

Space Time Data Mining of Reporting of Injuries, Diseases and Dangerous Occurrences Regulations Data

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1. Introduction

The Health and Safety Executive is responsible for enforcing health and safety in the United Kingdom's workplaces. The trends in the patterns of workplace accidents, illnesses and dangerous occurrences are recorded in the RIDDOR (Reporting of Injuries, Diseases and Dangerous Occurrences Regulations) database to reduce further similar occurrences and inform Health and Safety policy and legislation in the UK. However, although this data is geographically referenced, there has been little research into the geography of incidents, or of space-time patterns that may provide insights into the causes of such accidents.

2. Background

2.1 Daylight hours

The Health and Safety Executive reported significantly high rates of injuries at work in transport and storage, construction and manufacturing injuries (HSE, 2011). The job roles in these employment sectors involve working predominantly outdoors. The issues with this is that outdoor jobs rely mostly on daylight and some workers tend to work through the evening and into the night. Not only is there generally lower levels of management and supervisory support through the evening and night and typically workers suffering from fatigue due to long shift hours, workers suffer from reduced visibility due to darkness (Arditi *et al*, 2007), (Mustard *et al*, 2012), Shields (2002) and Åkerstedt (2003). Most jobs within the transport and storage, construction and manufacturing industries involve the use of tools and machinery therefore reduced visibility will clearly lead to accidents at work which are potentially fatal.

2.2 Seasonal effects

Seasonal effects on the risk of accidents have been explored in several studies. Specifically, it has been found that discomfort in hot weather causes a change in work behaviour by heat stress therefore increasing the risk of work-related accidents (Morabito *et al*, 2006). In contrast, in cold winter months, there is an increase in work-related accidents due to a heightened risk of hazards on the road such as rain, snow and ice (Hanbali, 1992) and secondly due to the level of hours of darkness compared to other seasons. In a study conducted by Johansson *et al* (2009), it was found that the risk of accident increases by nearly 30% in darkness in urban areas and by nearly 50% in rural areas.

2. Methodology

There has been little research into focusing on time of day of reported accidents looking at incidents that occur before sunrise and after sunset. This study therefore considers the geographical patterns in the level of accidents occurring during the hours of darkness via visualisation techniques. There are recurring issues in research on work accidents such as access to small limited sample sizes with restrictions to specific employment sectors (Folkard *et al* (2003). This study has the advantage however of a richly sourced dataset from the Health and Safety Executive providing over 100,000 individual cases referenced to geographic location with the addition of several other variables such as age, sex and employment sector amongst others for the year 2010-11.

In order to identify patterns with space and time of accidents a number of visualisation strategies are employed through the use of R and QGIS. The hours of daylight are computed through R and mapped geographically across the UK. The frequency of accidents are calculated and weighted against the population categorically by Local Authority region. These rates are then mapped showing the frequency of accidents annually across the UK. Thirdly, a mosaic plot is computed in R showing the standardised residuals of accidents corresponding to Local Authority region and month of the year. These visualisation techniques are used to facilitate the initial analysis of space-time data mining of the RIDDOR data.

3. Findings

The hours of daylight differ across the United Kingdom with Scotland having the lowest number of daylight hours and the South of England having the highest. There is a significantly noticeable pattern in the hours of daylight found across the British Isles, with hours gradually increasing from North to South of the country (Figure 1).

Across the country there is a spread of accidents occurring within workplaces. Generally it can be seen that the lowest rate of accidents occurred in the South of England, most notably around and within central London (Figure 2). This could be due to several factors: there being more officer workers within London than anywhere else in the country therefore workers most generally working indoors than outdoors and there being more hours of daylight within the South of England than further up north of England, Wales and Scotland.

The spread of the frequency of accidents moving north tends to increase, with mainly the rural and coastal areas seeing higher accident rates than the urban areas. One of the reasons

this could be due to is that workers within rural and coastal areas tend to work outdoors. This again can be explained that people working outdoors tend to rely on daylight therefore with a lower number of daylight hours than the South of England, there seems to be an increased risk of accidents.

Looking specifically at seasons, results have found that there is clearly a disproportionate number of accidents occurring in Scotland during December and January (Figure 3). During these winter months, the hours of daylight are notably shorter here than in the rest of the UK with Edinburgh having an estimate of approximately 7 hours 5 minutes of daylight in mid-January in 2012 compared to London having approximately 7 hours 55 minutes of daylight (HM Nautical Almanac office, 2011).

