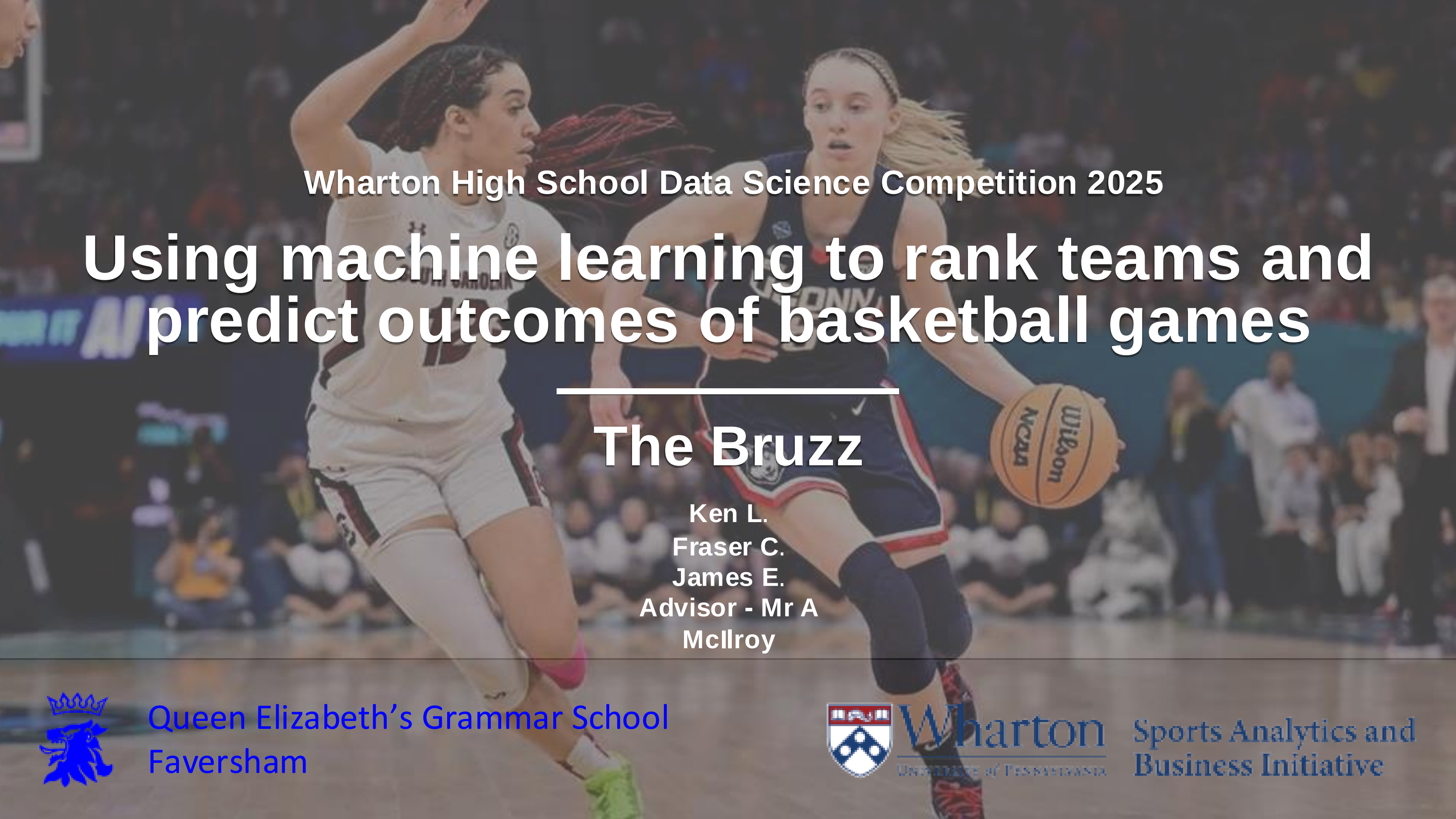

Wharton High School Data Science Competition 2025

Using machine learning to rank teams and predict outcomes of basketball games

The Bruzz

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Introduction and Background Research

- Previously, Stanford won the 2021 Women's NCAA title, beating Arizona 54-53.
- Many high level players competing
- Analysts predict NCAA basketball outcomes using statistical models, machine learning, expert polls, and tools like KenPom for team efficiency.
- Bracket simulations also help, but the unpredictable nature of the tournament makes predictions difficult.

