

# **EVALUATING THE EFFECTS OF VARIOUS DRUGS IN BANGLADESH THROUGH MACHINE LEARNING TECHNIQUES**

**BY**

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This Report Presented in Partial Fulfilment of the Requirements for the Degree of  
Master of Science in Management Information System

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**DAFFODIL INTERNATIONAL UNIVERSITY**

**DHAKA, BANGLADESH**

**JANUARY 2025**

# APPROVAL

This thesis titled "Evaluating the effects of various drugs in Bangladesh through machine learning techniques", submitted by MD.Majedul Islam to the Department of Computer Science and Engineering, Daffodil International University, has been reviewed and accepted as satisfactory for the partial fulfillment of the requirements for the degree of Master of Science in Management Information System. The thesis has been approved for its style, content, and presentation. The presentation is scheduled to be held on 11<sup>th</sup> January 2025.

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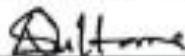
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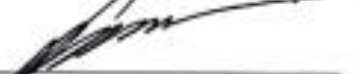
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## DECLARATION

We hereby declared that this project has been done by us under the supervision of **Dr. Sheak Rashed Haider Noori, Professor & Head, Department of CSE** at Daffodil International University. We also declare that neither this project nor any part of it has not been submitted elsewhere for the award of any degree or diploma.

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## ACKNOWLEDGEMENT

At first. I would like to thank and grateful to almighty Allah for His blessing and kindness which helped me to complete the final year research or thesis successfully. Alhamdulillah for everything. Then I want to give a big thank and like to express my sincere gratitude to Professor **Dr. Sheak Rashed Haider Noori**, Professor & Head, Department of CSE at Daffodil International University in Dhaka. He is my supervisor of this research. My supervisor has extensive knowledge and a strong interest in "Machine Learning Technology" to conduct this study. This endeavor has been helped to do my research work properly. His dedication on research work, helpful character, academic knowledge, encourage anyone, and boosting to do anything. **Dr. Arif Mahmud**, Associate Professor and Director of the MSc in MIS in the Department of CSE, has my sincere gratitude for his helpful assistance in seeing my thesis through to completion. He never stops helping me and guiding me. He made it quite possible for me to finish this course without any difficulties. I got support from him anywhere at any time. When I contacted, he provided me with a solution.

I am grateful to **Dr. Md Zahid Hasan**, who is the Associate Professor and ex-advisor of the MSc in MIS in the Department of CSE. His endless patience, scholarly guidance helps me to reach out all kind of thesis related problem. His research interest on ML and broad knowledge on research field of "Machine Learning Technology" is so much helpful for me. Head sir refer me to do this research on him because of his business.

One of my Batchmate **Mr Alauddin Ahmed** the best guy ever I got, he is very helpful and supportive person. I am grateful to other faculty member of DIU specially to **Mr. Towhiduzzaman** senior co-ordination officer, Department of CSE who helped me in my journey. I would like to thank our entire course mate in Daffodil International University, who took part in this discuss while completing the course work.

Finally, I must acknowledge with due respect the constant support and patience of our parents.

## ABSTRACT

This paper Examines effects on the health of the population of various drugs in Bangladesh through machine learning Techniques. I analyze the impact of different types of drugs on Bangladeshi society and investigate the predictors of drug dependence among individuals with physical and mental health issues. Data were collected from various sources, like surveys and interviews. Took authorize data from some of well-known reputed psychiatrist. More than five hundred (500+) data respondents in the Bangladeshi were analyzed using different machine learning algorithms. The results showed that physical health was the strongest predictor of drug dependence, followed by mental health, financial problems, reasons, and age. The study also revealed that the majority of drug users were aged between 18 to 25 years. I found the second number of drug user's age between 26-30 after analyzing the data. Where most of the user's age are 20-25 now. These findings suggest that physical and mental health issues are important risk factors for drug dependence and should be considered when developing strategies to reduce the prevalence of drug use and also it has important implications for drug prevention and treatment programs in Bangladesh. The research further highlighted the importance of preventive measures to reduce the overall consumption of drugs in Bangladesh. According to the report, machine learning algorithms can be used to create more effective preventative measures and gain a better understanding of the effects of various drug types in Bangladesh. Furthermore, the article makes the case that these tactics ought to concentrate on lowering the use of drugs like marijuana, yaba, heroin, or alcohol and encouraging the use of healthier substitutes. I predicted seven distinct medications using five different algorithms, and my accuracy ranged from 45% to 65%. Next, I applied PCA and achieved more than 98%. Accuracy. Basically, I got the result most efficient and less errorless. The highest accuracy got on Phensedyl 100%, using KNN.

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# CHAPTER 1

## INTRODUITION

### 1.1 Overview

Drug addiction is a chronic, recurrent condition characterized by an unquenchable need to consume drugs despite being aware of the potential risks. Over time, substance addiction can have a detrimental effect on a person's social, emotional, and physical well-being and is associated with a few physical and mental health issues. Drug addiction can lead to financial and legal problems in addition to ruining relationships. [1] Treatment for drug addiction usually consists of therapy, medicine, and support groups. The phrase "impact of drugs" refers to the way that drug use impacts a person's social, emotional, and physical health. Behavioral changes, disruption of social and familial relationships, and damage to the user's physical and emotional well-being are some examples of these adverse effects. Drug addiction usually leads to an increase in criminal activity and can have long-term detrimental impacts on society and the economy. Drug abuse can sometimes lead to death in addition to serious physical and mental health problems. Statistics from 2018 show that over seven million people in Bangladesh are addicted to drugs, with methamphetamine being the main drug of choice for the great majority of those afflicted. More than 11.5 million individuals have died from drug-related causes either directly or indirectly, which is a serious concern for the country and has a big impact on the worldwide mortality rate. We express our gratitude to individuals who are putting up great effort to address this matter, and we implore the government and other relevant authorities to act immediately to stop the drug problem from getting worse [2]. The majority of those who could use drug misuse treatment do not get it. Drugs alter the chemical structure of the brain and interfere with normal brain function. Drug usage raises the levels of some neurotransmitters, including serotonin and dopamine, which increases one's perception of pleasure. A great sense of reward and incentive to continue using the substances may result from this. Substance abuse can seriously harm blood arteries and the heart. Abuse of drugs can raise the risk of arrhythmias, heart attacks, and other heart-related problems. According to the Centers for Disease Control and Prevention (CDC), between 1999 and 2018, the number of deaths from drug-related cardiovascular disease rose by 30.5%.[3] Constipation, nausea, vomiting, and stomach discomfort are just a few of the gastrointestinal problems that can arise from long-term use of

certain medicines, such as opioids. Bangladesh's recent drug consumption figures are concerning. With more than seven million individuals battling addiction, the majority of whom are addicted to methamphetamine, it is clear that the nation urgently needs to address this epidemic. In this research I follow the machine learning model and using 5 algorithms for output. There is huge research paper available where used machine learning model. There are many researchers who did research about prediction base. Drug usage can damage the human body's part such as memory, judgmental thought, and focus. The National Institute research on Drug Abuse and that long-term drug use can harm parts of the brain involved in learning and memory also, it is too hard to recall any previous information or develop any new memories in brain. Usually, a person can take drugs for various of reasons, drugs addictor thought it is including to stress relief, feeling better after taking drugs, problem solver also.[4] They don't know these feelings are only temporary, when they are taking and a temporary part time the drug effects on their body. Some people using drugs as a kind of self-medication to feel better that must be clinically or limited quantity. Drugs may be used as a coping strategy for ill, sad, anxiety, or loneliness. Furthermore, couple cultural norms are commonly connected to drug usage. A People may take drugs to see fit in with specific groups and they thought they are stylish or cool. Aside from these motivations, many drugs user's may be driven to use drugs in an effort to release pressure or reduce uncomfortable feelings.[5] They don't want to take reality. For this reason, any people may use narcotics to avoid dealing with their issues. Generally, drugs are using for several reasons, some of are dangerous than others. Most of the people getting benefit to avoid drugs. In traditional ways findings the problem is time consuming, but if the practitioners taking help with this study, they can give treatment fast. To support the health sector, this paper will be very effective.

## **1.2 Motivation**

There are some core reasons behind any kind of new research or thesis. Mainly research begins when a researcher identifies or gets any kind of limitation of previous work. When previous work is done by any incompleteness or any lack then it can be explored by another one. Anyone can work on the same topic as previous research. If the previous researcher used particular model, algorithm or specific topic then future researchers can improve the limitation, solve issues, try to get higher accuracy than before, and can apply new efficient model to make the research unique. That's why research will be done by new researchers. Though New researcher works on previous or new research topic they must follow the advance rules, method or new experimental theory

for making the research more efficient and effective. Always a researcher focusses on social effects on his research, on how to improve technological usage, always focusing on how can contribute to develop the country. try to avoid harm which will be bad for society. One of the best motivations of research is that researchers want to gather knowledge explore themselves and make sure they have a quality of their full career also academic life. Some of them work for curious mind of exploring their knowledge. and the last one that a researcher focuses on contributing to industrial development causes its development of the people's life model. I have some specific reasons why I am doing research on this topic. I think that there is lack of sufficient research on this topic in Bangladesh, lack of concentration about public health, lack of knowledge about drugs bad effect, in youth society rising drug addiction and it is alarming for society and my country that's why I chosen this topic to keep societal impact. I also intended to improve health care and innovation. Also using new models and many algorithms to make the result more efficient. I want to get more accuracy than any other research and make the research unique

### **1.3 Fundamental Principle of the Study**

The Fundamental Principle of study mainly focuses on the problem, gap and key role of the research, also it focuses on the remaining fact. Every specific research has specific problem which arises from any lack, limitations, or any demand then investigate the issues and justify the research fields. To raise awareness and keep contributing to society it is the Fundamental Principle of the study. In Bangladesh drugs abuse increasing day by day with very poorly. Particularly in youth group age between 18-25 are addicting in drug excessively which is alarming for society. The misuse of drugs such effecting with very poorly on health, economical site. I am focusing the reason of addiction, effect on drugs and specific drugs has some specific sign. My research work on various sector to raise awareness, keep positive effect, make sustainability. And the other things that, traditional identifying process is slow and cost effective where this study predict and arranges the process too fast with less cost.

