

Simulation analysis of peak period income estimation model in tourism scenic of minority Areas

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Abstract: in the process of peak period income estimation in the tourism scenic of minority areas, the estimation results obtained by traditional estimation methods are affected by the mutability of tourist amount, existing local optimal problem, causing bigger error. Therefore, this paper proposes a method of establishing model to estimate the peak period income in tourism scenic of minority areas based on the largest Lyapunov exponent spectrum, and for the first time, this program is applied to the regional tourism revenue estimation field. By using phase space reconstruction method reconstruct the economic growth index time series, and the traditional Lyapunov exponent spectrum algorithm is improved. Computing period is shorten by setting the pre-estimator, to reduce the amount of calculation, and at the same time the method has the ability of calculating each Lyapunov exponent. Taking the requested maximum Lyapunov exponent as the basis of Wolf one step estimation method make accurate structural estimation model. The simulation results show, the improved model has the higher estimation accuracy compared with other models for peak period income estimation in tourist attractions of minority areas, can rapidly and accurately estimate the peak period income in tourist scenic areas of minority areas, which has important application value.

1 Introduction

The efficient development of tourist attractions in minority areas has important significance for China's overall economic progress [1, 2]. The scientific estimation and planning of the peak period income in scenic area of minority areas can ensure the scientific economic development of the tourist area in minority areas [3-5]. Usually, according to the peak period income data in tourist scenic of minority areas the development potential of the scenic spot can be estimated [6,7]. the peak period income in tourism scenic of minority areas is randomness and complexity, its development has a strong correlation with economy, weather, climate and other factors, it has a nonlinear relationship between these factors, making the related data reflected peak period income in tourism scenic spots of minority areas with certain nonlinear [8-9].

2 the principle of peak period income estimation method in tourism scenic of minority area based on the maximum Lyapunov exponent algorithm

2.1 description of Lyapunov exponent

In order to carry out the nonlinear estimation of peak period income in tourist scenic of minority area, reach to the purpose of peak period income growth estimation, it needs effective description of the original chaotic attractor. At this time, to define and describe some effective characteristics quantity of peak period income is necessary. The commons are the Lyapunov exponent, correlation dimension and K entropy. In the chaotic motion, it has the so-called "Butterfly Effect" argument, that although the two development trajectories are even similar initial conditions, in the process of motion development, with time progress, it shows exponentially separation. The Lyapunov exponent is the expression and characterization of the properties. Therefore, in practice, it can be obtained the time series of Lyapunov exponent, to realize the peak period income in tourism scenic of minority areas.

2.2 an improved Lyapunov exponent algorithm

The peak period income in tourism scenic of minority areas is made estimation of time

series $\{x_i\}_{i=1}^N$, and phase space reconstruction, to get the trajectory matrix of phase space reconstruction vector:

$$L = \begin{bmatrix} \mathbf{x}_1^T \\ \mathbf{x}_2^T \\ \vdots \\ \mathbf{x}_N^T \end{bmatrix} = \begin{bmatrix} x_1 & x_{1+\tau} & \cdots & x_{1+(m-1)\tau} \\ x_2 & x_{2+\tau} & \cdots & x_{2+(m-1)\tau} \\ \vdots & \vdots & \ddots & \vdots \\ x_{N-1} & x_{N-1+\tau} & \cdots & x_{N-1+(m-1)\tau} \end{bmatrix} \quad (1)$$

In the above formula, the dimension m , time delay τ , are embedded, and the singular value of L is made decomposition to get $L = U * S * C$. U and C are orthogonal matrix, and

$$C = (c_1, c_2, \dots, c_n) \quad (2)$$

In the formula, S is the singular value of L , and

$$S = \text{diag}(\sigma_1, \sigma_2, \dots, \sigma_n), \sigma_1 \geq \sigma_2 \geq \dots \geq \sigma_n \geq 0 \quad (3)$$

By using the phase space reconstruction trajectory matrix L and the best embedding dimension m obtain the subspace matrix X of which the dimension is $N \times m$:

$$X = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_N \end{bmatrix} = \begin{bmatrix} a_1^T c_1 & a_1^T c_2 & \cdots & a_1^T c_m \\ a_2^T c_1 & a_2^T c_2 & \cdots & a_2^T c_m \\ \vdots & \vdots & \ddots & \vdots \\ a_N^T c_1 & a_N^T c_2 & \cdots & a_N^T c_m \end{bmatrix} \quad (4)$$

