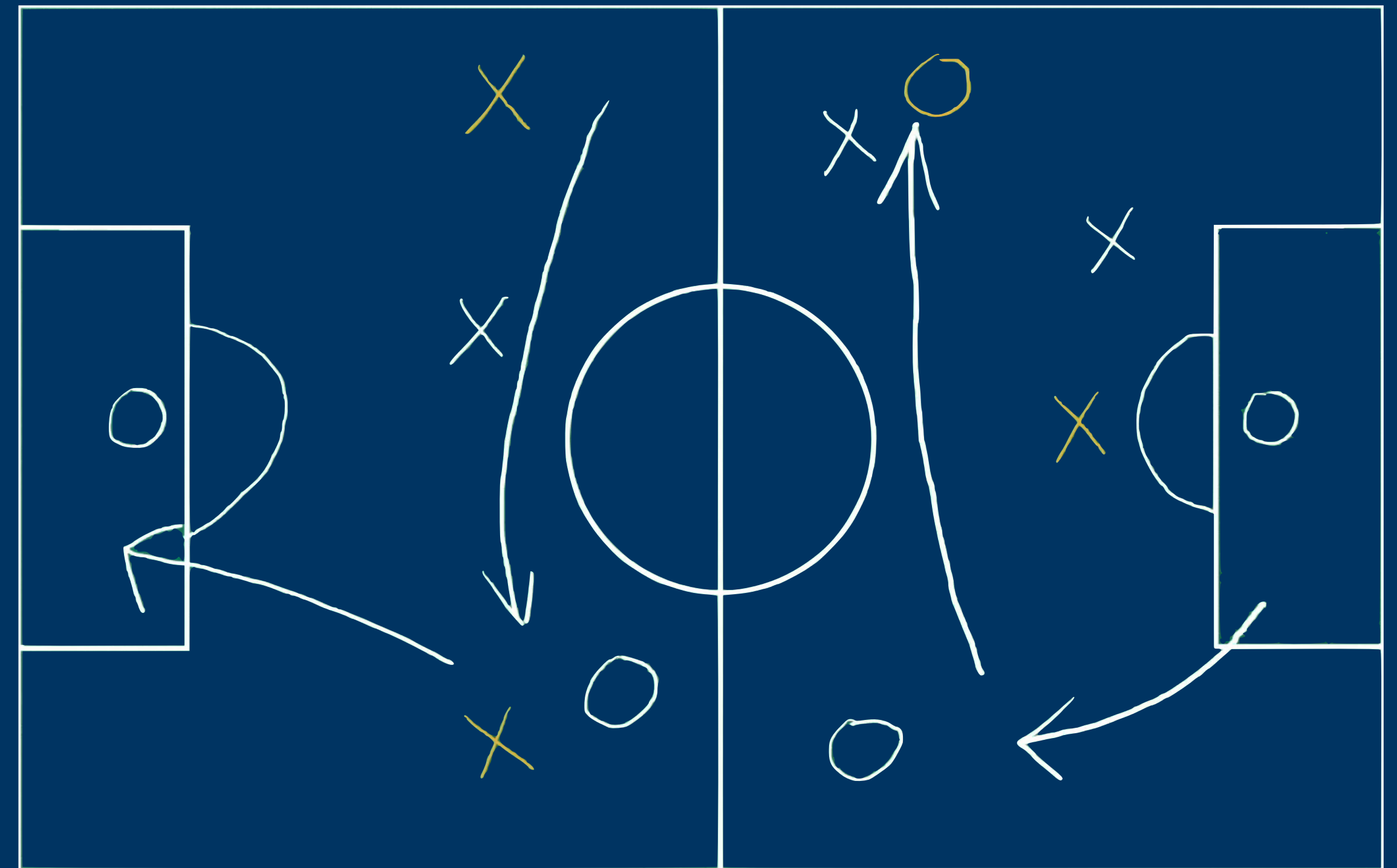


# Monte Carlo Simulation of Fixtures and a Profitable Betting System for the English Premier League

**ACM40960 -**  
***Projects in Maths Modelling***



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# English Premier League

## Background

- ▶ Top level football league in England
- ▶ 20 teams in total
- ▶  $2 \times \binom{20}{2} = 380$  fixtures total
- ▶ Current 20-team format in effect since 95/96 season:
  - 25 complete seasons to date

