), this did a much better job of visually representing the change in teams performance when in the presence of rain. We can reasonably conclude from the analysis that teams performances do get affected by the presence of rain and an extreme case showing a 14% decrease in winrate and other teams seeing a decrease/increase in win rate between 0-10%. Overall team performance saw a decrease in terms of winrate more often than an improvement.

Exploratory data analysis on Attendance:

Exploratory data analysis was performed on the results produced from the code. The graphs and tables indicated that attendance did play a factor in the victory and losses of AFL teams, however this varied from team to team. This was highlighted through the processed data which showed that certain teams performed better with a higher attendance (>30000) whilst others did not. In a similar sight, the analysis of AFL teams during the covid timeline shown through the table highlighted the fact that half the teams had a higher win percentage during covid whereas the other half had a better win percentage before covid. This 50/50 split may indicate that the covid outbreak may only have a significant impact on certain teams, especially when looking at the specific win percentages of each team during and before covid. This is

because some teams had a massive win percentage difference, whilst some only had a negligible difference.

Exploratory data analysis on Internal Variables:

Exploratory data analysis was performed on the stats and players data through correlation analysis by creating a code where a correlation matrix was created with 'corr()' function creating a data frame 'correlation_matrix'. Then to generate a visual representation the seaborn function 'heatmap()' paired with the matplotlib 'plt' module of the same correlation_matrix, in preparation for linear regression and modelling.(Figure 10)

Part 4:Summary of any undertaken modelling and any significant conclusions

The modelling was undertaken with the players and stats data, to analyse the relationship between each variable and their most positive and negative correlated variable for the 2021 AFL season. Two models were created: a linear regression model and a 10th degree polynomial model. The linear model was obtained by fitting a linear regression line to the degree of 1 to the point using the function 'np.polyfit'. The polynomial to the degree of 10 by fitting the polynomial curve to the data point with again using the function 'np.polyfit'. Using the 'plt.scatter' function, created the scatter plot between the variables and the 'plt.plot' to plot the linear and 10th degree polynomial model with labels and titles (Figure 11 and Figure 12) .The linear regression model provides an approximation while the the 10th degree polynomial model allows for a more complex representation of the relationship between all the variables. Each of the variables were categorised into groups to provide a more generalised conclusion

Category: Possession-related

The possession-related variables, such as Disposals, Handballs, and Kicks, have a positive correlation with each other. An increase in these variables is associated with an increase in uncontested possessions and marks. However, there is a negative correlation between Kicks and Handballs, indicating that as one variable increases, the other decreases.

Category: Scoring-related

Scoring-related variables, including Goals, Behinds, and Goal Assists, are interconnected. There is a positive correlation between Goals and Goal Assists, proposing that assisting goals leads to an increase in scoring. Moreover, Inside 50s have a positive correlation with Behinds, indicating that more scoring opportunities can result in both goals and behinds.

Category: Field position-related

Position related statistics are Inside 50s and Rebounds . Inside 50s have a positive correlation with Brownlow Votes, suggesting that creating opportunities near the goal is associated with receiving votes. Rebounds, on the other hand, have a positive correlation with Clangers, highlighting that defensive actions can lead to rebounding the ball.

Category: Contest-related

Contest-related variables, such as Contested Possessions, Uncontested Possessions, Clearances, Tackles, and One Percenters, are connected. There is a positive correlation between Contested Possessions and Brownlow Votes, suggesting that winning contested possessions can influence receiving votes. Tackles have a positive correlation with Contested Possessions, indicating that tackling is associated with winning contested possessions. Additionally, One Percenters have a positive correlation with Clearances, implying that providing efforts in the contest can lead to successful clearances.

Category: Field dominance-related

Field dominance-related variables Marks, Hit Outs, and Bounces, are also connected There is a positive correlation between Marks and Kicks, suggesting that marking the ball is often associated with taking kicks. Hit Outs have a positive correlation with Marks, suggesting that won hit outs lead to more marking opportunities. Additionally, Bounces have a negative correlation with Hit Outs , indicating that these variables have a relationship where when there is more hit outs teams have a lower chance of bouncing as opposition teams are in contact with each other prevention bounces of the ball

Category: Game impact-related

Game impact-related variables are Brownlow Votes and Clangers, which have their own unique relationships. Brownlow Votes have a positive correlation with Inside 50s, suggesting that players who contribute to inside 50s are more likely to receive votes. Clangers have a positive correlation with Frees Against, indicating that committing errors or fouls can lead to conceding free kicks.

Category: Penalty-related

Penalty-related variables are Frees and Frees Against. There is a positive correlation between Frees and Contested Possessions, indicating that winning contested possessions can result in receiving free kicks. Frees Against have a negative correlation with Marks, suggesting that committing fouls can lead to the opposition winning marks.

kNN Modelling

Using a kNN was used to try and determine what statistics reflect a player's position, whether it was forward, midfield, defence or ruckman. This was done by looking at the boxplots of each variable, separated by position, to try and establish patterns. The clearest statistic was hit outs, which are almost exclusive to ruckman, which resulted in the algorithm being able to identify ruckman very well. The confusion matrix (Figure 17), shows that ruckmen are identified incorrectly only 1% of the time, while the other 3 positions include a

lot of errors. The overall accuracy of the model is 0.727 and includes the number of goals scored per game, hit outs, disposals, tackles, clearances, inside 50s and rebounds. Removing 1-2 variables would bring the accuracy below 0.7 and then has a sharper drop after that.

The number of nearest neighbours chosen was 50 as although the recommendation is the square root of the number of data points (which was 70 000) is 270, increasing it beyond 50 had very little effect on the accuracy. The success of the model when lots of variables are used and lower success rate when fewer variables were used indicates that, with the exception of ruckmen, there is no 1 statistic that determines a player's position. All players all over the ground are able and expected to partake in all parts of the game. That being said, there are certain trends that allow a player's position to be predicted fairly accurately.

In order to improve this model certain statistics would need to be weighted and the outliers would need to be dealt with carefully. Outliers, which given the size of the data set were numerous, were kept in as removing even just the top 5% of each statistic would result in removing a large portion of the data.

