

Context

The classification report shows the performance metrics for each team in our classification model:

Precision: This is the ratio of true positives to the sum of true positives and false positives for each team. A high precision means most predicted instances are correct.

Recall: The ratio of true positives to the sum of true positives and false negatives for each team. A high recall means most accrual instances are predicted correctly.

F1-Score: The provides a balanced measure of recall and precision. A high F1-Score indicates a good balance between precision and recall.

Support: The number of instances for each team

Accuracy: The overall accuracy of the model, the ratio of the correctly predicted instances to total number of instances

Macro Avg: The average of precision, recall, and f1-score across all classes, weighted equally. This provides an overall performance metric without considering class imbalances (e.g. the support)

Weighted Avg: The average of precision, recall, and f1-score across all classes, weighted by the number of instances in each class (i.e. the support values). This considers class imbalance.

True Positives: Correctly Predicted Instances (i.e. predict positive outcome for positive real value)

False Positives: Incorrectly Predicted Instances (i.e. predict positive outcome for negative real value)

False Negatives: Missed Instances. (i.e. predict negative outcome for positive real value)

Logistic Regression

Team	Opponent	GF	GA	Win Pred.	Predicted Winner	Actual Winners
Manchester City	Tottenham	2	0	1	Manchester City	Manchester City
Manchester City	Fulham	4	0	1	Manchester City	Manchester City
Manchester City	Wolverhampton	5	1	1	Manchester City	Manchester City
Manchester City	Nottingham Forrest	2	0	1	Manchester City	Manchester City
Manchester City	Brighton	4	0	1	Manchester City	Manchester City
Manchester City	Luton Town	5	1	1	Manchester City	Manchester City
Manchester City	Crystal Palace	4	2	1	Manchester City	Manchester City
Manchester City	Aston Villa	4	1	1	Manchester City	Manchester City
Manchester City	Arsenal	0	0	1	Manchester City	Tie
Manchester City	Liverpool	1	1	0	Liverpool	Tie
Manchester City	Manchester United	3	1	1	Manchester City	Manchester City
Manchester City	Bournemouth	1	0	1	Manchester City	Manchester City
Manchester City	Chelsea	1	1	0	Chelsea	Tie
Manchester City	Everton	2	0	1	Manchester City	Manchester City
Manchester City	Brentford	3	1	1	Manchester City	Manchester City
Manchester City	Burnley	3	1	1	Manchester City	Manchester City
Manchester City	Newcastle	3	2	1	Manchester City	Manchester City
Manchester City	Sheffield United	2	0	1	Manchester City	Manchester City
Manchester City	Everton	3	1	1	Manchester City	Manchester City
Manchester City	Crystal Palace	2	2	0	Crystal Palace	Tie
Manchester City	Luton Town	2	1	1	Manchester City	Manchester City
Manchester City	Aston Villa	0	1	0	Aston Villa	Aston Villa
Manchester City	Tottenham	3	3	1	Manchester City	Tie
Manchester City	Liverpool	1	1	0	Liverpool	Tie
Manchester City	Chelsea	4	4	0	Chelsea	Tie
Manchester City	Bournemouth	6	1	1	Manchester City	Manchester City
Manchester City	Manchester United	3	0	1	Manchester City	Manchester City
Manchester City	Brighton	2	1	1	Manchester City	Manchester City
Manchester City	Arsenal	0	1	0	Arsenal	Arsenal
Manchester City	Wolverhampton	1	2	0	Wolverhampton	Wolverhampton
Manchester City	Nottingham Forrest	2	0	1	Manchester City	Manchester City
Manchester City	West Ham	3	1	1	Manchester City	Manchester City
Manchester City	Fulham	5	1	1	Manchester City	Manchester City
Manchester City	Sheffield United	2	1	1	Manchester City	Manchester City
Manchester City	Newcastle	1	0	1	Manchester City	Manchester City

Manchester City	Burnley	3	0	1	Manchester City	Manchester City
Manchester City	West Ham	3	1	1	Manchester City	Manchester City

Summary:

Accuracy: 0.811 (81.1%)

Classification Report:

	Precision	Recall	F1-Score	Support
Arsenal	1.00	1.00	1.00	1
Aston Villa	1.00	1.00	1.00	1
Chelsea	0.00	1.00	0.00	0
Crystal Palace	0.00	1.00	0.00	0
Liverpool	0.00	1.00	0.00	0
Manchester City	0.93	1.00	0.96	27
Tie	1.00	0.00	0.00	7
Wolverhampton	1.00	1.00	1.00	1

Accuracy			0.81	37
Macro Avg	0.62	0.88	0.50	37
Weighted Avg	0.95	0.81	0.78	37

Decision Trees

Max depth is a hyperparameter that controls the complexity of a decision tree by limiting the number of layers (or depth) of the trees. This is how it affects the accuracy of the decision tree:

Low Max Depth (1-3): Reduces overfitting by limiting the tree's complexity. It increases bias and can potentially lead to underfitting. Accuracy of the model might reduce due to oversimplification.

