# Introduction

Human brain is possibly the most critical part of the human body. From helping humans perform simple mundane tasks to caryying out extraordinary feats throughout history, the brain is what controls everything in humans. The brain works by sending and receiving signals throughout the body with the aid of the nerves. By analyzing such signals or electrical impulses, changes in brain activity and state can be measured. Electroencephalography, or EEG, is such method used to measure the electrical activity of the brain in which small metal electrodes are attached to the scalp surface. Analysing and interpreting such signals provides a wide range of information about the state of brain.

# Task 1

## Time Series Plot

A time series is a sequence of data which is recorded continuously over time. Time series helps in studying how variables changes or evolves through time. Generally, when plotting a time series graph, time (or date) is plotted on the X axis or the horizontal axis and the variable is plotted on the Y axis.

Plotting the signals against time provides a way of interpreting the data. Here, EEG input/output signals with their respective time in seconds has been provided. We can simply plot those signals against time to interpret the basic overview of the signals.

Below is a plot of the 4 input signals with respect to their times (in millisecond).

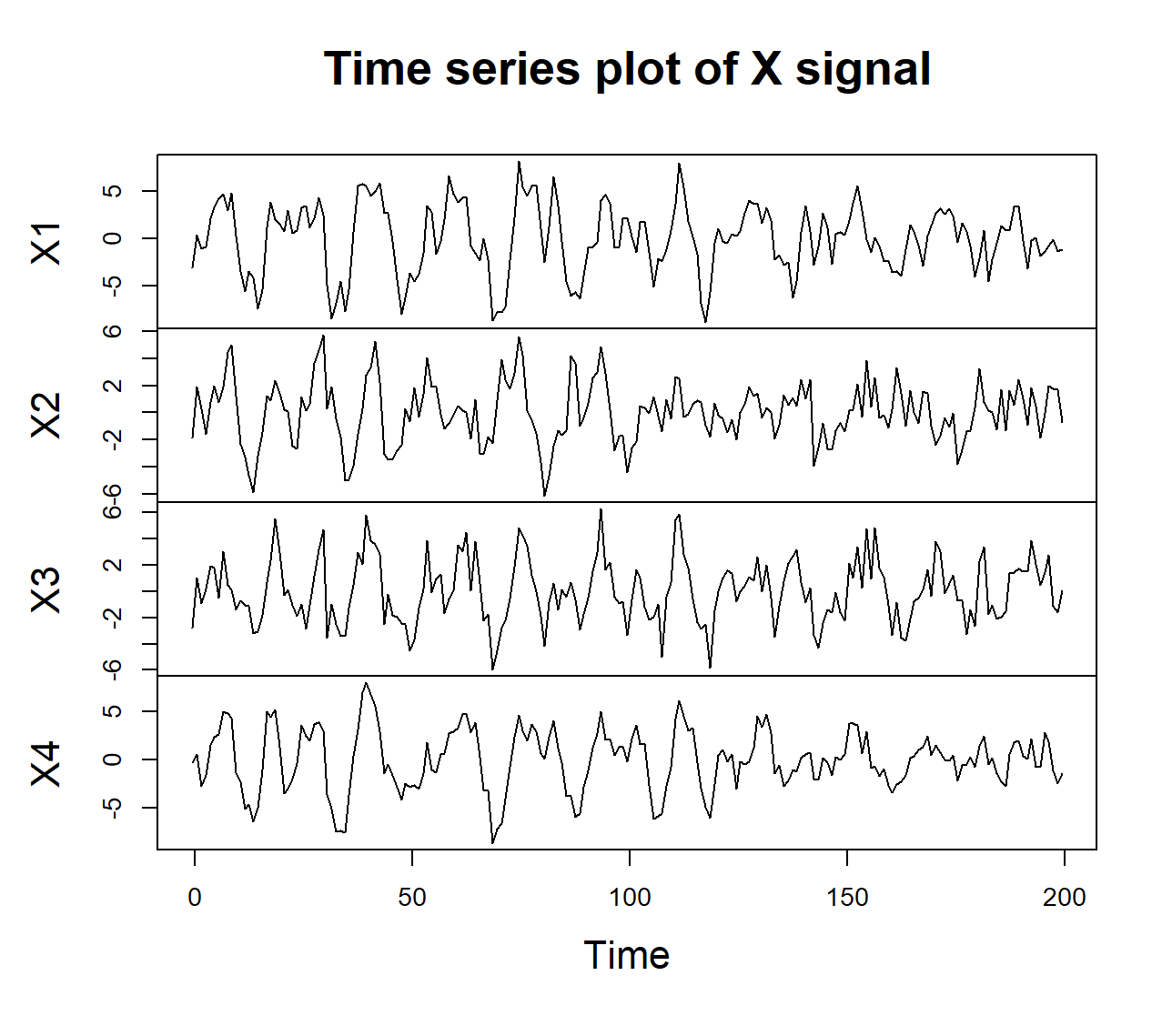


Figure Time Series Plot of X (input) Signal

The above plot shows how the signals change with time. Looking at the plot, it can be seen that there are some values that deviate from the general trend of the signal. Slight spikes can be seen in all the input signals right around the same time frames which gradually transitions into somewhat relaxed state after around 120ms. All the signals have been subjected to noise.