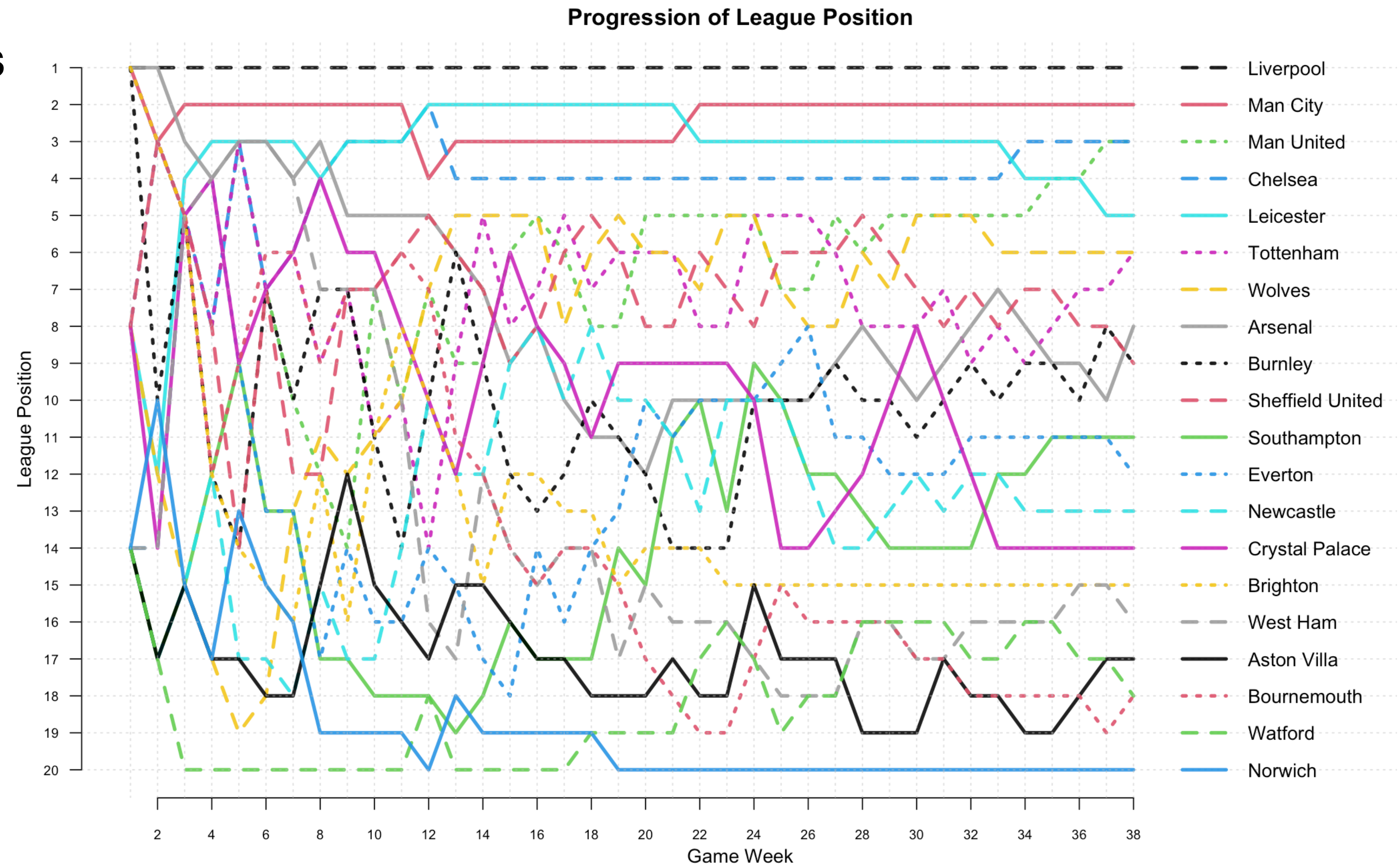


**Premier  
League**

# Simulation of the EPL

## Predicting Fixture Results

- ▶ Win/draw/loss probabilities based primarily on final points from previous season
- ▶ Home advantage should impact probabilities:
  - Home team should have slight advantage over Away team if they both have identical total points
- ▶ Current form also likely to affect probabilities:
  - Need to estimate values for first 5 games of each team
  - Iterative imputation - estimate form based on overall points



