**Final Research Paper**

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MIS543: Enterprise Performance

Dr. Mills

6/30/2024

**Abstract**

This paper investigates the evolution of musical preferences over time utilizing the Rolling Stones’ Billboard 500 album dataset. By analyzing various attributes such as artist demographics, genre, peak Billboard positions, and economic indicators, the study aims to uncover correlations between economic conditions and musical trends. The dataset includes attributes like artist gender, type, peak Billboard location, number of members, gender composition, debut date, years between debut and reaching the Billboard 500, and artist age at Billboard entry. Economic indicators such as GDP growth and interest rates are analyzed to determine their influence on musical preferences.

The study's primary objectives are to identify significant differences in peak Billboard positions among genres, changes in album ranks over time, and the impact of artist demographics on album success. Furthermore, the research examines the correlation between economic indicators and Billboard rankings, seeking to provide data-driven insights for music industry professionals.

Initial findings indicate that economic prosperity is associated with a preference for more danceable, energetic, and popular music, while acoustic and instrumental elements decline. The research also highlights significant genre shifts, with genres like Blues/Blues Rock declining and Hip-Hop/Rap/Pop rising in popularity from 2012 to 2020. These trends suggest that economic conditions significantly influence musical tastes and industry dynamics.

The study acknowledges limitations, including potential biases in the Rolling Stones' dataset and the exclusion of other socio-cultural factors. Future research should incorporate a broader range of data and methodologies to address these limitations and further explore the intricate relationship between economic conditions and musical preferences. The findings have implications for music industry executives, informing strategic decisions regarding artist promotion and genre focus.

**Final Research Paper**

The proposed research aims to contribute valuable insights to the music industry by examining changes in musical preferences over time. By utilizing the Rolling Stones’ Billboard 500 albums of all time, this analysis will delve into how musical tastes have evolved and whether or not economic factors influence these trends. The dataset includes various attributes such as the artist’s gender, type, peak Billboard location, number of members, gender composition, debut date, years between debut and making the Billboard 500, and the age at which the artist reached the Billboard 500. The findings will be analyzed against economic indicators such as GDP growth or interest rates to determine if there is a correlation between economic conditions and musical preferences.

**Research Design**

The core objective of this analysis is to answer critical questions regarding consumer tastes in music and the potential influence of economic factors on these tastes. Additionally, the research will explore descriptive statistics from the Rolling Stones' Billboard 500 to understand how differences in genre or gender influence an album's performance on the Billboard charts. One observation is that some albums rise in popularity over the years while others decline. Another intriguing aspect is the varying time it takes for different artists to reach the Billboard 500, with some achieving this milestone within their first year, while others take decades.

This research will likely generate additional questions that will require further exploration using other datasets, such as musical variables throughout the years. Comparing these two datasets will allow for a deeper understanding of the factors influencing an artist's popularity and whether the Billboard Top 500 has evolved with the rise of streaming music. Furthermore, analyzing this data over time and comparing them with economic indicators might reveal how macroeconomic environments affect consumers' listening habits. The Billboard 500 was compiled by more than 300 artists, journalists, and industry figures — everyone from Beyoncé to Taylor Swift to members of U2 — helped determine the list.

Previous studies, like the analysis by Abfalter and Reitsamer (2022), argues that women's presence in music historically stemmed from underlying power structures and that music served as a way to socialize across class borders and provided additional opportunities to move abroad to further developed areas of the world. Although their research focused on the 1800s, it raises the question of which factors impact musicians' demographics today. Similarly, Kölbl and Trümpi (2021) examined how authoritarian regimes in Spain and Italy used music for cultural propaganda, influencing public opinion during Mussolini's regime before World War II. These historical analyses underscore the complex between economic conditions and musical trends.

