SPATIAL DATA INTEGRATION AND PATTERN ANALYSIS: AN INDUCTION APPROACH

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KEY WORDS: Spatial Pattern Analysis, Data Integration, GIS Modelling, Decision Trees

ABSTRACT:

This paper proposed a methodology to integrate spatial and social data to map to map maltreatment of children using an induction method. It utilises Geographic Information Systems (GIS) technology as a spatial modelling and analysis tool to intelligently map the spatial distribution of these phenomena. The project uses administrative data, census data, and spatial analyses and map the rates and distribution of child abuse plus child neglect in three suburban localities. Particular attention is paid to how GIS technology can be used in conjunction with child maltreatment pattern analysis to explore relations between maltreatment as measured by mandatory notifications and the distribution of these unwanted phenomena over neighbourhoods. There has been some research on spatial crime analysis, educational planning, and other socio-economic application, and it is clear that the use of GIS for identifying and mapping of child maltreatment over neighbourhoods is a fertile area of research.

The finding of this research will provide significant information for related authorities such as child protective services; community-based agencies in order to more effectively target preventative services that might minimize child maltreatment. This can be used as a virtual tool to assist identify and target neighbourhoods where children can be at high risk of maltreatment.

1. INTRODUCTION

Recently there has been a tremendous increase in the utilisation of GIS into analysis of socio-economic applications (Bowers and Hirschfield, 1999). However, at present the use of GIS in community-based agencies (eg education department, schools) is still a new, albeit expanding area (Clark and Longley, 1995). The interface of GIS in the community and social services environment has attracted the attention of local authorities. For example, local educational authorities are increasingly paying attention to the problem of maintaining the quality of the education service against increasing costs and declining resources (Pacione, 1997). When used as a tool in a concept of pattern analysis in terms of school locations, exploring crime and disadvantage neighbourhoods, mapping child maltreatment, GIS can save significant government costs associated with each particular problem e.g. pupils' movements. For instance local authorities in UK spent over $AU70 billion on education in 91/92 (Clark and Longley, 1995). It is possible that some of this money can be saved if schools were planned more effectively. So far the use of GIS has experienced varied degrees of success in local authority applications. GIS in educational studies has been limited to its use as a basic mapping tool rather than for analysis. This is more associated with the strong lack of communication between the GIS experts and the educational authorities. Also the data capture (i.e. the ethics of releasing data) through authorities can be problematic.

This research aims to use GIS as a spatial modelling and analysis tool for identification and mapping child maltreatment (as represented in mandatory notifications) employing spatial and aspatial variables. There has been some research on spatial crime analysis, educational planning, and other socio-economic application, and it is clear that the use of GIS for identifying and mapping of child maltreatment over neighbourhoods is a fertile area of research.

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1.1 Prior Works

The literature review for this report is divided in two major parts. The first section will provide the use of GIS in a wide range of disciplines with special emphasis on social and educational applications. The second part will particularly concentrate around educational disadvantage and child abuse both from educational and spatial perspective.

Many authors including Clark and Longley (1995), Pacione (1997), Bowers and Hirschfield, (1999), Harris and Mercier (1999), Parsons et al (2000), and Swanson Ernst (2000) have developed methods for educational, crime, child abuse using spatial and asptial analysis. These include statistical analysis (Gibbs, 1997; Parsons et al 2000), spatial network analysis (Pacione, 1997), visualisation and buffering (Clark and Longley, 1995). Clark and Longley (1995) and (Thomson 1999) provide a review of the literature on these topics.

These authors identified key elements of the market reforms and the changing rule of the local education policy makers. Pacion (1997) examined the relationship between educational parameters and their socio-spatial context in order to map the differential incidence of educational disadvantage over the city of Galsgow. Findings show formulation of an education policy in provision of a socially sensitive response to the problem of the educational disadvantage within the city.

Pattern analysis in context of education has been characterised by two models namely spatial model and cooperative (aspatial) model where the first model tends to use GIS technology as a virtual tool which have a lot of advantages over the second model. The policy put the parents as a consumer on the top of triangle in order to create competitive element in to education provision. The belief was to improve standards overlay (Pacione, 1997). This approach placed for parents to put the children in to their desired school. The 1993 education Act in UK led to take the local, authority control in areas where there were surplus places and several schools in reasonable proximity schools, which compete for students. It is believed that these model force schools to see each other on the competition to be survive. Popular schools select s pupil when a vacancy arises, this cycle creates a situation to make pupils and the parent more active to seek places elsewhere. Therefor school resources declines so that founds also decline and good staff are increasingly hard to retain (Walton, 1993 cited by Pacion 1997).

Geographical locality is important due to the ways that affecting people's life. This includes tips of services, employment, cultures, litereacies, knowledge and histories. Even though our social life is partially depend upon where people live. There are advantages for people who live near to the towns and centres due to access to utilities and services (Thomson 2000). People who live in poor or relatively poor neighborhoods, they are likely more vulnerable it is related to costs of housing, health, education, transport, food and other utilities. In fact many families are now suffering as a result of this extreme pressure circumstances well behind their control and their health. This includes city siders and country siders. Depravation also caused by lake of access to the private service and as result social exclusion and also is a factor of dividing society to poor and rich level (Thomson, 2000).

