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# Research on Tourism Competitiveness of the Chengdu-Deyang-Meishan-Ziyang Metropolitan Area Based on SPSS Analysis

Jiao Feng[1], Han Wu[2]
[1]*Undergraduate of Yangtze Normal University, Address: No. 16, Juxian Avenue, Fuling District, Chongqing, China.*
[2]*Undergraduate of Yangtze Normal University, Address: No. 16, Juxian Avenue, Fuling District, Chongqing, China.*

***Abstract:*** *This study assesses tourism competitiveness in the Chengdu-Deyang-Meishan-Ziyang Metropolitan Area using SPSS and Principal Component Analysis (PCA). A 19-indicator system evaluates market, resource, development, scale, and environmental competitiveness. Seven principal components (cumulative contribution: 87.36%) highlight tourism service capacity, competitive potential, and resource endowment as key drivers. Clustering ranks 14 regions, revealing Mianzhu, Pengzhou, Chongzhou, and Dujiangyan as leaders due to superior location and infrastructure, while Zhongjiang and Renshou lag due to economic and market limitations. Tourism service capacity (25.99% contribution) is pivotal, with room occupancy and tourist reception as critical factors. Lower-ranked regions should optimize structures and leverage unique resources for growth. This study offers strategic insights for regional tourism development and methodological frameworks for urban agglomerations.*

***Keywords:*** *Tourism Competitiveness; Principal Component Analysis (PCA); SPSS; Regional Development.*

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## I. INTRODUCTION

With the deepening of economic globalization and regional integration, tourism has emerged as a vital force driving local economic development. Meanwhile, research on tourism competitiveness, grounded in competitiveness theory, has become a new academic frontier [1][2]. As a novel urban development model, urban agglomerations have garnered significant attention. Studies on their internal tourism competitiveness hold profound implications for advancing regional economic integration and enhancing overall tourism attractiveness. The 20th National Congress of the Communist Party of China, a significant political event in China, emphasized that "high-quality development is the primary task in building a modern socialist country in all respects" and called for "adhering to the theme of promoting high-quality development." As a strategic pillar industry for national economic development, tourism plays a pivotal role in optimizing economic structures. The deepening development of holistic tourism, the accelerated arrival of the mass tourism era, and the notable improvement in levels of common prosperity have further amplified tourism's positive impact on rural revitalization[3]. The Chengdu-Dezhou-Meishan-Ziyang Metropolitan Circle (CDMZMC), a key urban agglomeration in Sichuan Province, plays a strategic role in enhancing regional tourism competitiveness to foster sustainable development of its tourism industry.

This study employs SPSS software and builds upon domestic and international research to conduct a quantitative analysis of tourism competitiveness within the CDMZMC using Principal Component Analysis (PCA), a multi-indicator comprehensive evaluation method widely used in tourism competitiveness studies . By constructing a tourism competitiveness evaluation index system and integrating empirical data, this research ranks the competitiveness of sub-regions. The findings aim to provide theoretical references and technical support for formulating development strategies tailored to local conditions across counties and districts within the CDMZMC.

## II. MODEL CONSTRUCTION

### 2.1 Construction of the Tourism Competitiveness Evaluation Index System.

Regional tourism competitiveness is determined by the comprehensive level of social, political, economic, cultural, educational, and environmental factors within a region, as well as their interaction with the tourism industry. It depends not only on the management capabilities and operational strengths of tourism enterprises but also on the competitiveness of social, political, economic, cultural, educational, and environmental aspects[4].

Following the principles of reliability, accessibility, representativeness, and quantifiability, this study evaluates tourism competitiveness based on five major categories of factors. The constructed tourism competitiveness evaluation index system is presented in Table 1.

***Table 1Tourism Competitiveness Evaluation Index System.***

| Factor | Indicator |
|---|---|
| Market Competitiveness (P1) | Room occupancy rate (X1) |
| | Number of tourists received (X2) |
| | Per capita daily expenditure of tourists (X3) |
| | Number of star-rated hotels (X4) |
| | Number of travel agencies (X5) |
| Resource Competitiveness (P2) | Number of tourist attractions (X6) |
| | Number of museums (X7) |
| | Number of students enrolled in tourism institutions (X8) |
| Development Competitiveness (P3) | Average annual growth rate of tourism revenue (X9) |
| | Average annual growth rate of tourist arrivals (X10) |
| | Regional GDP growth rate (X11) |
| | Proportion of tourism revenue to GDP (X12) |
| Scale Competitiveness (P4) | Total tourism revenue (X13) |
| | Added value of accommodation and catering industry (X14) |
| | Number of employees in the tourism industry (X15) |
| Environmental Competitiveness (P5) | Per capita regional GDP (X16) |
| | Density of graded road networks (X17) |
| | Forest coverage rate (X18) |
| | Per capita water resources (X19) |

