Quantifying Passing:
Using NBA Tracking Data to Create an Expected Assist Model

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Inspiration / Direction

- What is a quality pass in the NBA?
- Adding the value of a pass to a shot
- Identifying passers who create opportunities for teammates
- Isolating team success from playmaking skill

Research Question

- How can tracking data be used to generate metrics that can predict expected points scored after a given pass?

Focus Data

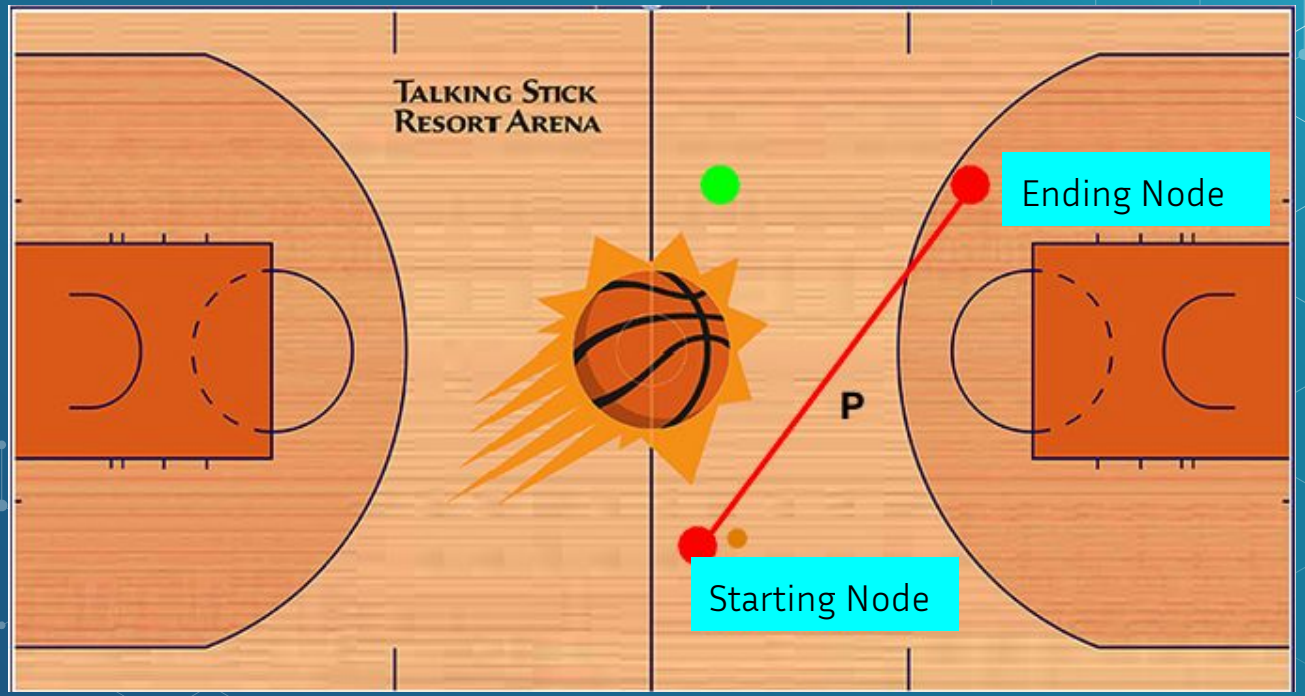
Los Angeles Clippers, December 2015 (total 15 games)

1

Identifying Passes

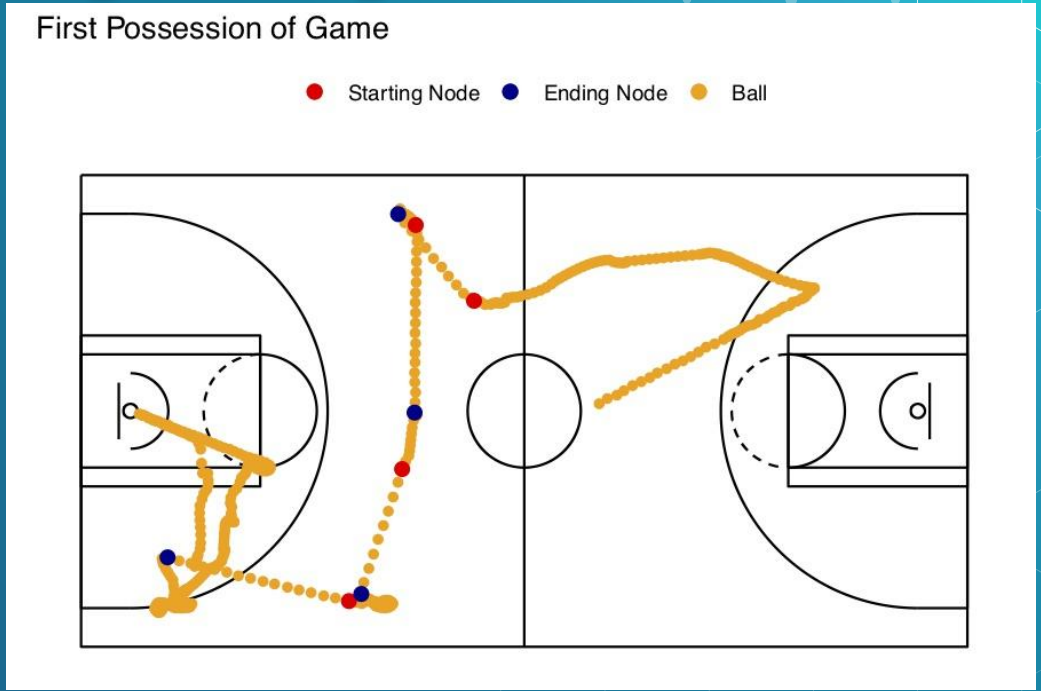
Directional Ball Tracking

Strategy



Refining + Evaluating the Algorithm

- We visually inspected film for a sample game (LAC v LAL, 12/25/15)
- 546 passes occurred in the game
- Our algorithm identified 393 (**72%**) of them.
  - Most of the missing passes were inbounds
- Additionally, of those plays flagged as passes, **85.8%** were in fact passes.
  - Most trouble misidentifying dribbles through traffic