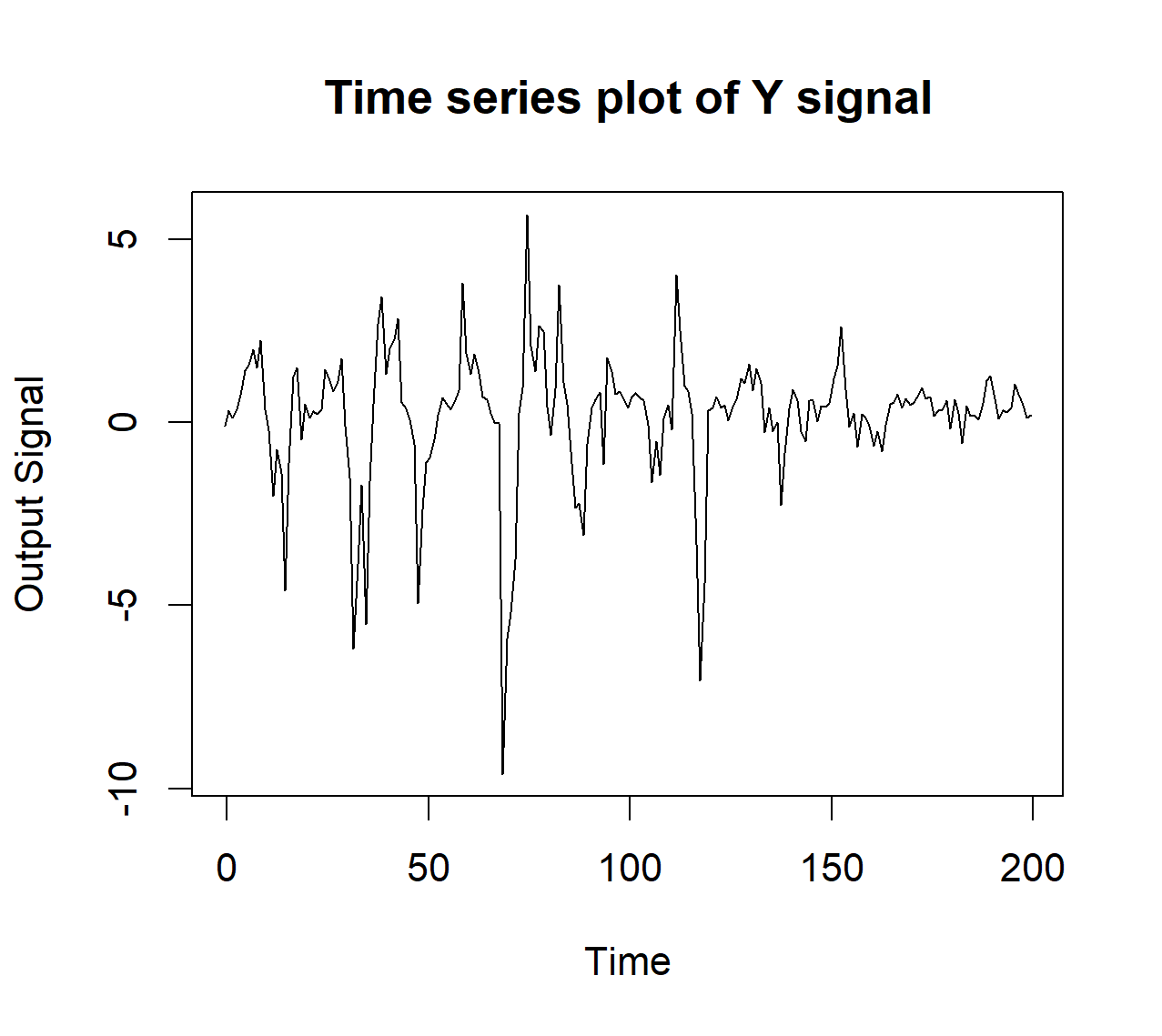


Figure Time Series Plot of Y (Output) Signal

The output signal has also been subjected to some additive noise. We can see certain abrupt spikes in the signal. The abrupt fall of the signal at ~60ms can be explained looking back at *Figure 1* where the input signals X1, X3 and X4 are seen the have gone down as well at the same time. It is more or less the same at 120ms where the ouput signal has shown abrupt change at the same time where input signals X1, X3 and X4 show similar downward spike.

The general movement of the signal seems quite similar to those of input signals where the spikyness calms down quite significantly after 120ms having seen that all the input signals become significantly steady after 120ms.

## Distribution Plots of EEG Signals

On the basis of our data, we can visualize it by plotting histograms and density plots. A histogram is a bar style chart that approximately represents *numerical* datas by classifying them into bins or intervals. Density plots simply shows the density of various points in the data. The distribution shape of a dataset can be determined with the help of distribution plots. The figures below show the histogram and density plot of the input signal.