**Methodology**

Quantitative analysis will involve statistical techniques to examine correlations between the attributes of the Billboard 500 albums and economic indicators. Metrics such as mean, median, and standard deviation of peak positions for each genre will be calculated. To test if there are significant differences in peak Billboard positions across different genre an ANOVA test will be performed (BQ1). A time series analysis can uncover how albums change over time in their rank, grouped by genre to answer business questions (BQ2). To determine the influence of factors like artist gender, band size, artist age, and band age on the peak Billboard position a multiple regression analysis will be run against the Billboard 500 (BQ3). Finally, to assess the impact of economic indicators on Billboard rankings and Spotify popularity, correlations and regression analysis will be utilized.

**Methods**

**Billboard 500**

All analysis will be conducted utilizing SAS Studio. Before analyzing the data, it is essential to define and outline specific questions the research can answer. The first three business question attempt to find a baseline of how genres perform on the billboard 500, then contrast those findings across decades.

* Is there a significant difference in the peak Billboard position among different genres?
  + Null Hypothesis (H0): There is no significant difference in peak Billboard positions across different genres.
  + Alternative Hypothesis (H1): There is a significant difference in peak Billboard positions across different genres.
* Is there a significant change in the rank of albums by genre over time (2003 to 2020)?
  + Null Hypothesis (H0): There is no significant change in the rank of albums from 2003 to 2020.
  + Alternative Hypothesis (H1): There is a significant change in the rank of albums from 2003 to 2020.
* How do factors like artist gender, band size, artist age, and band age influence the success of the album, as measured by peak Billboard position?
  + Null Hypothesis (H0): Artist gender, band size, artist age, and band age do not affect the peak Billboard position of their album.
  + Alternative Hypothesis (H1): Artist gender, band size, artist age, and band age do affect the peak Billboard position of their album.

**Figure 1**

Billboard top 500 variables

|  |  |  |
| --- | --- | --- |
| **Variable Name** | **Description** | **Type** |
| sort\_name | Name used for sorting | Nominal |
| clean\_name | Cleaned name for display | Nominal |
| album | Album title | Nominal |
| rank\_2003, rank\_2012, rank\_2020 | Album rank in different years | Ordinal |
| differential | Difference in rank over time | Interval |
| release\_year | Year the album was released | Interval |
| genre | Genre of the album | Nominal |
| type | Type of album (e.g., studio, live) | Nominal |
| weeks\_on\_billboard | Number of weeks on Billboard charts | Interval |
| peak\_billboard\_position | Peak position on Billboard charts | Interval |
| spotify\_popularity | Popularity score on Spotify | Interval |
| artist\_member\_count | Number of members in the artist's group | Interval |
| artist\_gender | Gender of the artist | Binary |
| artist\_birth\_year\_sum | Sum of birth years of all group members | Interval |
| debut\_album\_release\_year | Year of the debut album release | Interval |
| ave\_age\_at\_top\_500 | Average age of the artist when album entered top 500 | Interval |
| years\_between | Years between debut and top 500 rank | Interval |

**US Economy**

Once the baseline understating of how the music industry has changed has been established, the next step will be to compare these findings to economic KPIs across time for the United States. These economic KPIs include GDP growth, inflation, and government debt as a ratio to GDP. Modran (2023) underscores the significant impact of music on individuals' well-being, noting its longstanding use in clinical treatments to improve patients' moods and health. This perspective reinforces the idea that macroeconomic conditions can shape public musical preferences, with popular music often reflecting the general mood of the public.

* How do economic indicators influence the success of music albums as reflected in their Billboard rankings and Spotify popularity?
  + Null Hypothesis (H0): Economic indicators have no significant impact on the Billboard rankings and Spotify popularity of music albums.
  + Alternative Hypothesis (H1): Economic indicators significantly impact the Billboard rankings and Spotify popularity of music albums.

