Spatial Analysis of Quality of Life Indicators in Tehran City

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Extended Abstract

Introduction

For more than four decades, sociologists, politicians, economists and geographers have used a wide variety of statistical techniques to analyze and measure Quality of Life of individuals and communities. This was with the aim to obtain useful instruments for social, political and economic decision making. Quality of urban life has become an important field within urban studies. The increased level of attention to this topic is due to the increasing importance of Quality of Life studies in monitoring public policies and also due to the role they can play as effective tools in urban management and planning. In addition to development of Quality of Life indicators, geographers seek to identify and understand the geographical patterns of urban Quality of life indicators in relation to the processes that give rise to those patterns. Urban QoL is usually measured by either subjective indicators using surveys of residents' perceptions, evaluations and satisfaction with urban living or by objective indicators using secondary data and relative weights for objective indicators of the urban environment. This paper relying on the objective approach in study of Quality of life and also using principal component analysis method is developing the Quality of life index in Tehran city.

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Methodology

Use of census data, satellite images, quantitative GIS, GIS mapping and statistical analysis are powerful tools to investigate the variability of Quality of Life indicators among 117 municipality divisions of Tehran city. Four sets of data were used for the analysis of urban spatial structure in Tehran city. Census data (year 2006) were used for the analysis of socio-economic condition. ETM+ satellite images (year 2009), air pollution layer consisting of carbon monoxide (year 2009), and urban services dispersion layers (year 2006) were used for the spatial analysis. To measure the vegetation cover, the Normalized Difference Vegetation Index (NDVI) and Landsat 7 ETM+ image dated on summer 2009 were used. The NDVI is a simple numerical indicator that can be used to analyze remote sensing measurements, typically but necessarily from a space platform, and assess whether the target being observed contains live green vegetation or not. Using the Landsat ETM+ 7 satellite image, we therefore calculated the normalized difference vegetation index. Thermal infrared band of ETM+ provides the source to extract surface temperatures. The procedure to extract land surface temperatures involves three steps: (i) converting the digital number of Landsat ETM+ band 6 into spectral radiance; (ii) converting the spectral radiance to at-satellite brightness temperature, which is also called blackbody temperature; and (iii) converting the blackbody temperature to land surface temperature. The average values for the air pollution and specially carbon monoxide were calculated and mapped, using zonal statistic function in GIS. The amounts of air pollution were calculated and analyzed for each area. Accessibilities to six types of urban services were measured for 117 zones of Tehran. These 6 types of urban facilities: educational centers (day care centers, elementary schools, schools for talented students, middle schools, high schools and universities); emergency services (fire stations, emergency centers, and police); health services (hospitals, health and treatment centers); recreation and sport centers (parks, sport clubs, sport grounds); cultural services (libraries, mosques, cinemas, and cultural centers) and subway stations, all analyzed using Arc GIS. Distance was used as criteria for accessibility. In this research, a 500 meter distance was considered as an optimum distance to urban services. These distances were standardized (0 to 1). The value given to a areas reduces with the increase in distance. When the distance reaches 5000 meters, the value given is zero. After calculating the mean value of distances to mentioned urban services, separately and for every zone, the degree of optimum distance of each zone to urban services were measured with weighted linier index. To give weights to these six indicators, Analytical Hierarchical Process was used on the basis of paired comparisons.

Principal component analysis was used to extract factors related to socio-economic, environmental and accessibility variables. Factor analysis is a statistical technique used to determine the number of underlying dimensions contained in a set of observed variables. The underlying dimensions are referred to as factors. These factors explain most of the variability among a large number of observed variables.

Results and Discussion

Exploratory spatial data analysis (ESDA) is a subset of exploratory data analysis (EDA) that

focuses on the distinguishing characteristics of spatial data-specifically on spatial autocorrelation and spatial heterogeneity. More specifically, ESDA is a collection of techniques to describe and visualize spatial distributions, identify atypical locations or spatial outliers, discover patterns of spatial association, clusters or hot spots, and suggest spatial regimes or other forms of spatial heterogeneity. By using these methods we can identify spatial effects, which can be classified into two general types: spatial autocorrelation and spatial heterogeneity.

Extracted components are "housing and skill", "access to public services", " environmental quality" and "unemployment". Exploratory Spatial Data Analysis have been used to identify and understand geographical patterns of QoL in Tehran city. The results of Exploratory Spatial Data Analysis indicate the presence of clustering (a positive spatial autocorrelation) and spatial heterogeneity in distributions of Quality of life Index across the districts of Tehran city. Results show that spatial autocorrelation and spatial heterogeneity are detected in the spatial distribution of urban Quality of Life components in Tehran city. Therefore, intra-urban inequalities exist with respect to urban Quality of Life components.

Conclusion

The results of this explorative research of spatial data showed that there is a clustering (positive spatial autocorrelation) and unequal distribution of urban Quality of Life components in urban areas of Tehran. The results of the analysis approve the un-equality of socio-economic, environmental and accessibility variables among different areas of the Tehran city. The provided maps show the areas that need intervention and development of public infrastructure. The results of the analysis can guide policy makers and planners to reduce the city's un-equalities. Understanding of these variations can help to develop more realistic models, which are critical for Quality of Life planning.

Keywords: Exploratory Spatial Data Analysis, Principal Component Analysis, Quality of Life, Tehran City.