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Research on Music Influence Based on Directional Network Model and Similarity Model

Jie Xiang, Yi Wu, Qian Gong

School of Science, Hangzhou Normal University, Hangzhou, Zhejiang, 311121

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Abstract: In order to quantify the development of music, the paper have constructed a new model framework DSIS (Directional Network, Similarity, Infectiousness, SMT) to solve several problems about music. First of all, the directional network model and subnet model are established, and it is found that the influence of music reveals that music can be handed down from generation to generation, and artists do not always act as followers of a certain school, but also become influencers of different schools. Then 14 indexes are summed up into 5 comprehensive indexes by SPSS factor analysis, and *Python* is used to calculate the schools of ID in "FULL_MUSIC_DATA" data according to "influence data". Then, the *Matlab* grey relational analysis is used to compare the similarity, and finally it is concluded that the similarity within the artist genre may not be higher than that between the artists.

1. Introduction

Music is an essential part of human culture. By exploring the influence of different factors on music, we can develop a method to quantify music development. In the research process, we can measure the influence of songs by the similarity between song characteristics [1]. By studying the music characteristics of songs, we can get the mutual influence between music artists, and then we can further understand the development of music in the entire society over time.

2. Network Model Establishment

2.1 Directional network and subnetwork model establishment

To establish a targeted network of "music influence", we only need to connect all "influencers" with "followers" using directed line segments based on the "influence_data" set.

It can be seen from the figure that the denser the line segments sent by an influencer, the more followers it represents. Therefore, it can be seen intuitively that the parameter of "music influence" in this network is the "out-degree" of the "influencer" in the directional network model, that is, the number of followers affected by the affected person, as shown in Figure 1.

The establish a directional network model for these 5 genres, and intercept some images as shown in the figure below. The numbers in the figure represent the "id" numbers of the musicians they represent.

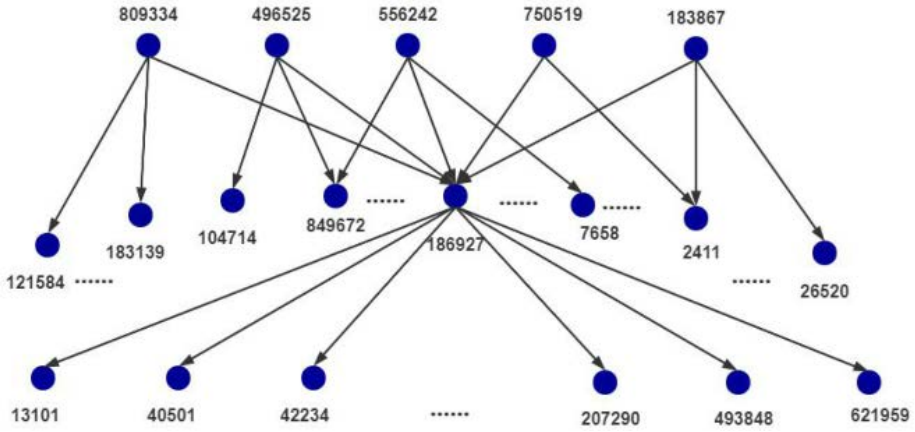

Figure 1: "Music influence" directional network model diagram

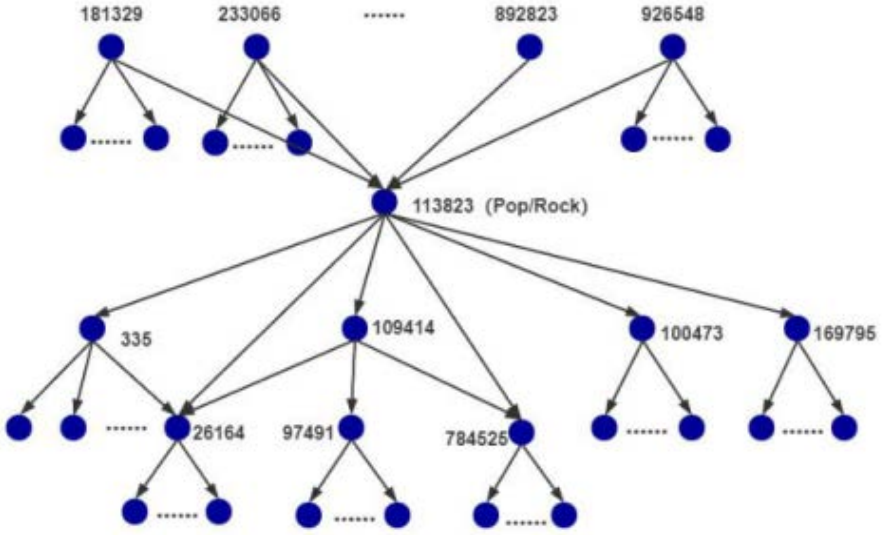

Figure 2: Subnetwork model diagram

2.2 Description and Discovery of Subnetwork

Figure 2 can be seen as a part of the network centered on the musician with the "id" number 113823. The music genre of the "113823" artists is "Pop/Rock", which is directly influenced by the 9 artists who belong to the "Pop/Rock" genre, and then directly affects the 6 artists who focus on the "Pop/Rock" genre[2][3]. And these 6 followers also influence the artists behind, and at the same time, these 6 artists also influence each other.