Hours of Daylight

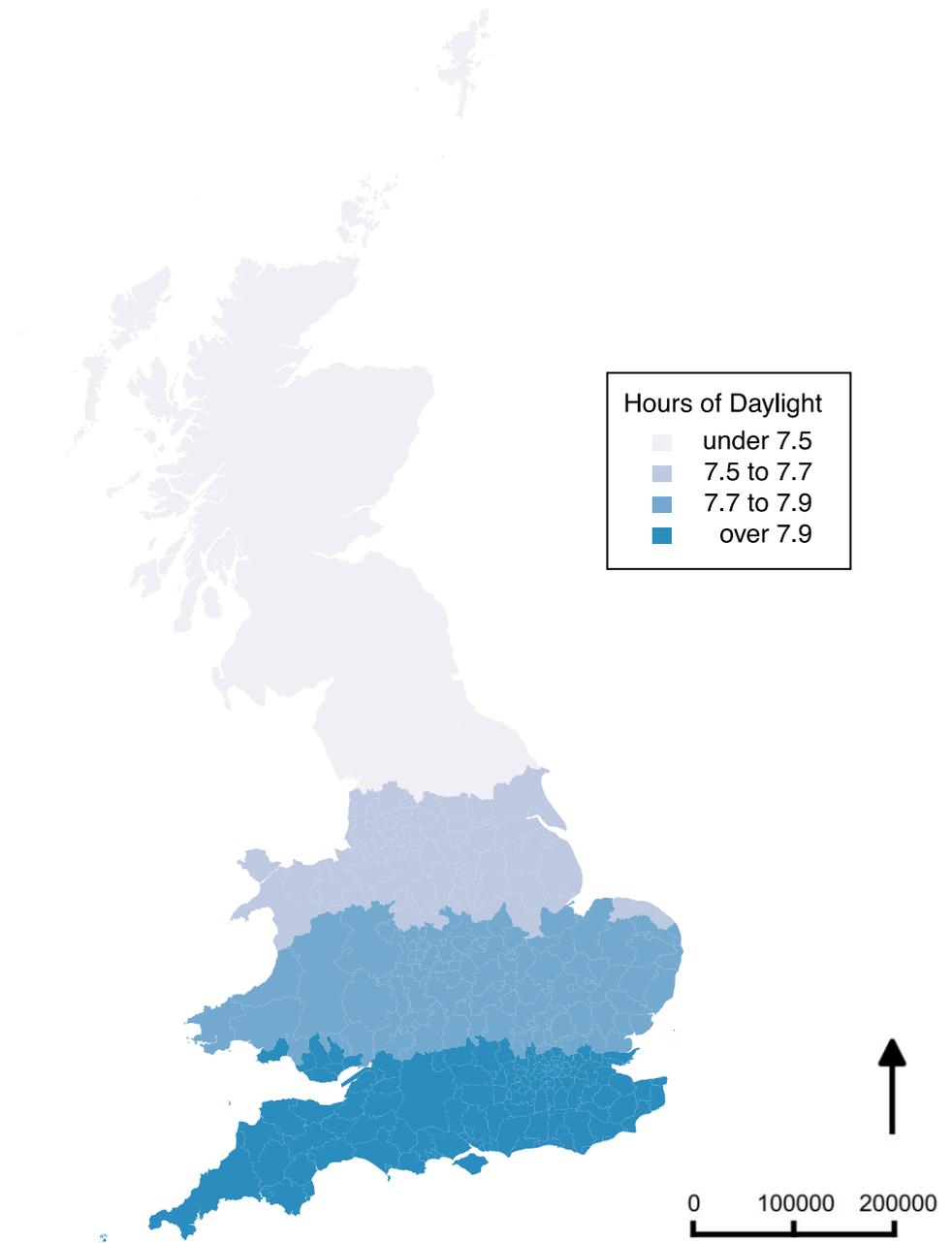


Figure 1. Daylight Hours at 1st January 2011.