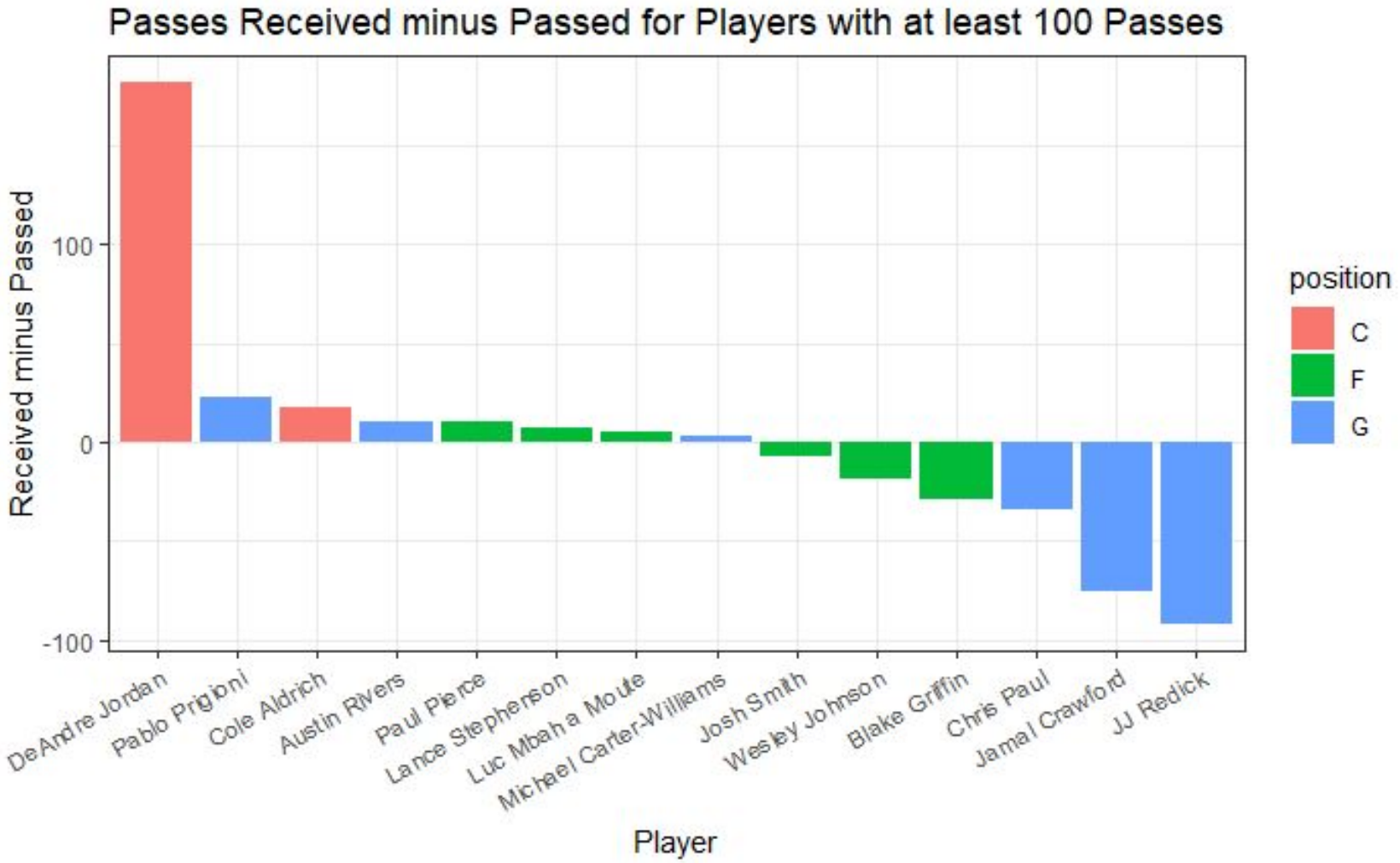
2

Analyzing Pass Patterns

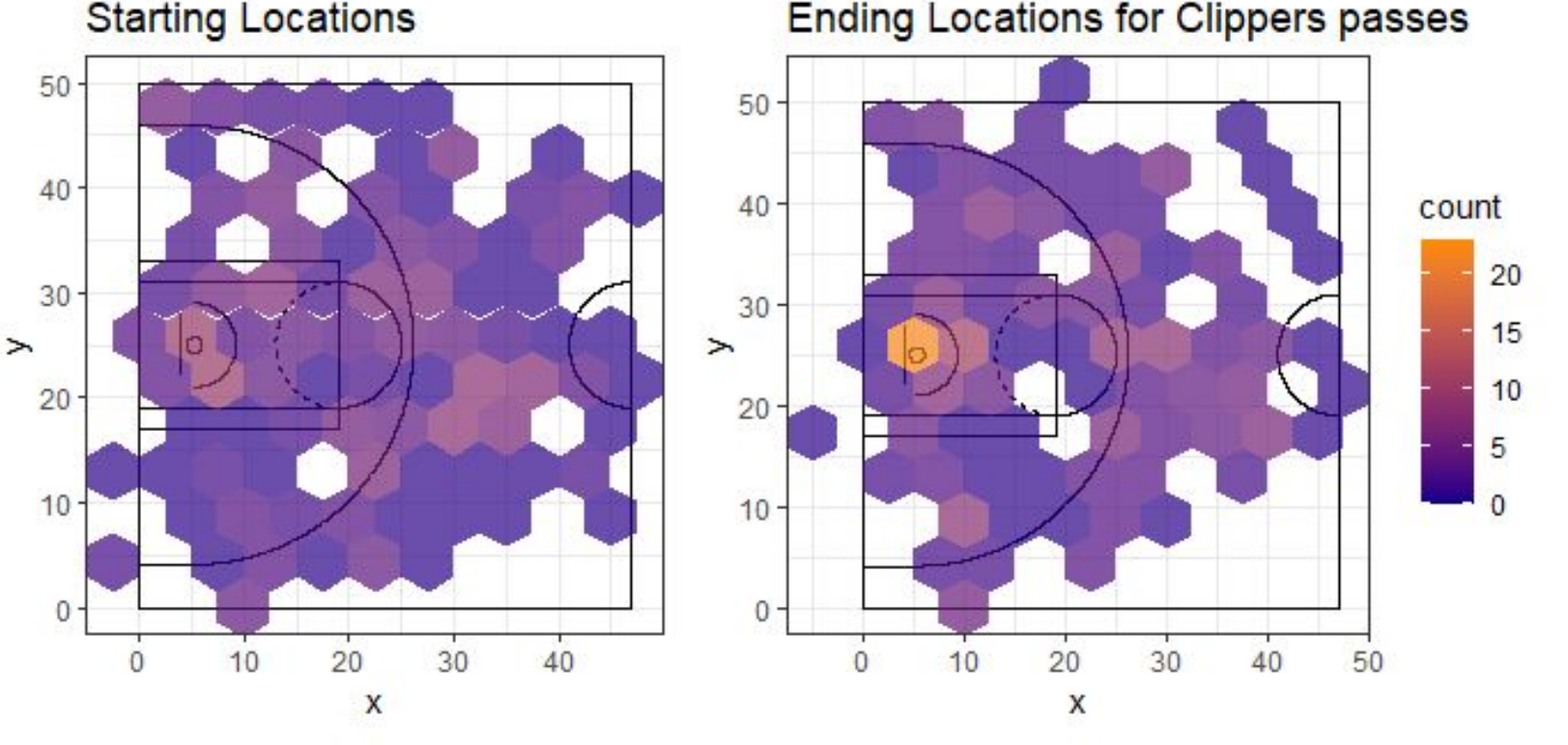
Passes Received vs Passes Made

Pass Starting/Ending Location Distribution

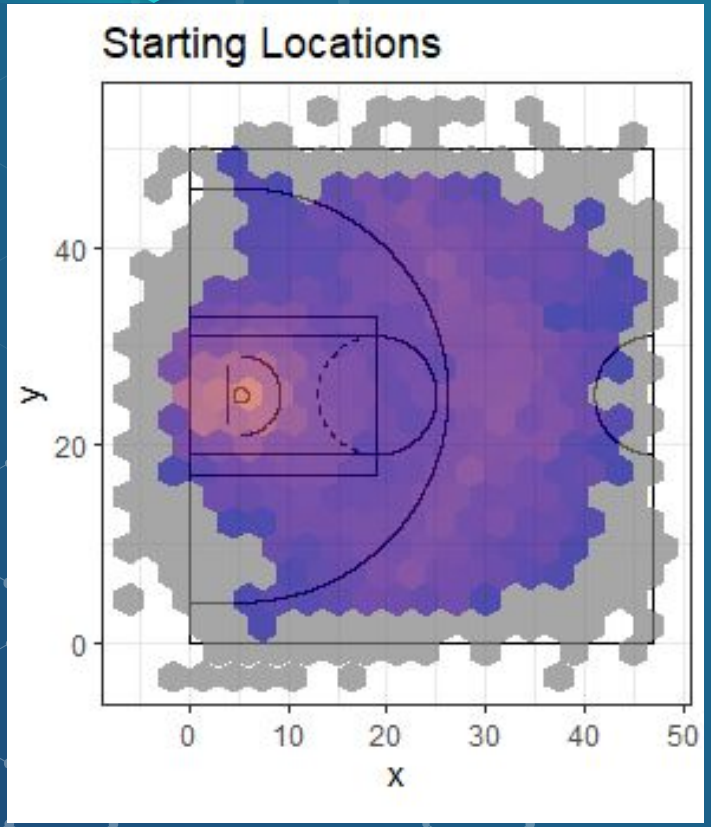
Nearest Defender

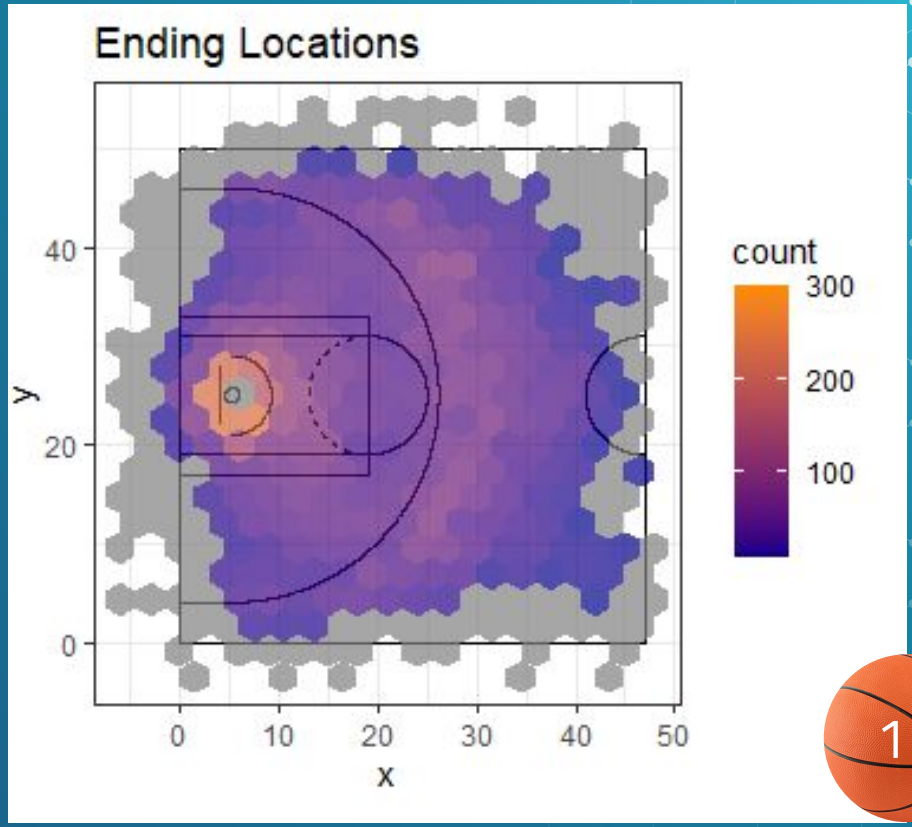

Passes Received minus Passed for Players with at least 100 Passes
Received minus Passed
100
0
-100
DeAndre Jordan
Pablo Prigioni
Cole Aldrich
Austin Rivers
Paul Pierce
Lance Stephenson
Luc Mbah a Moute
Michael Carter-Williams
Josh Smith
Wesley Johnson
Blake Griffin
Chris Paul
Jamal Crawford
JJ Redick
Player
position
C
F
G

