

MAPPING OF VEHICLE CRIME IN NORTHEAST PULAU PINANG

Mohd Sofian Redzuan¹, Tarmiji Masron² & Norhasimah Ismail³

ABSTRACT

Vehicle theft is categorized as a property crime which is a highly organised crime and is one of the many global issues affecting the world, including Malaysia. Although most stolen vehicles are equipped with security systems or immobilizers, the number of stolen vehicle cases are high and has increased over the years. The relevance of Geographic Information System (GIS) mapping in crime control and prevention is enormous. In this research, real data of vehicle theft cases reported from 2010 to 2012 for Northeast District Police Headquarters, Pulau Pinang was used. In order to produce a map on the distribution of vehicle thefts and a study on the patterns of vehicle theft occurrence, Global Moran I was applied. A total of 3,922 vehicle theft cases were reported at Northeast District Police Headquarters for 2010 – 2012, where motorcycle theft recorded the highest number of cases with a percentage of 84.37%; followed by motorcar theft (13.26%) and motor van/lorry theft (2.37%). Two types of vehicle theft spatial patterns were identified in Northeast District, Pulau Pinang, which were clustered and random. It is hoped that this research will assist the Royal Malaysia Police in preventing vehicle theft cases from increasing, based on the spatial distribution patterns that occurred between 2010 - 2012.

Keywords: *vehicle theft, mapping, GIS, property crime, Global Moran I.*

INTRODUCTION

From all over the world, crimes or criminal behaviour and violence has become a major concern for the past 20 over years (Belinda, 2004; Shelley, 1981). Crime affects and influences people's quality of life regardless of age, sex or race.

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Crime is an act or the commission of an act that is forbidden or the omission of a duty that is commanded by a public law and that makes the offender liable to punishment by that law (Brown, et al., 1998). Crime can also be defined as an act or any offence that endangers society and the offender can be convicted of a criminal offence and shall receive a fine or imprisonment.

Crime can cause loss of property, life and misery to the people of a country and Malaysia is not spared of this problem. It can be seen that crimes have now become more complex and sometimes impossible to detect. Criminals have taken a progressive road to enhance themselves with investigative knowledge thus making the work of the police forensic investigator more arduous and difficult. The phenomenon of crime has gained increasing attention and criminal activities have been given wide coverage in the press and media.

Various crime studies have been conducted to identify factors contributing to the increasing crime rate. Among the researches conducted, there are often studies that associated certain factors with criminal behaviour. For example, the study by Abdul Aziz (1987) and Ahmad Ragib (1987), showed a significant correlation between unemployment and property crime. The same result was also obtained in a study conducted by Mohd Sabri (2002), which showed the impact of unemployment on the increase in property crimes during the economic downturn of 1997.

Kleck and Chiricos (2002) studied the effect of unemployment on property crime by fitting the Poisson and negative binomial regression models. Demombynes and Ozler (2005) examined the effects of local inequality on property and violent crime in South Africa using the negative binomial regression model. Habibullah & Eng (2006) pointed out that the underground economy was one of the factors affecting criminal activity in Malaysia by applying vector error-correction model (VECM) in their analysis. Studies by Habibullah & Law (2007) showed that there was relationship between financial, economic and property crime in Malaysia.

Studies by Massari (1994) showed that the presence of foreign workers in Johor does not affect the increase in crime since the number of crimes committed by foreign workers were fewer than locals. Although immigrants contributed only low crime rate in the state, but they have a tendency to commit crimes of violence, especially immigrants coming from Indonesia (Zaidi, 1996).

The aim of this paper is to map out vehicle thefts in Northeast Pulau Pinang by applying GIS hotspot analysis. The identification of the hotspot areas for vehicle theft is important as this information can be used to establish practical steps for preventing or at least limiting vehicle theft cases.

CRIMES IN MALAYSIA

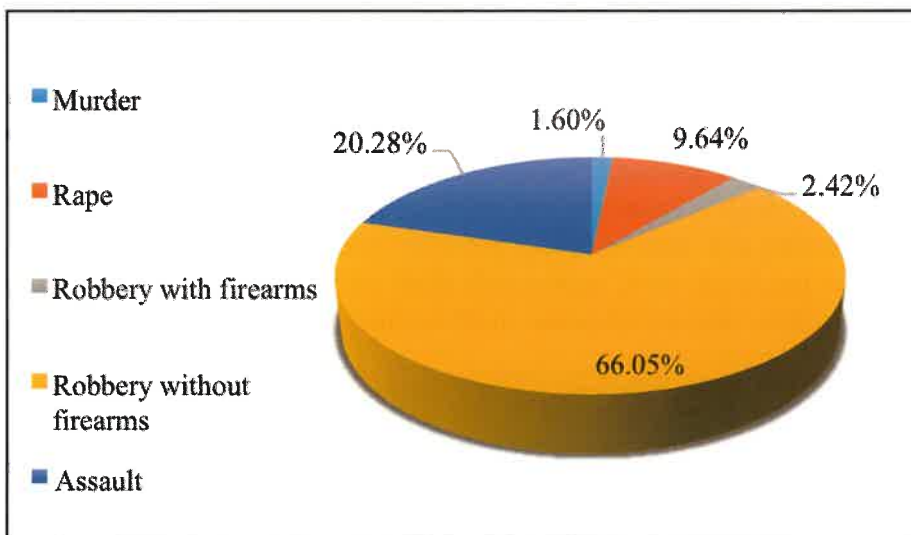
Generally, the trends and patterns of crime in Malaysia are similar to other developed countries, the only difference being the number of cases and levels. There are two types of crime in Malaysia, namely, violent crime and property crime. Violent crime is crime such as murder, rape, robbery with firearms, robbery without firearms and assault, while property crimes are burglary and theft, car theft, motor van/truck theft, motorcycle theft and others. Table 1 below shows the type of crime that are common in Malaysia.

Table 1: Types of crime in Malaysia.

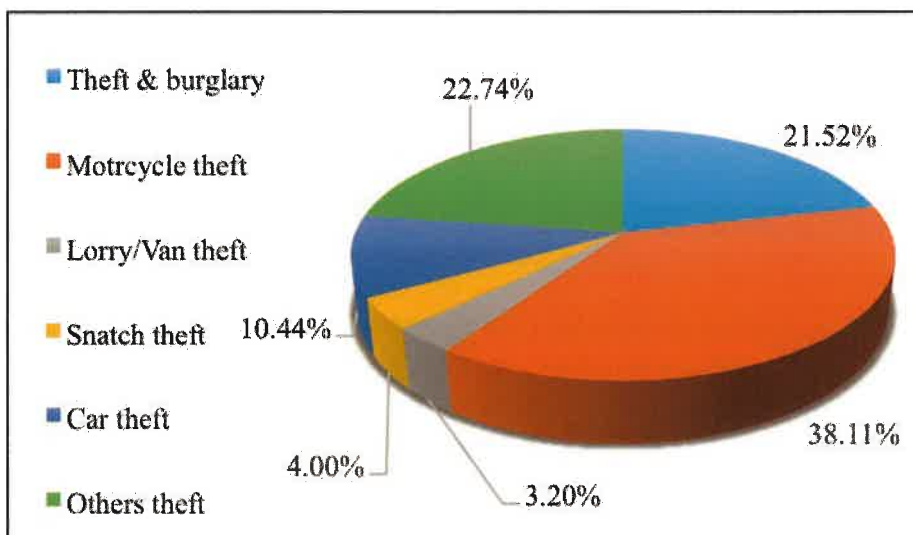
No.	Violent crime	Property Crime
1	Murder	Theft
2	Assault	Motorcycle theft
3	Rape	Car theft
4	Robbery with firearms	Motor van theft
5	Gang robbery with firearms	Lorry theft
6	Gang robbery without firearms	Burglary
7	Robbery without firearms	Snatch theft

Source: Zafirah Najmi, 2013.

