## Spatial – Local Evaluation and Analysis of Crimes Using Time Series Model and ARCGIS Software

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#### doi: http://dx.doi.org/10.13005/bbra/1589

#### (Received: 17 June 2014; accepted: 17 July 2014)

Subject of current research is illegal behaviors and acts and disorders known as crime during research time period which occurred in central part of Qazvin city. They are acts with are against society's moral values and national rules and are defined as crime according to the law and punishment is determined for them and were recorded as crime in police centers during research time period and for which file has been formed. To this end, the crimes related to theft from March 2011 to February 2011 as well as two years ago and one year later crimes were recorded and investigated in ARCGIS Software. Spatial identification and analysis of crime vulnerable foci in central part of Qazvin city was done by developing a database for these thefts and using statistical and graphical tests in ARC GIS software environment. Results for temporal analysis in this research indicated applying specific time and location in providing spatial patterns for crimes is not useful, because times of presenting statistics may not be correct due to two wanted and unwanted mistakes: 1. Providing incorrect information by peopled being robbed for different reasons such as lack of presence at home or reluctance for referring in early hours of theft, and 2. intentional and inadvertent errors in recording statistics by system users for various reasons. Investigation of type, composition and level of use of lands in central part of city and frequency crime occurrence indicate most crimes occurred in commercial and administrative areas of this part of city denoting relationship between type of land use and the way of using lands of central part and formation of crime foci.

Keywords: cluster analysis, ARCGIS software, Analytic Hierarchy Process (AHP), Time series, modeling .

Crime is considered as a behavioral distortion from normal behaviors which accompanies by loss and harms. Social, psychological, economic and environmental factors are considered in issues related to crime, all of these concepts influence on crime occurrence in different ways (Boba, 2005). It is attempted to explain crime with different theories from different sciences. Psychological and social theories associate origins causing crime occurrence to such factors as social disruption, disruption of personality, lack of parental attention, etc. however, some theories consider use of crime prevention versus its description as not useful. New advances in criminology science brought important content that can facilitate crime analysis and prevention (Boba, 2005). Crime and criminality identification criterion is different communities depend on way of thinking, vulture, development and

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underdevelopment of the community (Mafi, 1999). Thus, performing a behavior in one community may be normal, while it may be considered as crime in the other community. However, it can be said any violated social or illegal behavior alleged to have a certain penalty is called the crime. Various factors including economic, social, urbanism, disease, and similar factors are involved in developing such social disorders and crimes (Soltani, 1995). Generally such behavior as murder, assault and assault, suicide, drug addiction, theft and sexual issues can be identified as crime. However, incidence of crimes and disorders are considered as the main problems of the cities. In addition to sense of insecurity and pessimism, social disorders incur heavy damage physically, mentally, financially on the citizens. On the other hand, they cause that performance of legal and police system in reduction of crime rates seems ineffective despite of wide scope of activities and spending great budget in this regards. Identification of crime causes and attempt to eliminate or minimize their effects traditionally has been recognized as the main solution for preventing and decreasing social disorders. Crime prevention is an important issue which people are involved with it for the centuries. Crime prevention is regarded as a necessity for correction of people life in the world. To this end, it should be noted that all information and capabilities of the police should be utilized to reach crime management (crime prevention) in the city. However, the main point is that manually recorded criminal information cannot provide a direct way to achieve these goals and a better and more efficient method is needed. It should be considered that various factors influence provision of social security and provision of which is not possible only by the police. Various economic, social, cultural, skeletal, and political factors influence provision of security. These factors are mentioned in the following.

Security in cities is influenced by their socio - economic condition. Ethnic, cultural, and economic diversity is high in the cities and all security problems cannot be attributed to the city itself and its physical body. That is, if the social, economic and cultural conditions of the urban society are good, the city's security factor will increase (Dehghan, 2002).

One of the factors leading to urban

security is the physical factor. That is, the design of cities considerably affects the increase or decrease in security. It is one of the factors which exacerbates crime occurrence and reduces security. This type of design causes escape spaces in the cities. In the new urbanism structure and new way of settlement and apartment living, in which people are stranger to each other and don't know each other, the offender can easily enter such chessshaped textures, acts his crime and then leaves at any point he wants. Chess network is also problematic in terms of traffic and threatens security of citizens (Aliabadi, 2002).

