IE6600 Computation and Visualization

Engineering Spring Semester 2025

Project 1

Topic: Mental Health Care in the Last 4 Weeks

Group 3

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1. Introduction

Mental health is a critical aspect of human well-being, affecting not only an individual's emotions but also their physical health, relationships, and overall quality of life. Mental health issues, such as depression, anxiety, and stress, are widespread across different demographics, often making it harder for people to function normally in daily life. However, despite the growing prevalence of mental health challenges, the awareness and availability of mental health resources remain insufficient, especially in certain regions or social groups. This project seeks to use data to enhance our understanding of mental health conditions, identify key factors that contribute to these problems, and potentially offer predictive solutions. Through a detailed analysis of mental health data, we aim to uncover trends and insights that could improve how society approaches mental health care and prevention. By leveraging data analytics and machine learning, we aim to build a more informed model to predict mental health issues based on factors such as age, lifestyle, and medical history, ultimately working toward more effective solutions and treatments.

2. Background

Mental health disorders are one of the leading causes of disability globally, with conditions like depression, anxiety, and schizophrenia affecting millions. According to the World Health Organization (WHO), more than 264 million people suffer from depression alone, and this number continues to grow due to various factors such as societal pressures, work-related stress, and the ongoing global health crises. Despite the increasing awareness of mental health, the stigma associated with seeking mental health care remains a significant barrier, often preventing individuals from getting the support they need. Many of the current treatment plans are generalized and fail to consider individual differences, such as lifestyle, environment, and personal medical histories. With the rise of digital health technologies and the availability of large datasets, there is an opportunity to move towards more personalized approaches in mental health care. The ability to collect and analyze data about individuals' habits, mental states, and personal histories can lead to better-targeted interventions. Our project will explore these

opportunities by focusing on mental health data and how it can be used to predict and identify conditions more effectively.

3. Problem Statement

The primary issue with mental health is that many individuals do not receive the help they need until their condition becomes severe. This is due to the difficulty of diagnosing mental health conditions early on, the lack of awareness of symptoms, and the insufficient availability of resources. Moreover, the existing systems for diagnosing mental health conditions often rely on subjective reports from patients, which can be inaccurate or incomplete. This makes it difficult for healthcare providers to predict mental health problems before they become critical. While there are various questionnaires and assessments used to diagnose mental health conditions, they may not always provide accurate or timely results. Therefore, automating the analysis of mental health data and using predictive modeling can help identify those at risk for developing mental health issues earlier, allowing for timely intervention. This project will address these challenges by exploring how to predict mental health conditions through data analysis and machine learning models. The challenge lies in the quality of data, with issues like missing values, inconsistent information, or incomplete datasets that need to be dealt with carefully.

4. Objectives

This project has several key objectives that will help in understanding mental health conditions and improving the tools used for diagnosis and intervention. The first objective is to prepare the data, which will involve cleaning the data by filling in missing values, removing irrelevant information, and ensuring that all variables are in a suitable format for analysis. The next objective is to analyze the data to understand how different factors, such as lifestyle, age, and medical history, influence mental health. This will involve exploratory data analysis (EDA) techniques to uncover trends and correlations within the data. After that, the project will focus on identifying patterns and insights that could provide a better understanding of the factors contributing to mental health issues. Evaluating the results will be another important objective, where metrics like distribution, mean, variance, and correlation will be used to assess

relationships between different factors. Lastly, the project will focus on visualizing the results. By creating charts, graphs, and other visualizations, the findings will be presented in a clear and understandable way, which will help in making data-driven decisions about mental health care.

```
Missing Values in the Dataset:
Indicator                       0
Group                           0
State                           0
Subgroup                        0
Phase                           0
                               ..
Subgroup_West Virginia          0
Subgroup_Wisconsin              0
Subgroup_With disability        0
Subgroup_Without disability     0
Subgroup_Wyoming                0
Length: 104, dtype: int64
```

5. Methodology

The methodology for this project will involve several key steps: **Data Collection**, **Data Preparation**, and **Data Analysis**.

5.1 Data Collection:

The analysis uses data gathered from the Mental Health Care in the Last 4 Weeks dataset available on data.gov. This dataset includes responses about individuals' mental health conditions, focusing on factors such as their lifestyle habits, medical history, and general health status over the past four weeks. It provides a comprehensive view of mental health trends across different demographics, helping to understand the factors that impact mental well-being. The dataset can be accessed here: Mental Health Care in the Last 4 Weeks - data.gov.