3. Similarity Model

3.1 Factor analysis of each variable

The steps are as follows:

Step1: Import the data by SPSS.

Step2: Select the dimensionality reduction and factor analysis button, and select the principal component analysis method.

Step3: Use the maximum variance method to rotate and save the final variable.

The results of factor analysis are shown in Table 1 below:

Table 1: Explained total variance

Ingredient	*Initial eigenvalue*			*Extract the sum of squares and load*		
	Total	*Variance/%*	*Accumulation/%*	*Total*	*Variance/%*	*Accumulation/%*
1	10.252	26.287	26.287	10.252	26.287	26.287
2	8.552	21.928	48.214	8.552	21.928	48.214
3	7.256	18.605	66.819	7.256	18.605	66.819
4	4.185	10.730	77.549	4.185	10.730	77.549
5	3.081	7.900	85.449	3.081	7.900	85.449
6	0.99	2.538	87.987			
7	0.937	2.403	90.390			
8	0.83	2.128	92.518			
9	0.796	2.041	94.559			
10	0.684	1.754	96.313			
11	0.616	1.579	97.892			
12	0.373	0.956	98.849			
13	0.329	0.844	99.692			
14	0.12	0.308	100.000			

It can be seen from the above table that the cumulative variance rate of the first five factors is about 85.449%>85%, so the dimensionality reduction effect is better. Therefore, the 14 characteristic variables are reduced to 5 factors [4] [5], and the output component matrix table is as shown in Table 3 Shown:

Table 2: Component matrix

	Ingredients				
	1	2	3	4	5
Danceability	0.399	-0.676	0.056	0.332	-0.055
Energy	0.874	0.189	0.014	-0.108	0.149
Valence	0.478	-0.656	0.153	-0.033	0.281
Tempo	0.301	0.139	0.044	-0.404	0.357
Loudness	0.842	0.098	-0.067	-0.098	-0.01
Mode	-0.039	-0.151	-0.01	-0.638	-0.375
Key	0.046	0.027	0.064	0.421	0.467
Acousticness	-0.81	-0.221	0.187	0.011	-0.052
Instrumentalness	-0.445	0.232	-0.08	0.108	0.253
Liveness	0.087	0.334	0.607	-0.252	0.172
Speechiness	0.152	0.123	0.763	0.167	-0.116
Explicit	0.249	0.249	0.27	0.364	-0.524
Duration_ms	-0.022	0.5	-0.218	0.195	0.146
Popularity	0.59	0.189	-0.326	0.177	-0.291

From the above table, you can get the expression of each factor, such as F1:

$$f1 = 0.399 * Dan + 0.874 * Ene + 0.478 * Val + \cdots + 0.59 * Pop \quad (1)$$

From the above table, the factors can be divided into five categories as follows:
"Active" factor: including **Dan, Ene, Val, Lou, and Pop**
"Time" factor: including **Dur; "Vocal" factor**: including **Mod, Aco, Liv, Spe**
"Definition" factor: including **Exp "Rhythm" factor**: including **Tem, Key, Ins**

3.2 Establishment of similarity model based on factor analysis

Before building the model, we use *Python* to analyze the genre corresponding to each artist in the "full_music_data" data table based on the "influece_data". Then we use Excel to filter out artists belonging to each genre. Finally, we use the data in the "full_music_data" data table to calculate the average of the principal components of all artists in each genre.

Use the average value of each component of each genre as a reference series, and use ***Matlab*** to perform gray correlation analysis. We compare each principal component value of each piece of music in the "full_music_data" data table with the reference sequence in gray relation to get the degree of association between the music and each genre. It can be concluded that the greater the degree of association, the higher the similarity to the genre. At last, we use ***Matlab*** to perform gray correlation analysis, and some results are shown here (Table 3).

Table 3: Association list of some Genres with Blues Music

correlation degree	***Blues***	***Country***	***Electron***	***Folk***	***Jazz***	***Latin***
	0.7449	0.7817	0.6225	0.6351	0.8783	0.8699
rank	8	7	10	9	1	3
correlation degree	***New Age***	***Pop/Rock***	***R&B;***	***Religious***	***Vocal***	
	0.5823	0.7916	0.8362	0.8120	0.8783	
rank	11	6	4	5	2	

It can be seen from the above table that "Jazz" music has the highest correlation with "Blues" music, while the average correlation between "Blues" music and "Blues" music is only eighth.

