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Research on the Efficiency Measurement of Tourism Industry in Western Regions: Taking Sichuan Province as an Example

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Abstract: Based on the Data Envelopment Analysis (DEA) method, this paper takes Sichuan Province, which is rich in tourism resources, as an example to evaluate the efficiency of the tourism industry. Using the total number of tourists and the total revenue of tourists as output indicators, an evaluation system is constructed using three input indicators: tertiary industry employees, star rated hotels, and 3A level or above scenic spots, to measure the efficiency of the tourism industry in each region. The research results indicate that the tourism industry efficiency of Chengdu, Panzhihua, Luzhou, Suining, Neijiang, Leshan, Meishan, Yibin, and Ganzi prefectures in Sichuan Province is effective, while the other 12 cities (prefectures) are in an ineffective state; Seven cities (prefectures), including Zigong City, Guang'an City, Dazhou City, Bazhong City, Ziyang City, Aba Prefecture, and Liangshan Prefecture, have reached a state of increasing returns to scale; The level of modern information application technology and management system in Dazhou City and Liangshan Prefecture is relatively low; Zigong City and Aba Prefecture have experienced investment redundancy. Based on the research results, this paper analyzes the possible reasons for the inefficiency of tourism industry in Sichuan Province, and provides a reference for improving the efficiency of tourism industry in Sichuan Province.

Background: The tourism industry is an emerging industry that promotes the prosperity and development of modern society and economy, and is an effective means of achieving comprehensive, coordinated and sustainable development1. Sichuan has a variety of regional customs, unique natural and cultural landscapes, and rich tourism resources. It is planned as an inland open economic highland in the "the Belt and Road" initiative, which provides very favorable conditions for its tourism development 2. However, due to differences in socio-economic conditions, policy conditions, location conditions, resource endowments, and infrastructure among different cities (prefectures), there are problems of polarized development and low efficiency in some cities (prefectures) 3. How to seize historical opportunities and transform the development path, provide policy guidance to improve the efficiency of resource allocation in the tourism industry of Sichuan Province, and achieve high-quality development of its tourism industry is a problem worth studying 4.

The efficiency of the tourism industry is an important indicator to measure the quality of tourism economic development. The strong spatial mobility of tourism elements between regions results in significant spatial correlation effects in the efficiency of the tourism industry 5. Improving the efficiency of the tourism industry is conducive to optimizing the allocation of regional tourism resource elements and promoting high-quality development of regional tourism. Overall, relevant scholars have achieved certain results in evaluating the efficiency of the tourism industry, but research on the efficiency of cultural tourism resources in the western region has received little attention, such as the efficiency of the cultural tourism industry in Sichuan Province 6-14. In terms of research methods, scholars tend to analyze from a static perspective and overlook dynamic changes. In order to explore the reasons for regional differences and continuously promote the development of tourism throughout Sichuan Province, DEA method is used to analyze the efficiency of the tourism industry in 21 cities (prefectures) in Sichuan Province, promoting the transformation and upgrading of the tourism industry in each city (prefectures).

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Materials and Methods: The research object of this paper is mainly 21 cities (prefectures) in Sichuan province, as shown in Figure 1, they are Chengdu, Deyang, Mianyang, Yibin, Nanchong, Dazhou, Luzhou, Leshan, Neijiang, Zigong, Panzhihua, Guangyuan, Suining, Meishan, Guang'an, Ya'an, Bazhong, Ziyang, Aba Prefecture, Liangshan Prefecture, and Ganzi Prefecture.

(1) Building the indicator system. Based on the concept of tourism industry efficiency, combined with the particularity of the tourism industry, and based on the input and output of the tourism industry, an indicator system is constructed. The tourism industry covers a wide range of areas, so there are many internal and external factors that affect the efficiency of the tourism industry, such as policies and laws, economic changes, application of technology, management models of enterprises, and fixed asset investment of enterprises. DEA data envelopment analysis requires that the number of decisions be greater than twice the number of outputs and inputs. This article focuses on two output indicators: total tourism revenue and total number of tourists received; Among the six investment indicators of tourist attractions, star rated hotels, travel agencies, and accommodation and catering industry, the total population, number of beds, and grade roads, the method of selecting the best from the best was adopted. Finally, three investment indicators were selected: 3A level tourist attractions, star rated hotels, and tertiary industry employees. Based on this, construct a tourism industry efficiency measurement index system for 21 cities (prefectures) in Sichuan Province.