5.2 Data Preparation:

Once the data is gathered from the Mental Health Care dataset, the first step is data cleaning. This involves inspecting the dataset for missing values, inconsistencies, and duplicates, and handling them appropriately. In this project, the "Suppression Flag" column, which had the most

missing values, was dropped. Missing categorical values in the "Group" and "Subgroup" columns were imputed with the value "Unknown." Additionally, feature engineering was performed to enhance the dataset. One example is the encoding of categorical values, such as "Group" and "Subgroup," using one-hot encoding to make them suitable for analysis. This allows us to create new features and improve the overall quality of the data for further exploration.

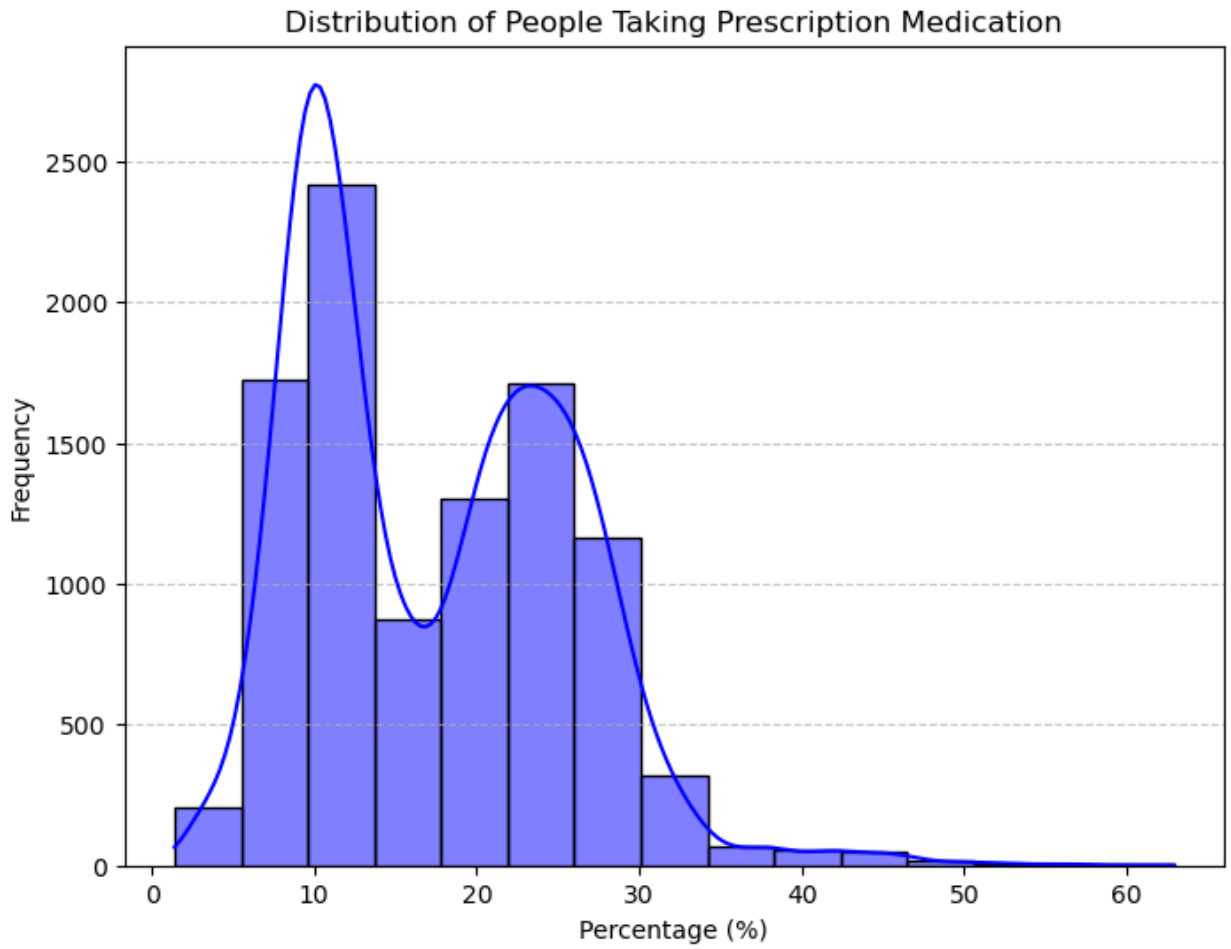
5.3 Data Analysis:

In the analysis phase, the project focused on summarizing the data and identifying key patterns related to mental health. First, we explored the distribution of people taking prescription medication by visualizing the percentage of individuals using medication with a histogram. This helped in understanding the overall trends in medication usage. To analyze trends over time, a line plot was created to track the changes in prescription medication usage over different time periods, with separate lines for each group to show their individual trends.