1.2 Objective

The aim of this research is to identify and map maltreatment of children based on aspatial (non-geographical) and spatial (geographical) variables using an integrated GIS approach.

2. METHODOLOGY

The proposed methodology composed of following sections:

2.1 Data

- A database is being created using statistics collected randomly from 3 suburbs plus existing spatial layers. The database includes:
- Administration data on mandatory notifications. This may be acquired from the Department for Family and Community Services, already been broken into postcodes
- Social and Census data (ethic/race, family literacy level, family structure e.g. divorced, separated, united, and census data)
- Economic (family level of income)
- Utilities; access to parks and recreational areas, libraries, education institutes, facilities i.e. computers, and Internet), and
- Spatial (school zone layer, land parcel market value layer, land use layer, and colour aerial photography data at 12,500 scale).

All above data are related to locating and mapping of disadvantaged neighborhoods, and utilize GIS to map the reported maltreatment. Particular attention is paid to child maltreatment pattern analysis to explore relations between the stated data and its contextual parameters.

2.2 Hardware & Software

An IBM compatible PC (e.g. Pentium 300) with 900 Mbytes disk space and 32 Mbytes RAM is being used mainly for data processing, analysis, presentation, and writing documents. The following software is used during this research:

1. ArcInfo and ArcView GIS
2. KnowledgeSEEKER
3. PaintShop Pro, Microsoft Word, and Microsoft Excel, Microsoft PowerPoint. This software is used for day to day tasks.
4. FTP, Internet Explorer (Netscape Communicator), E-mail software are used for networking, information transfer and extraction, etc.
5. Hand held GPS for field data collection and 1A0 digitiser.

ArcView GIS is used for mainly data integration, manipulation and presentation.
Arc/Info is utilised for data capture, editing, and data manipulation.

KnowledgeSEEKER (KS) is used for statistical data analysis. KS is the automatic data analysis software. It is a famous AI program that explores contextual information, and displays the information as a series of rules. This software is used to construct generic rules from gathered database. The generated rules (knowledge) help the interpretation of relationships between variables to identify and map maltreatment of children in suburban jurisdiction based on aspatial and spatial variables using an integrated GIS approach.

2.3 Hypothesis and Proposed Approach

This research proposal describes a methodology for identifying and map maltreatment of children in suburban with GIS technology. The data for this reset include geographical and non-geographical information as follow:

- Social and census (ethic/race, family literacy level, family structure e.g. divorced, separated, united, and census data) Economic (family level of income),
- Environmental (noise and pollution level both at residential or school, assess to utilities e.g. parks and recreational areas, library, and access other education institutes, facilities i.e. computers, and Internet), and
- Spatial (school zone, population/census, land parcel market value, land use, and aerial photography).

Some of non-geographical data for this research are being gathered randomly from e.g. 3 schools, and Australian Bureau of Statistics (ABS) or other government department (e.g. Department of Education) may provide some of the data. The geographical data can be obtained from Planning Department or other related government agencies. ArcView GIS plays an important role in integration of the two types of data.

The three schools will be nominated at the three different suburbs, which reflect the income levels (low, medium, and high), education, and family levels. A comprehensive Questionnaire is being developed for undertaking interviews to collect required information from pupils and schools.

The constructed dataset (multi-layer) will be analysed by KS in order to explore the inter relationships of variables that map the child abuse in a high-risk areas. This research uses an integrated statistical and spatial analysis. One of the popular statistical and contextually based approach is decision tree which incorporates decision rules and spatial relationships of attributes (if they are input to the process) to classify observations.

The decision tree facilitates grouping large numbers of observations and subsequently translates group membership into classification rules, which provides effective analytical tools for the GIS user. A number of statistical analysis algorithms are currently available to generate decision trees including CART, ID3, and KS. The use of decision trees in GIS analysis and modelling has been widely discussed. For example, Forghani (2000) provides a systematic approach to integrate existing knowledge with spatial information employing decision tree analysis.

The result of this study will assist the Education Department, Schools Administration, and other relevant community-based service providers to identify and target neighbourhoods where children can be at high risk of maltreatment. If accurate information is available at the local, state, and national levels, and then authorities are able to construct better polices and provide more effective services to the disadvantaged children and the identified suburbs.

2.4 Project Outcomes and Contributions

The process and contributions of this project are to:

- Examine the usefulness of integration of spatial and socio-economic data for child abuse and maltreatment issue,
- Collect data from three schools
- Develop a model which relates critical spatial variables to the child abuse data,
- Develop databases and user-friendly methodologies to provide easy access to the related community authorities, decision/policy makers and involved organisations in the community services area.

The principle outcome of the project is a model that links the above stated data that can be used throughout the Department of Human Services to make the

management of month to month child abuse treatment tasks easier, more efficient and more productive.

2.5 References

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2.6 Acknowledgments

I would like to sincerely thank Dr Alan Forghani for his constructive feedback and assistance with preparing this report.