

Surface Domain Spatial Autocorrelation Analysis of per Unit Area Yield of Grain

Hui Kong^{1, 2, 3, 4}

¹Shanxi Provincial Land Engineering Construction Group Co., Ltd, Xi'an 710075, China;

²Shaanxi Key Laboratory of Land Consolidation, Xi'an 710075, China;

³Institute of Land Engineering and Technology, Shaanxi Provincial Land Engineering Construction Group Co., Ltd., Xi'an 710075, China;

⁴Key Laboratory of Degraded and Unused Land Consolidation Engineering, the Ministry of Land and Resources, Xi'an 710075, China

E-mail: 283125485@qq.com

Abstract. This article embarks from the spatial analysis of geographic information system technology, the yield of grain yield data abstraction into planar data form in the GIS, by using geological data model to analyze the space of per unit area yield of grain production since the correlation. Spatial autocorrelation is mainly characterized by spatial autocorrelation coefficient, mainly divided into the global spatial autocorrelation and local spatial autocorrelation two categories, the use of global and local Morans' I analysis method and Morans scatter diagram to analyze the specific statistical standard per unit area yield of grain yield change trend of Shaanxi province.

1. Introduction

We often divides the data on the space expression of the point data, linear, planar and body shape data abstract model of the four types of space for the corresponding operation and analysis in general GIS(Geographic Information System) research [1]. Including how to point more data and application of the linear data and operation, for example to point pattern analysis, autocorrelation analysis, statistical analysis, theory of space statistics, visual analysis and so on many achievements, also relatively easy to operate, and the planar data based on the X, Y axis of a two-dimensional graphic data, relative to some data, the spatial analysis and the corresponding modeling, calculation is more complex [2], however is also important part of the planar data, Surface - based data is also widely used. In addition, the traditional classical statistical analysis technique can only analyze the numerical value of the data, and cannot reveal the change and development law of its geographical position. The emergence of geographic information technology has promoted the development and application of geographical analysis methods and ushered in a new era of geographical research.2 Data sources and research methods [3].

The spatial autocorrelation analysis method used in this paper refers to the analysis of the similarity between the value of the spatial variable and the value of the variable on the adjacent space unit. The purpose of spatial autocorrelation analysis is to determine whether a variable is spatially related and how relevant it is. Spatial autocorrelation coefficient is used to quantitatively describe the dependence of things on space. Specifically, the spatial autocorrelation coefficient is used to measure the spatial distribution of physical or ecological variables and their impact on the field. If the value of a variable becomes more similar with the reduction of the measured distance [4], the variable is spatially positive;



If the measured value is more different with the reduction of distance, it is called the negative correlation of space; If the measured value does not show any spatial dependence, then this variable shows spatial uncorrelation or spatial randomness [5].

This paper, which based on the data of actual yield of grain in shaanxi province of 100 counties of shaanxi province as the study area, is the study of the planar data, and on this basis, using the spatial [6] autocorrelation analysis method, from the viewpoints of both global and local actual yield of shaanxi province grain space structure forms are analyzed. Spatial autocorrelation analysis of standard grain yield to analyze the actual yield[7][8], the feasibility of different areas in shaanxi province to ascertain agricultural food production and the characteristics of the spatial distribution of can to a certain extent, reflects the research area of agricultural science and technology level and agricultural science and technology use potential. At the same time, it not only makes analysis on numerical value, but also makes statistics on data from space and time, and makes a judgment on its current potential and future development trend[9][10].