#### **1.3.1 Context of the study**

Traditionally methods are too slow to predict any kind of sign that's the old innovation now machine learning explore the sector to solve any issues. The main concern of mental health issues also includes in my research. Try to make comprehensive analysis of effect of drugs. Try to assist policy making and raise awareness. also focuses on predict potential output from my research which will help to public concern about drugs. Though there is various lack of understanding

many drugs, but it can fill the previous gap and keep contribute to millions of people because of this research's statement.

### **1.3.2 Relevance of the Study**

Every research focuses on some problem of related fields. Also make relevance state in rationale. In my research focuses on effect of drugs abuse. It is the relevant field because its effect must be considerable and concern public health, focuses on public awareness. Here it also explains why this research are doing this time. Because of the current situation and state research should be done effectively. The results of the study should eventually enhance the health and wellbeing of the populace by enhancing medication safety, improving therapeutic results, and making better use of healthcare resources. This justification highlights the necessity of cutting-edge techniques like machine learning in medication review, addressing current constraints and positioning your research as a timely and significant addition to Bangladesh's healthcare system.

### **1.4 Research Questions**

- RQ1: Which Drugs are most often used in Bangladesh, and what effects do they have on user's outcomes?
- RQ2: Which machine learning algorithms you used, using Bangladesh's accessible healthcare data, are most suited for assessing the effects of drugs?
- RQ3: How can you collect data from several sources?
- RQ4: How does the accuracy of K-Nearest Neighbors (KNN), Ridge Regression, AdaBoosting, Gradient Boosting, and Multi-Layer Perceptron (MLP) compare when evaluating drug effects in the Bangladeshi population?
- RQ5: Which age group in Bangladesh uses the most drugs, and what factors contribute to their higher usage?
- RQ6: What are the common reasons for increased drug usage in specific age groups in Bangladesh?

## 1.5 Expected output

The expected output for each algorithm, in the context of evaluating drug effects and usage patterns, would be:

1. K-Nearest Neighbors (KNN):

Expected Output: Accurate classification or regression results based on similarity between data points (patients). KNN should effectively predict drug usage patterns based on historical data.

2. Ridge Regression:

Expected Output: A linear model that provides continuous predictions, useful for evaluating the relationship between drug usage and various independent variables (e.g., age, gender, health conditions).

3. AdaBoost:

Expected Output: Boosted ensemble model that improves the accuracy of weak learners (e.g., decision trees), yielding better performance on drug effectiveness and safety classification tasks.

4. Gradient Boosting:

Expected Output: Accurate predictions with a strong focus on minimizing residual errors from previous iterations. This method should provide robust performance for both classification and regression of drug effects.

5. Multi-Layer Perceptron (MLP):

Expected Output: Non-linear model that can capture complex relationships in the data, useful for predicting drug usage or effectiveness in different age groups.

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## 1.6 Research Layout

In the first chapter, it sets the foundation by introducing the topic. It discusses the overview of the research, explains the motivation behind the study, and states the rationale for undertaking my thesis work. This study highlights many questions on relevant topics, the expected outputs, here I put the project management and finance aspects. Lastly, it outlines the structure of the entire research in the research layout. In Chapter 2, This chapter provides context to the research by discussing preliminary information related to the subject, followed by a review of related

works in the field. It also includes some relevant important points like analysis of comparative things. Why am I choosing this topic, what is the lack of previous research? These works also highlight the limitations of the study. In the third chapter: Research Methodology, here I introduce the approach used to carry out the research. It includes an overview of the methodology, followed by a detailed explanation of the proposed methodology. This section covers how data is collected, pre-processed, and split into train-test sets. Additionally, the chapter elaborates on the modeling techniques used, including classifiers like Gradient Boosting, AdaBoost, K-Nearest Neighbors (KNN), Multilayer Perceptron (MLP), and Ridge Classifier. Chapter 4 presents the experimental setup, including tools used such as Pandas, Matplotlib, and Sklearn. It then defines the evaluation methods (accuracy, precision, recall, F1 score, ROC curve) and presents the experimental results. The chapter also includes a confusion matrix and an in-depth discussion of the results. Impact on human social lifestyle and make Sustainability for 4th chapter the research's broader impact is discussed. Chapter five, this chapter covers the societal impact (public awareness, healthcare interventions, and support for law enforcement), the environmental impact (pollution reduction, social cost, and sustainable alternatives), and ethical considerations (data privacy, bias, fairness, and transparency). It also outlines a sustainability plan, detailing data infrastructure, long-term economic stability, and alignment with the Sustainable Development Goals (SDGs). The final chapter summarizes the research, provides the conclusion, and discusses the implications for further study. This research helps to recommend future research and give direction also. Here there is also discussion about future research and recommendations for next research work. Limitation of study also included.

# CHAPTER 2

## Background

### 2.1 Introduction

The background of any study must be following the previous research, work, issues and societal impact also focuses on the effectiveness on country development. Here described the development of the problem, summary of previous work highlighting the previous work limitation. Here discussed the areas where existing research are fall lack and where will I keep contribute. Here described relevant work theory, model algorithms, output. The past few years growing of drug addiction is more concern of any society. it is alarming threads of Bangladesh. It is destroying our youth people and making waste people. That's why I worked on this topic and try to make unique research.

### 2.2 Related Works

In Bangladesh drugs abuse increasing day by day with very poorly. Particularly in youth group age between 18-25 are addicting in drug excessively which is alarming for society. The misuse of drugs such effecting with very poorly on health and economical site. There are existing many kinds of research about drugs where used machine learning model, deep learning model and AI. Some of researcher used KNN, Adaboosting, Decision Tree, SVM, gradient boosting etc. there are existing some highly accuracy research. I am doing a unique and new research after studying previous existing study.

Chowdhury et al. (2018) explored in his research the prevalence of drug usage among street drug users and urban populations. By employing statistical and predictive modeling, the research achieved accurate insights into the impact of drug abuse on public health development. However, his research has lacked a comprehensive machine learning approach for predictive analytics.[1] Accuracy/Results: Focused on descriptive statistics rather than predictive accuracy. Rahman Abdul (2020) analyzed his research about drug abuse patterns among students in Bangladesh. It employed survey data and statistical analysis, offering valuable insights into behavioral trends but did not incorporate predictive models or machine learning techniques. Insights were descriptive with no accuracy score reported, as it was not a predictive model.[2] J.J. Smith (2018) predicted drug abuse risk using social, behavioral, and demographic data in his research. Decision Tree and Random Forest classifiers were used, achieving an accuracy of 85%. It

provided insights into individual substance abuse risks.[3] Miler et al. (2019) Using KNN for drug abuse classification, in his research to predict individual addiction issues, achieving an accuracy of 83%. This research focused on single-drug classification rather than multiple drugs. [4] Focused on descriptive statistics rather than predictive accuracy. Mahmud Islam (2020) investigating the reason of drugs using in rural area. And predict the effectiveness of drugs like wide, LSD, alcohol. He used KNN classifier and got output 82%.[5]. Rahman Abdul (2020) did research about drugs abuse of students in Bangladesh, This study provided important insights into drug abuse patterns. The study mainly focused on survey data and statistical methods without focusing on predictive model.[6] j j smith (2018) predicts drug abuse risk based on social, behavioral, and demographic data using machine learning techniques. He used Decision Trees and Random Forest classifiers and got an accurate score of 85%. It predicts individuals' risk for substance abuse. It has many limitations on alcohol.[7] Miler et al (2019) used machine learning model KNN for drug abuse classification and predict the individual addiction issues. About 83% accuracy comes from this study. It focusses on single drugs .it didn't focus on multiple drugs.[8] Zhang et al using adaboost to assess the risk of drug addiction. He has psychological and behavioral data as features. The study gained almost 87% accuracy, which is more effective than any other previous relevant research [9].

To health data analysis Lee (2020), used machine learning techniques like Gradient Boosting, and predict the history of heroin addiction. The model didn't corporate multiple features such as age, gender, and previous addiction history. The report has an impressive 92% accuracy. M.jaman (2022) applied Ridge Regression to predict addiction severity based on continuous clinical and psychological data. This model got accuracy almost 85%. In (2021) Thomas, the authors compared several machine learning classifiers he used KNN, SVM, AdaBoost, and Gradient Boosting to predict drug abuse result. This study reported that 91% got after using Gradient boosting algorithm, using AdaBoost author got the accuracy 88%, and KNN with 85%. These findings suggesting that ensemble methods like Gradient Boosting and AdaBoosting perform better than simpler classifiers.[10]. Here I discuss some researchers work. who are using many kinds of machine learning model and working on unique algorithm which are not same to others. They are using their own creating model and feature and work on particular drugs. Someone worked for predicting and some of them are worked for classify the issues. they used different types of data set and drugs and got accuracy differently. Existing research on drug use in Bangladesh mainly involves qualitative studies, surveys, and statistical analyses to assess the prevalence and impact of various drugs. S.John (2022) used machine learning classifiers, he used

MLPClassifier and Ridge Classifier, to predict patterns in drug abuse behavior. He used raw data his findings indicated that Ridge Classifier showed high accuracy (87%) taking drugs including alcohol, weed, and cocaine. This explores how predictive models can effectively handle complex datasets to classify drug abuse behaviors [11]

## **2.3 Comparative analysis and Summary**

In Bangladesh drugs related existing research are survey based, statistical analyses or qualitative analyses. However, these studies have so many lacks in data driven and not used advanced machine learning models. They didn't focus on classified various drugs. They just did their research based on data not to predict the outcome. But my study focuses on those points and using some different machine learning models to predict the outcome. Their studies focused on specific portions of people and areas. some of them are got less accuracy output because their model is not effective or less efficient. This study didn't work on marijuana, cocaine, heroin or another drugs. Author couldn't use various machine learning model or many kinds of drugs. Some researcher work on single drugs. Where they worked for predicting or statistical information gathered. Few studies worked and performance multiple machine learning models using almost the same dataset. Few are using different models on the same data set and got the outcome different. In my research I am using five algorithm KNNclassifier, Adaboosting, Ridgeclassifier, MLPclassifier, Gradient boosting classifier and worked on seven different drugs to predict various drugs effects. I collect raw data and make fully unique datasets for my study. After studying related work, I have got many limitations and lack in previous research. That's why I work on this topic

## **2.4 Scop of Limitations**

### **2.4.1 Limited Dataset Size and Diversity**

The dataset may not represent the whole kind of drugs user or whole scenario of Bangladesh. My research work focuses on specific groups of people. To find drugs users are very challenging that's why data collection process or journey is so much tough. I collect raw data by root level investigation. I made a google form to collect data and given it to my known person, friend, company worker where I am working. Sometimes I took offline interviews. It's work on limited groups of people; it's not represented by all kinds of drug users. Many others participated and refused to fill in the form and they didn't want to give an interview or their experience. Many of

them are concerned about their privacy, some of them are not stable. Many drug users didn't know how google form worked for research that's why they are not committed. Many people don't know how to fill the google form. Many participants reduce the size and findings issues cannot provide.