It is considered the other factor in reducing security and creating crime situations. In fact, no offender is able to commit crime in the environment where it is visible to others. In order to prevent from crime creating in such environments, they can be mobilized and citizens move in and out there. Thus, remoteness of the environment is eliminated and crime opportunity is decreased. For example, probability of child abduction is high in remote alleys. However, children need a location for playing and play in the alleys. Some parks can be designed in the neighboring so that children can play there and also other people are attracted and then the possibility for crime occurrence is reduced (Aliabadi, 2009).

Offender often commits crime in the place which is dark and invisible to others. If the environment is light and visible to others, the offender does not dare to commit crime there and hence crime occurrence is reduced (Aliabadi, 2009).

It means that ruled relationships are not present in physical body of the city. For example, when there is overcrowding undecided people in a location - such as people waiting in the squares – crime occurrence probability are high. Environmental disorder may also result from social factors and instability in urbanism regulation. This irregularity and disorder makes the urban space undecided. When the urban is unstable and undecided, construction pattern and street pattern is practically disordered and service delivery is inappropriate. Several factors affect the development of these spaces, main of which include:

Other factors also influence security reduction in the cities: Troublesome land uses in

urban areas (such as presence of several workshops and garages in residential areas), interference of residential, commercial and industrial uses (which leads to movement of many people in them that have no complete understanding of each other and a fertile ground is created for occulting the criminals and committing crime), lack of lighting at night, spaces with dense vegetation, remote passages and underpasses, urban under stairs, spaces around large cities,

	Qazvin area vs. Qazvin Province	Qazvin Distr	A	rea (sq.km)	Location	
_	23.49%	0.65%		3713 5693 15805	Qazvin Cit Qazvin Dist Qazvin Provi	ty rict nce
		Table 2. City p	opulation and	its main changes	5	
City – village	Growth Popula percent in 20	tion Grow 06 perce	th Popula ent in 19	tion Growth 96 percent	Population in 2006	n Population in 1996
Qazvin	2.02 3553	38 1.59	2911	17 5.97	248591	139258
	Table 3. Esti	mation of litera	acy level in Qa	zvin city populat	ion in 2006	
Gender	2006 Literacy percent	1996 Literate Population	Population	Literacy percent	Literate Population	Population
Male ar Male Female	nd female 84% 87% 85%	298471 156.259 142.210	355338 181220 174118	83.4% 86.7% 80.1%	243079 129972 113107	291117 149910 141207
	Table	4. Census of cr	imes in Qazvir	Police Station (	2010)	
Crime	Crime Type	Modarres 11	Bazar 12	Bahonar 13	Minoudar 14	Qiasabad 17
Security	Home theft Bank Car motorcycle plate	87 0 5 0	70 0 1 0	119 0 1 0	0 0 0 0	108 0 2 0
Economic	Shipment Store (jeweler) Store (other) Cars Motorcycle	0 0 40 75 92	0 1 29 52 73	0 0 31 70 93	0 0 0 0 0	1 0 39 41 62
Social	Inside the car Equipment and spare Livestock and Poultry Other types of theft Private places	132 161 6 275 23	68 140 16 101 32	64 212 4 128	0 0 0 0	79 163 7 327
Social	Public places Bag theft Picking Cash	3 56 30 75	6 11 21 30	1 1 10 23	0 0 0 0	1 10 3 19

**Table 1.** City area and comparison to district and province area

emergency stairs in large buildings, subway, hidden and out of public view corners or blind spaces, and etc. These problems can be overcome by appropriate physical designs, and urban security can be improved.

Political factors also influence insecurity increase or decrease. Governmental policies cause development or underdevelopment of other cities and villages by focus of capitals and resources on a few cities or one top city (or capital city), and may cause immigration from village to city.

It should be pointed out that above facts should be used in analysis of thefts.

The main goal of this project is providing new and effective methodology for local analysis of crime for police forces and particularly for Qazvin Police with following details:

-Finding a new method for proper analysis in order to prevent or decrease crime

-Identifying suitable place for police station establishment

-Analysis of factors which influence crime prevention.