Analyzing Team Pass Locations:
Clippers Nodes vs Lakers, Christmas 2015

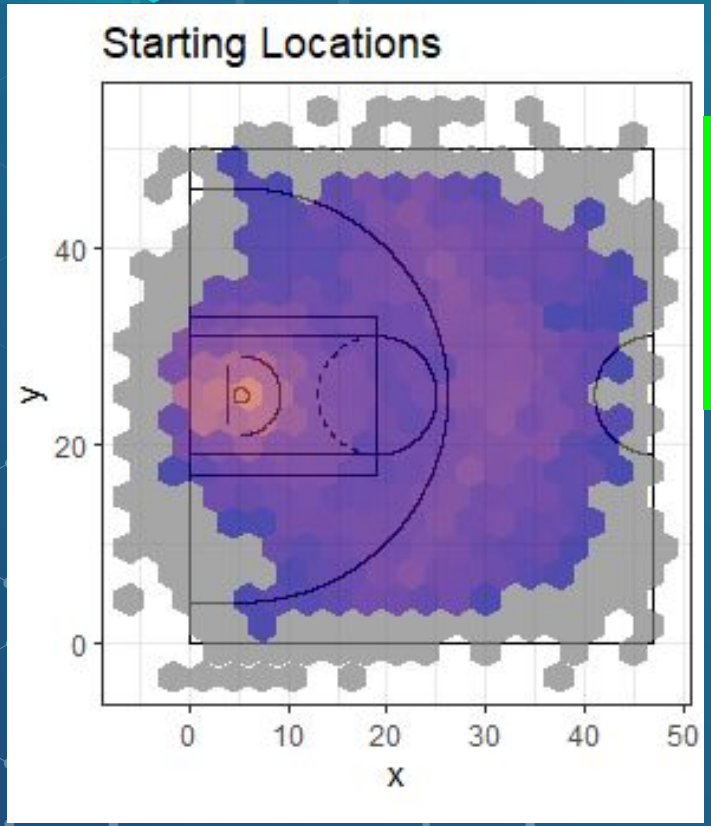


Analyzing Team Pass Locations:
Clippers Nodes December 2015

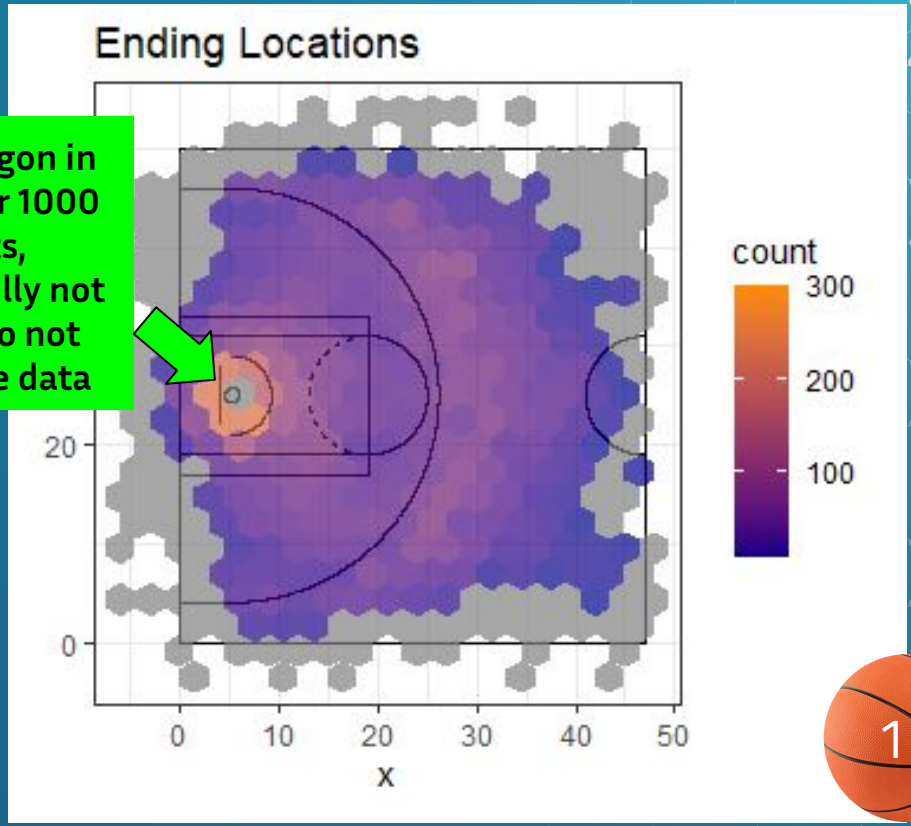




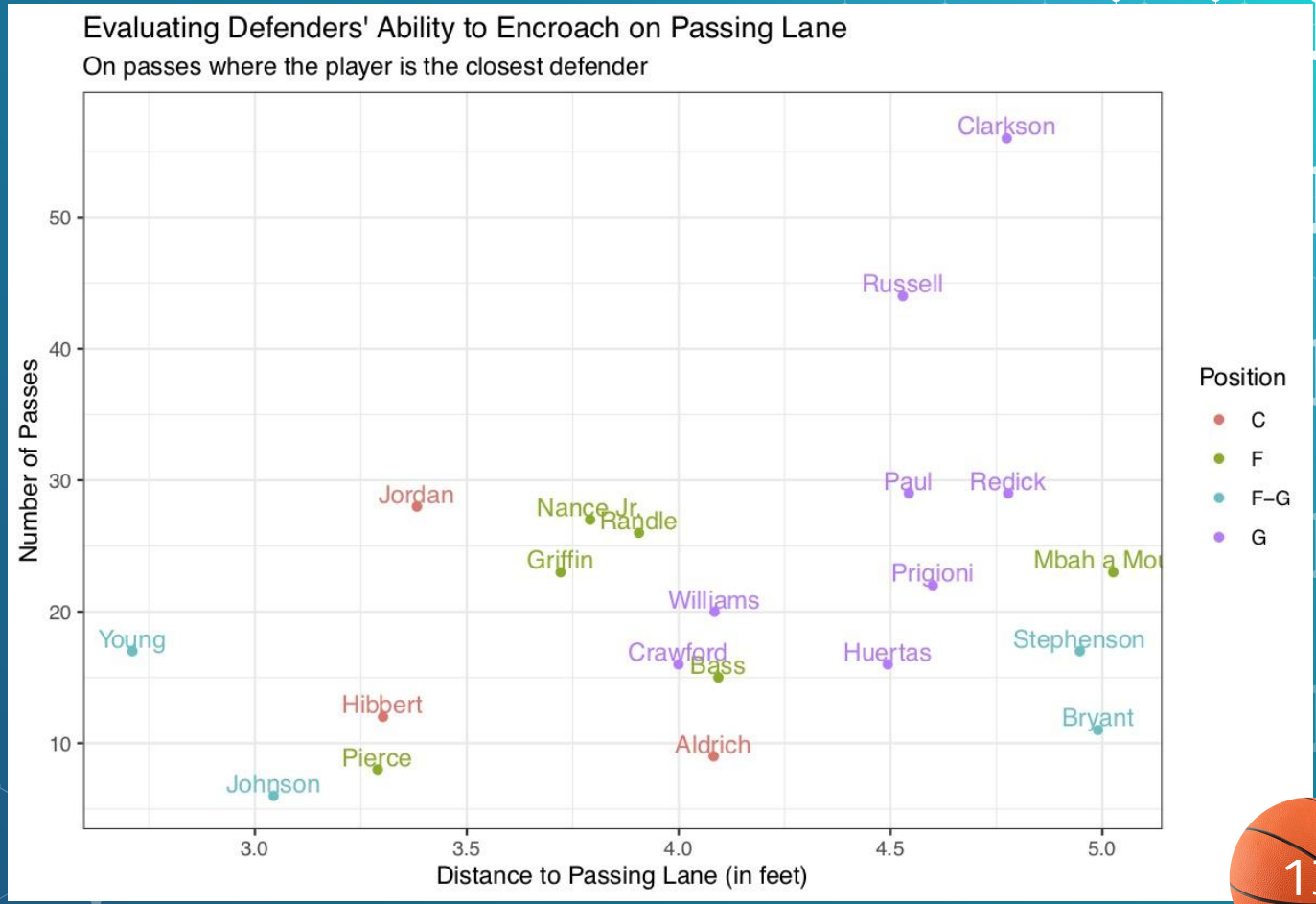
Analyzing Team Pass Locations:
Clippers Nodes December 2015



Gray Hexagon in Paint: Over 1000 data points, purposefully not included to not diffuse the data



From our sample game, we found guards to be more often in the passing lane, with wings coming next



3 Initial Model