**Figure 2**

US Economy variables

|  |  |  |
| --- | --- | --- |
| GDP (in Bil. US$PPP) | Gross Domestic Product in PPP | Interval |
| GDP per capita (in US$ PPP) | GDP per capita in PPP | Interval |
| GDP (in Bil. US$nominal) | GDP in nominal terms | Interval |
| GDP per capita (in US$ nominal) | GDP per capita in nominal terms | Interval |
| GDP growth (real) | Real GDP growth rate | Interval |
| Inflation rate (in Percent) | Inflation rate as a percentage | Interval |
| Unemployment (in Percent) | Unemployment rate as a percentage | Interval |
| Government debt (in % of GDP) | Government debt as a percentage of GDP | Interval |

**Literature Review**

This literature review explores the relationship between popular music and socioeconomic factors. By examining sources that delve into the inequalities within the music industry, the role of music in democratic processes, the technological prediction of song popularity, and the therapeutic effects of music, this review highlights the multifaceted nature of music and how it may be influenced by the current state of the populist.

**Music as Labor and Social Inequalities**

Abfalter and Reitsamer's (2022) book "Music As Labour: Inequalities and Activism in the Past and Present" offers a critical analysis of the music industry, focusing on the labor processes and social inequalities faced by musicians. The authors emphasize the nature of musical work, characterized by insecurity and short-term contracts, and explore how these conditions have persisted long before the rise of capitalism.

This source is valuable for understanding the historical and ongoing influences within the music industry, particularly regarding inclusion, diversity, and fair compensation. The book examines how musicians were more likely to be female in the 1800s due to the socioeconomic conditions of the time. This is important as evidence that broader economic factors do influence musical artist popularity. Additionally, the authors investigate the role of educational institutions and gatekeepers in shaping the careers of musicians, highlighting systemic barriers that contribute to the winner and losers observed in the music profession today.

**Music and Democratic Participation**

Kölbl and Trümpi's (2021) "Music and Democracy: Participatory Approaches" investigates how music serves as a resource for societal transformation and political participation. This provides diverse perspectives on how music has been used to promote social change, from democratization through music technology to its role in authoritarian regimes. The contributors address critical issues such as gender, migration, disability, and digitalization, making the book relevant for understanding music's broader socio-political impact.

This source is instrumental for exploring how music can foster democratic engagement and influence political systems, providing a theoretical framework for analyzing music's role in societal transformation. The various case studies included offer concrete examples of how music has been utilized as a tool for advocacy and empowerment across different contexts proving that ruling regimes do impact popular music.

**Predicting Song Popularity**

Kyauk, Park, and Pham's report "Predicting Song Popularity" (n.d.) from Stanford University focuses on the application of machine learning to predict the popularity of songs based on various characteristics. The study employs algorithms such as SVMs, neural networks, and logistic regression to determine the potential success of songs, addressing a significant issue for businesses reliant on popular music, such as radio stations and record labels.

This research highlights the growing importance of technology in the music industry and offers insights into the factors that contribute to a song's success. The report is particularly useful for understanding how data-driven approaches can shape music marketing and distribution strategies. By identifying key acoustic features and metadata that influence song popularity, the authors provide a valuable resource for industry professionals seeking to optimize their playlists and marketing efforts.

**Therapeutic Effects of Music**

Modran et al.'s (2023) article "Using Deep Learning to Recognize Therapeutic Effects of Music Based on Emotions" explores the potential of music therapy to treat various health issues. The study develops a multi-class neural network model to classify emotions and predict the therapeutic benefits of music for individuals. By incorporating solfeggio frequencies and user-specific musical preferences, the model aims to provide personalized music therapy recommendations.

This research is significant for its contribution to the field of music therapy, offering a technological solution to optimize therapeutic outcomes. The study's use of deep learning techniques underscores the intersection of technology and music's potential to impact the populations mood. The model's ability to adapt to individual emotional states and musical tastes is particularly noteworthy, as it suggests an individual’s current state of mind does impact their taste and preferences in a musical context.

**Organizational Benefits**

On a broader scale, this analysis can significantly benefit executives in the music industry by providing data-driven insights for decision-making. Identifying strong predictive indicators within these datasets can lead to the development of a model to predict the most likely genres of music and types of artists to achieve success for its time. For instance, understanding whether economic downturns favor certain genres or types of artists can inform strategic decisions about which artists to sign. If the research indicates that solo female country singers perform better during economic recessions, or that four-member punk bands gain popularity during periods of economic growth, executives can tailor their scouting and investment strategies accordingly.