**2.2 Comprehensive Evaluation Method for Tourism Competitiveness.**

Traditional methods such as the Analytic Hierarchy Process (AHP) and fuzzy evaluation are unable to effectively handle redundant information. In contrast, Principal Component Analysis (PCA) leverages theories from linear algebra and support vector machines to effectively address dimensionality reduction in nonlinear spaces. While resolving information redundancy, PCA extracts characteristic information from the original data. Building on PCA, systematic cluster analysis provides a more scientific basis for practical evaluation work[4]. Therefore, this study employs PCA and systematic clustering to comprehensively evaluate regional tourism competitiveness.

## III. RESEARCH ON TOURISM COMPETITIVENESS OF CITIES

In empirical analysis, researchers can adopt either a longitudinal approach to examine the evolution of tourism competitiveness within a specific region over time or a cross-sectional approach to compare tourism competitiveness across different regions. Utilizing the established indicator system and SPSS 26, a variance decomposition principal component extraction analysis was conducted[6][7], as illustrated in Table 2 .

**Table 2Variance Decomposition Principal Component Extraction Analysis.**

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 4.938 | 25.988 | 25.988 | 4.938 | 25.988 | 25.988 | 3.876 | 20.399 | 20.399 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 3.521 | 18.534 | 44.521 | 3.521 | 18.534 | 44.521 | 2.9 | 15.265 | 35.664 |
| 3 | 2.367 | 12.46 | 56.982 | 2.367 | 12.46 | 56.982 | 2.726 | 14.345 | 50.009 |
| 4 | 1.827 | 9.616 | 66.598 | 1.827 | 9.616 | 66.598 | 1.945 | 10.236 | 60.245 |
| 5 | 1.471 | 7.741 | 74.339 | 1.471 | 7.741 | 74.339 | 1.863 | 9.805 | 70.05 |
| 6 | 1.318 | 6.939 | 81.278 | 1.318 | 6.939 | 81.278 | 1.645 | 8.656 | 78.705 |
| 7 | 1.155 | 6.08 | 87.359 | 1.155 | 6.08 | 87.359 | 1.644 | 8.653 | 87.359 |
| 8 | 0.911 | 4.793 | 92.152 | | | | | | |

Eigenvalues serve as indicators of the influence of principal components. If an eigenvalue is less than 1, it suggests that the explanatory power of the corresponding principal component is weaker than that of directly introducing an original variable. Consequently, a common criterion is to retain principal components with eigenvalues greater than 1 [5]. As shown in Table 2, the eigenvalues of the first seven principal components all exceed 1, with a cumulative contribution rate of 87.359%. In line with the principle of selecting principal components with a cumulative contribution rate exceeding 85%, the first seven principal components were extracted for further analysis.

From Table 3, it is evident that the room occupancy rate, per capita tourist expenditure, and density of graded road networks exhibit high loadings on the first principal component. This indicates that the first principal component predominantly reflects the information encapsulated by these indicators, which collectively represent the economic level, reception capacity, and service scale of each region. Therefore, this component is termed the Tourism Service Capacity Factor. Indicators such as tourism revenue, number of tourists, annual growth rate of tourist numbers, and regional GDP growth rate demonstrate high loadings on the second principal component, reflecting the growth potential of local tourism development. Thus, this component is labeled the Tourism Competitive Potential Factor. The number of tourist attractions shows a high loading on the third principal component, indicating its reflection of the richness of tourism resources in the region. Consequently, this component is designated the Tourism Resource Endowment Factor. The number of travel agencies has a high loading on the fourth principal component, representing the operational status of local tourism enterprises, and is thus termed the Tourism Enterprise Viability Factor. Lastly, per capita water resources exhibit a high loading on the fifth principal component, reflecting the endowment of natural resources, and is labeled the Natural Resource Endowment Factor.

