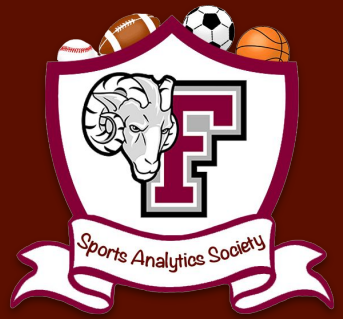
Milwaukee Bucks Hackathon:

The NBA's Top 10 3-Point Shooters



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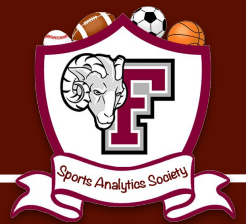
John Sprufero, & Matthew Goll

Part 1: Defining The Question



Defining “Best Shooter”

- Is the best 3-point shooter someone who simply makes shots from downtown at the highest rate? **Of course not.**
- Is it someone who can makes the most difficult shots consistently (contested or from deep)? **Nope, not that either!**
- In our estimation, the best three point shooters are those who consistently make shots beyond the arc at the highest rates, while also accounting for their difficulty!

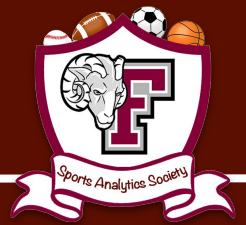
Our Objective

- Build an Model to predict 3PT% based on relevant shooting circumstances
  - Create “Shooting Difficulty+”, a difficulty index for each 3PT Attempt
  - Adjust each shooter’s 3PT% to “Shooting Difficulty+” to create our top-10 list

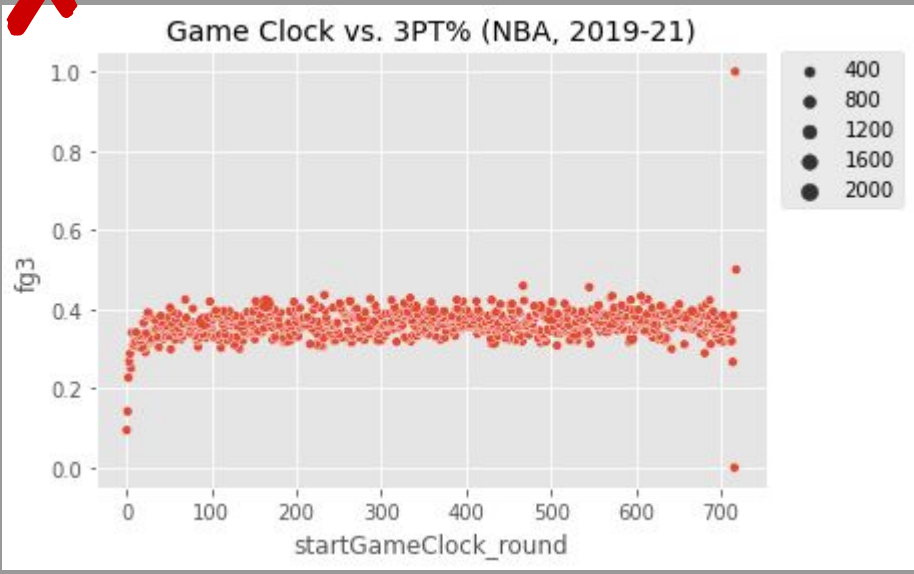
Our Objective (cont.)

- Our goal was not to build a model to simulate 3PT% across all possible scenarios, but to assign a level of difficulty to each attempt.
  - Other factors (ball-handling and decision making) could increase 3PT%.
  - Truly isolate for “shooter skill” by finding the most difficult shot situations.

