Art and Performance Letters (2021) 2: 95-99
Clausius Scientific Press, Canada

DOI: 10.23977/artpl.2021.23019
ISSN 2523-5877

Study and Development of a Model for Measuring the Impact of Music

Ling Kang[1], Huimeng Zheng[2]

[1]*Chang'an university School of civil engineering, Xi'an, Shaanxi, 710018*

[2]*School of Economics and Management, China University of Petroleum (East China), Qingdao, Shandong, 266500*

Keywords: Graph Theory, Pearson correlation coefficient, Entropy weight fitting model

Abstract: In this paper, we use graph theory, probability theory and data mining methods to develop a model to measure the impact of music. Firstly, the influence indexes of 181 influencers are established, and combined with the graph theory knowledge, the score ratio of two artists is used as the network weights to establish the directed graphs corresponding to the artists' music influence. Secondly, to analyze the indicators of music influence change, we first assume the attributes of music as indicators, using the entropy weighting method to determine the weights of ten features, ten years as an interval, weighted and obtained the influence score, and then through polynomial fitting to reach the indicators related to influence change, namely loudness, explicit, follower_num formula.

1. Introduction

Music is a form of art and cultural activity that uses sound as a medium, is part of human society, and is an important part of cultural heritage. There are no strict boundaries between the characteristics of different musical genres, but music belonging to the same genre has more similar characteristics. By considering networks of songs and their musical characteristics, it is possible to capture the influence of musical artists on one another, and also to better understand how music evolves in society over time.

2. Model Building

2.1 Music Influence Models (MIM), the music influence network

2.1.1 Music influence feature (MIF)

Based on the model requirement to evaluate music influence, the sample data of the top ten influencers in 20 fields were selected as evaluation data, the number of people in Children's and Garde genres was small, so a total of n=181 nodes were obtained as the sample to be tested. p=4 evaluation indicators were the number of artist influencers, the number of artist followers, tthe total number of artists in the year, and the number of artists in the same genre in the same year.

Step 1 with trending indicators

The indicators in the comprehensive evaluation indexes have different relationships with the evaluation objects, and they are all converted into whole indicators using the same trending approach. The number of artists' influencers and the number of people in their fields are both positive indicators, and the weights as follows:

Number of people affected by same genre,i=1,else i=0.5.

Step 2 dimensionless metrics

Normalization of the raw data is used to eliminate the magnitude of.The final analytical data matrix was obtained.

$$Z = \begin{pmatrix} z_{11} & \cdots & z_{ip} \\ \vdots & \ddots & \vdots \\ z_{n1} & \cdots & z_{np} \end{pmatrix} \tag{1}$$

2.1.2 Constructing a music impact model using TOPSIS

In the normalized analysis data matrix, the optimal solution and the worst solution among the finite solutions are found, and then the distance between the evaluation object and the optimal solution and the worst solution are calculated respectively, and this is used as a basis to evaluate the superiority and inferiority rank of the sample.

Step 1 Find the optimal and inferior values

Determine the optimal and inferior values of each index, and establish the optimal and inferior value vectors, the calculation yields:

$$z^{+} = (584.5,0.6799050632911392,12640) \tag{2}$$

$$z^{-} = (0.5,0.00012506253126563278,376) \tag{3}$$

Step 2 Calculate the distance between each evaluation object and the optimal and inferior values

$$D_i^{+} = \sqrt{\sum_j (z_{ij} - z_j^{+})^2} \tag{4}$$

$$D_i^{-} = \sqrt{\sum_j (z_{ij} - z_j^{-})^2} \tag{5}$$

Step 3 Calculate the relative proximity of each evaluation index to the optimal value

$$C_i = \frac{D_i^{-}}{D_i^{+} + D_i^{-}} \tag{6}$$

2.1.3 Music influence network model visualization

This paper used social network analysis to create a directed weighted transfer network for representing connected relationships.

The nodes in the network represent the music artists, the number of nodes represents the number of samples of musicians n=181, and the lines between the nodes represent the weights, the longer the lines, the greater the weights. The sample analysis data matrix is filled to 0, and the valid data about 181 samples in the two databases are defined to describe the length of the connecting lines.

Due to the complex linkage of 181 sets of sample data and the large difference in weights, it is difficult to represent them completely in the same graph, so we choose 100 sets of sample data, 35 sets of sample data and 17 sets of sample data to show the music influence network.

2.2 Indicators of evolution in music influence - Entropy weight fitting model (EWF)

2.2.1 Music evolution impact analysis

Here the jazz music genre is chosen as an indicator of popularity, and for the missing data the average of the two years before and after is interpolated, and then the relationship between the process of change in popularity and time is established. It can be obtained that the overall trend in the evolution of jazz music is good and its popularity is increasing.

In 1925, after the early silence, a major change was made, causing a climb in popular value and laying the foundation for the later sustained development; in 1939, after a certain popular foundation, another evolution was made to push the development process; in 1954, an orderly development evolution began, with a steady rise in average popular value and jazz music gradually becoming popular; in 2017, the new style of music was unstoppable and brought a certain impact on historical popular music, leading to a short decline; after 2018, jazz music successfully fused with melodic music, bringing a new climax of popularity.

