Spatial Modeling of Vacant Land Prices: Case study of Medina

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Abstract:

Vacant Empty Land costs are significant components and arising research region for the city overseers, city organizers and financial specialists. Its significance originates from the way that they decide the terrains' worth, on which the urban communities' development and the dispersion of land utilizes depend on. The land cost contrasts in better places inside the city in light of area, availability, encompassed land utilizes and different attributes connected with the capacity of Venture and lease.

Medina (northwestern Saudi Arabia) is the second heavenly city in Islam, possesses a spot among Muslims. It has visited by multiple million guests visited yearly. Medina has an area of roughly 589 km2, and the metropolitan regions involve around 293 km2. Then again, the city has seen a huge ascent in land costs since the declaration of the task to grow the Prophet's Mosque, because of the popularity and an absence of supply of void empty terrains that can be taken advantage of in the development of structures, offices, and public administrations.

Subsequently, it could be vital to distinguish those land cost areas of interest occasionally, in lined up with the making of a computerized guide of empty land in Medina. Estimating the costs of empty land becomes convoluted as it is a variable peculiarity with changing time highlights. To take care of this issue, the review proposed the utilization of insertion strategy, as well as leading a problem area examination to distinguish the empty plots with rising costs and researching the reason for these increments for the better administration of the city's land saves.

Hot Spot Maps to introduced prices' hot spots in terms of similar types of prices. In succession, the extrapolating of land prices for the rest of the city using the interpolation methodology was conducting, then checking the accuracy of the inferred data through the field study again and matching the results. IDW method matched more than 70% with the test sample prices. The study relied on a sample size of 80 points distributed in the neighborhoods of the city.

Key Words: Medina - vacant Land- prices- hotspot- triangulation- interpolation.

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1- Introduction:

Urban authorities and organizations are not accurate in their analysis of where and when specific future events will occur [1]. Geography thus becomes an important part of understanding and predicting future events with spatial aspects.

It's no doubt that Medina is: The Islam's second holy city having a place among Muslims. The city, which is visited by more than 3 million people annually, does not exceed a total area of 589 square kilometers, while the area of urbanization does not exceed 293 square kilometers.

Since the city is mostly surrounded by a number of complex mountains (figure1), on the other hand, and once the third Saudi expansion project for the Prophet's Mosque was announced, the land prices have increased significantly in the city, in line with the increased demand for vacant lands which can be exploited in the construction of buildings, facilities and services.

Since it is important to determine the real estate reserves of vacant lands and track land prices within the city periodically, in addition to the urgent need to map the land prices and track their hot spots, so that it can be easy to find out what is reasons behind this high price and to make it easy for the city's real estate reserves management.

The objective of this work is to design and implement the Geographic Information System (GIS) for Management the vacant lands inside Medina by mapping and analyzing their land prices. The first step was selecting of samples for vacant land prices and collecting their primary data through visits and using differential GPS (R1GNSS) for determining locations, then the determination of Hot Spot Maps through GIS analysis was the next step. The extrapolating of land prices for the rest of the city using the interpolation methodology (IM). Check the accuracy of the inferred data (by Experimenting with most types of interpolation) through the field study again is the final step. This method can be applied to analyze the city's vacant land prices through a map created as a part of technical steps.

(1) Fattah, E., 1997. "Criminology: past, present and future". Basingstoke, McMillan England.