Part 2: Exploratory Analysis

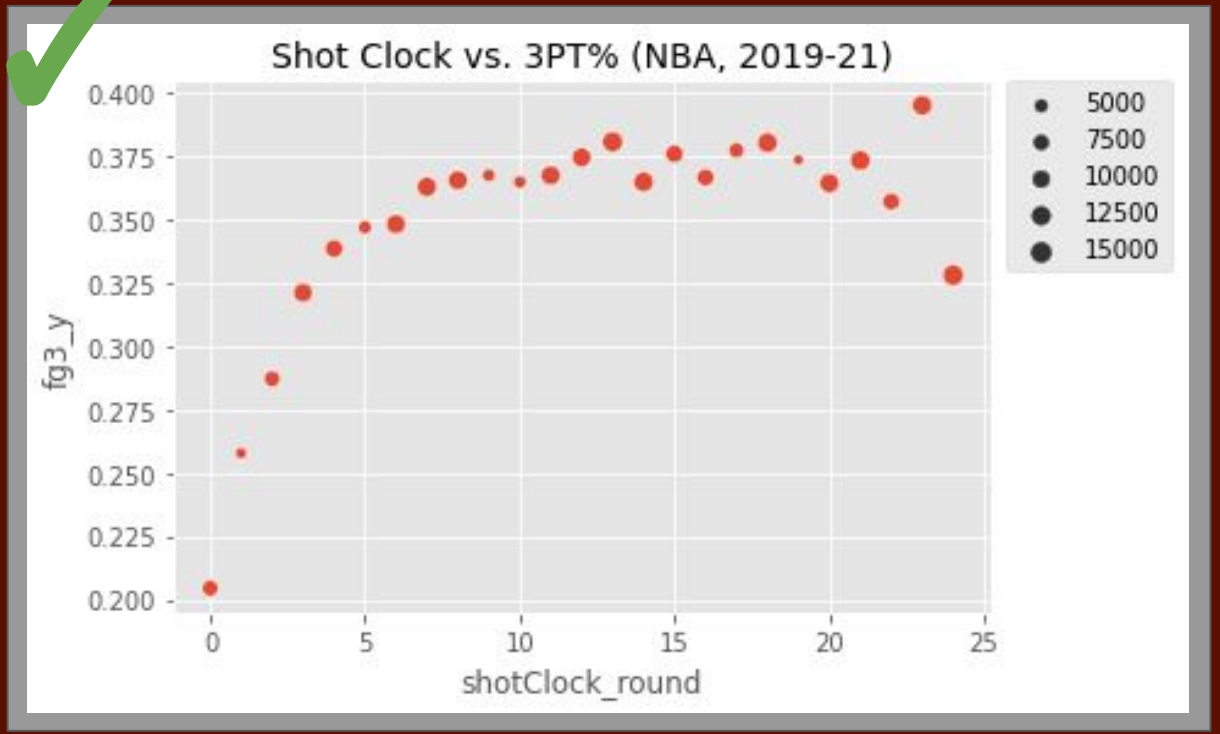


Game Clock & Period

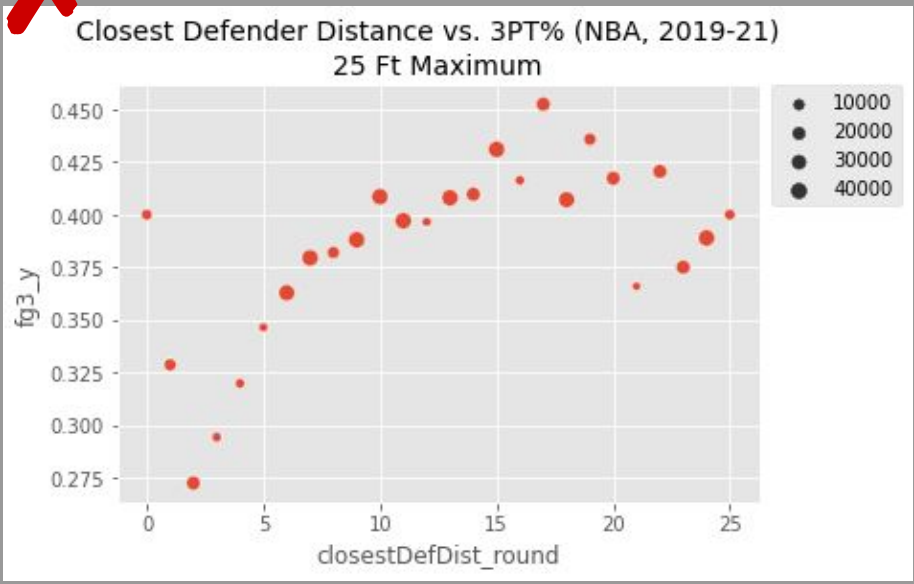


Period	3P FG%	3P FGA
1	37.1%	57,463
2	35.5%	55,943
3	36.1%	56,554
4	34.8%	55,790
5	31.2%	1,229
6	32.5%	129
7	35.7%	14

