Research on the Layout and Leakage of Tourism Industry in Urban Fringe Based on HMM Model

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Abstract: Based on the development characteristics and economic leakage of tourism industry in urban marginal areas, combined with many influencing factors and constraints in the tourism industry chain, HMM mathematical statistical methods are used to construct a model of tourism economic leakage minimum optimization algorithm in urban marginal areas, and obtain a water injection algorithm to reduce tourism economic leakage, which helps the rational layout and dynamic extension of the tourism industry chain.

Keywords: Urban fringe, Economic leakage, HMM model, Water injection principle

1 Introduction

Tourism leakage refers to the loss of foreign exchange caused by the need to purchase foreign goods, labor services or loans in tourist destinations. It also refers to the phenomenon that tourism income flows out of the tourism area economy in the process of flow and diffusion, Research on tourism leakage mainly focuses on the leakage caused by the ownership characteristics of travel agents/operators and imports, and their impact on economic sustainability[1][2], the explanation and strategy analysis of tourism leakage [3], and tends to believe that the tourism development model dominated by foreign enterprises is prone to tourism leakage and community conflicts [4]. Tourism investment in urban fringe areas has increased year by year, and gradually formed a tourism industry chain [5]. This paper selects the urban marginal area of Xi'an as the research area to study the leakage problem in tourism development, and proposes a water injection principle model to minimize tourism leakage, aiming to promote the rational layout and dynamic extension of the tourism industry chain in the urban marginal area.

2 Research method

In this study, a mixed tourism leakage model was established based on the Bayesian method of related variables by applying the HMM model. With the help of the characteristics of tourism industry development in the marginal area of Xi'an, the influencing factors of tourism economic leakage and the correlation between economic leakage among various industries were analyzed.

3 Feature analysis and model establishment

3.1 Tourism characteristics and economic leakage in urban fringe Areas

Urban marginal areas have the dual connotations of urban coordination and district and county coordination, and the development of tourism shows unique development characteristics [6]. (1) "Enclave" tourism development. The tourism area shows the unique pattern of key development and group management. Tourist areas are generally separated from the local community, presenting "economic islands" and "cultural islands". With the expansion of foreign tourism development capital and tourism management team, the leakage of local tourism revenue is gradually increasing. (2) "Blooming everywhere" tourism development. Local counties, districts or townships adopt the joint operation mode of districts, counties and townships to develop tourism industries such as ecological agriculture and folk customs, but most of them are mainly based on agricultural tourism and farmhouses, the tourism industry system is not strong, the industrial chain is short, and the tourism leakage is serious. This paper selects some districts and counties in the marginal area of Xi'an as a sample, and there are many tourism projects. Its spatial distribution is shown in Figure 1.
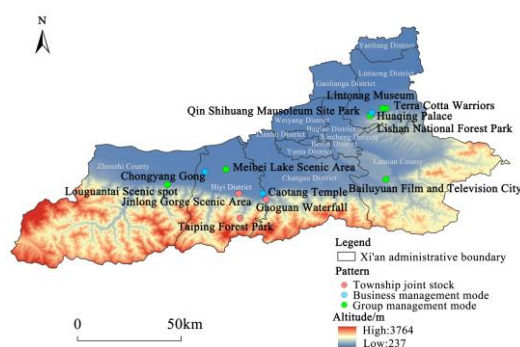

Fig. 1. Layout of tourism industry in Xi 'an urban fringe.

Most tourist areas are group management mode, followed by enterprise management mode, and finally the township joint-stock mode. Collectivization and undertaking belong to the higher authorities' direct participation in the operation and distribution, which is the main link to form the leakage of tourism income. In terms of tourism leakage impact effect. Through the study of the ownership of tourist facilities and the source of tourists in the two regions. The impact is shown in Table 1.