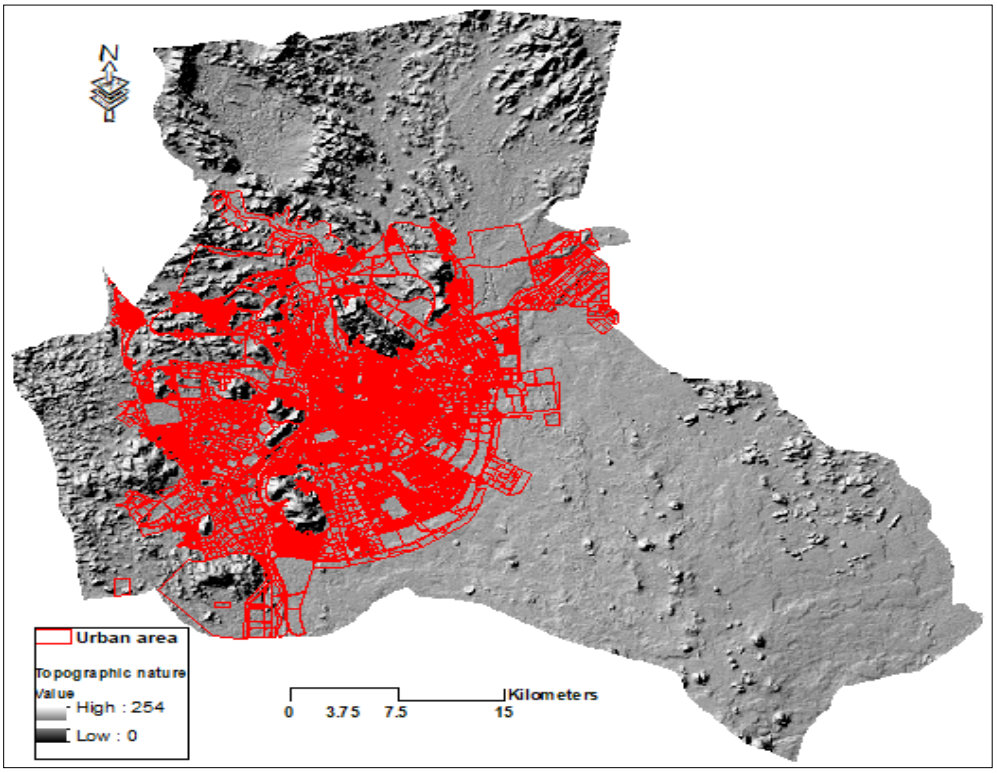


Figure 1; the complex mountains surrounding Medina

2. GIS temporary spatial databases:

Temporary spatial databases are defined as a database that manages the phenomena's information in the two dimensions: time and place. In this context, the vacant land prices can be defined as an object that has a spatial and temporal property. The spatial properties include the location and the accessibility of the vacant land, in addition to its neighboring land uses, services and Facilities, while the temporal property is defined as the time intervals between jumps of land prices' changes. Thus, the temporary spatial database.

The temporary spatial database includes geographical, temporal, and thematic land pricing attributes. Spatiotemporal data sets of vacant land prices include spatial and thematic attribute shift values over a period of time. These databases, with their content of vacant land price data in successive years, make it possible to analyze and compare hot spots in land prices between a number of years, which helps to identify the causes of change, and thus the successful management of those lands.

3. Vacant land prices Mapping:

Land price maps for city planners and land price analysts provide a flexible platform, through which they can view spatial and temporal land price change, account for each price category, and identify anomalous areas, whether hot or cold spots. The general perspective of the variation in vacant land prices at each stage of any study can accurately determine the reasons for the price rise of one place to others and the inventory of land hot spots, thus predicting the future development of prices.

Digital land price mapping can help city administrations in managing the city's real estate reserves more effectively. Land price maps that show high accuracy in signing and extrapolating land prices can help push investment and land use to the most appropriate places at both levels: investment and public benefit. On the other hand, land prices maps may be a cornerstone for the city planners and land-use policy makers in city administrations for drawing more complex maps to monitor trends of changing land prices within the city.

4. Methodology:

4-1. Data Acquisition:

There are various methods to obtain the data of vacant land prices to be processed in GIS environment.

The current study is based on the use of the spatial interpolation method to create the digital surface of land prices of Medina, through a sample of known coordinates and values points, collected in the field through with help of some brokers (real estate investment offices) and the use of GPS for measuring the points coordinates. Thus, the Land prices data were obtained for a sample of 181 points distributed across the city's neighborhoods, as well as ground coordinates for those points (figure 2).