Shot Clock

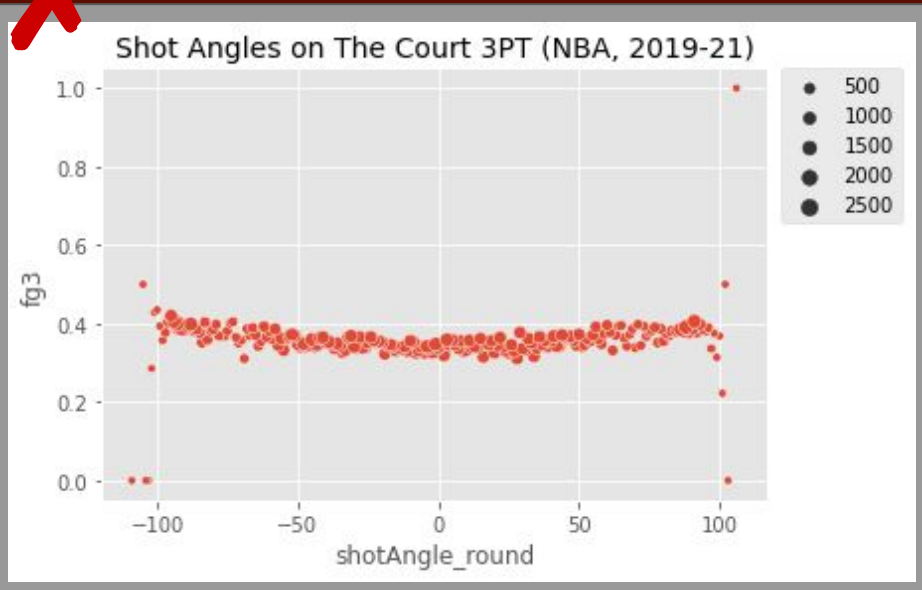

Shot Clock vs. 3PT% (NBA, 2019-21)
fg3_y
0.400
0.375
0.350
0.325
0.300
0.275
0.250
0.225
0.200
0
5
10
15
20
25
shotClock_round
5000
7500
10000
12500
15000

Defender Distance & Contest Level



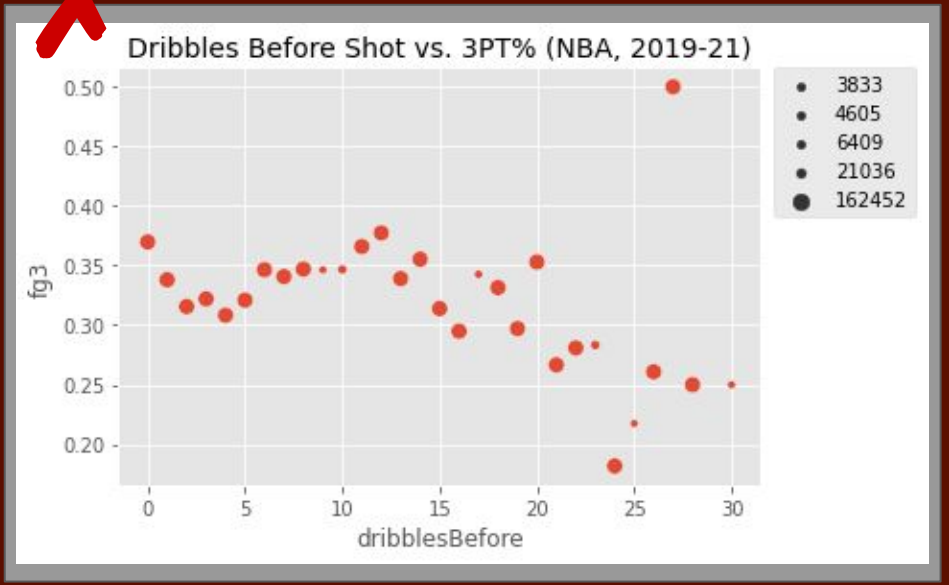
Contest Level	3P FG%	3P FGA	Avg. Def. Dist. (ft)
Heavy	33.9%	105,014	4.95
Light	37%	92,382	6.68
Uncontested	39.4%	29,747	11.24