**Table 3Initial Factor Loading Matrix.**

| | $F_1$ | $F_2$ | $F_3$ | $F_4$ | $F_5$ | $F_6$ | $F_7$ |
|---|---|---|---|---|---|---|---|
| $x_1$ | 0.775 | 0.147 | 0.001 | -0.293 | 0.163 | 0.089 | 0.030 |
| $x_2$ | 0.491 | -0.657 | -0.033 | 0.453 | -0.071 | -0.021 | 0.099 |
| $x_3$ | 0.841 | 0.023 | 0.362 | 0.098 | -0.116 | -0.216 | 0.034 |
| $x_4$ | 0.417 | 0.319 | 0.497 | 0.484 | 0.226 | -0.338 | 0.100 |
| $x_5$ | 0.337 | 0.034 | -0.088 | 0.858 | -0.026 | 0.245 | 0.250 |
| $x_6$ | 0.699 | -0.193 | -0.516 | -0.009 | -0.126 | -0.066 | 0.222 |
| $x_7$ | 0.629 | -0.637 | -0.051 | -0.208 | -0.147 | -0.109 | -0.289 |
| $x_8$ | 0.501 | 0.376 | 0.745 | 0.020 | -0.003 | -0.076 | -0.077 |
| $x_9$ | 0.400 | 0.403 | -0.454 | -0.099 | -0.358 | 0.021 | 0.162 |
| $x_{10}$ | 0.078 | 0.648 | -0.249 | 0.098 | -0.147 | 0.506 | 0.106 |
| $x_{11}$ | 0.534 | 0.606 | -0.295 | -0.044 | 0.323 | -0.155 | 0.085 |
| $x_{12}$ | 0.028 | -0.252 | 0.488 | -0.249 | 0.527 | 0.242 | 0.411 |
| $x_{13}$ | 0.588 | -0.681 | -0.059 | -0.076 | -0.098 | -0.082 | -0.107 |
| $x_{14}$ | 0.236 | 0.513 | -0.459 | 0.312 | 0.348 | -0.046 | -0.399 |
| $x_{15}$ | -0.018 | -0.449 | 0.172 | 0.413 | -0.124 | 0.480 | -0.385 |
| $x_{16}$ | 0.350 | 0.326 | 0.468 | -0.221 | -0.388 | 0.540 | 0.045 |
| $x_{17}$ | 0.882 | 0.226 | -0.004 | -0.290 | -0.152 | 0.046 | -0.149 |
| $x_{18}$ | 0.306 | -0.528 | -0.311 | -0.113 | 0.359 | 0.269 | 0.415 |
| $x_{19}$ | 0.339 | -0.050 | -0.065 | -0.095 | 0.596 | 0.350 | -0.451 |

**Table 4 Rotated Principal Component Factor Loading Matrix.**

| | $F_1$ | $F_2$ | $F_3$ | $F_4$ | $F_5$ | $F_6$ | $F_7$ |
|---|---|---|---|---|---|---|---|
| $X_1$ | 0.376 | 0.504 | 0.288 | 0.330 | -0.067 | 0.210 | 0.329 |
| $X_2$ | 0.722 | -0.142 | 0.099 | -0.153 | 0.551 | 0.107 | -0.071 |
| $X_3$ | 0.520 | 0.245 | 0.715 | 0.229 | 0.124 | 0.009 | -0.013 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $X_4$ | -0.078 | 0.090 | 0.903 | -0.119 | 0.292 | 0.029 | 0.046 |
| $X_5$ | 0.031 | 0.044 | 0.198 | 0.033 | 0.967 | -0.046 | 0.036 |
| $X_6$ | 0.629 | 0.605 | -0.115 | 0.015 | 0.295 | -0.006 | 0.011 |
| $X_7$ | 0.965 | -0.029 | 0.025 | 0.045 | -0.123 | -0.017 | 0.114 |
| $X_8$ | 0.006 | 0.003 | 0.884 | 0.403 | -0.096 | 0.051 | 0.063 |
| $X_9$ | 0.073 | 0.686 | -0.106 | 0.304 | 0.130 | -0.303 | -0.074 |
| $X_{10}$ | -0.444 | 0.371 | -0.145 | 0.524 | 0.314 | -0.169 | 0.170 |
| $X_{11}$ | -0.106 | 0.788 | 0.297 | -0.004 | 0.059 | -0.039 | 0.388 |
| $X_{12}$ | -0.031 | -0.166 | 0.168 | 0.054 | -0.098 | 0.894 | 0.042 |
| $X_{13}$ | 0.912 | -0.029 | 0.011 | -0.024 | 0.047 | 0.099 | 0.032 |
| $X_{14}$ | -0.197 | 0.383 | 0.092 | -0.179 | 0.226 | -0.415 | 0.679 |
| $X_{15}$ | 0.261 | -0.688 | -0.116 | 0.208 | 0.382 | -0.092 | 0.209 |
| $X_{16}$ | -0.024 | 0.005 | 0.251 | 0.932 | -0.023 | 0.071 | -0.058 |
| $X_{17}$ | 0.488 | 0.517 | 0.339 | 0.500 | -0.104 | -0.107 | 0.260 |
| $X_{18}$ | 0.430 | 0.204 | -0.35 | -0.104 | 0.260 | 0.643 | 0.123 |
| $X_{19}$ | 0.176 | -0.041 | 0.010 | 0.071 | -0.036 | 0.204 | 0.856 |

