**Effects of Music on Mental Health**

BUAN 6312.002: Applied Econometrics and Time Series Analysis

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Group 3

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**Introduction :** ​

In recent years, there has been a burgeoning interest in exploring the therapeutic potential of music for enhancing mental health and well-being. As the prevalence of mental health disorders continues to rise globally, the need for effective and accessible interventions has become increasingly urgent. Music, with its profound ability to evoke emotions, stimulate memories, and induce relaxation, holds promise as a non-invasive and culturally inclusive therapeutic modality. Understanding the mechanisms through which music influences psychological and physiological processes can provide valuable insights into its therapeutic effects and inform the development of evidence-based interventions tailored to individual needs.

The present study seeks to investigate the effects of music on mental health across various dimensions, encompassing mood regulation, stress reduction, and cognitive enhancement. By examining the impact of different music genres, individual differences in music preferences, this research aims to contribute to a deeper understanding in potential of music. By elucidating the role of music in promoting mental well-being, this research endeavours to bridge the gap between science and practice, paving the way for innovative approaches to mental health care in the 21st century.

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**Literature Review :**

The current study builds upon existing research examining the therapeutic effects of music on mental health while extending the scope to investigate the differential impact of listening to various music genres. Consistent with previous findings, music therapy has demonstrated efficacy in alleviating symptoms of anxiety and depression (Carr et al., 2017; Fancourt et al., 2019). Moreover, self-selected music listening has been associated with stress reduction and mood improvement (Pelowski et al., 2017; Krause et al., 2019), highlighting the potential of music as a self-directed coping mechanism for managing emotional states. However, the specific effects of different music genres on mental health outcomes remain understudied, representing a gap in the existing literature.

In addition to exploring the effects of music genres, the present study aims to examine the influence of factors such as music genre preferences, active engagement with music (e.g., playing an instrument, being a music composer), and listening habits on mental well-being. Previous research has highlighted the potential impact of these factors on individuals' emotional responses to music and their overall psychological well-being (Sleigh & McElroy, 2014; Fancourt & Finn, 2019). By integrating these factors into the analysis, the current study seeks to provide a more comprehensive understanding of the complex relationship between music and mental health.

**References:**

* <https://www.tandfonline.com/doi/full/10.1080/17437199.2020.1846580>
* <https://journals.sagepub.com/doi/abs/10.1177/1029864919850606>

**Data :**

The dataset **“**Music & Mental Health Survey Results**”** (available as mxmh\_survey\_results.csv) was collected from survey responses related to music taste and self-reported mental health. The dataset contains several columns (features) that capture information about respondents’ music preferences and their self-reported mental health

* **Age** : Respondent's age.
* **Timestamp**: Date and time when form was submitted
* **Primary streaming service** : Respondent's primary streaming service
* **Hours per day** : Number of hours the respondent listens to music per day
* **While working** : Does the respondent listen to music while studying/working?
* **Instrumentalist** : Does the respondent play an instrument regularly?
* **Composer** : Does the respondent compose music?
* **Fav genre** : Respondent's favorite or top genre
* **Exploratory** : Does the respondent actively explore new artists/genres?
* **Foreign** **languages** : Does the respondent regularly listen to music with lyrics in a language they are not fluent in?
* **BPM** : Beats per minute of favorite genre
* **Frequency** [**Music** **Genre**] : How frequently the respondent listens to the music genre
* **Anxiety** : Self-reported anxiety, on a scale of 0-10
* **Depression** : Self-reported depression, on a scale of 0-10
* **Insomnia** : Self-reported insomnia, on a scale of 0-10
* **OCD** : Self-reported OCD, on a scale of 0-10
* **Music** **effects** : Does music improve/worsen respondent's mental health conditions?
* **Permissions** : Permissions to publicize data

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**Data Cleaning :**

* The dataset used in this study has 17 missing values from 7 variables, which were removed due to their low percentage (≈2% of the data) and lack of non-random pattern.
* However, the variable measuring beats per minute (BPM) has 107 missing values, accounting for approximately 15% of the dataset. To address this, regression imputation was used and two outliers in the BPM data were removed.
* Additionally, the response variable "music effect" had an imbalance issue, with only 17 "worsen" responses compared to 534 "improve" and 165 "no effect" responses. To mitigate this effect, the "no effect" and "worsen" levels were merged into one response level called "no improvement".
* Dropping NANs because The independent variable should not have any NANS  becz they are not allowed when fitting an OLS regression model