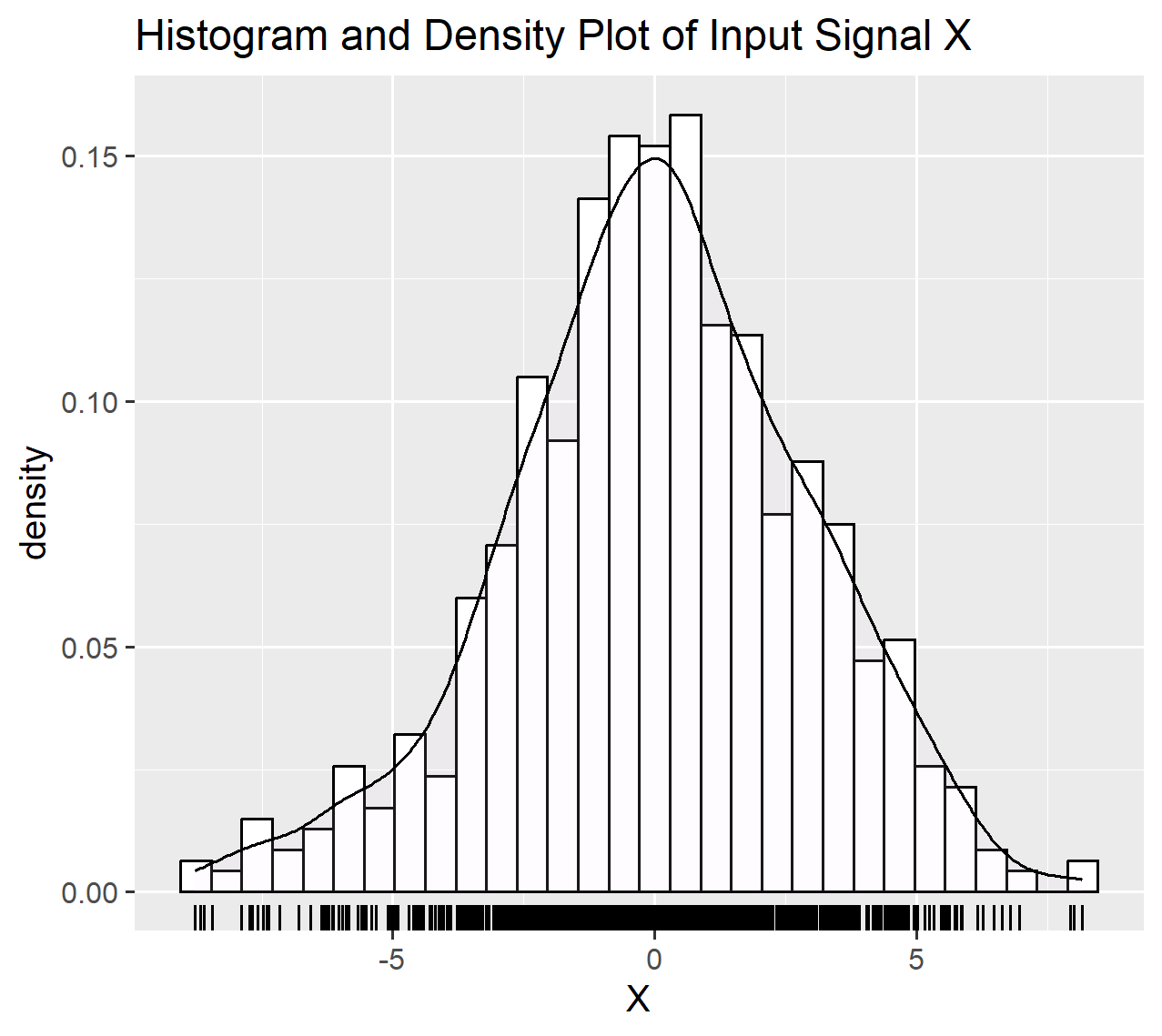