According to Nor-Ina & Norizan (2007), 80% of crimes in Malaysia are made up of property crimes compared to only 20% involving violent crimes. According to statistics from the Department of Statistics Malaysia (2013), from year 2008 until 2012, cases of robbery without firearms were the highest number of violent crimes reported, while the lowest violent crime reported was murder (Figure 1). For property crime, it was found that the highest reported crime was motorcycle theft and the lowest property crime cases reported was van and lorry theft.



(a)



(b)

Figure 1: Percentage of crime from year 2008-2012, (a) violent crime; (b) property crime.

Source: Department of Statistics Malaysia, 2013

Over the past decade, the crime rate in Malaysia has increased significantly. Property crime and violent crime showed an increasing trend since 1970 (Figure 2). Statistics released by the police shows that more than 167,000 criminal cases occurred in Malaysia in the year 2000 and about 70 percent of these cases are still pending (Tang, 2009). Crime statistics show that the crime rate in Malaysia during the last three decades (1973-2003) rose between 1-8% per annum (Habibullah & Baharom, 2008). More than 80% of the crimes committed during this period were related to property crimes such as burglary, vehicle theft and theft. For violent crimes such as murder, robbery, rape and assault, it increased between 4% to 10% per year.

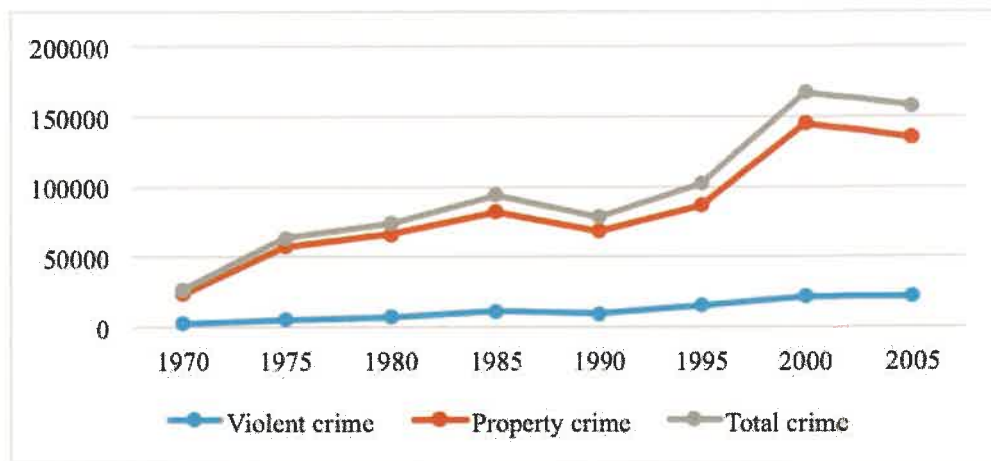


Figure 2: Crime case from year 1970-2005.

Note: Total crime = violent crime + property crime.

Source: Department of Statistics Malaysia, 2013.

Theft is one of the many cases reported, especially theft of vehicles such as cars, motorcycles, vans and lorries. Theft is committed by those who take or remove goods or any property owned by any individual without the individual's consent (Find Law, 2014). Vehicle theft is categorized as a property crime, also known as a highly organised crime and is one of the many global issues affecting the world, including Malaysia. Although most stolen vehicles are equipped with security systems or immobilizers, the number of vehicle thefts are high and has increased over the years.

Various measures and steps have been taken to reduce criminal activity. These included measures taken by the government that has been proactive in implementing a number of policies or approaches to contain it. National Key Result Areas or NKRA is the Malaysian government effort to provide and improve the welfare

of the people to meet their needs which was introduced by the Prime Minister of Malaysia, Datuk Seri Najib Tun Razak on July 27, 2009. NKRA has seven core areas of focus, namely: crime, corruption, education, improving the living standards of low-income people, improving infrastructure in rural and remote areas, improving public transport and finally improving the cost of living.

The implementation of the Reducing Crime NKRA was a decision made by the Government after studies showed that crime is the second largest area of concern, after economy to the people. Several initiatives to reduce crime and improve public satisfaction with the police service brought encouraging results, which were reported under the Government Transformation Programme (GTP). GTP is a program that focus on people with all its initiatives designed to benefit the people. With the implementation of NKRA, it can be seen that reported cases of crime have been decreasing in line with the objectives of NKRA (Table 2).

Table 2: Total crime reported for year 2008-2012.

Crime types	2008	2009	2010	2011	2012
Violent crime					
Murder	654	571	487	446	602
Rape	3,494	3,742	3,382	3,026	2,964
Robbery with weapon	258	1,035	2,345	408	127
Robbery without weapon	26,763	28,365	18,988	19,606	20,013
Assault	6,648	8,302	7,685	6,048	6,244
Sub-total	37,817	42,015	32,887	29,534	29,950
Property crime					
Burglary	35,588	37,641	32,603	28,020	24,939
Van/lorry theft	6,263	5,346	4,067	3,658	4,256
Car theft	15,198	14,206	15,333	16,129	16,196
Motorcycle theft	67,359	60,886	52,782	48,945	51,259
Snatch theft	8,205	9,665	5,849	3,323	2,500
Other theft	41,215	40,058	33,999	28,255	24,299
Sub-total	173,828	167,802	144,633	128,330	123,449
Total	211,645	209,817	177,520	157,864	153,399

Source: Department of Statistics Malaysia, 2013.

GEOGRAPHIC INFORMATION SYSTEM

Geographic Information System or GIS is a computer-based system that is designed to enter, store, process, analyse and display spatial data and data instead of columns (attributes) for the purpose of planning, problem solving and decision making (Star and Estes, 1990; Ruslan Rainis & Noresah, 1998; Narimah & Tarmiji, 2008). The information is controlled using a combination of information system operation involving planning, monitoring, collecting, storage, processing and analysing data to generate information that can be used in the decision-making process. GIS is a system that is very important in the study of crime in Malaysia.

GIS is a system for the retrieval, storage, update, consolidation, manipulation, analysis and display of spatial data, in reference to the earth. In general, GIS can process geographical data to produce information. The information generated through GIS is usually in the form of maps (topographic or thematic maps), and statistical models. According to Foster & Shand (1990), GIS can be summarized into four sub-systems, the system data, data storage, manipulation and analysis of data. Data display and data components of GIS include hardware, software, procedures, applications, resources and information.

In Malaysia, GIS has been used as a tool of analysis and mapping in various fields such as tourism (Azizul, et al., 2013; Tarmiji, et al., 2014; Tourism et al., 2016), local wisdom (Norizawati, et al. 2015; Tarmiji, et al., 2015), cultural heritage (Norhasimah & Tarmiji, 2013; Bachad, et al., 2013; Shariff & Zakaria, 2011), health and food (Narimah, et al., 2010; Tarmiji, et al., 2014), population study (Tarmiji & Aimi Shamimi, 2014) and so on. The use of GIS help investigators in giving a clearer picture to the public on a study in the form of mapping that is easily understood. In addition, GIS also assists in running the column statistical analysis that can help decision makers to solve a problem.

