

# ***Evaluating Olympic Sports: A Data-Driven Model for SDE Selection Based on IOC Criterion***

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**Abstract:** With the categorization of ever more activities in the realm of sports, such as break dancing and BMX cycling, our definition of sports is rapidly shifting. According to the IOC (International Olympic Committee), an SDE (Sport, Discipline, or Event) that resonates with Olympic values should satisfy 6 criteria: Popularity and Accessibility, Gender Equity, Sustainability, inclusivity, Relevance and Innovation, Safety and Fair Play. To help the IOC create a standard to find the lagging or potential SDEs, it's important to examine the factors associated with the 6 criteria. We considered numerous variables, such as the number of viewers, economic output, gender ratio of athletes, and culture index as an extra variable. For the overall model, we adopt the Analytic Hierarchy Process (AHP) to evaluate the weight of each factor. We divide the issue into a hierarchy of criteria and sub-criteria, then calculate the weights of variables on each level. After calculating the weights, we applied the model to our data collected to test the model. In order to rank the SDEs and determine potential SDEs for later Olympic Games, we adopt the TOPSIS model. TOPSIS functions by comparing the distances between each alternative to the ideal best and ideal worst and providing a score for each. To conclude, we wrote a letter to the IOC to introduce our model that accurately followed the IOC's criteria, providing an evaluation of SDEs and offering a comprehensive and appropriate model to consider the addition or elimination of SDEs.

**Keywords:** Olympics, Analytic Hierarchy Process, TOPSIS

## **1. Introduction**

### **1.1. Background**

The 2024 Paris Olympic Games have recently dropped the curtain after hundreds of athletes competed for their country's glory. Traditional ones, such as track and field sports and ball games, captured the audience's attention, while emerging sports, like break dancing and BMX cycling, amazed people from all over the world. These sports showed the innovation and diversity of the Olympic Games, which is one of the core Olympic spirits. With the rapid development of the Internet and social media, sports are becoming an important part of our lives and entertainment. People of all ages devote their time to different sports events. The Olympic Games, as the most authoritative international sports event, reveals not only the peaks of competitive sports but also serves as an important stage for

cultural exchanges and the cultivation of international friendships. On this grand stage, while hundreds of different events have already emerged for a long time, changes remain a constant topic. The Olympic tradition of innovation introduces new blood in such addition and elimination of SDEs, keeping up with the development of The Times.

However, the introduction of SDEs (Sports, Disciplines, and Events) requires careful consideration and evaluation by a set of criteria developed by IOC's (International Olympic Committee's) Olympic Program Commission. In this process, many factors and aspects need to be carefully considered, some of which contradict with others, making the decision of choosing SDEs complex and difficult. For example, some kinds of sports have a great influence on encouraging health but demand a high standard in carrying out the sport. Besides, some considerations include cultural and social impacts, which vary from country to country. The Olympic Program Commission's criteria are designed to assess whether a new sport obeys key standards, including Popularity and Accessibility, Gender Equity, Sustainability, Inclusivity, Relevance and Innovation, and Safety and Fair Play. This paper analyzes how relevant models, such as AHP and TOPSIS, develop an evaluation system that models the standards and predicts the SDEs for future Olympic Games, ensuring that the selection process is both precise and forward-looking.

## 1.2. Problem Restatement

The essential problem is to develop a model to evaluate a system about SDEs based on IOC's criteria, help organize the current situation and analyze the alignment of current sports to give suggestions for future decisions. The question can be broken down into the following suggestions

**Question 1:** We need to identify all the factors derived from the 6 major aspects of IOC criteria. We also need to describe them, demonstrate the types of each, and collect data about the factors to enrich our model and suggestions.

**Question 2:** Using the factors identified in question 1, we need to develop a marking system that assigns different weights to different factors. This model should be applicable to any SDEs and can return the most appropriate and precise choice of SDEs to IOC.

**Question 3:** We need to test our model using previous datasets about information in early Olympics, then identify and rank 3 new SDEs that could add to the 2032 Olympics. Also, we look for any SDEs that have potential for future inclusion in 2036 or beyond.

