The Leeds Burglary Simulator

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1. INTRODUCTION

Quantitative analysis of crimes often proceeds at an aggregate level, utilising environmental and crime statistics aggregated over both time and space. However, the drivers of crime are, more often than not, individual, as are the decision-making processes (here we exclude organised crime, though the same techniques are ultimately appropriate). Agent-based modelling offers the opportunity to step away from traditional aggregate analyses, and concentrate on the detailed actions of individuals within an environment. Agent modelling additionally allows more sophisticated modelling of individual drivers, decision making, and history. These models thus represent an excellent opportunity to bring a greater level of depth to crime modelling, and the last ten years has seen a slow rise in crime models of this type.

Burglary, particularly theft from private houses, is a major criminal issue in Britain, where these crimes tend to be perpetrated by individuals or small informal groups, and where a major driver is the purchasing of drugs. Burglary is inherently spatial, controlled as it is by the location of offenders, the demographic patterns of potential victims in a city, and the location of guardians like the police and passers-by. These spatial ties cause aggregate hotspots that can be analysed on a predictive basis for policing purposes and primary crime prevention. What is harder, however, is predicting quantitatively how these hotspots will respond to policing, or how criminals might
react and/or be removed from the crime system. Work on crime displacement and offender decision making is harder at the aggregate level because of the very individually-driven nature of the crimes. Burglary is, therefore, a clear candidate for agent-based modelling. An agent-based model of burglary promises to provide a predictive analysis for primary crime prevention, but also a framework for modelling detailed criminal, victim, and guardian behaviour, with a concomitant ability for modelling secondary responses to prevention efforts.

With this in mind, this paper describes a sophisticated model of individual-level criminal behaviour. The paper utilises the OOD protocol\(^2\) to describe the model and its validation. We then introduce, very briefly, some of the results from the model.

2. Overview

2.1. Purpose

The model is designed to a) allow for spatio-temporal predictions of burglaries at the city scale, both under current conditions and “what if” policy and other changes, and b) provide a framework for modelling and testing our understanding of the criminal system. The model does not, currently, predict the number of crimes, but runs to a fixed number of criminal events (usually the current crime figures) or for a fixed period or stopping criteria (usually until the spatial pattern of crimes stabilises). Predicting crime numbers would require an additional model relating agent histories to economic predictions. As the relationship between these elements of the crime system are far from well understood, the model currently assumes crime drivers are entirely based on individual-level steady-state economics (that is, each agent has a fixed non-crime income that does not vary) and the needs of the individuals that the income must satisfy (drugs, socialising), along with key biological drivers (in this case, sleep). The drivers have diurnal variations –