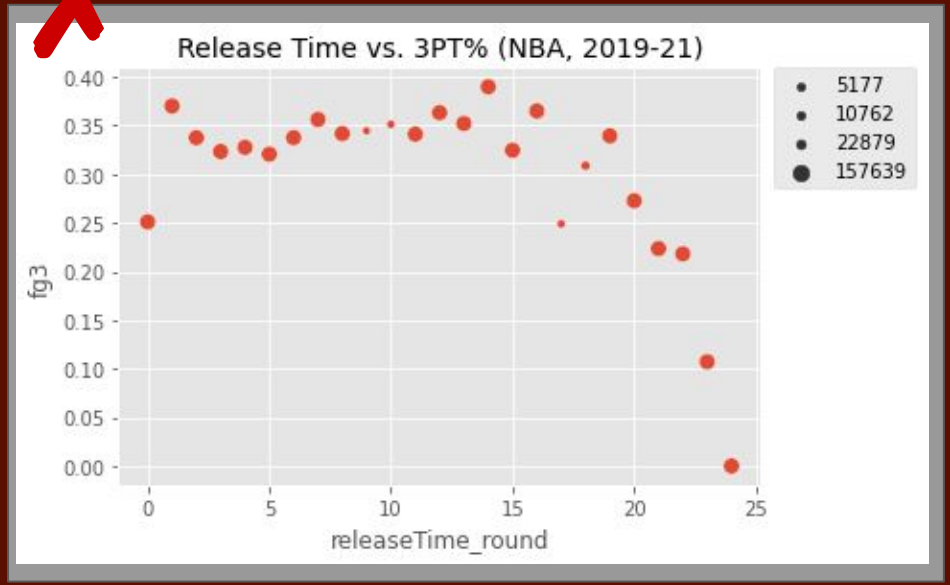
Shot Angle & Region



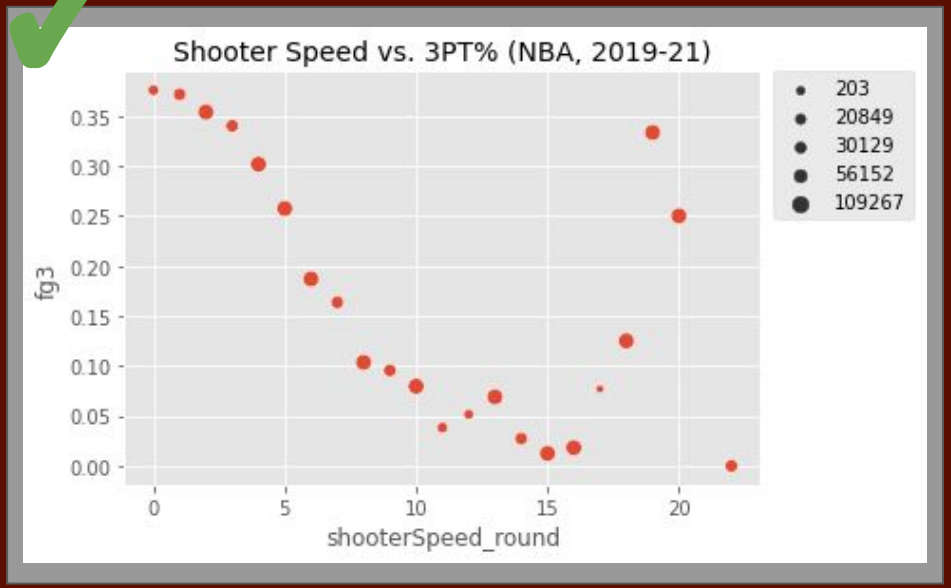
Region	3P FG%	3P FGA
Middle 3	35%	60,588
Left Wing 3	35.5%	56,022
Right Wing 3	35.5%	49,955
Left Corner 3	38.9%	30,512
Right Corner 3	38.2%	27,753
Backcourt	2.5%	1,194
Far	12.2%	1,119

