**How Does Urban Environment Shape Crime Rates**

1. **Introduction**

Environmental factors strongly shape urban crime. Governments at all levels treat crime prevention as a key policy goal. Although environmental ecology has become an important area in crime prevention and urban planning research(Lai *et al.*, 2025), scholars still disagree about the specific ways built environment features influence crime(He and Li, 2022). Existing studies show that factors like the permeability of built environments, the mix of land uses, and road connectivity interact in complex ways with community collective efficacy and crime risk(Anderson *et al.*, 2013).

This study aims to use spatial data from London to test the relationship between built environment features and crime rates. We will control for social and demographic factors and apply nonlinear modeling methods. We will explore how different features of the built environment affect property and non-property crimes, and how these effects vary across space.

1.1 Requirements to run the analysis

1.2 Literature review

Many studies have explored how the built environment affects crime, but there is no clear answer. For example, residential areas often have lower crime than commercial or mixed-use zones. In addition, crime tends to fall after commercial spaces are turned into housing（Anderson et al., 2013）.

New Urbanism promotes compact, walkable, and mixed-use areas to support sustainable cities. But some criminologists question its safety. Some studies show mixed results on how the built environment affects property crime. Also, they often overlook the effects of nearby social disadvantage.(He and Li, 2022). In addition, Butts and others pointed out that there is a "nonlinear relationship" between population density and crime(Butts *et al.*, 2012). This shows that it is important to consider nonlinear effects.

Most current studies use linear methods and do not fully capture the possible nonlinear relationships between environmental factors and crime rates. Given the complex causes of crime, it is necessary to explore nonlinear effects as a complement. Also, existing research mainly focuses on property and violent crimes, while giving less attention to crimes like disorder and drug offenses(He and Li, 2022).

(Groff and Lockwood, 2014) pointed out that property crimes are most common on street segments, but disorder crimes are much less frequent.Therefore, this study will look at both property and non-property crimes. It will use changes in crime rates as the main outcome variable. The goal is to better show how built environment features influence urban crime patterns.

**Research Questions**

This study aims to explore whether crime in London shows spatial regularities and whether these patterns are linked to features of the built environment. It further examines if such relationships are consistent over time or potentially contribute to shifts in local crime risk.

This leads to the following research questions:

**RQ1** | Do crime rates vary spatially across London? Are the patterns of property crime and non-property crime distributed in the same way?  
**RQ2** | If spatial differences exist, are they correlated with built environment features such as greenspace, road density, and transport accessibility?  
**RQ3** | If such relationships hold, can we identify whether built environment changes—like housing growth—have a measurable temporal effect on crime?

1. **Data**

2.1 Boundaries Data

Ward-level boundary data were taken from the UK Office for National Statistics GeoPortal. Only London wards were kept. Geometric areas were calculated in square kilometers.

Wards in the City of London (LAD code: E09000001) were merged into one unit for consistency. It serves as the base for merging other data.

**2.2 Crime Data**

Crime data were sourced from the [London Datastore](https://data.london.gov.uk/dataset/recorded_crime_summary), specifically the Metropolitan Police Service ward-level datasets. Two datasets were used:

* **Recent 24-month crime data**: for spatial correlation and ratio analysis.
* **Historical monthly crime data (2001–2022)**: for long-term panel analysis of temporal trends.

In the recent dataset, monthly crime counts were aggregated by ward to calculate total crime volume. The classification follows the FBI Uniform Crime Reporting (UCR) scheme, where property crimes include burglary, larceny-theft, arson, and motor vehicle theft at the census block group level (He and Li, 2022).

2.3 Built Environment Data

This section uses spatial data from OS OpenMap to describe the built environment in each London ward. Each feature was matched to a ward using a spatial join. Four density indicators were created:

• **Building density**: total building area divided by ward area

• **Road density**: total road length divided by ward area

• **Greenspace density**: total green area divided by ward area

• **Public transport density**: number of bus stops and stations divided by ward area

These maps reveal clear spatial disparities in built environment features across London. Building and road densities are highest in central areas, which also tend to have higher crime rates. In contrast, greenspace is more common in outer wards, where crime is generally lower. Public transport access shows mixed patterns, with high densities both in central boroughs and specific peripheral zones. These differences suggest that built environment factors may shape crime distribution by influencing accessibility, surveillance, and urban activity intensity—key aspects relevant to crime opportunity and deterrence.

