JDiBrief - Analysis
Space-Time Pattern Analysis: SUMMARY (1 of 5)

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PURPOSE: Research consistently shows that crimes do not occur everywhere, but that ‘hotspots’ of crime instead form. But it also shows that there are patterns to precisely where and when crimes occur, such that crimes are more likely to occur at or near those locations that crimes have recently taken place. Where crimes occur nearby and shortly after another they are referred to as “near repeats”. That such patterns exist has clear implications for crime prevention. The aim of this brief is to discuss some of the more advanced analyses possible to detect such patterns and to consider how they might inform crime reduction activity.

THEORY: Research based on the anlaysis of crimes detected by the police, interviews with burglars and computer simulation suggests that patterns of near repeats can be explained by two things: 1) some places are more risky than others; and, 2) for acquisitive crime at least, offenders act like foragers, selecting those places that they believe to offer the greatest rewards (with acceptable risks). This often means that they return to commit further offences at those places they have successfully targeted and those nearby, since they are likely to offer similar rewards, with similar associated risks and require a similar amount of effort.

METHOD: There are a number of techniques for detecting space-time patterns of crime. The “Knox test” can be used to determine if crimes of the same type (e.g. burglary) cluster in space and time more than would be expected on the basis of chance, or if the patterns could be explained by the fact that some areas are hotspots while others are not. A second type of analysis compares patterns across crime types and allows the analyst to determine if crimes of one type are more likely to occur at location if crimes of another have recently occurred at that location. For example, one might see if incidents of shoplifting tend to occur near to, and shortly after, incidents of burglary (or vice versa). A third type of analysis can be used to inform comparative case analysis by assisting the analyst in identifying and mapping crimes (of the same or different types) that occur near to each other in space and time.

APPLICATION: Patterns of “near repeats” have been observed in cities around the world and for a variety of crime types. Such intelligence has informed a number of interventions that have been implemented to successfully reduce crime. For example, in Edmonton (Canada) a Neighbourhood Empowerment Team (N.E.T.) developed an intervention referred to as the Notification of Community Crime (NOCC). As part of this, youth volunteers visit burglary victims and their neighbours to deliver crime prevention advice and kits. Teams deliver advice and kits as swiftly as possible. First implemented in 2009, the teams involved claim it to have had “a substantial impact on rates of residential burglary” - reducing burglary by 66% in a six-month interval in the Bonnie Doon N.E.T. area, for example.

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PURPOSE: Research consistently shows that crimes do not occur everywhere, but that ‘hotspots’ of crime instead form. But it shows more than this - it indicates that there are patterns to precisely where and when crimes occur. That is, even in high crime neighbourhoods crime does not happen all the time. Instead, when one crime occurs, others are more likely at the same location (repeat victimisation) or nearby (near-repeat victimisation) over the next week or so. Research on residential burglary even shows that the risk of burglary is greatest on the same side of the street as a recent event. These observations have implications for crime prevention, some of which have been discussed in the JDiBrief ‘Repeat Victimization’. The aim of this brief is to discuss some of the more advanced analyses possible and consider how they might inform crime reduction activity.

THEORY: Two types of theory have been offered to explain the patterns described above. According to the flag account, some locations are just more risky than others and so will be (re)victimised frequently. Support for this idea comes from studies that show that the risk of victimisation differs according to certain characteristics of people (e.g. age) or places (e.g. levels of security). Interviews with offenders also clearly reveal preferences for the types of people or places they target. However, simulation experiments suggest that this theory cannot explain why the risk of (near-)repeat victimisation is highest immediately after an offence.

The second type of explanation suggests that the risk of victimisation is boosted following an offence. According to the offender-as-forager hypothesis offenders are – just like everyone else – subject to constraints and try to maximise the benefits of their activity (criminal or otherwise) within those limitations. Constraints include their knowledge of criminal opportunities, and how far they can travel during a particular interval of time. When deciding where to commit crimes, offenders are assumed to select locations that maximise benefits and minimise costs (e.g. risk of apprehension).

In the case of burglary, offenders learn much about homes they burgle (e.g. ease of access, and what might be stolen). They also learn about homes nearby, since these are likely to share many characteristics of the burgled home(s). Where a home is believed to offer an acceptable mix of risk and rewards, the foraging offender is expected to return to that home and/or those nearby. As time passes, knowledge of particular opportunities fades. What’s more, returning to an area too often may lead to it being ‘over-foraged’ (with little of value being left to steal) and may attract unwanted attention. Consequently, offenders are expected to return to locations swiftly but to move on as the (perceived) risks of so doing increase.

Interviews with offenders, computer simulations, and the analysis of crimes detected by the police all provide support for this account. For example, the analysis of detected burglaries indicates that those that are committed near to each other in both time and space are the most likely to be the work of the same offender(s).