Part 5: Conclusions in the relation to the original problem

In conclusion, the analysis of internal variables within the game, such as disposals and inside 50s, have significant positive and negative correlations with other variables, indicating their impact on team performance and individual recognition which ultimately results in a positive correlation of the win rate of teams, while if there is a decrease in the number of statistics, it will have a negative impact on the team's win percentage

On the other hand, our investigation suggests that in terms of external factors, all of them do have an impact on the win percentage of AFL teams. However, the analysis of external factors such as weather, attendance, covid, etc highlighted their effects on each individual team as shown in the discussion section and figures, and this underlines how these factors have a more consistent and strong impact on certain teams, whilst having a negligible effect on the remaining teams.

Overall, the analysis can be considered a success as there were correlations found between both external/internal factors and the outcome of the games. This investigation can also be taken a step further if any future studies are needed to be made, using more complex data science approaches such as predictive modelling to predict the win/losses of games in correlation to the results obtained, data mining to identify patterns within the games data that were overlooked, etc.

Figures

Figure 1

| | gameId | year | round | date | venue | startTime | attendance | homeTeam | homeTeamScore | awayTeam | awayTeamScore | rainfall |
|------------------------|----------|------|-------|-------------|-------------------|-----------|------------|-------------|---------------|------------------|---------------|----------|
| 0 | 2021R101 | 2021 | R1 | 18-Mar-2021 | M.C.G. | 7:25 PM | 49218 | Richmond | 105 | Carlton | 80 | 0.0 |
| 1 | 2021R102 | 2021 | R1 | 19-Mar-2021 | M.C.G. | 7:50 PM | 46051 | Collingwood | 53 | Western Bulldogs | 69 | 0.0 |
| 2 | 2021R103 | 2021 | R1 | 20-Mar-2021 | M.C.G. | 1:45 PM | 21365 | Melbourne | 80 | Fremantle | 58 | 0.0 |
| 3 | 2021R104 | 2021 | R1 | 20-Mar-2021 | Adelaide Oval | 4:05 PM | 26985 | Adelaide | 103 | Geelong | 91 | 0.0 |
| 4 | 2021R105 | 2021 | R1 | 20-Mar-2021 | Docklands | 7:25 PM | 25128 | Essendon | 91 | Hawthorn | 92 | 0.0 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 2019 | 2012SF01 | 2012 | SF | 14-Sep-2012 | Football Park | 8:15 PM | 31742 | Adelaide | 81 | Fremantle | 71 | 0.0 |
| 2020 | 2012SF02 | 2012 | SF | 15-Sep-2012 | M.C.G. | 7:45 PM | 65483 | Collingwood | 73 | West Coast | 60 | 2.0 |
| 2021 | 2012PF01 | 2012 | PF | 21-Sep-2012 | Stadium Australia | 7:50 PM | 57156 | Sydney | 96 | Collingwood | 70 | 0.0 |
| 2022 | 2012PF02 | 2012 | PF | 22-Sep-2012 | M.C.G. | 5:15 PM | 69146 | Hawthorn | 97 | Adelaide | 92 | 1.0 |
| 2023 | 2012GF01 | 2012 | GF | 29-Sep-2012 | M.C.G. | 2:30 PM | 99683 | Hawthorn | 81 | Sydney | 91 | 8.4 |
| 2024 rows x 12 columns | | | | | | | | | | | | |

Figure 2

| | gameId | team | year | round | playerId | displayName | gameNumber | Disposals | Kicks | Marks | ... | Brownlow Votes | Contested Possessions | Uncontested Possessions | Contested Marks | Marks Inside 50 |
|-------|-----------|------------------|------|-------|------------|--------------------|------------|-----------|-------|-------|-----|-------------------|--------------------------|----------------------------|--------------------|-----------------------|
| 0 | 2021R104 | Adelaide | 2021 | R1 | 2021661124 | Berry, Sam | 1 | 8 | 6 | 1 | ... | 0 | 4 | 5 | 0 | 0 |
| 1 | 2021R104 | Adelaide | 2021 | R1 | 2012662083 | Brown, Luke | 168 | 5 | 2 | 0 | ... | 0 | 2 | 3 | 0 | 0 |
| 2 | 2021R104 | Adelaide | 2021 | R1 | 2020665315 | Butts, Jordon | 3 | 10 | 5 | 3 | ... | 0 | 5 | 5 | 1 | 0 |
| 3 | 2021R104 | Adelaide | 2021 | R1 | 2018689604 | Doedee, Tom | 31 | 13 | 9 | 4 | ... | 0 | 8 | 6 | 0 | 0 |
| 4 | 2021R104 | Adelaide | 2021 | R1 | 2018703883 | Frampton, Billy | 9 | 14 | 10 | 8 | ... | 0 | 5 | 9 | 3 | 4 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 89465 | 2012R2309 | Western Bulldogs | 2012 | R23 | 2011838967 | Skinner, Zephaniah | 8 | 2 | 1 | 1 | ... | 0 | 2 | 1 | 0 | 0 |
| 89466 | 2012R2309 | Western Bulldogs | 2012 | R23 | 2012833342 | Smith, Clay | 16 | 22 | 11 | 5 | ... | 0 | 6 | 16 | 0 | 0 |

Figure 3

| | playerId | displayName | height | weight | dob | position | origin |
|---|------------|---------------|--------|--------|-------------|-------------------|--------------------|
| 0 | 2021661124 | Berry, Sam | 181 | 81 | 12-Feb-2002 | Midfield, Forward | Gippsland Power |
| 1 | 2012662083 | Brown, Luke | 181 | 81 | 22-Sep-1992 | Defender | Norwood |
| 2 | 2020665315 | Butts, Jordon | 198 | 83 | 31-Dec-1999 | Defender | Murray Bushrangers |
| 3 | 2021678665 | Cook, Brayden | 189 | 80 | 18-Jul-2002 | Midfield, Forward | South Adelaide |
| 4 | 2019683521 | Davis, Ben | 187 | 85 | 19-May-1997 | Forward | UNSW |