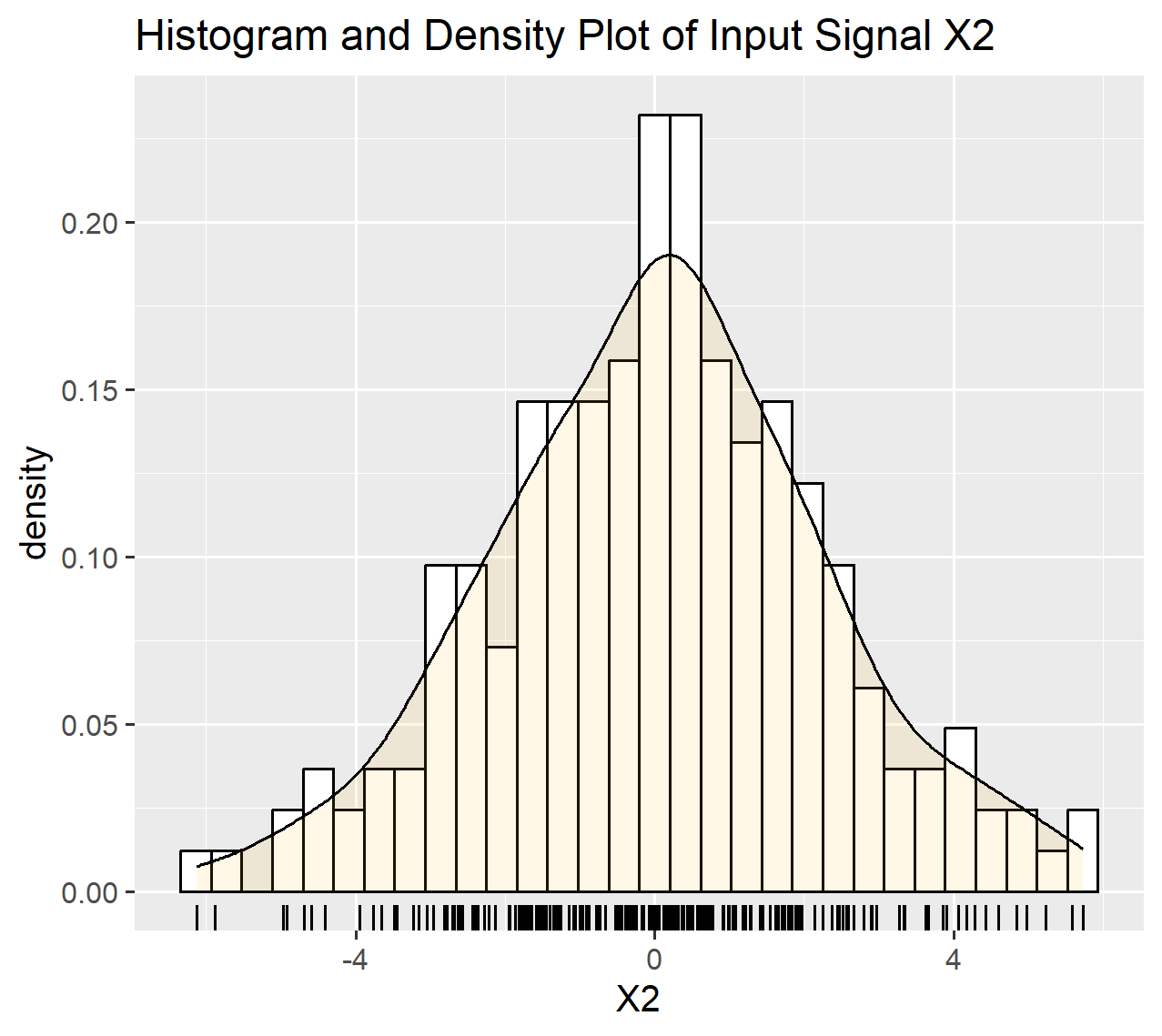