Sources: ESPN, collegeinsider.com, analytics8.com

Research Question - Can Machine Learning effectively be used in sports?

- Binary classification problem (two outcomes/labels)
  - In basketball, games can only result in a win or loss due to overtime rules.
- We decided that a machine learning classification algorithm can be employed
  - These algorithms also produce, quantitative results which can be interpreted as probabilities.

LLMs

- Used ChatGPT to develop 4 models
  - XGBoost
  - Logistic regression
  - Naive Bayes
  - Random Forest

Definition:
Classification Algorithms try to predict the correct label of given input data.

Methodology - Data Cleaning, Transformation and Analysis

Data Cleaning

- Aggregate match data
- Non-D1 team data was excluded
- NBA level statistics
- Lead Retention Rate

$$\text{LRR} = \frac{\text{Final Score Differential (team score - opponent score)}}{\text{Largest Lead}}$$

Data Transformation

- Machine Learning models perform better with strong linear correlations
- Weaker correlations can be transformed using polynomial and log functions

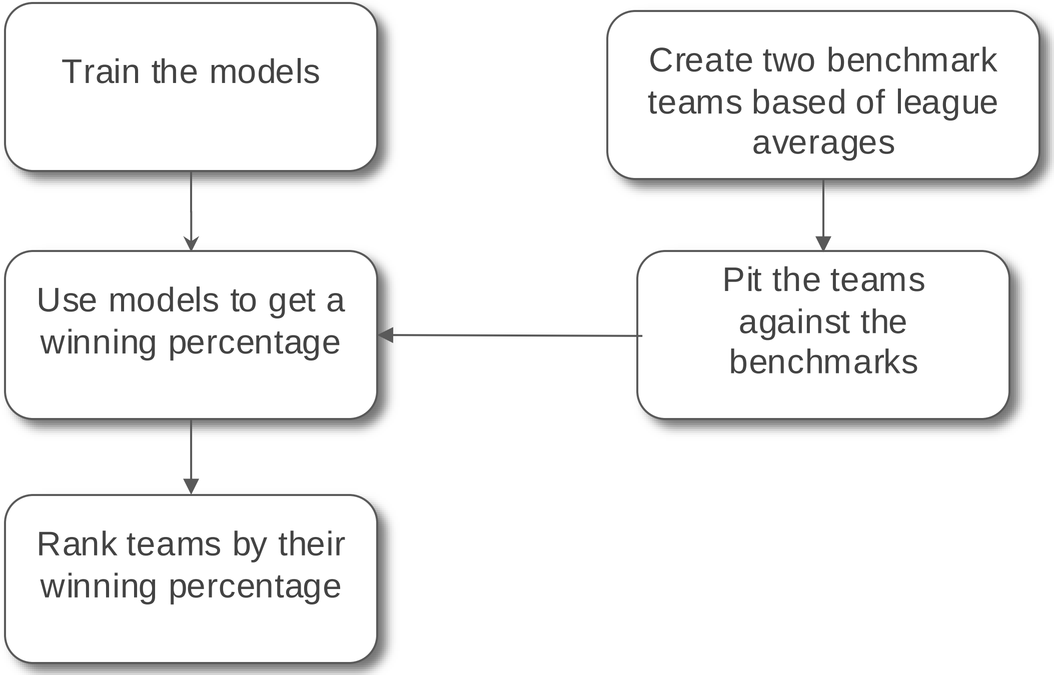
Correlation Analysis

- Analyse and evaluate the relationship between variables.
- Spearman’s rank correlation coefficient
- Select the most correlated variables to use as inputs in our models.