(2) DEA Data Envelopment Analysis DEA is a very effective method for evaluating the efficiency of decision units with multiple inputs and outputs. The basic idea is to treat each evaluation unit as a decision-making unit (DMU), and by comparing the weighted inputs and outputs of different decision-making units at the same time, form a DEA frontier. Then, by measuring the degree to which each decision-making unit deviates from the DEA frontier, the relative effectiveness of the decision-making unit is evaluated, and the direction and degree of improvement for each decision-making unit are determined. This article will use an output oriented DEA model and use DEAP2.1 software to analyze the efficiency of the tourism industry in 21 cities (prefectures) in Sichuan Province, and calculate the specific results.

Results: The research results of this article indicate that among 21 different cities in Sichuan Province, Chengdu, Panzhihua, Luzhou, Suining, Neijiang, Leshan, Meishan, Yibin, and Ganzi have achieved effective tourism industry efficiency. The tourism industry efficiency in Zigong City, Deyang City, Mianyang City, Guangyuan City, Nanchong City, Guang'an City, Ya'an City, Dazhou City, Bazhong City, Ziyang City, Aba Prefecture, and Liangshan Prefecture is invalid. Among them, Zigong, Guang'an, Dazhou, Bazhong, Ziyang, Aba Prefecture, Liangshan Prefecture seven cities (Prefectures) reached the state of increasing returns to scale, it shows that the comprehensive efficiency of tourism management can be improved by enlarging the scale of tourism Deyang, Mianyang, Guangyuan, Nanchong and Ya'an show diminishing returns to scale, suggesting that expanding the tourism industry at its current scale will increase resource redundancy, reduce the overall efficiency, the phenomenon of diseconomies of scale. The results also show that the overall efficiency and pure technical efficiency of Dazhou and Liangshan Prefecture are lower than the pass line (0.6) .From the perspective of input redundancy and output insufficiency, the tertiary industry employees and star rated hotels have a large redundancy rate, of which Zigong City and Aba Prefecture have problems of input redundancy and output insufficiency.

Conclusion: the efficiency of the tourism industry in various cities (prefectures) in the southwestern region of Sichuan Province is significantly higher than that in the northeastern region, showing an overall effective state of tourism industry efficiency. This also indicates that there are significant spatial differences in the efficiency of the tourism industry in Sichuan Province. Therefore, Sichuan Province should pay attention to improving the efficiency of the tourism industry, strengthen the top-level design of tourism industry transformation and upgrading, enhance the output rate of tourism resource elements, and play a structural optimization effect, Expand the space for improving the efficiency of the tourism industry and achieve the transformation of tourism development from quantity to quality; Fully leverage the radiative driving role of Chengdu, Leshan, Ganzi Prefecture and other regions, improve the integration ability of cross regional tourism elements, strengthen the advantages of tourism market clusters and the positive externalities of spatial flow, drive the overall coordinated development of the tourism industry, and bridge the spatial imbalance of regional tourism industry efficiency development, promoting high-quality development of the tourism industry. Some of the conclusions obtained in this study echo the findings of existing literature, namely that the spatial distribution pattern of tourism industry efficiency

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exhibits significant spatial dependence and regional imbalance characteristics.
Key Word: Sichuan Province; Tourism industry efficiency; Returns to scale

I. Introduction

The tourism industry is an emerging industry that promotes the prosperity and development of modern society and economy, and is an effective means of achieving comprehensive, coordinated and sustainable development[1]. Sichuan has a variety of regional customs, unique natural and cultural landscapes, and rich tourism resources. It is planned as an inland open economic highland in the "the Belt and Road" initiative, which provides very favorable conditions for its tourism development[2]. However, due to differences in socio-economic conditions, policy conditions, location conditions, resource endowments, and infrastructure among different cities (Prefectures), there are problems of polarized development and low efficiency in some cities (Prefectures)[3]. How to seize historical opportunities and transform the development path, provide policy guidance to improve the efficiency of resource allocation in the tourism industry of Sichuan Province, and achieve high-quality development of its tourism industry is a problem worth studying[4].