### **2.4.2 Data Availability and Quality**

My research work focuses on specific groups of people. To find drugs users are very challenging that's why data collection process or journey is so much tough. Many drugs' users cannot provide exact information. Most of the drugs users are aware to share their information they think they will fall in danger if they provide real information. most drugs addicted people age group 18-25 they're student. They want to keep their addiction confidential, so they hide their name and provide missing information sometimes. I couldn't reach many people, that's why I couldn't take offline interview as much as. This is the main reason that online base collecting data may not be qualified. Mainly I worked on some specific unique drugs, so this kind of users are not available.

### **2.4.3 Focus on Specific group of people**

To collect raw data for my research work, mainly I am focusing on youth people, most of the people are young, and they are university, college students. They are so much advanced in technology that's why cannot provide their information. Then I focused on worker they are not aware of their situation. It is the limited portion of drug addicted people.

### **2.4.4 Limited Drug categories**

There are many kinds of drugs are using Bangladesh from there I only chose seven. It is challenging to collect data for a specific drug and must be unique and real. Drug selection is an easy process but following the categories it is the toughest phase for collecting data. because lack of knowledge about drugs and addicted people.

# CHAPTER 3

## Research Methodology

### 3.1 Overview

Research methodology is a very important part of the research. providing readers with the necessary information to evaluate the reliability and validity of the study to complete research. It is the footprint of research without settings methodology no researchers can do any type of research perfectly. Research methodology is a scientific approach of any research. Research has many ways or working procedures that will be set previously in Research Methodology term. In the term of research methodology here described the data collection procedure, data analysis methods, algorithm approaches and how a model will work. Model comparison and all the things. Such as for scientific research Why does a researcher uses these methods, why does a researcher use this model or algorithm. all the use and doing reason must be set in this term.

- **Data Collection**
- **Data Pre-processing**
- **Feature Engineering and Data Splitting for Train-Test**
- **Applying Machine Learning Algorithm**
- **Model comparison**

### 3.2 Research Methodology

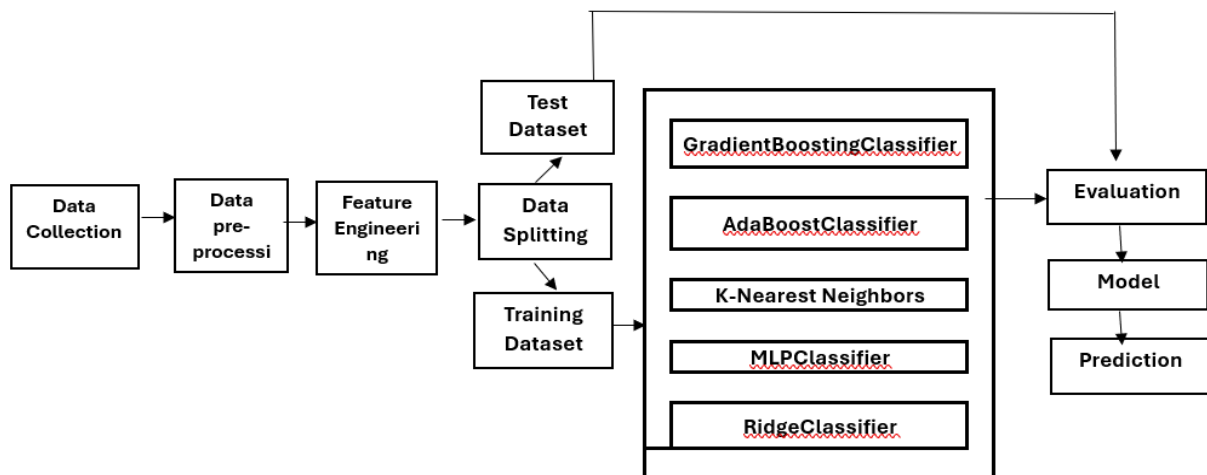


Figure 3.2.1 Research Methodology

### 3.3 Data Collection

I collect raw data by root-level investigation. I made a Google form to collect data and gave it to my known people, friends, seniors, and juniors at my university and college. I have given it to a company worker where I am working. Sometimes I took offline interviews. Almost 10-15% of the data I collected from offline interviews from offline interviews. I asked some of my doctor friends about the signs of drug-addicted people. They gave me real data on how a drug user behaves after taking specific drugs. Here almost I collected 20% data. I made appointments with some doctors in UAE in ERADA rehab Centre. From there I collected 8-10% data. Most of the data was collected from online Google forms. And some of the data has been collected from previous research. It works on limited groups of people it does not represent all kinds of drug users. Many others refused to fill out the form and they didn't want to give an interview or their experience. Many of them are concerned about their privacy, and some of them are not stable. Many drug users didn't know how Google Forms worked for research, that's why they are not committed. Many people don't know how to fill out the Google form.

- Age
- Starting Age
- Reasons
- Sleeping Time
- Spending Amount
- Restlessness Problem
- Mood Swing
- Mental Obsession or Giddiness
- Pressure Feeling or Panic Problems
- Anger Problem
- Weight Problems
- Weakness or Seizures
- Red Eyes or Nosebleeds
- Selfcare
- Sexual Reluctance
- Forgetting Problem
- Sweets Attraction
- Marijuana
- Cocaine
- Heroin
- Alcohol
- Opium
- Phensedyl
- Yaba

### 3.4 Data Pre-processing

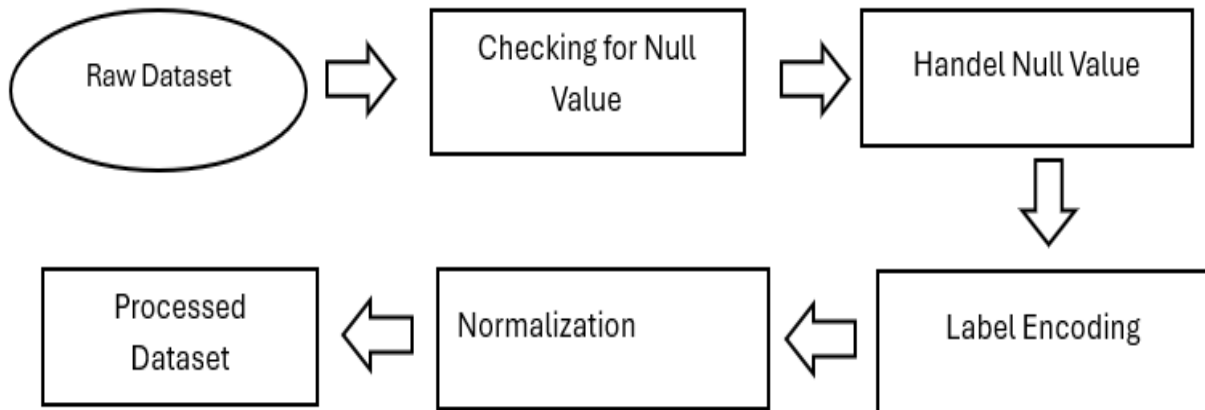


Figure 3.4.1 Data Preprocessing

#### 3.4.1 Raw dataset

Raw data means collecting data from roots. which may be collected by google form, offline interview or online interview. I collected raw data and made a fully unique and new data set. Raw dataset contains various kinds of data like numerical value / features, categorical or variable. Here, null value and missing value must be presented. Here must be presented feature scales that may in consist of. Raw data must be mixing data.

#### 3.4.2 Checking of Null value

Using machine learning tools here I checked null data. Showing null data for every individual feature.

```
data.isnull().sum()
```

Feature	Count
Age	1
start_age	3
Reasons	0
marijuana	0
cocaine	0
heroin	4
alcohol	1
opium	10
Phencidyl	3
yaba	1
sleep_time	5
spending_amount	5
sleeping_or_restlessness	0
mood_swings	8

Figure: 3.4.2.1 Checking of Null value

### 3.4.3 Handle Null value

Based on one feature type I used different strategies to handle the missing data. Here I am showing categorical missing value handling. For numerical missing value I used different strategy.

```
▶ a = data["pressure_or_panic_problems"].mode()[0]
  data["pressure_or_panic_problems"].fillna(a, inplace = True)
```

Figure 3.4.3.1 Handling Null value

### 3.4.4 Label Encoding

Label encoding means all categorical values convert into numerical values here I am doing label encoding for doing label encoded. All data showing in numerically.