The principal component comprehensive model is expressed as follows:

$F = 0.260ZX_1 + 0.185ZX_2 + 0.125ZX_3 + \ldots + 0.001ZX_1$

Using this model, the comprehensive values of the principal components were calculated. By ranking the results based on these comprehensive values and comparing the scores and rankings of each principal component, a comprehensive evaluation and comparison of tourism competitiveness across provinces were conducted. The detailed calculation results are presented in Table 2.

**Table 5 Scores and Rankings of Principal Component Factors and Comprehensive Evaluation Values.**

| | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F | Rank |
|---|---|---|---|---|---|---|---|---|---|
| Miazhu | 15.509 | -1749.735 | 5365.977 | 1676.740 | -1076.692 | 227.785 | 1407.207 | 530.6969 | 1 |
| Pengzhou | 375.183 | -702.859 | 680.547 | 168.844 | 227.186 | 192.565 | 1,353.35 | 328.3494 | 2 |
| Chongzhou | 483.34 | -602.95 | 523.824 | 60.717 | 401.471 | 173.406 | 929.817 | 237.6074 | 3 |
| Dujiangyan | 693.059 | -617.663 | 212.256 | -129.636 | 545.816 | 225.826 | 1449.801 | 226.0624 | 4 |
| Shifang | -53.936 | -804.861 | 2279.074 | 757.138 | -601.292 | 151.340 | 1060.943 | 223.5073 | 5 |
| Qionglai | 127.277 | -748.315 | -201.62 | 138.986 | -299.957 | 409.631 | 3,016.43 | 192.3259 | 6 |
| Jingyang | 120.434 | -227.216 | 426.219 | 97.566 | 37.846 | 51.83 | 307.803 | 161.6801 | 7 |
| Jintang | 329.079 | -143.837 | 179.795 | -100.126 | 363.182 | 32.224 | 138.498 | 110.4499 | 8 |
| Jianyang | 197.538 | -579.263 | 119.859 | 55.375 | -12.186 | 240.229 | 2038.121 | 104.4573 | 9 |
| Pujiang | 250.067 | -335.337 | 18.266 | -28.216 | 152.688 | 153.898 | 1012.685 | 86.704 | 10 |
| Dayi | 251.539 | -400.637 | -26.953 | -34.293 | 195.108 | 190.523 | 1,213.98 | 57.14502 | 11 |
| Pengshan | 121.261 | -171.841 | -7.048 | -16.675 | 84.807 | 79.288 | 525.615 | 41.3188 | 12 |
| Renshou | 209.012 | -165.255 | 85.792 | -46.756 | 182.717 | 63.802 | 386.886 | 31.58773 | 13 |
| Zhongjiang | 160.05 | -84.918 | 85.307 | -41.612 | 149.216 | 23.303 | 131.646 | 17.66414 | 14 |

The evaluation results reveal that the comprehensive tourism competitiveness rankings of Mianzhu City, Pengzhou City, Chongzhou City, and Dujiangyan City are leading within the Chengdu-Deyang-Meishan-Ziyang metropolitan area. These cities exhibit significant advantages in transportation accessibility, geographical location, tourism resource endowments, market potential, economies of scale, enterprise development, and tourism infrastructure, thereby objectively forming a robust and dominant tourism competitiveness. Some cities even

demonstrate certain monopolistic advantages in specific tourism market segments.

