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Research Article

Analysis and Study on Spatial Matching between Governmental Affairs' Service Resources and Population: Empirical Analysis Based on the Statistical Data of L City in Central China

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Objective. To construct a coupling model between resources for governmental affairs services and population data and its evaluation system, this research investigates and surveys offline (site, hardware, and human resources) and online service resources of governmental affairs on the basis to the Seventh National Census. The study aims to provide countermeasures and suggestions to promote governmental affairs service resources for people in specific areas more effectively. *Method*. This study analyzes and examines spatial matching between governmental affairs' service resources and the population by using principal component analysis. Using the coupling matching degree model for reference, this study constructs a matching model based on governmental affairs' service resources and its evaluation system. Furthermore, the study analyzes and demonstrates the coupling matching degree between governmental affairs' service resources and the population system. *Conclusions*. Over the past five years, the matching level between governmental affairs' service resources and the population has been categorized as moderate coordinative matching on the whole. From the perspective of changing trends, which are affected by population fluctuations, the matching degree also fluctuates, thus indicating a close relationship. Therefore, some relevant governmental departments need to continue promoting the "One Net, One Access, One Time" reform further and encouraging the equal allocation of governmental affairs' service resources.

1. Introduction

According to the Seventh National Population Census, the total number, structure, and distribution of China's population are comprehensively investigated, which accurately reflects the population change and provides a large number of valuable information resources. To analyze and study the census data deeply and give full play to the social benefits of the data, the leading group of the seventh national census of the State Council has carried out research in the fields of population and education, housing, and medical treatment.

Previous research has mostly focused on the matching degree between the economy and the environment, between the economy and tourism, and between urbanization and ecological environment [1–5]. Meanwhile, few research studies have been conducted on governmental affairs' service resources and population allocation. Under the Internet + governmental affairs' service policy, the critical factor in the reform of administrative management system is to construct a better and more accurate service-oriented government. In addition, the spatial fairness of the distribution of governmental affairs' service resources is the premise and material basis for achieving the equalization of

basic public services. It is also the most important goal of the government.

The governmental affairs' service resources and the population are two different systems. Their coordination relationship and degree are formed by the interaction of multiple factors. The analysis on matching and coordination between these two aspects is the basis of the One Net, One Access, One Time reform in governmental affairs' service. Furthermore, it is of great practical significance for building a service-oriented government to satisfy people's needs and overcome the last kilometer barriers in convenient services.

Under this guidance, the L municipal government in Central China has launched research on the population structure and education, elderly care, and the adaptation of governmental affairs service resources in combination with regional characteristics. The organization where the author is affiliated has made an in-depth study on the governmental affairs service resources of the city together with the Data Resource Management Bureau of L City. On the basis of population census data, they have investigated the spatial accessibility of governmental affairs service resources, established the matching calculation model using statistical methods, and calculated the matching degree. Furthermore, they have found the problems in the adaptation and provided some suggestions.

2. Data and Methods

2.1. Data Sources. The population data come from the seventh population census and statistical yearbook of L City in 2017–2020. The data on governmental affairs' service resources come from the annual open report on the government information of the L City Data Resources Bureau and the statistical work. In addition, the relevant data have been placed on the GitHub open source data site. According to the characteristics of the population and regional structure, the data processing and description are as follows. (1) All data are collected and sorted according to the spatial partition of data. (2) In terms of spatial allocation of the population and governmental affairs' service resources, resources have been unevenly allocated due to the registered residents. However, the resident population is taken as the main object of the optimal allocation of governmental affairs service resources in this study.

2.2. Establishment of Evaluation Index System. According to the overall evaluation goal in the spatial matching between governmental affairs' service resources and the population, the target layer and branch indexes are set up on the basis of the model in the establishment of the evaluation index system [6–8]. The population data of L City from 2017 to 2021 are divided into three categories according to the population number and distribution. The data of governmental affairs service resources are divided into three categories: hardware resources, human resources, and network resources. A total of 23 indicators from six categories are selected to analyze the spatial matching between governmental affairs' service resources and the population (Table 1).

Tables 2 and 3 present the population data and governmental affairs service resources, including hardware resources (service halls and number of service networks), human resources (number of service personnel and number of village-level agents), and network resources (number of "All-in-one Netcom" offices at the municipal level and the number of "Trans-provincial Netcom" offices).