2. Research methods and data source preprocessing

The spatial autocorrelation analysis is generally divided into three steps: 1) sampling, 2) calculating space self-correlation coefficient or establishing autocorrelation function, and 3) self-correlation significance [11] test. There are various spatial autocorrelation coefficients, which are suitable for different data types. Spatial autocorrelation analysis is widely used in the field of geographic statistics. There are many indexes available [12], but the main two indexes are Moran's I coefficient and Geary 'C' coefficient. In addition, the correlation degree of spatial data has been analyzed since the normalized value Z and generalized G values. The spatial autocorrelation coefficient also varies with the observation scale (or analysis scale). Therefore, when conducting spatial autocorrelation analysis [13][14], it is better to calculate the autocorrelation coefficient on a series of different scales to reveal the change of the self-correlation degree of the studied variables with the spatial scale. The graph is called autocorrelation graph with the self-correlation coefficient as the ordinate and the distance between the sample points as the horizontal coordinates [15] [16]. The autocorrelation graph can be used to analyze the spatial structure characteristics of the landscape, to determine the size of the patch and the scale of the pattern. This article mainly Moran, I value and standardize Z and Moran scatter plot both reveal the corresponding degree of spatial relations and related data, this paper USES ArcGIS10.2 software in the global and local Moran, I operated tools for data processing, spatial autocorrelation and visualization is based on 2010 in shaanxi province farmland productivity calculation for the data[17].

In 2010 in shaanxi province farmland productivity calculation table data in excel format, map file is based on MapGIS format, this paper discussed the spatial autocorrelation and spatial analysis function of visualization is ArcGIS10.2 and its autocorrelation analysis functions Geoda software for technical support, therefore, need to transform the original data for the following processing:

(1) The raw data in the excel spreadsheet not ended area, center and baqiao merged into xi, wang yi, stamp pad merged into tongchuan city, excel spreadsheets into DBF format, with actual grain yield (kg/m^2) to analyze the data.

(2) Use the file conversion function in MapGIS to convert the original image into shape format file. Due to the default units are mm in the MapGIS, ArcGIS the default units are meters, so in the process of transformation, first of all have to be projection transformation in MapGIS, coordinate projection system is changeless, by gauss Lv Ge projection, Beijing 54 coordinate system, scale the denominator is divided by 1000.

(3) Replace the DBF file in the corresponding shape format file in step 2 with the DBF file in step 1. Note that the attribute data in DBF is consistent with the field location in the figure.

(4) Conduct spatial autocorrelation analysis and visualization.

3. Example operation and result analysis

This example using ArcGIS10.2 statistical analysis module of 100 counties in shaanxi province of per unit area yield of grain is abstract planar data calculation, using global Morans' I coefficient to judge the different domain correlation of data on the space distribution, thus draws the different geographic

unit area yield of grain and regional correlation. A variety of weight matrix is suitable for Morans' I, based on centroid distance from here to get binary adjacency matrix and distance of the center of gravity of the weight matrix calculation Morans' I to actual standard food output statistics.

Table 1. According to the calculation results of binary adjacency matrix

Standard grain yield per unit	Moran'I	E	V	Z
The actual yield	0.195250	-0.0101	0.000132	17.858136

E is the value of expectation; V is the variance; Z is the value of Significance statistics.

Table 2. According to the result of center distance weighting

Standard grain yield per unit	Moran'I	E	V	Z
The actual yield	0.368000	-0.0101	0.000560	15.979312

E is the value of expectation; V is the variance; Z is the value of Significance statistics.

To actual standard grain yield to the result of the global spatial autocorrelation analysis through the table 1 and table 2 show that using two kinds of weighting matrix to calculate the standard grain yield Morans' I have a value greater than 0, and less than 1, within the scope of the permit, and are all greater than expected to the value of E, suggests that the standard grain yield in the global has certain positive space since the correlation. However, it is impossible to determine whether the spatial autocorrelation is significant. This would require the use of significant test statistic Z, can be seen through the table 1 and table 2, two kinds of weighting matrix to calculate the standard food statistics Z values are positive, and are far greater than the critical value of $\alpha = 0.05$ significance level of 1.96, suggesting that actual standard grain yield in the global scope of shaanxi province since there were significantly positive space correlation.

