

MODELING SPATIAL EXPECTED POINTS ALLOWED BY NBA DEFENSES

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INTRODUCTION: BEYOND THE BOX SCORE

- There are a great number of stats to measure offense in basketball, but not for defense
- Traditional counting stats like steals and blocks are rare and do not reflect true defensive ability
- Defensive metrics often ignore **spatial context**

OUR GOAL

To create a metric for analyzing team defensive efficiency that takes into account the location of shots taken.

OUR APPROACH

We'll use a **Generalized Additive Model (GAM)**:

- Smooths over the variance seen in binning to provide a **continuous surface** of expected points per shot taken.
- Less susceptible to noise, captures the broad spatial trends of a defense.

We can use GAMs to create a new metric, **EP_x**, representing the **E**xpected **P**oints a defense allows per shot taken at a point **x**.

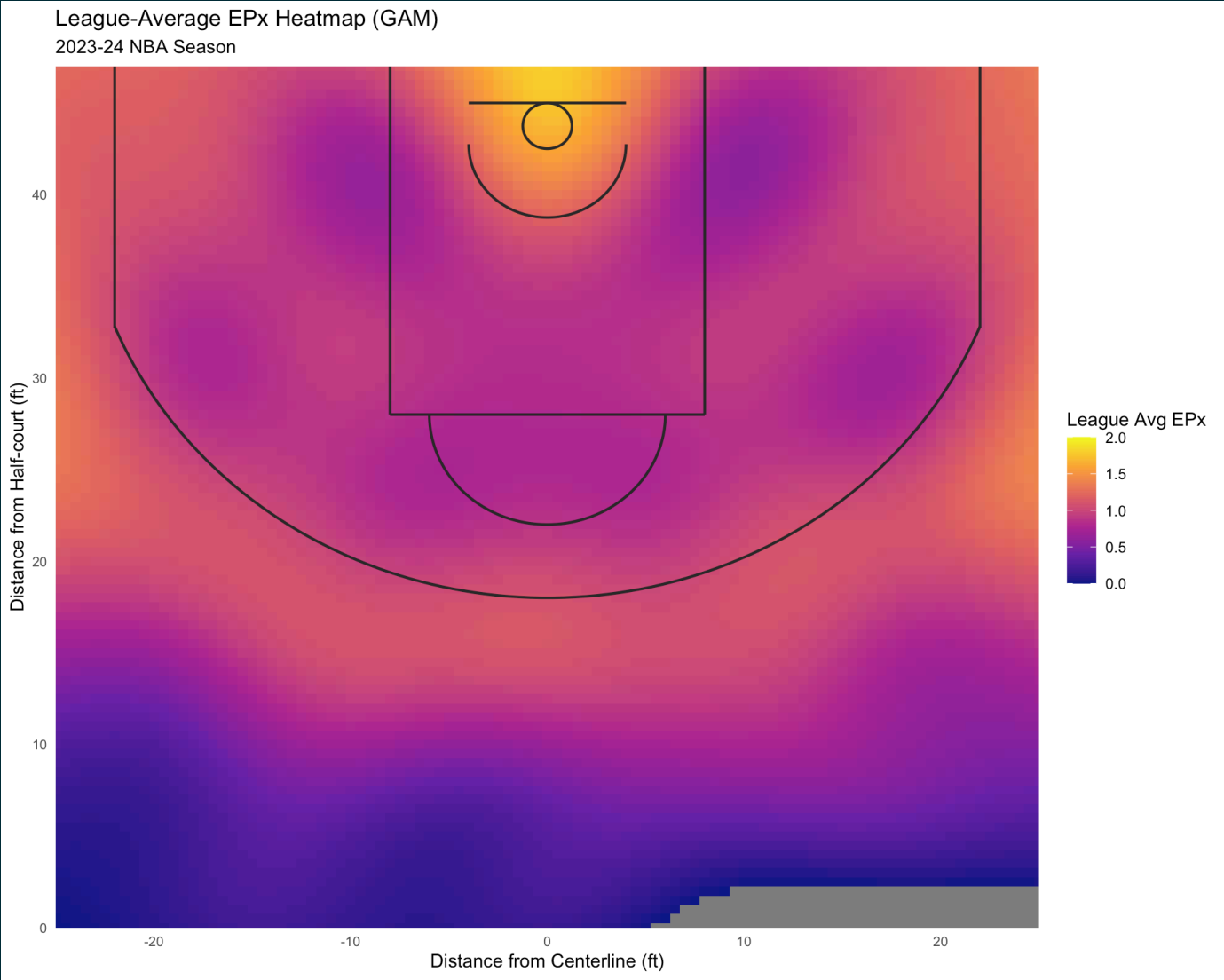
THE CODE

We use the **mgcv** package in **R** to fit our GAMs based on the **score_value** (0, 2, or 3) of any shot taken as a function of its **x** and **y** coordinates on the half court. We use play-by-play data accessed via **hoopR**:

► Code

Using this GAM, we can create a heatmap for the league-average **EPx** at any location on the court.

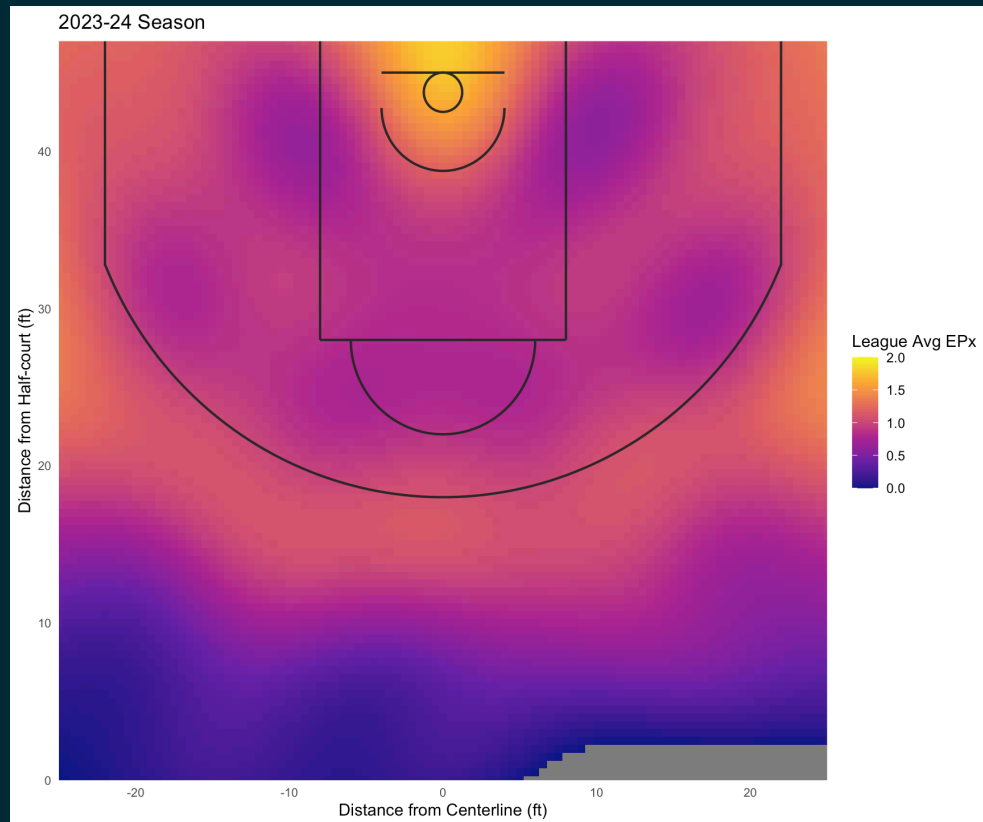
LEAGUE AVERAGE PLOT (2023-24)



