

Research on Olympic Games Hosting Strategy Based on Multimodal Analysis

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Abstract. In order to study the impact of the strategy of hosting the Olympics in all seasons, the data of four indicators of latitude, temperature and suitability of the 36 host cities collected were used to calculate the rating of each city in different seasons by using an AHP-EWM-TOPSIS (AET) based model, and the ideal cities for hosting the Olympics in each season were derived in a hierarchical manner by coupling the most suitable cities for each season. It was found that using a strategy of hosting the Olympics in four seasons provides a significant economic boost(21.65%) to the host city, but it also results in a significant loss of reputation(-15.02%). Finally, to explore additional possibilities that could help solve the Olympic dilemma, we developed innovative strategies for multiple neighboring city clusters to host the Games. We collected the number of neighboring cities, available land area, GDP per capita, and carbon emissions for 36 core cities, calculated scores for each city cluster using AET, and used cluster analysis to identify the most suitable city clusters to host the Olympics, plus weighting to calculate new weights, concluding that this clustering model would improve the economy (3.42%) and environment (6.57%) of the city clusters, but would also lead to a regression in reputation (-7.55%).

Keywords: Olympic, AWP-EWM-TOPSIS, Cluster analysis.

1. Introduction

1.1. Problem Background

Originating in ancient Greek times, the Olympic Games are the world's largest comprehensive sporting event encompassing a wide range of sports, attracting athletes from every country and region, and have become an important symbol of global sporting development and cultural exchange [1-4]. However, as the scale and cost of the Olympic Games continue to increase, the IOC is facing a decline in the number of Olympic Games declared, and this trend is likely to continue in the coming years.

As different countries and cities have different conditions for hosting the Olympic Games, and the impact of hosting the Games varies from country to country [5-7], the IOC needs to adopt innovative policies and approaches to achieve the success and legacy of the Games. How to come up with an innovative Olympic Games program to inspire individual countries and cities to host the Games is an urgent issue to be addressed [8].

1.2. Restatement of the Problem

Considering the background information and restricted conditions, we need to solve the following problems:

Choose a permanent location to host the summer and Winter Olympics and analyze the impact of this strategy.

Explore the impact of the strategy of splitting two Olympics sports into four seasons.

1.3. Our Work

In order to establish the Olympic Games impact assessment model, measure the impact of hosting the Olympic Games on different countries or cities, and assess the impact of different policies on hosting the Games. Our work mainly includes the following:

We built a model to assess whether a city is suitable to host the Olympics and divided Countries or cities into three categories based on their scores.

Establish an evaluation system to assess the strategy of choosing a permanent location hosting the Games or splitting two Olympics sports into four seasons.

2. Explore Four Seasons Olympics

2.1. Four Seasons Olympic Impact Coefficient

2.1.1. Latitude coefficient

In general, differences in environmental conditions at different latitudes can affect athletes' performance. For example, in hot areas near the equator, high temperatures and high humidity may negatively affect athletes' bodies, while in high latitudes, cold and low oxygen may affect athletes' performance [9-12]. Therefore, the most suitable latitude for athletes' sports will vary according to different sports and individual differences, so we set the ideal latitude for athletes' sports in each season according to the different characteristics of the seasons as follows:

Ideal latitude for spring: 36°N, Ideal latitude in summer: 25°N, Ideal latitude for fall: 35°N. Ideal latitude in winter: 45°N

The actual latitude refers to the geographical coordinates where a city is located, and we express the absolute value of the difference between the ideal latitude and the actual latitude as the latitude coefficient. The formula is

$$\Delta l = |IML - \widehat{IML}| \quad (1)$$

Here Δl is the Latitude change amount, IML is the ideal motion latitude, $\widehat{IML}$ and is the actual latitude [13].

2.1.2. Temperature Coefficient

The most suitable temperature for the athlete's sport is the one that has the most suitable ambient temperature range for different sports and athletes, which can make the athletes perform the best in the game or training. This temperature range varies depending on the sport and the athlete's physical condition, so for different seasons and sport characteristics, we define the ideal temperature for athletes to exercise in each season:

Ideal temperature in spring: 17°C, Ideal temperature in summer: 24°C

Ideal temperature in fall: 16°C, Ideal temperature in winter: -1°C

The actual temperature refers to the average monthly temperature where the city is located, and we express the absolute value of the difference between the ideal sports temperature and the actual temperature as the temperature coefficient.

$$\Delta T = |IT - \widehat{IT}| \quad (2)$$

Where ΔT is the temperature change amount, IT is the ideal temperature, $\widehat{IT}$ is the actual temperature [14, 15].