3. Principal Component Analysis and Matching Degree Calculation Model

3.1. Principle Component Analysis. Principle component analysis [9–11] refers to a multivariate statistical method to convert multiple indicators into several comprehensive indicators. The premise of this method is the small information loss based on the idea of dimensionality reduction. Through principle component analysis, some main components can be determined from the complex relationship between things, which can then be simplified. Through effective quantitative analysis on a large number of statistical data, deep enlightenment on the characteristics of things and their development laws is obtained. The essential law of data is also found.

In the quantitative analysis model, the quantitative relationship between the classification cause index Y_i and original index X_i is as follows:

$$\begin{aligned} Y_1 &= \alpha_{11}X_1 + \alpha_{12}X_2 + \cdots + \alpha_{1m}X_m \\ Y_2 &= \alpha_{21}X_1 + \alpha_{22}X_2 + \cdots + \alpha_{2m}X_m \\ &\cdots\cdots \\ Y_m &= \alpha_{m1}X_1 + \alpha_{m2}X_2 + \cdots + \alpha_{mm}X_m. \end{aligned} \tag{1}$$

Therefore, when the research object has many indicators and if the contribution rate of the first t principal components in the cumulative variance is greater than or equal to 85%, the newly generated t variables can be used to replace the original indicator variables. These new variables can fully absorb the information on the original indicators and greatly improve the accuracy and reliability of the evaluation results through mathematical modeling.

3.2. Theoretical Analysis of System Matching. The matching process is shaped by a combination of resource development and demographic changes in government services. The "coordination" matching examines the degree of variation between systems in the dynamic evolution of time series. The lower the degree of difference between the two systems, the higher the degree of mutual optimization and cooperation between the systems. "Comprehensive development level" examines the comprehensive advantage state of system combination. The detailed analysis of the above ideas is as follows:

Assuming the existence of two interrelated systems with development levels X and Y, their linear equations are as follows:

Table 1: Evaluation index system on matching between governmental affairs' service resources and population.

Target layer	System layer	Criterion layer	Index sign layer
Spatial matching between governmental affairs' service resources and population	Population system	Total population of the city	Total population, $p1$
			Total population in urban area, $p2$
			Total population in rural area, $p3$
		Population size in urban area	Population size in Jin'an district, $p4$
			Population size in Yu'an district, $p5$
			Population size in Yeji district, $p6$
		Population size in rural area	Population size in Shucheng County, $p7$
			Population size in Jinzhai County, $p8$
			Population size in Huoshan County, $p9$
			Population size in Huoqiu County, $p10$
	Governmental affairs' service resources	Governmental affairs' service-hardware resources	Number of service halls, $q1$
			Number of community service networks, $q2$
			Number of service networks at the county level, $q3$
			Number of service networks at the village level, $q4$
		Governmental affairs' service-human resources	Number of staff in the hall, $q5$
			Number of staff in community service networks, $q6$
			Number of staff in service networks at county level, $q7$
			Number of staff in village-level agents, $q8$
		Governmental affairs' service-network resources	Total number of service matters in the city, $q9$
			Number of service matters at the municipal-level Netcom, $q10$
			Number of service matters in Trans-provincial Netcom, $q11$
			Number of service matters in changjiang river delta Netcom, $q12$
			Coverage of Internet review, $q13$

Table 2: Population indicators of L city in 2017–2021 (unit: ten thousand people).

Year	$p1$	$p2$	$p3$	$p4$	$p5$	$p6$	$p7$	$p8$	$p9$	$p10$
2017	480	201	219.7	83.7	101	16.3	99.2	67.1	36.2	17.2
2018	483.7	222.9	260.8	85.3	91.4	23.4	77.2	53.6	32.9	119.8
2019	487.3	229.5	257.8	85.7	92.3	23.6	77.8	54.1	33.2	120.5
2020	439.4	213.3	226.3	82.9	92.3	21.6	69.7	49.6	28.6	94.5
2021	436.4	211.3	220.3	81.9	91.3	20.6	68.7	48.6	27.6	93.7

Table 3: The number of governmental affairs' service resource indicators of L city in 2017–2021.