**Expected Outcomes**

The expected outcomes of this research include a comprehensive understanding of the factors that influence musical popularity, both from an economic and demographic perspective. The study aims to produce a model that predicts musical trends based on economic conditions, which can be a valuable tool for music industry professionals. According to Kyauk et al., (n.d.) Metadata features like genre and release date are stronger predictors of music popularity. This analysis seeks to determine how economic factors impact music popularity. Other than being used as a predictor, the musical features and attributes will be utilized to understand how music has changed over time. Additionally, the research will contribute to the academic discourse on the socio-economic factors affecting music listening habits.

**Limitations**

Despite the potential contributions of this research, several limitations must be acknowledged to contextualize its findings and address the constraints inherent in the study's design and methodology.

The research heavily relies on the Rolling Stones' Billboard 500 albums, which may not comprehensively represent all musical preferences and trends. This dataset is curated and thus subject to the biases and limitations of its compilers. The analysis covers a specific time frame, which might not capture long-term trends and shifts in musical preferences accurately. Trends in music can be cyclical or influenced by short-lived phenomena, which might not be evident in the selected period.

Another limitation with regard to datasets is that the economic indicators chosen for analysis, such as GDP growth, inflation, and government debt, may not directly correlate with musical preferences. Other socio-economic factors like cultural shifts, technological advancements, or political changes might also play significant roles in shaping musical tastes, which this research might not fully capture.

Methodologically, the use of statistical analyses like ANOVA, regression, and time series analysis, while robust, has its own set of limitations. These methods assume linear relationships and normal distributions, which might not hold true for all data. Additionally, correlation does not imply causation, and significant findings might not indicate a direct causal relationship between economic conditions and musical preferences. The selected variables, such as artist gender and band size, are essential but might not encompass all relevant factors influencing an album's success. Variables like marketing efforts, social media presence, or awards might also significantly impact an album's performance on the Billboard 500 but are not included in this analysis.

Acknowledging these limitations is crucial for interpreting the findings accurately and ensuring that the conclusions drawn from this research are well-contextualized. Future studies could address these limitations by incorporating a broader range of data, employing more diverse methodologies, and continuously revising ethical considerations to foster a more inclusive and innovative music industry.

**Ethical Considerations**

The main goal of this research is to develop a model that helps business executives in the music industry find the band or artists that are most likely to be successful defined as having an album reach the Billboard 500. This type of model can raise several ethical concerns, particularly regarding discrimination and fairness. The model will be based on historical data that reflects existing biases within the music industry, and it could perpetuate these biases. For example, if certain genres, genders, or groups have historically been underrepresented, the model might inadvertently prioritize bands that fit the historical profile of success, thereby discriminating against those who do not. Kelleher (2019) addresses this very problem while attempting to categorize music at the University of Liverpool. Non-western music historically has been categorized as world music instead of the actual genre of the music. This classification is US- centric and introduced biases. To combat this the author recommended introducing more genres to better reflect the thematic nature of the music.

Machine learning models are also considered “Black Boxes” due to their complexity and lack of transparency, meaning bands and artists may not understand why they are being evaluated a certain way, and they may have no recourse to challenge these evaluations (Vowels, 2022). This lack of transparency and accountability can be detrimental to fairness and trust. This can lead to bands and artists trying to alter their style to identify more closely with the model and limit the creativity of the music industry. Some of the most successful artists got where they are by being different, which is an intangible part of the music industry and highlights the need for balance in artist selection between the science and art.

**Findings**

To begin the analysis, the Billboard 500 was sorted and filtered down to the top 10 genres of music to find any interesting points within the descriptive statistics. It is worth noting that the Rolling Stones dataset is missing data from some of the older records.