Methodology - Ranking systems

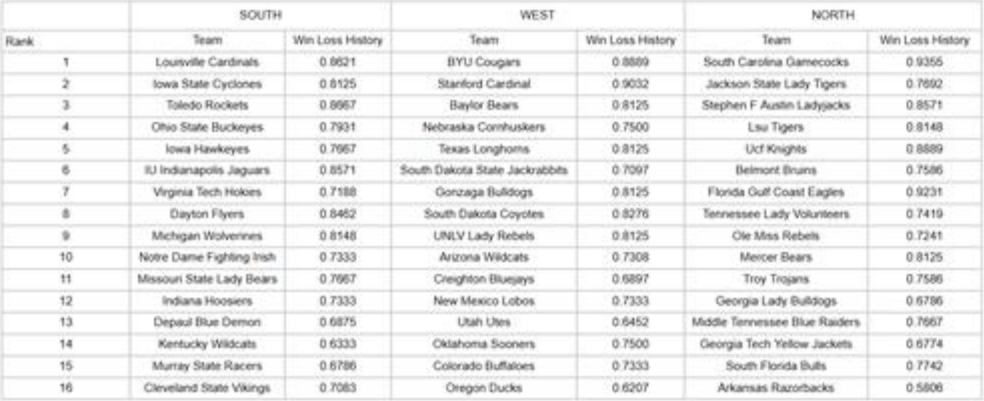
- Many sports use ELO systems (point allocation)
- A system that uses our machine learning algorithms
- Benchmark teams
  - League Average
  - Region Average

Ranking System

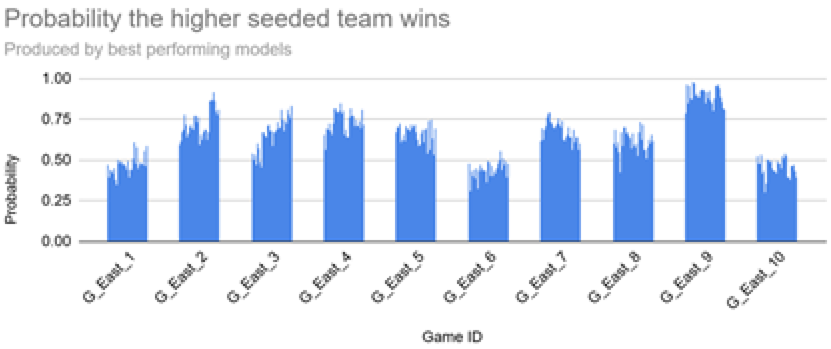

Train the models
Create two benchmark teams based of league averages
Use models to get a winning percentage
Pit the teams against the benchmarks
Rank teams by their winning percentage

Results

Results



	SOUTH		WEST		NORTH	
Rank	Team	Win Loss History	Team	Win Loss History	Team	Win Loss History
1	Louisville Cardinals	0.8621	BYU Cougars	0.8889	South Carolina Gamecocks	0.9355
2	Iowa State Cyclones	0.8125	Stanford Cardinal	0.9032	Jackson State Lady Tigers	0.7692
3	Toledo Rockets	0.8667	Baylor Bears	0.8125	Stephen F Austin Ladyjacks	0.8571
4	Ohio State Buckeyes	0.7931	Nebraska Cornhuskers	0.7500	Lsu Tigers	0.8148
5	Iowa Hawkeyes	0.7667	Texas Longhorns	0.8125	Ucf Knights	0.8889
6	IU Indianapolis Jaguars	0.8571	South Dakota State Jackrabbits	0.7097	Belmont Bruins	0.7586
7	Virginia Tech Hokies	0.7188	Gonzaga Bulldogs	0.8125	Florida Gulf Coast Eagles	0.9231
8	Dayton Flyers	0.8462	South Dakota Coyotes	0.8276	Tennessee Lady Volunteers	0.7419
9	Michigan Wolverines	0.8148	UNLV Lady Rebels	0.8125	Ole Miss Rebels	0.7241
10	Notre Dame Fighting Irish	0.7333	Arizona Wildcats	0.7308	Mercer Bears	0.8125
11	Missouri State Lady Bears	0.7667	Creighton Bluejays	0.6897	Troy Trojans	0.7586
12	Indiana Hoosiers	0.7333	New Mexico Lobos	0.7333	Georgia Lady Bulldogs	0.6786
13	Depaul Blue Demon	0.6875	Utah Utes	0.6452	Middle Tennessee Blue Raiders	0.7667
14	Kentucky Wildcats	0.6333	Oklahoma Sooners	0.7500	Georgia Tech Yellow Jackets	0.6774
15	Murray State Racers	0.6786	Colorado Buffaloes	0.7333	South Florida Bulls	0.7742
16	Cleveland State Vikings	0.7083	Oregon Ducks	0.6207	Arkansas Razorbacks	0.5806