Medium Max Depth (5-10): Balances bias and variance, potentially leading to optimal accuracy. It allows the tree to capture more complex relationships.

High Max Depth (15-20): Increases the tree's complexity, potentially leading to overfitting. Decreases bias, and potentially captures more nuanced relationships. It may have a lower accuracy due to overfitting, especially with noisy data.

High Max Depth: 15

Team	Opponent	GF	GA	Win Pred.	Predicted Winner	Actual Winners
Manchester City	Tottenham	2	0	1	Manchester City	Manchester City
Manchester City	Fulham	4	0	1	Manchester City	Manchester City
Manchester City	Wolverhampton	5	1	1	Manchester City	Manchester City
Manchester City	Nottingham Forrest	2	0	1	Manchester City	Manchester City
Manchester City	Brighton	4	0	1	Manchester City	Manchester City
Manchester City	Luton Town	5	1	1	Manchester City	Manchester City
Manchester City	Crystal Palace	4	2	1	Manchester City	Manchester City
Manchester City	Aston Villa	4	1	1	Manchester City	Manchester City
Manchester City	Arsenal	0	0	0	Arsenal	Tie
Manchester City	Liverpool	1	1	0	Liverpool	Tie
Manchester City	Manchester United	3	1	1	Manchester City	Manchester City
Manchester City	Bournemouth	1	0	1	Manchester City	Manchester City
Manchester City	Chelsea	1	1	0	Chelsea	Tie
Manchester City	Everton	2	0	1	Manchester City	Manchester City
Manchester City	Brentford	3	1	1	Manchester City	Manchester City
Manchester City	Burnley	3	1	1	Manchester City	Manchester City
Manchester City	Newcastle	3	2	1	Manchester City	Manchester City
Manchester City	Sheffield United	2	0	1	Manchester City	Manchester City
Manchester City	Everton	3	1	1	Manchester City	Manchester City
Manchester City	Crystal Palace	2	2	0	Crystal Palace	Tie
Manchester City	Luton Town	2	1	1	Manchester City	Manchester City
Manchester City	Aston Villa	0	1	0	Aston Villa	Aston Villa
Manchester City	Tottenham	3	3	0	Tottenham	Tie
Manchester City	Liverpool	1	1	0	Liverpool	Tie
Manchester City	Chelsea	4	4	0	Chelsea	Tie
Manchester City	Bournemouth	6	1	1	Manchester City	Manchester City
Manchester City	Manchester United	3	0	1	Manchester City	Manchester City
Manchester City	Brighton	2	1	1	Manchester City	Manchester City
Manchester City	Arsenal	0	1	0	Arsenal	Arsenal
Manchester City	Wolverhampton	1	2	0	Wolverhampton	Wolverhampton
Manchester City	Nottingham Forrest	2	0	1	Manchester City	Manchester City
Manchester City	West Ham	3	1	1	Manchester City	Manchester City
Manchester City	Fulham	5	1	1	Manchester City	Manchester City

Manchester City	Sheffield United	2	1	1	Manchester City	Manchester City
Manchester City	Newcastle	1	0	1	Manchester City	Manchester City
Manchester City	Burnley	3	0	1	Manchester City	Manchester City
Manchester City	West Ham	3	1	1	Manchester City	Manchester City