## 2. Model Overview

### 2.1. Analytic Hierarchy Process

As mentioned earlier, the initial phase in addressing the IOC's criteria is identifying the factors that are taken into account. We apply the Analytic Hierarchy Process (AHP) to assess the importance of each factor to certain SDEs. Besides, the characteristic of AHP is to construct a hierarchical structure model after an in-depth analysis of the essence, influencing factors, and international relationships of complex decision-making problems. Then, using less quantitative information, the decision-making process is made more mathematic, providing a simpler method for solving complex problems with multiple objectives. This method not only has the function of calculating weights but also reduces the amount of data to be calculated compared with the Entropy weight method and improves our efficiency. Before applying the model, we have already considered subjective opinions to come up with a wide range of factors. By using the AHP model, we are able to settle a ranking to the weight of each factor for specific SDEs, enabling us to pinpoint the most critical factor affecting them and make decisions on whether an SDE should be added, retained, or eliminated. The process of AHP is shown in figure 1:

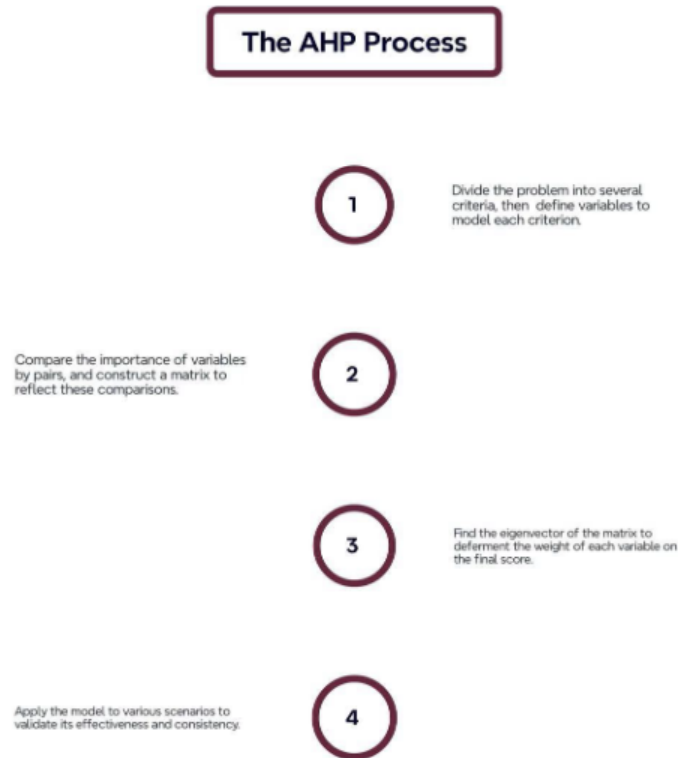


Figure 1: Steps of AHP

## 2.2. TOPSIS

In order to rank the SDEs we also apply the TOPSIS model, which has a basic idea of determining the optimal solution by comparing the similarity between factors solutions and ideal and negative ideal solutions. The ideal one refers to the solution where all indicators achieve the optimal state, while the negative ideal solution means the solution where all indicators reach the worst state. The model determines the relative closeness of each factor's solution to the ideal solution and negative ideal solution by calculating the distance between them and sorting them accordingly. The performance index data of each scheme is organized into a decision matrix, and the decision matrix is standardized to eliminate the dimensional differences between different indicators and ensure the fairness and accuracy of the evaluation. The above analytic hierarchy process (AHP) is used to determine the weight of each and to reflect the importance of each index in the evaluation. Then, according to the properties in the decision matrix, the ideal solution and the negative ideal solution are determined, as well as the distance between each factor and the ideal solution and the negative ideal solution are calculated using some distance measure. The candidate schemes are sorted according to the closeness degree, and the scheme with the 3 highest closeness degrees is selected as the scheme with the most potential and will be used for SDE sorting.

## 3. Variables

### 3.1. Input variables

Based on the IOC Criteria for Sports Inclusion, we have developed a set of specific and measurable variables to model each SDE.

#### **Popularity and Accessibility**

**Number of views:** Although some may view televisions as outdated, with nearly 80% of households worldwide still owning one, it remains a primary medium for accessing news and information.

**Economic cost:** Hosting a major sporting event can be challenging and expensive. A sport that requires a lower investment is generally easier to organize and more accessible.

**Number of relevant news:** ESPN, as the largest and most reputable sports news outlet, covers nearly every corner of the globe and produces a vast amount of content daily—often by the hour.

#### **Gender Equity**

**Ratio of male to female athletes:** The ratio of male to female athletes is the most persuasive factor in discussing gender equity.

#### **Sustainability**

**Carbon output/footprint:** Carbon output could be the main source of Global warming. Too much carbon destroys the environment.

**Industry revenue growth rate:** A measure of the size and value of a certain sport market.

**Health:** A measurement of the probability decreased for getting chronic diseases due to participating in certain kinds of sports, different SDEs, used to determine how socially responsible SDEs are.