The efficiency of the tourism industry is an important indicator to measure the quality of tourism economic development. The strong spatial mobility of tourism elements between regions results in significant spatial correlation effects in the efficiency of the tourism industry[5]. Improving the efficiency of the tourism industry is conducive to optimizing the allocation of regional tourism resource elements and promoting high-quality development of regional tourism. Overall, relevant scholars have achieved certain results in evaluating the efficiency of the tourism industry, but research on the efficiency of cultural tourism resources in the western region has received little attention, such as the efficiency of the cultural tourism industry in Sichuan Province[6,7,8,9,10,11,12,13,14]. In order to explore the reasons for regional differences and continuously promote the development of tourism throughout Sichuan Province, DEA method is used to analyze the efficiency of the tourism industry in 21 cities (Prefectures) in Sichuan Province, promoting the transformation and upgrading of the tourism industry in each city (Prefecture).

II. Material And Methods

2.1Study Area Overview

The research object of this paper is mainly 21 cities (prefectures) in Sichuan province, as shown in Figure 1, they are Chengdu, Deyang, Mianyang, Yibin, Nanchong, Dazhou, Luzhou, Leshan, Neijiang, Zigong, Panzhihua, Guangyuan, Suining, Meishan, Guang'an, Ya'an, Bazhong, Ziyang, Aba prefecture, Ganzi prefecture and Liangshan prefecture.

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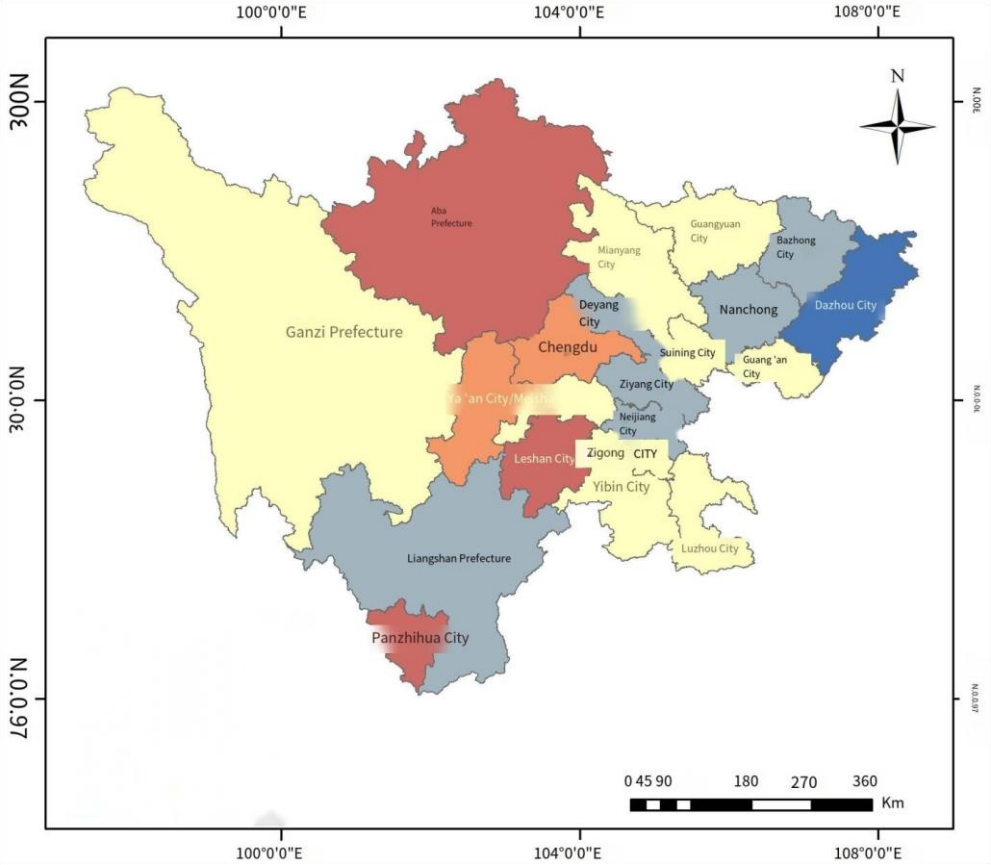
Figure 1: Spatial distribution pattern of tourism industry in Sichuan Province