Further, the analysis delved into medication usage across different subgroups, where a bar plot illustrated the percentage of people taking prescription medication by subgroup, allowing for comparisons between different categories. To understand the broader trends over time, a time series analysis was performed, which showed the average value of medication usage across time periods.

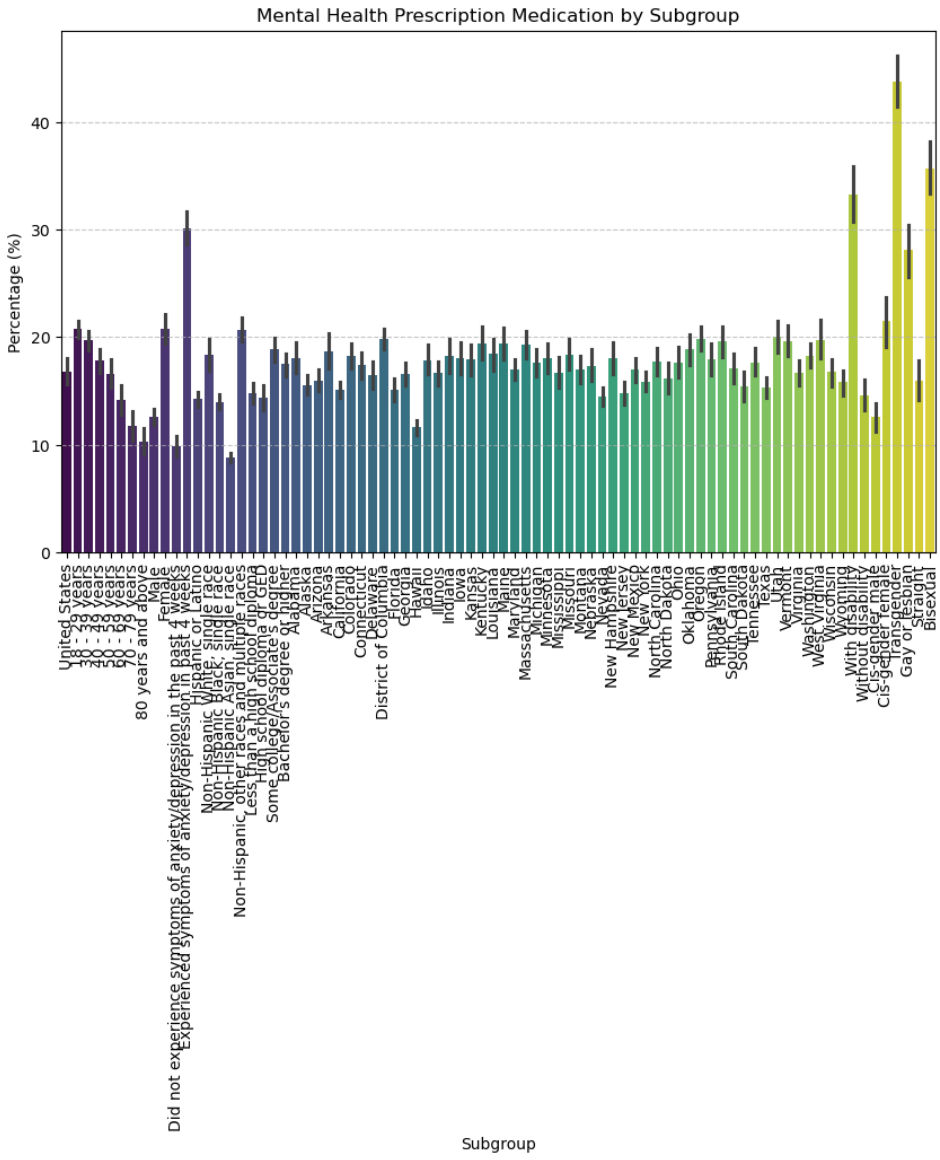
Additionally, a heatmap was used to visualize medication usage trends across groups and subgroups, providing a clearer view of how medication usage varies between these categories. These tasks were accomplished using various visualizations such as histograms, line plots, bar plots, time series plots, and heatmaps, which helped to uncover key insights and trends in mental health medication usage.