#### **Inclusivity**

**International medal ratio (dominant situation):** It is obvious that if the distribution of the medals of a SDE is balanced, this SDE is more inclusive than others dominated by 1 or 2 countries. In order to analyze the dominance, we need to examine the proportion of medals won by the No. 1 country in a specific SDE. If the proportion of a certain country is over 50 percent, we defined it as "1", then this sport is regarded as dominant, or we will record the ratio as the data. If the SDE is not included in the Olympics, find the corresponding data from an authoritative global or international competition.

**Number of countries with professional leagues:** The presence of a professional domestic league is a symbol of the maturity of a certain SDE in a country. So, by investigating sports, seeing if each global country and culture has a domestic league and calculating the number of countries that have certain SDEs competition, making statistics, we can examine how prevailing and inclusive SDEs are.

#### **Relevance and Innovation**

**Innovation index:** we refer to whether it has ever had innovative behavior, and evaluate its innovation potential and possibility based on the level of science and technology and history, and obtain an innovation index with 1 as the maximum value and 0 as the minimum value.

**Relevance to young audiences:** Based on more specific data on viewer composition by age, we define the proportion of viewers below age 24 as this variable.

**Search trend:** We calculate the average rate of growth in interest of SDEs over the past 5 years according to Google Trends. A growth in interest signals increasing future relevance, while a decline can be the prelude of insignificance.

#### **Safety and Fair Play**

**Chance of injuries/deaths:** Vigorous sports come with high risks of injury or even death. The most intuitive approach to measuring the safety of SDEs is counting the number of athletes injured during the event over the total number of participating athletes in the most recent year [1].

**Number of doping incidents:** Evident in past athletic competitions, doping, the intake of drugs to boost performance, is one of the most prominent approaches to cheating. We search for the number of doping incidents per year for an SDE to measure its tendency for athletes to engage in unfair play [2].

### 3.2. Extra variable

**Culture index:** A measurement of the closeness of relationship of the certain SDE and a country's culture. Only with the Olympics contractor in the specific year of Olympics. More specifically, if the sport is a symbol or regarded as a national sport for the contractor country, we will add an addition of 0.1 mark to the total score value after applying the evaluation model, and back to normal the other years. If not, no extra score will be considered.

Since this is an extra variable independent from our evaluation model and does not influence any of the factors mentioned above, we won't discuss it during the process of modeling and sensitivity analysis. But we will consider it when discussing and applying the results.

Table 1 presents all the variables including their symbols and definitions:

Table 1: Definitions of Symbols

| Symbol                  | Definition                                                            |
|-------------------------|-----------------------------------------------------------------------|
| $a_{ij}$                | Relative importance of the $i$ -th criteria to the $j$ -th criteria   |
| $w_i$                   | Weight of the $i$ -th criteria                                        |
| $\lambda_{max}$         | Principle eigenvector                                                 |
| $CI$                    | Consistency index                                                     |
| $RI$                    | Random consistency index                                              |
| $CR$                    | Consistency Ratio                                                     |
| $x_{ij}$                | The $j$ -th indicator of the $i$ -th SDE                              |
| $ij^x$                  | The $j$ -th indicator of the $i$ -th SDE after unifying the direction |
| $ij_*^x$                | The $j$ -th indicator of the $i$ -th SDE after standardizing          |
| $M_j$                   | Maximum $x_{ij}$ for the $j$ -th indicator                            |
| $m_j$                   | Minimum $x_{ij}$ for the $j$ -th indicator                            |
| $[m, n]$                | Optimum interval for an interval-scale indicator                      |
| $c_j$                   | Maximum value between $m - m_j$ and $M_j - n$                         |
| $m$                     | Number of evaluation objects                                          |
| $n$                     | Number of evaluation indicators                                       |
| $(x_{ij})_{m \times n}$ | Evaluation matrix with $m$ objects and $n$ indicators                 |
| $r_{ij}$                | Normalized value of $x_{ij}$                                          |
| $R$                     | Normalized evaluation matrix                                          |
| $w_j$                   | Weight of the $j$ -th indicator                                       |
| $W_{ij}$                | Original weight of the $j$ -th indicator                              |

Table 1: (continued).

|          |                                                                                                |
|----------|------------------------------------------------------------------------------------------------|
| $t_{ij}$ | Weighted indicator value, $t_{ij} = r_{ij} \times w_j$                                         |
| $J_+$    | Set of maximizing indicators                                                                   |
| $J_-$    | Set of minimizing indicators                                                                   |
| $A_w$    | Negative ideal solution (worst values across all indicators)                                   |
| $A_b$    | Positive ideal solution (best values across all indicators)                                    |
| $d_{iw}$ | Euclidean distance between the $i$ -th evaluation object and the negative ideal solution $A_w$ |
| $d_{ib}$ | Euclidean distance between the $i$ -th evaluation object and the positive ideal solution $A_b$ |
| $s_{iw}$ | use as a basis for evaluation, calculated as $s_{iw} = \frac{d_{iw}}{d_{iw} + d_{ib}}$         |

