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Interdisciplinary studies: Music and statistics[1]

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Abstract

For handling the problem from different point of views and for reaching correct solutions through these views, different branches of science should be used in scientific studies together. Interdisciplinary studies, by using different disciplines which provides different approaches to the problem, make the studies richer. This study aims to emphasize the importance of the depth which is provided by different disciplines in musical researches and to help to widespread these kinds of studies. In this study, the usage of statistical methods by the help of computer technology is worked out. The meanings and the usage of some statistical terms in musical researches like maximum-minimum values, range, standard deviation, grouping, line up, median, kurtosis and skewness are tried to be explained by giving some examples.

Keywords: *Interdisciplinary studies, music, statistics, musical analysis.*

1. Introduction

Technological developments which occurred during second half of 20th century caused a great change and differentiation in philosophy. The speed of this change reached to a point which is far beyond the dreams. An invention which has been made just today may leave its place to a new one tomorrow (Bayraktar, 1993, p. 140). Today, most branches of science, try to follow the improvements in computer technology and try to implement these improvements in their branch fields. The results of the studies which have been made up to now show that computer technology and devices based on computer technology presented unlimited opportunities to the related field of science (Cevher, 2002, p. 277). With the recognition of the advantages of the computer technology in our country and all around the world, these advantages have begun to be used in arts and education.

After the entrance of the computer technology to the world of music, lots of studies including statistical analysis became easier, more quick and sharable. So, the studies which hadn't been dared to be made because of their hard, monotonous, and long term procedures began to spread among the educators. The spreading of these studies provided new point of views to the researchers and made a great contribution to the researches. These developments which can be accepted a revolution in musical analysis, provided also new interdisciplinary fields of studies and gave the opportunity to research many new subjects.

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The subjects of the studies used to be very limited because of the hardness of the analysis which is made about the musical notes in songs, and the inability of implementation of much analysis which are made by different disciplines. With the programs which can change the notes into numbers, statistics became applicable in musical analysis. Statistics, gives the chance to gain more trustable results in musical analysis. For instance, to analyze a musical composition which consists of 300 notes, counting, grouping, finding the median value and the calculations like these, takes really long time if it's done without the help of the computer technology. And at the end of this long and hard work, just one composition can be analyzed. But, with the advantages of the computer, notes can turn into numbers easily, and lots of different statistical analysis maximum-minimum values, range, standard deviation, grouping, line up, median, kurtosis and skewness, can be done on data base which consist of millions of notes, just in seconds.

Computer is superior to human if the abilities of keeping the data base and proceeding on this base are compared. Today, for the music educators, using the computer technology and methods of the other sciences became an obligation (Can, 2006, p. 2). Music has been a branch of art and science which has been collaborating with different disciplines like mathematics, physics and medicine. Interdisciplinary studies, gave the opportunities to work on different subjects.

In this article, the musical researches which has been done by using the statistical analysis with the computer, all around the world and especially in our country, are studied and the usages of different statistical analyzes methods are showed on examples.

2. Literature

Düzbastılar (2013a) in her study named "The Usage Frequency of the Rhythm Patterns in Kreutzer's Violin Method" aimed to help solving the rhythm problems in violin education by determining the usage frequency of rhythm patterns in 29 etudes which take place in Rudolf Kreutzer's (1766-1831) "42 Etuden oder Capricen fur Violine" method and do not contain two-voice notes. By analyzing the data obtained from musical analysis, the meter signitures of the 29 etudes, which take place in Rudolf Kreutzer's "42 Etuden oder Capricen fur Violine" method and do not contain two-voice notes, and according to these meter signitures the most frequently used rythyhm patterns and their frequencies are determined.

Müezzinoğlu (2004), in her study named "The analysis of Zeybek's by SQL" examined to 60 Anatolian Zeybek's and the "Sarhoş Zeybek" amongst Cypriot Zeybek's have been studied according to the duration and frequency of use of frets, sound field, melodical behavior, the use of intervals and rhythmic analysis, as 5 major topics.

Düzbastılar (2013b) in her study named "The Examination of Kreutzer Violin method by using the Double Chain Markow Model and Computer Supported Analysis" aimed of this study are to help the students to learn the etudes in a short time, to set an example study for similar etudes and compositions and to make contribution to the violin learning process by defining the intervals between sequential notes and advising pre-studies for the etudes according to the results of the study.

Erol (2007) in her study named "The Determination Violin Accordness of Nihavent Melodies with Statistical Methods" examined to total 200 West's violin (100 Major and 100 minor) and Nihavent songs with Duyek tempo –key signature- have been scrutinized from point of voice area, tessitura, melodical movement, rhythmic structure, intervals, length etc.

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Düzbastılar (2013c) in her study named "Examination of the Rast Maqam's Appropriateness to the Violin from the Point of Range and Tessitura" aimed to determine the appropriateness of Rast maqam for the violin by comparing the voice ranges and the tessituras of Rast and violin. As the result of the study, some differences caused of belonging to different cultures are determined while some similarities can also be seen.

Göher (2006)) in her study named "The Comperative Analysis of Turkish and the West's Children Songs" examined to 1000 Turk and 1000 the West's children songs have been scrutinized from the point of scale, voice area, intervals, tessitura, tone / maqam, rhythmic structure, topics etc? The similarities and differences have been determined and interpreted respectively. As a result of study, while it has been observed the similarities arisen from simpleness and easiness in the nature of the children songs, it has been coincided with the differences on the other hand, due to belonging to other cultures.

Düzbastılar (2012) in her study named "Usage of Intervals in Rast Compositions" aimed to this study is to analyze the usage of Rast maqam intervals by using computer technology. This study is important because of displaying characteristics of Rast melodies. According to the results of this study B2 interval to the direction of low pitched voice field is determined as the most frequently used interval, and K6 interval to the direction of low pitched voice field is determined as the least used interval of the Rast Maqam.