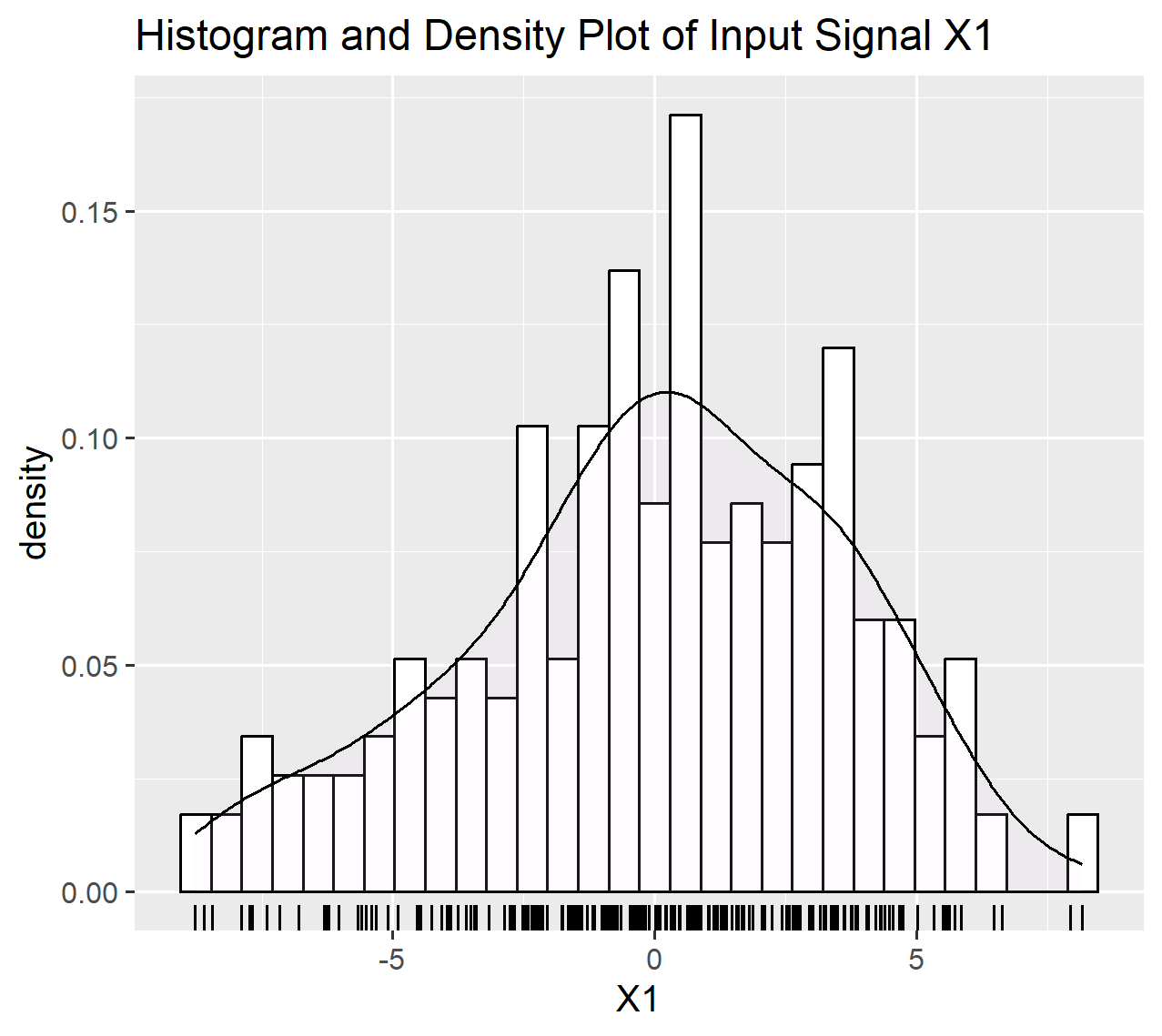