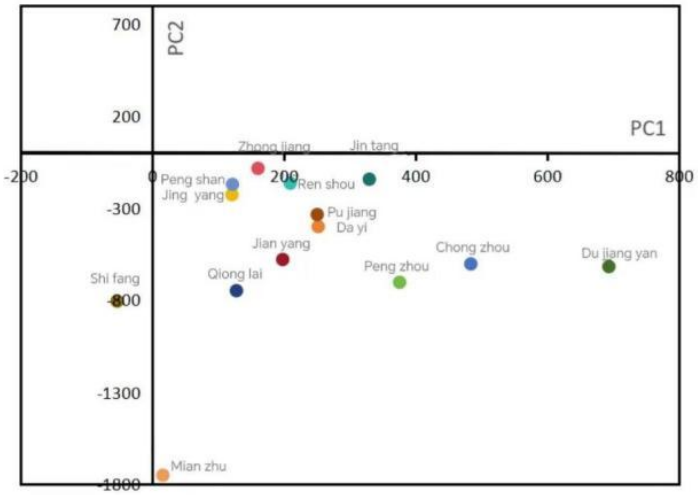
The comprehensive tourism competitiveness rankings of Shifang City, Qionglai District, Jingyang District, Jintang County, and Jianyang City are positioned in the middle tier within the metropolitan area. Although these regions possess favorable geographical conditions, well-developed transportation networks, and relatively high levels of economic development, they share a common challenge of insufficient market development and promotion efforts. In the context of significant spatial differentiation between tourism destinations and source markets, their tourism competitiveness is constrained, resulting in relatively lower rankings within the metropolitan area. Through sustained strategic efforts, there remains substantial potential for enhancing the tourism competitiveness of these regions through destination marketing and product development.

Pujiang County, Dayi County, Pengshan District, Renshou County, and Zhongjiang County exhibit relatively weaker competitive positions in the tourism sector. In terms of resource utilization alone, compared to the product development paradigms of top-ranking regions, these cities demonstrate less optimal development intensity and methodologies. Most of them face challenges of relatively weaker economic foundations, limited geographical advantages, and lower levels of openness, compounded by their considerable distance from major tourism markets and source regions. The tourism competitiveness rankings of these cities are relatively lagging, necessitating a strategic approach that leverages their unique strengths, adjusts industrial structures, pursues intensive development models, and adopts distinctive development pathways to enhance regional tourism competitiveness.

From an overall perspective, the tourism competitiveness of Mianzhu City, Pengzhou City, Chongzhou City, and Dujiangyan City exceeds the metropolitan average, while other regions fall below this benchmark. Among them, Jingyang District, Jintang County, and Jianyang City demonstrate tourism competitiveness levels closest to the metropolitan average. This analytical outcome generally aligns with the actual economic development status and tourism resource endowments of these regions. These areas should formulate tailored development strategies based on their comparative advantages to enhance tourism competitiveness through strategic positioning and product differentiation.

The principal component scores of each evaluation unit were projected onto a two-dimensional coordinate system based on Factor 1 (Tourism Resource Endowment and Infrastructure) and Factor 2 (Market Accessibility and Economic Development), and subsequently divided into four quadrants according to their respective scores. For detailed visualization, please refer to Figure 1.

**Figure 1: Projection of Evaluation Units on Factor 1 and Factor 2.**




In Figure 1, the scores of Principal Component 1 (PC1) and Principal Component 2 (PC2) are categorized into four quadrants based on their high (H) or low (L) values. These quadrants are defined as follows:

Quadrant I (H-H): High Service Capacity – High Tourism Competitive Potential

Quadrant II (L-H): Low Service Capacity – High Tourism Competitive Potential

Quadrant III (L-L): Low Service Capacity – Low Tourism Competitive Potential

Quadrant IV (H-L): High Service Capacity – Low Tourism Competitive Potential

Given that Factor 1 represents the level of tourism service capacity (encompassing infrastructure, hospitality services, and operational efficiency) and Factor 2 represents the level of tourism competitive potential (including resource attractiveness, market accessibility, and economic viability), the evaluation units in each quadrant can be interpreted as follows:

Quadrant I (H-H): Evaluation units in this quadrant represent regions with outstanding tourism service

capacity and high tourism competitive potential. These regions exhibit a strong alignment between service delivery and competitive advantages, creating a synergistic effect that fosters sustainable tourism development and enhances destination competitiveness. Such regions are well-positioned to achieve long-term growth and maintain a leading position in the tourism market.