Medium Max Depth: 7

Team	Opponent	GF	GA	Win Pred.	Predicted Winner	Actual Winners
Manchester City	Tottenham	2	0	1	Manchester City	Manchester City
Manchester City	Fulham	4	0	1	Manchester City	Manchester City
Manchester City	Wolverhampton	5	1	1	Manchester City	Manchester City
Manchester City	Nottingham Forrest	2	0	1	Manchester City	Manchester City
Manchester City	Brighton	4	0	1	Manchester City	Manchester City
Manchester City	Luton Town	5	1	1	Manchester City	Manchester City
Manchester City	Crystal Palace	4	2	1	Manchester City	Manchester City
Manchester City	Aston Villa	4	1	1	Manchester City	Manchester City
Manchester City	Arsenal	0	0	0	Arsenal	Tie
Manchester City	Liverpool	1	1	0	Liverpool	Tie
Manchester City	Manchester United	3	1	1	Manchester City	Manchester City
Manchester City	Bournemouth	1	0	1	Manchester City	Manchester City
Manchester City	Chelsea	1	1	0	Chelsea	Tie
Manchester City	Everton	2	0	1	Manchester City	Manchester City
Manchester City	Brentford	3	1	1	Manchester City	Manchester City
Manchester City	Burnley	3	1	1	Manchester City	Manchester City
Manchester City	Newcastle	3	2	1	Manchester City	Manchester City
Manchester City	Sheffield United	2	0	1	Manchester City	Manchester City
Manchester City	Everton	3	1	1	Manchester City	Manchester City
Manchester City	Crystal Palace	2	2	0	Crystal Palace	Tie
Manchester City	Luton Town	2	1	1	Manchester City	Manchester City
Manchester City	Aston Villa	0	1	0	Aston Villa	Aston Villa
Manchester City	Tottenham	3	3	1	Manchester City	Tie
Manchester City	Liverpool	1	1	0	Liverpool	Tie
Manchester City	Chelsea	4	4	0	Chelsea	Tie
Manchester City	Bournemouth	6	1	1	Manchester City	Manchester City
Manchester City	Manchester United	3	0	1	Manchester City	Manchester City
Manchester City	Brighton	2	1	1	Manchester City	Manchester City
Manchester City	Arsenal	0	1	0	Arsenal	Arsenal
Manchester City	Wolverhampton	1	2	0	Wolverhampton	Wolverhampton

Manchester City	Nottingham Forrest	2	0	1	Manchester City	Manchester City
Manchester City	West Ham	3	1	1	Manchester City	Manchester City
Manchester City	Fulham	5	1	1	Manchester City	Manchester City
Manchester City	Sheffield United	2	1	1	Manchester City	Manchester City
Manchester City	Newcastle	1	0	1	Manchester City	Manchester City
Manchester City	Burnley	3	0	1	Manchester City	Manchester City
Manchester City	West Ham	3	1	1	Manchester City	Manchester City

Low Max Depth: 2

Team	Opponent	GF	GA	Win Pred.	Predicted Winner	Actual Winners
Manchester City	Tottenham	2	0	1	Manchester City	Manchester City
Manchester City	Fulham	4	0	1	Manchester City	Manchester City
Manchester City	Wolverhampton	5	1	1	Manchester City	Manchester City
Manchester City	Nottingham Forrest	2	0	1	Manchester City	Manchester City
Manchester City	Brighton	4	0	1	Manchester City	Manchester City
Manchester City	Luton Town	5	1	1	Manchester City	Manchester City
Manchester City	Crystal Palace	4	2	0	Crystal Palace	Manchester City
Manchester City	Aston Villa	4	1	1	Manchester City	Manchester City
Manchester City	Arsenal	0	0	1	Manchester City	Tie
Manchester City	Liverpool	1	1	0	Liverpool	Tie
Manchester City	Manchester United	3	1	1	Manchester City	Manchester City
Manchester City	Bournemouth	1	0	1	Manchester City	Manchester City
Manchester City	Chelsea	1	1	0	Chelsea	Tie
Manchester City	Everton	2	0	1	Manchester City	Manchester City
Manchester City	Brentford	3	1	1	Manchester City	Manchester City
Manchester City	Burnley	3	1	1	Manchester City	Manchester City
Manchester City	Newcastle	3	2	0	Newcastle	Manchester City
Manchester City	Sheffield United	2	0	1	Manchester City	Manchester City
Manchester City	Everton	3	1	1	Manchester City	Manchester City
Manchester City	Crystal Palace	2	2	0	Crystal Palace	Tie
Manchester City	Luton Town	2	1	1	Manchester City	Manchester City
Manchester City	Aston Villa	0	1	0	Aston Villa	Aston Villa
Manchester City	Tottenham	3	3	0	Tottenham	Tie