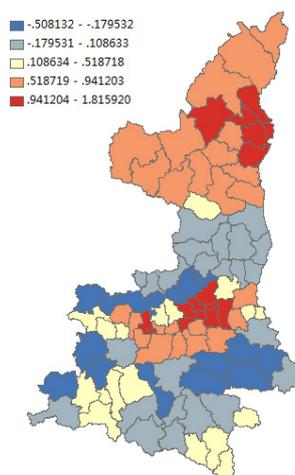


Figure 1. The actual yield moran 's I coefficient

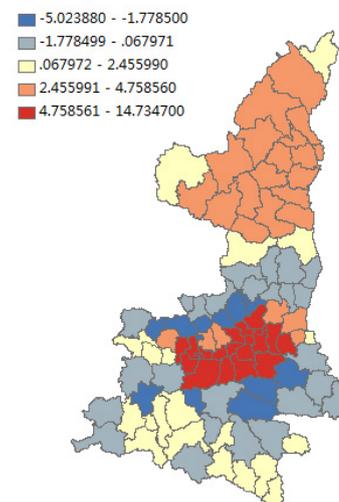


Figure 2. The actual yield standardization Z value distribution

Can be seen from table 1 and figure 2, the actual standard grain yield in northern shaanxi, the guanzhong, shaanxi province in the three regions presents two kinds of space structure, in northern shaanxi area and part of the guanzhong and parts are present in varying degrees of positive spatial autocorrelation. The guanzhong area of baishui county, tongchuan city, yao obviously, linyou county, chunhua county, the regionalization, qianyang county, in southern shaanxi of yongshou, YongShou and luonan, fengxian county, shangluo city, taibai county, ZhaShui county, dam, NingShan county, foping

county, the county, shiquan, hanyin these areas such as part with dark blue and gray area in the picture, said their local Morans' value is negative, I present a certain degree of negative spatial autocorrelation.

In terms of guanzhong area, except for the above areas (shown in the dark blue region), other regions show a certain degree of positive spatial autocorrelation. The red region shows high positive spatial autocorrelation, and the actual yield of standard grain is very high in these regions, with high similarity. The positive space of the orange region is slightly weaker than that of the red region, showing a strong positive spatial autocorrelation level, and the light yellow region is weaker than the red and blue regions.

Most of northern shaanxi area all showed a strong positive spatial autocorrelation, this standard grain yield in these areas are not too high, and has strong similarity, adjacent area around the strong "sex". Southern shaanxi in addition to the above diagram of dark blue and grey areas, other areas are showed positive spatial autocorrelation, but they are spatial autocorrelation high level clearly didn't and the guanzhong region of shaanxi, with pale yellow in the picture and part of the "gray areas, namely the standard grain yield in these areas is not high and the weaker trend.

Standardize the Z values to explain them. The standardized z-value of the actual single yield of standard grain in shaanxi province can be seen from table 2 and figure 1. When a significant test is performed by standardizing the z-value, there is a need to have a limit, that is, a standardized Z value that exceeds this threshold to indicate that the result is significant. The threshold value of the standardized Z value here is the threshold value of the significant level (-1.96, 1.96), which is greater than 1.96 or less than -1.96, and the results can be interpreted as significant.

The normalized Z values in the red region in FIG. 1 are obviously higher than the critical value of 1.96 at the significant level of the above, and therefore, the correlation between these regions is significant. The normalized Z values of the silver gray area in the figure are all less than the critical value at the significant level of the above 0.05 level, and the correlation of these regions is also significant.

4. Conclusions

Based on the above two local spatial autocorrelation analysis methods, the local autocorrelation characteristics of standard grain yield in shaanxi province are well explained.

Local Moran's I indicated local spatial autocorrelation through Moran's I value, and the significance of local spatial autocorrelation was explained by the significance statistic Z value. Based on the comparison and analysis of the above two local spatial autocorrelation methods, the results show that the results of local spatial autocorrelation analysis are correct.