2.2Data Sources and Survey

Based on literature review and data availability, this study selected 3A-class scenic spots, star-rated hotels and tertiary sector of the economy professionals as the input indicators for this study, two variables, the number of tourist visitors and the total income of tourist visitors, are selected as the output indicators of this study. A total of 105 observations, all indicators are based on official data published by the Sichuan Tourism Yearbook 2019, the Sichuan Statistical Yearbook 2019, the Sichuan Provincial Department of Culture and Tourism, and the municipal (prefectures) tourism bureaus. The data provided by tourism-related departments mainly include:2019 Sichuan 21 cities (prefectures)3A-level tourist attractions data..

2.3Data Analysis and Processing

(1) Building the indicator system: Based on the concept of tourism industry efficiency, combined with the particularity of the tourism industry, and based on the input and output of the tourism industry, an indicator system is constructed. The tourism industry covers a wide range of areas, so there are many internal and external factors that affect the efficiency of the tourism industry, such as policies and laws, economic changes, application of technology, management models of enterprises, and fixed asset investment of enterprises. DEA data envelopment analysis requires that the number of decisions be greater than twice the number of outputs and inputs. This article focuses on two output indicators: total tourism revenue and total number of tourists received; Among the six investment indicators of tourist attractions, star rated hotels, travel agencies, and accommodation and catering industry, the total population, number of beds, and grade roads, the method of selecting the best from the best was adopted. Finally, three investment indicators were selected: 3A level tourist attractions, star rated hotels, and tertiary industry employees. Based on this, construct a tourism industry efficiency measurement index system for 21 cities (prefectures) in Sichuan Province.

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(2) DEA Data Envelopment Analysis: DEA is a very effective method for evaluating the efficiency of decision units with multiple inputs and outputs. The basic idea is to treat each evaluation unit as a decision-making unit (DMU), and by comparing the weighted inputs and outputs of different decision-making units at the same time, form a DEA frontier. Then, by measuring the degree to which each decision-making unit deviates from the DEA frontier, the relative effectiveness of the decision-making unit is evaluated, and the direction and degree of improvement for each decision-making unit are determined. This article will use an output oriented DEA model and use DEAP2.1 software to analyze the efficiency of the tourism industry in 21 cities (prefectures) in Sichuan Province, and calculate the specific results.

III. Result

3.1Analysis of Tourism Efficiency in Each City(prefecture)

In order to analyze the tourism industry efficiency of 21 cities in Sichuan province, this paper adopts the output-oriented DEA model and uses DEAP2.1 software to calculate the concrete results as shown in Table 1. From this, we can see that there are 9 cities (prefectures) out of 21 cities (prefectures) in Sichuan province, that is, Chengdu, Panzhihua, Luzhou, Suining, Neijiang, Leshan, Meishan, Yibin and Ganzi prefecture have achieved efficiency in the tourism industry. The efficiency of the tourism industry in the other 12 cities (prefectures) is ineffective. Seven cities (prefectures), including Zigong, Guang'an, Dazhou, Bazhong, Ziyang, Aba Prefecture, and Liangshan Prefecture, have reached a state of increasing returns to scale, which means that as the scale of the tourism industry increases, its benefits are also continuously improving. The other five cities (prefectures) have experienced a decline in returns to scale. In addition, based on the geographical distribution of cities in Table 1, it can be found that if Sichuan Province is divided into the northeast region and the southwest region by taking Ganzi Prefecture, Chengdu, and Ziyang as the dividing lines, the cities with effective tourism industry efficiency are mainly concentrated in the southwest region of Sichuan Province.