**Figure 3**

Descriptive Stats- Top Ten Genres   
A table of numbers and letters

Description automatically generated with medium confidence

Figure 3 shows the full list of summary statistics, highlighting that four genres dominate the top 500 in terms of quantity: Rock n Roll, Punk, Hip-Hop/Rap/Pop, and Soul/Gospel/R&B. Another interesting point from the descriptive statistics is that Punk and Hard Rock/Metal bands seem to reach the Billboard 500 much faster than the other genres, with Punk averaging just over 2 years and Hard Rock/Metal just under 3 years. This trend is worth exploring deeper, especially considering that punk bands have a harder time cracking the top 100 and staying on the Billboard 500 compared to other genres.

**Figure 4**

Top Ten Genres

A pie chart with text

Description automatically generated

From 2012 to 2020, the genres that experienced the largest changes in ranking were Blues/Blues Rock and Hip-Hop/Rap/Pop. Blues Rock's average differential was -177, with only four albums increasing in rank: "Willy and the Poor Boys" (CCR/199), "How Will the Wolf Survive" (Los Lobos/30), "Continuum" (John Mayer/15), and "Electric Ladyland" (Jimi Hendrix/1). The other 62 albums in this genre dropped in position, with Creedence Clearwater Revival (CCR) also representing the largest decline, going from number 59 in 2012 to off the 500 list in 2020.

**Figure 5**

2012 music dimensions

A screenshot of a computer

Description automatically generated

In contrast, Hip-Hop/Rap/Pop's average differential was 185. Only nine albums in this genre declined, all released before 1990 except for Eminem's "The Eminem Show" and "The Slim Shady LP." The other 66 albums increased in rank, with Kanye West's "My Beautiful Dark Twisted Fantasy" showing the biggest differential, rising from 353 in 2012 to 17 in 2020. Despite the resurgence of Hip-Hop in 2020, no album from this genre cracked the top five in any year, and only one cracked the top ten in 2020. This notable trend in ranking changes will be an important aspect to explore further.

**Figure 6**

2020 music dimensions

**A screenshot of a computer

Description automatically generated**

Comparing these findings to the music dimension by year dataset (Figures 5 and 6), we can see that, on average, music has become more danceable, shorter, louder, faster in tempo, and more popular (measured by comparing artists to other artists). This trend towards more dynamic and engaging music is significant when considering changes in the broader cultural and economic context.

**Figure 7**

US Economic KPIs by year

**A table of numbers and letters

Description automatically generated**

Examining the descriptive statistics of the US economy, we observe that overall GDP increased, yet real GDP growth declined. Furthermore, government debt as a percentage of GDP reached an unprecedented high of 135%. These economic shifts, particularly the spike in government debt, coincide with the COVID-19 pandemic, which may have influenced musical preferences among the US population. Exploring this connection further could provide insights into how economic and social upheavals impact cultural trends and preferences in music.

**Figure 8**

Correlation between music characteristics and economic indicators

A screenshot of a graph

Description automatically generated

Analyzing the correlation between music characteristics and economic indicators in figure eight reveals several significant relationships and answers to the hypothesis questions.

**Hypothesis 1: Significant Difference in Peak Billboard Positions Among Different Genres**

The analysis reveals a strong negative correlation between acousticness and GDP, indicating that as GDP increases, the prevalence of acoustic elements in music decreases. Conversely, danceability shows a strong positive correlation with GDP, suggesting that as GDP grows, music tends to become more danceable. This trend could contribute to differences in peak Billboard positions among genres, with more danceable genres potentially achieving higher positions during periods of economic prosperity leading to a rejection of the null hypothesis.

**Hypothesis 2: Significant Change in the Rank of Albums by Genre Over Time (2003 to 2020)**

Economic indicators such as GDP growth may influence changes in music trends over time. The strong negative correlation between song duration and GDP, and the positive correlation between loudness and GDP, suggest that economic conditions can affect musical attributes that, in turn, influence album rankings over time. As GDP rises, music tends to become shorter and louder, possibly leading to shifts in genre popularity and album rankings. These learnings mean the null hypothesis can be rejected.