Figure 4

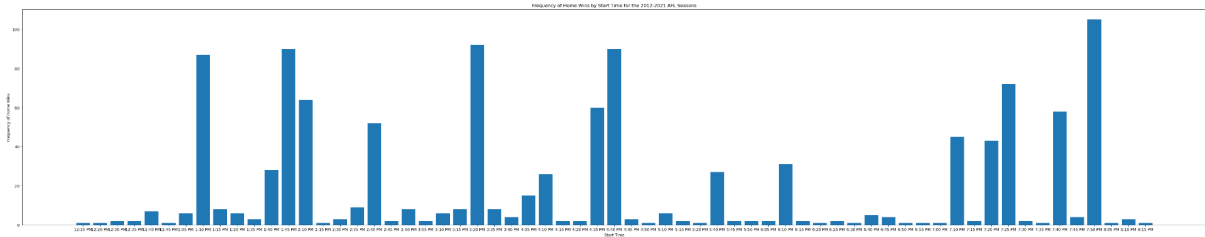


Figure 5

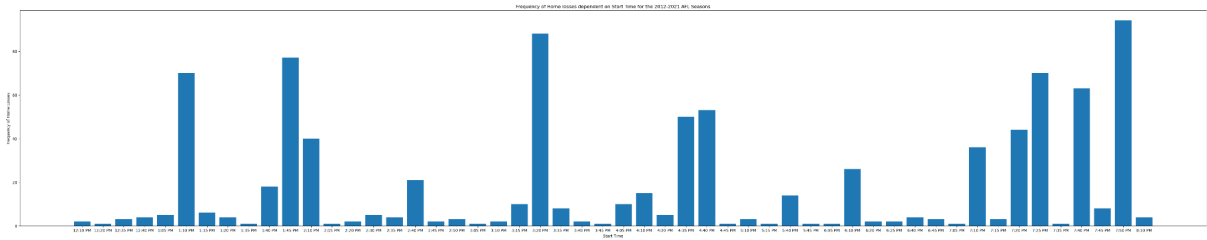


Figure 6

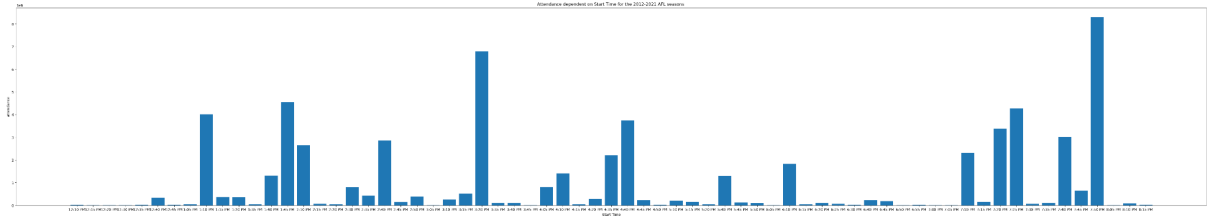


Figure 7

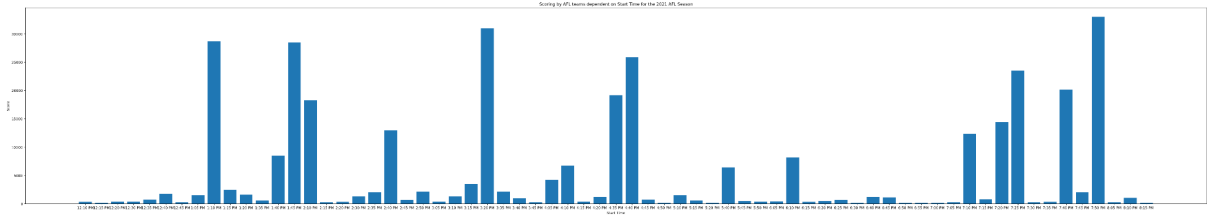


Figure 8

| | Disposals | Kicks | Marks | Handballs | Goals | Behinds | Hit Outs | Tackles | Rebounds | Inside 50s | Clearances | Clangers | Frees | Frees Against | Brownlow Votes | (Pos |
|------------------------------|-----------|-------|-------|-----------|-------|---------|-------------|---------|----------|---------------|------------|----------|-------|------------------|-------------------|----------|
| team | | | | | | | | | | | | | | | | |
| Adelaide | 7781 | 4545 | 1758 | 3236 | 230 | 197 | 749 | 1244 | 904 | 1095 | 769 | 1261 | 465 | 449 | 51 | |
| Brisbane Lions | 7747 | 4983 | 2081 | 2764 | 313 | 207 | 696 | 1302 | 862 | 1244 | 865 | 1265 | 448 | 454 | 80 | |
| Carlton | 7673 | 4836 | 2098 | 2837 | 250 | 201 | 705 | 1175 | 887 | 1106 | 749 | 1260 | 447 | 427 | 52 | |
| Collingwood | 8335 | 4907 | 2360 | 3428 | 225 | 166 | 841 | 1191 | 878 | 1024 | 714 | 1309 | 389 | 405 | 45 | |
| Essendon | 8067 | 4639 | 2048 | 3428 | 287 | 189 | 642 | 1247 | 831 | 1158 | 756 | 1214 | 405 | 416 | 78 | |
| Fremantle | 7826 | 4521 | 1980 | 3305 | 219 | 220 | 803 | 1076 | 832 | 1122 | 795 | 1236 | 394 | 407 | 61 | |
| Geelong | 8525 | 5003 | 2308 | 3522 | 269 | 191 | 753 | 1241 | 782 | 1174 | 856 | 1173 | 435 | 404 | 82 | |
| Gold Coast | 7849 | 4978 | 2309 | 2871 | 201 | 180 | 580 | 1366 | 936 | 1071 | 753 | 1280 | 406 | 422 | 44 | |
| Greater Western Sydney | 8029 | 4800 | 2020 | 3229 | 258 | 177 | 670 | 1303 | 901 | 1097 | 806 | 1266 | 433 | 405 | 71 | |
| Hawthorn | 8342 | 4654 | 2053 | 3688 | 239 | 145 | 797 | 1327 | 891 | 1072 | 758 | 1200 | 406 | 408 | 53 | |
| Melbourne | 8100 | 4822 | 1997 | 3278 | 270 | 211 | 960 | 1383 | 874 | 1218 | 802 | 1334 | 425 | 440 | 96 | |
| North Melbourne | 7835 | 4690 | 2195 | 3145 | 210 | 154 | 856 | 1159 | 887 | 1041 | 726 | 1316 | 431 | 411 | 39 | |
| Port Adelaide | 8430 | 5007 | 2073 | 3423 | 276 | 192 | 782 | 1349 | 852 | 1180 | 781 | 1300 | 446 | 429 | 91 | |
| Richmond | 7857 | 4490 | 1983 | 3367 | 253 | 183 | 614 | 1237 | 831 | 1130 | 661 | 1352 | 376 | 461 | 46 | |
| St Kilda | 8126 | 4900 | 2127 | 3226 | 237 | 184 | 842 | 1363 | 839 | 1120 | 771 | 1284 | 401 | 433 | 68 | |
| Sydney | 8229 | 4941 | 2081 | 3288 | 293 | 184 | 732 | 1327 | 858 | 1178 | 782 | 1234 | 432 | 444 | 85 | |
| West Coast | 7785 | 4967 | 2363 | 2818 | 257 | 168 | 888 | 1070 | 794 | 1091 | 798 | 1165 | 393 | 381 | 61 | |
| Western Bulldogs | 8288 | 4687 | 1931 | 3601 | 288 | 206 | 613 | 1268 | 757 | 1204 | 869 | 1134 | 437 | 365 | 85 | |