Studies on crime and GIS in Malaysia is growing in order for researchers to find the cause and the factors leading to rising crime rates and indirectly help the authorities, especially the police in suppressing and formulate action to ensure crime rate decreases. Nurul Hazwani (2013) conducted a research using the analytic hierarchy process model and GIS in determining potential areas of crime. Syerrina & Nuzlinda (2015), using GIS analysis Moran I index to study and analyze the spatial clustering of criminal cases in Peninsular Malaysia found that crime is not distributed randomly, indicating positive spatial autocorrelation exists.

In addition, GIS is also used in the *Sistem Pemantauan Bandar Selamat* (SPBS) which was developed in a collaboration between the Royal Malaysia Police (PDRM), the Ministry of Home Affairs (KDN), the Department of Town and Country Planning, the Ministry of Housing and Local Government (KPKT) and Local Authorities (PBT). The system uses GIS to monitor the effective implementation of the Safe City Programme in order to suppress street crimes in local authorities' areas, and also identify as well as monitor the existing and potential crime hotspots and crime-prone locations (PDRM, 2011; *Sistem Pemantauan Bandar Selamat*, 2016).

At the international level, the study of crime and space and information technology has long been ongoing. Among them is a study by Weir & Bangs (2007) that shows the use of GIS in the analysis of crime in England and Wales, which was developed with the involvement of the police and the Crime and Disorder Reduction Partnership (CDRP). Levine (2005) discussed the potential of Crimestat Program for crime mapping and other GIS applications. Crimestat Program was developed under a research grant from Mapping and Analysis for Public Safety (MAPS) at the National Institute of Justice (NIJ). Crimestat is a statistical programme for crime scene analysis with the use of GIS with the goal of providing additional statistical data and help to law enforcement agencies.

STUDY SITE

Pulau Pinang is the second smallest state in Malaysia and located on the Northwest coast of Peninsular Malaysia. With an area of 1,046.3 km² and a population of 1,561,383 in 2010 (Department of Statistics Malaysia, 2010), Pulau Pinang is divided into five administrative divisions: Seberang Perai Tengah, Seberang Perai, Seberang Perai Selatan, Northeast and Southwest (Figure 3). Pulau Pinang is one of the states listed from 50 crime hotspots that have been identified, apart from the state of Selangor, Johor and Kuala Lumpur. In addition, Pulau Pinang has also contributed to the overall number of street crimes in Malaysia, which is 70% with Selangor, Johor and Kuala Lumpur.

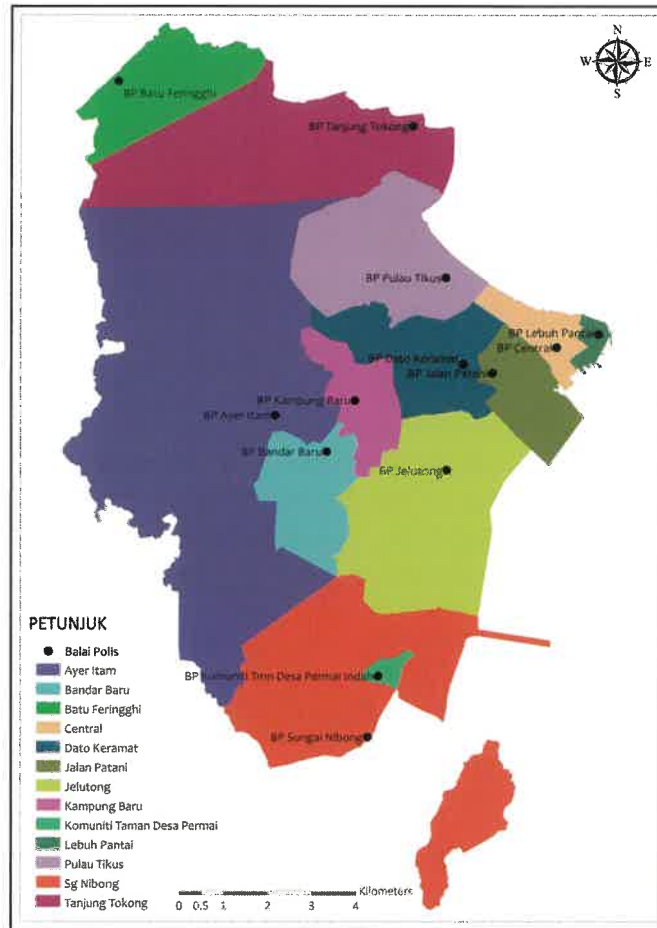


Figure 3: Map of police station locations.

Source: Northeast district, Pulau Pinang, 2010.

The study was conducted in the Northeast district, Pulau Pinang, one of the five administrative districts in the state of Pulau Pinang. There are 13 police stations in the administrative area of IPD Northeast (Figure 4): Air Itam police station, Bandar Baru police station, Batu Feringghi police station, Central police station, Dato Keramat police station, Komuniti Taman Desa Permai police station, Jelutong police station, Jalan Patani police station, Kampung Baru police station, Lebuah Pantai police station, Tanjung Tokong police station, Sungai Nibong police station and Pulau Tikus police station. According to a study conducted by Nor-Ina & Norizan (2007), Northeast district showed the highest crime index with 51.3% as compared to other districts for the period of 1990-2003, where most of the crime consisted of property crime (88.4%).

METHODOLOGY

In this research, real data of vehicle theft cases reported from 2010 to 2012 for IPD Northeast, Pulau Pinang was used. In order to produce a distribution map of vehicle theft and study the patterns of vehicle theft occurrence, the Global Moran I was applied. The Moran's I test is a test that measures the spatial autocorrelation in a random field. Spatial autocorrelation in a random field is the correlation between an observation at region i, x_i and an observation at region j, x_j . Spatial autocorrelation measures the correlation between the same attributes at two locations. A positive autocorrelation implies that observations in close spatial proximity are expected to be more similar than observations that are more spatially separated. Conversely, a negative spatial autocorrelation implies that, proximity in space should not provide similar attribute values. The Moran's I test is calculated as the ratio of the product of the variable of interest and its spatial lag, to the cross product of the variable of interest, adjusted for the spatial weights used (Figure 4). Its formula is given by:

$$I = \frac{N \sum_{i=1}^n \sum_{j=1}^n w_{ij} (x_i - \bar{x})(x_j - \bar{x})}{(\sum_{i=1}^n \sum_{j=1}^n w_{ij}) \sum_{i=1}^n (x_i - \bar{x})^2}$$

Where, x_i = the observation or attribute value in region i,
 \bar{x} = the mean of the variable of interest,
 w_{ij} = the spatial weight of the link between region i and region j,
 N = total of point or polygon.

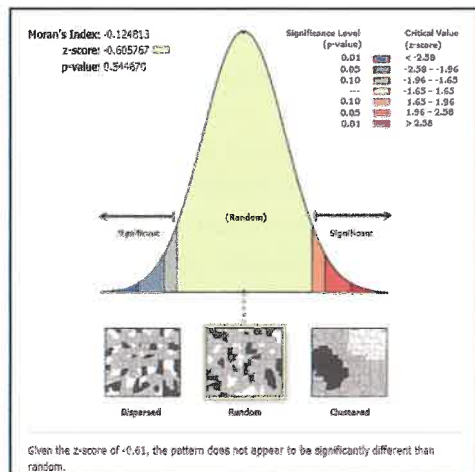


Figure 4: Global Moran I analysis.

Source: Lee & Wong, 2013.