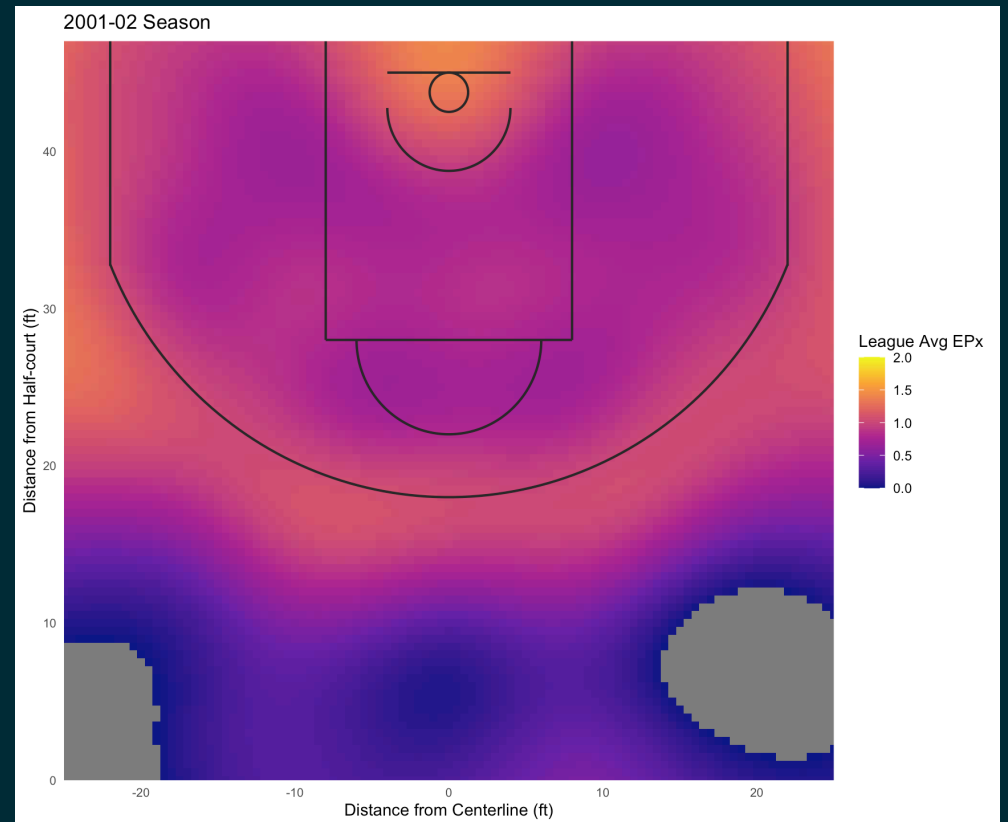
2023-24 League-Average EPx heatmap. Yellow: most efficient, Purple: least efficient

HISTORICAL COMPARISON PLOTS: 2024 VS. 2002

2023-24 Season



2001-02 Season



Were offenses worse or defenses better in 2001-02?