**Exploratory Data Analysis (EDA):**A colorful circle with white text

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The donut chart consists of 12 segments, each representing a different music genre and its percentage popularity. Rock is the most popular genre, accounting for 23.25% of preferences, followed closely by Pop at 15.67%. Other notable genres include Metal, Hip hop, and EDM. Classical music has the smallest representation at 2.7%. Overall, the chart provides insights into the diverse musical tastes within the group surveyed.A blue and white graph

Description automatically generatedThe horizontal bar graph illustrates the impact of music on people’s mood based on their favorite music genres.

* The graph shows two categories: “Improved” (dark blue) and “No effect” (light blue).
* For most music genres, more than half of the respondents reported an improved mood when listening to that type of music.
* **Rock** and **Pop** have the highest percentage of respondents experiencing an improved mood (above 80%).
* **Metal** and **Video game music** have slightly higher percentages of people who feel no effect on their mood compared to those who feel an improvement.

Overall, the chart highlights the positive influence of music across various genres on people’s emotional well-being.

A screenshot of a graph

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The above graph displays the distribution of scores for four different mental health conditions: **Insomnia**, **OCD**(Obsessive-Compulsive Disorder), **Depression**, and **Anxiety**. Each condition has a separate bar graph showing the count of individuals who scored at various levels on a scale from 0 to 10.

Here are the key points for each condition:

* + **Insomnia**: Most people have lower scores, indicating less severity.
  + **OCD**: The distribution is more varied, with some individuals scoring higher.
  + **Depression**: Similar to OCD, there’s variability in scores, but overall, it’s not as severe as Insomnia.
  + **Anxiety**: Like Insomnia, most people have lower scores, suggesting less severity.

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* **Anxiety and Depression:** A strong positive correlation (r = 0.52) was observed between anxiety and depression levels among participants. This suggests that individuals with higher anxiety levels tend also to experience higher levels of depression.
* **Depression and Insomnia:** A moderate positive correlation (r = 0.38) between depression and insomnia indicates that increases in depression scores are associated with higher levels of insomnia.
* **Age and Listening Hours:** Both age and hours spent listening to music per day showed weak correlations with anxiety, depression, and insomnia, suggesting these factors have less direct impact on mental health metrics within this dataset.

**Empirical Methods:**

1. **Analysis of Variance**

Since we have observed that the top three favorite genres were Rock, Pop and metal. We perform Anova test to check whether there are significant differences in Anxiety and Depression for different levels of the variables

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For **Anxiety**:

* + The independent variable **Frequency Metal** is statistically significant at the 0.001 level.
  + The independent variables **Frequency Pop** and **Frequency Rock** are not statistically significant.

For **Depression**:

* + - Both **Frequency Metal** and **Frequency Pop** are statistically significant at the 0.001 level.
    - The independent variable **Frequency Rock** is not statistically significant.

In summary:

* + Listening to metal music appears to have a significant impact on both anxiety and depression scores.
  + Pop music also shows a significant effect on depression scores.
  + Rock music does not significantly influence anxiety or depression scores.

1. **Hypothesis Testing**We have decided to perform a hypothesis test comparing the anxiety levels between two groups: individuals with high music listening hours and those with low music listening hours. The goal is to determine whether there is a statistically significant difference in anxiety levels based on music listening habits

*Null Hypothesis (H0):*   
There is no difference in anxiety levels between individuals who listen to music for more than the median hours per day and those who listen less.

*Alternative Hypothesis (H1):*  
Individuals who listen to music for more than the median hours per day have different anxiety levels compared to those who listen less.

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* The **T-statistic** measures how many standard errors the sample mean is away from the null hypothesis mean. In this case, a positive T-statistic indicates that the high-listening-hours group has a higher mean anxiety level than the low-listening-hours group.
* The **P-value** represents the probability of observing such a difference (or more extreme) if the null hypothesis were true. Since the P-value is less than the common significance level of 0.05, we reject the null hypothesis.
* Therefore, we conclude that there is a **statistically significant difference** in anxiety levels between the two groups. The high-listening-hours group tends to have higher anxiety levels.