Year	$q1$	$q2$	$q3$	$q4$	$q5$	$q6$	$q7$	$q8$	$q9$	$q10$	$q11$	$q12$	$q13$ (%)
2017	36	154	144	1776	832	545	861	2190	120000	0	0	0	30
2018	34	162	144	1769	932	570	933	2207	130000	0	0	0	43
2019	39	162	144	1777	1139	663	1074	2166	165500	30	0	51	78
2020	37	158	144	1775	1289	766	1084	2639	166800	30	0	51	60
2021	40	164	142	1779	1657	810	1112	2741	161308	281	52	51	71.81

$$\begin{aligned} C &= MX - NY, \\ I &= \theta X + \delta Y, \end{aligned} \tag{2}$$

where C is the deviation of X, Y and I is the comprehensive development level of X and Y, and M, N, θ, and δ are the model parameters. Further derivation leads to

$$X = \frac{C}{M} + \frac{N}{M}Y, \tag{3}$$

$$X = \frac{I}{\theta} - \frac{\delta}{\theta}Y. \tag{4}$$

From (3), we can see that, according to the definition of coordinated matching, the smaller the deviation of X and Y, the higher the degree of matching.

From (4), if the comprehensive development levels of X and Y are constant, then there is a complete substitution relationship between X and Y, which can form a linear systematic nondifference curve. If the general law of diminishing marginal rate of substitution of the nondifferentiable curve is followed, then the convex curve can be obtained. The key significance is that the outward shift to the right with the convex curve indicates an increasing level of comprehensive development level.

Table 4: Division of matching degree.

Matching degree D	[0, 0.2)	[0.2, 0.35)	[0.35, 0.5)	[0.5, 0.8)	[0.8, 1)
Evaluation	Low-grade matching	Little matching	Moderate matching	Good matching	High-grade matching

Table 5: Population indicators of L city in 2017–2021 (after standardization).

$Zp1$	$Zp2$	$Zp3$	$Zp4$	$Zp5$	$Zp6$	$Zp7$	$Zp8$	$Zp9$	$Zp10$
1	1	0.927	1	0.103	1	0.298	0.297	0.651	1
0.856	0	0	0.473	1	0	1	1	1	0
0.929	0.768	1	0.898	0.01	0.977	0.278	0.27	0.616	0.993
0.058	0.431	0.16	0.263	0.103	0.726	0.033	0.054	0.116	0.748
0	0.361	0.014	0	0	0.589	0	0	0	0.74

Table 6: Governmental affairs' service resource indicators of L city in 2017–2021 (after standardization).

$Zq1$	$Zq2$	$Zq3$	$Zq4$	$Zq5$	$Zq6$	$Zq7$	$Zq8$	$Zq9$	$Zq10$	$Zq11$	$Zq12$	$Zq13$
0.333	0	1	0.7	0	0	0	0.041	0	0	0	0	0
0	0.8	1	0	0.121	0.094	0.287	0.071	0.213	0	0	0	0.27
0.833	0.8	1	0.8	0.372	0.445	0.848	0	0.972	0.107	0	1	1
0.5	0.4	1	0.6	0.553	0.833	0.888	0.822	1	0.107	0	1	0.625
1	1	0	1	1	1	1	1	0.882	1	1	1	0.871

Applying the above theoretical resolution principles, the objective of this study is to determine and evaluate the "deviation" and "comprehensive development level" of the two systems of government service resources and population.

3.3. Matching Degree Calculation Model. The model is analyzed on the basis of [12–15]. In addition, the calculation formula of the coordination degree between the population and governmental affairs' service resource system [12, 16–18] is as follows:

$$D = (C * T)^{1/2}. \tag{5}$$

In this regard, the coordination degree can be derived from the deviation formula of the two systems, while the development index can be equated to the comprehensive development level of the two systems, where C refers to the coupling degree between the population and governmental affairs service resource system and T refers to the total development index of the population subsystem and the governmental affairs' service subsystem. Their calculation formulas are as follows:

$$C = \left\{ \frac{U_{\text{population}} * U_{\text{government}}}{\left[\left(U_{\text{population}} + U_{\text{government}}\right)/2\right]^2} \right\}^2$$
$$T = \partial_{\text{population}} U_{\text{population}} + \partial_{\text{government}} U_{\text{government}}, \tag{6}$$

where $\partial_{\text{population}}$ and $\partial_{\text{government}}$ are undetermined coefficients, and their values reflect the importance of the population and government service resources. Here, the population and government service resource system are equally important. These coefficients are set to $\partial_{\text{population}} = \partial_{\text{government}} = 1/2$ [19–21].