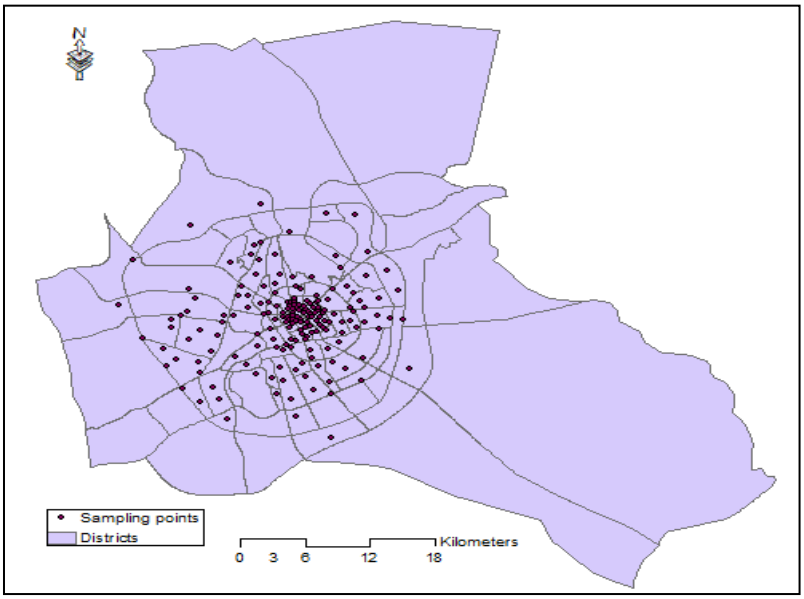


Figure 2; the sampling points of land prices across Medina

The average nearest neighbor's scale of Arc GIS was used for verifying the distribution pattern of the points sites that the land prices data gathering from, where it showed that the points were dispersed and covered the city appropriately (figure 3).

4-2. The hot-spot analysis:

The ARC GIS Hot spot analysis was applied on the land prices' sample of point gathering in order to identify the vacant plots with rising prices compared to the low prices ones and investigating the cause of these increases for the better management of the city's real estate reserves.

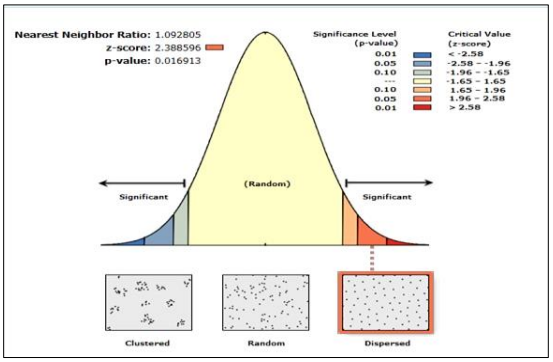


Figure 3; average nearest neighbor's report of the sampling points of land prices across Medina

Hot spots are spatial clustering areas for certain types of land

values which reflect a predominance of operation, allowing them to provide more resources and services needed. Accordingly, vacant lands in Medina could be classified as 'hot spots' and 'cold spots' depending on their observed prices. The sites with hot spot prices exhibiting a good image of the vacant land values compared with the cold ones in Medina. They can help the decision makers to design optimum plans for the future land uses, considering the correlation between the presence of hot spots and the housing price, although few studies have reported that.

The hot spot analysis was conducted for the Medina's land prices (figure 4). It shows that the hot spots that represent the high prices' lands. The hot spots are concentrated around the Prophet's Mosque in the central area, and inside the middle circular road, while they decrease out of the second ring road, with some medium-priced hot spots in the northwest between King Fahd Road and Abu Bakr Al Siddiq Street in Bir Uthman neighborhood.

as it is logical, the cold spots with cheap land prices alternate by appearing unlike hot spots, where cold spots with very low land prices appear on the outskirts of the city, then prices increase inward to reduce the color saturation of cold spots until they connect to hot spots in Chromatic saturation.

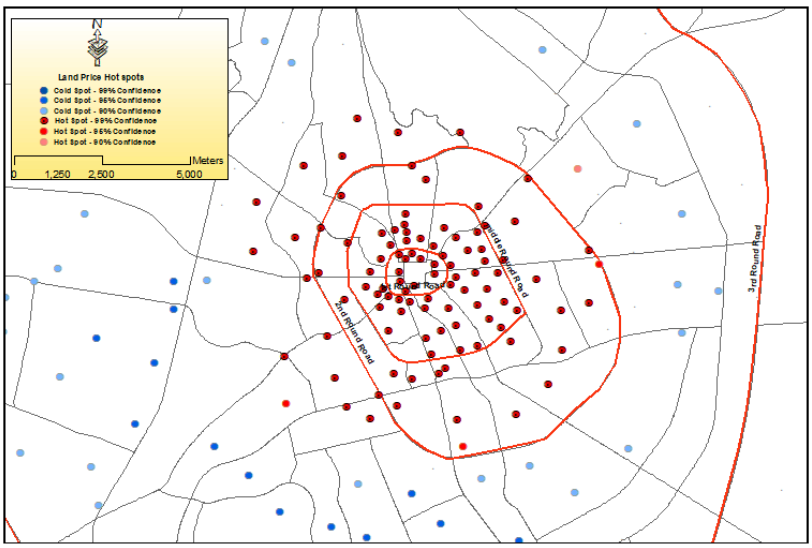


Figure 4; The hot spot analysis of the sampling points of land prices across Medina