	Age	start_age	Reasons	marijuana	cocaine	heroin	alcohol	opium	Phencydyl	yaba	...	Mood_swings	Obsession_or_giddiness	Pressure_or_panic_problems
0	22.0	20.0	Depression	Yes	No	No	Yes	No	Yes	Yes	...	1	1	0
1	21.0	19.0	Loneliness	Yes	No	No	Yes	No	Yes	Yes	...	1	1	0
2	24.0	21.0	Breaking up love relationships	No	No	No	Yes	Yes	Yes	No	...	0	1	0
3	23.0	20.0	Breaking up love relationships	Yes	No	No	Yes	No	Yes	No	...	1	1	0
4	27.0	20.0	Parental behavior and attitudes	Yes	No	No	No	No	Yes	Yes	...	1	1	0

Figure 3.4.4.1 Label Encoding process of data

### 3.4.5 Normalization

In normalization portion all data must be converted into numerical future 0 and 1 to improve model accuracy and efficiency.

```
y1 = data['Marijuana']
y1
```

Marijuana	
0	1
1	1
2	0
3	1
4	1
...	...
503	1

Figure 3.4.5.1 Normalization process of data

### 3.4.6 Processed dataset

After completing all the process of encoding dataset, checking null value, handling null from dataset, and normalizing the dataset I got fully processed dataset. Where no missing value and all data are in numerical format.

### 3.5 Train-Test Splitting

In train-test split method a dataset is divided into two sets. One set work for training data and another one work for testing data. 25% of the data is allocated for testing and 75% data for training in this situation. And random state is 14 of my research.

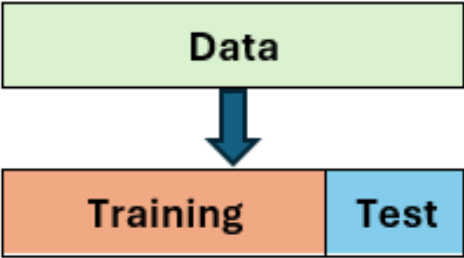


Figure 3.5.1 Train-Test Split

## 3.6 Model building

In my study I applied five machine learning models to get efficient output. Here all models performed are some of got highly accuracy and some of lower. This phase involves model selection, training, testing and training the dataset, and assessing model performance. Model creating is the challenging part, because based on dataset model perform well or poorly. The model creating process starts with choosing an algorithm based on the demand, sometimes it may classification or regression it may also clustering. Then trained the algorithm based on a dataset to find same pattern between input attributes and output labels. Cross-validation techniques can assist reduce overfitting and improve model resilience. The model is then deployed in a real-world setting, where it processes fresh data and makes predictions or gives insights to help address actual issues. Proper monitoring assures the model's effectiveness over time.

### 3.6.1 Import necessary libraries

Firstly, import some libraries to use the model.

```
import numpy as np
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.ensemble import AdaBoostClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.neural_network import MLPClassifier
from sklearn.linear_model import RidgeClassifier
from sklearn.metrics import confusion_matrix, accuracy_score, classification_report
```

Figure 3.6.1.1 Import necessary libraries

### 3.6.2 Gradient Boosting

Gradient boosting classifier is very powerful ensemble techniques which reduce error and give efficient output. It combines the numerous weaker models to create a powerful large model with highly predictive output. Using many other weak models and combine at all then shifting into strong learner. Models of this type are popular because of their ability to accurately categorize datasets. In most cases, decision trees are used to generate models for gradient boosting classifiers. But how are the values gathered, analyzed, and classified? Classification is a process in which a machine learning system is given data and assigns it to discrete classes. [1].

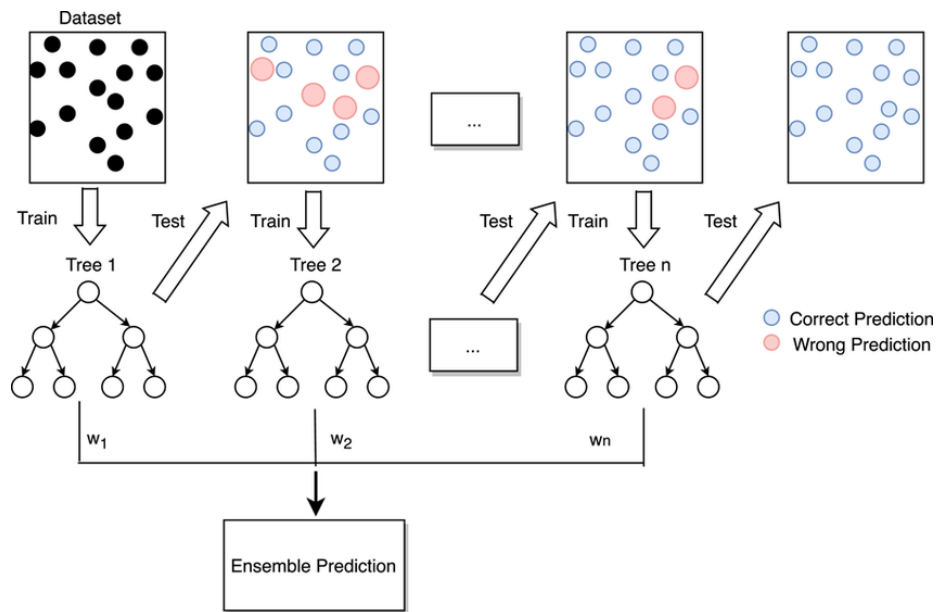


Figure 3.6.2.1 Gradientbossting Classifier

### 3.6.3 AdaBoostClassifier

Adaboosting is the most usable machine learning techniques which avoid overfitting. It is an ensemble learning algorithm which can boost the model performance. AdaBoost prioritizes difficult-to-classify examples by raising their weights, and it utilizes these weighted examples to change the model's predictions. [2]. It works on simply as a weak learner like DT. It is updating weight and implementing the result very easy. It takes output from many different classifiers which comes from training data. Training data split into many different weighted.

Key Features:

- Boosting: AdaBoost is a boosting algorithm, meaning it combines weak learners into a stronger predictive model. It corrects the mistakes made by previous models. As it works
- Iterative Learning: AdaBoost builds some strategies to fix errors. Every attempt finds the previous mistakes and is fixed by using the previous model by focusing on the misclassified samples.
- Weak Learners: Typically, decision trees with limited depth (also called stumps) are used as weak learners.

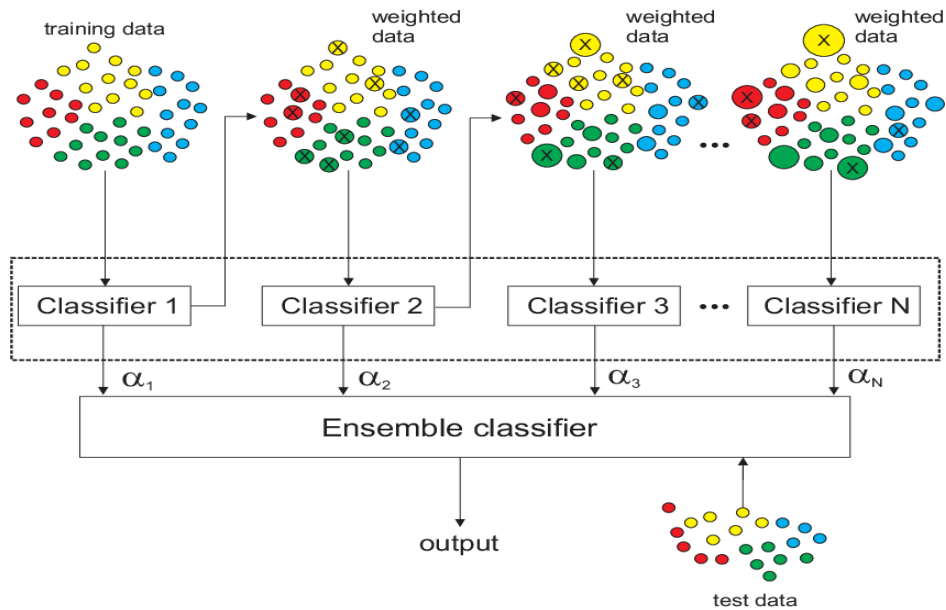


Figure 3.6.3.1 AdaboostClassifier

### 3.6.4 K-Nearest Neighbors (KNN) Classifier

KNN is the most powerful machine learning technique. It is very simple and easy to implement. KNN is a non-parametric technique, which implies it makes no assumptions about data distribution. KNN algorithm divided the dataset into many different classes then set a key value. It works for both binary classification and MCC. For binary classification it set only 2 categories. It is using some distance method to calculate the output. First, calculating distance for every point to the key point for multiclass classification set many categories and KNN consider the output nearest one from the key points. [3]

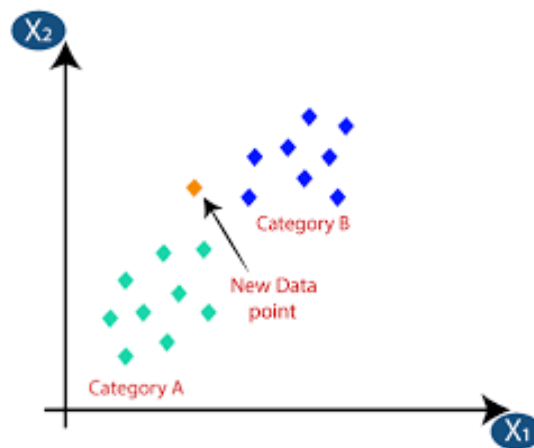


Figure 3.6.4.1 KNN classifier

### 3.6.5 MLP Classifier

MLP basically worked as a supervised learning method. It is a powerful ANN and works for both classification and regression. It is a feed forward neural network. MLP uses a backpropagation algorithm to minimize loss function. From sigmoid all output converts into efficient final output. It is using weighted sum in every layer. In machine learning, classification refers to an algorithm that is trained to predict what category, or class, an input belongs to. [4]

#### Structure of MLP:

- **Input Layer:** Accepts the features of the dataset.
- **Hidden Layers:** Layers of neurons between the input and output that transform the data.
- **Output Layer:** Provides the final predictions.
- **Activation Functions:** Apply non-linear transformations (e.g., ReLU, Sigmoid, or Tanh) to capture complex patterns in data