Graph 1 : Distribution of People Taking Prescription Medication



This histogram illustrates the distribution of individuals taking prescription medication for mental health conditions, showing how widespread the use of medication is. By displaying the percentage of people in different ranges, it provides insight into the prevalence of mental health issues that require pharmaceutical intervention. A higher frequency in certain percentage ranges suggests that mental health conditions are being actively managed, but it also indicates potential gaps in non-medication interventions or early diagnosis. This visualization helps to identify whether a significant portion of the population is seeking help through medication and could point to areas where further research, outreach, or alternative treatments might be beneficial. Analyzing these trends can help healthcare providers and policymakers improve mental health resources and identify groups that may need more targeted support.

Graph 2 : Medication Usage by Subgroup



This bar chart highlights how prescription medication usage for mental health varies across different subgroups. By visualizing the percentage of individuals within each subgroup taking medication, it provides a clear comparison of medication usage across diverse categories such as age groups, employment status, or other demographic factors. The variation in medication usage across these subgroups could suggest that certain populations are more affected by mental health conditions, necessitating more focused interventions. For example, if certain subgroups show significantly higher medication usage, it could point to higher levels of stress, lack of access to

mental health care, or other underlying factors. This visualization is valuable for identifying which subgroups may benefit from targeted mental health initiatives or preventive measures.

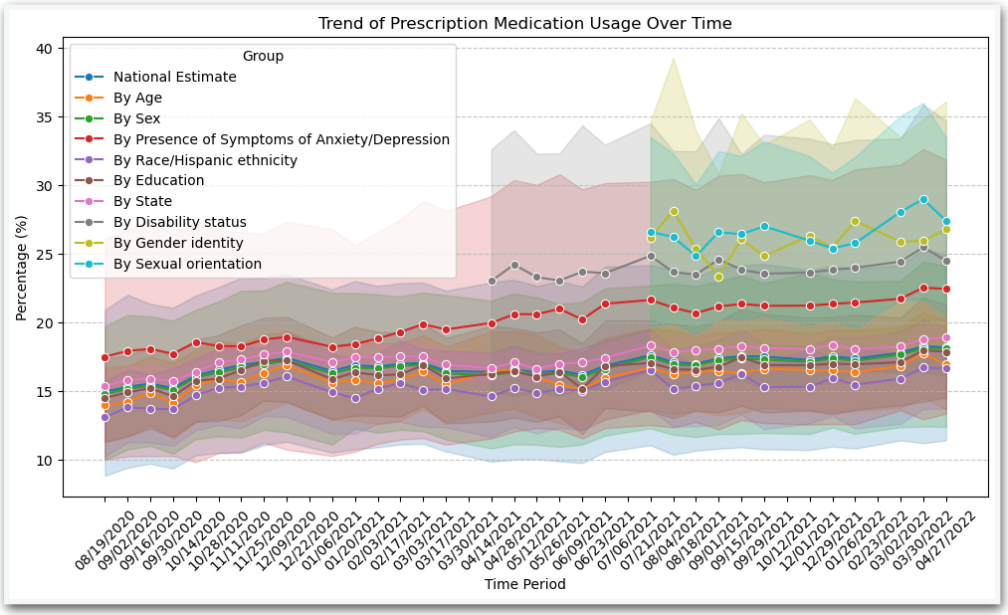
6. Results

The results of the analysis gave us a clearer understanding of mental health trends. We found that the percentage of people taking prescription medication changed over time, showing how mental health treatment patterns have evolved. By looking at these changes over different periods, we could see fluctuations in how people were using medication for mental health issues.

We also found that some subgroups had higher medication usage than others, which suggests that factors like age, lifestyle, and health conditions might play a role in this. A heatmap further showed how different groups had varying levels of medication usage, helping us identify where mental health treatments are more or less common.