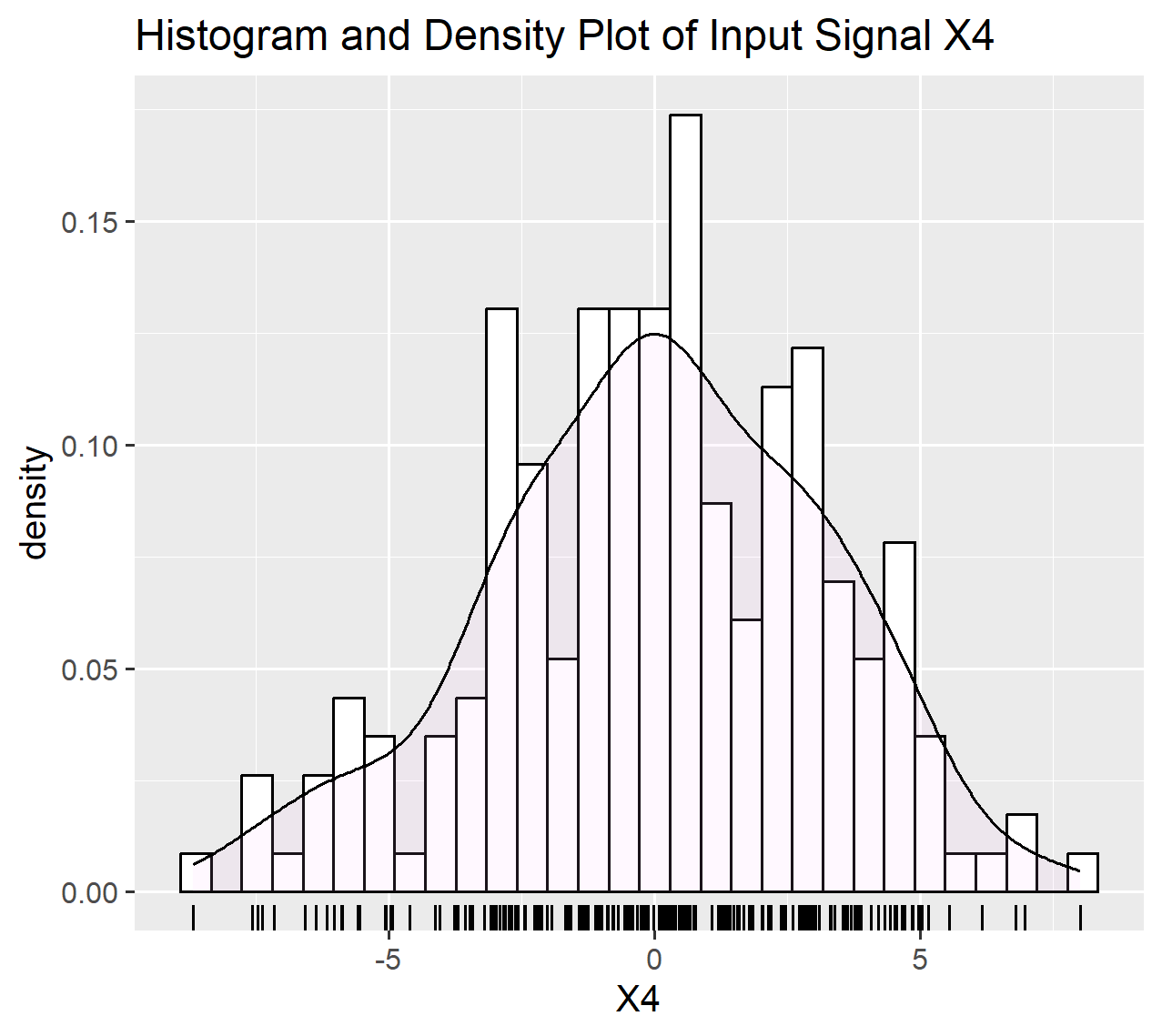