Table 1. Analysis of tourism leakage effect in urban fringe areas

District	Ownership of tourism facilities	Opportunities for tourists to interact with local residents	Links with the local economy	Employment	Cultural effect	Ecological effect	Tax effect
Lin tong	few	few	Weak	Low	Great	Great	Great
Zhouzhi	few	few	Weak	Low	Great	Great	Great

Lantian	few	few	Weak	High	Great	Great	Great
Huyi	many	many	Strong	Low	Little	Little	Little

3.2 Establishment of statistical model of tourism leakage

Invisible Markov Process (HMM) is a sequence. For a certain period of time, the sequence of the state of various tourism industries is $S = (s_1, s, \ldots, s_T)$, this sequence comes from the probability distribution density function $p(s_t|s_{t-1}, \ldots, s_1) = p(s_t|s_{t-1})$, $X = (x_1, x, \ldots, x_T)$ is the economic benefit of the tourism industry chain. Due to the influence of various complex factors, the distribution function of each factor in the tourism industry chain is $p(x_t|\theta_{s_t})$, where θ_{s_t} is the parameter set. The initial value of the sequence is $p(s_1)$. For HMM, the transition of each state in each tourism industry chain is discrete and multi-distributed, and each state can be reached after several steps. In order to minimize the leakage of tourism economy, assuming that the expected leak age cost is d, and the income of each link in each tourism industry chain is $(x_1, x_2, \ldots, x_T)$, among which the weights corresponding to the income are respectively $(w_1, w_2, \ldots, w_T)$, the optimal expression of leakage is

$$(P) \begin{cases} min \sum_{i=1}^{T} w_i x_i \\ s.t b_{ij} x_j = c_i & j = 1,2 \ldots, T \\ x_j \geq 0 & j = 1,2 \ldots, T \end{cases} \tag{1}$$

(1) It is the minimum optimization problem of tourism leakage, in which each tourism industry chain must be configured according to the local actual situation, and how to configure it specifically must be based on the optimal weight. Based on this consideration, in order to get the local industrial chain, the parameters of the transfer process of the industrial chain can be described as follows: A $D \times D$ is the transition matrix from state i to state j, Where the element is a_{ij} ;B $D \times M$ indicates the update from state i to observation j, Where the element is b_{ij}; π D is the probability mode function for the initial state.

Set the observed data as X and the potential data as S, then the posterior probability distribution function of the transfer index of the industrial state chain is formula (2):

$$p(\alpha_{ij}|V_{ij}, c, d) = Gamma\left(c + 1, d - ln(1 - V_{ij})\right) \tag{2}$$

Based on the above discussion, in order to establish the correlation between economic leakage and industrial economic chain, we use hierarchical Dirichlet process HMM to describe the correlation. In order to minimize the leakage, it is necessary to maximize the industrial benefits. When the observed values are given, the post-test distribution likelihood function of each random parameter related to the industrial chain should be maximized, that is

$$\underset{\theta}{argmax} p(A, B, \pi, \{S\}_1^N, \alpha, \alpha_\pi | X) \tag{3}$$

In the formula (3), $\{S\}_1^N$ indicates the state sequence of N industrial chain transfers. According to *Bayesian* statistical inference principle, the conditions of each state parameter of the industrial chain can be obtained. The corresponding economic leakage expression of each industrial chain is:

$$\sum_{i=1}^{N} \lambda_i = t \tag{4}$$

The formula (4) λ_i indicates the economic leakage corresponding to each industry. In order to

verify the estimation performance of this model to the economic leakage problem, this paper compares the nonlinear HMM model with the least square method which is widely used at present. The obtained simulation diagram is shown in Figure 2. As can be seen from Figure 2, given the real curve of economic leakage, it is obvious that the estimation performance of HMM model is obviously higher than that of the least square method. Based on the above process, when the sum of tourism industry's revenue and corresponding leakage in all industrial chains in expression (1) is a constant value, this paper adopts the optimization theory to obtain the optimization model of water injection algorithm to describe the optimal value of tourism economy leakage.
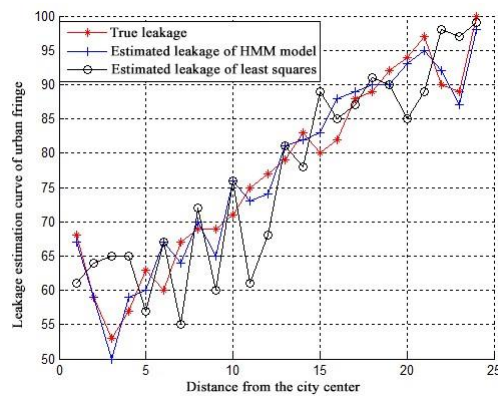