Yalçınkaya (2004)) in her study named "The Statistical Analysis with computer Traditional Turkish Music Songs and an example Algorithmic Composition" aimed to towards to be used analysis of Traditional Turkish Classical Music Song of the computer technology which have an important position in practice of musicology, music education, composition, musical analysis and compose of that proper of traditional musical arts with method of algorithmic composition.

Düzbastılar (2008) in her study named "Preparing Violin Etudes and Exercises in Maqams by Using Kirnberger's Composing Method" examined to instead of using personal knowledge, experience and talents, results gained by analyzing maqam melodies, violin etudes and exercises with statistical methods are used. This study is important because the violin etudes are prepared basing on statistical results and measurements; and Kingsberger's composing method has been used for the first time in preparing violin etudes in maqams.

3. Findings and discussion

The first step in statistical analysis in music is, turning the musical notes to the numbers by using the computer programs. After this step any kinds of statistical studies can be done on this data base. At that phase, the important point is commenting on the results gained by the analysis. It is shortly explained below the results and the comments on the results of the analysis with examples.

Range in statistics is the distance or difference between smallest and biggest of the observed measurements (Arıcı, 2005, p. 71). Range in music is, the distance between the highest note voice and the lowest note voice of a human or musical instrument (Rushton, 1980, p. 583). Range in music, gives important knowledge about the voice field of a melody.

If the voice field of a melody is short, it means that the distance between the highest note voice and the lowest note voice of the melody is small; If the voice field of a melody is large, it means

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that the distance between the highest note voice and the lowest note voice of the melody is big. For instance a child song which consist of three notes has a short (small) voice field, a song consist of two octaves has a large voice field.

The knowledge gained by calculating the range value can be used in many places in music. For example, knowledge about the voice field of a song has a great importance for the singer. The voice field of an instrument or an etude of an instrument is a very important knowledge for both the teacher and the student in the different phases of the education. For a composer, knowing the voice field of the target group, for example voice field of children, is important for composing appropriate and performable songs.

Recently, one of the most used statistical method is median which can be calculated dividing the total value of the measurements to the number of the measurements. (Arıcı, 2005, p. 41).

The median in musical analysis is frequently used because it gives trustable results and it's applicable to many subjects. For example voice field median gives information about the voice field; the median of the notes in the melodies and the medians of the measures give general idea about the melody structure and the length of the melody.

Min-max values in musical analysis, gives information about the lowest and highest values in a melody. For instance, min-max values gives information about the most used time values. Min-max values can also be used for finding the highest-pitched and lowest pitched voice of the melody and finding the longest and shortest songs among the data base which consists of lots of songs.

Counting method, which is used in nearly all subjects, is often used in musical researches and analysis. In musical analysis, notes, number of the measures, time values of the notes, repetitions in melodies, the techniques written for the instruments or human voice etc. can be counted. Each counting will give the researchers lots of different information.

It can be observed especially in the recent studies that the usage of grouping, one of the most used statistical method, has increased. Grouping can be used in different subjects in music. For example, in a data base which consists of lots of compositions, songs can be grouped according to the width of their voice field, according to their length, according to the notes, rhythms, melodies used in the song or they can be grouped according to the time values of the notes used in the song etc.

Line up method has been used in lots of studies like counting and grouping. The notes in a melody, the nuances and the forces of the moldy and rhythm groups can be enumerated according to their repetitions. Also, line up of the transitions of notes which follow each other, give very important information which can make contribution to the researches.

Standard deviation which can be accepted as the most used and most stable variation value in statistics is equal to the square root of the median of the square of the difference of the measures from the median. (Arıcı, 2005, p. 74).

Standard deviation has a widespread usage and recently it has been frequently used in music researches. If the standard deviation of a composition equals to zero, it means that in that song, the same note is repeated. If the standard deviation is low, it means that the neighboring voices are used or the ranges of the notes are small in the song; if the standard deviation is high, it means

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that the distances between the notes are far. In a lot of musical analysis, standard deviation is used with the aim of determining the distribution of the notes in the melody (von Hippel, 2000, p. 317).

The hardship level of a melody can be learned through the standard deviation which gives the information about the usages of the intervals in a melody. For example, apart from the technical characteristics, a melody in which small intervals are used can be accepted easy; and a melody in which the big intervals are used can be accepted hard.

In the voice field of a melody, the areas in which the notes are used more frequently can be determined by calculating of kurtosis and skewness. If the skewness in musical composition equals to zero, it means that the dispersion of the notes in that song is normal, in another words, the middle areas of the voice field are mostly used. If the low-pitched areas are mostly used in the song, it means that there is skewness to the right; and if the high-pitched areas are mostly used in the song, it means that there is skewness to the left (Erol, 2007, p. 44).

Kurtosis, gives information about the frequencies of the voices in a melody and so it shows that the dispersion of the notes is homogeneous or not. If there is a kurtosis in a measurement, it shows that the dispersion of the notes are homogeneous. If there is sharpness in the graphics, it shows that the usage frequencies of the notes are not close to each other, so the dispersion of the notes is not homogeneous.

4. Results

Interdisciplinary studies give the researchers different points of view and enrich the results of the studies. During the last years, the usage of the statistical analysis has increased in musical researches. Counting, grouping, line up, median, standard deviation; range, max-min values, kurtosis and skewness are the most used methods of the statistics in music. After the entrance of the statistics to the musical researches, a lot of unknown points of the musical compositions became clear and this gave the chance of a better recognition of the compositions. Supporting the interdisciplinary studies in music will contribute the dispersion of these kind of studies and will enrich the work field.

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