The matching degree between the population and governmental affairs' service system is calculated according to the matching calculation model. The comprehensive evaluation is carried out according to the division standard of the system matching degree in Table 4 and [22–24].

4. Empirical Analysis

4.1. Data Standardization Processing. Tables 2 and 3 demonstrated that the original data are in different units and different orders of magnitude to reflect the characteristics of a group of data from various perspectives. Therefore, the original data must be standardized [25]. The standard conversion is conducted for the original data by 0–1 standardization method in Tables 2 and 3. Tables 5 and 6 are presented as follows.

4.2. Principle Component Analysis. Using the statistical software IBM SPSS Statistics 23, standardized data ($Zp1$–$Zp10$, $Zq1$–$Zq13$) in Tables 5 and 6 are selected to make principle component analysis. Based on KMO and Bartlett sphericity test, where the KMO values are more than 90%, two principle components are extracted in the population system to explain 99.240% of the original variable information. Moreover, three principle components are extracted in the governmental affairs' service resource system to explain 93.756% of the original variable information. Thus, promising results are obtained. The component matrix of the population and governmental affairs' service resources must be constructed (see Table 7).

Table 7: Principle component score matrix of population and governmental affairs' service resources.

Population	Component		Governmental affairs' service resource	Component		
	1	2		1	2	3
$Zp1$	0.232	0.969	$Zq1$	0.884	0.086	0.323
$Zp2$	−0.801	0.574	$Zq2$	0.626	0.007	−0.721
$Zp3$	−0.551	0.827	$Zq3$	−0.789	0.605	0.059
$Zp4$	−0.164	0.982	$Zq4$	0.694	−0.052	0.667
$Zp5$	0.987	0.118	$Zq5$	0.980	−0.121	−0.062
$Zp6$	−0.941	0.330	$Zq6$	0.945	0.081	0.019
$Zp7$	0.904	0.427	$Zq7$	0.919	0.362	−0.126
$Zp8$	0.910	0.415	$Zq8$	0.791	−0.228	0.049
$Zp9$	0.638	0.769	$Zq9$	0.832	0.546	−0.030
$Zp10$	−0.976	0.214	$Zq10$	0.859	−0.504	−0.039
			$Zq11$	0.789	−0.605	−0.059
			$Zq12$	0.881	0.456	0.118
			$Zq13$	0.844	0.447	−0.154

4.3. Development Indicators of Population and Governmental Affairs' Service Resources Based on Principle Component Analysis. According to the obtained principle component score matrix, the data in the principle component load matrix are divided by the eigenvalue corresponding to the principle component. Then, by taking the square root, the coefficient corresponded by each indicator in two principle components is determined. In addition, the expressions of the two principal components of the population system are obtained:

$$U_{\text{population}}1 = \frac{(0.232Zp1 - 0.801Zp2 - 0.551Zp3 - 0.164Zp4 + 0.987Zp5 - 0.941Zp6 + 0.904Zp7 + 0.910Zp8 + 0.638Zp9 - 0.976Zp10)}{\sqrt{5.893}}, \tag{7}$$

$$U_{\text{population}}2 = \frac{(0.969Zp1 + 0.574Zp2 + 0.827Zp3 + 0.982Zp4 + 0.118Zp5 + 0.330Zp6 + 0.427Zp7 + 0.415Zp8 + 0.769Zp9 + 0.214Zp10)}{\sqrt{4.031}}. \tag{8}$$

In the same way, the expressions of three principal components of governmental affairs' service resource system are obtained:

$$U_{\text{government}}1 = \frac{(0.884Zq1 + 0.626Zq2 - 0.789Zq3 + 0.694Zq4 + 0.980Zq5 + 0.945Zq6 + 0.919Zq7 + 0.791Zq8 + 0.832Zq9 + 0.859Zq10 + 0.789Zq11 + 0.881Zq12 + 0.844Zq13)}{\sqrt{9.144}}, \tag{9}$$