A further finding consistent with the theory is that research suggests that when (near) repeats occur, they are more likely to occur during the same interval of the day (e.g. between 8am and 4pm) as a previous event, a finding that has implications for crime prevention.
METHODS: A number of analytic techniques have been developed:

1. The analysis of repeat and near repeat victimisation patterns. This type of analysis can establish whether patterns of repeat and near repeat victimisation exist. A number of police forces and other agencies have implemented successful crime prevention initiatives that are based on the finding that the risk of crime ‘spreads’ (see below). To be effective, such interventions need to be implemented in areas where there actually is a pattern of near-repeats, and they will be most effectively targeted if the distance and time over which risk spreads is known. To do this, it is necessary to conduct an analysis of patterns of crime.

   To do this, a test (the Knox test) originally developed to detect disease contagion has been adapted for the study of crime. The idea behind the test is that if the risk of a particular type of event (e.g. cases of a disease, or crime) does ‘spread’ then more events will be seen to occur near to each other in space and time than would be expected on a chance basis, or if the flag account were correct (see previous brief). For example, where patterns of near repeats occur, we would expect to see more crimes occurring within (say) one week and 1-100m of each other than would be expected by chance.

2. In addition to establishing whether near repeat patterns exist in general, it is possible to ask more precise questions such as “when one crime occurs in an area, what is the probability that another will occur shortly afterwards nearby in a particular area?” This type of analysis can be useful for understanding how crime risk is likely to change in an area following one or more offences, and how it differs from one area to another.

3. The analysis of near-repeat patterns across crime types. It is possible, for example, to examine whether incidents of burglary are more likely to occur in an area if incidents of (say) shop theft have just been committed. Where such patterns exist, this would suggest that offenders who commit one type of crime also tend to commit another and that the timing and location of one type of crime might be predicted on the basis of that of the other.

4. As noted, research in various police force areas has established that crimes that occur close to each other in space and time are more likely to be the work of the same offender(s). Establishing this can help to determine if near repeats (for the same or different crime types) tend to be the work of returning offenders, which could influence police tactics. Mapping series of offences that occur near to each other in space and time may provide further insight into a crime problem, or inform comparative case analysis (linking unsolved crimes to particular offenders).
APPLICATION: Analyses for the county of Merseyside (UK) examined space-time patterns of residential burglary. Figure 1 shows how the risk of burglary appears to ‘spread’ along streets.

Figure 1 shows that the burgled home and those nearest it were at the greatest risk in the week that followed an initial burglary.

The findings from the Knox analysis are usually summarised in a table (e.g. Table 1). This summarises how frequently pairs of crimes occur within particular distances and times of each other (e.g. 100m and 7 days), but for simplicity, the table usually shows the ratio of the observed frequencies against those expected.

<table>
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<tr>
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<th>&lt;7 days</th>
<th>&lt;14 days</th>
<th>&lt;21 days</th>
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<td>Repeat</td>
<td>6.33</td>
<td>1.21</td>
<td>1.36</td>
</tr>
<tr>
<td>1-100m</td>
<td>1.69</td>
<td>1.08</td>
<td>1.21</td>
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<td>1.27</td>
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<td>1.19</td>
<td>1.04</td>
<td>1.08</td>
</tr>
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<td>1.20</td>
<td>1.09</td>
<td>1.08</td>
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<tr>
<td>401-500m</td>
<td>1.13</td>
<td>1.09</td>
<td>1.07</td>
</tr>
</tbody>
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Table 1 Example Knox analysis showing the ratio of observed burglary frequencies to those expected

In this example (for Birmingham, UK), 6 times as many burglaries occurred at the same location within 7 days of each than would be expected (e.g. 10 may have been expected but 60 were observed); 1.7 times more burglaries occurred within 100m and 7 days of each other, and so on - clear patterns of repeat and near-repeat victimisation.

Informed by such knowledge, in Edmonton (Canada) a Neighbourhood Empowerment Team (N.E.T.) developed an intervention referred to as the Notification of Community Crime (NOCC). As part of this, youth volunteers visit burglary victims and their neighbours to deliver crime prevention advice and kits. Teams deliver advice and kits as swiftly as possible. First implemented in 2009, the teams involved claim it to have had “a substantial impact on rates of residential burglary” - reducing burglary by 66% in a six-month interval in the Bonnie Doon N.E.T. area, for example.

As well as summarising overall patterns, it is possible to examine them in more detail. Figure 2 shows how mapping “near-repeat spates” of crimes might assist in comparative case analysis or other purposes. In this example, four colour-coded spates are identified for which the last burglary in a series is shown as an ‘X’. Such analysis could be conducted with other offence types or for a combination of offence types.
GENERAL RESOURCES

- Near repeat calculator - http://www.temple.edu/cj/misc/nr/
- The software noted above allows you to conduct the basic Knox test only.
- The UCL Space-Time Cluster Analyst®, developed as part of a project funded by the ESRC and West Midlands Police, allows you to conduct the basic Knox test, to examine patterns across crime types, and to “map” near repeats.

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