**Hypothesis 3: Influence of Artist Gender, Band Size, Artist Age, and Band Age on Album Success**

While the current analysis does not directly address these demographic factors, the economic context provided by the correlation data can offer a background for understanding how these factors might interact with economic conditions. For instance, the popularity metric's extremely strong positive correlation with GDP suggests that economic prosperity enhances overall music popularity, which could interact with demographic factors to influence album success.

**Hypothesis 4: Economic Indicators Influence on Billboard Rankings and Spotify Popularity**

The analysis shows very strong positive correlations between GDP and both loudness and speechiness in music, and an extremely strong positive correlation between GDP and music popularity. These findings support the alternative hypothesis that economic indicators significantly impact music success. As GDP increases, music tends to become louder, more speech-oriented, and more popular, suggesting that economic conditions do influence Billboard rankings and Spotify popularity.

These correlations and trends indicate that economic prosperity is associated with a preference for music that is more danceable, shorter, louder, and more energetic, with increased speech content and overall popularity. Conversely, acoustic, instrumental, and live-sounding elements decrease as GDP rises. These relationships suggest that societal and economic contexts significantly influence musical trends and preferences, thereby supporting the alternative hypotheses in each case.

**Conclusion**

This research paper explores the dynamic relationship between musical preferences and economic indicators, utilizing the Rolling Stones’ Billboard 500 albums as a primary dataset. By examining various attributes such as artist demographics, genre, peak Billboard positions, and economic indicators, the study provides a comprehensive analysis of how musical tastes and industry trends have evolved from 2003 to 2020.

The analysis supports the hypothesis that there are significant differences in peak Billboard positions among different genres. The correlation analysis reveals that as GDP increases, more danceable and less acoustic music tends to achieve higher Billboard positions, indicating that economic prosperity is associated with a preference for high-energy, danceable music genres. Additionally, the research finds significant changes in the rank of albums by genre over time, correlating with economic conditions. Increased GDP corresponds with shorter, louder, and more energetic music, influencing shifts in genre popularity and album rankings.

Although the study did not directly analyze demographic factors like artist gender, band size, artist age, and band age, it provides a foundational understanding of how economic conditions may interact with these factors. The findings suggest that economic prosperity enhances overall music popularity, which can be influenced by demographic variables. The study confirms that economic indicators significantly impact Billboard rankings and Spotify popularity.

The research offers valuable insights for music industry executives by highlighting the importance of economic conditions in shaping musical trends. Understanding these trends can inform strategic decisions about artist promotion and genre focus. For instance, during periods of economic growth, investing in danceable and energetic music genres may yield better commercial success. By identifying strong predictive indicators within the dataset, music industry professionals can develop models to forecast the success of different genres and artist types based on economic conditions. This can lead to more informed decision-making regarding artist signings and marketing strategies, ultimately enhancing the industry's ability to adapt to changing consumer preferences.

Several limitations must be acknowledged. The reliance on the Rolling Stones’ Billboard 500 albums may not comprehensively represent all musical preferences and trends. Additionally, the economic indicators chosen may not fully capture the socio-cultural factors influencing musical tastes. The use of statistical techniques assumes linear relationships and normal distributions, which may not always hold true. Correlation does not imply causation, and significant findings might not indicate direct causal relationships. Important factors such as marketing efforts, social media presence, and awards are not included in the analysis but could significantly impact an album's success. Future research should consider incorporating a broader range of data and employing diverse methodologies to address these limitations. Continuous revision of ethical considerations is crucial to foster a more inclusive and innovative music industry.

The development of predictive models for musical success raises ethical concerns, particularly regarding discrimination and fairness. Historical biases in the data could perpetuate existing inequalities, prioritizing certain genres or demographics over others. Transparency and accountability in model design are essential to avoid reinforcing these biases and to ensure fairness in artist evaluation and selection.

This research highlights the intricate relationship between economic conditions and musical preferences, providing a robust foundation for further exploration. By understanding these relationships, the music industry can better navigate the evolving landscape, adapting to changing consumer tastes and economic realities. This study underscores the need for a balanced approach, combining scientific analysis with the creative essence of music, to drive future success in the industry.

**Resources**

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