# UNPACKING SPATIO-TEMPORAL DIFFERENCES OF RISK FOR CRIME:

# AN ANALYSIS IN LITTLE ROCK, ARKANSAS

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## Introduction

Risk terrain modeling (RTM) is spatial analysis that constructs an assessment of how the built environment influences events, such as crime, and is designed to provide actionable results that move the focus off of people and turn the attention to risky places. Excluded from previous studies utilizing RTM is the inclusion of a temporal element, which should be considered when developing tailored policing strategies. The goal of the current study is to account for police shifts and the modal violent crime within each police division in Little Rock, Arkansas. Using RTM to build division and shift specific models allows results to be translated into actionable intel by Little Rock Police Department (LRPD) to develop crime and risk reduction strategies tailored to their respective divisions and shifts.

## Study Setting

This study focuses on Little Rock, Arkansas, which houses approximately 200,000 residents across roughly 119 square miles. The city had the 7th highest violent crime rate and the 4th highest property crime rates with cities over 100,000 residents in 2015. Little Rock is comprised of three police divisions - Downtown, Southwest, and Northwest –with officers within each division being separated into three shifts - 0700–1459, 1500–2259, and 2300–0659. LRPD employs crime analysts for each division and holds weekly CompStat meetings to develop strategic initiatives tasked with controlling crime. Our findings have translational value with regards to the way LRPD crime analysis units operate.

**Data & Methodology**

LRPD provided Part I crimes for calendar year 2015, as well as police division boundaries. The crime data were first divided by division and then by shift before selecting the modal category to focus upon as the outcome of interest (Table 1). Aggravated assaults excluded incidents on a family or household member in our analysis. Our analysis examined 18 different risk factors (greater than prior Little Rock RTM studies) and included place features such as banks, liquor stores, bus stops, and unsafe buildings. Place feature data was collected from various municipal agencies.

**Table 1.** Modal Violent Crime by Division and Shift

| Division | Shift | Modal Crime Type | $n$ |
|----------|-------|------------------|-----|
| Northwest | 0700 – 1459 (1) | Aggravated Assault | 36 |
| | 1500 – 2259 (2) | Aggravated Assault | 59 |
| | 2300 – 0659 (3) | Robbery | 39 |
| Southwest | 0700 – 1459 (4) | Aggravated Assault | 56 |
| | 1500 – 2259 (5) | Robbery | 84 |
| | 2300 – 0659 (6) | Robbery | 64 |
| Downtown | 0700 – 1459 (7) | Aggravated Assault | 78 |
| | 1500 – 2259 (8) | Aggravated Assault | 112 |
| | 2300 – 0659 (9) | Robbery | 68 |

To quantify risk across the study area, the RTM Diagnostics (RTMDx) Utility was utilized as a means of automating the RTM process to produce an output list of environmental risk factors with their corresponding spatial influence upon the outcome event. We built nine separate models within RTMDx – three per division to correspond to the three shifts that police officers work. By doing so, we were able to compare the spatial dynamics of place-based features throughout the environment (police divisions) based on time of day (police shifts) that increase the likelihood of experiencing the modal crime type.

**Results**

When comparing across models where the outcome crime and the police shift is the same, we find evidence to support our expectation that the risk associated with the same place-based feature varies when anchoring upon police division. Analyzing the summary of temporal differences (Table 2), the only significant risk factor across shifts and crimes is in the Downtown division with respect to rental units over 100 units. There are also multiple

instances of a risk factor being significant in one division, but not in any other regardless of crime type (e.g. major department retail stores in the Northwest, fast food in the Southwest, and unsafe vacant buildings in the Downtown). This is likely due to not only the differing environments (divisions) where the place-based features sit, but also the way they collocate with other features that would increase/decrease risk of victimization.

When analyzing across models with aggravated assault as the outcome crime, gas station/convenience stores are the only risk factor that held statistical significance, specifically during the 0700–1459 police shift. For both the Northwest and Downtown division where aggravated assault is the modal crime type for the first two police shifts, gas stations/convenience stores fail to be included in the model of best fit when transitioning from the 0700–1459 to 1500–2259 police shift. Additionally, both divisions had risk factors drop out and appear from one shift to the next (i.e. bus stops, rental homes single to quad, rental apartments with over 100 units, and liquor stores). This not only displays the ability for place features to vary across the landscape, but also by time of day. These two aspects are significant to police officers within each division who must allocate their time and resources, and to the overall department who is tasked with controlling crime.