To this end, one of the main goals is developing temporal – spatial crime prediction model based on GIS with reliance on local statistical methods so that an appropriate model can be provided. One of effective methods is crime analysis and identification and effective analysis using ARCGIS software and statistical analysis such as clustering which are used for identifying crime hot spots. ARCGIS statistical analysis and clustering analysis help collecting data to the groups according to various algorithms (Brown, 2000). The other issue in crime analysis is crime prediction (Harris and Gorr, 2003). They define crime prevention aiming at preventing from crime and imposing regulations and developing reliable methods for future crime prevention. One of the main recommendations for correction is crime prevention and measurement of its reduction. Spatial and local crime prediction is used for longand short-term plans by advancements in crime prediction. Achieving accurate prediction for effective resource management and transfer to outside area of police intervention for crime prevention will be possible in such situation (Cohental, 2007). Also, regarding classification of these regions based on the importance is an important task which can help overcoming these problems. In addition to dependence of geographical analysis scale, a hot spot may have different meanings (Brown, 2000).

Recent studies by Crime Research Center of National Institute of Justice in England specified a classification for manifesting hot spots and its analysis methods. This classification technique is as follows (Brown, 2000):

Crime	Crime Type	Modarres 11	Bazar 12	Bahonar 13	Minoudar 14	Qiasabad 17
Security	Home theft	84	73	95	25	138
	Bank	0	0	0	0	0
	Car	6	1	2	0	4
	motorcycle plate	0	0	1	0	0
	Shipment	0	3	3	0	1
Economic	c Store (jeweler)	0	0	0	0	0
	Store (other)	42	36	38	2	38
	Cars	92	60	76	20	62
	Motorcycle	101	134	105	7	75
	Inside the car	152	70	65	8	116
	Equipment and spare	119	154	156	39	104
I	Livestock and Poultry	4	4	2	1	2
	Other types of theft	216	135	115	73	238
Social	Private places	18	23	4	3	11
	Public places	1	3	3	0	4
	Bag theft	60	12	12	1	19
	Picking	19	10	7	0	1
	Cash	56	27	13	1	13

**Table 5.** Census of crimes in Qazvin Police Station (2011)

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Crime	Crime Type	Moda	tres 11	Bazi	ar 12	Bahon	ar 13	Minoud	lar 14	Qiasabad	17
		Occurrence	Discovery								
Security	Home theft	ų	-67	4	0	-20	-38	2500	700	28	-45
	Bank	0	0	0	0	0	0	0	0	0	0
	Car	20	50	0	100	100	0	0	100	100	100
	motorcycle plate	0	00	0	0	100	0	0	0	0	0
	Shipment	0	0	300	0	300	0	0	0	0	-100
Economic	Store (jeweler)	0	0	-100	0	0	0	0	0	0	0
	Store (other)	5	17	24	100	23	0	200	0	က်	-42
	Cars	23	46	15	35	6	13	2000	006	51	52
	Motorcycle	10	31	84	100	13	ς.	700	200	21	150
	Inside the car	15	209	ŝ	8	2	8-	800	400	47	37
	Equipment and spare	-26	-44	10	91	-26	-17	3900	1400	-36	-36
	Livestock and Poultr	ry -33	-100	-75	-71	-50	-75	100	0	-71	-50
	Other types of theft	-16	26	34	81	-10	-30	7300	2400	-27	-29
Social	Private places	-22	-38	-28	67	-73	-83	300	100	0	25
	Public places	-67	-100	-50	-100	200	-100	0	0	300	-100
	Bag theft	7	157	6	-33	6	-100	100	0	90	25
	Picking	-37	-100	-52	-82	-30	-100	0	0	-67	-100
	Cash	-25	-48	-10	-67	-43	-64	100	0	-32	140
Total sum		9	L-	30	14	-19	-11	18000	6200	-12	Ņ

- 1. Visual interpretation
- 2. Choropleth map
- 3. Grid cells analysis
- 4. Spatial autocorrelation.