4-3. Interpolation for Land Prices Mapping:

Interpolation is the process of proposing values of unknown points from some known values. It is usually used to predict the elevation surface using only some known points. It is one of the most common methodologies used to find the missing values by using the values present in the nearest locations. Data interpolation is performed using the inverse distance weighting process, according to the literature. This approach is used by taking the average weight of surrounded known points to calculate the unknown value of a particular point. On the other hand, interpolation method is based on the spatial autocorrelation theory, which tests the degree of relationship / dependence between close and distant features.

4-4. GIS Interpolation Methods:

As it is known, there are a range of spatial interpolation methods. It depends on many factors to choose the correct type of interpolation method. There is no universal approach suitable for all issues: it depends on the variable's existence and the time-scale on which the variable is represented. A range of known interpolation methods were piloted, then the next step was choosing a sample of inferred land prices in the field to select the best of these methods for application. The researchers tried various methods of interpolation and compared the results in order to determine the best method of interpolation for a given project.

As it was reported by Knotters, M. et al., (M. Knotters 2010) “IDW, Kriging and Spline are geo-statistical interpolation methods in which the value at an unobserved location is predicted by a linear combination of the values at surrounding locations”, the researchers tries them to find the suitable method of interpolation for predicting the land prices of Medina.

4-4-1. Inverse Distance Weighted (IDW) interpolation method:

The IDW is applied to characterize the spatial structure of the land prices in a raster layer, then the color symbols were reclassified based on the change of the classification method. Standard deviation, Natural breaks and equal interval (with 4 and 20 intervals) methods are applied to interpolate land prices all around the city of Medina (Saudi Arabia).

The classification methods are used for classifying numerical fields for graduated symbology in general. The data classification goal is to position locations with identical land prices in the same category and separate locations with very different rates in different classes. On the other hand, applying the different classification methods to interpolate the missing areas of land prices supports the ability of drawing true image of the distribution of land prices in Medina.

As figure 5 shows that, the equal interval methods (both four classes and twenty) on the right are unable to diagnose the state of land prices variation in the city. Where the equal interval (with four classes) method could not show the real contrast of the land prices. It just showed up between the central area around the Prophet Mosque and the rest of the city. By increasing the classes to 20, it's not much different, where the contrast appears between the area within the ring road and the other areas.

On the other hand, the standard deviation, Jenks natural breaks seem to design a better arrangement of values of land prices. The natural breaks end its role in displaying land prices variation with approximately the second ring road, while the standard deviation role extends beyond this limit to display the variation.