2.2.2 Dynamic indicator impact analysis

Modeling the influence of influencers, it is believed that both musical characteristics as well as the number of followers play a role in the change of influence, therefore 15 dynamic indicators were identified for analysis.

Setp 1 data processing

The followers' number indicator is measured in decades, and the remaining 14 music features eliminate the impact of the difference in the scale on the evaluation results for the unification and standardization process, which contains the jth indicator, the maximum and minimum values of the jth indicator, respectively, and then standardized.

Setp 2 feature screening

Described by Pearson similarity as the extent to which different objects deviate from the fitted centerline, eliminating invalid features.

$$\rho_{XY} = \frac{Cov(x,y)}{\sigma_X \sigma_Y} \tag{7}$$

Setp 3 entropy weight method

For the 15 evaluation indicators of the m samples to be measured, the original indicator data matrix is formed.

$$X = \begin{pmatrix} X_{11} & \cdots & X_{1n} \\ \vdots & \ddots & \vdots \\ X_{m1} & \cdots & X_{mn} \end{pmatrix} \tag{8}$$

Calculate the weight of the ith sample sign value in the jth indicator and build the weight matrix.

$$P = \begin{pmatrix} P_{11} & \cdots & P_{1n} \\ \vdots & \ddots & \vdots \\ P_{m1} & \cdots & P_{mn} \end{pmatrix} \tag{9}$$

Calculate the entropy value of the indicator.

$$e_j = -\frac{1}{lnm} \sum_i^m p_{ij} lnp_{ij} \tag{10}$$

The corresponding weights of each indicator are obtained by assigning weights according to the degree of difference between the sign values of each indicator, and defining characteristic weights for comprehensive evaluation.

Setp 4 results show:

Table 1: Results

FEATURE NAME	WEIGHT VALUE	FEATURE NAME	FEATURE NAME
DANCEABILITY	0.0558	acousticness	0.0588
ENERGY	0.0797	speechiness	0.0628
VALENCE	0.0728	explicit	0.3267
TEMPO	0.1217	popularity	0.0597
LOUDNESS	0.0901	follower_num	0.0718

Setp 5 Impact Change

The obtained weight percentages are used to derive the influence scores for each decade, describing the change relationship in decadal units.

Through the trend of the results, it can be found that the average influence score is in the same direction as the change feature of followers' number with larger de-weighting, i.e. this feature is reasonably chosen.

Setp 6 linear fit to determine the index

Polynomial fitting is to use a polynomial expansion to fit all observation points in a small analysis area containing several analysis grid points to obtain an objective analysis of the observation data. With time as the independent variable, the fitting function is set as:

$$y = p_0 t^n + p_1 t^{n-1} + p_2 t^{n-2} + \ldots\ldots + p_n \tag{11}$$

By trying to fit in turn to get the highest sub-term to match the image points when the highest sub-term is four times, to avoid over-fitting the final fit function is considered to be a quadratic function.

$$y = 0.0002644t^4 - 2.085t^3 + 6164t^2 + 809800t + 3990000000 \tag{12}$$

3. Conclusion

Music Influence Evaluation Features The design of MIF is closely related to the establishment of the music influence network model MIN. MIF constructs the ratio of the number of people in the same genre in the same year as the influencer, and has the distinction of changing the weight when counting the number of followers, which better quantifies the music influence of the influencer,Music Influence Network The model is based on graph theory, and the influence of the influencers is visually described by the degree of entry of the nodes.

For the analysis of dynamic influence index, Entropy weight fitting model (EWF) is used, entropy weighting method in evaluating the weight of music features, pay more attention to its information variability. That is, information gain, with the correlation coefficient screening out the music features, the weighting results will be closer to the actual situation, in addition to choosing 10 years as an interval to take the average, effectively reducing some accidental data anomalies.

References

[1] Zhang Chi. Research on Missing Data Filling Algorithm Based on Cluster Analysis [D]. Wuhan Light Industry University, 2013.

[2] Du Youchen. Research on music genre classification based on convolutional neural network [D]. Dalian University of Technology, 2019.

[3] Hu Jianbao. A simple method for selecting independent variables in multiple regression [J]. Science and Technology Economic Market, 2019(05): 14+33.
[4] Hu Yuehua,Yu Shicheng,Qi Xiao,Zheng Wenjing,Wang Qiqi,Mao Hongyan. Multiple linear regression model and its application [J]. Chinese Journal of Preventive Medicine, 2019(06): 653-656.
[5] Li Xuerui, Hou Xinggang, Yang Mei. A decision model for industrial design plan preference and its application based on multilevel gray comprehensive evaluation method [J/OL]. JournalofGraphology:1-16[2021-02-09].http://kns-cnki-net.vpn.chd.edu.cn:8080/kcms/detail/10.1034.t.20201222.1410.002.html.