Accidents by Local Authority

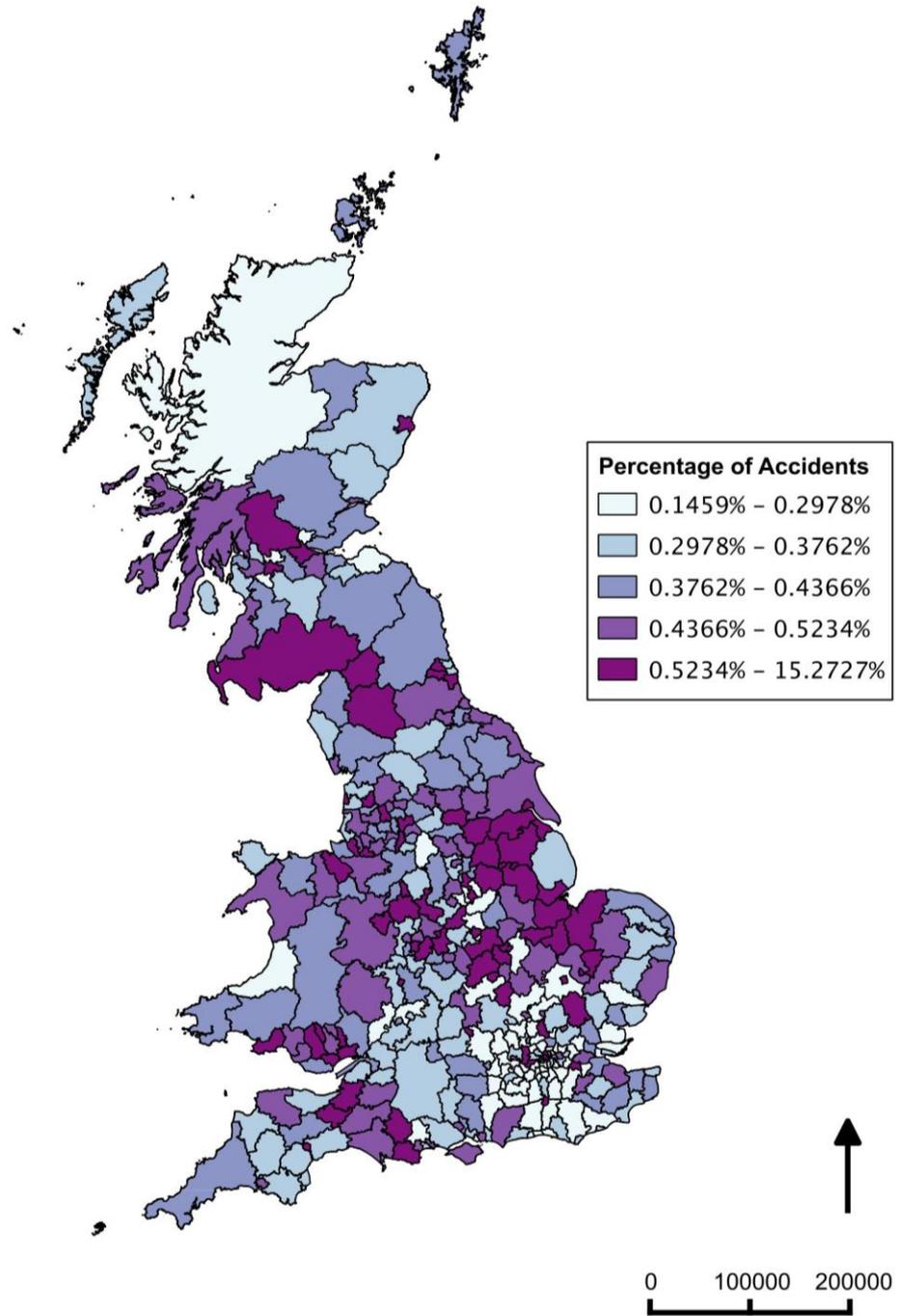


Figure 2. Percentage of Accidents by Local Authority population.