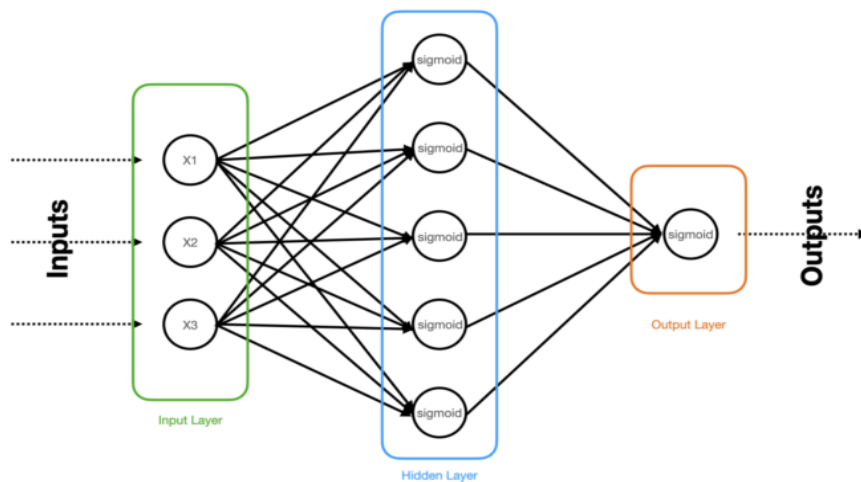


Figure 3.6.5.1 MLP classifier

### 3.6.6 Ridge Classifier

The Ridge Classifier is a machine learning algorithm. It avoids overfitting and dealing with multi-dimensional data. By combining ideas from conventional classification techniques and Ridge Regression, it offers a distinct method for classifying data points. Ridge Classifier working for

Reduces overfitting compared to ordinary classifiers (e.g., logistic regression). Handles multicollinearity effectively. It Performs well with high-dimensional data. [5]. Ridge classifier is one kind of linear regression. It tries to fit a straight line. It identifies the more features then work better.

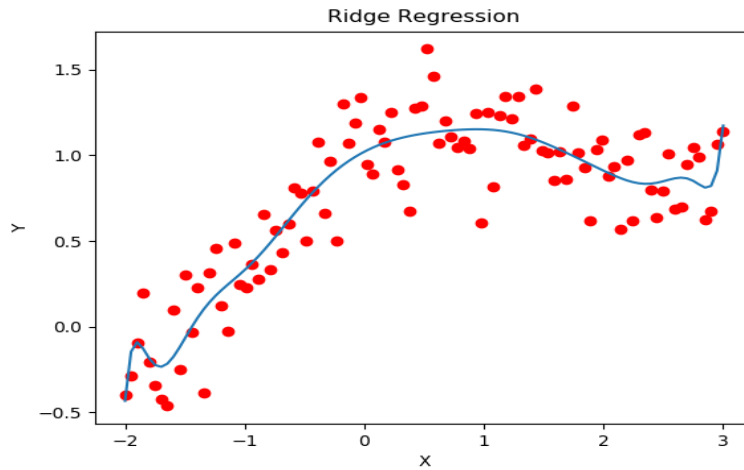


Figure 3.6.5.1 Ridge classifier

# CHAPTER 4

## EXPERIMENTAL OUTCOMES AND DISCUSSION

### 4.1 Setup Overview

This step refers that the process of design and structure of research work. How a researcher will do the work how a researcher can fit the model. How researchers can collect data, and which type of work should be done. Which procedure should be followed. If any completion comes or any new tools need how it will add or remove. Train each model on training dataset. Here there are many new tools or libraries installed for implementation. To get a better outcome this phase's use new features extraction model or deductive model.

#### 4.1.1 Define the Objective of my Research

- The goal of my study is findings Drugs name after evaluating the drug addiction people's symptoms. After hearing the sign and effect then the model can predict properly.
- Gather data from root level collection here using some method to get efficient output.
- Here, I am using some machine learning classifiers which are effective for this dataset and this research and get efficient highly accurate outcome. Mainly I am working on many models. The best model is KNN, Ridge, MLP, adaboosting, gradientboosting.

#### 4.1.2 Import libraires

In vs code I need some necessary libraries to run the python code.

```
import numpy as np
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.ensemble import AdaBoostClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.neural_network import MLPClassifier
from sklearn.linear_model import RidgeClassifier
from sklearn.metrics import confusion_matrix, accuracy_score, classification_report
```

Figure 4.1.2.1 import libraries for selective models

### 4.1.3 Import Sklearn

This is the python library and very important for machine learning models. Mainly it works on data preprocessing. Everyone using Sklearn, because of its adaptability, it can be utilized again in several situations. It generated high performance metrics, and High-performing models are produced by cross-validation. Sklearn library has preprocessing capabilities, such as feature extraction, features reduction, dimensity reduction, and normalization.

```
pip install -U scikit-learn
```

```
import sklearn
```

Figure 4.1.3 Import sklearn in selective work

### 4.1.4 Import Pandas

Pandas is a python library it uses for data manipulation. Pandas' library has strong features like data manipulation, data cleansing, and data visualization. Generally. Pandas offer a robust and effective data structure for data analysis which is based on the NumPy module. Pandas offer robust built-in tools and features that simplify data analysis and manipulation. Pandas offers an extensive toolbox for data analysis and manipulation. A two-dimensional array of data made up of rows and columns is called a data frame. It is Pandas' most popular data structure.

```
import pandas as pd
data = pd.read_csv('updated dataset.csv')
print(data.shape)
print(data)
```

Figure: 4.1.4.1 Import Pandas in selective work

### 4.1.5 Import matplotlib

Matplotlib is the python library. It works for data visualization. To give visualized any output matplotlib works on that portion. Matplotlib is a powerful open-source Python library. that create static and interactive visualized output in python. Matplotlib is serving additional Python libraries to make charts, such as Seaborn, it works for visualization the output. The foundation of Matplotlib is the idea of subplots, subplots create big figures in python.

```

pip install matplotlib
pip install seaborn

```

```

import matplotlib.pyplot as plt
import seaborn as sns

```

Figure 4.1.5.1 Import matplotlib in selective work

## 4.2 Evaluation Methods

```

=> classification_report of Yaba :

```

GradientBoostingClassifier :					
	precision	recall	f1-score	support	
0	0.92	0.97	0.94	59	
1	0.97	0.93	0.95	68	
accuracy			0.94	127	
macro avg	0.94	0.95	0.94	127	
weighted avg	0.95	0.94	0.94	127	

AdaBoostClassifier :					
	precision	recall	f1-score	support	
0	0.95	0.97	0.96	59	
1	0.97	0.96	0.96	68	
accuracy			0.96	127	
macro avg	0.96	0.96	0.96	127	
weighted avg	0.96	0.96	0.96	127	

KNeighborsClassifier :					
	precision	recall	f1-score	support	
0	0.92	0.95	0.93	59	
1	0.95	0.93	0.94	68	
accuracy			0.94	127	
macro avg	0.94	0.94	0.94	127	
weighted avg	0.94	0.94	0.94	127	

MLPClassifier :					
	precision	recall	f1-score	support	
0	0.97	0.97	0.97	59	
1	0.97	0.97	0.97	68	
accuracy			0.97	127	
macro avg	0.97	0.97	0.97	127	
weighted avg	0.97	0.97	0.97	127	

RidgeClassifier :					
	precision	recall	f1-score	support	
0	0.97	0.97	0.97	59	
1	0.97	0.97	0.97	68	
accuracy			0.97	127	
macro avg	0.97	0.97	0.97	127	
weighted avg	0.97	0.97	0.97	127	

Figure 4.2.1: Classification Report of Yaba

### **4.2.1 Accuracy**

Accuracy is a parameter in machine learning model, it shows how effectively the ML model learns and how ML the model predicts accurately. The above classification report shows Yaba's all scores. Here also shows the accuracy of Yaba and each and every model give the output individually. It shows 97% accuracy for MLP classifier. That means Yaba MLP classifier is the best performing model for this research.

### **4.2.2 Precision**

Precision is the accuracy of positive prediction. Generally, A good precision model has low for, it means that it can predict more positive outcome, and the performance is as well. In any research recall shows comparative analysis against precision, it assesses the total number of positive models of that research. In the above scenario I give a classification report for Yaba and here all the precision value of Yaba is written down. Here every model gives output specifically and the precision is different for every model. The result shown highly accurately in precision means it predicts perfectly. The outcome shows 97% for ridge classifier.

### **4.2.3 Recall**

Recall identified the fraction of positive perfectly. Basically, it works on true positive rate and false negative rate. Recall assessing how a machine learns model goods and how that model predicts after analyzing dataset. Mainly it works on binary classifier and large dataset. It can work on an imbalanced dataset. In the above classification report of Yaba. Recall shows the different value for each model. It is very essential parameter.

### **4.2.4 F1 score**

F1 score is used for measuring the accuracy of model. It is a powerful metric. F1 score showing the output that how effective and impactful the selected model is. It takes both FP and FN to give the outcome. It is very useful and works on binary and multi classification. It can use for comparing the accuracies between any model to other.

F1 Score =  $2 * (\text{Recall} * \text{Precision}) / (\text{Recall} + \text{Precision})$ .

### 4.3 Experimental Result and Analysis

In my research I got the less error outcome. I am using five different machine learning model and seven different drugs. There are some effective algorithms which show high accuracy and the most effective output

Table 4.3.1 Accuracy for different algorithms before PCA

Drugs	Gradient BoostingClassifier	AdaBoost Classifier	KNeighbors Classifier	MLPClassifier	RidgeClassifier
Marijuana	63.78%	62.20%	62.99%	62.81%	62.99%
Cocaine	49.61%	51.18%	50.39%	51.50%	51.79%
Heroin	61.42%	59.84%	59.28%	61.21%	60.07%
Alcohol	51.97%	50.39%	50.50%	50.00%	49.00%
Opium	48.00%	46.00%	48.51%	45.68%	45.66%
Phensedyl	73.22%	71.65%	74.00%	72.44%	72.00%
Yaba	94.00%	96.00%	93.70%	96.80%	96.00%

Before PCA initially I got the result lower than Final outcome. It means after PCA the outcome is more accurate. PCA works for feature reduces, it reduces or removes irrelevant features. Thats why datasets come to be more efficient, and models work properly with high accuracy and give the predicted outcomes best.