Table 1: The efficiency of tourism industry in 21 cities (prefectures) of Sichuan Province.

City(prefecture)	crste	vrste	scale		City(prefecture)	crste	vrste	scale	
Chengdu	1.000	1.000	1.000	-	Meishan	1.000	1.000	1.000	-
Zigong	0.900	0.961	0.936	irs	Yibin	1.000	1.000	1.000	-
Panzhihua	1.000	1.000	1.000	-	Guangan	0.887	0.945	0.938	irs
Luzhou	1.000	1.000	1.000	-	Dazhou	0.569	0.613	0.927	irs
Deyang	0.803	0.805	0.998	drs	Ya’an	0.900	0.966	0.931	drs
Mianyang	0.706	0.773	0.913	drs	Bazhong	0.653	0.765	0.855	irs
Guangyuan	0.831	0.866	0.959	drs	Ziyang	0.808	1.000	0.808	irs
Suining	1.000	1.000	1.000	-	Aba	0.850	0.905	0.939	irs
Neijiang	1.000	1.000	1.000	-	Ganzi	1.000	1.000	1.000	-

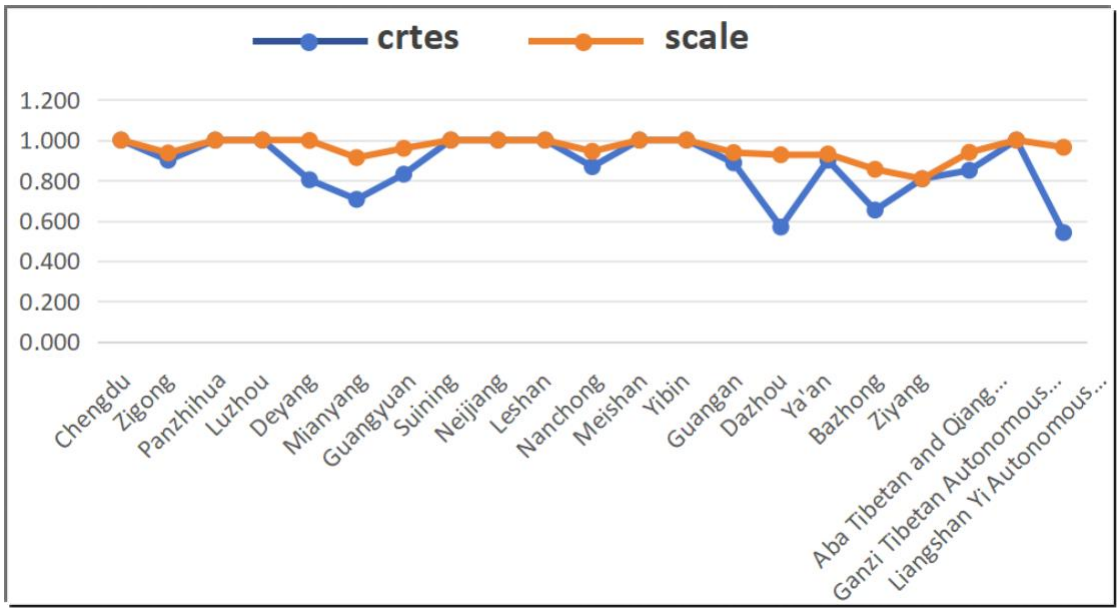
Leshan	1.000	1.000	1.000	-	Liangshan	0.541	0.561	0.964	irs
Nanchong	0.868	0.920	0.944	drs					

Note: crste represents comprehensive efficiency, also known as technical efficiency; vrste represents pure technical efficiency; scale represents scale efficiency; drs represents diminishing returns to scale;- Indicates that the return on scale remains unchanged; irs stands for increasing returns to scale.