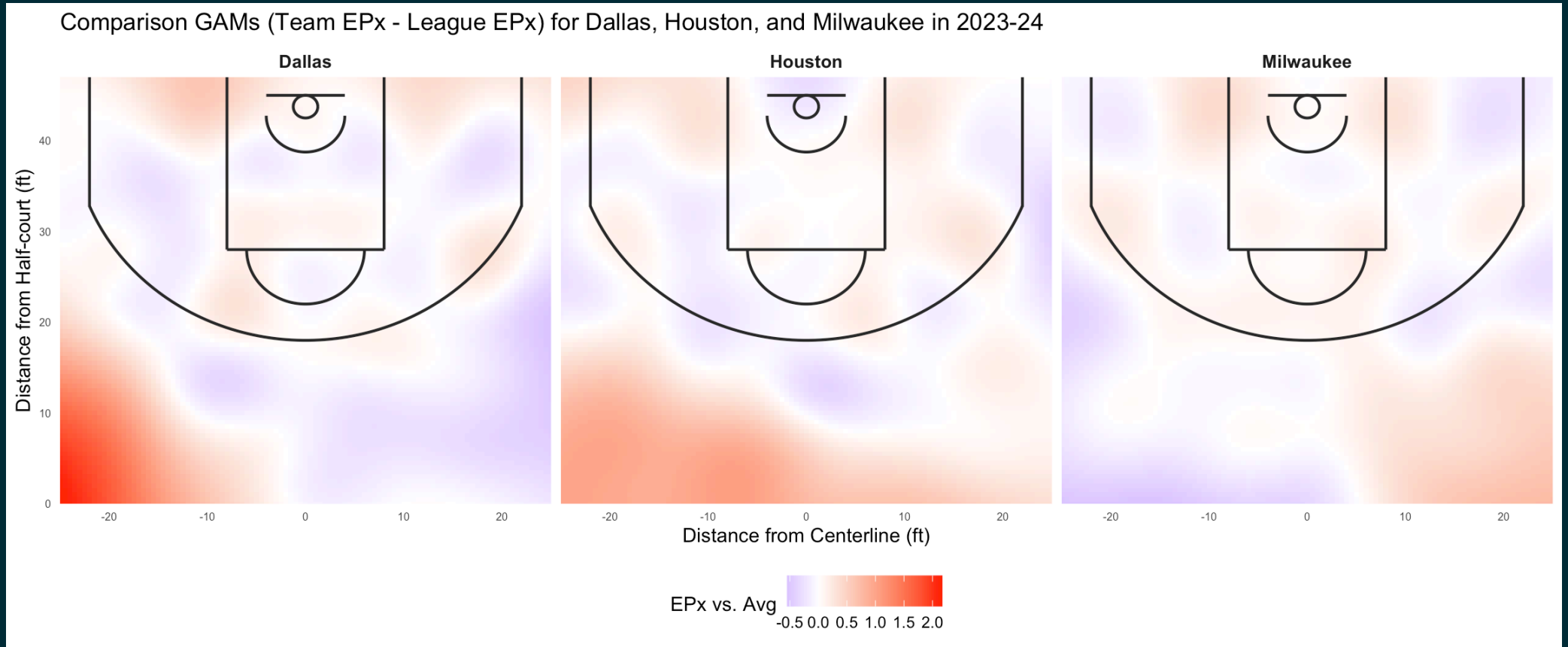
TEAM-BY-TEAM COMPARISONS

We can also create **Comparison GAMs** by running a model for each team defense in the NBA, and then *subtracting* the league average from each team's map.

- **Red** = Worse than Avg. Defense (Vulnerable Area)
- **Blue** = Better than Avg. Defense (Strong Area)

These heatmaps are useful for seeing at a glance where a team has weaker than league average defense.

