Predicting NBA Player Props Using Monte Carlo Simulations

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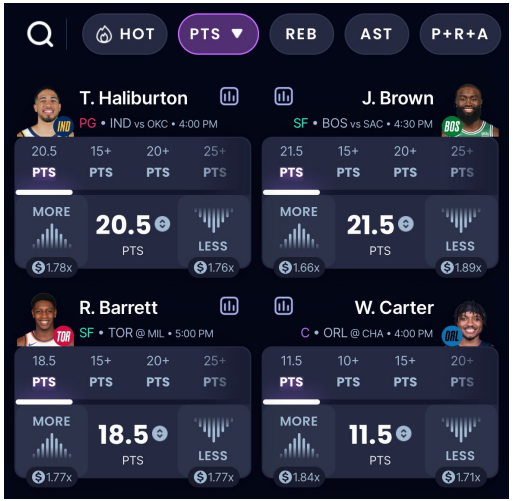
Project Goal: NBA Player Points Props

- Prop betting is a form of sports betting that involves wagering on specific player performances within basketball games
  - Ex: Will LeBron James score over or under 25 points against the Cavaliers?
- These props encompass a wide variety of statistical categories, but this project focuses on points



Example from Sleeper Picks

Monte Carlo Simulations - What are they?

Basic Overview:

- The Monte Carlo methodology involves running thousands of simulations using random sampling techniques to obtain the likelihood of a range of results occurring

Application to Predicting Point Totals:

- By simulating numerous hypothetical games based on season data and player performance metrics, Monte Carlo simulations can provide probabilistic forecasts for player scoring
- For this project, the distributions that I sample from are solely based on the 2023-2024 NBA season

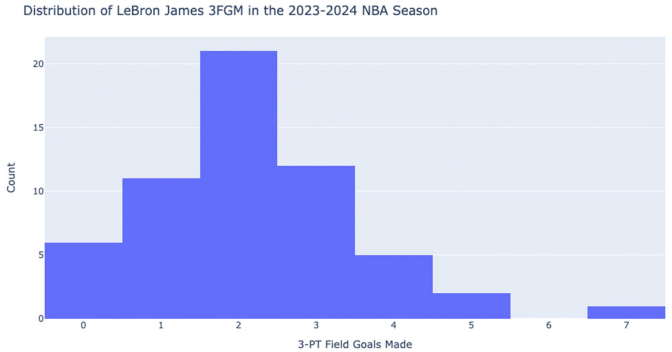
Data Collection and Model Construction

Obtaining Data and Feature Variables:

- Data used for this project consisted of game by game statistics for all players in the league
- Variables used in the final model:
  - 2-PT field goals made (FG2M), 3-PT field goals made (FG3M), Free throws made (FTM) each game for every player
  - FG2M, FG3M, and FTM allowed each game by teams to specific positions

Creating the Distribution:

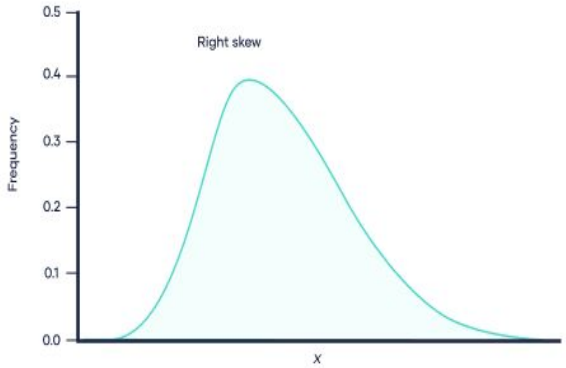
- In order to decide what type of probability distribution to use, I created histograms for each variable. To of them are shown to the right depicting LeBron James' 2FGM and 3FGM this season (as of 3/17/24)

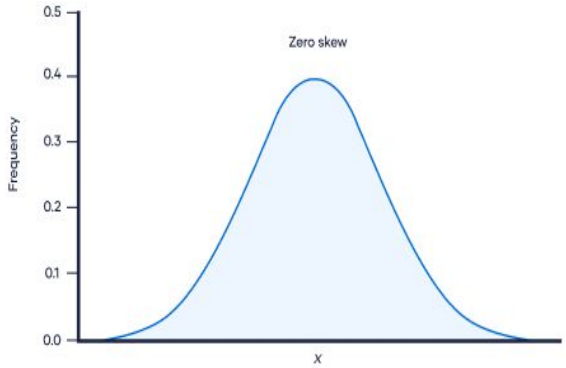


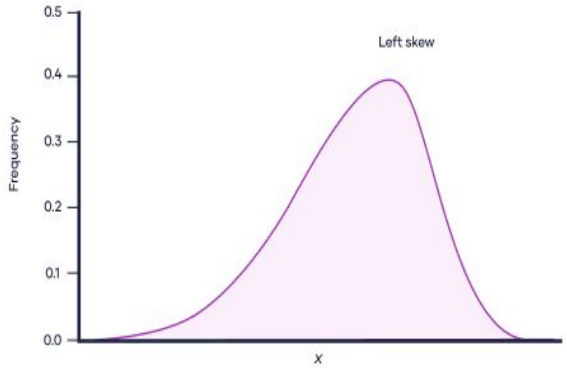
Model Construction Continued

Analyzing the Histograms:

- Based on such histograms, it was determined that a skew normal distribution would best fit our metrics. Using this type of distribution would require the mean, standard deviation, and skewness factor of our data for each variable. To find these values, I simply ran the skewnorm.fit function on this data.