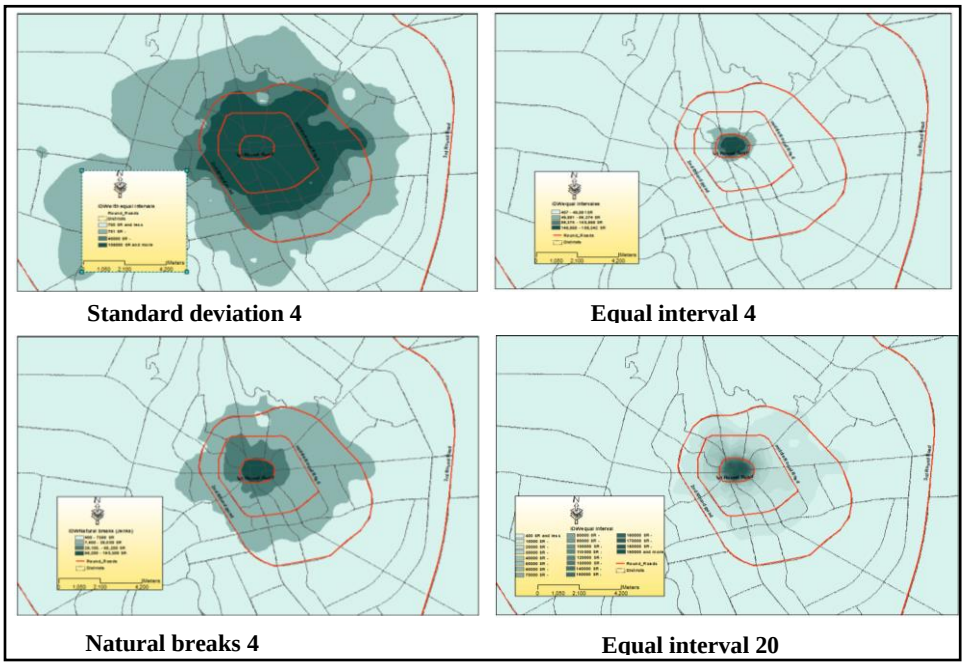


Figure 5; IDW interpolation method with change of the classification method

4-4-2. Kriging interpolation method:

As it is known, Kriging is used for the visualization of surfaces applying the weighted average technique, so it is proportional to the limited samples of points in order to predict of a greater number of point values within the same space. Applying This method with the change the color scheme according to the above-mentioned methods drew a different image characterized land price surface in another way.

The equal intervals maps (4/20 classes) on the right do not clearly show the variation in land prices, where their role does not exceed the area within the middle ring road. On the other hand, there are similarities between the two maps on the left, but the difference lies in the extension of the high prices from the core to the northwest in the area around Abu Bakr Al-Siddiq Street with applying the standard deviation classification.

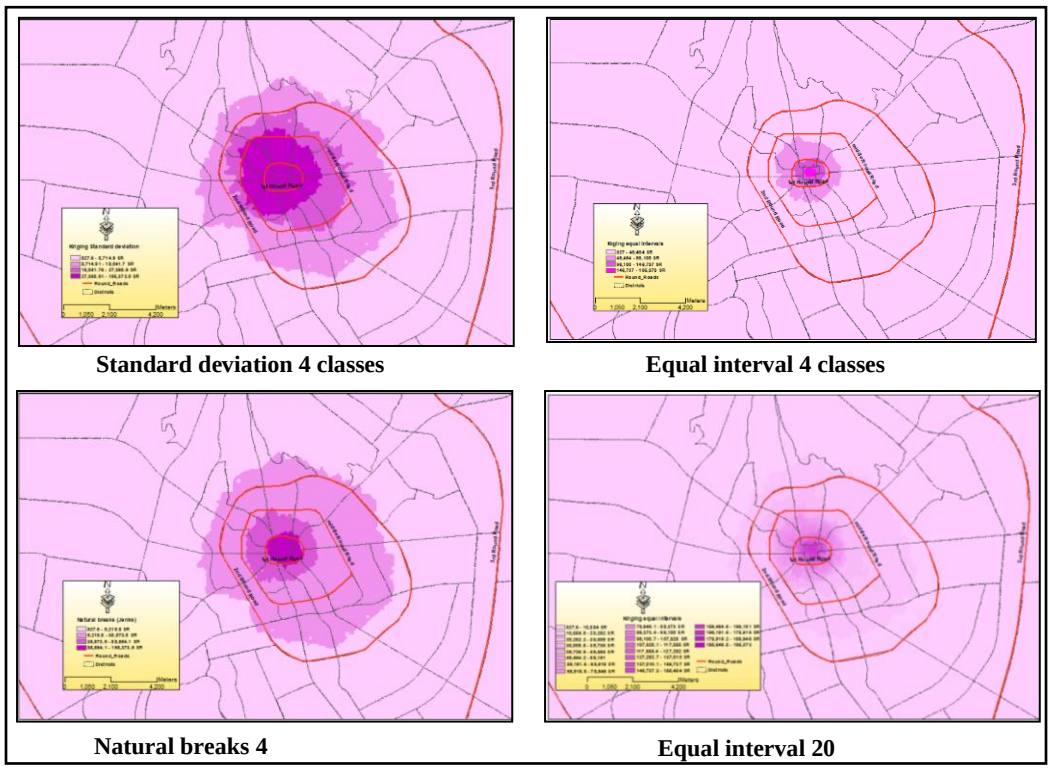


Figure 6; Kriging method with change of the classification method

4-4-3. Spline interpolation method:

In the same context, Spline interpolation method was applied for the same purpose of characterizing the spatial structure of the land prices in Medina, the color symbols were reclassified based on the

change of the classification method as figure 7 shows.