TEAM-BY-TEAM COMPARISON HEATMAPS

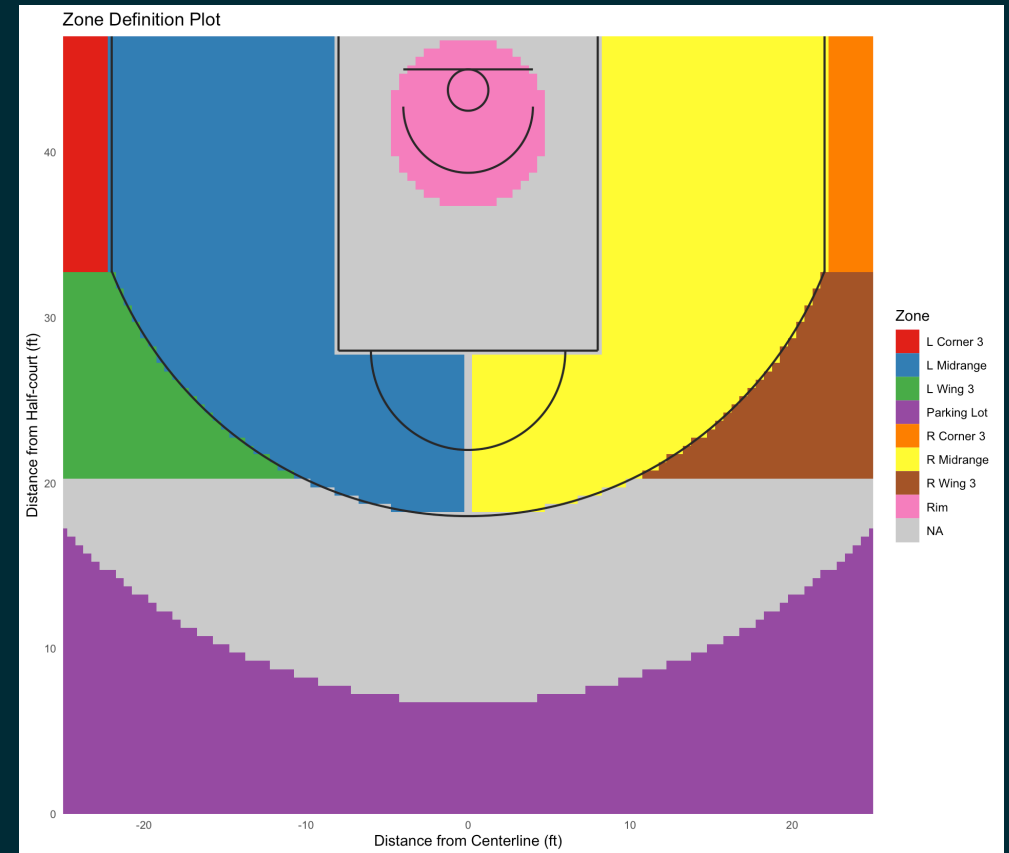


(**Red** = Vulnerable Area, **Blue** = Strong Area.)

ZONAL ANALYSIS

Let us define a number of specific zones on the court to compare defenses on:

- Around the rim
- Left/Right Corner 3s
- Left/Right Wing 3s
- Left/Right Midranges
- The Parking Lot



Gray areas are not assigned to a zone.

ZONAL ANALYSIS (CONT.)

Now let us take a look at the $\text{Team EPx} - \text{League EPx}$ for our defined zones.

Note that $\text{Team EPx} - \text{League EPx}$ being a negative value means a team allows that many fewer points on average per shot taken in the zone!

