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E		2300050

Measuring and Mitigating the Impacts of Light Pollution with EWM-TOPSIS Method

Summary

Keywords: Entropy weight method, TOPSIS, ;

Contents

1 Basic Introduction

1.1 Background

Light pollution is a term used to describe the excessive or inappropriate use of artificial light, which can take the form of light trespass, over-illumination, and light clutter. These phenomena are often visible as a glow in the night sky in large cities, but they can also occur in more remote areas. Light pollution affects our environment, health, and safety by altering our view of the night sky, delaying or accelerating plant maturation, disrupting wildlife migration patterns, and affecting our circadian rhythms. Excessive artificial light can lead to poor sleep quality and may contribute to physical and mental health problems, while glare from artificial lights can increase the risk of motor vehicle accidents.

However, artificial light has both positive and negative impacts that can vary based on location. The effects of light pollution can depend on factors such as a location's level of development, population, biodiversity, geography, and climate. Therefore, assessing the extent of the effects and potential impacts of intervention strategies must be tailored to the specific location, and intervention strategies are needed to mitigate the negative effects of light pollution.

1.2 Literature Review

1.3 Problem Restatement

- The indicators of the EWM-TOPSIS model should be determined, in other words, it is equal to build a broadly applicable metric for identifying the light pollution risk level.
- Apply the indicators and the related data to the EWM-TOPSIS model, then analyse the result in the four diverse types of locations.
- Design 3 possible strategies for addressing light pollution, and how the indicators change with the strategies.
- Select 2 locations, and implement the most effective intervention strategies for each of them. See how the indicators change and the impact of the chosen intervention strategy.
- Write a 1-page flyer to community officials or local groups in a specific location to promote its most-effective intervention strategy.

1.4 Our works

[1]

2 Assumptions and Notations

2.1 Assumptions and Justifications

- Assume that

Justifications:

- Assume that

Justifications:

2.2 Notations

The mostly used symbols and their definitions are defined (Table 1), and more symbols will be defined later in the text.

Table 1: Notations of symbols

Symbol	Description
a_{ij}	The value of the j-th indicator of the i-th city to be evaluated.
$A = (a_{ij})_{ij}$	Data matrix composed by a_{ij}.
p_{ij}	The proportion of the i-th evaluation objective to the j-th indicator.
e_j	The entropy value of the j-th indicator.
w_j	The weight of the j-th indicator.
b_{ij}	The data from a_{ij} after standard 0-1 transformation.
$B = (b_{ij})_{ij}$	The decision matrix composed by b_{ij} after processing.
$C = W * B$	The vector normalization attribute matrix after weighting.
C_i	The i-th roll of the C matrix.
$C^* = [b_1^{max}, b_2^{max}, \cdots, b_j^{max}]$	The positive ideal solution.
$C^* = [b_1^{min}, b_2^{min}, \cdots, b_j^{min}]$	The negative ideal solution.
s_i^*	The distance from C_i to the positive ideal solution.
s_i^0	The distance from C_i to the negative ideal solution.
f_i	The night-time light intensity of the i-th city.

3 Data Preprocessing

3.1 Data Collection

We got historical population density data in **Census.gov** [2], time ranging from 1910 to 2020.

3.2 Processing of Missing Value

4 The EWM-TOPSIS Model

4.1 Indicators of the Model

We selected 8 indirect indicators as evaluation indicator variables to evaluate the night light level of the city,

1.

4.2 The Entropy Weight Method (EWM)

The entropy weight method is a multi-criteria decision-making method that is used to determine the relative weights of different criteria in a decision-making process.

We use the entropy weight method (EWM) to get the weight of indicators.

4.3 The TOPSIS Method

The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) is a multi-criteria decision-making method that is used to determine the best option from a set of alternatives based on multiple criteria.

5 Strategy Making and Implementation

5.1 Strategies for Addressing Light Pollution

5.1.1 Strategy 1

5.1.2 Strategy 2

5.1.3 Strategy 3

5.2 Tailored Strategy Implementation

5.2.1 Location 1

5.2.2 Location 2

6 Sensitivity Analysis

6.1 Sensitivity Analysis of the TOPSIS Model

7 Strengths and Weaknesses

7.1 Strengths

Our work aims at investigating trends of global language users and their distrubution situation. With this model, we put forward targeted proposal for a multinational service company, and optimize its planned number of offices. At last, we evaluate the effectiveness of our model. To sum up the above, the model and the policies proposed have the following strengths:

- Inclusive

The model involves 5 indicators, well presenting most of the major factors determining the trends of golbal languages and their distribution. This makes the data analysis and policy-making reliable and rigorous.

- Quantified

- Comparitive

7.2 Weaknessess

Despite the advantages, there are still some shortcomings in our models and the proposal:

- Ignoring External Shocks

As a major premise, we exclude catastrophic disasters and wars. Too big these changes are that we cannot precisely predict the trend of world population distribution and language development trends afterward. But in real world, all circumstances are possible, so our model is still limited.

- Ignoring the Second Generation of the Immigrants

We generally consider that native languages will not change after immigration to another cultural circle. But after 50 years, the next generation of the immigrants are born. Our model does not take their native languages into account.

8 Conclusion

9 Flyer

References

[1] London Bullion Market Association [EB/OL]. https://www.lbma.org.uk/prices-and-data/lbma-gold-price.

[2] Bureau U C. Historical Population Density Data (1910-2020). https://www.census.gov/data/tables/time-series/dec/density-data-text.htmlSection: Government.