3.1.1 Comprehensive efficiency analysis

Comprehensive efficiency, also known as technical efficiency, refers to the ratio between the output utility of the tourism industry and the input of production resources when obtaining the maximum tourism output. The closer the technical efficiency is to 1, the higher the validity of DEA, which means that all inputs have reached the expected output effect to the maximum extent, and the investment and allocation of tourism elements are more reasonable, with less wasted resources. Even if the technical efficiency is equal to 1, it does not mean that all tourism industry resource inputs are not wasted, because overall efficiency is a relative concept. Low technological efficiency indicates that the tourism resources, services, and products invested by the city (prefecture) have not yet been fully converted into tourism economic benefits, and are in a state of excessive investment or unreasonable conversion.

Figure 2: Comprehensive efficiency and scale efficiency of tourism industry in 21 cities(prefectures) of Sichuan Province



As can be seen from Figure 2, the comprehensive technical efficiency of Chengdu, Panzhihua, Luzhou, Suining, Neijiang, Leshan, Meishan, Yibin and Ganzi prefecture is 1 and the scale benefit is unchanged, the overall efficiency of other cities (prefectures) did not reach 1. This shows that the investment of tourism resources in nine cities has achieved a high level of output, and the efficiency of resource utilization has reached an ideal state.

In addition, cities (prefectures) such as Zigong, Deyang, Guangyuan, Nanchong, Guang'an, Ya'an, Ziyang, and Aba prefecture have relatively low tourism input and output, which makes their tourism industry more efficient. The comprehensive tourism efficiency of Mianyang and Bazhong cities is higher than the passing line (0.6) and at a moderate level. Mianyang city is rich in tourism resources, but its attractiveness is relatively poor. Due to its relatively developed transportation, the tourism economy has great potential; Bazhong city

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is relatively rich in tourism resources and has obvious tourism characteristics. However, its tourism development is affected by economic, social, ecological and other environmental factors, and its geographical location and transportation conditions are poor, resulting in insufficient industrial competitiveness and a moderate level of comprehensive tourism efficiency. Dazhou city and Liangshan prefecture have the lowest comprehensive efficiency, lower than the passing line. The non optimal limitations of tourism resources in Dazhou city and the low economic benefits of tourism have led to a low overall efficiency of the tourism industry; Liangshan prefecture has abundant tourism resources and is the largest Yi ethnic settlement in China, with unique cultural landscapes. However, the low efficiency of human capital in tourism, as well as the low foreign exchange income and number of inbound tourists, result in a lower overall efficiency of the tourism industry.