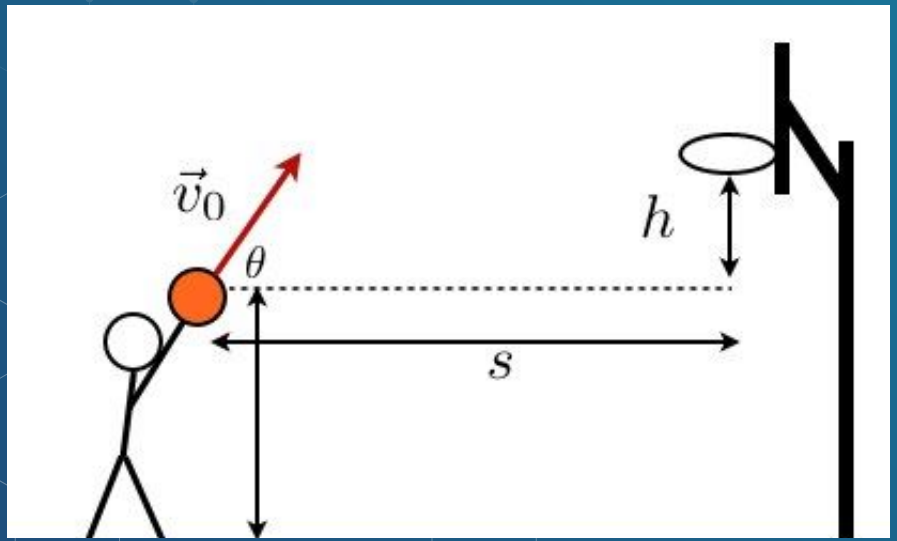
Expected Points Added from a Pass

Finding Assist Opportunities

- Identify all shots
- Look for the most recent pass prior to a shot
  - Only examine passes within 3 seconds of the shot

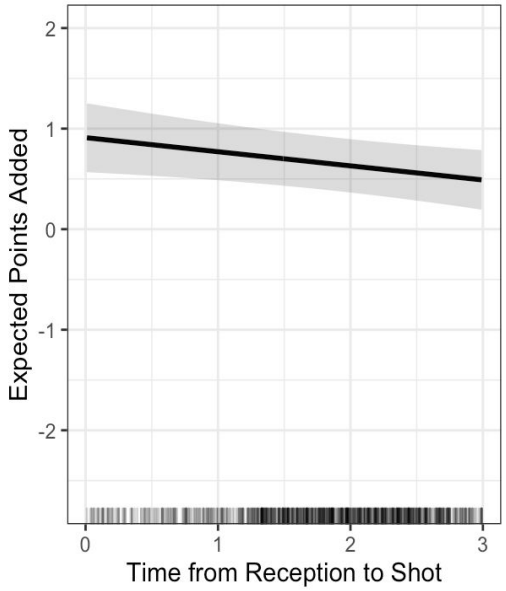
Variable Selection

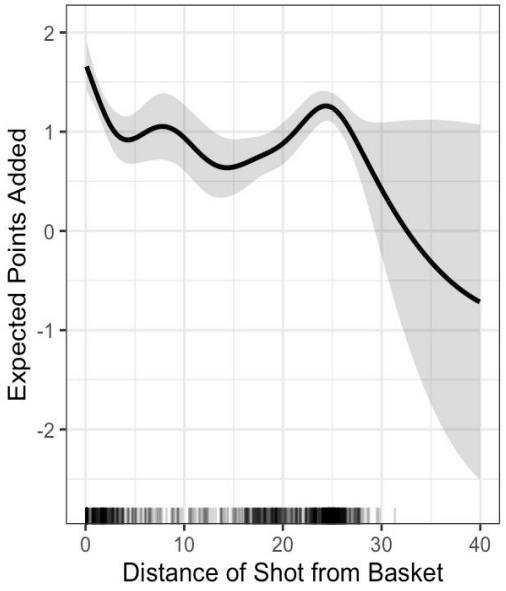
- Shot-specific metrics
  - Angle to basket
  - Distance from basket

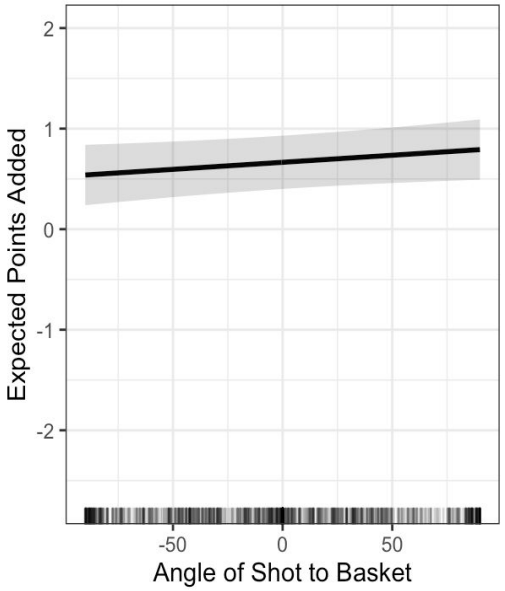


- Pass-specific metrics
  - Time from reception to shot
  - **Other:**
    - Distance to nearest defender
    - Number of defenders