This method uses a mathematical function that reduce the degree of total curvature of the surface so that the product is different. Using the equal intervals classification on the right, the high price zone appears only in the central area, while the rest of the city's land is classified as the lowest price. The boundaries of the categories appear zigzag, reflecting price variations in the two maps on the left, while the standard deviation map assumes the extension of the high prices from the core towards specific ends that appear in some fringes within the middle ring road.

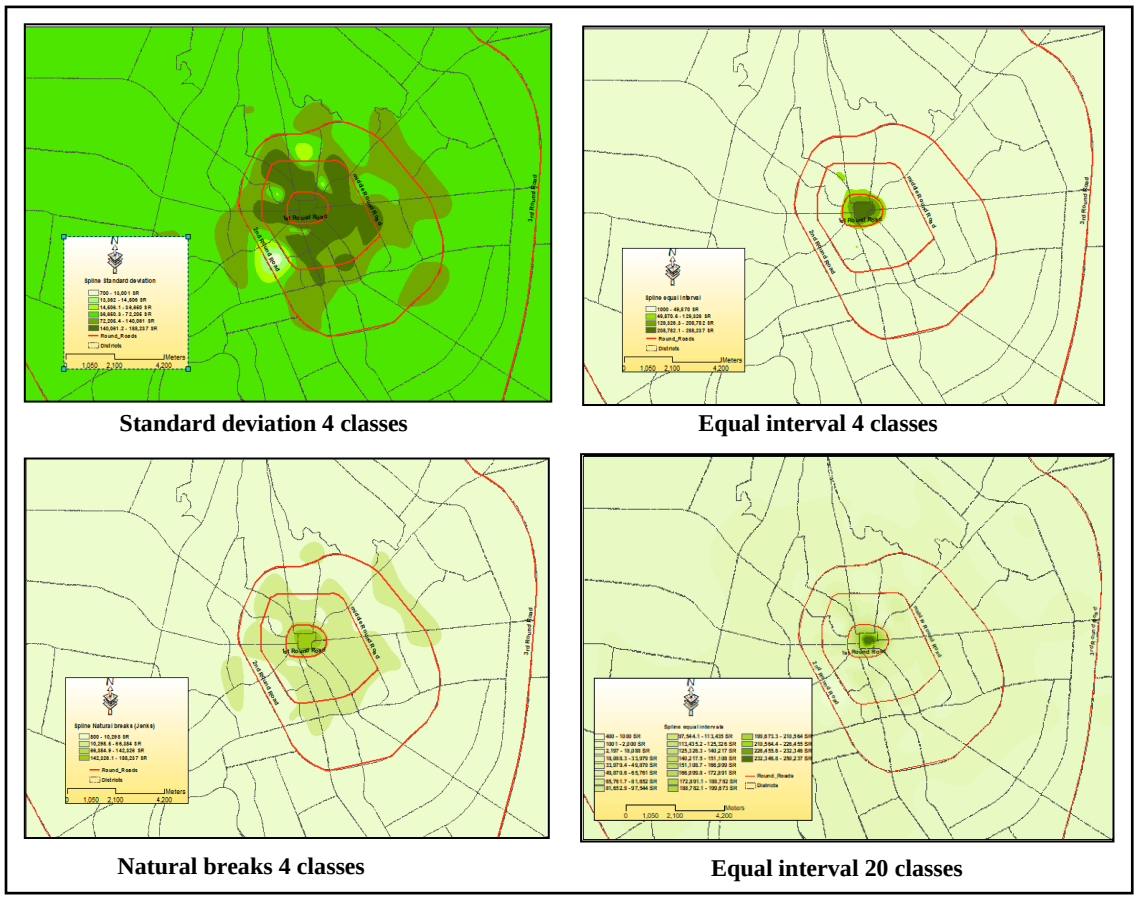


Figure 7; Spline method with change of the classification method

4-5. Checking the accuracy of the inferred data:

A sample of 35 points were chosen in Order To check the accuracy of the data interpolated through up mentioned methods. By conducting a field study, land prices of these points have been registered in addition to their coordinates that measured by a GPS.

As it is shown in figure 8, the points were added overlaying all the

raster layers of the experimented interpolation methods in Order to demonstrate the better method for Medina.