2.1.3. GDP Per Capita Coefficient

GDP per capita is an effective tool for people to understand and grasp the macroeconomic performance of a country or region, and is a measure of the living standard of people in each country. If a country does not host the Olympics, GDP pc will change according to the original trend, which is set as GDP pc forecast, and the impact of the Olympics on the economic level of the country can be seen as the difference between the actual and forecast values of GDP pc. We can construct the following equation.

2.1.4. Olympic Suitability

Olympic suitability is used to measure the suitability of a city to host the Olympics, and we refer to the score derived from the second question for 36 countries using the AHP-EWM-TOPSIS as Olympic suitability (Figure 1).

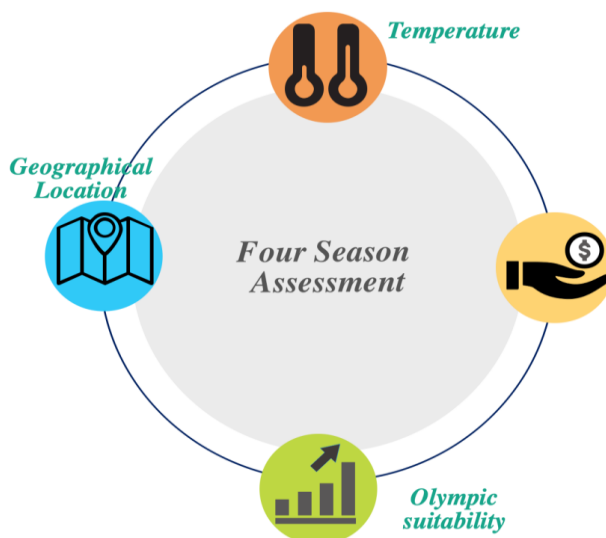


Figure 1. Diagram of Coefficient in Evaluation System.

2.2. Determination of the best host city for the Olympic Games

For each season, we calculated the scores of each city by the above four evaluation coefficients through the AHP-EWM-TOPSIS model, and classified the 36 cities into three levels of suitability as an Olympics venue using K-means aggregation analysis. The result is shown in Figure 2.

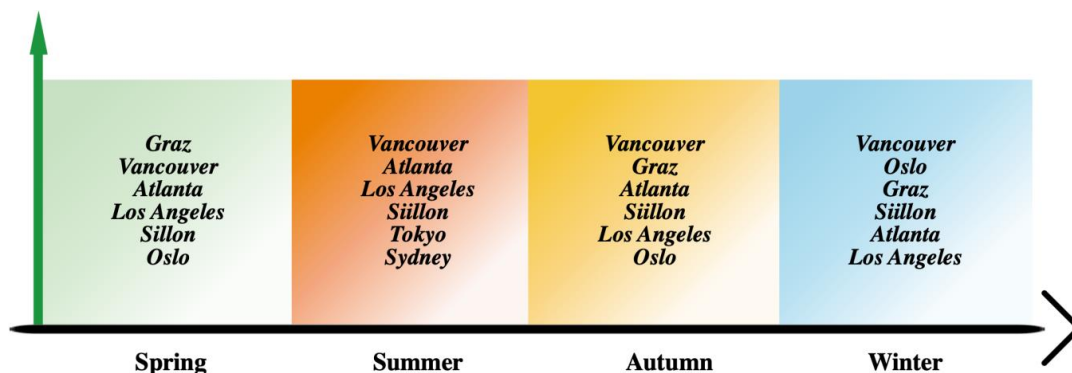


Figure 2. Best Host City for the Olympic.

2.3. Analysis of the Impacts

We used AHP-EWM to calculate the most suitable cities for hosting the Olympics, and by comparing the new weights with the original weights, we analyzed the impact of the Olympics on the host cities:

The most significant improves the economy of the host city (21.65%), the impact on the environment (-0.57%) and tourism (-0.35%) is not significant, and the greatest impact on the decrease in prestige (-15.02%).

3. Explore Co-Hosting Olympics

3.1. City Cluster Evaluation Indicators

3.1.1. Number of Cities Coefficient

We group the core cities and the surrounding adjacent cities into city clusters. The number of cities coefficient refers to the sum of the number of core cities and surrounding neighboring cities, and is an important indicator of the amounts of resources available to an urban cluster.

3.1.2. Land Area Coefficient

The land area coefficient is an important indicator to measure the available land area of an urban cluster. We take the sum of available land area in a city cluster as the land area coefficient, and the more available land area, the more area can be used for the construction of Olympic venues and facilities.

3.1.3. Economic Coefficient

The economic coefficient is an important index to measure the economic strength of a city cluster. We take the total GDP of the cluster cities as the economic index, and the larger the total GDP of the city cluster, the larger the amount of funds that can be invested in the construction of the Olympic Games.