Considering these differences it is possible to provide a consistent definition of crime by taking principles from these schools: the crime is violation of social behavior rules in such a way that it is explained by a legal – criminal article, which is developed by the people with political and social power. Individuals who violate rules will experience punishment which is imposed by the law's executives. It brings social stigma and loss of social status for them (Gorr and Oligsehlaeger, 1997).

It is attempted to answer following questions in this study:

1. How is geographical distribution of crime type and extent in the cities and what pattern does it follow?

 What is the best methodology for crime analysis based on clustering and spatial analysis?
 What are effective physical characteristics or local factors which encourage or facilitate crimes in the city?

4. What are useful parameters for crime mapping and spatial analysis?

5. In which sector crime concentration (severity) tends to be more?

 
 Table 7. Ranking goals in terms of crime percentage in 2011 versus each police station

Police stations	Crime percent per year	No.
Modarres 11	37.28	1
Bazar 12	21.8	2
Bahonar 13	20.41	3
Minoudar 14	5.26	4
Qiasabad 17	24.16	5
	100	Total Sum

#### Data Collection Methods and Results Statistical Population

Statistical population in this research includes crimes (thefts) occurred within the central part of the city during 3 years (since March 21, 2009 to March 20, 2012). Statistical methods and statistical and graphical analysis as well as Office/ Excel software were used for data analysis in this work. GIS software was used for statistical and graphical analysis. It should be noted GIS capabilities were used in identifying spatial patterns of foci vulnerable to crime. Use of GIS in geographical investigation of crime was started sine 1970s. Using capabilities and techniques of this system, it is possible to develop databases, ordering, spatial representation of criminal information, information integration and its spatial analysis.

Table 1 shows city area and comparison to district and province area. Table 2 indicates city population and its main changes. Table 3 shows estimation of literacy level in city population in 2006. Table 4 gives Census of crimes in Qazvin Police Station (2010). Growth and decrease of these cases in two years can be observed by comparison of these data with date in Table 5. Figure 1 compares cases occurred in 2010 and 2011. Statistics for crime discovery and occurrence can be compared in two years in figure 2.

Table 6 gives normalization of security, economic and social crimes. Tables 7 to 11 give other data which were obtained from investigations. **Findings and Discussion** 

Considering results obtained in Qazvin city concerning relationship between crime and urban factors, following results can be mentioned. Of course it should be acknowledged that many of these cases may seem evident and easy, but they are very important in planning of public offices to consider location of the points, because there are

Table 8. Ranking	goals of	police	stations in	Oazvin	(2010-2011)	)
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Rank	social	Rank	economic	Rank	security
14.2	Police Station 11	40.5	Police Station 11	4.8	Police Station 11
25.4	Police Station 12	51.62	Police Station 12	23	Police Station 12
12.6	Police Station 13	45.62	Police Station 13	2.2	Police Station 13
6.6	Police Station 14	24.12	Police Station 14	25.6	Police Station 14
24.2	Police Station 17	48	Police Station 17	11.6	Police Station 17

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many similar points within every city like Qazvin, which are problematic for decision makers to adopt macro decisions.

# As observed, there are weakness and strength in three aspects:

Security crimes: police station 17 is in the top rank and police stations 13, 11, 12, and 14 are in the next ranks, respectively, and it suggests that the number of crime is reduced the more it is moved to population influence and social mobility phase to mere residential areas in Minoudar. Of course, exceptional high rate in Police Station 17 is associated to Daneshgah Street and Qiasabad Street boundaries. It shows high demographic relationships in these regions affect distribution of such crime rate. The other important point is related to Molasadra region which is in high economic level. Occurrence of such cases is expected in this level of social life in this region and previously mentioned regions. Economic crimes: Police Station 11 has highest rank in terms of these crimes and police stations 17, 12, 13 and 14, respectively, are in the next ranks. It is an evident result, because majority of economic centers are located in this part of the city and its focus in the regions with this phase of society is more observed. Of course, it should be pointed out that presence of economic centers has direct impact in this regard and causes such result.