RESULT AND DISCUSSION

Distribution of Vehicle Theft Cases

A total of 3,922 vehicle theft cases were reported at Northeast district police headquarters for 2010 – 2012 (Table 3), where motorcycle theft recorded the highest number of cases with a percentage of 84.37%; followed by motorcar theft (13.26%) and motor van/lorry theft (2.37%) (Figure 5). Motorcycle theft cases reported showed a decrease in number from 2010-2012, where 1,292 cases were reported in 2010, 1,080 cases reported in 2011 and 937 cases reported in 2012. Motorcar theft showed an increase in the number of cases where, 127 cases were reported in 2010, 188 cases reported in 2011 and 205 cases reported in 2012. Finally, for motor van/lorry theft cases, in 2010 the number of cases reported was 23. In 2011, the reported cases decreased to 15 cases while in 2012 the reported cases increased to 55 cases. Figure 6a-6d showed the distribution map of vehicle theft cases reported from 2010-2012.

Table 3: Types of vehicle reported missing at northeast district police headquarters for 2010 – 2012.

Types	2010	2011	2012	Total
Motorcycles	1,292	1,080	937	3,309
Motorcar	127	188	205	520
Motorvan/lorry	23	15	55	93
Total	1,442	1,283	1,197	3,922

Source: Authors, 2013

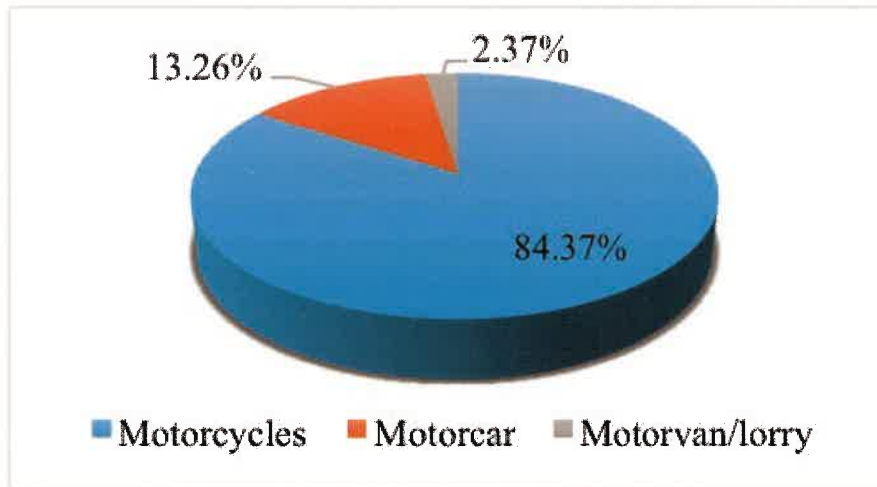


Figure 5: Percentage of Vehicle Theft Cases for 2010-2012.

Source: Authors, 2013.

In 2010, a total of 1,442 (Figure 7a) vehicle theft cases were reported with 1,292 (Figure 7b) cases of motorcycle theft, 127 (Figure 7c) cases of motorcar theft and 23 (Figure 7d) cases of motor van/lorry theft. For 2011, a total of 1,283 (Figure 8a) cases of vehicle theft were reported, where 1,080 cases were for motorcycle theft (Figure 8b), 188 cases for motorcar theft (Figure 8c) and 15 cases for motor van/lorry theft (Figure 8d). Finally, in 2012, a total of 1,197 (Figure 9a) vehicle theft cases were reported with 937 cases for motorcycle theft (Figure 9b), 205 cases for motorcar theft (Figure 9c) and 55 cases for motor van/lorry theft (Figure 9d).

Mapping of Vehicle Crime in Northeast Pulau Pinang

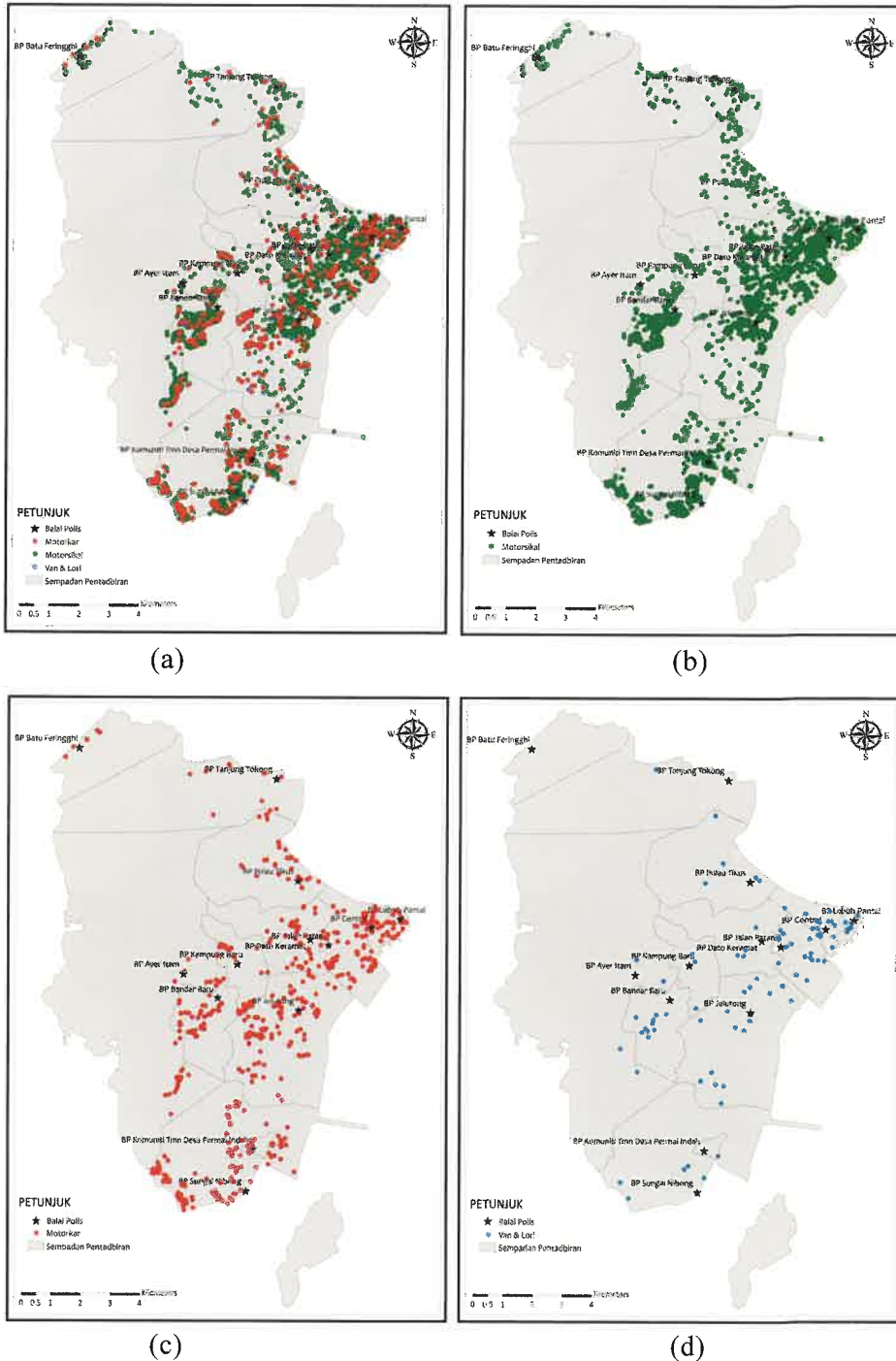


Figure 6: Distribution map of vehicle theft for 2010-2012 (a) all vehicle types, (b) motorcycle, (c) motorcar and (d) motor van/lorry.

Source: Northeast District, Pulau Pinang, 2010.