## 4. Modeling

### 4.1. AHP Model

#### 4.1.1. Factor Division

Based on the factors we extracted before, we will find the weight of each factor in the following section, and then we can gain a more accurate and comprehensive understanding of the evaluation of SDEs. In order to achieve this, we will set the AHP model (Analytic Hierarchy Process) to create a matrix. The hierarchy structure is shown in figure 2 and their symbols is shown in the table 2:

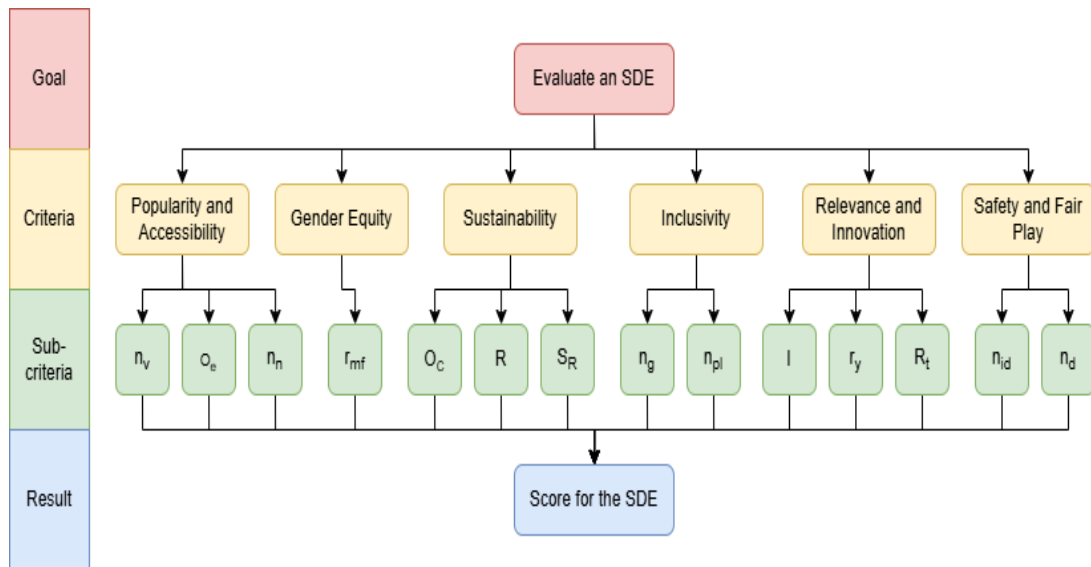


Figure 2: The Hierarchy structure

Table 2: Variables and definitions

| Symbol   | Definition                                                      |
|----------|-----------------------------------------------------------------|
| $n_v$    | number of viewers on television over the past year              |
| $O_e$    | economic cost for a major competition on average                |
| $n_n$    | number of news articles on ESPN/global media over the past year |
| $r_{mf}$ | ratio of number of male / female athletes                       |
| $O_C$    | total carbon dioxide output over the course of the SDE          |
| $R$      | yearly industry revenue                                         |
| $S_R$    | health index (social responsibility)                            |
| $n_g$    | national medal ratio (dominant situation)                       |
| $n_{pl}$ | number of countries with professional leagues                   |
| $I$      | innovation index                                                |
| $r_y$    | ratio of young audiences in all viewers                         |
| $R_t$    | growth in search trend                                          |
| $n_{id}$ | number of injuries / deaths over the past year                  |
| $n_d$    | number of doping incidents over the last year                   |

#### 4.1.2. Construct the Pair-wise Comparison Matrix

The AHP model effectively organizes and arranges factors into hierarchical structures. This method—according to the included 1-9 scale table (table 3)—implicating different weights and comparing the importance to factors, determines the relative significance of each.