**Table 2.** Comparison across RTMs

| Risk Factors | Northwest | | | Southwest | | | Downtown | | |
|---|---|---|---|---|---|---|---|---|---|
| | Aggravated Assault | | Robbery | Aggravated Assault | Robbery | | Aggravated Assault | | Robbery |
| | 0700 - 1459 | 1500 – 2259 | 2300 - 0659 | 0700 - 1459 | 1500 – 2259 | 2300 - 0659 | 0700 - 1459 | 1500 – 2259 | 2300 - 0659 |
| Banks | - | - | - | - | - | - | - | - | - |
| Barber and Beauty Shops | - | - | X (P, 216) | - | - | - | - | X (P, 216) | - |
| Bus Stops | X (P, 648) | X (P, 1080) | - | - | - | - | X (P, 216) | - | X (P, 864) |
| Check Cashing and Pawn | - | - | - | - | - | - | - | - | - |
| Fast Food and Beverage | - | - | - | - | X (D, 216) | - | - | - | - |
| Gas Station and Conv. Mart | **X (D, 216)** | - | X (D, 216) | **X (D, 216)** | - | - | X (D, 864) | - | X (D, 648) |
| Grocery Super Market | - | X (D, 216) | - | - | - | - | X (P, 216) | X (P, 216) | - |
| High Schools Public | - | - | - | - | - | - | - | - | - |
| Hotel Motel | - | - | X (D, 216) | - | - | X (D, 216) | - | - | - |
| Liquor Stores | - | - | - | - | - | - | - | X (P, 216) | - |
| Major Dept. Retail Discount | X (P, 432) | X (D, 864) | - | - | - | - | - | - | - |
| Mixed Drink Bar Restaurant Club | - | - | - | - | - | - | - | - | - |
| Rental Mobile Homes | N/A | N/A | N/A | - | **X (D, 216)** | **X (D, 216)** | N/A | N/A | N/A |
| Rental Single to Quad | X (D, 216) | - | - | - | - | - | - | X (D, 432) | X (P, 864) |
| Rental Apts. Less Than 100 Units | X (D, 216) | X (D, 216) | - | - | - | - | - | - | - |
| Rental Apts. Over 100 Units | - | **X (D, 216)** | **X (D, 216)** | - | - | - | **X (P, 216)** | **X (P, 216)** | **X (P, 432)** |
| Tattoo Piercing | - | - | - | - | - | - | - | - | - |
| Unsafe Vacant Buildings | - | - | - | - | - | - | X (P, 1296) | X (P, 1296) | - |
| Risk Factor Total | 5 | 5 | 4 | 1 | 2 | 2 | 5 | 6 | 4 |

Note: P = Proximity, D = Density

216 = ½ Block, 432 = 1 Block, 648 = 1 ½ Blocks, 864 = 2 Blocks, 1080 = 2 ½ Blocks, 1296 = 3 Blocks

**Discussion**

A large portion of existing literature utilizing RTM to guide policing strategies has examined the spatial dynamics of the crime throughout the entire extent of the jurisdiction, overlooking nuanced temporal and spatial patterns at smaller units of analysis. As previously stated, LRPD's CompStat meetings are centered around the three shifts and three policing divisions, making our study informative to not only LRPD but the general law enforcement community. Overall, results generally supported our expectations that each division would exhibit unique spatial dynamics for experiencing crime depending on police shift.

Specifically, we have demonstrated that not only can information be gained to inform the officers on a division-specific level, but also on a temporal level with regards to shift. Most notably, efforts aimed at agency wide change to reduce crime may overlook issues occurring at a smaller geographic level (division) and may disregard the element of time (shift), both of which our analysis has shown to be of statistical importance when considering practical interventions. By utilizing RTM, LRPD and other police agencies across the nation, can develop a deeper understanding of the spatial dynamics that are influencing crime across their shifts and within their divisions.