Fig. 2. Economic leakage estimation curve

3.3 Simulation analysis of tourism economic leakage

In order to study the optimal estimation of tourism economic leakage, based on the release probability of HMM, this simulation uses water injection algorithm to study the local tourism leakage. The research shows that the development of tourism economy leads to the uneven development of various industries in the economic chain of tourism industry, and the layout of various industrial structures in the industrial chain also presents a Poisson random process change. As shown in Figure 3.
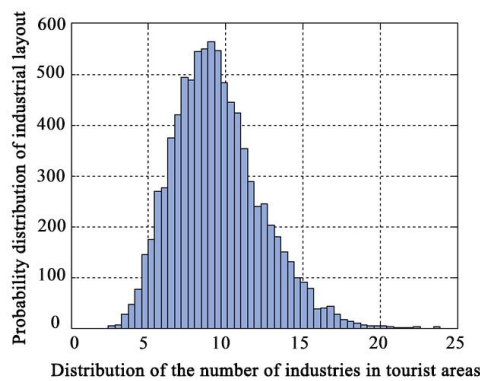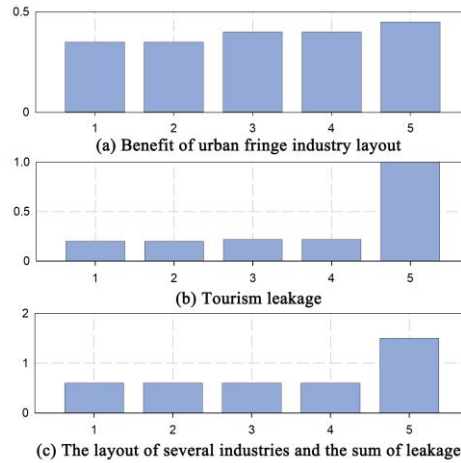

Fig. 3. The tourism industry sector change pattern in the tourism economic chain

Based on this statistical law, when $\sum_{i=1}^{N} \lambda_i = t$, the Lagrange optimization theory was adopted, and the following simulation curve with minimum economic leakage was obtained.

(a) Benefit of urban fringe industry layout

(b) Tourism leakage

(c) The layout of several industries and the sum of leakage

Fig. 4 Water injection optimization model minimizing economic leakage

In the tourism industry chain, because each industry obeys the statistical law of Poisson distribution, the economic benefits of each industry in the industry chain are different in different degrees, as shown in Figure 4a. In Figure 4, (a) represents the corresponding economic benefits of each industrial chain; (b) indicates the corresponding economic leakage value of the industry, and (c) indicates that the economic leakage value is injected into the uneven economic benefits formed by all industrial chains, resulting in two situations: (1) If the economic leakage in the industrial chain is too great, it is necessary to withdraw from the industrial chain; (2) If the industries in the industrial chain are complementary and uneven in development, all the economic leakage is injected into the chain of the industrial structure, and a highly consistent superposition value of industrial economy and leakage is obtained (Figure 4c). As can be seen from Figure 4, for industries with large economic leakage in the industrial chain, it is necessary to cooperate with the local government to carry out industrial transformation, technological innovation, absorb local labor force and extend the upstream and downstream of the industrial chain to reduce economic leakage. For the industries with small economic leakage and large profits, while the agglomeration effect plays its role, it is necessary to construct the peripheral industrial system, and combine the benefits of tourism industry in marginal areas with social benefits to improve the living standard of local residents.

4 Conclusion

The economic value of urban fringe tourism system is mainly reflected in the pulling effect of the extension of tourism industry chain on the economic development level of fringe tourism destinations. In the principle of water injection, the relationship between tourism industry chain and economic leakage in this fringe area is shown as follows: when the extension of tourism industry chain improves the market value of tourism products and increases the flow and velocity of tourism flow in the fringe area, it will integrate and absorb the tourism industry

cluster, thus having a significant economic pulling effect on the fringe area tourism system. Based on the detection of economic benefits, the leakage of tourism economy is injected into the industrial chain in real time. With the help of the extension of tourism industry chain, the integration ability of tourism-related peripheral industries can be improved, and the industrial chain can be rationally optimized to get the minimum economic leakage. At the same time, the quality of life of community residents in marginal tourist areas can be improved.

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