Table 3: 1-9 scale of importance

| Scale      | Importance Level             |
|------------|------------------------------|
| 1          | Equally important            |
| 2          | Equal to moderate important  |
| 3          | Moderate important           |
| 4          | Moderate to strong important |
| 5          | Strong important             |
| 6          | Strong to valid important    |
| 7          | Valid important              |
| 8          | Valid to extreme important   |
| 9          | Extreme important            |
| Reciprocal | Inverse relationship         |

Based on the 1-9 scale table, it is possible to establish a comparison matrix for the variables. A comparison matrix is a square matrix of the following form. For each entry,  $a_{ij}$  represents importance of element  $i$  relative to element  $j$ , as measured by the above scale table

$$A' = \begin{bmatrix} 1 & a_{12} & a_{13} & a_{14} & \dots & a_{1n} \\ a_{21} & 1 & a_{23} & a_{24} & \dots & a_{2n} \\ a_{31} & a_{32} & 1 & a_{34} & \dots & a_{3n} \\ a_{41} & a_{42} & a_{43} & 1 & \dots & a_{4n} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & a_{n3} & a_{n4} & \dots & 1 \end{bmatrix}$$

After determining the relative importance of each criterion, we proceed to construct the exact Pair-wise Comparison Matrix, both for the six main criteria and their corresponding sub-criteria.

$$A = \begin{bmatrix} 1 & 3 & 4 & 5 & 5 & 7 \\ 1/3 & 1 & 2 & 3 & 2 & 4 \\ 1/4 & 1/2 & 1 & 2 & 2 & 3 \\ 1/5 & 1/3 & 1/2 & 1 & 1 & 3 \\ 1/5 & 1/2 & 1/2 & 1 & 1 & 2 \\ 1/7 & 1/4 & 1/3 & 1/3 & 1/2 & 1 \end{bmatrix}$$

#### 4.1.3. Weight Calculation and Consistency Check

Table 4: The scores(evaluation) of SDEs

| Destination Layer              | Criterion Layer              | Weight | Sub-Criterion Layer | Weight | Final Weight |
|--------------------------------|------------------------------|--------|---------------------|--------|--------------|
| The scores(evaluation) of SDEs | Popularity and Accessibility | 0.449  | $nv$                | 0.701  | 0.314        |
|                                |                              |        | $O_e$               | 0.106  | 0.048        |
|                                |                              |        | $n_n$               | 0.193  | 0.087        |
|                                | Gender Equity                | 0.200  | $r_{mf}$            | 0.200  | 0.200        |
|                                | Sustainability               | 0.133  | $O_c$               | 0.625  | 0.083        |
|                                |                              |        | $R$                 | 0.238  | 0.032        |
|                                |                              |        | $S_R$               | 0.136  | 0.018        |
|                                | Inclusivity                  | 0.086  | $ng$                | 0.167  | 0.014        |
|                                |                              |        | $n_{pt}$            | 0.833  | 0.072        |
|                                | Relevance and Innovation     | 0.085  | $I$                 | 0.143  | 0.012        |
|                                |                              |        | $r_y$               | 0.571  | 0.049        |
|                                |                              |        | $R_t$               | 0.286  | 0.024        |
|                                | Safety and Fair Play         | 0.045  | $n_{id}$            | 0.667  | 0.03         |
|                                |                              |        | $n_d$               | 0.333  | 0.015        |

The scores of SDE are shown in the table 4 above. On top of obtaining the weights, it is essential to perform a consistency check on the judgment matrix to ensure that the AHP matrix is logically consistent and self-coherent. This is because although we tried our best to fill the matrix as precisely as we could, the process of determining the relative importance of criteria in AHP involves a degree of subjective judgment, which may introduce errors. This consistency check helps validate the reliability of the results.

To perform the consistency check, we first calculate the product of the judgment matrix and the weight vector. This results in a set of new vectors, which we then normalize by dividing each entry by the corresponding weight we calculated previously. The maximum eigenvalue is approximated by computing the arithmetic mean of the normalized values:

With the maximum eigenvalue calculated, we can determine the Consistency Index (CI) and the Consistency Ratio (CR):

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

$$CR = \frac{CI}{RI}$$

Where RI represents the Random Consistency Index, which is determined by the dimension of the matrix. If the CR is smaller than 0.1, we can consider the matrix to exhibit acceptable consistency.

## 4.2. TOPSIS

In addition to directing using the weights given in the AHP model, it is also possible to further compare the data we are given using TOPSIS (Technique for Order Preference by Similarity to an Ideal Solution). With this method, we first normalize our data for the SDE alternatives, so each criterion is given indexes on relatively the same scale. Then, we multiply the criteria using the weights found in the AHP model. For each criterion, we find the ideal best and ideal worst and construct ideal best / worst alternatives. At last, we find the distance of each alternative to the ideal best and ideal worst, and rank them based on their alignment to the ideal best and distance from the ideal worst.