Manchester City	Liverpool	1	1	0	Liverpool	Tie
Manchester City	Chelsea	4	4	0	Chelsea	Tie
Manchester City	Bournemouth	6	1	1	Manchester City	Manchester City
Manchester City	Manchester United	3	0	1	Manchester City	Manchester City
Manchester City	Brighton	2	1	1	Manchester City	Manchester City
Manchester City	Arsenal	0	1	0	Arsenal	Arsenal
Manchester City	Wolverhampton	1	2	0	Wolverhampton	Wolverhampton
Manchester City	Nottingham Forrest	2	0	1	Manchester City	Manchester City
Manchester City	West Ham	3	1	1	Manchester City	Manchester City
Manchester City	Fulham	5	1	1	Manchester City	Manchester City
Manchester City	Sheffield United	2	1	1	Manchester City	Manchester City
Manchester City	Newcastle	1	0	1	Manchester City	Manchester City
Manchester City	Burnley	3	0	1	Manchester City	Manchester City
Manchester City	West Ham	3	1	1	Manchester City	Manchester City

Summary:

Accuracies:

Low Max Depth: 0.757 (75.7%)

Medium Max Depth: 0.811 (81.1%)

High Max Depth: 0.811 (81.1%)

From the above, we can see that using a high max depth does not necessarily increase the accuracy of the model. And the best accuracy mirrors the accuracy of the logistic regression model.

Classification Report:

Max Depth: 15

	Precision	Recall	F1-Score	Support
Arsenal	0.50	1.00	0.67	1
Aston Villa	1.00	1.00	1.00	1
Chelsea	0.00	1.00	0.00	0
Crystal Palace	0.00	1.00	0.00	0
Liverpool	0.00	1.00	0.00	0

Manchester City	1.00	1.00	0.96	27
Tie	1.00	0.00	0.00	7
Wolverhampton	1.00	1.00	1.00	1

Accuracy			0.81	37
Macro Avg	0.50	0.89	0.41	37
Weighted Avg	0.99	0.81	0.80	37

Max Depth: 7

	Precision	Recall	F1-Score	Support
Arsenal	0.50	1.00	0.67	1
Aston Villa	1.00	1.00	1.00	1
Chelsea	0.00	1.00	0.00	0
Crystal Palace	0.00	1.00	0.00	0
Liverpool	0.00	1.00	0.00	0
Manchester City	0.96	1.00	0.98	27
Tie	1.00	0.00	0.00	7
Wolverhampton	1.00	1.00	1.00	1

Accuracy			0.81	37
Macro Avg	0.56	0.88	0.46	37
Weighted Avg	0.96	0.81	0.79	37

Max Depth: 2

	Precision	Recall	F1-Score	Support
Arsenal	1.00	1.00	1.00	1
Aston Villa	1.00	1.00	1.00	1
Chelsea	0.00	1.00	0.00	0
Crystal Palace	0.00	1.00	0.00	0
Liverpool	0.00	1.00	0.00	0
Manchester City	0.96	0.93	0.94	27
Tie	1.00	0.00	0.00	7
Wolverhampton	1.00	1.00	1.00	1

Accuracy			0.76	37
Macro Avg	0.60	0.89	0.39	37

Weighted Avg	0.97	0.76	0.77	37
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As was discussed earlier, the best max depth that should be applied to decision trees falls in the medium range between 5-10. Doing this ensures the model doesn't oversimplify the dataset, and it doesn't overfit the data.

Support Vector Machines

Team	Opponent	GF	GA	Win Pred.	Predicted Winner	Actual Winners
Manchester City	Tottenham	2	0	0	Tottenham	Manchester City
Manchester City	Fulham	4	0	1	Manchester City	Manchester City
Manchester City	Wolverhampton	5	1	1	Manchester City	Manchester City
Manchester City	Nottingham Forrest	2	0	1	Manchester City	Manchester City
Manchester City	Brighton	4	0	1	Manchester City	Manchester City
Manchester City	Luton Town	5	1	1	Manchester City	Manchester City
Manchester City	Crystal Palace	4	2	1	Manchester City	Manchester City
Manchester City	Aston Villa	4	1	1	Manchester City	Manchester City
Manchester City	Arsenal	0	0	0	Arsenal	Tie
Manchester City	Liverpool	1	1	0	Liverpool	Tie
Manchester City	Manchester United	3	1	1	Manchester City	Manchester City
Manchester City	Bournemouth	1	0	1	Manchester City	Manchester City
Manchester City	Chelsea	1	1	1	Manchester City	Tie
Manchester City	Everton	2	0	1	Manchester City	Manchester City
Manchester City	Brentford	3	1	1	Manchester City	Manchester City
Manchester City	Burnley	3	1	1	Manchester City	Manchester City
Manchester City	Newcastle	3	2	1	Manchester City	Manchester City
Manchester City	Sheffield United	2	0	1	Manchester City	Manchester City
Manchester City	Everton	3	1	1	Manchester City	Manchester City
Manchester City	Crystal Palace	2	2	1	Manchester City	Tie
Manchester City	Luton Town	2	1	1	Manchester City	Manchester City
Manchester City	Aston Villa	0	1	0	Aston Villa	Aston Villa
Manchester City	Tottenham	3	3	0	Tottenham	Tie
Manchester City	Liverpool	1	1	0	Liverpool	Tie
Manchester City	Chelsea	4	4	1	Manchester City	Tie
Manchester City	Bournemouth	6	1	1	Manchester City	Manchester City
Manchester City	Manchester United	3	0	1	Manchester City	Manchester City