1) Standard in shaanxi province was the global spatial autocorrelation analysis of actual standard grain yield adopted global Moran's I method, the result showed that shaanxi province this standard grain yield in the global show significantly positive spatial autocorrelation.

2) Local spatial autocorrelation analysis indicates the local spatial autocorrelation of the actual yield of standard grain in shaanxi province, which is exactly where the high and low values are gathered. Local Moran's I statistics and Moran scatter plots are used in local autocorrelation analysis. Local Moran's I statistics by Moran's I Z value shows that the value and significance of statistics from local space correlation and its significance, and the exact points out that in most parts of northern shaanxi, parts of the guanzhong and shuhe parts showed positive spatial autocorrelation and significant, and global spatial autocorrelation level trends are basically identical. The results show that it has the same trend as the global spatial autocorrelation analysis.

3) In shaanxi province, the global spatial autocorrelation analysis of actual standard grain yield and local autocorrelation analysis results show that the high standard of grain yield per unit of low concentration of consistent on the whole, compared with the aggregation degree of field production, based on the overall trend consistent. To some extent, this paper provides theoretical basis for the feasibility of the model of actual production of grain in Shaanxi province.

5. Acknowledgement

Thanks for study on the Fundamental Research Funds for the Central University of Changan University (300102278502).

6. References

- [1] Wu lun, zhang jing, zhao wei. Geographic information system [J]. Technical term research, 1999, 2: 34-36.
- [2] Tang guoan, Chen zhengjiang, et al. Method of spatial analysis of ArcView geographic information system [M]. Science press, 2002.
- [3] The principle and method of geographic information system [M]. Surveying and mapping press, 1996.
- [4] Zhou chenghu, sun zhanli et al. Research on cellular automata [M]. Science press, 1999.
- [5] Huang xingyuan, ma jinsong. Introduction to geographic information system [M]. Higher education publishing house, 2008.
- [6] Wu xincai. Geographic information system of MAPGIS [M]. Electronic industry press, 2004.
- [7] Tang guoan, Yang xin. Experimental course of spatial analysis of ArcGIS geographic information system [M]. Science press, 2006.
- [8] Huang, zhong. The simplification and unification of the definition of dot line surface map symbols [J]. Surveying and mapping science, 2005, 30 (6): 69-70.
- [9] Chen jianjun, zhou chenghu, cheng wei-ming. Analysis on the area error of surface element vector rasterification in GIS [J]. Journal of surveying and mapping, 2007, 36 (3): 344-350.
- [10] Johnston R J, Johnston R j. Classification in Geography[M]. Geo Abstracts Limited, 1976.
- [11] Li ying, hu yinghan, li kun, et al. Evaluation of cultivated Land intensive utilization based on agricultural Land classification and other achievements [J]. China Land Science, 2011, 25(8):61-68.
- [12] Wang yuanfei, he honglin. Spatial data analysis method [M]. Science press, 2007.
- [13] Ren ruoen, wang huiwen. An example of the theoretical method of multivariate statistical analysis [M]. National defense industry press, 1997.
- [14] Zhang songlin, zhang kun. Comparative study of global spatial autocorrelation Moran index and G coefficient [J]. Journal of sun yat-sen university: natural science edition, 2007, 46 (4):93-97.
- [15] Ge ying, yao shimou, pu yingxia, et al. Use spatial autocorrelation analysis to gather the geographical pattern of economic types [J]. Human geography, 2005, 20 (3): 21-25.
- [16] Chen yanguang. Development and method improvement of spatial autocorrelation theory based on Moran statistics [J]. Geographical research, 2009, 28 (6): 1449-1463.
- [17] Hu qingfeng, zhang ziping, he rong, et al. Study on spatial statistical analysis of economic growth rate in Geoda095i region [J]. Mapping and spatial geographic information, 2007, 30 (2): 53-55.