$$U_{\text{government}}2 = \frac{0.086Zq1 + 0.007Zq2 + 0.605Zq3 - 0.052Zq4 - 0.121Zq5 + 0.081Zq6 + 0.362Zq7 - 0.228Zq8 + 0.546Zq9 - 0.504Zq10 - 0.605Zq11 + 0.456Zq12 + 0.447Zq13}{\sqrt{1.907}}, \tag{10}$$

$$U_{\text{government}}3 = \frac{(0.323Zq1 - 0.721Zq2 + 0.059Zq3 + 0.667Zq4 - 0.062Zq5 + 0.019Zq6 - 0.126Zq7 + 0.049Zq8 - 0.030Zq9 - 0.039Zq10 - 0.059Zq11 + 0.118Zq12 - 0.154Zq13)}{\sqrt{1.137}}. \tag{11}$$

Then, the variance proportion of eigenvalues corresponded by the two principal components of the population system and the three principal components of the governmental affairs' service resource system are taken as the weight coefficients. The comprehensive function of the principal components is calculated as follows:

$$U_{\text{population}} = 0.589U_{\text{population}}1 + 0.403U_{\text{population}}2, \tag{12}$$

$$U_{\text{government}} = 0.703 * U_{\text{government}}1 + 0.147U_{\text{government}}2 + 0.087U_{\text{government}}3. \tag{13}$$

Substituting the standardized data of the population system in Table 5 into Formulas (7), (8), and (13), the development level score of the population system from 2017 to

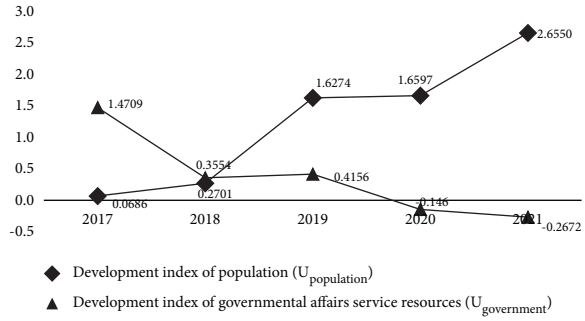

Figure 1: Development level of population and governmental affairs' service resources of L City in 2017–2020. ◆, development index of population ($U_{population}$); ▲, development index of governmental affairs service resources ($U_{government}$).

Table 8: Measurement of spatial matching between population and governmental affairs' service resources of L city.

Year	2017	2018	2019	2020	2021
Population development level, $U_{population}$	1.4709	0.3554	0.4156	−0.1460	−0.2672
Governmental affairs' service resource development level, $U_{government}$	0.0686	0.2701	1.6274	1.6597	2.6550
D	0.1495	0.5488	0.6517	0.3680	0.5437

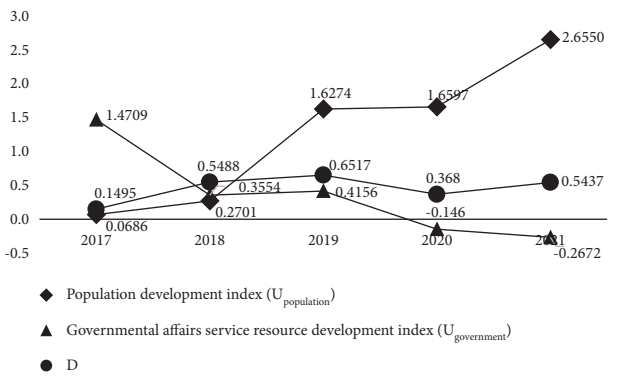

Figure 2: Development level of population and governmental affairs' service resources of L City in 2017–2020 and their matching degree D. ◆, population development index ($U_{population}$); ▲, governmental affairs' service resource development index ($U_{government}$). ● D.

2021 is obtained. Similarly, substituting the standardized data of governmental affairs' service resources in Table 6 into formulas (10)–(13), the development level score of governmental affairs service resources from 2017 to 2021 is obtained, as shown in Figure 1:

Figure 1 demonstrates that the total population of the city is in a downward trend from 2017 to 2021, with a sharp decline from 2019 to 2020. In addition, the development index from 2020 to 2021 is negative, which is at an extremely low level.

In terms of the development index of governmental affairs' service resources, the governmental affairs' service resources of *L* City is always in a upward trend from 2017 to 2021, with a sharp rise from 2018 to 2019, a stable rise from 2019 to 2020, and large rise from 2020 to 2021.