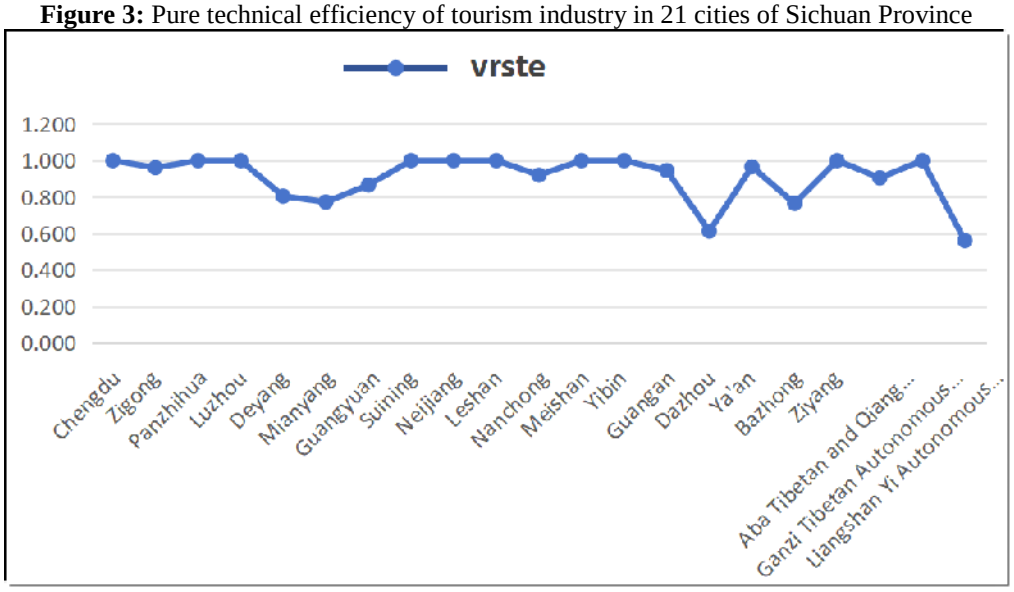
3.1.2 Analysis of Scale Efficiency

Scale efficiency refers to the effective degree of production scale, which reflects the input of tourism resource factors and the satisfaction of regional demand for tourism resources. As can be seen from Table 2, the trend of overall tourism efficiency and scale efficiency of 21 cities (prefectures) in Sichuan is basically the same. If the technical efficiency is divided into high efficiency, medium efficiency and low efficiency, the value space and the value space of the overall efficiency are basically the same. Only Mianyang, Dazhou, and Liangshan prefecture have relatively high technical efficiency compared to overall efficiency. The technical efficiency of Liangshan prefecture has reached 0.96, indicating that the current investment in tourism resources in Liangshan prefecture basically meets the demand for tourism resources. Because comprehensive efficiency equals pure technical efficiency X scale efficiency, it indicates that the factors that affect the comprehensive efficiency of tourism in Liangshan prefecture are more concentrated in the application of technology and management system.

3.1.3 Analysis of Scale Efficiency

Pure technical efficiency reflects the technical and operational management level of the tourism industry economic activities in each city (prefecture). On the one hand, it is related to the tourism resource endowment and economic development status of the city itself, and on the other hand, it is related to the management level, service level, and product development level of the city's tourism industry.

Figure 3: Pure technical efficiency of tourism industry in 21 cities of Sichuan Province



As shown in Figure 3, the pure technical efficiency of tourism industry in 21 cities (prefectures) of Sichuan is higher than 0.6 except Liangshan prefecture. As high as 11 cities (prefectures) of pure technical efficiency close to 1, which shows that in 2019 the full use of modern information technology, high level of management. However, the pure technical efficiency of Dazhou

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and Liangshan prefecture is less than 0.6, according to the 2019 annual report on tourism development of cities and states in Sichuan Province, liangshan prefecture tourism market management confusion, lack of regulation, lack of effective supply, lack of innovation in its management system; However, Dazhou suffers from lagging tourism infrastructure, insufficient institutional innovation and imperfect management system.

3.2 Input-Output Redundancy Analysis

Input redundancy refers to the number of units that invest more in tourism industry resources; Output redundancy refers to the number of units invested in a certain factor that are less than the expected tourism output. After calculation with DEAP2.1 software, it was finally discovered that two cities (prefectures) in Sichuan Province have experienced investment redundancy. The specific data is shown in Table 2. Analyzing the redundancy of resource input factors in the tourism industry has more practical significance in adjusting the tourism input factors of each city (prefecture), improving the utilization rate of resources, and transforming resource input factors into the tourism economy. From Table 2, it can be seen that there are relatively few cities (prefectures) in Sichuan Province with input-output redundancy, less than one tenth. The main investment redundancy is concentrated in the two elements of the tertiary industry employees and the number of star rated hotels. The number of 3A level scenic spots in various cities (prefectures) of the province has not experienced redundancy.

Table 2: Pure technical efficiency of tourism industry in 21 cities of Sichuan Province

	output indicators		input indicators					
	Tourism revenue	Total number of tourists received	Employees in the tertiary industry		Number of 3A level scenic spots		Number of 3A level scenic spots	
			Original	Redundancy	Original	Redundancy	Original	Redundancy
Zigong	440	0.47	58.91	-0.45				
Aba	227	0.31					16	-1.19

There are 589100 employees in the tertiary industry in Zigong city, with a redundant workforce of 4500. The phenomenon of redundant investment in the tertiary industry in Zigong is related to its unique industrial structure. Zigong is the capital of well salt in China and also a famous hometown of folk lantern art. Tourism development has both salt culture and lantern culture characteristics. Among them, there are more than 700 lantern enterprises with numerous direct employees, but their scale is generally small. Moreover, lantern culture has not been fully integrated with local cultural resources, so the scale effect should be focused on adjusting the structure of employees, appropriately reducing the number of tourism enterprises, fully exploring the tourism connotation of folk art, actively developing the tourism industry, and continuously increasing tourism income. There are 16 star-rated hotels in Aba prefecture, and there are 1.16 redundant investment. Therefore, the future development should adjust the allocation of investment and consider reducing the number of star-rated hotels appropriately, increase the occupancy rate of star-rated hotels.