3.1.4. Environmental Protection Coefficient

The smaller the total carbon emission of a city cluster, the better the environmental benefit of the Olympic Games.

3.2. Model Solving and Analysis

3.2.1. Determination of Weights

We used the coupled AHP-EWM method to determine the weights of the city cluster indicators (Figure 3).

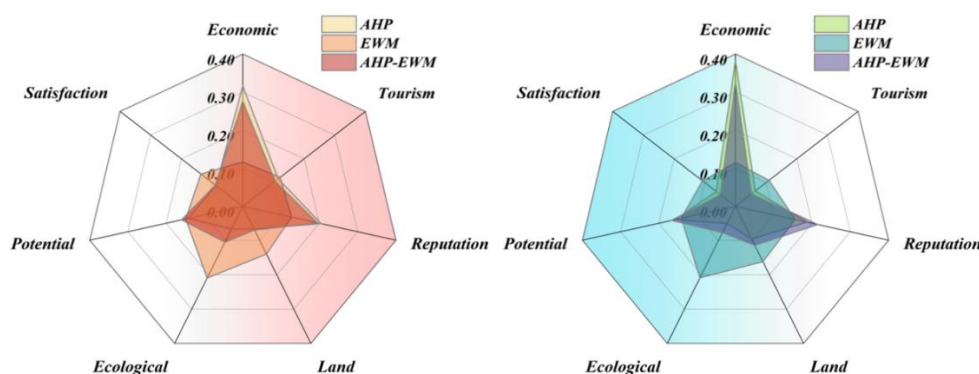


Figure 3. Diagram of Different Weight.

3.2.2. Determining the Best Olympic Host City

Based on the index data of 36 city clusters, we calculated the comprehensive scores of 36 city clusters using the TOPSIS method modified based on the AHP-EWM coupling weights, and conducted K-means cluster analysis based on the comprehensive scores of the city clusters, and classified the city clusters into the most suitable city clusters for the Olympic Games, moderately suitable city clusters for the Olympic Games, and unsuitable city clusters for the Olympic Games (Figure 4).

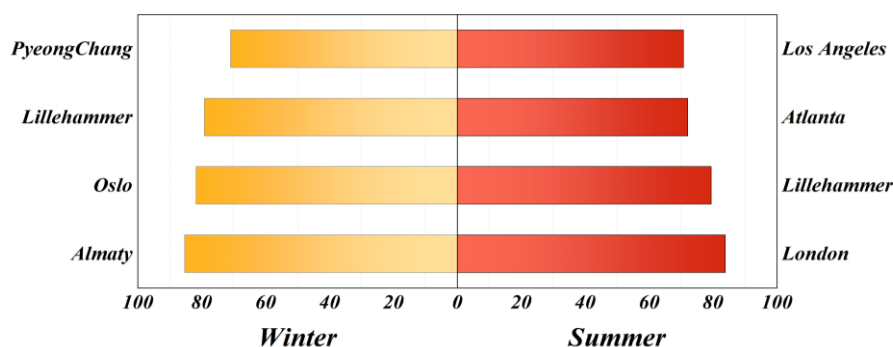


Figure 4. Scores of Cities.

3.3. Impact of the cluster policy

We perform AHP-EWM coupling assignment based on the OIC of the optimal Olympic city cluster to obtain the OIC weight of the optimal Olympic city cluster, solve for the difference between this weight and the OIC weight of the non-city cluster hosting the Olympic Games, and analyze the benefits of exploring city clusters hosting the Olympic Games based on the difference. We find that the Olympics cluster city strategy will improve the economy (3.42%), environment (6.57%), and satisfaction (1.54%) of the host city cluster, but will also lead to a regression in tourism (-0.14%), reputation (-7.55%), land (-0.39%), and potential (-3.45%).

4. Conclusions

In order to study the influence of the strategy of hosting the Olympic Games in each season, this paper uses the latitude, temperature and suitability data of 36 host cities based on the AHP-EWM-TOPSIS (AET) model to calculate the rating of each city in different seasons. By coupling the most suitable cities in each season, the most suitable cities for hosting the Olympic Games in each season are deduced hierarchically. The study found that the strategy of hosting the Olympic Games in four seasons provided significant economic growth for the host city (21.65 %), but also led to a significant loss of reputation (-15.02 %). Finally, in order to explore other possibilities that can help solve the Olympic dilemma, we have developed innovative strategies for hosting the Olympic Games in multiple adjacent urban agglomerations. We collected the number of surrounding cities, available land area, per capita GDP and carbon emissions of 36 core cities, used AET to calculate the score of each urban agglomeration, and used cluster analysis to determine the most suitable urban agglomeration for hosting the Olympic Games. With the new weight calculated by weighting, it is concluded that the clustering model has an improved effect.

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