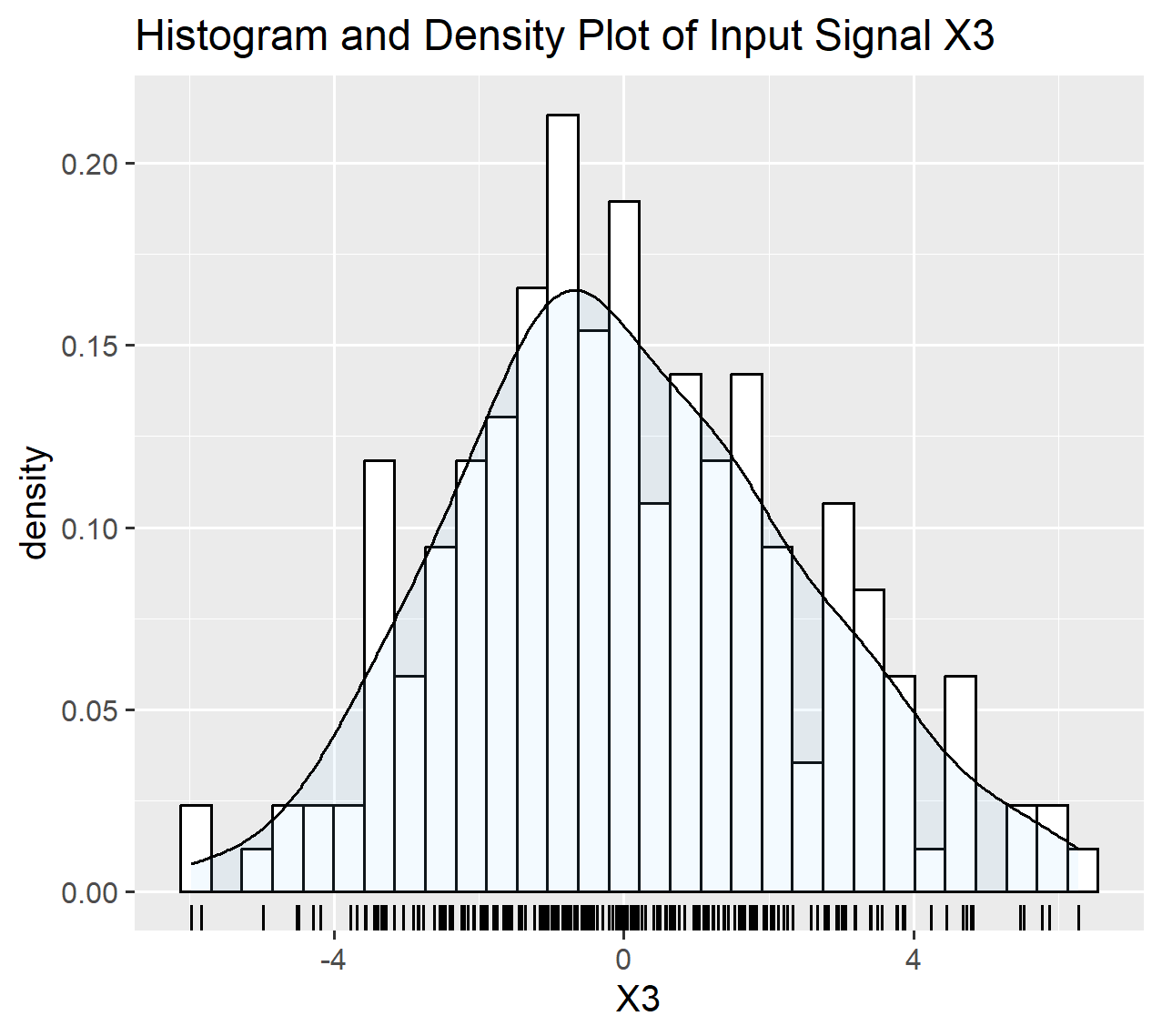