Figure 9

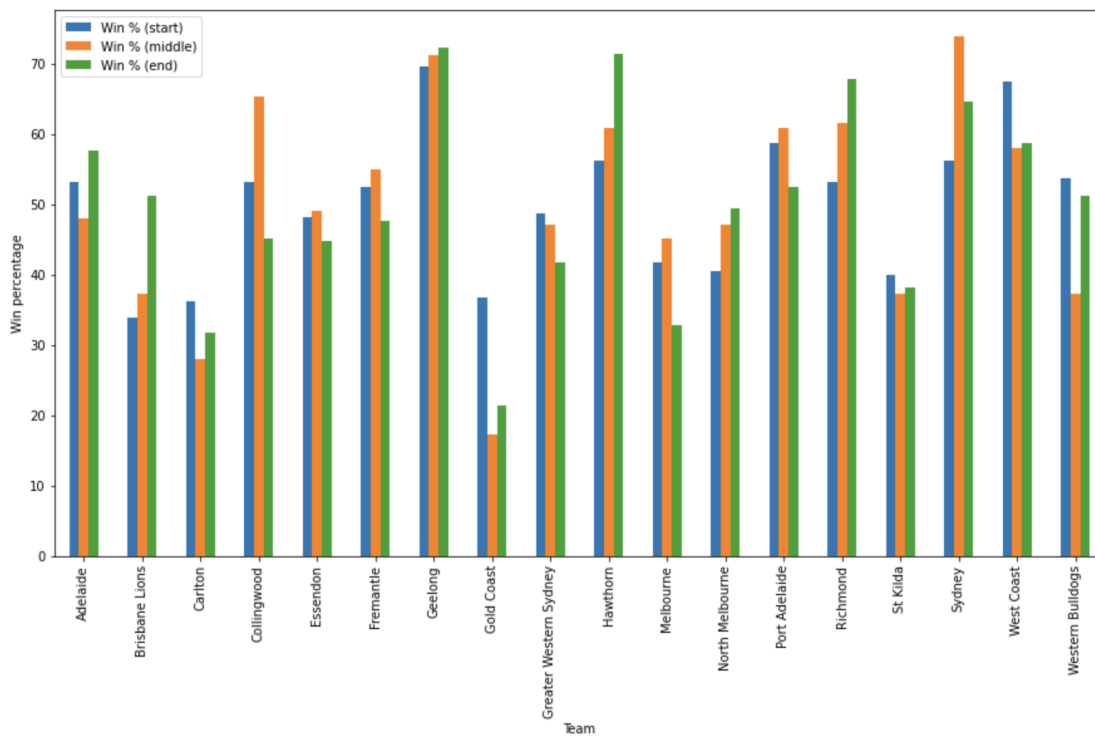


Figure 10

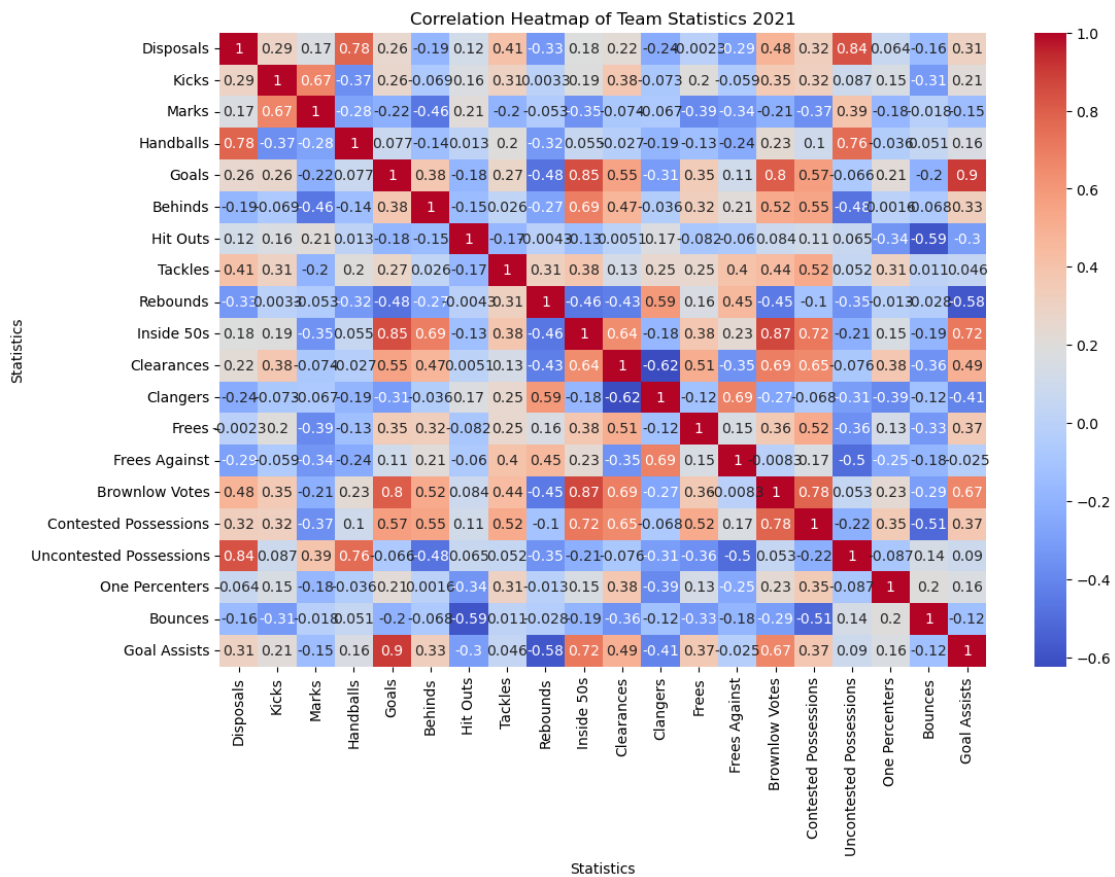


Figure 11

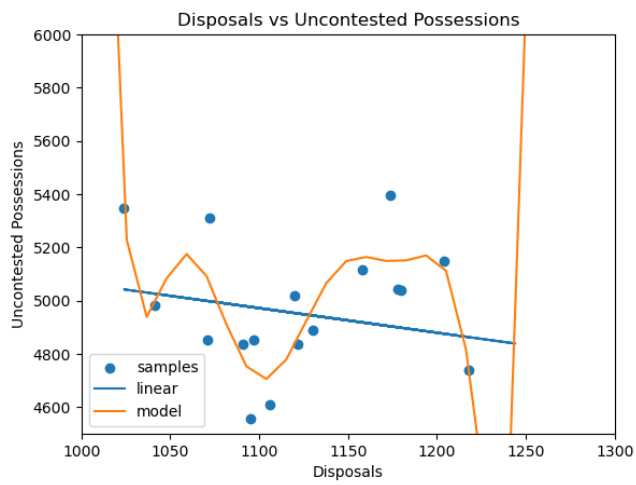


Figure 12

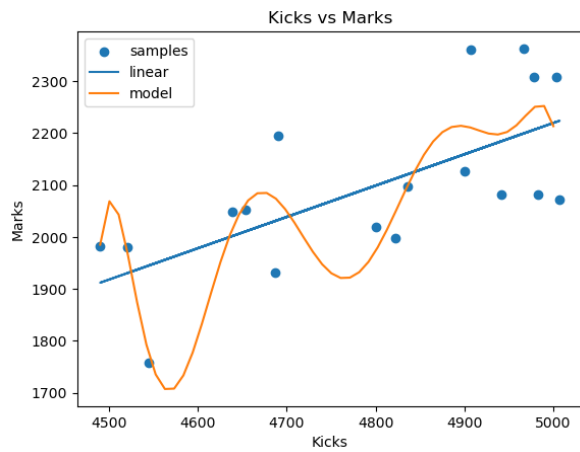


Figure 13

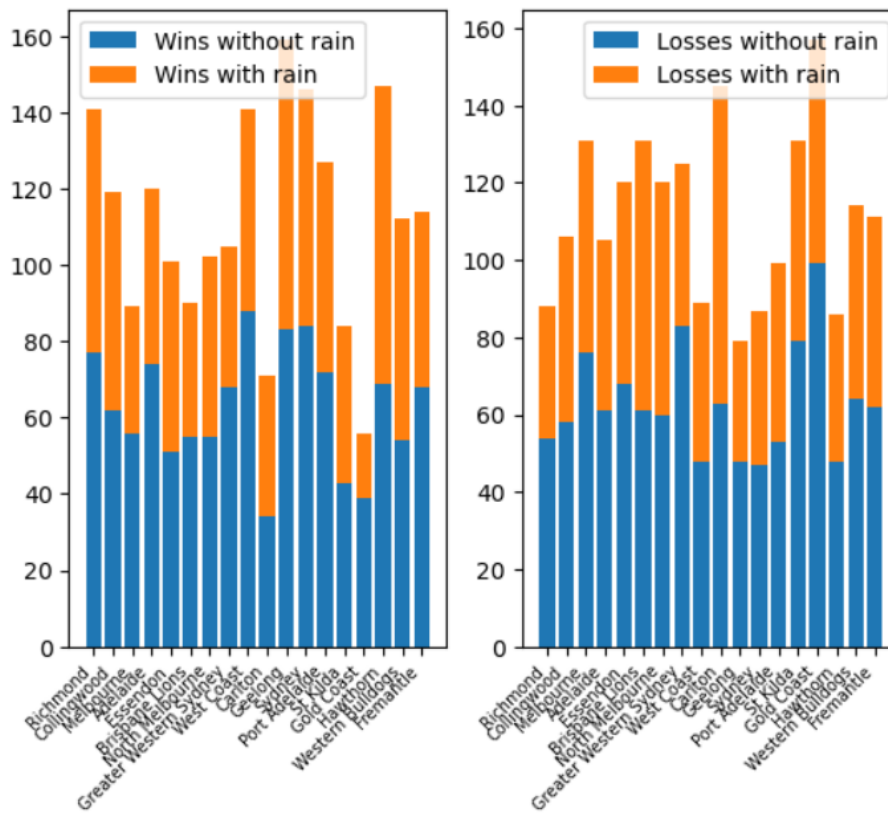


Figure 14

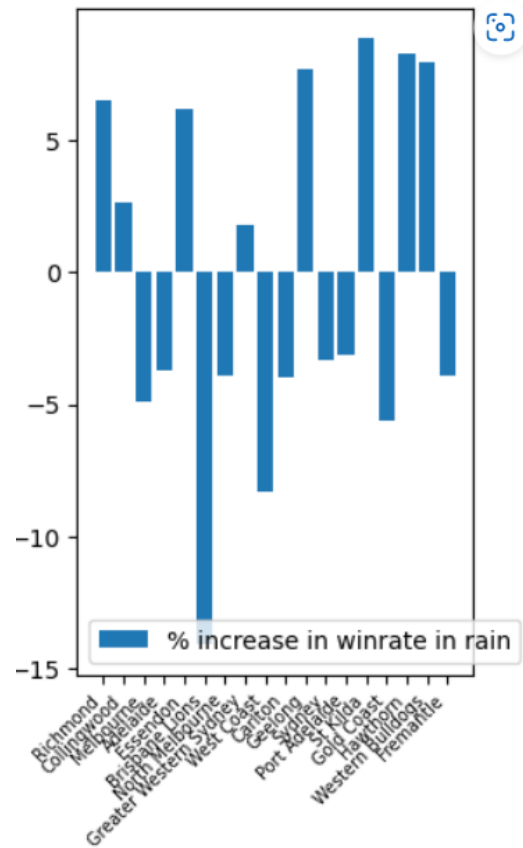


Figure 15

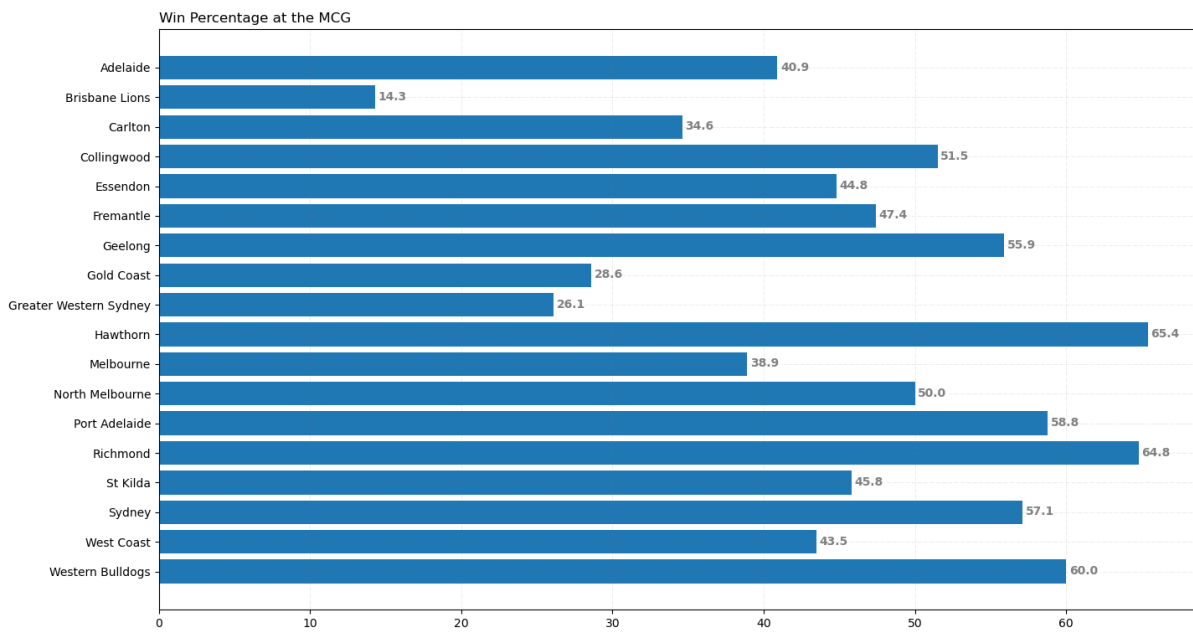


Figure 16

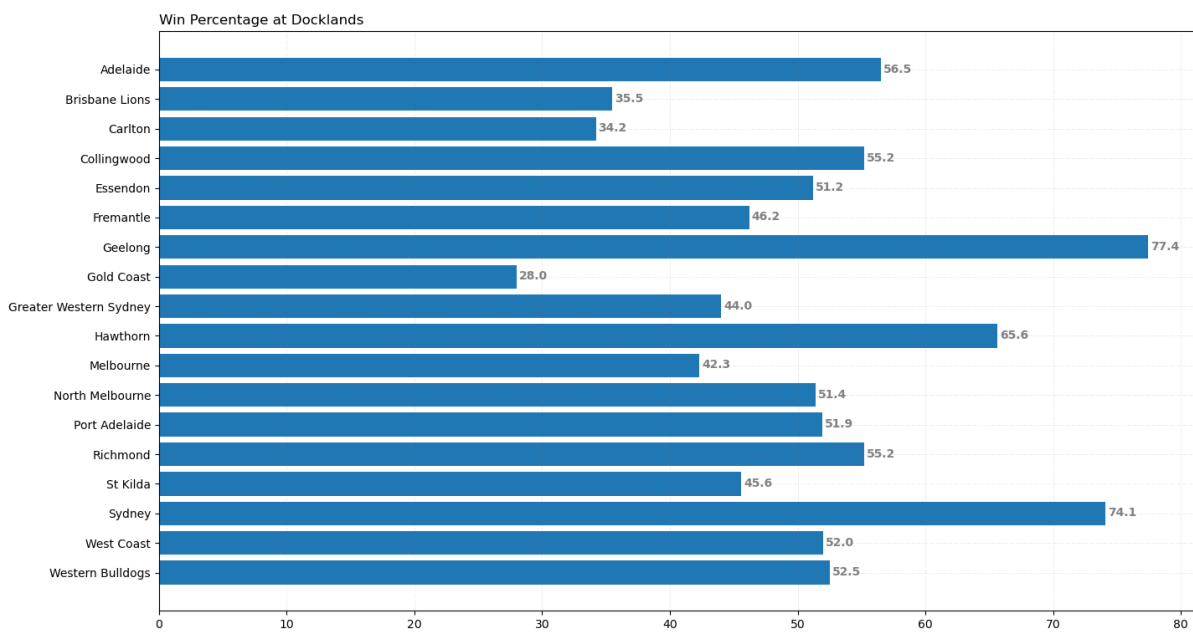


Figure 17

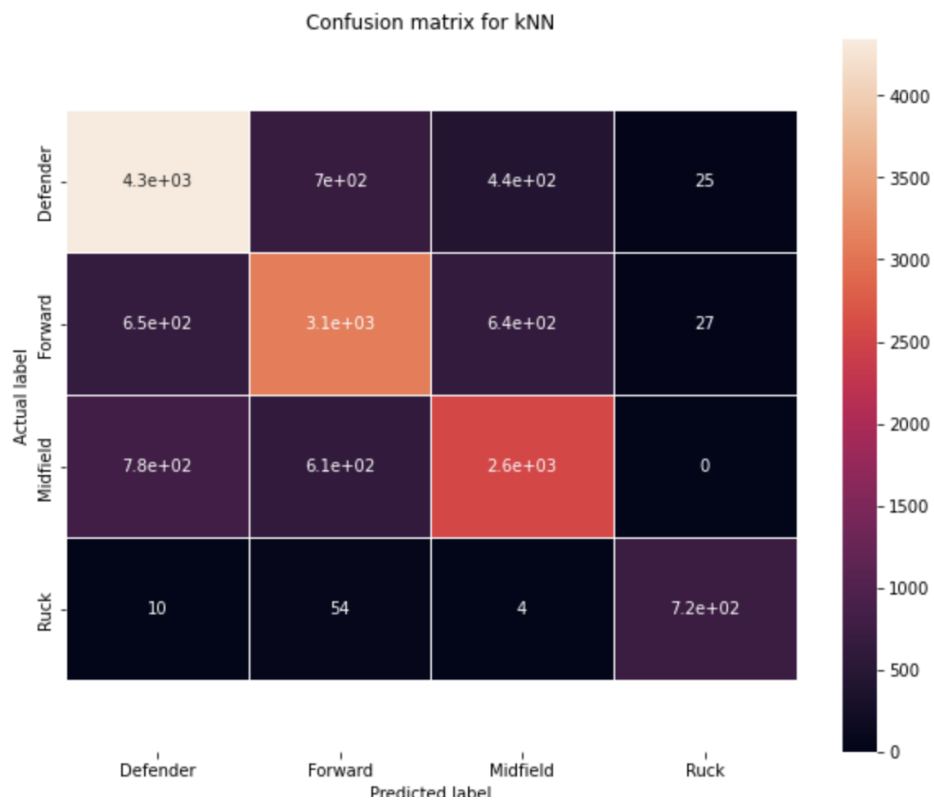


Figure 18

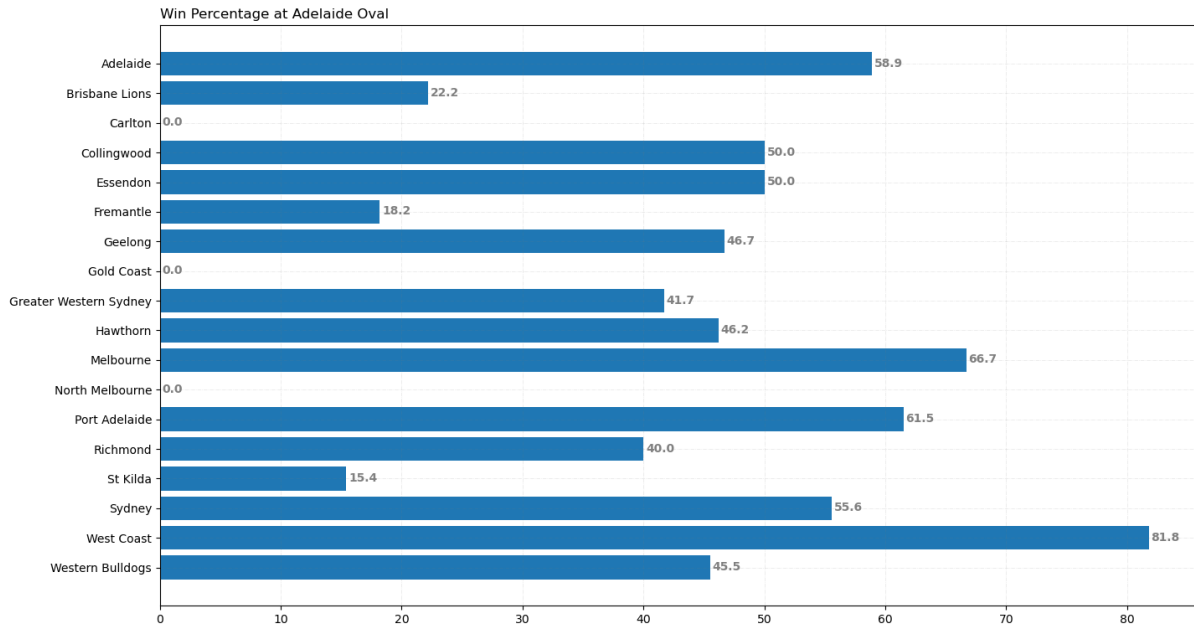


Figure 19

| | Venue | GamesPlayed |
|----|-------------------|-------------|
| 0 | M.C.G. | 454 |
| 1 | Docklands | 425 |