Results - GAM


Expected Points Added
2
1
0
-1
-2
0
1
2
3
Time from Reception to Shot


Expected Points Added
2
1
0
-1
-2
0
10
20
30
40
Distance of Shot from Basket


Expected Points Added
2
1
0
-1
-2
-50
0
50
Angle of Shot to Basket

Results - Evaluating Performance

	ball_handler	count	avg_EPA	pts_over_expected
	<chr>	<int>	<dbl>	<dbl>
1	Chris Paul	120	1.08	0.230
2	Austin Rivers	26	1.05	0.215
3	DeAndre Jordan	24	0.972	-0.0134
4	Blake Griffin	66	1.12	-0.118
5	Pablo Prigioni	27	1.17	-0.134
6	JJ Redick	33	1.20	-0.135
7	Jamal Crawford	47	1.08	-0.248

4 Moving Forward

Calculating Pass Metrics

How is a successful pass defined?

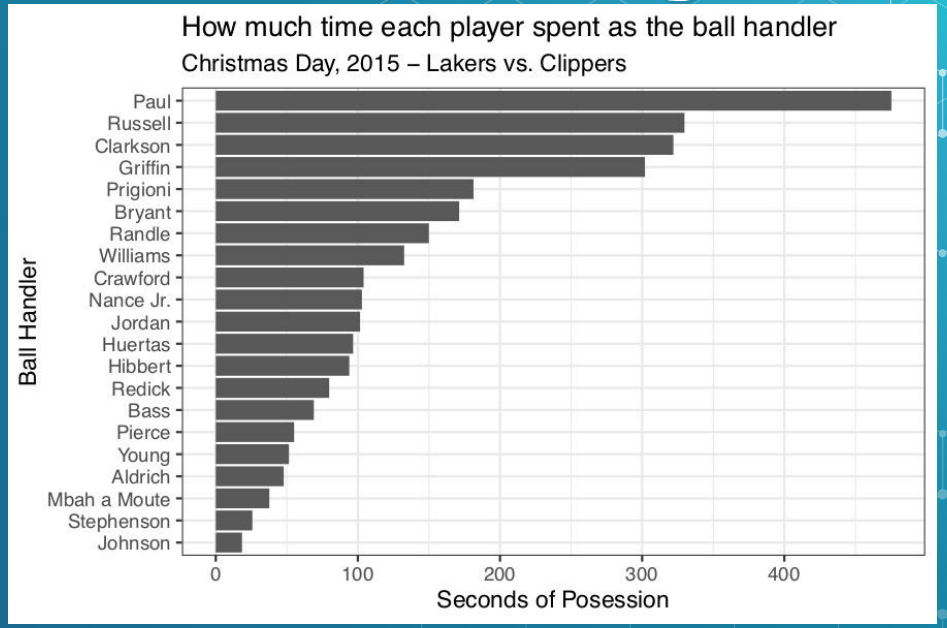
- Spacing - does it open up the floor
- Difficulty of the pass - influence of the closest defenders (how open is the passing lane)
- **Smart decision?** Quantifying the decision by evaluating passing lanes and percentage of shot created

Pass Metrics to create/analyze

- Overall passer rating of a player
- Optimizing timing or number of passes in a possession
- Evaluating the change in centroids of the **convex hulls** after a pass
- Look at previously created passing evaluation metrics (Ben Taylor)

Priority: Translating our Data to the Playbook

- Replicating our methods across multiple teams
- Possible translatable Ideas to investigate with Passing and Tracking data:
  - Ability to identify Time of Possession per player
  - Compare with our passing metrics and advanced passing stats to measure playmaking effectiveness
  - Model most efficient offensive lineup possible for each team
  - Identify paint touches



THANKS!

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Appendix: The Basics of the NBA

- Game:
  - 4 quarters, 12 minutes each (720 seconds)
  - Back and forth game of possessions
- Court :
  - 94 by 50 feet

Appendix: Where We Found Data

- SportVU Data
- Sealneaward
  - https://github.com/sealneaward/nba-movement-data
  - Access to movement and play by play events data for games from Nov-Jan 2015-16
- Rajshah4
  - https://github.com/rajshah4/NBA_SportVu
  - Access to _functions.R source to convert JSON to dataframe and to calculate player distance matrices from ball
  - Example code to help set up

Appendix: Data Structure

Movement Data

- 2.3 million obs, 13 variables
- 5 character variables
  - Jersey Number, playerID,
  - Position
  - First name and lastname
- 8 numeric variables
  - event.id (~possession)
  - x_loc (x coordinate)
  - y_loc (y coordinate)
  - Radius (z coordinate of ball in air)
  - Game clock, shot clock, quarter, teamID

Play by Play Events Data

- 426 obs and 43 variables
- Variables of Note:
  - Score and Score Margin
  - “Event Type”: Stat associated with play
    - made shot, miss shot, rebound
  - “Event Action Type” (specific version of event)
    - If event type was a made shot, the types of actions would be a layup, dunk, 3pt, etc
  - Home, Away, and Neutral Description, the play by play

Appendix: Advanced Stats

NBA.com Player Passing Data

- Data provided by Second Spectrum
- Nine pass related variables for each player per game
- Potential Assists - credits each pass that leads to a shot
- AST Points Created - total number of points gained after a pass including free throws

Application with Tracking Data

- Verifying pass identification
- Investigating why some players have a higher Assist to Potential Assist ratio

Appendix: Identifying Starting Nodes

- IF the direction of travel changes rapidly OR the ball begins to accelerate rapidly
- AND the next node is a different ball handler *(to exclude dribbles)*
- AND the ball is released at a height lower than 9 feet *(to exclude rebounds off the rim)*
- AND the game clock is less than 12:00 *(to exclude tap outs from jump balls)*
- THEN Node = True

Appendix: Identifying End Nodes

Choose the next camera frame where:

- The ball suddenly decelerates OR the distance between frames is below a threshold
- AND the height of the ball is greater than 1 foot (to exclude bounce passes)