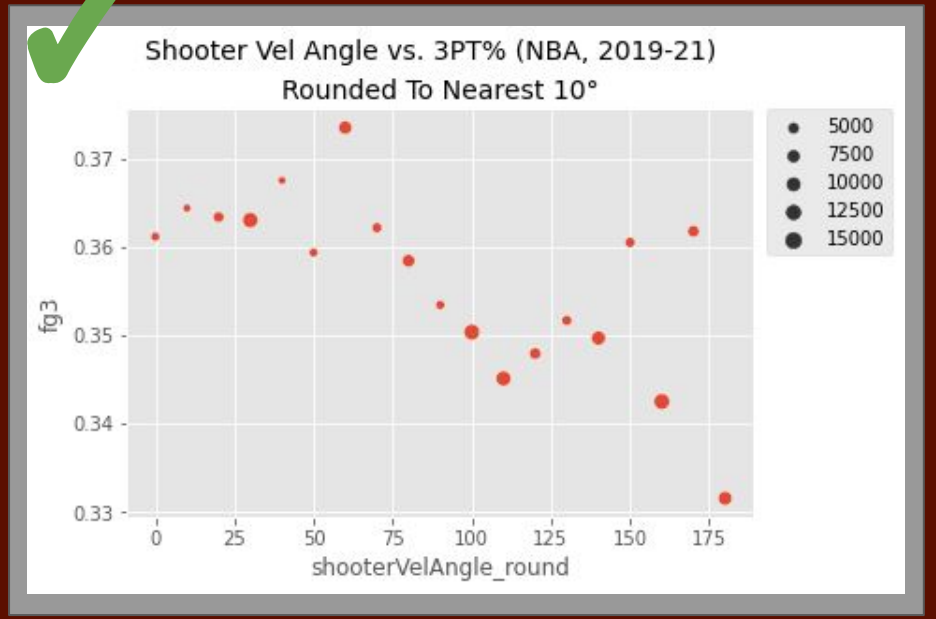
Dribbles & Release Time



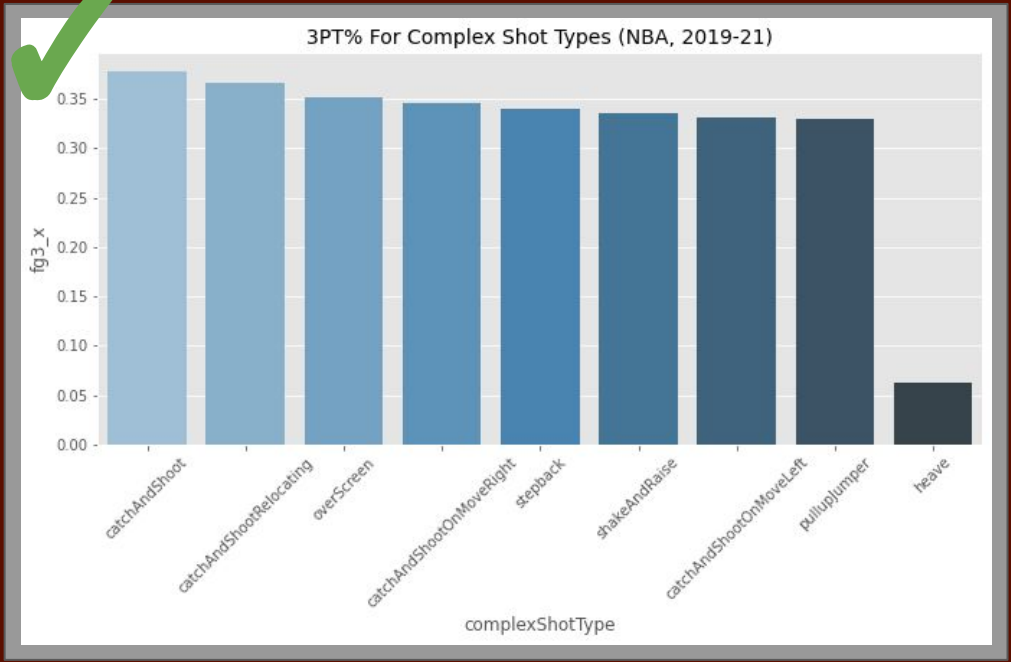


Shooter Speed & Vel Angle





Assist Opportunities & Shot Type



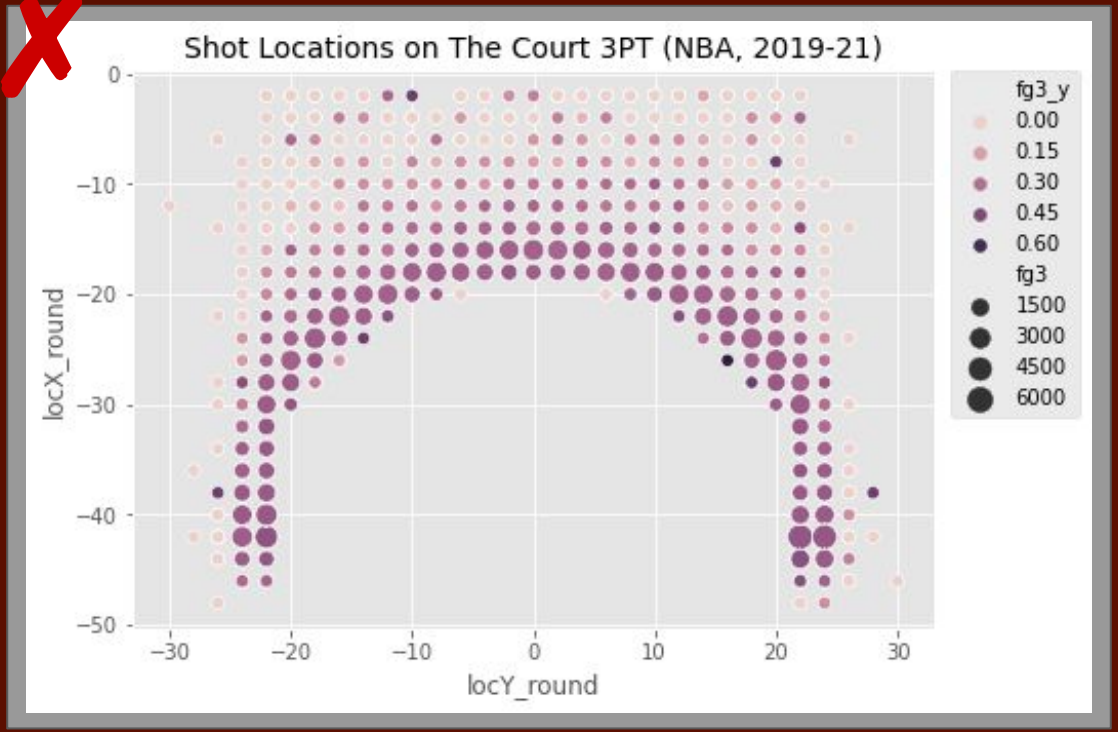
Assist Opp.	3P FG%	3P FGA
Yes	36.7%	176,585
No	32.8%	50,558

Assist Opp.	% of Catch & Shoot "Type" Complex Shots
Yes	84.5%
No	1.3%

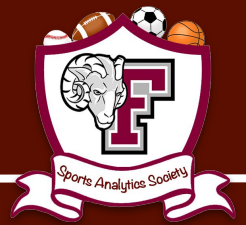
Rearview Contests

Rearview Contest	3P FG%	Average Defender Distance (ft)
Yes	35.9%	3.60
No	35.8%	6.57

3-Point % by Court Coordinates



Part 3: Logistic Regression



Recapping Model Features

Included In Logistic:

(Time & Speed Rounded To Nearest 1)
(Angles Rounded To Nearest 10°)

Shot Clock
Region
Contest Level
Complex Shot Type
Shooter Speed
Shooter Vel Angle

Not Included In Logistic:

Game Clock
Period
Release Angle
Shot Angles On The Court
Release Time
Dribbles Before
Assist Opportunity
Rearview Contests
Court Coordinates