4. Characteristics of the genre

4.1 The difference of genres

Through the comparison of the results, it is concluded that the internal type is not necessarily more similar than the genre, because different artists have different styles. These can be found by comparing the influence between and within the genres in the problem. Based on this, the differences between some types are as follows.

Table 4: Types and differences

Blues	It mixes the rhythm and rhyme similar to the form of recitation in the church. It is based on pentatonic vocal and instrumental music. Another feature is its special harmony.
Jazz	Developed from folk songs, it presents a prosperous scene in a variety of forms. Its music style is extremely dazzling, and the rhythm is sharp and strong.
Pop/Rock	Express emotions with its flexible and forms of expression and passionate rhythm.
Electronic	Music is made with electronic sounds produced by electronic synthesizers, computers, etc. It has a wide range, among which electronic dance music is the most.
Country	The earliest country music is traditional mountain music, with simple tunes, and narrative. Different from the sentimental pop songs in the city, it has a strong local flavor.

4.2 Changes in genre

The id and the genre have been used to correspond one-to-one by *Python*, and the corresponding id and genre are output in *Python* to obtain the new "full_music_data" data. Then use *R* to draw

images of genres that change with the year. Because of space limitations and too many years, only the first 672 pieces of data are selected for drawing. The drawn image is shown below (Fig3: The abscissa is the year, and the ordinate is the popularity, that is, the degree of popularity and influence. The scattered dots of different colors represent different genres.).

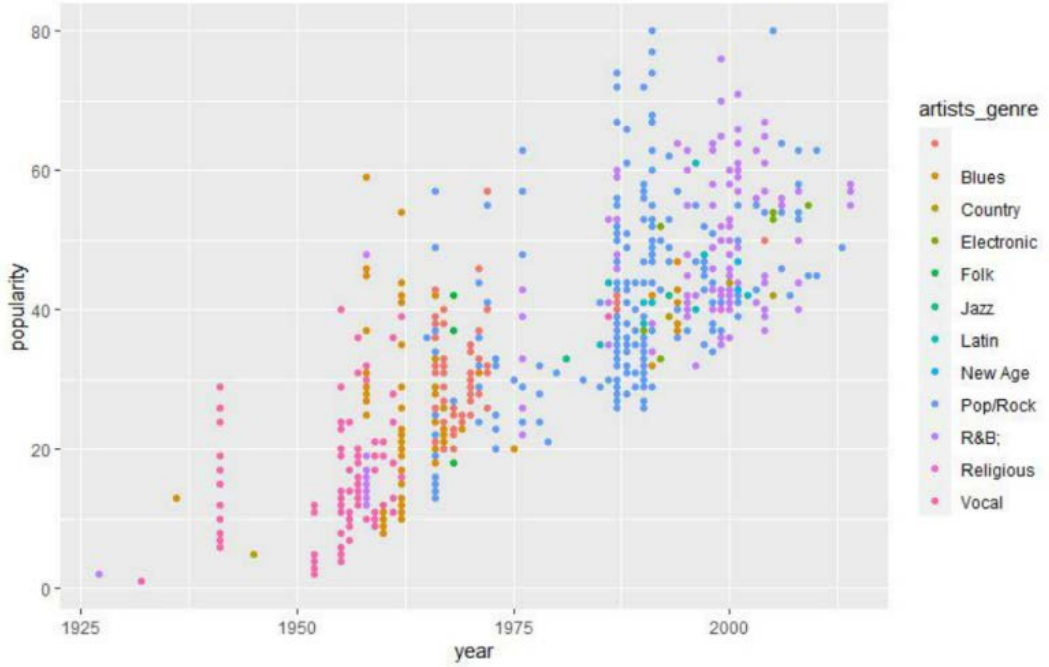

Figure 3: Genre changes with years

As can be seen from the picture, with the change of years, the genre is constantly changing. In the absence of promotion, there will be no schools in a year, nor will it exist in the same year. At the same time, schools will continue to merge and develop, and some types will integrate the development of other types and form new types in the future.

5. Conclusion

In this paper, the influence of music is modeled and analyzed, the orientation and subnet model is established and find that music can be passed on from generation to generation, and artists don't always act as followers of a certain genre, but also become influencers of different genres. Then, the indexes are classified and classified by *SPSS* factor analysis, and the results of FULL_MUSIC_DATA data are calculated by *Python*. Finally, the similarity problems are compared by grey management analysis of *Matlab* house arrest. Artists within genre may not be more similar than artists between genres.

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