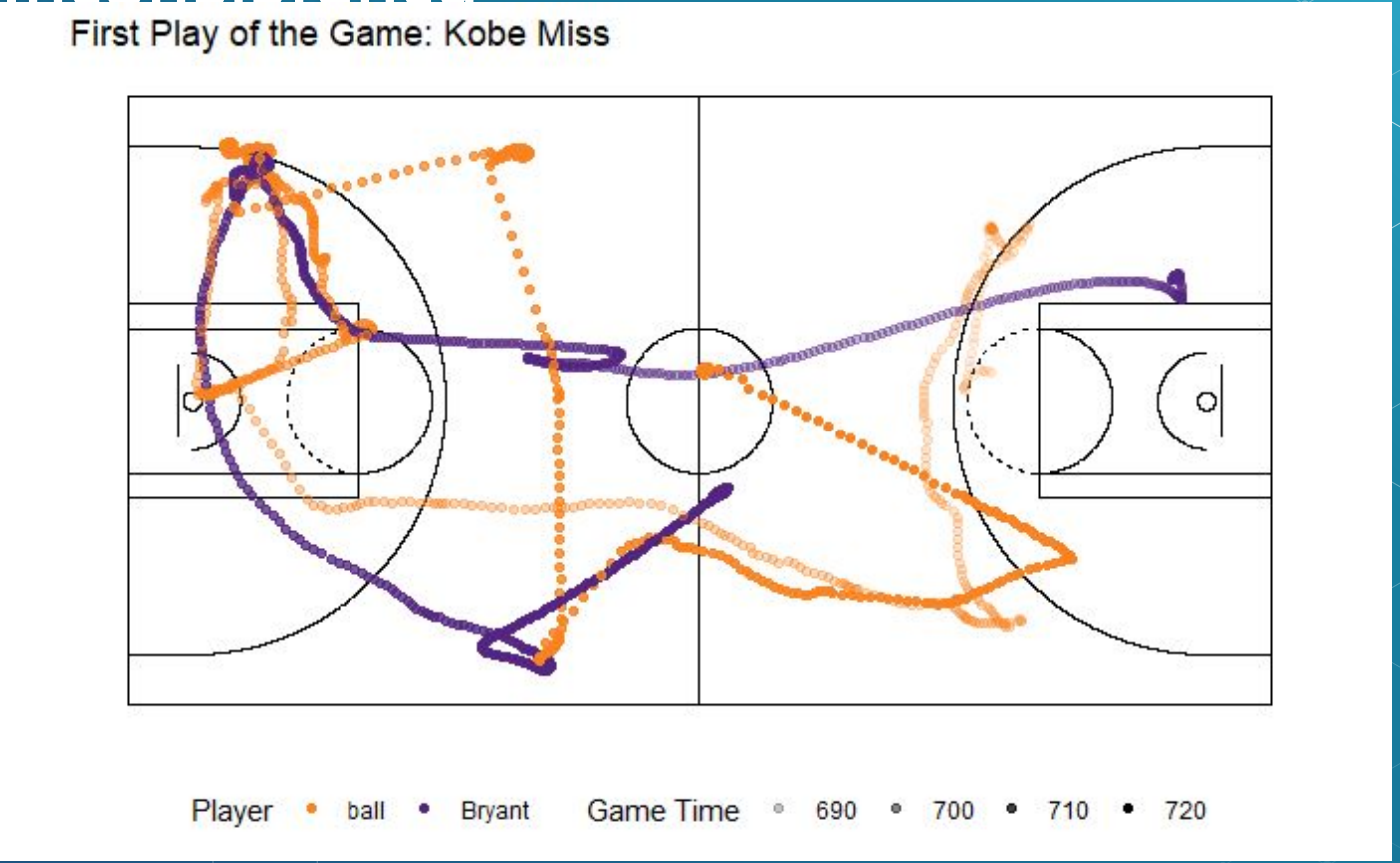
Appendix: Refining the Algorithm

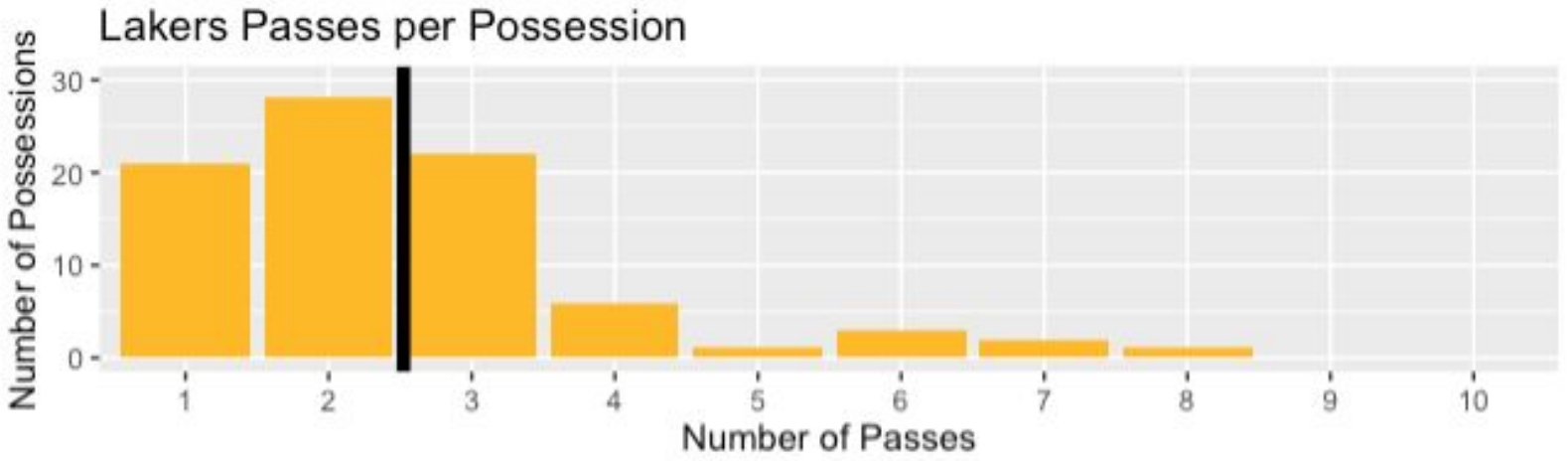
Problem plays

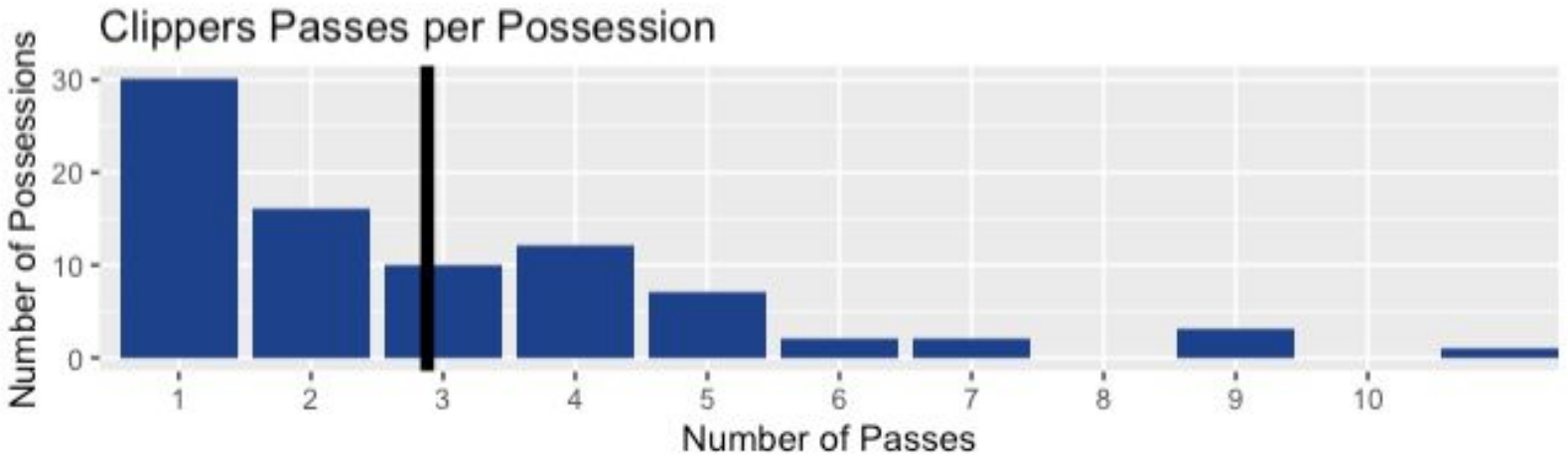
- Shot attempts
  - Remove IF end node is within two feet of the basket
- Dribbling through traffic
  - Remove IF the ball handler and the receiver are from opposite teams

Note: This will make it difficult to identify lobs and steals.