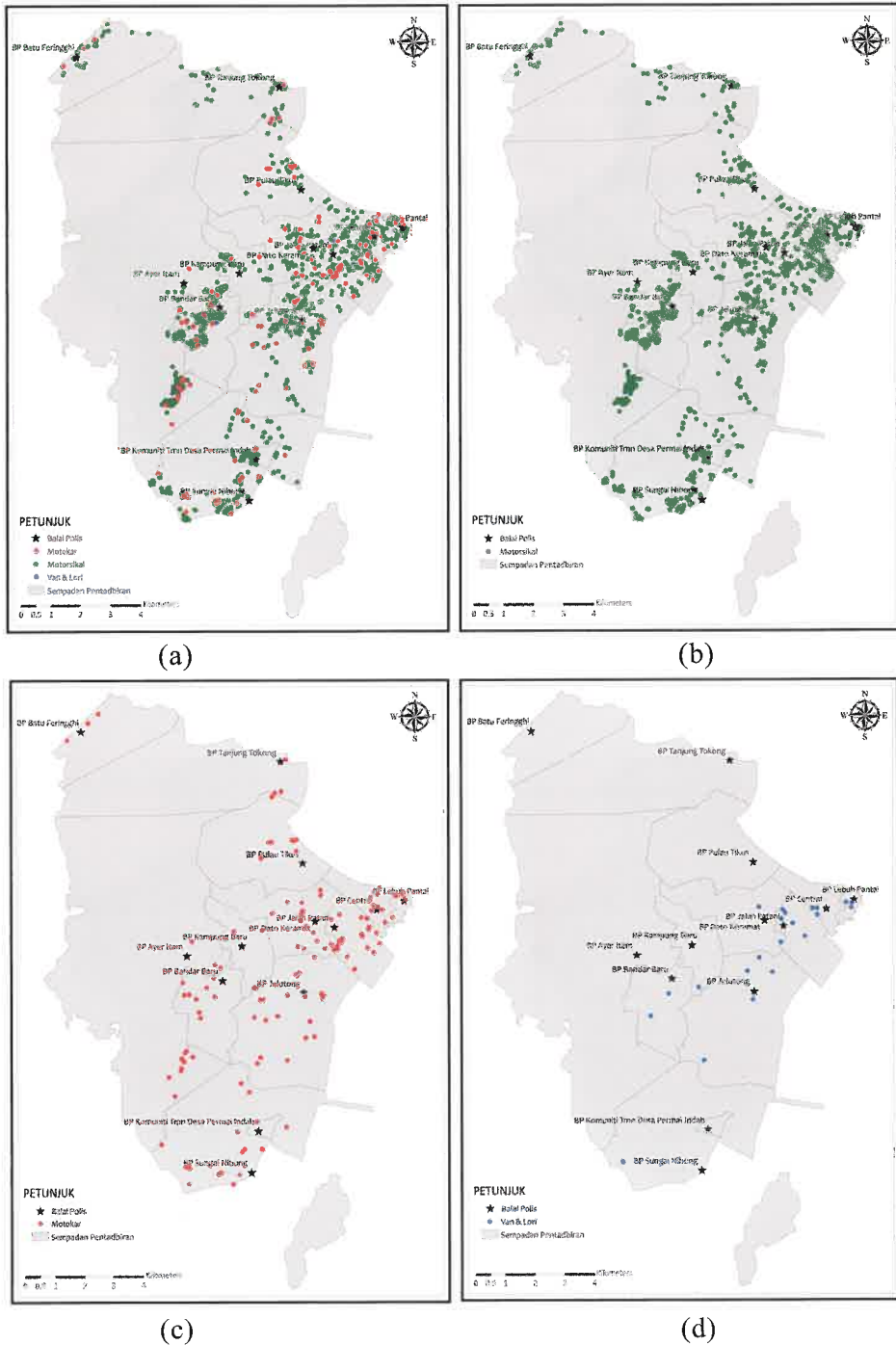


Figure 7: Distribution map of vehicle theft for 2010 (a) all vehicle types, (b) motorcycle, (c) motorcar and (d) motor van/lorry.

Source: Northeast District, Pulau Pinang, 2010.

Mapping of Vehicle Crime in Northeast Pulau Pinang

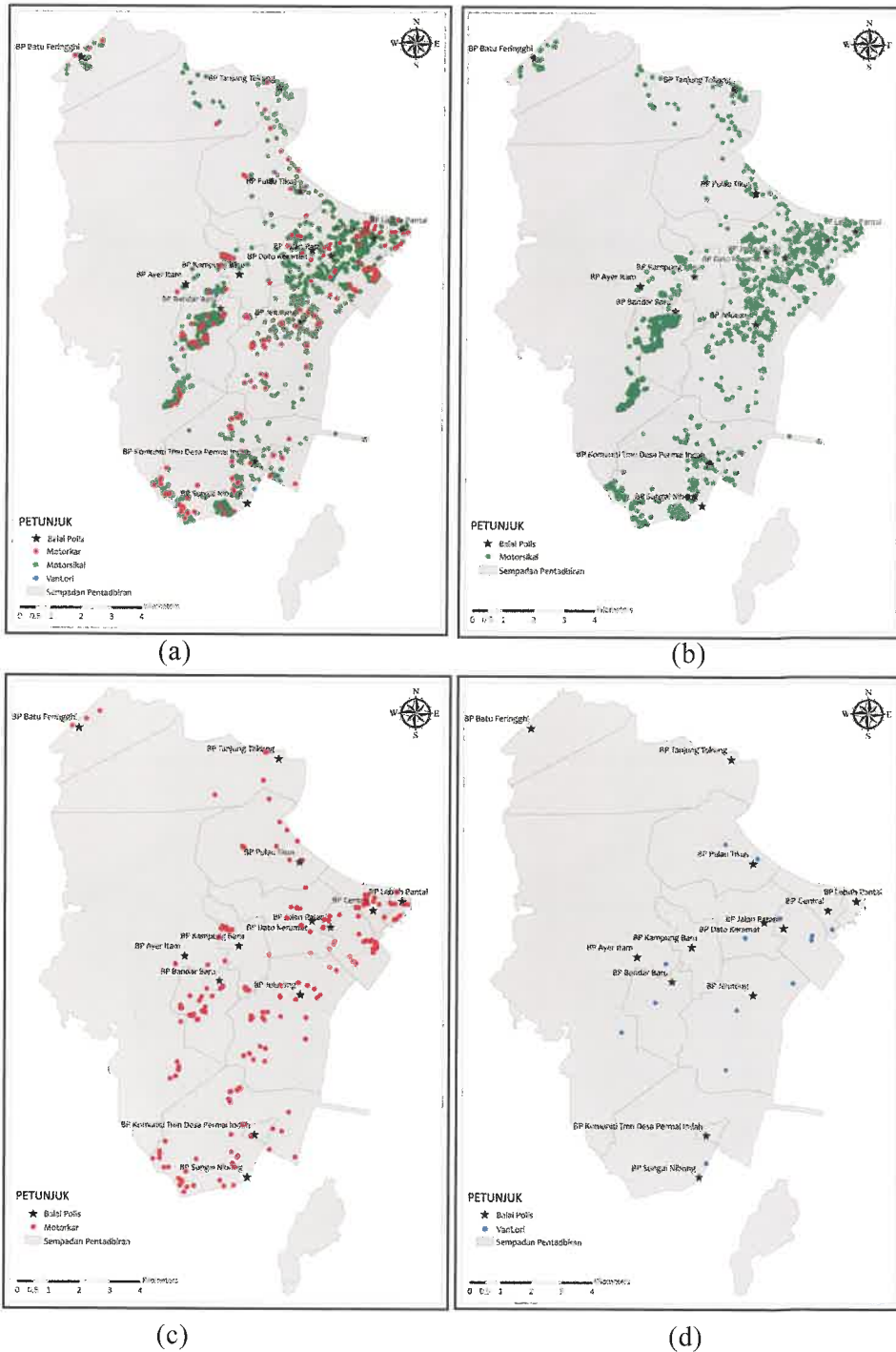


Figure 8: Distribution map of vehicle theft for 2011 (a) all vehicle types, (b) motorcycle, (c) motorcar and (d) motor van/lorry.