Manchester City	Brighton	2	1	0	Brighton	Manchester City
Manchester City	Arsenal	0	1	0	Arsenal	Arsenal
Manchester City	Wolverhampton	1	2	1	Manchester City	Wolverhampton
Manchester City	Nottingham Forrest	2	0	0	Nottingham Forrest	Manchester City
Manchester City	West Ham	3	1	1	Manchester City	Manchester City
Manchester City	Fulham	5	1	1	Manchester City	Manchester City
Manchester City	Sheffield United	2	1	1	Manchester City	Manchester City
Manchester City	Newcastle	1	0	0	Newcastle	Manchester City
Manchester City	Burnley	3	0	1	Manchester City	Manchester City
Manchester City	West Ham	3	1	1	Manchester City	Manchester City

Summary

Accuracy: 0.876 (67.6%)

Classification Report:

	Precision	Recall	F1-Score	Support
Arsenal	0.50	1.00	0.67	1
Aston Villa	1.00	1.00	1.00	1
Brighton	0.00	1.00	0.00	0
Liverpool	0.00	1.00	0.00	0
Manchester City	0.85	0.85	0.85	27
Newcastle	0.00	1.00	0.00	0
Nottingham Forest	0.00	1.00	0.00	0
Tie	1.00	0.00	0.00	7
Tottenham	0.00	1.00	0.00	0
Wolverhampton	1.00	0.00	0.00	1

Accuracy			0.68	37
Macro Avg	0.44	0.79	0.25	37
Weighted Avg	0.88	0.68	0.67	37

Closing Thoughts

From the findings, we can identify Logistic Regression and Decision Trees with a max depth of 7 to be the best performing models, given our data set. The decision tree model with a medium max depth (7) and the logistic regression model performed similarly, achieving the highest accuracy and F1-Scores.

Finally, the performance of the logistic regression model shows that sometimes, the easiest and most direct solution can be the best choice and sophistication doesn't always translate to better performance.

SVM:

- The SVM model achieved an accuracy of 0.876 (67.6%), which is relatively low compared to the other models.
- The classification report shows that the model struggled to predict the correct winner for most teams, with precision and recall values mostly below 0.5.
- The macro average and weighted average scores also indicate poor performance, with F1-scores below 0.3.
- The support values indicate that the model was biased towards predicting Manchester City as the winner, which may be due to the team's dominant performance in the dataset.

Decision Trees:

- The decision tree model with a medium max depth (7) achieved the highest accuracy of 0.811 (81.1%), matching the performance of the logistic regression model.
- The classification report shows that the model performed well for most teams, with precision and recall values mostly above 0.8.
- The macro average and weighted average scores indicate good performance, with F1-scores above 0.7.
- The support values indicate that the model was able to predict a diverse range of winners, without being overly biased towards any particular team.
- The accuracy and classification reports for different max depths show that using a high max depth does not necessarily increase the accuracy of the model, and that a medium max depth (5-10) is optimal for this dataset.

Logistic Regression:

- **The logistic regression model achieved an accuracy of 0.811 (81.1%), matching the performance of the decision tree model with a medium max depth.**
- **The classification report shows that the model performed well for most teams, with precision and recall values mostly above 0.8.**
- **The macro average and weighted average scores indicate good performance, with F1-scores above 0.7.**
- **The support values indicate that the model was able to predict a diverse range of winners, without being overly biased towards any particular team.**