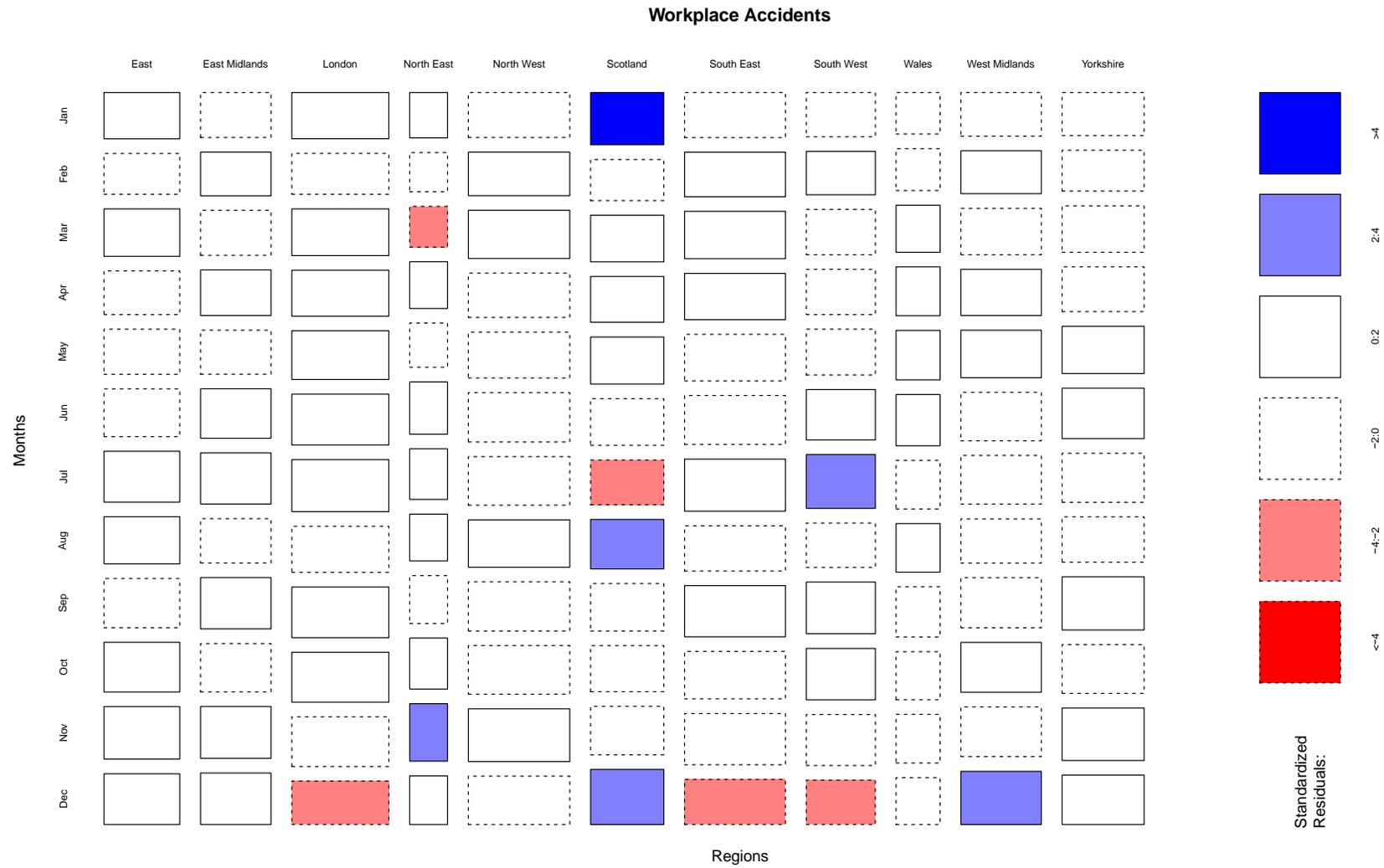


Figure 3. Workplace Accidents by UK Region and Month in 2010/11.

4. Conclusions

It is evident from the results thus far that daylight hours have an effect on work-related accidents. It has been shown that particularly outdoor working roles within rural and coastal areas tend to have a higher frequency of accidents than indoor roles within urban built up areas.

In the UK the issue of whether to alter daylight savings time, is regularly debated, and these findings are directly relevant to this debate - as changing these alters the amount of the typical working day spent in darkness. Given this debate, and the evidence here, policy implications for Health and Safety are discussed.

6. Acknowledgements

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Biography

Linda Blade is currently a postgraduate researcher at the University of Liverpool investigating accidents and injuries at work using text mining and visualisation techniques. Prior to this she studied a masters in Town Planning at the University of Liverpool and has a Bachelors degree in Geography and Mathematics from the University of Sheffield.