Source: Northeast District, Pulau Pinang, 2010.

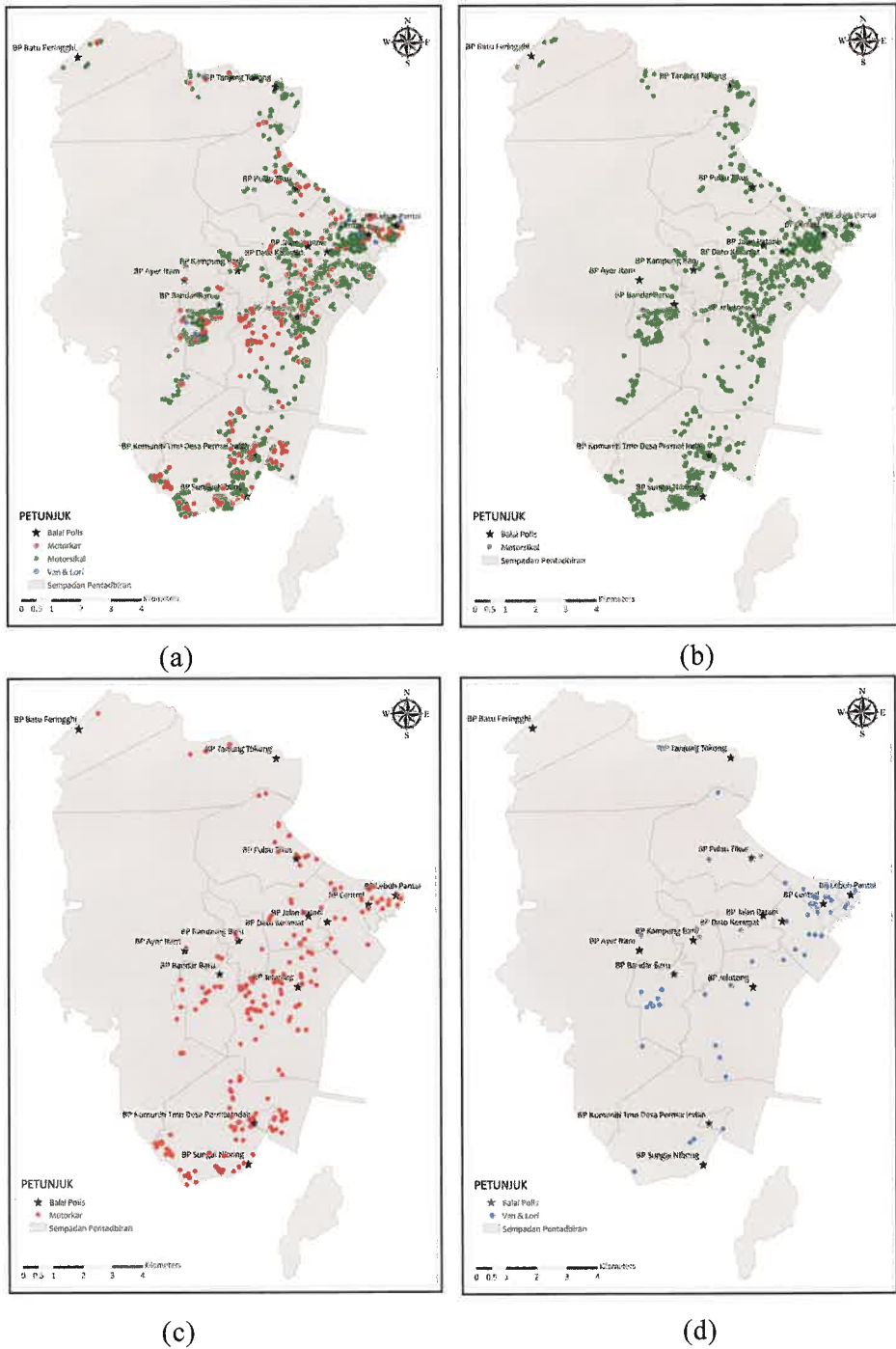


Figure 9: Distribution map of vehicle theft for 2012 (a) all vehicle types, (b) motorcycle, (c) motorcar and (d) motor van/lorry.

Source: Northeast District, Pulau Pinang, 2010.

There are 5 police stations that showed an increase in vehicle theft cases as reported in comparison from 2010 and 2012 (Table 4). Sungai Nibong police station showed the highest increase of cases reported with a total of 75 cases, followed by Pulau Tikus police station (19), Jelutong police station (12), Desa Permai police station (11) and Tanjong Tokong police station (4). While 8 police stations showed a decreasing in vehicle theft cases as compared from 2010 and 2012. Bandar Baru police station showed the highest decreasing in cases as reported with 109 cases, followed by Jalan Patani police station (93), Air Itam police station (86), Dato Keramat police station (30), Batu Feringghi police station (23), Kampung Baru police station (22), Central police station (2) and lastly Lebu Pantai police station (1).

Table 4: Vehicle theft rate by police stations for 2010-2012.

No.	Police Station	2010	2011	2012
1	Air Itam	130	114	44
2	Bandar Baru	213	149	104
3	Batu Feringghi	33	21	10
4	Central	70	61	68
5	Dato Keramat	117	118	87
6	Desa Permai	20	13	31
7	Jelutong	237	194	249
8	Jalan Patani	267	192	174
9	Kampung Baru	54	42	32
10	Lebu Pantai	29	33	28
11	Pulau Tikus	44	43	63
12	Sungai Nibong	194	250	269
13	Tanjong Tokong	34	53	38
Total		1,442	1,283	1,197

Source: Authors, 2013.

Global Moran I Analysis

Distribution of vehicle theft cases in Northeast district, Pulau Pinang for year 2010 until 2012 was modelled using autocorrelation spatial analysis, Global Moran I. There are three types of spatial patterns that can be identified; random, scattered

and clustered. The result of Global Moran I depends on the reading of each value of z score, p score and Moran I index. If the value of z score is between -1.96 and +1.96 at the confidence level of 95%, then the p score will be greater than 0.05 and the null hypothesis cannot be rejected. Thus, the resulting pattern is likely a random pattern. Vice versa, if the index of Moran I is close to +0.1, the resulting pattern is clustered and if the index of Moran I is close to -0.1, the resulting pattern is random. In this study, the spatial distribution of vehicle theft cases was analyzed using Global Moran I in order to find the distribution patterns for each type of vehicle cases which were, motorcycle theft, motorcar theft and motor van/lorry theft. The hypothesis is as follows:

i Attribute for motorcycle theft cases

H_0 : No spatial patterns existing motorcycle theft crime behaviour

H_1 : Patterns exist in motorcycle theft crime behaviour

ii Attribute for motorcar theft cases

H_0 : No spatial patterns exist in motorcar theft crime behaviour

H_1 : Patterns existing motorcar theft crime behaviour

iii. Attribute for motor van/lorry theft cases

H_0 : No spatial patterns exist in motor van/lorry theft crime behaviour

H_1 : Patterns exist in motor van/lorry theft crime behaviour

Global Moran I Analysis year 2010

Moran I analysis for motorcycle theft cases in 2010 showed that the Moran I index value was 0.099997 (Figure 10a) while the z score value at 0.05 confidence level was 3.503527 and p value was 0.000459. Since the z score was greater than +1.96 and the p value less than 0.05, the null hypothesis for motorcycle theft cases was rejected and the distribution patterns were clustered. As for motorcar theft cases, the Moran I index was 0.039164 (Figure 9b), the z score value was 1.591060 and the p value was 0.111596. For motorcar theft cases in 2010, the null hypothesis was accepted and the pattern distribution was at random, since the z score was less than +1.96 and not more than -1.96 with p value larger than 0.05. Finally, for motor van/lorry cases (Figure 10c), the Moran I index was 0.023644, while at 0.05 confidence level, the z score value was 1.186300 and p value was 0.235504. Since the z score was less than +1.96 and -1.96 and p value was larger than 0.05, the null hypothesis for motor van/lorry theft cases was accepted and the distribution patterns showed random distribution.

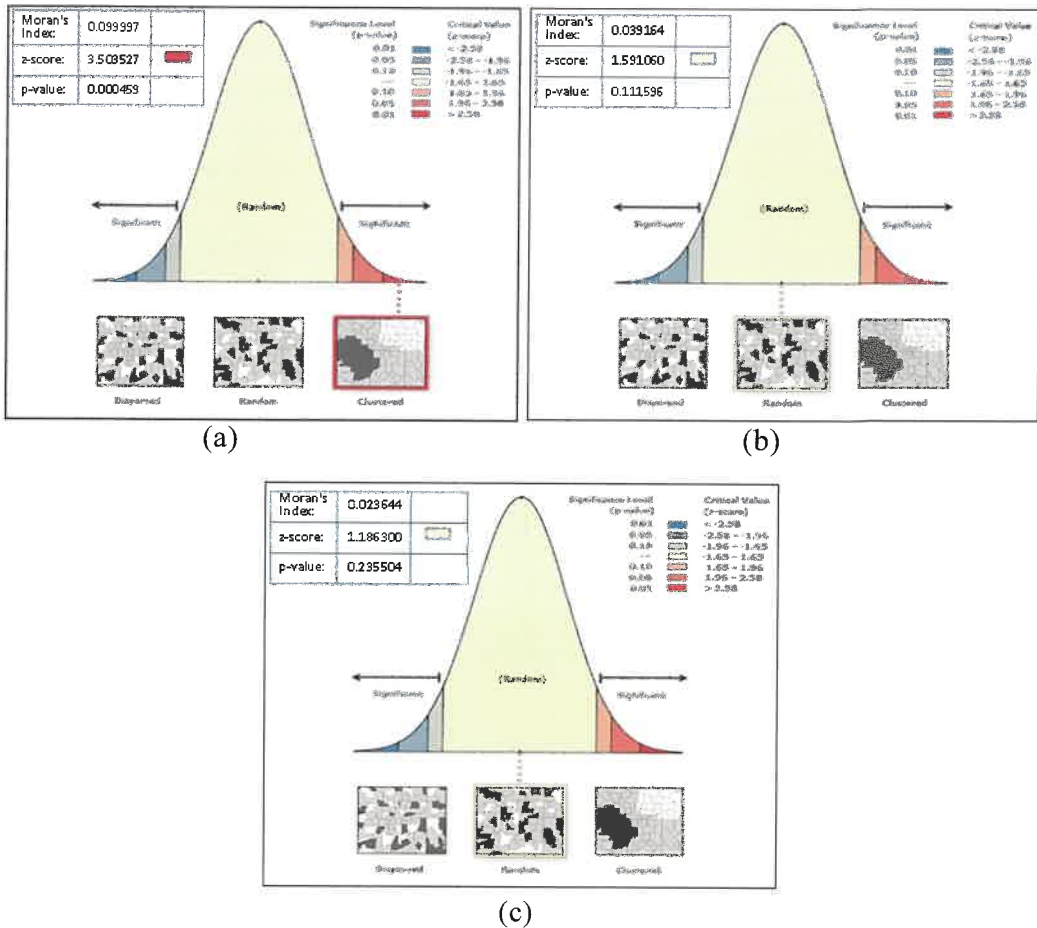


Figure 10: Spatial autocorrelation in 2010, (a) motorcycle theft; (b) motorcar theft; (c) motor van/lorry theft.

Source: Authors, 2013.

Global Moran I Analysis year 2011

Moran I analysis for motorcycle theft cases in 2011 showed that the Moran I index value was 0.076356 (Figure 11a) while the z score value at 0.05 confidence level was 2.797293 and p value was 0.005153. Since the z score was greater than +1.96 and the p value was less than 0.05, the null hypothesis for motorcycle theft crime cases was rejected and the distribution patterns were clustered. For motorcar theft cases in 2011, the Moran I index was 0.051516 (Figure 11b), the z score value was 2.045558 and the p value was 0.040800 at a confidence level of 0.05. For motorcar theft crime cases in 2011, the null hypothesis was rejected and the distribution patterns were clustered, since the z score was more

than +1.96 and the p value was less than 0.05. Finally, for motor van/lorry cases (Figure 10c), the Moran I index was -0.034702, while at 0.05 confidence level, the z score value was 0.714107 and p value was 0.475161. Since the z score was less than +1.96 and not more than -1.96 and p value was larger than 0.05, the null hypothesis for motor van/lorry theft crime cases was accepted and the distribution patterns showed random distribution.