Progression of League Positions - EPL 2019/2020 Season



# Simulation of the EPL

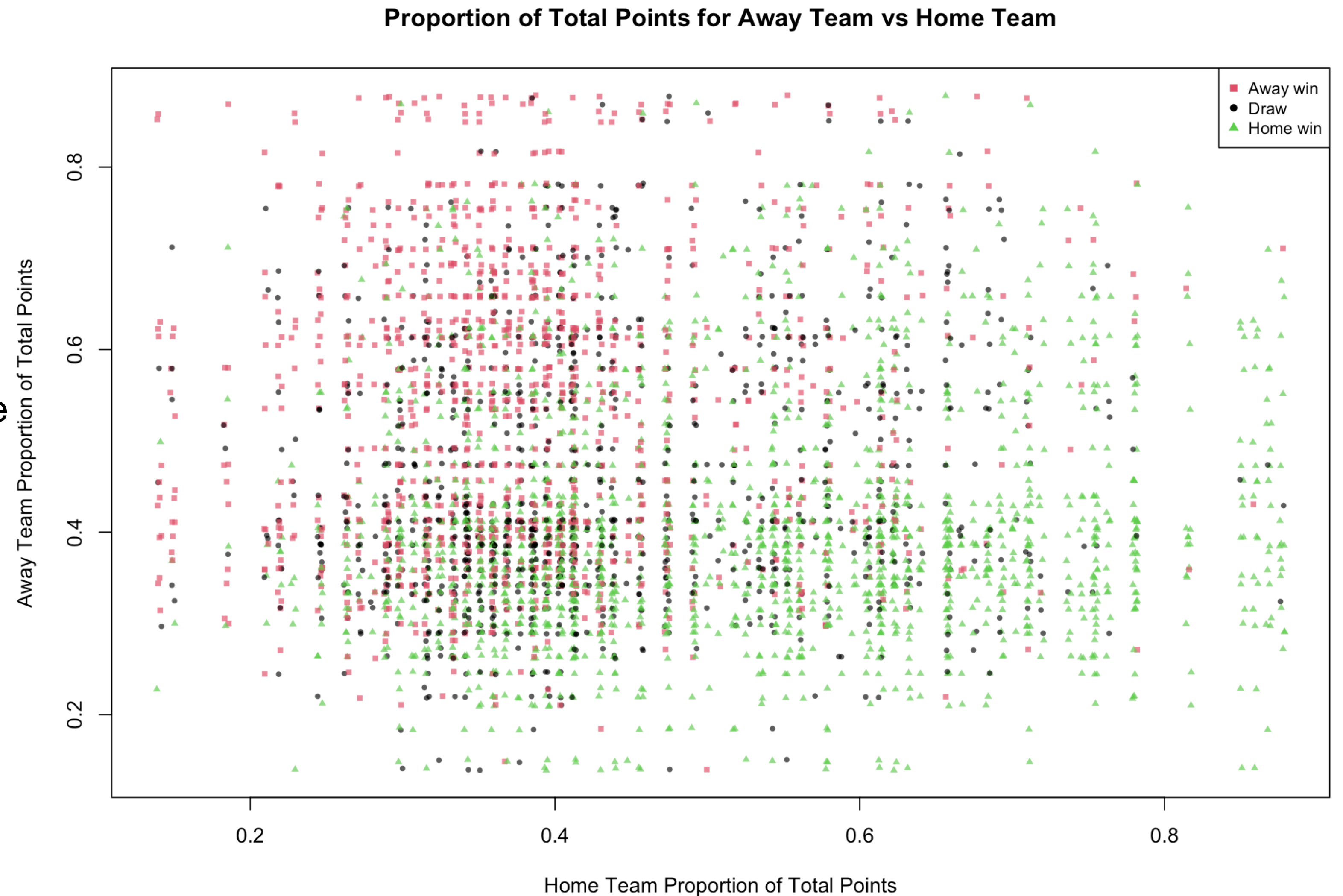
## Monte Carlo Simulation

- ▶ Estimate result probabilities using machine learning classification algorithms:
  - Train/validate/test multiple classification models (25 seasons of data)
  - Multi-class classification models (e.g. LDA, QDA, random forests, boosting)
  - Binary classification models with One-vs-Rest / One-vs-One (e.g. SVM, logistic regression)
- ▶ Use best model to predict probabilities for new fixtures
- ▶ Individual fixtures simulated by random sampling of results using predicted probabilities
- ▶ Monte Carlo simulation of fixtures over multiple seasons:
  - Recalculate proportion of total points for each team after each season

# Simulation of Betting System

## Betting Odds

- ▶ Set up a betting system:
  - Odds based on outcome probabilities calculated for each fixture
  - Marginally adjusted to ensure the house always profits
- ▶ Consider different methods of adjusting predicted odds to ensure marginal gain:
  - Constant margin
  - Normally distributed margin



*Proportion of Total Points for Away vs Home Teams - EPL Seasons 2009-2020 All Fixtures*

# Simulation of Betting System

## Monte Carlo Simulation

- ▶ Simulate multiple bets on each fixture (e.g. 10,000)
- ▶ Randomly set probabilities for proportions of bets placed on each outcome for each fixture
- ▶ Review the distribution of bets on each fixture after specified intervals (e.g. after each 1000 placed bets):
  - If bets are biased towards a particular outcome, consider readjusting odds to cover the house
  - E.g. if 90% of bets are placed on Win, decrease the given odds for a win
- ▶ Consider readjusting probabilities of proportions of bets:
  - reduced odds should reduce interest in betting on that outcome
- ▶ Use results from simulated fixtures to evaluate profitability of the betting system

Thank you!