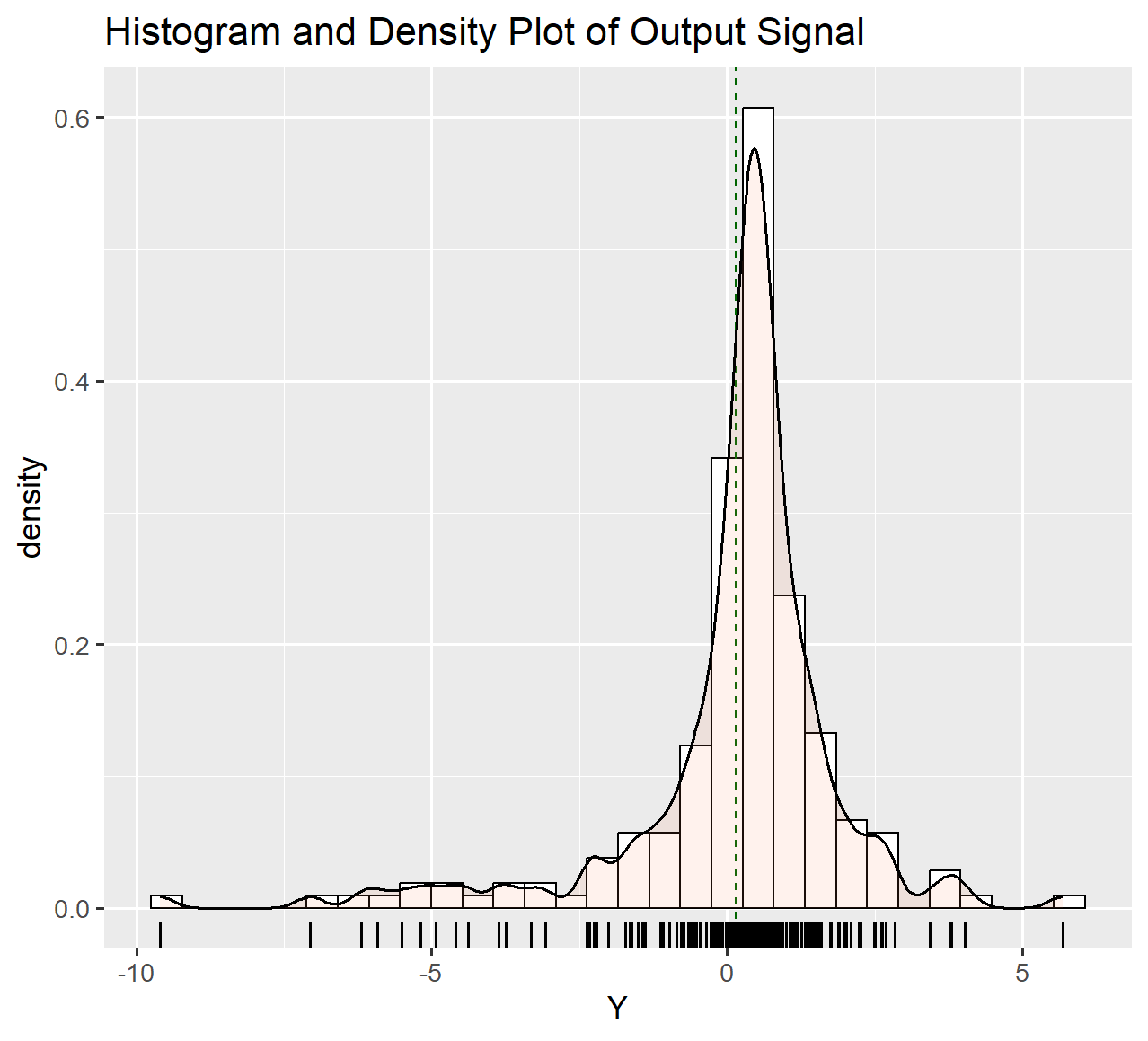
Figure Plot of the Input Signal

The shape of the density plot represents a bell-shaped curve. From the figure we can see that most values are accumulated around the center and there are lesser values at the far end signifying that the signal does not have a lot of extreme values or outliers as the tails of the density plot tapers down.





The distribution shapes of all the input signals are fairly close to a bell shaped curve. They data does not have extreme outliers so there is no need to refactor the dataset.



From the plot above, we can see that most values