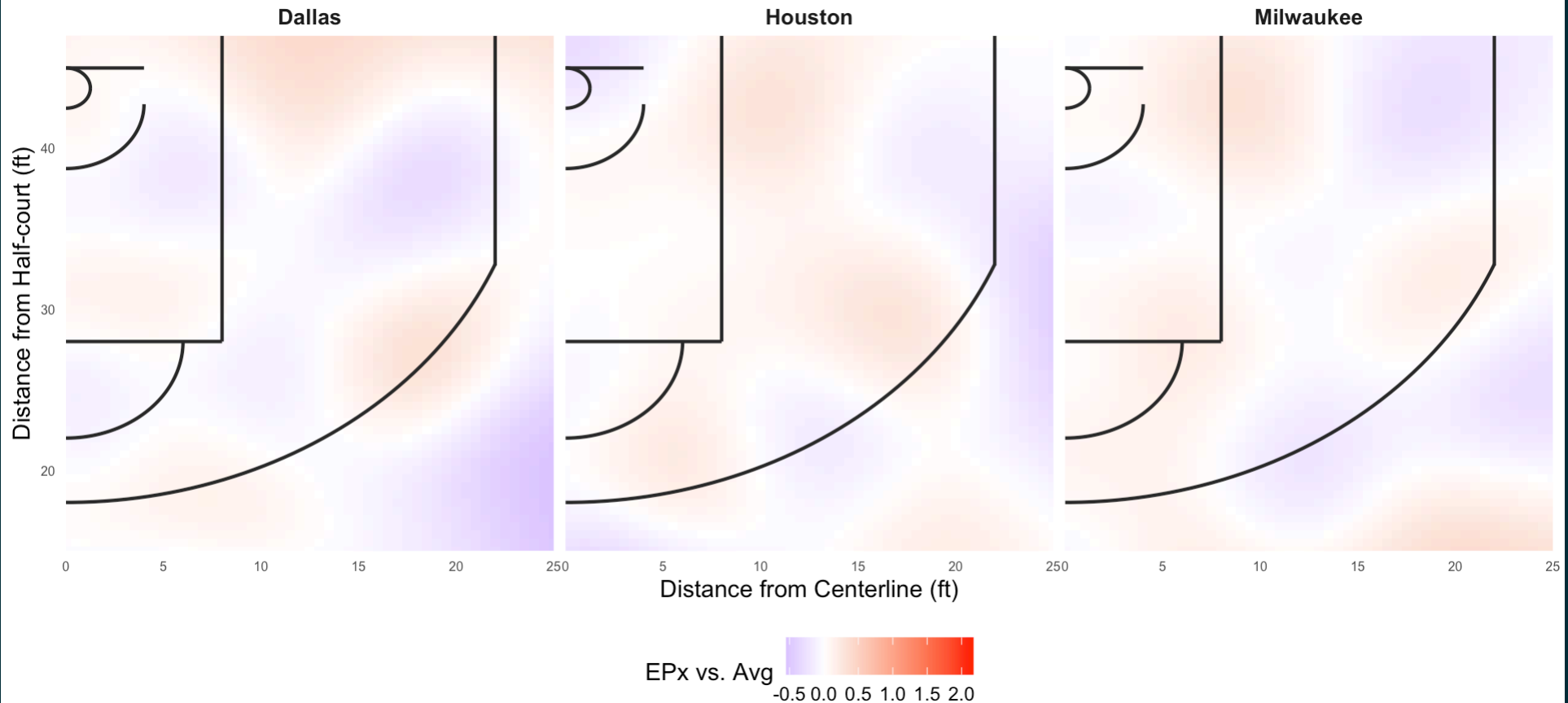
ZONAL ANALYSIS TABLE

Team EPx vs. League Average by Zone in 2023-24 (Δ Team = Team EPx - League EPx)

Zone	League Avg EPx	Dallas EPx	Δ DAL	Houston EPx	Δ HOU	Milwaukee EPx	Δ MIL
Rim	1.362	1.384	0.023	1.292	-0.069	1.403	0.041
L Corner 3	1.171	1.177	0.006	1.267	0.096	1.147	-0.023
R Corner 3	1.203	1.263	0.059	1.061	-0.142	1.153	-0.050
L Wing 3	1.133	1.157	0.024	1.065	-0.068	1.063	-0.069
R Wing 3	1.145	1.087	-0.058	1.037	-0.108	1.025	-0.120
L Midrange	0.906	0.956	0.050	0.924	0.018	0.958	0.052
R Midrange	0.887	0.903	0.016	0.957	0.069	0.897	0.009
Parking Lot	0.262	0.606	0.344	0.843	0.581	0.339	0.077