4.4. Measurement and Analysis on Coupling Degree between Governmental Affairs' Service Resources and Population System. In the previous section, the development level scores of the population system and the government service resource system in *L* City from 2017 to 2021 was determined. On this basis, the matching coefficient between population and governmental affairs' service resources in L City is calculated using the matching calculation model (Table 8). The population development index and governmental affairs' service development index and their matching degree D are shown in Figure 2.

4.4.1. Overall Evaluation of Data. The population data development index has been in a downward trend. With the increase of migrant workers from L City and the promotion of the Yangtze River Delta integration strategy, the population of L City will still be in a state in which more people go out for work. Moreover, the number of permanent residents is expected to have a declining trend. With the in-depth reform of Internet + governmental affairs' service, the development level of governmental affairs' services is in a steady rising state. It also reflects the achievements of the governmental affairs' service reform in the past five years. According to the division of system matching degree in Table 1, the overall average matching between the population and governmental affairs' service in L City is moderate, with the highest value of 0.6517 in 2019, thus reaching a good matching level.

4.4.2. Data Evolution Analysis. The population and governmental affairs' service resources in *L* City experienced a significant changing trend in 2017–2021. In addition, the population development level has increased continuously. Meanwhile, the matched governmental affairs' service resources have risen steadily, with a synchronous growth and coordinated change trend, thus reaching its best match in 2019. However, in 2019–2021, the increase of people going

out for work led to a sharp decline of permanent residents and a negative value of the population development index. In contrast, with the promotion of the Internet + governmental affairs' service and the implementation of the One Net, One Access, One Time reform plan, the development index of governmental affairs' service resources has experienced an upward trend. On the one hand, the population decreased sharply in 2019–2020. On the other hand, the governmental affairs' service level increased steadily. Hence, the matching degree experienced a downward trend in 2019–2020. However, in 2020–2021, the decrease in the population index slowed down, while the governmental affairs' service resources retained a steady rise. As a result, the matching degree rose again in 2021.

5. Conclusions and Recommendations

5.1. Conclusions. The matching level between governmental affairs' service resources and population is categorized as moderate coordinative matching. From the perspective of changing trends, which are affected by population fluctuations, the matching degree also fluctuates, thus indicating a close relationship between these two aspects.

The principle component analysis method used in this study not only evaluates the development level of the population system and the governmental affairs service resource system but also can effectively calculate and comprehensively evaluate the matching between population and governmental affairs' service resources by using the matching degree model. The evaluation model can also be applied to the provincial or national data on the population and governmental affairs' service resources. It provides a more scientific and effective research and evaluation means for the matching calculation and intelligent matching between governmental affairs' service resources and the population. Thus, the model is of far-reaching significance.

This study finds the matching degree and trend of government service resources and population allocation from a macroperspective and fails to do in-depth research on more refined and personalized matching due to the complexity and diversity of population data; we intend to conduct the corresponding study in our future work.

5.2. Suggestions. The matching between governmental affairs' service resources and population is moderate. Moreover, it still has great development potential. Hence, the government needs to promote the development of matching between governmental affairs' service resources and population further. The following suggestions are proposed in this study. First, the service resources based on spatial accessibility are more accurately allocated. On the basis of the total population, the population characteristics are analyzed, and the needs of the masses are more accurately judged. For example, the day of a governmental affairs' service is determined through the gathering places of the elderly or those with low education to provide door-to-door services. In the gathering places of middle-aged and young people or those with high education, intelligent means, such as the all-in-one machine for governmental affairs' services, are promoted; for instance, a specific policy is implemented in one district to provide services more accurately. Second, service in the grassroots units needs to be enhanced. Moreover, itinerant services must be provided in villages, and the construction of village-level agents must be strengthened. The standardization of village-level services must be perfected, and the last kilometer of governmental affairs' service must be covered in all aspects in detail. Third, the government must upgrade the One Netcom Office. On the basis of the One Netcom Office and the Anhui Governmental Affairs' Netcom Office in the early stage, more One Netcom matters are explored according to regional characteristics to provide the public with more convenient governmental affairs' services.

Data Availability

The data used to support the findings of the study are available at https://github.com/grcpeng/The-number-of-governmental-affair-service-resource-and-population-of-L-City-in-2017-2021.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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