1. **Binary Logit Model with Backward Elimination**

Binary logistic regression is a statistical method used to model the relationship between a **binary dependent variable**  and one or more **independent variables**

Backward elimination is a **variable selection technique** used to simplify a regression model by iteratively removing less significant variables. The process starts with including all candidate variables (both main effects and interactions) in the model. Then, at each step, the least significant variable (based on statistical tests or criteria) is removed from the model. The goal is to arrive at a more parsimonious model that retains only the most relevant predictors.

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**Result :**  
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The final model from the result of backward elimination process is :  
  
Logit (Music effects) = -0.286 + 0.717 [`While working` = Yes] + 0.460 [`Instrumentalist` = Yes ] + 0.605 [`Exploratory` = Yes] + 0.264 [`Frequency [Gospel]`Rarely ] - 0.265[`Frequency [Gospel]`Sometimes] + 15.610[`Frequency [Gospel]`Very frequently] - 0.002[`Frequency [R&B]`Rarely] + 0.423[`Frequency [R&B]`Sometimes] + 0.552[`Frequency [R&B]`Very frequently]

This equation represents the log-odds of the event “Music effects” based on the given coefficients

**Interpretation :**

Listening to music while working increases the log odds of improved mental state by approximately 0.72

Being an instrumentalist is associated with better mental health and increases the log odds of improved mental state by approximately 0.46.

Exploring different types of music positively impacts mental well-being by increasing the log odds of improved mental state by 0.60.

The coefficients for different frequency levels of listening to gospel and R&B music are not statistically significant at 95% level. This is also supported from our Exploratory data analysis where we observed that Gospel and R&B were among the least favourite music genres.

Testing for multicollinearity between the predictor variables from the final model, we can observe that the multicollinearity levels, while present, may not be severe enough to cause major issues with the model coefficients

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A graph of a normal plot

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* A QQ plot (Quantile-Quantile plot) is used to assess whether the residuals (differences between observed and predicted values) follow a normal distribution. The plot compares the quantiles of the residuals to the quantiles of a theoretical normal distribution.
* Most of the data points lie close to the reference line, indicating that the residuals are approximately normally distributed. There are some slight deviations at both ends of the curve, but overall, the residuals follow the expected pattern.

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**Conclusion :**

In this study, we set out to examine the effects of music on mental health, with a specific focus on anxiety, depression, insomnia, and OCD. Through a comprehensive analysis utilizing binary logistic regression, ANOVA tests, and hypothesis testing, several key findings emerged, shedding light on the complex relationship between music consumption habits and mental well-being.

Our results underscored the significant impact of music engagement on mental state, revealing that listening to music while working was associated with an increased likelihood of experiencing improved mental well-being. Furthermore, exposure to music performed by instrumentalists emerged as a predictor of better mental health outcomes, highlighting the potential therapeutic benefits of instrumental music in promoting emotional regulation and relaxation.

Exploring different types of music was found to have a positive impact on mental health, suggesting that diversifying one's musical repertoire may contribute to enhanced psychological well-being. However, it is essential to note that our analysis also uncovered nuanced effects of specific music genres on anxiety and depression. Individuals who reported listening to metal and pop music more frequently exhibited higher levels of anxiety and depression, indicating the need for personalized music recommendations tailored to individuals' preferences and mental health needs.

Additionally, our findings revealed a significant association between anxiety levels and the duration of music listening, with individuals experiencing higher anxiety tending to listen to music for longer durations per day. This suggests that music consumption habits may vary as a function of individuals' psychological states, underscoring the importance of considering individual differences in music therapy interventions.

Overall, our study contributes to the growing body of evidence supporting the therapeutic potential of music in promoting mental well-being. By emphasizing the importance of incorporating music into daily activities and exploring diverse musical genres, our findings underscore the versatility and accessibility of music-based interventions for improving mental health outcomes. Moving forward, further research is warranted to elucidate the underlying mechanisms of music's effects on mental health and to develop tailored interventions that harness the full potential of music as a tool for psychological well-being.