Quadrant II (L-H): Evaluation units in this quadrant indicate regions with moderate tourism service capacity that constrains the full realization of their high tourism competitive potential. These regions face challenges in service delivery, including infrastructure gaps or operational inefficiencies, which hinder the exploitation of their inherent competitive advantages. Strategic investments in service capacity enhancement are critical to unlocking their tourism potential and improving overall competitiveness.

Quadrant III (L-L): Evaluation units in this quadrant reflect regions with moderate tourism service capacity and moderate tourism competitive potential. These regions require comprehensive structural adjustments to their tourism industry, including resource optimization, product diversification, and market repositioning. By exploring intrinsic development opportunities and adopting innovative strategies, they can gradually improve their competitiveness and market positioning.

Quadrant IV (H-L): Evaluation units in this quadrant represent regions with outstanding tourism service capacity but moderate tourism competitive potential. While these regions may lack inherent competitive advantages, their strong service capacity provides a solid foundation for strategic transformation. By adopting new development models, such as niche tourism markets or experiential tourism products, they can leverage their acquired strengths to enhance competitiveness and achieve sustainable growth.

Based on the spatial distribution of evaluation units in Figure 1, the tourism competitiveness levels of the 14 selected cities, districts, and counties are classified. The classification results are presented in Table 6.

**Table 6 Systematic Clustering Results of Tourism Competitiveness.**

| Region | Clustering Result | Region | Clustering Result |
|---|---|---|---|
| Pujiang county | Ⅳ | Chongzhou city | Ⅳ |
| Shifang city | Ⅲ | Dayi county | Ⅳ |
| Dujiangyan city | Ⅳ | Jingyang district | Ⅳ |
| Jintang county | Ⅳ | Pengzhou city | Ⅳ |
| Jianyang city | Ⅳ | Renshou county | Ⅳ |
| Pengshan district | Ⅳ | Zhongjiang county | Ⅳ |
| Mianzhu city | Ⅳ | Qionglai district | Ⅳ |

## IV. CONCLUSIONS AND DISCUSSION

This study employs SPSS software and Principal Component Analysis (PCA) to conduct a comprehensive quantitative analysis of tourism competitiveness within the Chengdu-Deyang-Meishan-Ziyang metropolitan area. By constructing a robust evaluation index system and utilizing empirical data, the research ranks the tourism competitiveness of various regions, providing both theoretical and technical support for the formulation of regional development strategies.

The findings reveal significant disparities in tourism competitiveness across different regions, primarily reflected in economic conditions, resource endowments, infrastructure development, and market potential. Cities such as Mianzhu, Pengzhou, Chongzhou, and Dujiangyan exhibit strong competitiveness, characterized by well-developed tourism ecosystems and robust market performance. In contrast, Zhongjiang County lags behind, indicating a need for strategic interventions. Notably, Renshou County demonstrates exceptional performance in terms of tourist reception numbers, highlighting its potential as a key tourism destination.

The study identifies tourism service capacity as the most critical determinant of tourism competitiveness. Seven principal components, including hotel occupancy rates, tourist reception numbers, and other key performance indicators, contribute to competitiveness at varying rates ranging from 25.99% to 6.08%. This underscores the pivotal role of enhancing service capacity—encompassing hospitality quality, infrastructure efficiency, and operational management—in driving regional tourism competitiveness.

Regions with higher rankings exhibit strong performance across all principal components, indicating that the benefits of regional tourism development stem from comprehensive and multi-faceted industrial growth. While lower-ranking regions currently lag behind top performers, the tourism industry in these areas has entered a phase of intensive growth, where operational efficiency and management effectiveness will become critical factors in enhancing competitiveness. These regions should strategically leverage their natural resources and ecological advantages to achieve sustainable improvements and competitive differentiation.

In conclusion, this study provides a quantitative analysis framework and methodological reference for research on tourism competitiveness in the Chengdu-Deyang-Meishan-Ziyang metropolitan area and other urban

clusters. It highlights the importance of a systematic and multi-dimensional approach in enhancing regional tourism competitiveness, offering valuable insights for policymakers, industry stakeholders, and researchers aiming to optimize tourism development strategies.

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