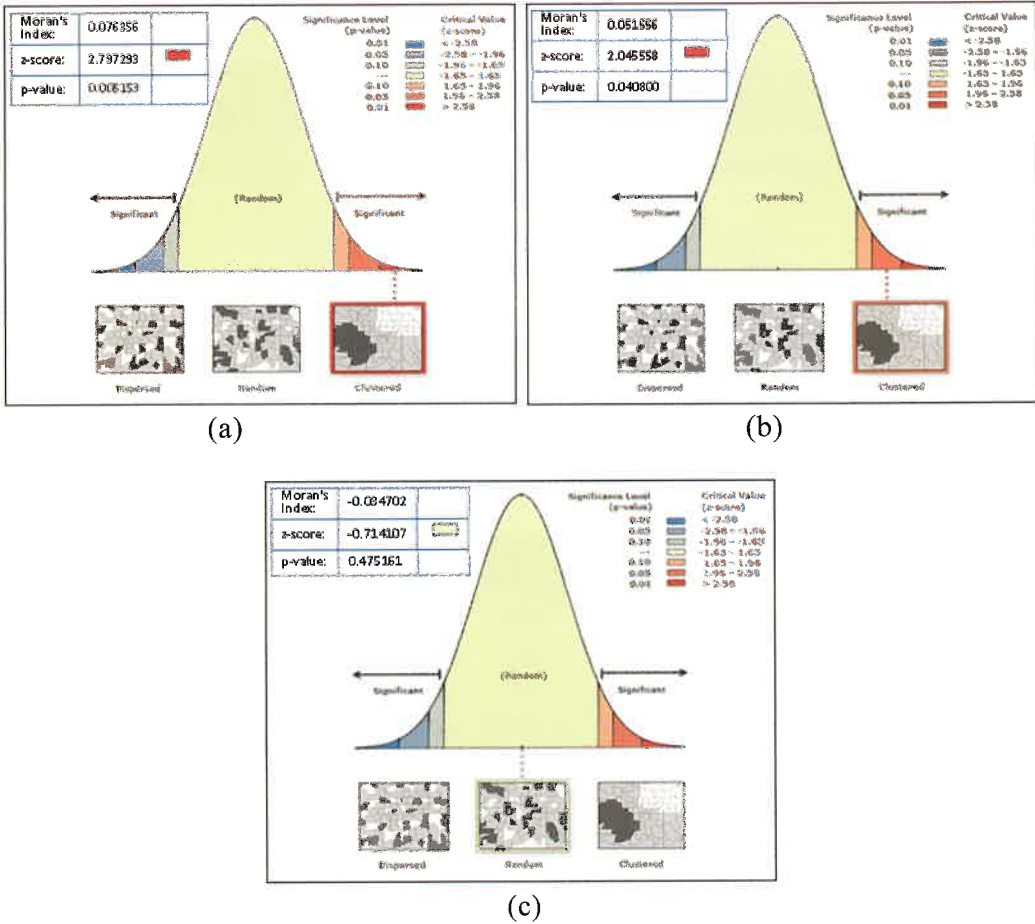


Figure 11: Spatial autocorrelation in 2011, (a) motorcycle theft; (b) motorcar theft; (c) motor van/lorry theft.

Source: Authors, 2013.

Global Moran I Analysis year 2012

In 2012, Moran I analysis for motorcycle theft cases showed that the Moran I index value was 0.056684 (Figure 12a) while the z score value at 0.05 confidence level was 2.252360 and p value was 0.024300. Since the z score was greater than +1.96

and the p value was less than 0.05, the null hypothesis for the motorcycle theft crime cases in Northeast district, Pulau Pinang was rejected and the distribution patterns were clustered. For motorcar theft cases in 2012, the Moran I index was 0.119578 (Figure 12b), the z score value was 4.269342 and the p value was 0.000020 at confidence level of 0.05. For motorcar theft cases in 2012, the null hypothesis was rejected and the distribution patterns were clustered, since the z score was more than +1.96 and the p value was less than 0.05. Lastly, for motor van/lorry cases in 2012 (Figure 12c), the Moran I index was 0.073399, while at 0.05 confidence level, the z score value was 2.828903 and p value was 0.004671. Since the z score was more than +1.96 and the p value was less than 0.05, the null hypothesis for motor van/lorry theft crime cases was rejected and the distribution patterns were clustered.

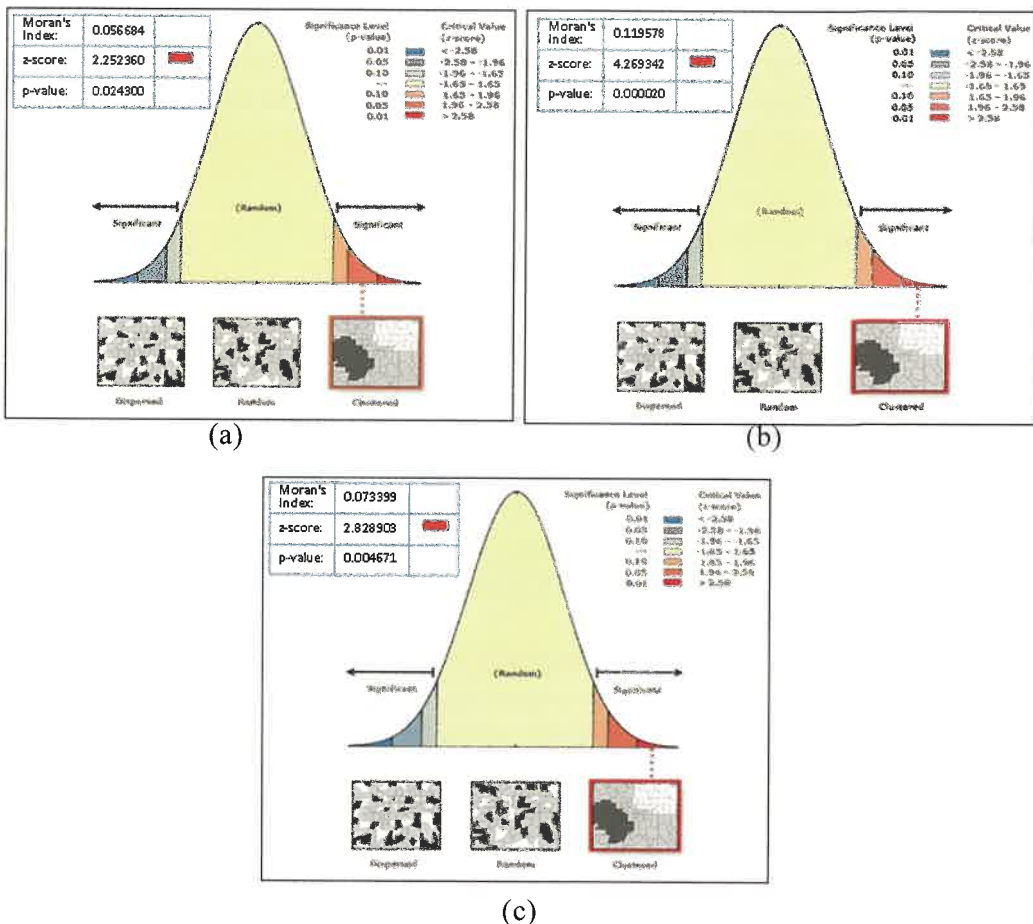


Figure 12: Spatial autocorrelation in 2012, (a) motorcycle theft; (b) motorcar theft; (c) motor van/lorry theft.

Source: Authors, 2013.

The Global Moran I analysis shows that, in 2010, reported motorcycle theft cases were distributed in clustered patterns, while for reported motorcar and motor van/lorry theft cases, the patterns showed random distribution. In 2011, the motorcycle and motorcar theft cases showed clustered distribution patterns while motor van/lorry theft cases were distributed randomly. Finally, in 2012, all types of vehicle theft cases in the Northeast district of Pulau Pinang showed clustered distribution patterns. From the analysis conducted in this study, all parties involved in crime management can now understand crime scene and vehicle theft cases patterns more easily and clearly. GIS is the key to understanding the spatial and temporal occurrence of crime. The fact that criminal activity is non-random in time and space raises questions about its location and the reasons for its location. Through GIS application the police in particular are expected to be able to predict and prevent vehicle crimes before they occur using the distribution patterns for year 2010-2012. From the resulting patterns, it can be concluded that the clustered pattern shows that vehicle crimes occurred in the same vicinity in the past from 2010 until 2012, whereas for the random pattern, it shows that the vehicle crimes occurred randomly in the vicinity.

CONCLUSION

The objective of this paper is to build up a crime-fighting programme by combining the information from PDRM and GIS Analysis to create maps of vehicle theft locations in Northeast Pulau Pinang. Geographic Information System (GIS) uses geography and computer-generated maps as an interface for integrating and accessing massive amounts of location-based information. GIS allows the police to plan effectively for emergency response, analyse historical crime events, and predict future events. Other than that, it can also be used to get critical information in a map form for better view and understanding.

The map and the accompanying analyses will help policymakers to classify districts and identify primary factors regarding vehicle theft. This information can also be supplied to local authorities for planning strategies to reduce car thefts. Property managers in the vicinity of areas of higher crime rates may also assist by providing protected and secured parking, as well as hiring security guards. The results may also assist the Royal Malaysia Police to strategize by increasing the number of police stations and locating them in hot areas, especially in the areas that show large numbers of reported vehicle thefts on the map.

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