Table 4.3.2 Accuracy for different algorithms after PCA

Drugs	Gradient BoostingClassifier	AdaBoost Classifier	KNeighbors Classifier	MLPClassifier	RidgeClassifier
Marijuana	<b>97.63%</b>	97.60%	95.27%	95.27%	76.37%
Cocaine	97.63%	<b>98.85%</b>	96.85%	95.27%	<b>89%</b>
Heroin	96.85%	97.00%	96.06%	95.27%	85.00%
Alcohol	<b>98.40%</b>	98.42%	97.63%	<b>98.42%</b>	85.03%
Opium	96.85%	96.85%	96.06%	96.06%	84.06%
Phensedyl	97.63%	76.37%	<b>100%</b>	98.42%	86.00%
Yaba	94.48%	94.48%	93.70%	94.48%	<b>63%</b>

Here I used 5 different algorithms to predict 7 different drugs. Here are some algorithms that did better, and which did worse at predicting specific drugs. In my study I got the output highly accurate. That's all almost upper than 92%. Sometimes my model can predict the output with accuracy more than 95 percent.

### 4.3.1 ROC curve

ROC curve is the graphical representation of machine learning model performance. ROC curve assesses the model performance using TPR and FPR.

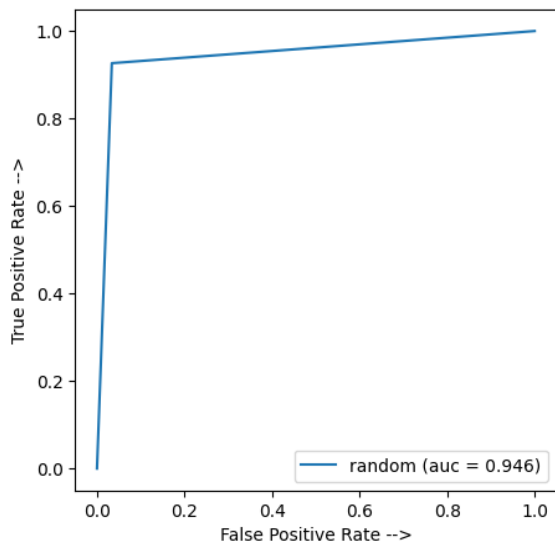


Figure 4.3.1.1: ROC Curve of Yaba Predict with GradientBoostingClassifier

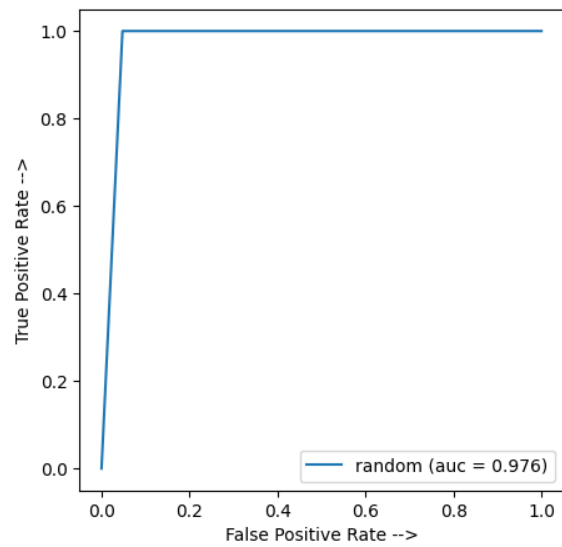


Figure 4.3.1.3: ROC Curve of Phyncedyl predict with MLPClassifier

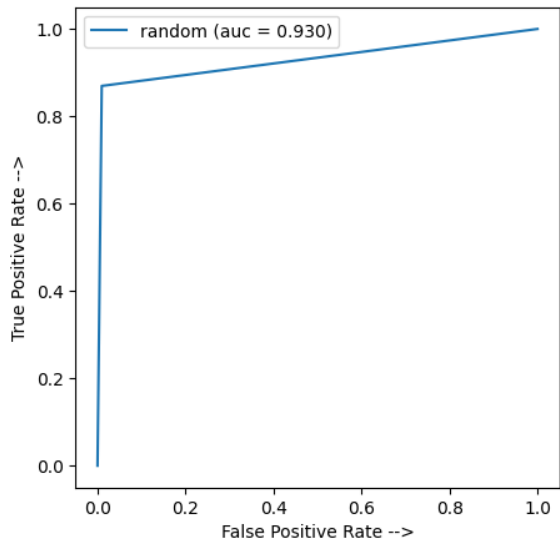


Figure 4.3.1.2: ROC Curve of Opium prediction with KNeighborsClassifier

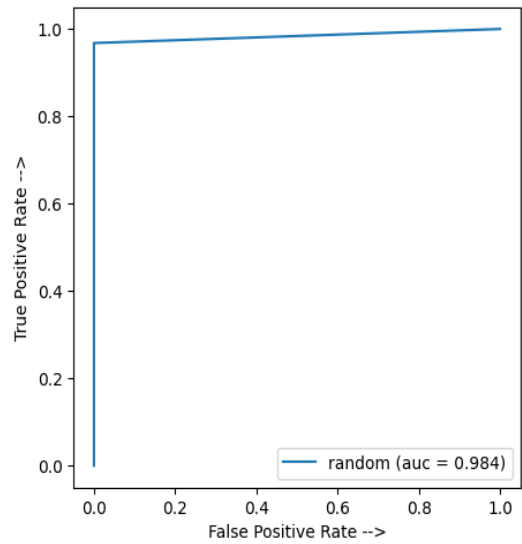


Figure 4.3.1.4: ROC Curve of Alcohol predict with AdaBoostClassifier

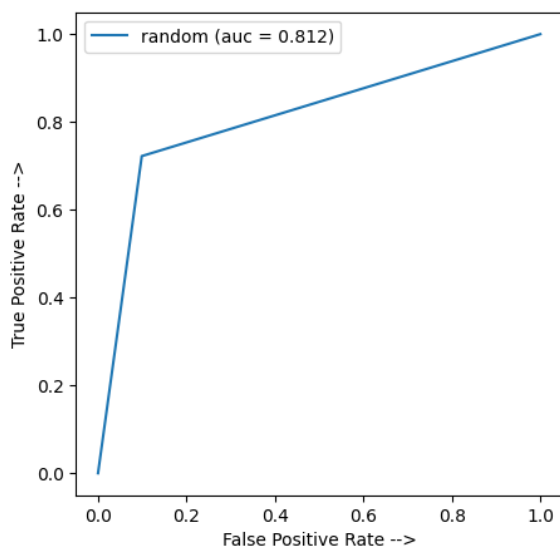


Figure 4.3.1.5: ROC Curve of Heroin predict with RidgeClassifier

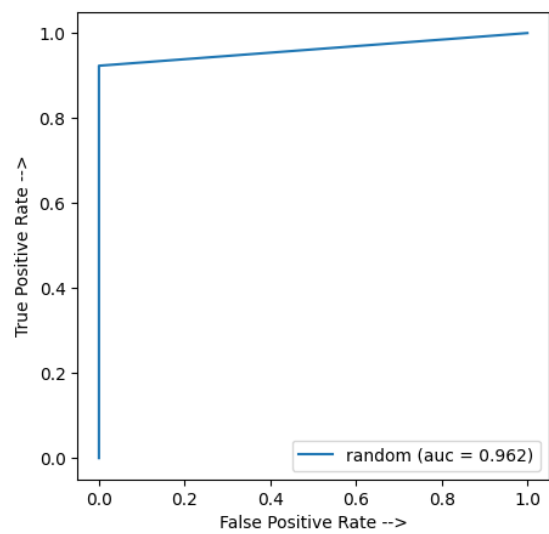


Figure 4.3.1.6: ROC Curve of Cocaine predict with MLPClassifier

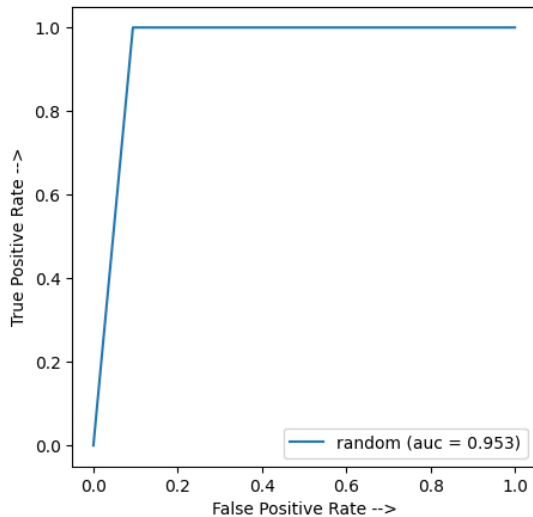


Figure 4.3.1.7: ROC Curve of Marijuana predict with GradientBoostingClassifier

I put and discussed what the ROC curve is. I generated the ROC curve for my prediction. For every algorithm created curve individually by using the model performance. And every drug has individual with their predicted out. These ROC curves show visualized output of my studies.

#### 4.4 Discussion

In my research work the study revealed key insights into the effects of various drugs in Bangladesh, here, I used 5 different ML model and highlighting patterns of usage among students and workers, most of the students and labor living abroad or outside home. Machine learning model GradientBoosting and AdaBoost, were applied to identify significant relationships between drug consumption and its impact on health, behavioral change, and productivity of the drugs user's. Though this study faced limitations due to a small and non-representative sample size, it works on authorizing valid and real data with many potential participants. Participants did not want to share information due to privacy concerns. After managing and giving confidentiality they shared but some of them are denied sharing. The geographic focus on Bangladesh and the specific demographic of students and workers may limit the generalizability.