$J_x^{(N)}$ can be obtained through $J_{x_i}^{(N)}$. Setting a predictor calculate $J_x^{(1)}$, and it is:

$$\delta x_{i+1} \approx J_{x_i}^{(1)} \delta x_i \quad (5)$$

in formula $\delta x_i = x_j - x_i$, x_j is a vector next to x_i , and $x_j \in \mathbb{R}^m$, $j \in 1, 2, \dots, N$, and $\delta x_{i+1} = x_{j+1} - x_{i+1}$, it can be obtained δx_i and δx_{i+1} . Through the income predictor in peak period in the tourist attraction of minority calculate $J_{x_i}^{(1)}$. The distance of two points in the phase space is defined as:

$$\|x_j - x_i\| \leq \varepsilon \quad (6)$$

In formula, (ε is the positive number and minimum enough), so as to determine that x_j is N_b , and calculate $\{\delta x_i(j_k) = x_{jk} - x_i | k \in 1, 2, \dots, N_b\}$, it can be generated N_b m -dimensional vector quantity, so as to compose a neighborhood matrix:

$$B_{x_i} = (\delta x_i(j_1), \delta x_i(j_2), \dots, \delta x_i(j_{N_b}))^T \quad (7)$$

Calculating the vector $\{\delta x_{i+1}(j_k) = x_{jk+1} - x_{i+1} | k \in 1, \dots, N_b\}$, it can be obtained another neighborhood matrix

$$B_{x_i}^{(1)} = (\delta x_{i+1}(j_1), \delta x_{i+1}(j_2), \dots, \delta x_{i+1}(j_{N_b}))^T \quad (8)$$

ε is minimum enough, that:

$$B_{x_i}^{(1)} = B_{x_i} (J_{x_i}^{(1)})^T \quad (9)$$

Setting $B_{x_i}^\dagger$ is the generalized inverse matrix of B_{x_i} , it can be obtained:

$$(J_{x_i}^{(1)})^T = B_{x_i}^\dagger B_{x_i}^{(1)} \quad (10)$$

Supposing $B_{x_i}^\dagger = (B_{x_i}^T B_{x_i})^{-1} B_{x_i}^T$, that:

$$J_{x_i}^{(1)} = \left((B_{x_i}^T B_{x_i})^{-1} B_{x_i}^T B_{x_i}^{(1)} \right)^T \quad (11)$$

After getting $J_{x_i}^{(1)}$, QR decomposition is made to obtain the spectrum of Lyapunov exponents. For an arbitrary orthogonal matrix, taking the column vector is as the base of tangent space of x_0 . In order to obtain the Lyapunov exponent spectrum, the column of $J_{x_0}^{(1)} Q_0$ is made orthogonal:

$$Q_1 R_0 = J_{x_0}^{(1)} Q_0 \quad (12)$$

The row of Q_1 is orthogonal basis of x_1 , R_0 is upper triangular matrix with positive diagonal

element. Making the process to circulate can be obtained:

$$\begin{aligned} Q_2 R_1 &= J_{x_1}^{(1)} Q_1 \\ Q_N R_{N-1} &= J_{x_{N-1}}^{(1)} Q_{N-1} \end{aligned} \quad (13)$$

that:

$$J_{x_0}^{(N)} Q_0 = Q_N R^N = Q_N R_{N-1} R_{N-2} \cdots R_1 R_0 \quad (14)$$

Making all Q_0 :

$$\lambda_i = \lim_{N \rightarrow \infty} \frac{1}{N} \sum_{j=0}^{N-1} \log(R_j)_{ii} \quad (15)$$

In formula (15), $(R_j)_{ii}$ is the first i -th diagonal element of R_j . The obtained λ_i is each Lyapunov exponent of time series. Of course, taking the maximum Lyapunov exponent is the largest Lyapunov exponent. The algorithm can shorten computing period through the predictor set, and reduce the amount of calculation, but also improve the accuracy of the computation. At the same time, the method has the ability to calculate each exponent of Lyapunov.

2.3 implementation of peak period income estimation in tourism scenic of minority area

For the income development track of two peak periods with different initial conditions, the process of income estimation shows exponential separation with the time progress, Lyapunov exponent is the an important characteristic quantity to represent this nature. Therefore, in the time series of peak period income estimation in tourism scenic of minority areas, through obtaining the maximum Lyapunov exponent of time series, the peak period income can be estimated. After obtaining the maximum Lyapunov exponent, the method for nonlinear chaotic time series estimation based on maximum Lyapunov exponent proposed by Wolf is applied to estimate the peak period income in tourism scenic of minority area. In the phase space, X_m is the central point, the nearest point is X_k , the distance between two points is Euclidean distance:

$$d_m(0) = \|X_m - X_k\| \quad (16)$$

Through further development X_m and X_k are evolved into X_{m+1} and X_{k+1} . The maximum Lyapunov exponent represents the classification exponent of two vector growth change, the formula is:

$$\|X_{m+1} - X_{k+1}\| = \|X_m - X_k\| e^{\lambda_i} \quad (17)$$

In the formula, the last component $x(t_{n+1})$ of X_{m+1} is unknown, and it is the only unknown. The calculation expression is:

$$\begin{aligned} X_{m+1}(m) &= X_{k+1}(m) \\ &\pm \sqrt{(d_m(0)e^{\lambda_i})^2 - \sum_{i=1}^{m-1} [X_{m+1}(i) - X_{k+1}(i)]^2} \end{aligned} \quad (18)$$

So as to get the time series estimation value of peak period income estimation in tourist scenic of minority areas is:

$$x(t_{n+1})' = X_{m+1}(m) \quad (19)$$

Because in this method, the next time point prediction is through the phase space trajectory with on step, it is called one step prediction method based on maximum Lyapunov exponential value.