**Step 1:** We first create an evaluation matrix consisting of  $m$  alternatives and  $n$  criteria, The value of the  $j$  th index of the  $i$  th evaluation object is given as  $x_{ij}$ . Therefore, we have a matrix  $(x_{ij})_{m \times n}$

**Step 2:** The matrix  $(x_{ij})_{m \times n}$  is then normalized to form the matrix  $R = (r_{ij})_{m \times n}$ , the calculation method is shown as following:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{k=1}^m x_{kj}^2}}, i = 1, 2, \dots, m, j = 1, 2, \dots, n$$

**Step 3:** Calculate the weighted normalized decision matrix:

$$t_{ij} = r_{ij} \cdot w_j, i = 1, 2, \dots, m, j = 1, 2, \dots, n$$

**Step 4:** Determine the worst alternative ( $A_w$ ) and the best alternative ( $A_b$ ):

$$A_w = \{ \langle \max(t_{ij} \mid i = 1, 2, \dots, m) \mid j \in J_- \rangle, \langle \min(t_{ij} \mid i = 1, 2, \dots, m) \mid j \in J_+ \rangle \}$$

$$\equiv \{ t_{wj} \mid j = 1, 2, \dots, n \}$$

$$A_b = \{ \langle \min(t_{ij} \mid i = 1, 2, \dots, m) \mid j \in J_- \rangle, \langle \max(t_{ij} \mid i = 1, 2, \dots, m) \mid j \in J_+ \rangle \}$$

$$\equiv \{ t_{bj} \mid j = 1, 2, \dots, n \}$$

**Step 5:** Calculate the  $L^2$ - distance between the target alternative  $i$  and the worst condition  $A_w$  and the distance between the alternative  $i$  and the best condition  $A_b$ :

$$d_{iw} = \sqrt{\sum_{j=1}^n (t_{ij} - t_{wj})^2}, i = 1, 2, \dots, m$$

$$d_{ib} = \sqrt{\sum_{j=1}^n (t_{ij} - t_{bj})^2}, i = 1, 2, \dots, m$$

Where  $d_{iw}$  and  $d_{ib}$  are  $L^2$ -norm distances from the target alternative  $i$  to the worst and best conditions, respectively.

**Step 6:** Calculate the similarity with the worst-case scenario

$$s_{iw} = \frac{d_{iw}}{(d_{iw} + d_{ib})}, 0 \leq s_{iw} \leq 1, i = 1, 2, \dots, m$$

with  $s_{iw} = 1$  If and only if the evaluation object is a positive ideal solution; as well as  $s_{iw} = 0$  If and only if the evaluation object is a negative ideal solution.

**Step 7:** based on the above process  $s_{iw}$  ( $i = 1, 2, \dots, w$ ) we can rank the SDEs.

## 5. Result and discussion

### 5.1. Implement the Model on Multiple SDEs with Weighted Summation

We implement our model on four SDEs that have been continuously included in the Olympic program since the 1988 Games or earlier: the 100-meter race, football, tennis, and archery. Additionally, we incorporate three SDEs for sports that have been added or removed from the program in recent years: karate, climbing, and baseball. We use a weighted summation approach to compute the overall score for each SDE, the score of each sports is shown in figure 3:

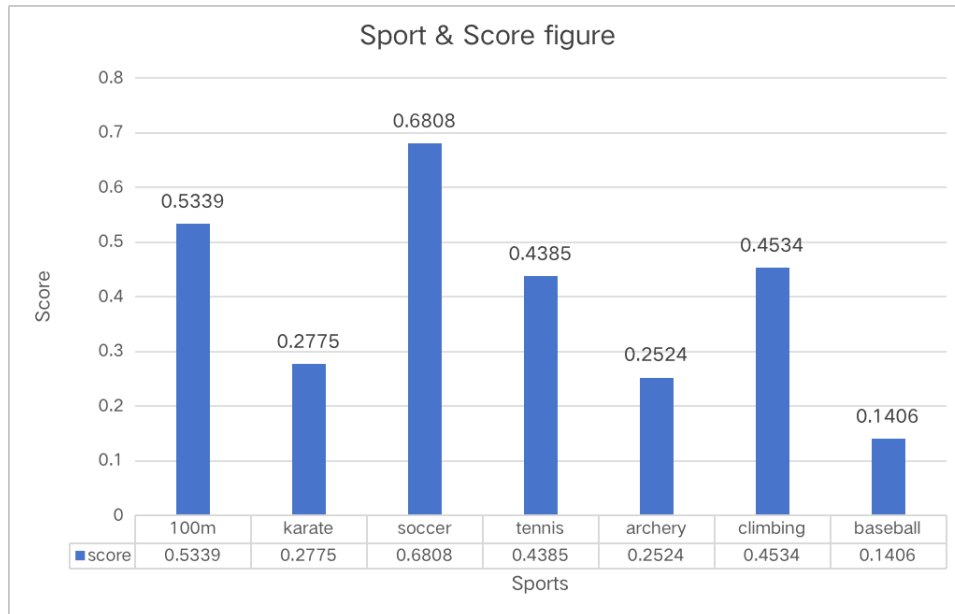


Figure 3: The result (Sports and Score) figure

**SDEs that have continuously been in the Olympic program since the 1988 Games or earlier:**

**Football:** As the unarguable No.1 sport on Earth, possessing the highest attention, football unsurprisingly scores 0.681 out of 1 in our comparison, the highest among the 8 SDEs. This score reflects football's status in the Olympics, having been added in 1900 in Paris and never removed since. Although the FIFA World Cup, a more prominent tournament, is regarded as a more important

competition in the eyes of fans, football remains an essential sport in the Olympics—both now and in the future [3].

**100 Meters Race:** The 100 meters race is another indispensable event in the Olympics. It scores 0.534 in our evaluation, ranking second. The 100 meters race was included in the first Olympics in 1896 in Athens and has been considered one of the most exciting events ever since. For every champion of the 100 meters race, from Carl Lewis to Usain Bolt, they are often named the fastest humans in the world.

**Tennis:** Tennis scores 0.439 out of 1, which also ranks highly. Like the 100 meters race, tennis was included in the first Olympics in 1896 in Athens. Although it was listed as a demonstration sport from 1968 to 1984, tennis has always been a prominent figure in the Olympics. Therefore, this score is fair and well-deserved for tennis [4].

**Archery:** Archery, a sport that has been part of the Olympics since 1900 in Paris, only scores 0.252 in our comparison. This is not very flattering for a sport that has been part of the Olympic program for such a long time. We attribute its lower score mainly to its relatively low viewership compared to other sports. Considering that in this evaluation, its opponents are sports like football and tennis, this score is acceptable.

#### **SDEs that have been removed or added:**

**Karate:** Karate was added to the Olympics in 2020, Tokyo, but quickly removed afterward. Our model gives it a score of 0.278 out of 1. However, karate is closely related with Japanese culture and considered as a symbol of Japan which satisfy the criteria of the extra variable— culture index. In this case, the total score of karate in 2020 Japan Olympics will be added to 0.378, but only 0.278 all other years. This score is rationally acceptable, explaining why karate was added into the 2020 Olympics but only included in the Olympics for a single cycle.

**Climbing:** Climbing is a new sport that was added to the Olympics in 2020 in Tokyo. It scores 0.453 out of 1 in our model, not far behind other established sports. The attention to this emerging sport has surged in recent years. The inclusion of climbing in the Olympics seems both logical and well-timed, based on our model and practical conditions [5].

**Baseball:** Baseball scores only 0.141 in our evaluation. At first glance, this may seem unreasonable, as baseball is often considered one of the top five sports in North America. However, a closer examination reveals that baseball is not very inclusive and does not perform well in other criteria in our model. This assessment also aligns logically with baseball's status in the Olympics: it has been included and removed multiple times.

The overall output of our model is promising most of the SDEs for sports that have been continuously included in the Olympics, as well as those that were newly added, achieve relatively high scores in the comparison. In contrast, sports that were removed tend to perform poorly under our model. This effectively demonstrates the validity of the status of these SDEs and highlights the reliability of our model.

## **5.2. SDEs Recommendations based on TOPSIS**

For potential new additions to the 2032 Brisbane Olympics, we consider six SDEs in total with the ability to satisfy the Olympics criteria: Wushu, Tug of War, Darts, Ultimate Frisbee, Parkour, and Pickleball. The figure 4 is the ranking of the 6 SDEs based on Technique for Order of Preference by Similarity to Ideal Solution:

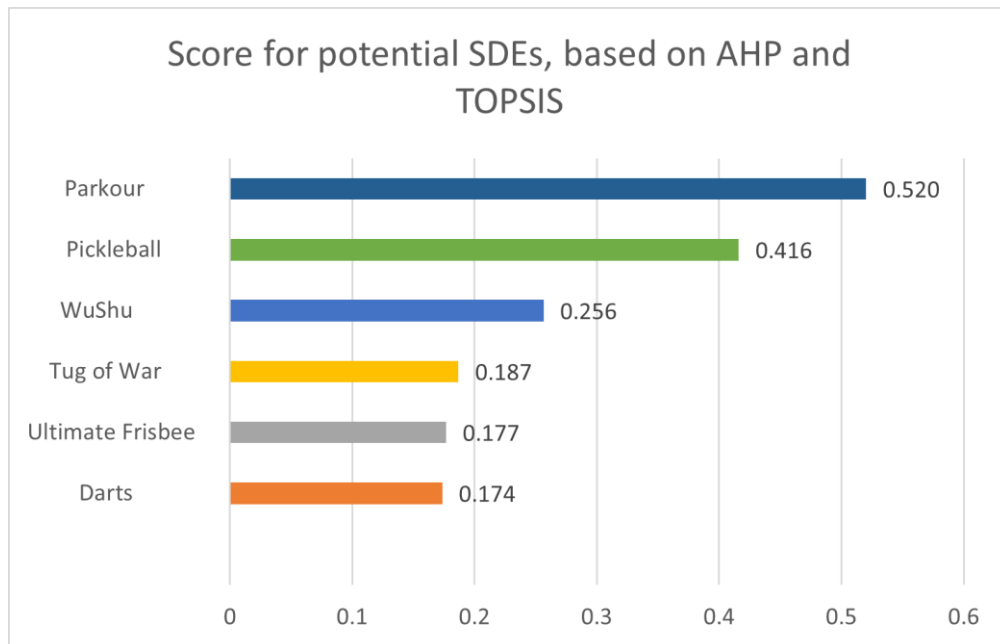


Figure 4: Scores for potential SDEs

After obtaining the results we found that Parkour, Pickleball and Wushu are regarded as top 3 competitive candidates for the new entry of 2032 Olympics, Brisbane.

**Parkour:** Parkour ranks as the top candidate, scoring 0.520 out of 1. This dynamic and creative movement discipline involves navigating urban environments by overcoming obstacles with speed, agility, and fluidity. It's exciting and visually engaging nature makes it a perfect fit for the Olympics. We believe introducing parkour to the 2032 Brisbane Olympics would be an excellent choice, offering a unique and thrilling addition to the Games.

**Pickleball:** Pickleball is the second candidate, scoring 0.416. The sport has been experiencing rapid growth, with a 645.5% increase in search trends on Google over the past five years. According to CNBC, more than 36.5 million people played pickleball between August 2021 and August 2022. With its surge in popularity and widespread participation, adding pickleball to the 2032 Olympics in Brisbane is a highly feasible and exciting option [6].

**Wushu:** Wushu, a traditional combat sport that blends physical techniques with philosophical principles, is the third candidate, scoring 0.256. While it originated in China, it has gained increasing popularity worldwide. With its rich cultural heritage and global appeal, Wushu could be an excellent addition to the 2032 Brisbane Olympics, showcasing both athletic skill and artistic expression.

#### Recommendations for 2036 and beyond Olympics

The process of deciding which recommendations to make is similar to the modeling one we have done for Brisbane 2032 Olympics. We need not only to focus on past trend about famous sports but also pay attention to the emerging ones. All the factors considered in the variable list need to be considered as well as the culture index as an extra one. However, since the year 2036 or beyond is still far away with more than a decade to go, we don't have the data and cannot predict the exact future trend of emerging popular sports based on the preference of the next generation. Meanwhile, the contractor country hasn't been decided yet, so the consideration-based culture identity is unattainable currently as well. Even so, the trend of the era towards more personalized, more creative and more diverse and inclusive sports can provide a brief idea on sports for future Olympics. Esports, for example, satisfy the era trend and has a potential for being included for 2036 Olympics or beyond in this case, but it still needs to overcome a lot of difficulties to achieve the qualification for joining.

## 6. Conclusion

In this study, we developed several models to help the International Olympic Committee evaluate and select Sports, Disciplines, and Events for future Olympic Games. we use the Analytic Hierarchy Process Model to create a framework based on the IOC's six key criteria: Popularity and Accessibility, Gender Equity, Sustainability, Inclusivity, Relevance and Innovation, and Safety and Fair Play. Then, we use the TOPSIS to help ranking the selected SDEs.

The AHP model indicates that the number of viewers is the most important factor, and TOPSIS provides the ranking of SDEs by comparing them to ideal and negative ideal solutions. Our results shows that traditional sports like football always get a better score, which can reflect that they align with Olympic values strongly. On the other hand, sports such as baseball, which haven't been included in Olympics before, often receives lower scores.

In general, this study provides a data-driven approach to evaluate SDEs, which can help the IOC to make better decisions when considering which sports to add in the future Olympics Competetion. By balancing tradition with innovation, our model not only includes the core values of IOC's main criterion, but also follows the rapidly development of the society and Olympics.

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