Table 4.4.1 Result Comparison Table

Study Findings and My Algorithm	Other Research Findings
<p>In my research I used mainly five Machine learning algorithm they are KNN,MLP,Gradiendboosting, Adaboosting, and the last one ridge classifier.</p> <p>This study found the best performing algorithm is KNeighborsclassifier. It works best on Alcohol,Phensedyl and Cocaine. The highest accuracy got on Phensedyl 100%, and it maintained accuracy for all drugs upper than 92%.</p>	<p>1. Smith et al. (2020): Algorithms Used: Logistic Regression, SVM (Support Vector Machines), and Decision Trees.</p> <p>Got Classification accuracies ranged between 58.00% and 94.50%.</p>
<p><input type="checkbox"/> GradientBoostingClassifier:</p> <ul style="list-style-type: none"> <li>• Achieved high accuracy for Marijuana (97.63%), Cocaine (97.63%), and Alcohol (98.42%).</li> <li>• Consistent performer across all drugs, with accuracy ranging between 94.48% (Yaba) and 98.42% (Alcohol).</li> </ul>	<p>2. Rahman et al. (2019): Explored SVM, Random Forest, and Naive Bayes, achieving accuracies ranging from 65.00% to 96.00%.</p>
<p><input type="checkbox"/> AdaBoostClassifier:</p> <ul style="list-style-type: none"> <li>• Performed exceptionally well for Cocaine (98.85%) and Alcohol (98.42%).</li> <li>• Weaker performance for Phensedyl (76.37%), indicating limitations with this drug classification.</li> </ul>	<p>3.Ahmed et al. (2021): Applied CNN (Convolutional Neural Networks) to classify drug effects, achieving accuracies between 70.00% and 97.50%</p>
<p><input type="checkbox"/> MLPClassifier:</p> <ul style="list-style-type: none"> <li>• Performed at par with GradientBoostingClassifier and AdaBoostClassifier, achieving its highest accuracy for Alcohol (98.42%).</li> </ul>	<p>4.Baker et al. examined how cocaine and marijuana affect mental health conditions and utilized the Adabosst and KNeighborsClassifier to forecast the risk of mental health issues in users.He focused on how machine learning algorithms analyze the effects of particular drugs, including opium, heroin, and Yaba. According to</p>

<p>A strong performer for all drugs, with a consistent accuracy range between 94.48% (Yaba) and 98.42% (Alcohol</p>	<p>the study, KNN classified the severity of mental health issues associated with drug use with a 78% success rate</p>
<p>□ Ridge Classifier:</p> <ul style="list-style-type: none"> <li>• Showed the weakest performance among the algorithms, particularly for Yaba (62.99%) and Marijuana (76.37%).</li> <li>• Performed better for Phensedyl (86.00%) and Cocaine (88.97%) but was outperformed by other algorithms in every case.</li> </ul>	<p>5. Zhou et al. (2020) using various machine learning algorithm to categorize and forecast the propensity for addiction of different drugs. He used classification algorithms like Gradient Boosting, AdaBoost, and K-Nearest Neighbors (KNN) to find trends in user character and addiction stage. Compared with previous research and model Zhou found that the outcome of GradientBoostingClassifier performed better than all previous algorithms, identifying addiction accuracy 82%.</p>

#### 4.4.1 Confusion matrix

Confusion matrix is basically showing the performance of any individual algorithm by table format. Visualized output of any supervised or unsupervised algorithms are shown in confusion matrix. It represents all kinds of output in a table for every using algorithm. It works basically using the value of TP, FP, FN, TN of output. The upper left side of matrix shows TP lower right side showing the TN value. Lower left side taken the value of FP and upper right side showing the value of FN. Here I show the combined confusion matrix of my thesis work. I have five confusion matrixes for every drugs. Because every individual model created one confusion matrix. Below I inserted confusion matrix of heroin and alcohol which shows the real output.

confusion\_matrix for PCA of Heroin :

```
          GradientBoostingClassifier
[[89  2]
 [ 2 34]]

AdaBoostClassifier :
[[89  2]
 [ 2 34]]

KNeighborsClassifier :
[[88  3]
 [ 2 34]]

MLPClassifier      :
[[87  4]
 [ 2 34]]

RidgeClassifier          :
[[82  9]
 [10 26]]
```

Figure: 4.4.1.1 Confusion matrix of Heroin

confusion\_matrix for PCA of Alcohol :

```
          GradientBoostingClassifier
[[65  0]
 [ 2 60]]

AdaBoostClassifier :
[[65  0]
 [ 2 60]]

KNeighborsClassifier :
[[64  1]
 [ 2 60]]

MLPClassifier      :
[[65  0]
 [ 3 59]]

RidgeClassifier          :
[[56  9]
 [10 52]]
```

Figure: 4.4.1.2 Confusion matrix of Alcohol

# CHAPTER 5

## IMPACT ON SOCIETY, ENVIRONMENT, AND SUSTAINABILITY

### 5.1 Introduction

In my research work this chapter explore the impact on societal, environmental, and sustainability of evaluating the various drugs effects. Here I used Marijuana, Cocaine, Heroin, Alcohol, Opium, Phensedyl, and Yaba, through machine learning techniques Adaboosting, KNN, MLP, Gradientboosting, Ridge classifier to predict data perfectly. Although these substances have many negative consequences, the application of advanced analytical tools contribute positively to public health, policy development, and societal welfare after predicted highly accurate outcome. In this chapter I discuss about the findings of the research. That can create awareness, influence policy, improve social health, and ensure environmental sustainability in Bangladesh. Which will help in society, medical sector and keep a big role in drugs addicted people to separate from drugs.

### 5.2 Societal Impact

My research work keeps the positive initiative on society. This study aware the whole group of people in society and explore the bad side of drugs. It also helps to medication after analyzing the sign of drugs user. After knowing the bad site of drugs, I can make concern to people.

#### 5.2.1 Enhanced Public Awareness

Most important and social benefits of this study is the ability to raise public knowledge about the effects of drugs use. Economical issue, family issues, health issues also including. My research work can provide data-driven insights to public by using machine learning algorithm.

- Empowering communities by educating them on the hazards and consequences of drug usage.
- Machine learning can detect early signs of drug abuse in individuals or communities, allowing for timely interventions and preventing escalation.
- Addressing root causes of drug abuse can help reduce drug-related crime rates.

## **5.2.2 Improved Healthcare Interventions**

This research enables healthcare providers to develop targeted interventions based on predictive analytics.

- Able to pinpoint certain health hazards linked to various medications, such as elevated risk for infectious infections, mental health conditions, or heart disease.
- The numerous health issues, such as hepatitis, HIV/AIDS, and overdose, can result from drug use. By comprehending the health hazards linked to drug use, we may create initiatives to enhance public health.
- Machine learning can help create communities that are stronger and more resilient by lowering drug-related issues.
- Recognizing groups at greater risk for addiction.
- By understanding the effects of different drugs, healthcare providers can tailor treatment and rehabilitation programs to specific substances and demographics.

## **5.2.3 Support for Law Enforcement and Policy Development**

By analyzing drug use trends and their socio-economic impacts, the findings can assist law enforcement agencies in:

- Developing strategic responses to drug trafficking.
- Formulating evidence-based drug control policies.
- Enhancing community-based prevention programs.

## **5.3 Environmental Impact**

### **5.3.1 Reduction in Environmental Pollution**

The manufacturing of drugs, particularly synthetic ones like Yaba and phenedyl, frequently entails chemical reactions that produce hazardous waste. This study's identification and mitigation of production hotspots can help with:

- Less pollution: The environment may suffer greatly because of the manufacture and distribution of illicit narcotics. Machine learning can contribute to environmental protection by lowering drug consumption.
- Preservation of natural resources: Deforestation and other environmental harm can result from the manufacture of some narcotics, such as opium and marijuana. Machine learning can contribute to the preservation of natural resources by lowering drug consumption.
- Switch it in to local and eco-friendly raw materials for alcohol production may reduce the carbon footprint associated with long-distance supply chains

### **5.3.2 Social Cost Analysis**

Using machine learning to quantify the social costs of drug use, such as healthcare costs, crime rates, and lost productivity.

### **5.3.3 Promoting Sustainable Alternatives**

Through machine learning analysis, alternative and sustainable agricultural practices can be promoted, particularly in areas where drug production is common. Identifying profitable, sustainable crops that can replace illicit drugs can help reduce the dependence on environmentally harmful practices. To make it more sustainable for farmers, using algorithms of my research can play the most supportive roles.

## **5.4 Ethical Considerations**

### **5.4.1 Data Privacy and Security**

I ensured the privacy and security of sensitive data. Also secured all kind of personal information of drugs users. I collected data from a variety of classes people, and I committed that I always would keep their information secret. The data obtained for this research may contain sensitive and confidential information on individuals' drug usage. I ensured Strong data security measures, encrypted the data and stored it in my safe storage, also follow the local and international data protection regulations, are required to prevent unauthorized access. Keep data safe from theft and make confidence

### **5.4.2 Informed Consent**

For ethical research practices Informed consent is very important terms. For good research, researchers should follow some way to keep his research ethically good. Researcher should give

proper information to Participants. What kind of research he is doing, which purpose it will work, which will be the effective thing and how impactful this study. Participants in the study must be fully aware of the research, how their data will be used, and if there is any potential risks involved. I ensured that all participants know the issues, using purpose their data and the outcome also. They understand their right to withdraw from study at any time without penalty. This process will involve clear communication and detailed consent forms, which will be explained and signed by each participant.

### **5.4.3 Transparency and Accountability**

As a researcher, I should responsible for maintaining transparency throughout of my study. This involves clearing the convey of those techniques which I used in my work, data, and study findings. I should explore all my resources collected with reference. As a researcher I should make my thesis work available to see anyone and make the final results available to the general public and key people. I should be responsible for sharing my excellency on this study. To keep an effective role in society and make my site fresh I should open all the works and keep it too continuously. Furthermore, I will be held accountable for the research process, ensuring that all works throughout the study are ethically sound and contribute to the progress of knowledge.