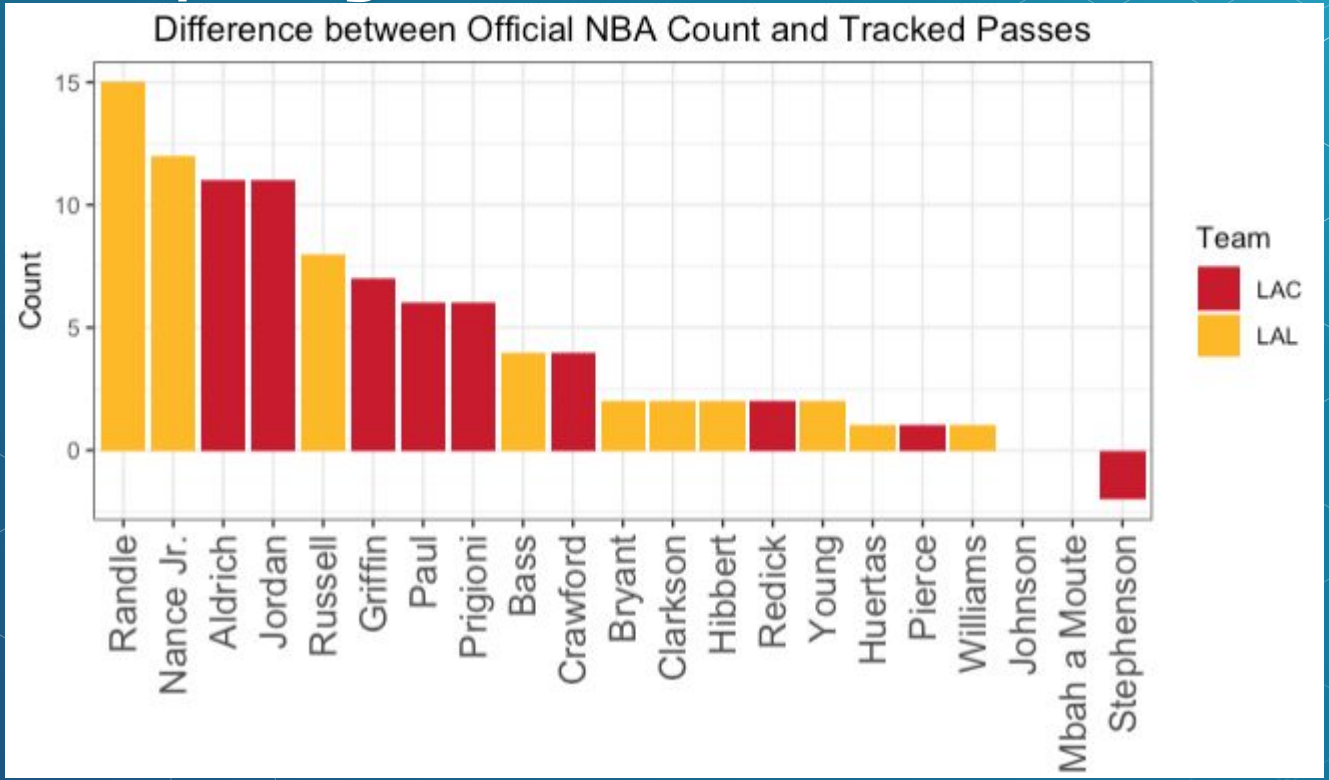
Appendix: Possession Overlap: Event ID Inconsistency



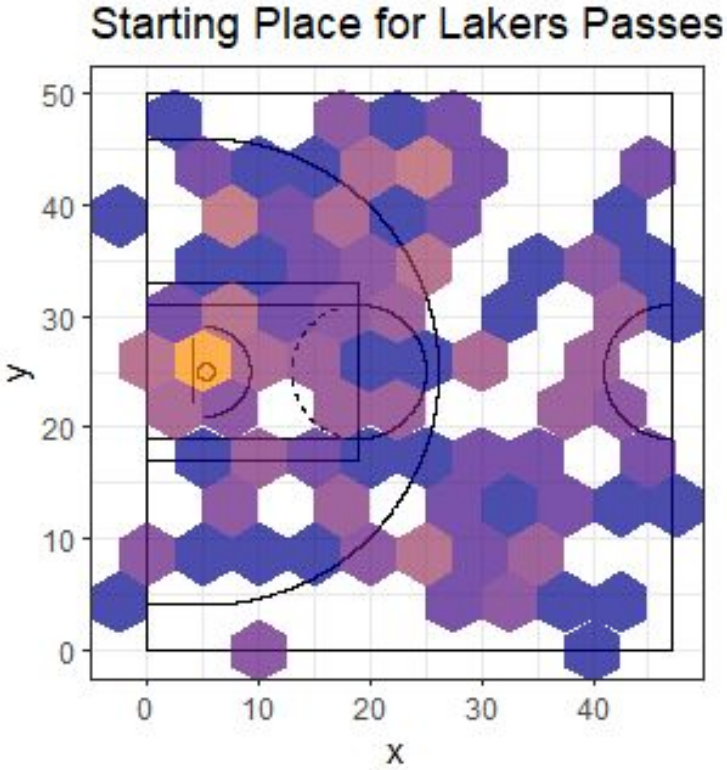

Lakers Passes per Possession
Number of Possessions
30
20
10
0
1
2
3
4
5
6
7
8
9
10
Number of Passes

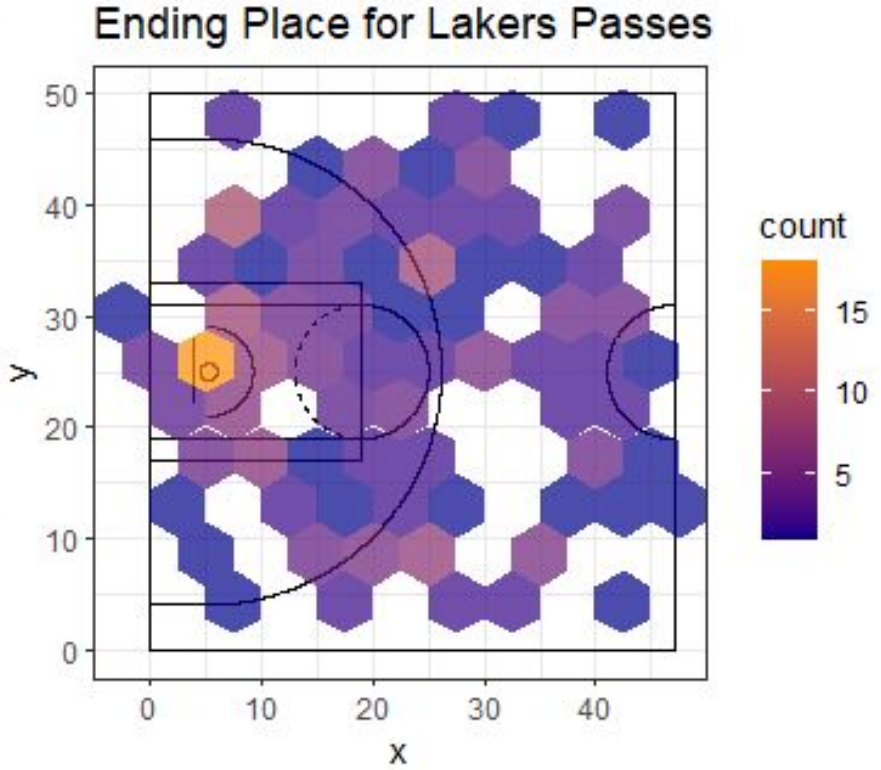

Clippers Passes per Possession
Number of Possessions
30
20
10
0
1
2
3
4
5
6
7
8
9
10
Number of Passes