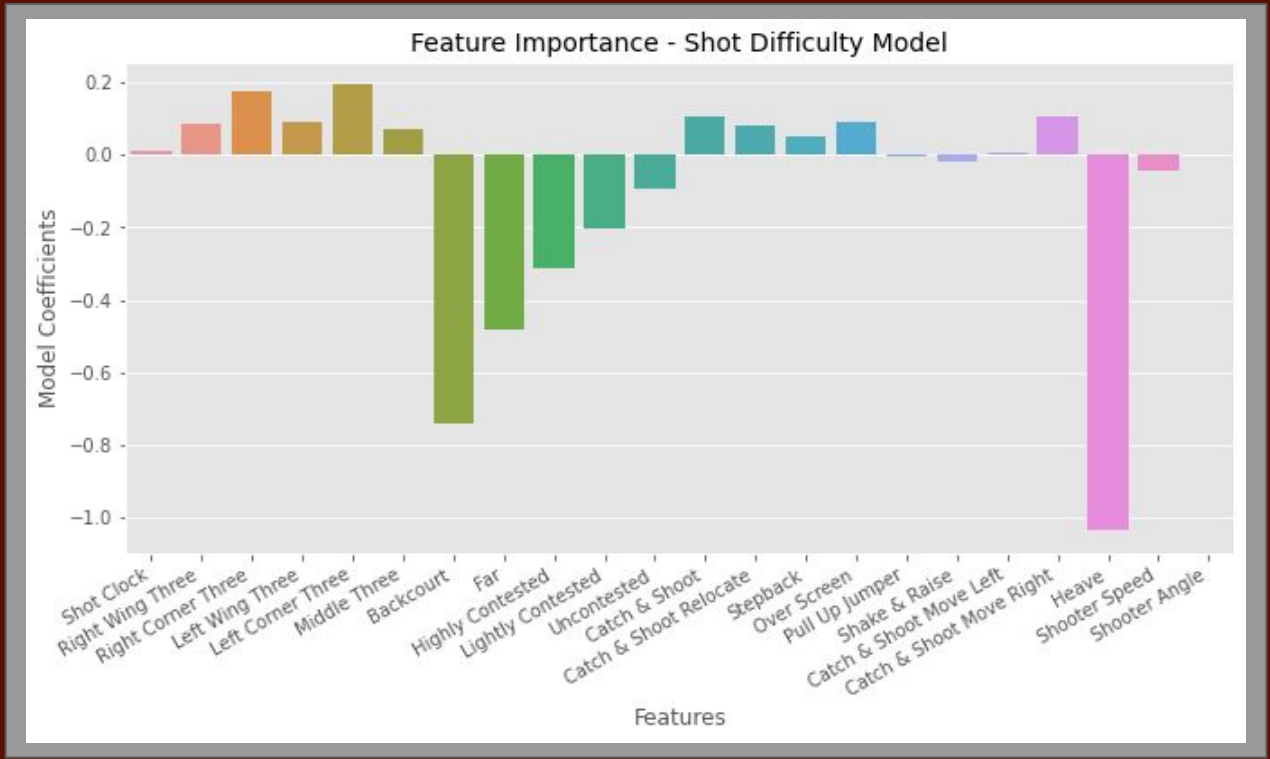
Why Did We Even Have To Build One?

- Looked At Observations For Each Combination of Included Features:
  - Most Popular Made 3-Pointer Made: 12 sec Shot Clock, Light Contest, Catch & Shoot, Right Wing Three, Shooter Not Moving, Standing at 70°
    - Only 70 instances over three seasons
- Average Count Across All Combinations: 2.7 Shots Made
- Modeling What Should Happen in These Scenarios With Greater Volume!

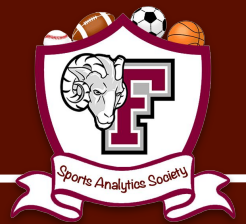
Logistic Regression Details

- Test/Train Split (80/20) and Used MinMaxScaling()
- Ensured Equal Sample Variances Across Test & Train (35.8%)
- Fit Model Onto 82,692 Possible “Difficulty” Scenarios
- Accuracy: 64% (Not The Objective)
- Log Loss: .648

Logistic Regression Feature Importance



Part 4: Shooting Difficulty+



Kruder-Richardson Formula

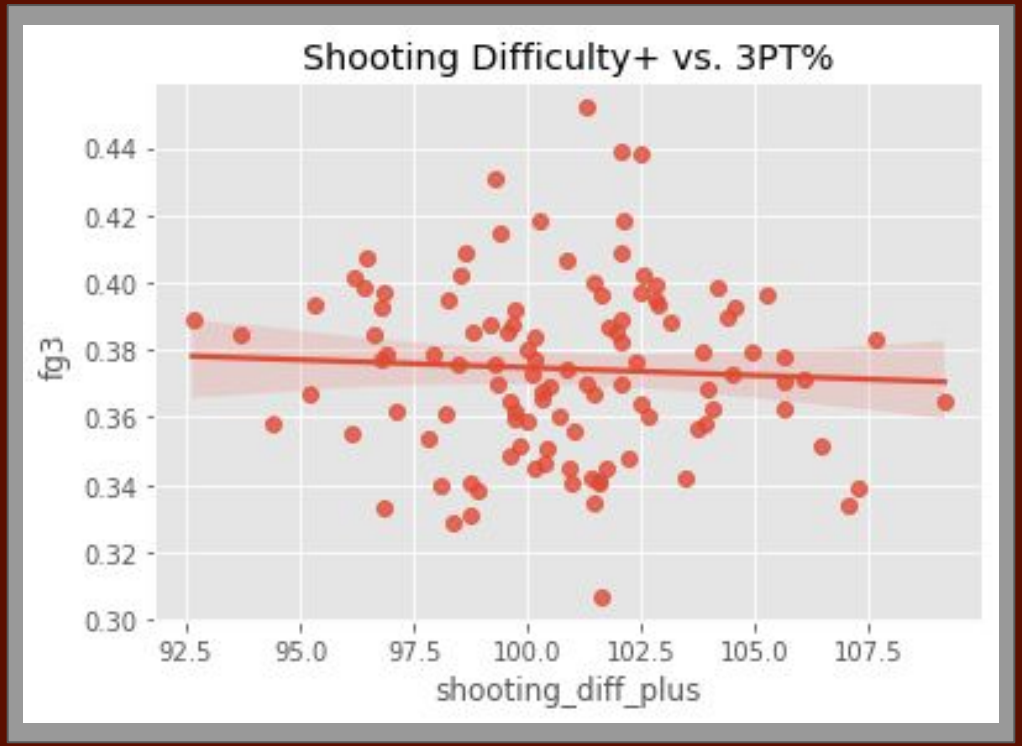
- Measuring Sampe Reliability of 3 Pointer Attempts
- Article by Darryl Blackport From 2015 Discusses Reliability in Basketball
  - At 750 attempts, A shooter's 3PT% reaches .7 Reliability
  - 50% Variance Attributable To Skill, Other Half To Luck
- Only 111 of the 730 shooters from the data reached the stabilization threshold!