IV. Conclusion and Discussion

The research results of this article indicate that among 21 different cities in Sichuan Province, Chengdu, Panzhihua, Luzhou, Suining, Neijiang, Leshan, Meishan, Yibin, and Ganzi have achieved effective tourism industry efficiency. The tourism

industry efficiency in Zigong, Deyang, Mianyang, Guangyuan, Nanchong, Guang'an, Ya'an , Dazhou, Bazhong, Ziyang, Aba prefecture, and Liangshan prefecture is invalid. Among them, Zigong, Guang'an, Dazhou, Bazhong, Ziyang, Aba State, Liangshan prefecture seven cities (prefectures) reached the state of increasing returns to scale, it shows that the comprehensive efficiency of tourism management can be improved by enlarging the scale of tourism Deyang, Mianyang, Guangyuan, Nanchong and Ya'an show diminishing returns to scale, suggesting that expanding the tourism industry at its current scale will increase resource redundancy, reduce the overall efficiency, the phenomenon of diseconomies of scale. The results show that the efficiency of the tourism industry in various cities (prefectures) in the southwestern region of Sichuan Province is significantly higher than that in the northeastern region, showing an overall effective state of tourism industry efficiency. This also indicates that there are significant spatial differences in the efficiency of the tourism industry in Sichuan Province. Therefore, Sichuan Province should pay attention to improving the efficiency of the tourism industry, strengthen the top-level design of tourism industry transformation and upgrading, enhance the output rate of tourism resource elements, and play a structural optimization effect, Expand the space for improving the efficiency of the tourism industry and achieve the transformation of tourism development from quantity to quality; Fully leverage the radiative driving role of Chengdu, Leshan, Ganzi prefecture and other regions, improve the integration ability of cross regional tourism elements, strengthen the advantages of tourism market clusters and the positive externalities of spatial flow, drive the overall coordinated development of the tourism industry, and bridge the spatial imbalance of regional tourism industry efficiency development, promoting high-quality development of the tourism industry. Some of the conclusions obtained in this study echo the findings of existing literature, namely that the spatial distribution pattern of tourism industry efficiency exhibits significant spatial dependence and regional imbalance characteristics[5,15,16,17,18,19,20].

The results also show that the overall efficiency and pure technical efficiency of Dazhou and Liangshan prefecture are lower than the pass line (0.6) . Among them, Dazhou is located in the Qinba Mountains. Its natural tourism resources are mainly mountain and water landscapes, similar to those of Nanchong, Bazhong, Guang'an and Guangyuan in eastern Sichuan, but the lack of representative tourism brands, tourism resources present non-superior constraints, the overall competitiveness is not strong. Moreover, as a heavy industrial city, the local government in Dazhou lacks sufficient attention to the development of the tourism industry, and the economic contribution rate of the tourism industry is relatively small, lower than the average level in Sichuan. Therefore, its comprehensive efficiency and pure technical efficiency are relatively low; Liangshan prefecture has a large number of tourism resources and is a region with relatively rich tourism resources. However, there are problems with the unreasonable development of the tourism industry structure, low economic development level, and poor social security situation in the local area. Therefore, the comprehensive efficiency and pure technical efficiency of its tourism industry are relatively poor.

From the perspective of input redundancy and output insufficiency, the tertiary industry employees and star rated hotels have a large redundancy rate, of which Zigong and Aba prefecture have problems of input redundancy and output insufficiency. Therefore, we should adjust the structure of employees, increase the proportion of professional employees, appropriately reduce the number of travel agencies and star rated hotels, and appropriately reduce the fixed assets investment of tourism enterprises.

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