Appendix: Confirming the Inbound Discrepancy



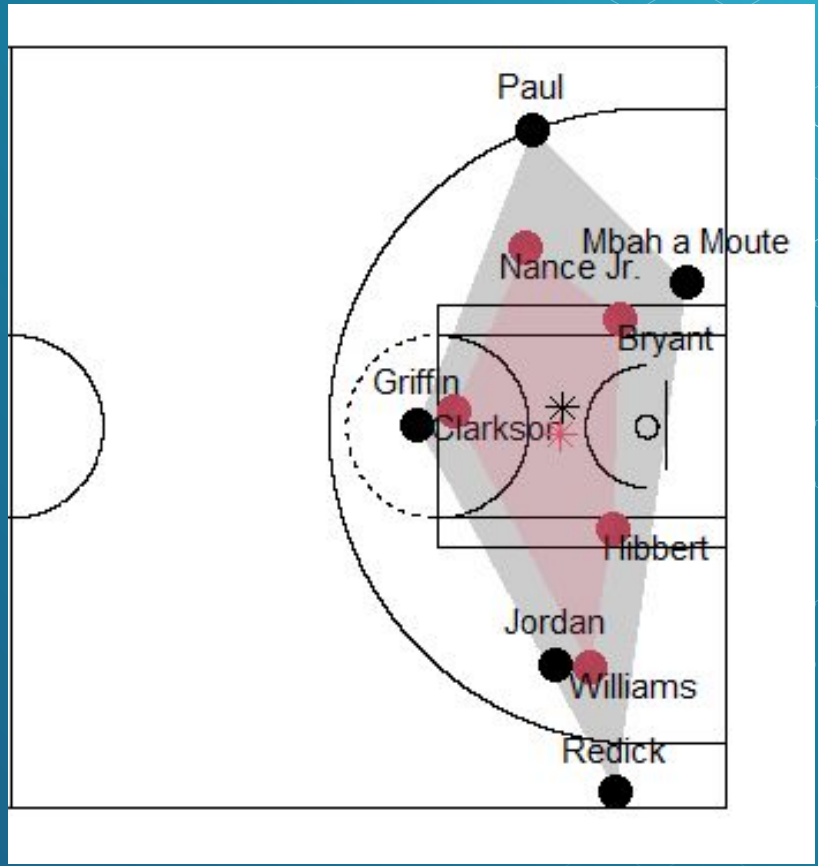
Appendix: Analyzing Team Pass Locations: Lakers





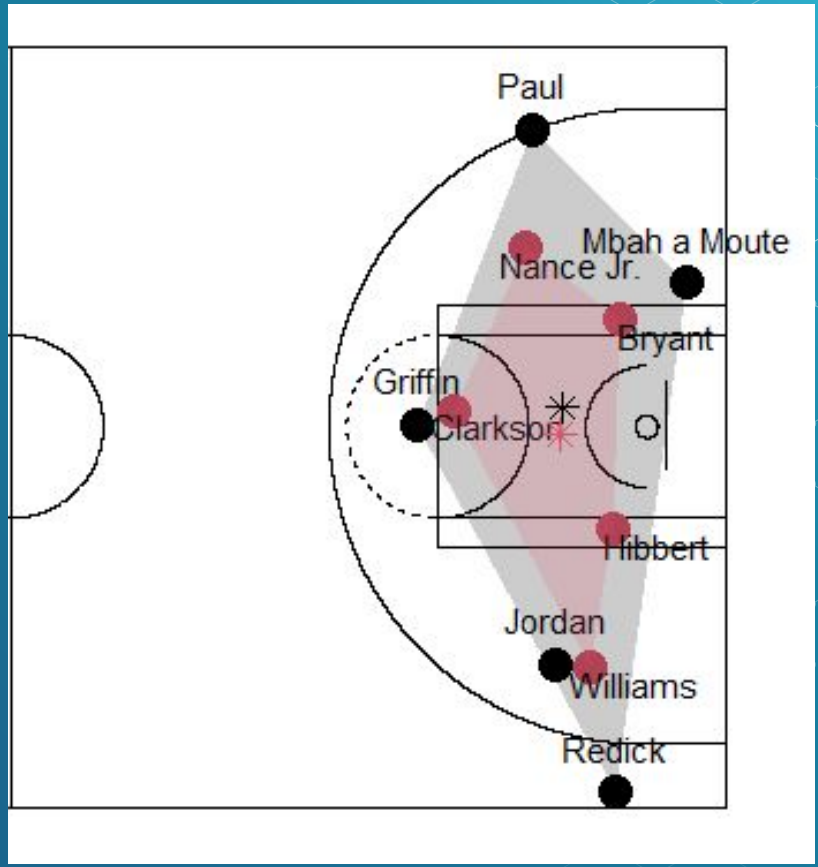
Floor Spacing: Convex Hulls

- Smtg concise about how we will use it / any results we can produce



Floor Spacing: Convex Hulls

- “A set of points defined as the smallest convex polygon that encloses all of the points in the set”
  - “Convex”: polygon has no corner that is bent inwards

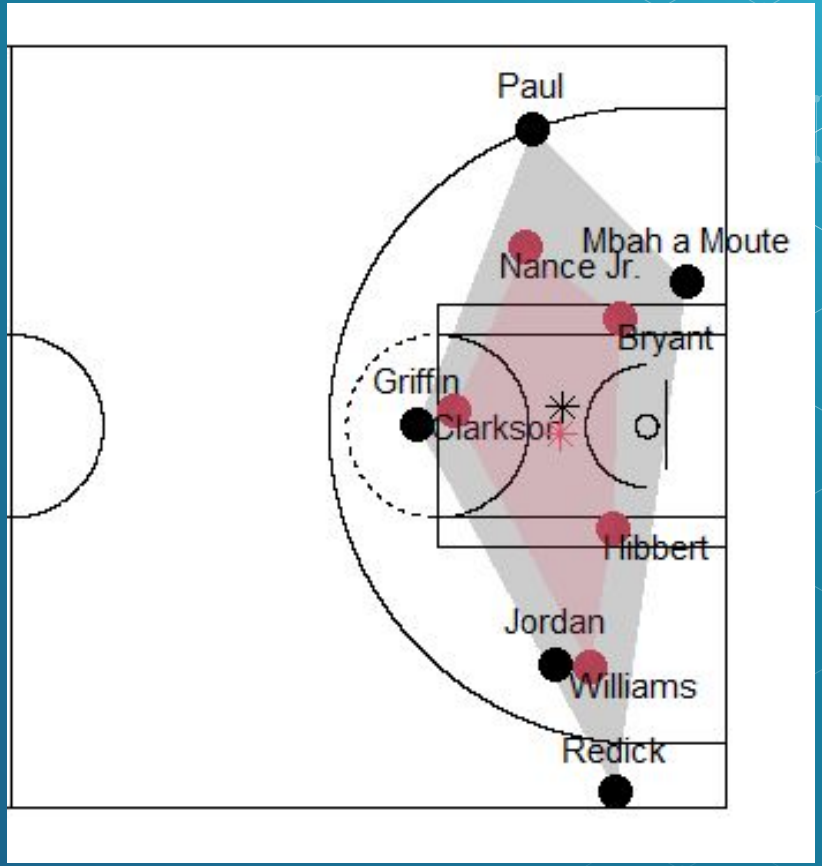


Importance of Spacing

Generally accepted rule: Spacing, specifically on offense, leads to more opportunity and therefore production

Defender's Dilemma

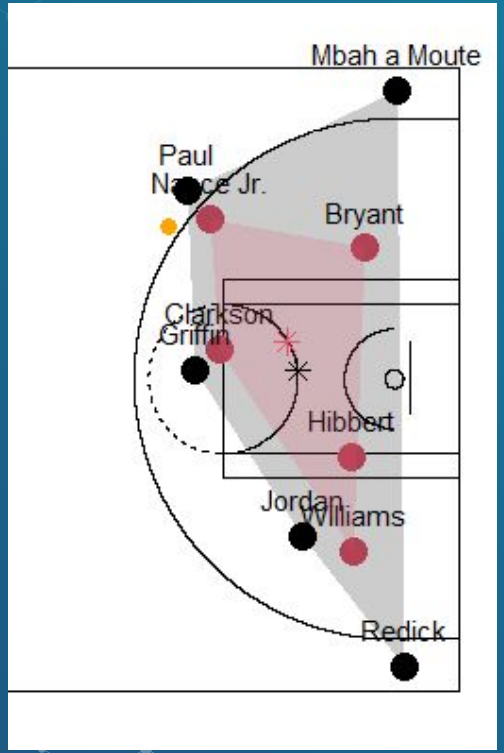
- Stay closer to the paint, help guard dribble-penetration, give your defensive assignment more space
- Stay close to defender, take away their perimeter opportunities



Example Analysis: First Basket

Areas:
Clippers: 515.79 ft^2
Lakers: 203 ft^2

Centroids:
Clippers:
85 by 32.3 ft
Lakers:
81.2 by 24.6 ft



Areas:
Clippers: 452..51 ft^2
Lakers: 178.95 ft^2

Centroids:
Clippers:
83.4 by 21.85 ft
Lakers:
83.16 by 23.68 ft