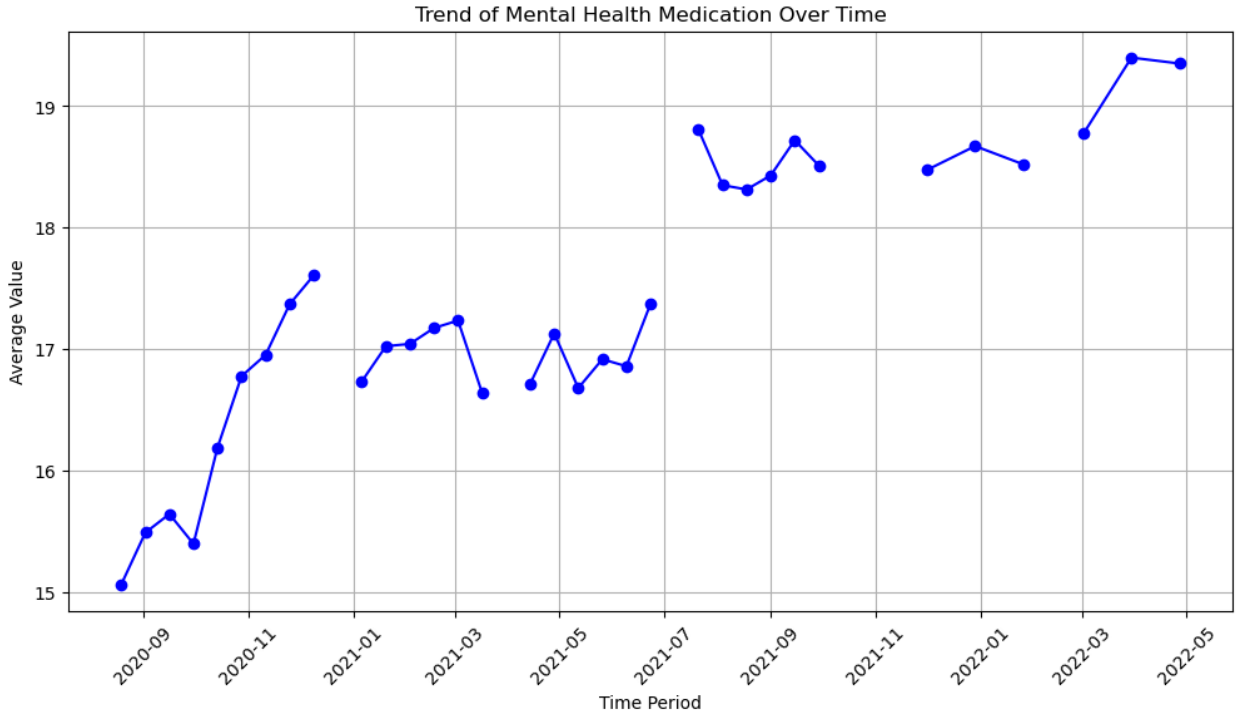
Overall, the results highlighted important patterns in medication usage and pointed out how different factors can influence mental health. This understanding can help in creating better, more targeted mental health care strategies for specific groups.

Graph 3 : Medication Usage Over Time



This line plot illustrates the trends in prescription medication usage for mental health over various time periods, with data segmented by different groups. By tracking how medication usage fluctuates over time, the chart reveals important insights into how mental health treatment patterns evolve. For example, if a particular group shows a consistent increase in medication usage, it could reflect growing awareness of mental health or changes in societal attitudes toward treatment. Conversely, a decline in medication usage in certain groups may suggest improvements in mental health care or prevention strategies. This visualization helps us understand temporal shifts in mental health care practices and identify patterns that might inform future interventions.