**2.5 Social Environment Data**

Social variables were collected from multiple sources on the [London Datastore](https://data.london.gov.uk/), including census and deprivation data. The key indicators include:

* **Male ratio**: share of male residents
* Working-age ratio: residents aged 16–64, follows the age band definition used in the Index of Multiple Deprivation (IMD)
* **Population density**: population divided by ward area
* **Ethnicity ratios**: share of residents in major groups (White, Black, Asian, Mixed)
* **Average deprivation**: weighted index across four household deprivation dimensions

Prior research highlights that property crime is often linked to community-level characteristics such as income level, deprivation, and ethnic composition (He and Li, 2022). Controlling for these factors allows for a clearer assessment of how the built environment shapes crime independently.

**2.4 Housing Data**

Housing data were obtained from the Greater London Authority's dataset on net additional dwellings. It reports the number of new homes completed each year in every London borough from 2001 to 2022. This variable is used to explore whether changes in housing supply relate to trends in crime levels.

**3. Methods**  
This study uses a three-step approach to understand how built and social environments affect crime in London:

1. **Spatial Pattern Analysis**  
   We first mapped crime ratios across wards using choropleth maps. This helped show where property and non-property crimes are more common and revealed possible spatial clusters.
2. **Crime Correlation Modeling**  
   We trained CART, Random Forest, and XGBoost models to predict crime density using multiple variables. The model with the highest R² was chosen, and we used permutation importance to find the most important features.
3. **Temporal Effect Estimation**  
   We then used a panel fixed effects model to test if yearly housing growth changes crime over time. By comparing models with and without time effects, we checked whether the results were driven by shared yearly events.

**4.1 Spatial Distribution of Crime**

The maps show clear differences in crime across London. **Crime density is highest** in the center, showing a strong center-to-edge pattern. The City of London appears blank, as its data was excluded.

**Property crime** is most common in central areas like Westminster, where busy streets and shops may increase theft. This supports the idea that crime rises where more people gather.

**In contrast**, non-property crime is more common in outer or mixed residential areas like Newham, Southwark, and Croydon. This suggests that different types of crime follow different spatial patterns.

**Overall**, these patterns may relate to land use or local conditions.

**4.2 Association Between Built Environment and Crime**

The results show that the built environment explains much of the difference in crime across London. **Among all models**, XGBoost had the highest accuracy, showing that the layout of an area is closely linked to its crime level.**In particular**, places with high building and population density had more crime. This supports the idea that dense areas may create more crime opportunities.

**On the other hand**, social and demographic factors had little effect once the built environment was considered. This means that how a city is built may matter more than who lives there.

**4.3 Temporal Dynamics of Housing Growth and Crime**

In 2020, crime in London dropped sharply due to the pandemic. Westminster alone accounted for nearly one-third of this decline. This shows that sudden events can disrupt long-term crime trends, so time-related shocks should be considered in analysis.

Earlier findings showed that building density is the strongest predictor of crime. This raises a key planning question: if higher density is linked to more crime, should new housing projects consider safety impacts?

To test this, we used a panel fixed effects model to study the link between yearly housing growth and crime. Before controlling for time, housing growth showed a weak but significant link to crime. After adding time fixed effects, this link disappeared.

This suggests that housing growth does not directly cause crime changes. Instead, stable features like building density have a stronger and more consistent impact.

**Conclusion**  
This study shows that crime in London varies widely across space and is closely tied to features of the built environment. Building density is the most consistent factor linked to crime, while short-term housing growth has little clear effect over time.

Crime is not just a social issue—it is also shaped by space. Features like density, land-use mix, and how people move through the city affect where crime happens. Planners should focus less on how many homes are built each year and more on how city spaces are designed. Thinking about crime prevention in urban design could help build safer, more sustainable cities.

**Limitations**

* **Transport effects unclear**  
  Station closures often come with other changes, so their impact on crime is hard to separate. (Phillips and Sandler, 2015).
* **Crime underreporting**  
  Not all crimes are reported, so actual levels may be higher than the data shows.
* **Limited spatial detail**  
  Borough-level data may miss neighborhood-level patterns.