| 2 | Adelaide Oval | 181 |
| 3 | Subiaco | 140 |
| 4 | Carrara | 139 |
| 5 | Gabba | 137 |
| 6 | S.C.G. | 97 |
| 7 | Perth Stadium | 90 |
| 8 | Sydney Showground | 79 |
| 9 | Kardinia Park | 77 |
| 10 | Football Park | 46 |
| 11 | York Park | 40 |
| 12 | Bellerive Oval | 28 |
| 13 | Manuka Oval | 26 |
| 14 | Stadium Australia | 18 |
| 15 | Cazaly's Stadium | 12 |
| 16 | Marrara Oval | 12 |
| 17 | Eureka Stadium | 8 |
| 18 | Traeger Park | 7 |
| 19 | Jiangwan Stadium | 3 |
| 20 | Wellington | 3 |
| 21 | Riverway Stadium | 1 |
| 22 | Blacktown | 1 |

Figure 20

| homeTeam | Pre-covid Win Percentage | During-covid Win Percentage | homeTeam | Better Win Percentage |
|------------------------|--------------------------|-----------------------------|------------------------|-----------------------|
| Adelaide | 0.452381 | 0.315789 | Adelaide | Before Covid |
| Brisbane Lions | 0.659574 | 0.826087 | Brisbane Lions | During Covid |
| Carlton | 0.243902 | 0.263158 | Carlton | During Covid |
| Collingwood | 0.476190 | 0.333333 | Collingwood | Before Covid |
| Essendon | 0.500000 | 0.333333 | Essendon | Before Covid |
| Fremantle | 0.558140 | 0.523810 | Fremantle | Before Covid |
| Geelong | 0.760870 | 0.772727 | Geelong | During Covid |
| Gold Coast | 0.243902 | 0.421053 | Gold Coast | During Covid |
| Greater Western Sydney | 0.585366 | 0.444444 | Greater Western Sydney | Before Covid |
| Hawthorn | 0.525000 | 0.352941 | Hawthorn | Before Covid |
| Melbourne | 0.522727 | 0.636364 | Melbourne | During Covid |
| North Melbourne | 0.400000 | 0.117647 | North Melbourne | Before Covid |
| Port Adelaide | 0.666667 | 0.750000 | Port Adelaide | During Covid |
| Richmond | 0.822222 | 0.736842 | Richmond | Before Covid |
| St Kilda | 0.475000 | 0.600000 | St Kilda | During Covid |
| Sydney | 0.511628 | 0.600000 | Sydney | During Covid |
| West Coast | 0.782609 | 0.750000 | West Coast | Before Covid |
| Western Bulldogs | 0.595238 | 0.684211 | Western Bulldogs | During Covid |