Comparing points' prices to price ranges in each layer has proved That, the previous methods varied in their appropriateness for this purpose. The highest proportions of the appropriateness were achieved in four methods displayed in figure No 9.

the IDW interpolation method was better than others in predicting and interpolation of the total land price map of Medina through some measured random points. The land prices in the verification sample matched by 77.1% with the natural breaks (Jenks) and 71.3% with the standard deviation. It was 62.9% with Kriging with Nature breaks (4 classes) and Spline (standard deviation classification method), while it didn't get 50% with the other methods.

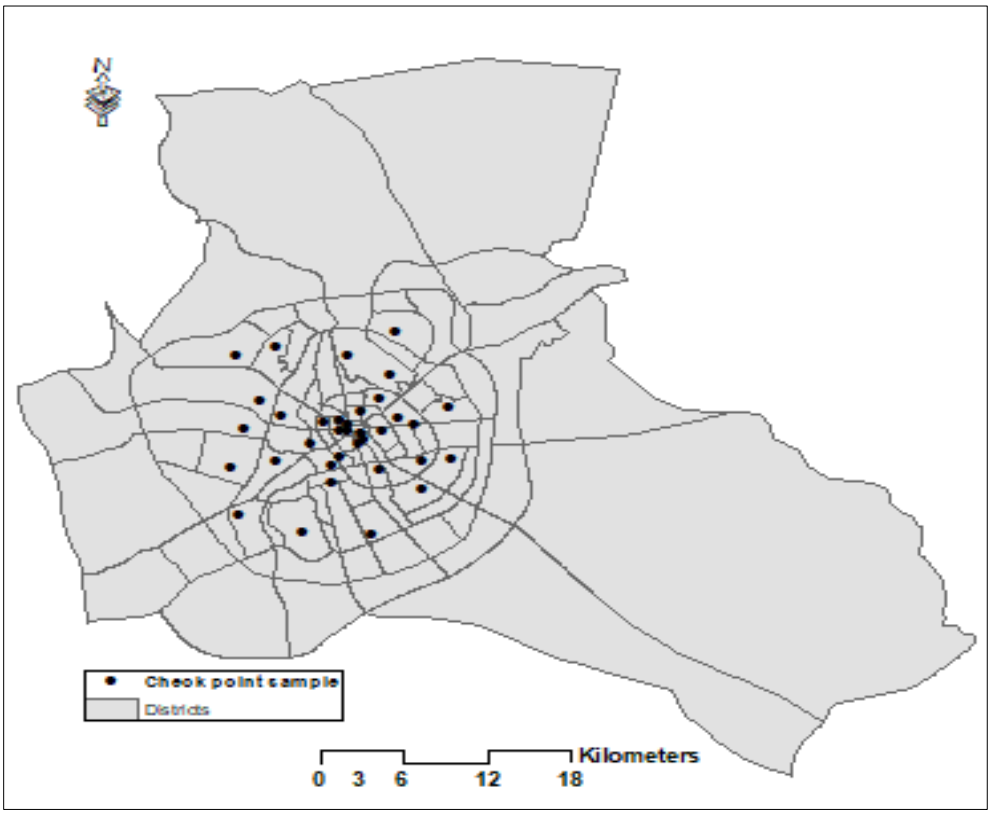
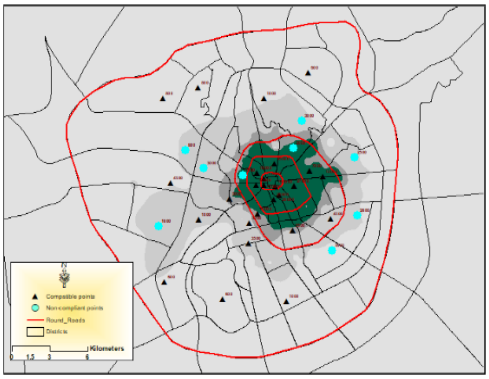
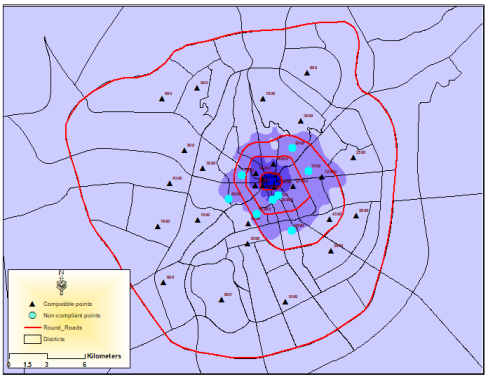