3 Experiment results and analysis

In order to verify the validity of the proposed estimation model for peak period income in tourism scenic of minority areas, it shall carry out the relevant experiments. In this paper, the experimental sample data is a peak time income data in tourism scenic of minority area from 2010 to 2014. This paper completes the related experiment using the Matlab 7 Simulation software.

Table 1 the estimated results by using the model in this model

Years	Estimate million	income/ 100	Actual income/100 million	error/%
2010	1.28		1.31	-2.3
2011	1.34		1.37	-2.2
2012	1.58		1.56	1.3
2013	2.24		2.26	0.9
2014	3.13		3.11	0.6

The experimental data are collected and analyzed, which can get the following figure:

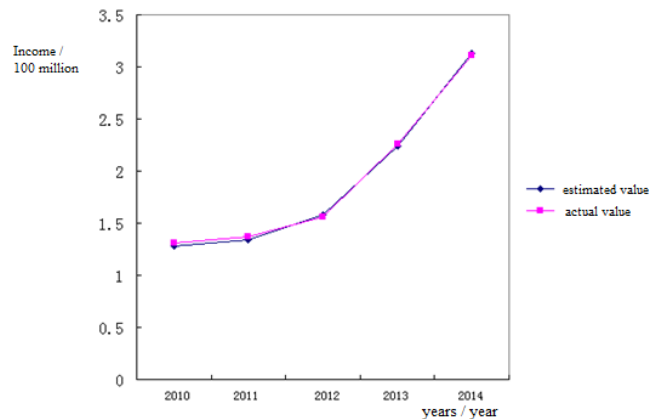


Figure 1 comparison results of the actual value to estimate values in this model

The results analysis of Table 1 and Figure 1 show that, the fitting effect of tourism scenic income growth estimation in this minority area in recent five years is better. The estimated income value by using the proposed model have a high consistency with the actual value of the scenic area. This method for peak period income estimation in tourism scenic can achieve satisfactory estimation accuracy, which indicates the design model in this paper is feasible.

In order to further verify the superiority of the model are adopted, time series model, ant colony search model and the model proposed in this paper are used respectively to estimate the peak period income in tourist attractions of minority areas, the detailed result is illustrated in figure 2.

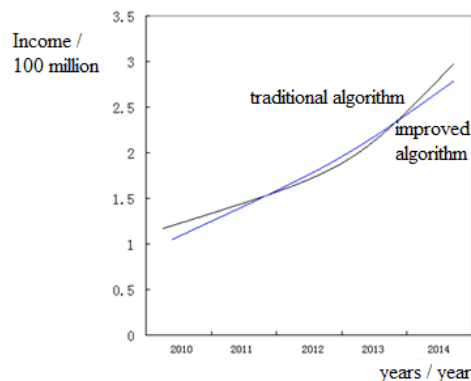


Figure 2 the estimate effect of different models

Making comprehensive analysis of above available results, it can be seen that the estimation effect in this model is better than time series model and ant colony algorithm model. the value of the model in this paper for peak period income estimation in tourism of minority areas are very closed to the actual value, fully explaining the model for peak period income estimation in tourism scenic of minority areas presented in this paper has high performance, and it is a kind of effective revenue estimation model.

4 Conclusion

For the local optimal problem of using traditional estimation methods to obtain the estimation

results is easy to be affected by the mutability of tourist amount in the process of peak period income estimation in the tourism scenic of minority areas. This paper proposes a method of establishing model to estimate the peak period income in tourism scenic of minority areas based on the largest Lyapunov exponent spectrum, and for the first time, this program is applied to the regional tourism revenue estimation field. By using phase space reconstruction method reconstruct the economic growth index time series, and the traditional Lyapunov exponent spectrum algorithm is improved. Computing period is shortened by setting the pre-estimator, to reduce the amount of calculation, and at the same time the method has the ability of calculating each Lyapunov exponent. Taking the requested maximum Lyapunov exponent as the basis of Wolf one step estimation method make accurate structural estimation model. The simulation results show, the improved model has the higher estimation accuracy compared with other models for peak period income estimation in tourist attractions of minority areas, can rapidly and accurately estimate the peak period income in tourist scenic areas of minority areas, which has important application value.

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