

## Modeling the spatial relations in the factors effective on installation of current financial and credit institutes of Tehran using geographically weighted regression

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### Expanded Abstract

#### Introduction

Financial and credit institutes, especially banks, are assumed as the most important economic centers in the urban space. The significant role of these centers in offering services to the citizens in one hand, and the competition between these centers on the other hand reveal the necessity of investigations about the optimum place for their site selection (Rahnamaee et al., 2012: 48). In such studies, the amount and the way that the space would affect is of importance. Neglecting the effect of the space would lead to consequent errors in estimating, forecasting, and projecting (Soltani et al., 2000: 100). Multiplicity of effective variables in site selection in urban spaces has made the spatial decision makings complex, and modeling spatial relations necessary. Modeling these relations requires spatial methods due to the spatial nature of these factors.

In most studies about identifying the optimum place for installation sites of various activities and services, some methods are used that are based on experts' ideas. Multi-variable decision making techniques in geographical information system are widely used. While in these researches the spatial relations between the variables are not identified and modeled with respect to the current distribution pattern and the current situation are not used for further prediction.

One well-known spatial statistic method that deals with modeling the spatial relations between a set of variables is the Geographically Weighted Regression. This method models the relations between the variables that are connected to geographical factors and provides the possibility of predicting the value of unknown variables and a better perception of the factors affecting a variable. While in ordinary regression, each observation is assumed as independent and due to the self-correlation between the spatial data, in most observations the use of ordinary regression is not a suitable method for modeling the relations between the variables with spatial nature.

The main purpose of this article is to investigate the efficiency and to illustrate the superiority of the Geographically Weighted Regression in modeling the spatial relation of factors effective on installation of the financial and credit centers of Tehran.

#### Methodology

In this research, in order to model the spatial relations of effective factors on identifying the suitable place for installing the financial and credit centers, some variables were employed:

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educational and cultural centers, administrative centers, recreational centers, sanitary and therapeutic centers, economical and commercial centers, Traffic, Transportation and population. These were considered as the independent variables and the current situation of the financial and credit branches were considered as the dependant variables in the geographically weighted regression.

In this research, the Repeating Shape tool was employed to create Hexagons in ArcGIS in order to divide the study area. Each hexagon's data was aggregated in each unit. Then, the geographically weighted regression was conducted to model the spatial relations of effective factors on identifying the suitable place for installing the financial and credit centers with spatial statistic tools in ArcGIS. In this research, the Fixed Kernel, which is more appropriate for observations with semi-constant distributions (amounts, and number of neighbors), was employed beside the Akaike Information Criterion to determine the observation threshold.

### Results and Discussion

After conducting the geographically weighted regression on the model's parameters, the results were analyzed. The first output is the general information about the estimated model. The results indicated that the model has an acceptable accuracy in modeling spatial relations with the  $R^2= 0.8883$  and the adjusted  $R^2= 0.8841$ . Also, the estimated self-correlation between the remaining values of the geographically weighted regression using the Moran's I parameter shows an insignificant self-correlation. The mentioned index indicates a value of 0.026337 as no spatial clustering between the data sets and the geographical features. The map based on  $R^2$  values shows that the model has more reliability in predicting values in northern, central, and southeastern regions in comparison with western regions. Furthermore, the outputs show a value more than 0.5 for all regions.

The results for Tajrish, Enqelab, Ferdowsi, 15<sup>th</sup> Khordad, Valiasr, and Madadar square, and intersection of Enqelab and Valiasr, Ferdowsi and Jomhuri Eslami, Shahid Beheshti and Khaled Eslambuli and Valiasr, and Keshavarz and Jouibar avenues, and Doctor Fatemi avenue and Jihad square revealed the Afriqa Avenue as the highest values for financial and credit branches. Other regions are in other classes. As it could be seen, this model was somewhat able to predict the installation sites of these branches.

### Conclusion

The importance of the installation sites of financial and credit centers beside a set of affecting factors has made the modeling of the relations between these factors necessary. Due to the spatial self-correlation which usually exists in spatial data, the use of a regression model has been locally calibrated. It seems to be essential to identify the relations between the spatial variables. Geographically weighted regression, as one of the methods of spatial statistics, models the spatial relations between the sets of variables.

As the results show, the geographically weighted regression has modeled the spatial relations of effective factors on identifying the optimum place for installing the financial and credit centers with an appropriate accuracy ( $R^2= 0.8883$  and the adjusted  $R^2= 0.8841$ ) by the spatial variations in relations between the variables. In addition, the map derived from the local  $R^2$  values indicates that the model is of more efficiency in northern, central, and southeastern regions in comparison to western regions. Furthermore, the outputs show a value more than 0.5 for all regions.

These results could be a significant help for managers and planners of financial and credit centers to analyze the region in order to identify the potential sites to open new branches and services. Also, it helps the centers identify their current condition in comparison with their competitors for further planning.

**Keywords:** financial and credit centers, geographically weighted regression, Spatial Relations, Tehran city.

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