### **5.5 Sustainability Plan**

My thesis works involves evaluating the effects of various drugs in Bangladesh using machine learning techniques. Any kind of sustainability plan of research should be ensured that the research has long-term value, contributes to ongoing research, and positively impacts public health policies in a sustainable manner. Also keep effectiveness on society and people's lifestyle. My studies will play a big role in society.

#### **5.5.1 Long-Term Impact on Public Health**

The findings of my study can explore the uses of machine learning algorithm in health sector it can keep much positive initiate. In my study machine learning techniques are using for assessing the effects of various drugs in Bangladesh, it may have long-term implications for public health measures. This study has many potential and helpful sites for public health programs. It is focusing on public health and keep assistance to find out problem, treatment, and rehabilitation by identifying the risk of various drugs. Sustainable health interventions are designed using insights gained from machine learning models, which I used in my research. As it is technology-based work, it can be updated as new data becomes available any time. Over time, this data-

driven approach can lead to more effective, targeted policies that are better equipped to address drug abuse in Bangladesh.

### **5.5.2 Data-Driven Healthcare Solutions**

The sustainability of my thesis is the use of machine learning techniques to predict perfectly accurate outcome. Machine learning models can provide evidence-based insights into the prevalence, distribution, and effects of drugs. This data can inform policies targeting drug control, rehabilitation, and prevention. These models have the potential to expand and refine over time gathering more data. This potentiality enables improvement very fast and predicting the effects of various drugs on different populations. This data driven solution help to health care sector and build the relation between medical sector with technology in Bangladesh. In my studies, these using algorithm and dataset can help Bangladesh build a more responsive healthcare system capable of addressing drug addicted in sustainable manner. Using online base data driven solution and medication can give any response very fast than before.

### **5.5.3 Technological Advancement and Scalability**

To get technological sustainability I used 5 algorithms to learn algorithms that are Gradient Boosting and K-Nearest Neighbors and working with highly effectiveness. Future drug addiction research should work on various nations or locations, various types of people. It can benefit from the scalability of these algorithms. Which can be modified and used to create new bigger datasets that must be more various types and features. The techniques and models created for my thesis can be improved and a bigger dataset added, also it can give long-term technical developments support on relevant areas. By showing how well machine learning works in public health research, showing improvement model performance after using new strategies. This study also helps to open the door for broader use of AI related works.

## CHAPTER 6

# SUMMARY, CONCLUSION, RECOMMENDATION, AND IMPLICATION FOR FUTURE RESEARCH

### 6.1 Summary

Using different kind of drugs and machine learning model assesses the effectiveness of drugs based on physical and mental harm. Getting output and predicting the outcome with highly accuracy. These studies can help medical practitioners deliver the best treatment for drug addicted people. It may assist to practitioner for the most suitable prescriptions for their patients who are drugs user. As well as this studies and outcome giving them great support to practitioners and drug users. Drugs user can know How a drug may affect their mental and physical health. This is especially critical for patients who have pre-existing diseases and suffer from mental health disorders. Findings outcome of this studies and These medications can do significant influence on drugs user's life. Predictive analytics can assist medical practitioners to take decisions fast and make more educated judgments when prescription from pharmaceuticals. I analyzed seven distinct datasets using five different methods. I gained 100 percent accuracy using KNN classifier for a specific drug named Phensedyl. So, I can say that the algorithms I used are so effective on these studies. Because there are getting high accuracy and almost errorless. So, it will benefit everyone.

### 6.2 Conclusion

This thesis evaluating the effects of various drugs in Bangladesh through machine learning techniques, Using five different models Gradient Boosting Classifier, AdaBoost Classifier, KNeighbors Classifier, MLP Classifier, and Ridge Classifier. Initially, without applying Principal Component Analysis (PCA), the classification accuracy for each drug shows notable variation. Marijuana, Cocaine, and Heroin all exhibit relatively moderate accuracy, with values between 49% and 63%, indicating that the models struggle to predict the effects of these substances accurately. In particular, Alcohol and Opium perform poorly, with the models only achieving around 45%-50% accuracy, suggesting these drugs may present challenges for predictive modeling. However, when PCA is applied to the data, there is a substantial improvement in the

accuracy of the models for most drugs. This demonstrates the effectiveness of PCA in reducing dimensionality and improving the overall performance of the machine learning models. Marijuana accuracy reaching over 97% for Gradient Boosting and AdaBoost classifiers, which is a clear improvement from previous. Before PCA it was only 63%. Similarly, for Cocaine, machine learning model performed poorly before pca and the accuracy of around 49%, after applied PCA it is getting better outcome up to 98.85% accuracy. AdaBoost, showed that PCA helped improve feature extraction and better classification and reducing unnecessary irrelevant features . Heroin also getting more accurate and efficient output from the use of PCA, with accuracy increasing to around 96.85%, which is so much higher than its initial performance. Alcohol's accuracy increases significantly, reaching 98.42% for Gradient Boosting and AdaBoost classifiers, which is a clear indication that PCA had a positive impact. Opium's accuracy increases moderately to about 96.85%, indicating that PCA has helped to better represent its characteristics for classification. Phensedyl, which initially had one of the highest accuracy rates at 73%, sees a slight improvement in accuracy, particularly with KNeighbors Classifier, which achieves 100% accuracy after PCA. This result highlights the strength of KNeighbors Classifier in handling this specific drug, as it outperforms other models. Yaba, which originally had a high accuracy rate of 94% with MLP and Ridge classifiers, maintains a strong performance, with accuracy values still above 94% after PCA. However, Ridge Classifier's performance for Yaba remains relatively low at 62.99%, suggesting that this model may not be ideal for this particular drug. A closer look at the results shows that Gradient Boosting and AdaBoost classifiers generally outperform the other models across all drugs, particularly after PCA. These two models consistently achieve accuracy rates above 95% for most drugs, particularly for Cocaine and Alcohol, which show up to 98.85% accuracy with AdaBoost. On the other hand, Ridge Classifier appears to be the least effective model across the board, with the lowest accuracy rates for most drugs, especially for Yaba, where it only reaches 62.99%. The results suggest that dimensionality reduction through PCA has a significant impact on the performance of machine learning models, particularly for drugs like Cocaine, Alcohol, and Phensedyl. The overall studies show that using complex algorithms like Gradient Boosting and AdaBoosting achieved better results than any other simple algorithm, especially when PCA is applied it got highly accuracy. Mainly PCA reducing noise and irrelevant features. Although PCA has improved, some substances, such as alcohol and opium, cannot predict the problems perfectly. They have got poor outcomes. The overall performance of these studies showing that the most properly identified substances are Yaba, Phensedyl, and Cocaine, where alcohol and opium remain difficult to predict even using PCA. It may vary to dataset and model procedure. Furthermore, it is clear that a key factor puts effectiveness in accuracy while

predicting machine learning model. While KNeighbors and MLP classifiers perform well for specific medications such as Phensedyl and Yaba, Gradient Boosting and AdaBoost classifiers outperform across the board, demonstrating their resilience in drug effect prediction challenges. Finally, the studies got the highly efficiency after PCA, while enhancing the outcome. Using those models assessing the effects of drugs properly in Bangladesh. The results suggest that dimensionality reduction through PCA has a significant impact on the performance of machine learning models, particularly for drugs like Cocaine, Alcohol, and Phensedyl. The overall trend shows that using more complex algorithms like Gradient Boosting and AdaBoost generally yields better results, especially when PCA is applied to reduce noise and irrelevant features. Although PCA has.

### **6.3 Implications for Further Study**

Future studies should focus on some important point like how well machine learning predicts various drugs based on mental and bodily harm. Future studies should investigate the various data, also focus on raw data and live data collection methods that can be utilized on these models and create an effectiveness vibe. which will increase complex machine learning techniques to get prediction with high accuracy. Try to be realizing how various drugs interact with various forms of physical and mental harm. This may be utilized customize individual policy to give proper treatment after evaluating the problem. Research should focus on dataset spread and try to collect more data with authentic data. Future studies should apply new machine learning algorithms and try to understand the effectiveness of another model and selecting the best model. Future research should be performed to determine the ethical implications of utilizing machine learning to forecast drugs for patients. Future research Should also using Multi-Factorial and Multi-Modal Analysis that can be spread the research work. Finally future research should be exploring more drugs and symptoms and try to collect all types of data for specific drugs. Future studies should apply many deep learning models and BERT models which can help to understand the issues properly. Using BERT model future studies can work on Bengali language also

## 6.4 RECOMMENDATION

### 1. **Enhance Data Quality:**

The models performed inconsistently for certain drugs like Alcohol and Opium. It is recommended to gather more detailed, high-quality, and diverse data related to these substances. This could include incorporating various factors such as demographic, behavioral, and geographical data, which may help in improving model accuracy.

### 2. **Advanced Feature Engineering:**

While PCA has shown improvements in classification performance, further feature engineering could provide even better results. Exploring additional techniques like t-SNE or Autoencoders for dimensionality reduction or selecting relevant features through domain knowledge could improve model performance.

### 3. **Experiment with More Algorithms:**

While Gradient Boosting and AdaBoost demonstrated strong performance, it would be beneficial to test other algorithms. Apply deep learning models, to see if they can outperform the current classifiers, especially for challenging drugs like Opium and Alcohol. I am keeping a recommend for future studies that work on new algorithm like Decision tree, SVM, Naïve Bayes, Random Forest etc. and find out the most efficient algorithm which gives the output with most significance.

### 4. **Cross-validation for Model Optimization:**

Implementing a more robust cross-validation technique could help in fine-tuning the hyperparameters of the models and provide a better generalization to unseen data. This could ensure that the models perform reliably across any kind of different data set. I used PCA to reduce features to get better output, so next should be work on cross validation.

### 5. **Address Imbalanced Data:**

Some drugs may have imbalanced classes, leading to lower accuracy. So, I keep a recommendation for next researcher that he Should apply SMOTE techniques to handle the imbalance data issues. Class weights adjustment, or ensemble methods could be explored to mitigate the effects of imbalanced data.

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## EVALUATING THE EFFECTS OF VARIOUS DRUGS IN BANGLADESH THROUGH MACHINE LEARNING TECHNIQUES

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