#### Table 9. Security crimes in Qazvin

Crime	Crime Type	Modarres 11	Bazar 12	Bahonar 13	Minoudar 14	Qiasabad 17
Security	Home theft	84	73	95	25	138
	Bank	0	0	0	0	0
	Car	6	1	2	0	4
	motorcycle plate	0	0	1	0	0
	Shipment	0	3	3	0	1
	Sum	18	15.4	20.25	5	28.6
Ranking cr	ime in terms of statisti	ics 3	2	4	1	5

Crime	Crime Type	Modarres 11	Bazar 12	Bahonar 13	Minoudar 14	Qiasabad 17
Economic	Store (jeweler)	0	0	0	0	0
	Store (other)	42	36	38	2	38
	Cars	92	60	76	20	62
	Motorcycle	101	134	105	7	75
	Inside the car	152	70	65	8	116
	Equipment and spare	119	154	156	39	104
	Livestock and Poultry	4	4	2	1	2
	Other types of theft	216	135	115	73	238
	Sum	90.75	74.12	69.62	18.75	79.37
Ranking cri	me in terms of statistics	5	3	2	1	4

Table 10. Economic crimes in Qazvin

 Table 11. Social crimes in Qazvin

Crime	Crime Type	Modarres 11	Bazar 12	Bahonar 13	Minoudar 14	Qiasabad 17
Economic	Private places	18	23	23	3	11
	Public places	1	3	3	0	4
	Bag theft	60	12	12	1	19
	Picking	19	10	10	0	1
	Cash	56	27	27	1	13
	Sum	30.8	15	15	1	9.6
Ranking cr	ime in terms of sta	atistics 5	4	2	1	1



Fig. 1. Percentage of crime discovery to crime occurrence in Qazvin Police Station



Fig. 3. Overall crime evaluation in Qazvin

- Social crimes: Police Station 11 has highest rank in terms of these crimes and police stations 12, 17, 13 and 14, respectively, are in the next ranks. Considering distribution and relevance of these crimes with previous crimes suggest the fact that demographic density in these parts of city has such influence and unlike previous cases, demographic density in this phase of the city causes such result.
- High rate of crime occurrence is repetitive in most cases in three categories which were mentioned in crime triangle analysis. According to crime triangle, a criminal act occurs when a motivated vulnerable goal is met in a suitable environment (Gorr and Oligsehlaeger, 1997).
- Concerning conditions for crime occurrence, it can be said if "possible offender" are put beside with "appropriate goal" in identical "time and location" in absence of efficient and competent guardian, then crime occurs. Thus, urban crowding and poor texture should be mentioned in these regions, which would bring about natural outcomes.
- Frequency of crimes in Police Stations 11 and 17 and its absence in Police Station 14 has a geographical reason in urban phase and it is population mobility is more important than population settlement in the crimes.



**Fig. 2.** Statistics for crime increase and decrease in Qazvin police stations compared to 2010-2011

Figure 3 shows overall crime evaluation in Qazvin. Despite of difference in problems in different regions and police stations, three mentioned cases offer the same problems.

#### CONCLUSION

A system was proposed in this work to reduce crime data based on the spots. Nuclear density estimation was proposed. This method has been used for producing a continuous crime density level of crime spot data. Analyst begins with a spot map of the crime event. Special advantage of this method is that unlike regional (block) consensus, the analysis is not confined to some geographical boundaries and spatial pattern can be recognized more easily (compared to a spot complicated map). It is better to use animation of changes in crime distributions over the time for linking these changes and crime prevention. Animation works with crime maps generated by nuclear density, because short time interval can be perceived from animation visually, and it is easily understood. Ability of this technique especially in clustering analysis can be mentioned as the main cases that can be applied in the analysis. Advantages of this method include as follows: the calculation is easily done and the output is easily described. Regional (block) method is accurate and flexible. Analysis at regional level can be yet useful; this method manages a small number of data. Management of the regions may change data. Some regions integrate the parks, while some other only refer to small areas. Large regions often have larger numbers of crimes, especially crisis foci are divided to smaller units (2-3 blocks). This method was used because its advantages are more than its disadvantages and it is an important tool for studying historical crime pattern, and it provides valuable base for discovering relationship between crime and socioeconomic conditions. Local crime analysis is a powerful tool and it is easily used in GIS, because it includes mapping, analysis and police reporting tools for crime analyst and police directors.

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