Model Construction Continued

Sampling from our Distributions:

- Having produced these distributions, we proceeded to continuously sample from them for each iteration. For each simulation, we used the following formula to calculate the player's point total:

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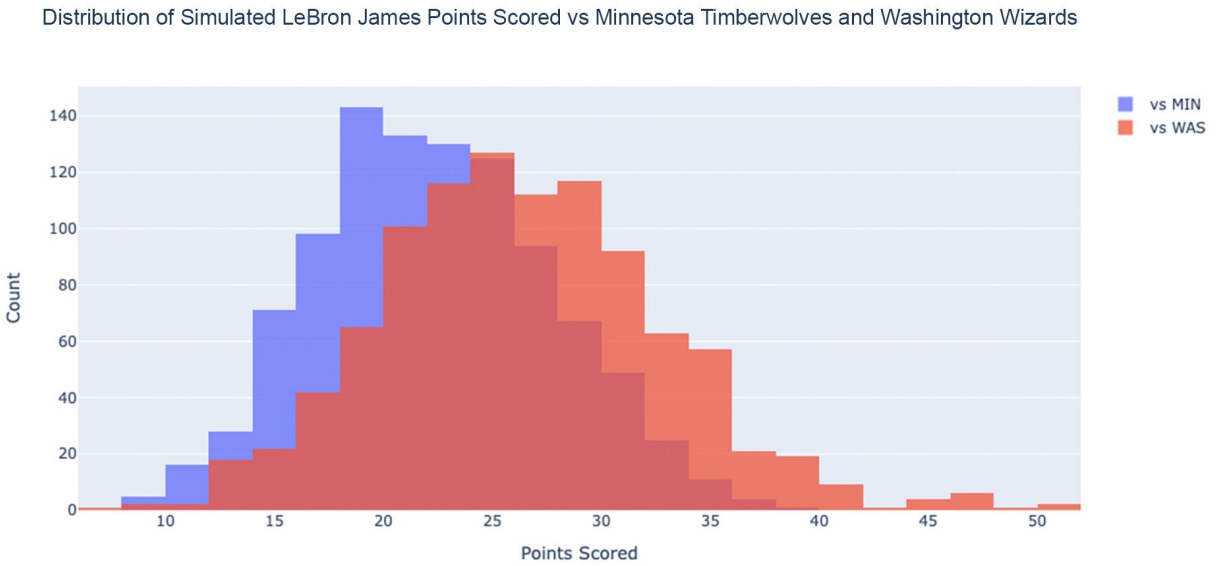
player_points = 2FGM * (2FGM_allowed / league_average_2FGM) * 2) +
                3FGM * (3FGM_allowed / league_average_3FGM) * 3) +
                FTM * (FTM_allowed / league_average_FTM)
```

- Here, 2FGM, 3FGM, and FTM are samples from our skew normal distributions
- We multiply these values by their respective point values as well as constants that represent how many 2FGM, 3FGM, and FTM the opposing team allows to the given player's position in comparison to league average.
- This calculation was run over 1000 simulations

Model Results



The last step was to compute the median of the distribution for each opponent, and this value would be the model's final prediction for a player's point total

Interpreting the Results

Determining Whether to bet on a Point Prop:

- The predicted values could now be compared to prop bets set by oddsmakers. If there is a significant difference between the predicted and actual props, it could signify an opportunity to place a bet
- For example, shown below are the top 5 largest differences in predicted vs actual props for featured players on March 17th's slate of games. All props listed are from Sleeper Picks. This chart tells us that these 5 players are most likely to score more their point props, suggesting that bettors should take the over on them.

NBA Player Point Props vs Predictions (3/17/24)

Actual Prop Totals from Sleeper Picks

Player	Opp	Predicted Points	Actual Prop	Difference
Kevin Durant	MIL	27.84876	24.5	*3.348762*
Damian Lillard	PHX	24.64812	22.5	*2.148120*
Paolo Banchero	TOR	23.76033	22.5	*1.260332*
Paul George	ATL	24.92235	23.5	*1.422347*
Luka Doncic	DEN	32.42831	31.5	*0.928305*

Concluding Thoughts

- Although we were able to successfully create a working betting model, it's important to note that there is much more detail and complexity that goes into this process, and it's still extremely risky to trust any such predictor.

- However, through Monte Carlo simulations, we're able to navigate some of those uncertainties, providing a valuable tool for bettors seeking to make more informed decisions in the world of NBA player prop betting.

Thank you!