Model Type	Accuracy	AUC	F1
XGboost	0.7677	0.8499	0.8137
Logistic Regression	0.7768	0.8572	0.8181
Naive Bayes	0.7609	0.8414	0.7926
Random Forest	0.7732	0.8515	0.8166

- Unweighted average of probabilities
- Final ranks did not reflect win loss history

Can Machine Learning effectively be used in sports?

Answering the research question created at the beginning of our methodology

Conclusion: Machine learning method is effective with some drawbacks

Pros:

- High model accuracy
  - Mean accuracy - 0.7727
  - Peak accuracy - 0.8047

Cons:

- Sports is affected by other factors
  - Luck, sentiment, condition etc
- Limited dataset

With the right resources, experience and knowledge, machine learning is an effective tool for sports

- Our model is trained on this league data

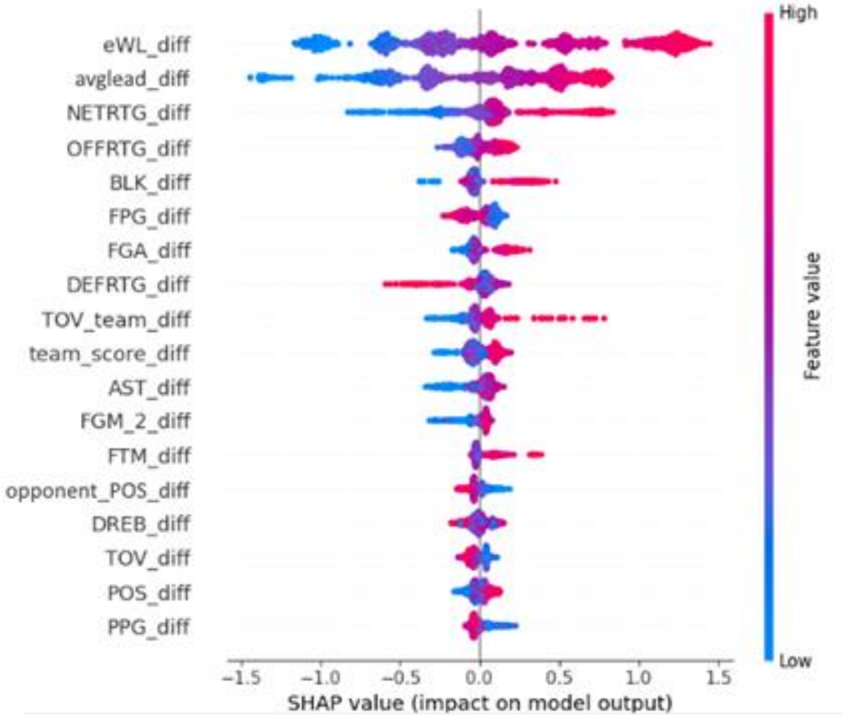
- Insights are specific to this league

Discussion

Through SHAP values, coaches can view areas of focus such as:

- Expected Win Loss
- Average Lead
- Net Rating
- Turnovers
- Free throw scoring

which are high value features in our model


eWL_diff
avglead_diff
NETRTG_diff
OFFRTG_diff
BLK_diff
FPG_diff
FGA_diff
DEFRTG_diff
TOV_team_diff
team_score_diff
AST_diff
FGM_2_diff
FTM_diff
opponent_POS_diff
DREB_diff
TOV_diff
POS_diff
PPG_diff
SHAP value (impact on model output)
High
Feature value
Low