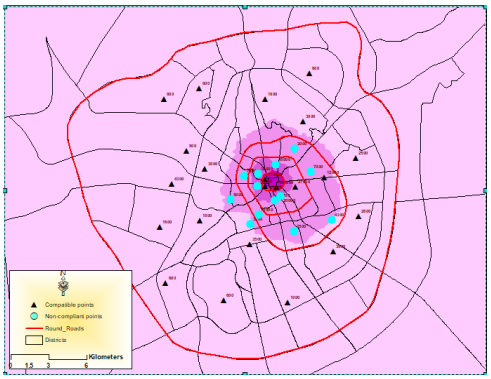
Figure 8; Check point sample



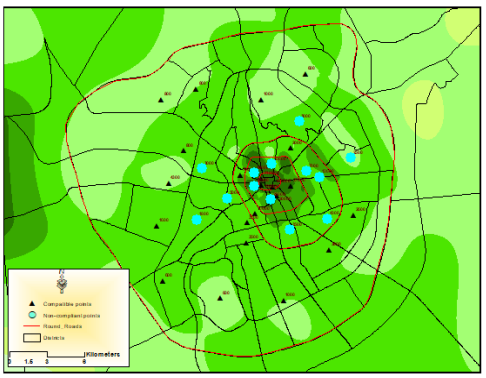
IDW with Standard



IDW with Nature breaks (4



Kriging with Nature breaks (4



Spline with standard deviation

Figure 9; Checking the accuracy of the inferred data

5- CONCLUSION:

Geographic Information System (GIS) plays an important role in Management the vacant lands inside Medina by mapping and analyzing their land prices. In this work, selecting of samples for vacant land prices and collecting their primary data through visits, and the differential GPS (R1GNSS) for determining locations, then drawing of Hot Spot Maps to introduced prices' hot spots in terms of similar types of prices. In succession, the extrapolating of land prices for the rest of the city using the interpolation methodology was conducting, then checking the accuracy of the inferred data (by Experimenting with most types of interpolation) through the field study again and matching the results. IDW method matched more than 70% with the test sample prices. The experimental model conducted demonstrate that the proposed methodology can deliver the better results and can improve accuracy and rate of recall.

References:

- *Can, A (1990), The measurement of neighborhood dynamics in urban house prices. Economic Geography 66(3), 254-272.*
- *Chung M. Y., (1992), Research of Building Mass Appraisal Approach, Doctoral Dissertation, Dept. of Land Policy, National Cheng Chi University, Taiwan.*
- *Demetriou, D., 2016a. The assessment of land valuation in land consolidation schemes: The need for a new land valuation framework. Land Use Policy, 54 (2016), 487-498.*
- *Dubin, R (1988), Estimation of regression coefficients in the presence of spatially auto correlated error terms. Review of Economics and Statistics 70, 466-474.*
- *Lemmens, M.J.P.M. (1999): Developing a Valuation and Transaction Information System*
- *(VTIS) for the Estonian Cadastre, Proceedings UDMS 1999, Venice.*
- *LiXin, CHENG Guodong and LU Ling2000 Comparision of spatial interpolation Methods. Progress in Earth Sciences.15(3)260-5.*
- *LuoMingand PeiTao2009 Renew on Soft Spatial Data and its Spatial Interpolation MethodsJ.Progress of Geographical Science.28(5)663-72.*
- *M. Knotters, G. B. M. H., T. Hoogland, D.J.J. Walvoort (2010). A disposition of interpolation techniques. Wageningen, Statutory Research Tasks Unit for Nature and the Environment: 26.*
- *Paugam, A. (1999): Reform toward an ad valorem property tax: fiscal and non-fiscal benefits*
- *in transition economies, Journal of property tax assessment & administration, vol. 4, no.2, pp. 3-26.*
- *ZhuQiuan, Zhang Wanchang and Yu Junhui 2004 The spatial interpolations in GIS J. Journal of Jiangxi Normal University (NATURAL edition)28(2)183-8*
- *Li J2008 a Review of Spatial Interpolation Methods for Environmental Scientists J. Record -Geoscience Australia. 137.*