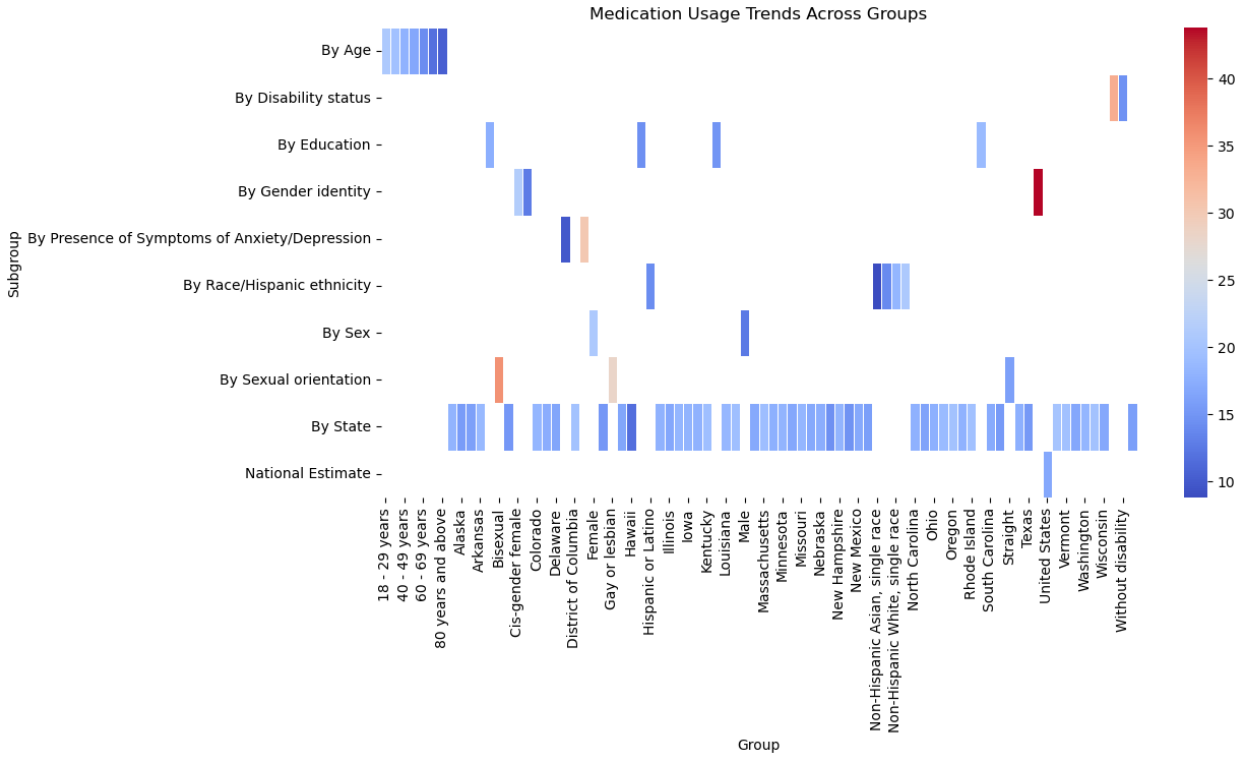
Graph 4 : Time Series Analysis



This time series plot displays the average trend of mental health medication usage over time. By tracking the average value of medication usage across various time periods, we gain a clear view of how mental health treatment has evolved. Fluctuations in the graph may reflect changes in public awareness, healthcare policies, or even seasonal variations in mental health conditions. This visualization is crucial for understanding long-term trends and can inform strategies to address the rising or falling demand for mental health care. Insights from this plot can guide

policymakers and healthcare providers in making timely interventions based on emerging patterns.

Graph 5 : Medication Usage Trends Across Groups



This heatmap illustrates the variation in medication usage trends across different subgroups and groups. By using a pivot table, the data is organized to show the average medication usage for each subgroup, compared across various groups. The heatmap's color intensity represents the level of medication usage, providing a quick visual indicator of where medication use is higher or lower. This visualization can help identify specific subgroups or groups that may require more focused interventions or support. It highlights disparities or trends that could inform targeted healthcare strategies or policies for mental health.

6.1 Interpretation of Results

Once the results are presented, we will look at what the data tells us about mental health. We will focus on how different factors, like age, sleep patterns, and lifestyle habits, affect mental health. For example, if we find that people with poor sleep habits are more likely to take medication, we

can say that sleep is an important factor in mental health. By understanding these patterns, we can suggest ways to improve mental health, like focusing on better sleep or reducing stress. This will help guide interventions and preventive measures.

7. Discussion

The analysis uncovered several important insights about mental health. It showed a clear connection between lifestyle factors, such as sleep patterns and stress levels, with mental health outcomes. People with poor sleep or high stress were more likely to report mental health issues, highlighting the potential for improving sleep hygiene and stress management as preventive measures. Additionally, medication usage was found to differ across various groups, indicating that some populations might need more targeted mental health support, especially those in high-stress environments like certain work sectors.

Over time, the data revealed a trend where more people were using medication for mental health, which suggests a growing awareness and acceptance of mental health care. While challenges like missing data affected the analysis, the findings strongly point to the importance of addressing lifestyle factors when it comes to mental health prevention and treatment. Promoting healthier habits and offering more mental health resources could make a significant impact on improving overall well-being.

8. Conclusion

In this project, several key tasks were carried out to analyze the mental health dataset. The data was cleaned by handling missing values, removing irrelevant columns, and encoding categorical variables. Exploratory analysis was conducted using various visualizations such as histograms, line plots, bar charts, and heatmaps to identify trends in medication usage and its relationship with different subgroups and time periods. Time series analysis helped track changes in mental health medication usage over time. Heatmaps were also used to compare medication usage trends across groups. These visualizations provided valuable insights into the distribution of mental health conditions and medication usage, enhancing the understanding of the data.