Creating “Shooting Difficulty +”

- Found Average 3PT% Across Three Season Sample & Per Player
- “Shooting Easy +” = (Predicted 3PT% For Each Situation / League Average) * 100
- “Shooting Difficulty+” Reversed “Shooting Easy +” Differences From 100
- Grouped “Shooting Difficulty +” By Weighted Average Of Each Player’s Attempts

- In 111 Player Sample (Stabilized Group):
  - Mean: 100.8
  - Standard Deviation: 3.07

“Shooting Difficulty +” And 3PT%



Who Took The Most Difficult Shots?

111 Qualified Shooters	
Player	**Shooting Percentage Difficulty +**
Antonio Casillas	109.2%
Damon Collins	107.6%
Cain Norman	107.3%
Darius Lister	107.1%
Jesse Elliott	106.5%

Our Top-10 3-Point Shooters

Player	3P FGA	Shooting Difficulty+	3P FG%	3P FG% Scaled
Andrew Miramontes-Granillo	938	101.3%	45.2%	45.8%
Tayveon Sharp	945	102.5%	43.8%	44.9%
Eris Hurd	788	102.0%	43.9%	44.8%
Toby Deherrera	780	99.3%	43.1%	42.8%
Cory Ney	896	102.1%	41.9%	42.8%
Timothy Whitaker	1001	100.3%	41.9%	41.9%
Shaquille Yetemegn	1599	105.2%	39.6%	41.7%
Richard Gibb-Morgan	1803	102.1%	40.6%	41.7%
Daquan Pollock	1407	104.1%	39.9%	41.5%
Jemal Grindle	1111	102.6%	40.2%	41.3%

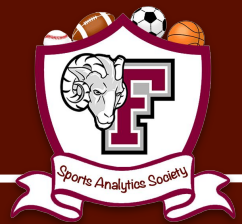
Key Takeaways:

- The “best” shooters are those who execute their shots at the highest rates, while also taking into consideration how difficult the shots they are taking
- By attempting to model shot difficulty, we can gain an understanding of those shooters who can overcome tough situations, while isolating for other skill sets
- While shooting difficulty only marginally alters the top-10 shooters from a traditional 3PT% leaders list, “Shooting Difficulty+” gives us a better understanding of the shot decisions made player-to-player

If We Had More Time:

- Use “rimDepth” and “rimLeftRight” To Calculate Miss Distance For Shooters
  - Train Multiple Linear Regression / XGBoost On Miss Distance On All Difficulty Scenarios (Continuous)
    - Determine Whether Median Miss Distance or Field Goal Percentage Reacts More To “Shooting Difficulty +”
- Cluster Shooters By Shooting Strengths/Weaknesses To Bypass “League Average”
  - Train Model On Each Cluster of Shooters Instead of All

References

- Blackport, Darryl. “Kruder-Richardson Formula.” *FanSided*, FanSided, 29 Aug. 2014,https://fansided.com/2014/08/29/long-take-three-point-shooting-stabilize/#:~:text=To%20find%20the%20point%20at,aspect%20will%20outweigh%20the%20noise.

Thank You!
Any Questions?