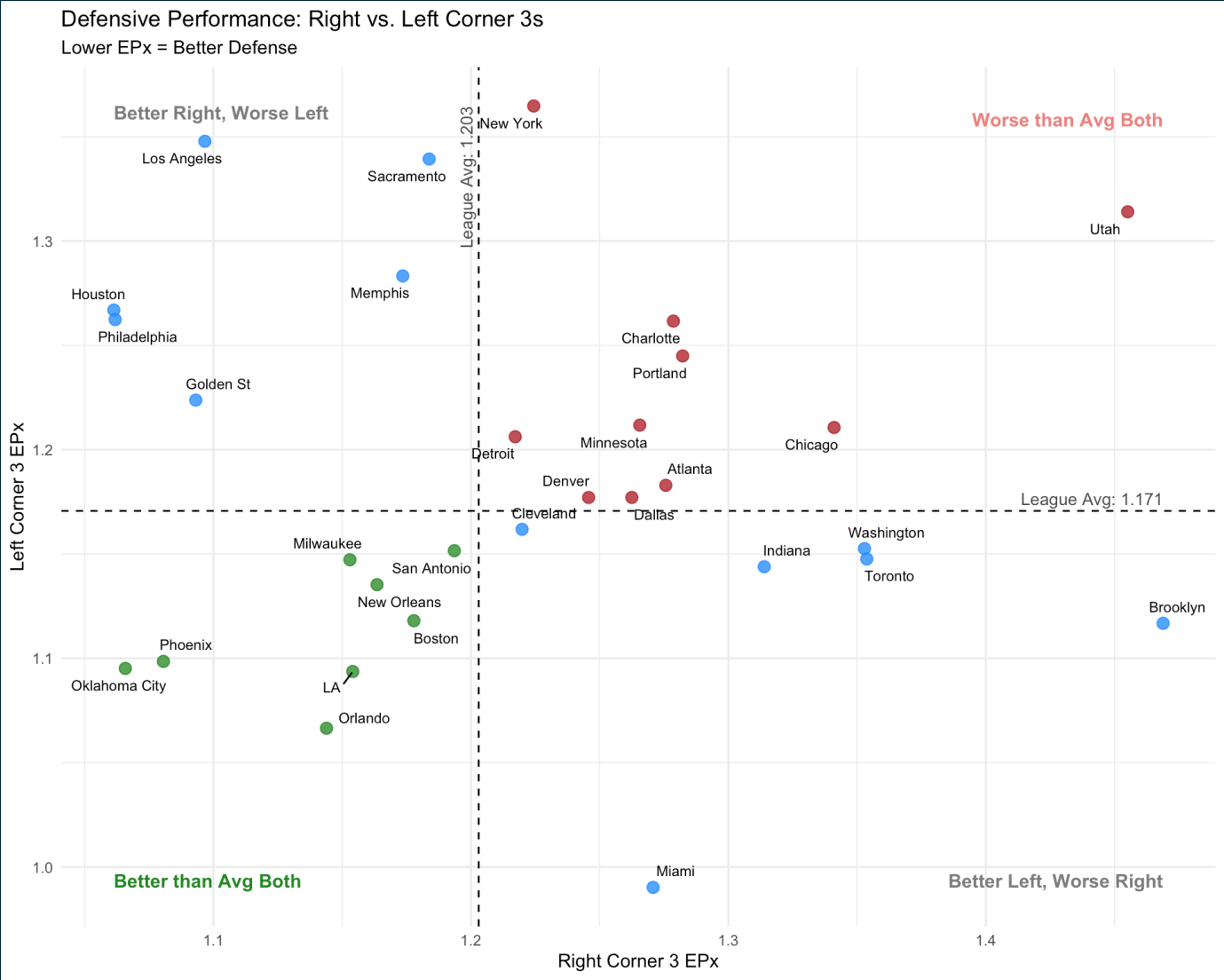
CASE STUDY: RIGHT CORNER 3 EPX

Comparison GAMs (Team EPx - League EPx) for Dallas, Houston, and Milwaukee in 2023-24



R Corner 3: Δ DAL = 0.059, Δ HOU = -0.142, Δ MIL = -0.050

CORNER 3 DEFENSE SCATTER PLOT



Comparison of 2023-24 Zonal EPx on Left vs. Right Corner 3s

FINAL THOUGHTS

HOW TEAMS CAN USE EPX TODAY:

- Opponent Scouting
- Self-Scouting
- Player Evaluation

CURRENT LIMITATIONS:

- Defender Context
- Game State
- Foul/Possession Data

FUTURE STEPS:

1. Incorporate Tracking/Possession Data
2. Player-Level Analysis

THANK YOU FOR LISTENING!
QUESTIONS?