Figure 21

| attendance | {0, 10000}_home | {10000, 20000}_home | {20000, 30000}_home | {30000, 40000}_home | {40000, 50000}_home | {50000, 60000}_home | {60000, 70000}_home | {70000, 80000}_home | {80000, 90000}_home | {90000, 100000}_home |
|------------------------|-----------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|----------------------|
| homeTeam | | | | | | | | | | |
| Adelaide | 0.000000 | 0.222222 | 0.500000 | 0.789474 | 0.648148 | 0.611111 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Brisbane Lions | 0.666667 | 0.448276 | 0.545455 | 0.285714 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Carlton | 0.333333 | 0.200000 | 0.458333 | 0.400000 | 0.538462 | 0.142857 | 0.000000 | 0.000000 | 0.250000 | 0.000000 |
| Collingwood | 0.800000 | 0.333333 | 0.250000 | 0.521739 | 0.473684 | 0.733333 | 0.416667 | 0.307692 | 0.800000 | 1.000000 |
| Essendon | 0.142857 | 0.333333 | 0.454545 | 0.592593 | 0.428571 | 0.571429 | 0.500000 | 1.000000 | 0.600000 | 0.500000 |
| Fremantle | 0.333333 | 0.500000 | 0.631579 | 0.676471 | 0.529412 | 0.333333 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Geelong | 0.833333 | 1.000000 | 0.886792 | 0.842105 | 0.500000 | 0.750000 | 0.500000 | 0.500000 | 1.000000 | 0.000000 |
| Gold Coast | 0.300000 | 0.375000 | 0.500000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Greater Western Sydney | 0.472727 | 0.630435 | 0.200000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Hawthorn | 0.454545 | 0.777778 | 0.625000 | 0.615385 | 0.888889 | 1.000000 | 0.363636 | 0.900000 | 0.666667 | 0.000000 |
| Melbourne | 0.500000 | 0.125000 | 0.464286 | 0.363636 | 0.500000 | 0.428571 | 0.500000 | 0.500000 | 0.000000 | 1.000000 |
| North Melbourne | 0.250000 | 0.727273 | 0.448276 | 0.470588 | 0.444444 | 0.000000 | 0.000000 | 1.000000 | 0.000000 | 0.000000 |
| Port Adelaide | 1.000000 | 0.588235 | 0.565217 | 0.657895 | 0.520000 | 0.571429 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Richmond | 1.000000 | 0.600000 | 0.500000 | 0.692308 | 0.692308 | 0.666667 | 0.625000 | 0.714286 | 0.714286 | 0.571429 |
| St Kilda | 0.555556 | 0.500000 | 0.428571 | 0.400000 | 0.333333 | 0.500000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Sydney | 0.454545 | 1.000000 | 0.794872 | 0.566038 | 0.428571 | 1.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| West Coast | 1.000000 | 1.000000 | 0.750000 | 0.666667 | 0.764706 | 0.791667 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Western Bulldogs | 0.823529 | 0.466667 | 0.441860 | 0.578947 | 0.714286 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |

Figure 22

| attendance | 1 | (10000, 20000]_away | (20000, 30000]_away | (30000, 40000]_away | (40000, 50000]_away | (50000, 60000]_away | (60000, 70000]_away | (70000, 80000]_away | (80000, 90000]_away | (90000, 100000]_away |
|------------------------|---|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|----------------------|
| homeTeam | | | | | | | | | | |
| Adelaide | | 0.600000 | 0.476190 | 0.520000 | 0.300000 | 0.285714 | 0.500000 | 0.000000 | 0.000000 | 0.000000 |
| Brisbane Lions | | 0.538462 | 0.218750 | 0.185185 | 0.333333 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Carlton | | 0.315789 | 0.461538 | 0.218750 | 0.076923 | 0.250000 | 0.400000 | 0.750000 | 0.000000 | 0.500000 |
| Collingwood | | 0.545455 | 0.636364 | 0.560000 | 0.692308 | 0.294118 | 0.818182 | 0.428571 | 0.428571 | 0.750000 |
| Essendon | | 0.588235 | 0.307692 | 0.400000 | 0.423077 | 0.400000 | 0.200000 | 0.500000 | 0.142857 | 0.000000 |
| Fremantle | | 0.518519 | 0.250000 | 0.500000 | 0.312500 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Geelong | | 0.583333 | 0.416667 | 0.464286 | 0.857143 | 0.384615 | 0.714286 | 0.333333 | 0.000000 | 0.000000 |
| Gold Coast | | 0.291667 | 0.172414 | 0.090909 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Greater Western Sydney | | 0.379310 | 0.333333 | 0.318182 | 0.250000 | 0.000000 | 1.000000 | 0.500000 | 0.000000 | 0.000000 |
| Hawthorn | | 0.333333 | 0.611111 | 0.653846 | 0.714286 | 0.538462 | 0.333333 | 0.428571 | 0.250000 | 0.666667 |
| Melbourne | | 0.333333 | 0.217391 | 0.384615 | 0.562500 | 0.444444 | 0.000000 | 0.000000 | 0.000000 | 1.000000 |
| North Melbourne | | 0.473684 | 0.611111 | 0.406250 | 0.250000 | 0.200000 | 1.000000 | 0.000000 | 0.000000 | 1.000000 |
| Port Adelaide | | 0.520000 | 0.476190 | 0.333333 | 0.416667 | 0.285714 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Richmond | | 0.428571 | 0.666667 | 0.482759 | 0.500000 | 0.400000 | 0.800000 | 0.666667 | 0.800000 | 1.000000 |
| St Kilda | | 0.440000 | 0.421053 | 0.281250 | 0.071429 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Sydney | | 0.764706 | 0.677419 | 0.608696 | 0.500000 | 0.500000 | 0.750000 | 0.500000 | 0.000000 | 1.000000 |
| West Coast | | 0.590909 | 0.535714 | 0.500000 | 0.416667 | 0.400000 | 0.333333 | 0.000000 | 0.000000 | 0.000000 |
| Western Bulldogs | | 0.166667 | 0.482759 | 0.500000 | 0.437500 | 0.000000 | 0.500000 | 0.000000 | 1.000000 | 1.000000 |