

# Statistics in Music

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*Abstract— Implicit statistical arguments are widely used in music analysis to analyze seemingly odd musical aspects and to claim the normative forms of musical structures. Explicit statistical methods are increasingly being used in music theory, as the subject moves more and more toward corpus studies and music informatics. The overview of various statistical and probabilistic reasons that music theorists should take into account when describing musical elements as data for analysis is provided in this essay. When analyzing individual works, conventional statistics may not seem to apply. However, the characteristics of predicted distributions of musical elements in the data may aid in determining if a particular musical trait is a noteworthy discovery or just a coincidence.*

*Keywords- Statistics, musical instruments, computerized music, digital computing sounds*

## I. INTRODUCTION

In computer music, melody prediction— which attempts to anticipate melody words given musical context—is a crucial area of study. In addition to helping with autonomous composition's melody creation duty, melody prediction can be used to better understand how humans develop melodic expectation while listening. These days, most research focuses mainly on creating novel techniques for modeling musical sequences.

Statistics—sales goals, breakeven points, success ratios, royalties splits, website traffic, ticket sales, listener counts, piracy abuses, and big data— power the music industries. Statistics have implications. They affect the music that customers hear, the money that musicians make, and the laws and regulations that legislators and governments enact. However, a lot of these figures are produced by the music industry, thus it's possible to doubt their veracity. To examine these topics in-depth from a statistical perspective, despite other works providing advice on how the music industries operate and academic criticism of record labels' policies.

In music study, correlations between variables can be found using statistical methods.

Regression and correlation, for instance, can be used to measure the type and strength of associations between variables.

As part of the cognitive process of statistical learning, listeners create internal models of the statistical regularities found in music. Another cognitive function that makes use of these learnt models is probabilistic prediction.

Math is also used in music. Octaves, or groups of twelve notes that increase in pitch, are the foundation of Western music. Each note in an octave is tuned using a mathematical formula, with the frequency of each note rising by approximately 5.95% from the one before it. There are further connections between math and music. To improve learning, for instance, lyrics, melodies, and dancing can be employed.

### 1. Characteristic statistics

The average annual number of digital concerts that an artist plays. Because the researcher averaged the total number of concerts over a five-year period, this is a descriptive statistic.

## II. BUSINESS

The entire music business was estimated to be worth \$26.2 billion in 2022, with 67% of revenue coming from streaming.

### 1. US music revenue

In terms of both revenue and consumption, the U.S. market dominated in 2022, accounting for \$28.8 billion of global recorded music revenue.

### 2. Revenue from music streaming

The revenue from music streaming rose from \$0.4 billion to \$13.6 billion between 2010 and 2020, a 34x increase. The revenue from music streaming was estimated to be \$17.5 billion in 2022.

### 3. Vinyl record sales

Vinyl record sales in the United States grew by 4.2% in 2022.

### III. EVOLUTIONARY STATISTICS

Statistical evolutionary laws have been uncovered through data analysis of Western classical music, according to Scientific Reports - Nature. The mean and standard deviation of some infrequent musical occurrences, such as discordant intervals, are two examples.

#### 1. Statistical Evaluation in the Recovery of Music Data

All music theories that assert anything regarding a repertory rely on statistical justifications. In many cases, such as when a starting music student is informed that chord X “generally” proceeds to chord Y and not to chord Z in typical practice tonal music, the mathematical nature of these claims is implicit. This kind of analytical claim is used to characterize the relative frequency of chord progressions and other musical elements, whether or not it is quantified using real percentages or other numerical data. Such rudimentary assertions serve as a foundation for our more intricate assessments of music. We can assume that a progression from chord X to chord Z does not “generally” occur.

In the recorded music industry, sales figures for different artists are described using descriptive statistics. Tables and charts outlining various musicians' profits are visible. An instance of employing inferential statistics in the recorded music sector would entail surveying many music enthusiasts regarding their preferences or shopping behaviors, and subsequently estimating the quantity of sales throughout the total populace.

The aforementioned descriptive example might entail measuring every sale and then summarizing the outcomes. A digital music platform, for instance, might keep track of every sale and then generate a graphical representation of the numbers. The inferential approach, on the other hand, only samples a subset of the population before estimating the overall number. The distinction is if one reports every observation they have made,

### IV. STATISTICS OF HEARING

❖ The amount of time spent hearing  
People listened to music for 20.1 hours on average per week in 2022 compared to 18.4 hours in 2021. That figure rose to 20.7 hours in 2023.

❖ Using streaming  
In the United States, streaming music income reached \$13.3 billion in 2020. R&B/hip-hop is the most streamed musical genre.

❖ Streaming audio subscription  
Subscription audio streaming generates 48.3% of revenue for the global recorded music industry. Mental and physical wellness: 69% of respondents believe that listening to music helps them stay mentally and physically well.

❖ Indian song  
The value of the Indian music industry is 22 billion rupees. Bollywood is the most popular music genre.

❖ The American music business

- "Anti-Hero" by Taylor Swift is the number one digital song in the United States. The most watched music video of all time
- A Statistical Approach to the Analysis of Musical Structure and Performance
- This work presents a statistical method for examining a score's metric, harmonic, and melodic structures.

#### 1. A Study of Written and Performed Music Using Statistics

In order to examine compositional principles and coordination and expression issues in “punctual” serial music, this work uses statistical approaches such as correlation and analysis of variance. Analyzing music in ABC format statistically at the item and corpus levels

Three distance metrics and three statistical tests for comparing music expressed in ABC format are examined in this work.

### V. DATA

The following data relates to the brain and music:

- According to a 2020 Harvard Health study, 69% of those who frequently attend musical performances believe that their brain health is “excellent” or “very good.”
- According to a Brain study, those who regularly listen to music after having a stroke report higher improvements in verbal memory and cognitive function than people who listen to audiobooks.
- According to a 1991 survey, over 80% of adults have emotional or bodily reactions to music,

including thrills, tears, or laughing.

- According to a 2019 study, college students who devote two months of daily listening to classical music report far reduced anxiety levels.

You may mentally exercise and excite your brain by listening to music.

In addition to predicting the next big hit and understanding what listeners are listening to, statistics may also assist the music industry in projecting the future of music. For instance, Shav Garg's business, Indify, uses analytics to assist music industry professionals in identifying the next big thing in music.

## VI. PROCESS

According to the statistical learning hypothesis, or SLH, listeners gradually develop internal models of the statistical and structural regularities found in the musical genres they are exposed to over brief (such as an individual piece) periods of time. This process of implicit statistical learning is known as musical enculturation.

## VII. CONCLUSION

Finds that learning statistics is superior, and that studying statistics also altered one's capacity for music, thus we can say that they are interconnected. The majority of research also demonstrates a connection between them rather than being purely theoretical. Despite various limitations in their research, researchers nevertheless suggest that studying music helps students learn statistics. The two fields of study that are visible in the literature review are neuroscience and cognition. The cognitive field of research examines the capacity for mastery in both music and statistics, as well as the relationship between the two.

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