**Abstract**

The aim of this project is to present a multidimensional performance analysis of mobile 3G and 4G networks of rural morphology in India. The Mobile Network performance analysis is carried out based on measurement data obtained through drive tests (DT) conducted in rural areas located in West Bengal, namely Kalyani. The measurement data pertains to the performance of three national mobile network operators (MNOs), namely Reliance Jio and Airtel, in rural areas. The Mobile Network performance measurement data was collected between October and November using modified Redmi Note 5 smartphone handsets.

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**Chapter** **4:** **Data** **Preprocessing** **&** **Analysis** **1.** **Preprocessing**

We have collected data for the whole month of October. For every 15minutes, the application wakes up and does a single web cycle i.e upload and download speed through the default web platform due to which we used two different devices of the same model. The preprocessing steps are:

1) Average of the intervals i.e 15mins for each day into a single value. Discarded last few days due to improper collection of values in proper intervals.

2) Usage of Regular Expressions to recover the values from the text of the csv files.

3) Separation of the files on the basis of:

a) Operator names

b) Operations performed i.e upload, download etc.

c) On the basis of platforms that is used to perform the operations.

d) On the basis of network type i.e 3G, 4G etc.

**2. Coding**

🡺Ploting of Comparison Graph

1) Uses:

A> Python library like matplotlib.pyplot, numpy

B> Python build-in package csv ,re ,io.

*import matplotlib.pyplot as plt*

*import numpy as np*

*import csv*

*import re*

*import random*

2) Open and Read CSV files.

*with open('csvname\_jio.csv','r') as csvfile:*

3) Plot Graph and accondingly mention X and Y coordinate name, like

*plt.plot(x\_jio,y\_jio, label='Jio')*

*plt.xlabel('Number of Days')*

*plt.ylabel('Kbps')*

1. Python code for comparison Uploading speed between two operator.

*import matplotlib.pyplot as plt*

*import csv*

*import re*

*x\_jio = []*

*y\_jio = []*

*with open('csvname\_jio.csv','r') as csvfile:*

*plots = csv.reader(csvfile, delimiter=',')*

*for row in plots:*

*try:*

*#print(row)*

*x\_jio.append(int(row[0]))*

*s=[float(s) for s in re.findall(r'[-+]?\d\*\.\d+|\d+',row[2])]*

*#print(s)*

*y\_jio.append(s[0])*

*except:*

*continue*

*x\_airtel = []*

*y\_airtel = []*

*with open('csvname\_airtel.csv','r') as csvfile:*

*plots = csv.reader(csvfile, delimiter=',')*

*for row in plots:*

*try:*

*#print(row[0])*

*x\_airtel.append(int(row[0]))*

*s=[float(s) for s in re.findall(r'[-+]?\d\*\.\d+|\d+',row[2])]*

*print(s)*

*y\_airtel.append(s[0])*

*except:*

*continue*

*# print(x\_airtel)*

*# print(y\_airtel)*

*plt.plot(x\_jio,y\_jio, label='Jio')*

*plt.plot(x\_airtel,y\_airtel, label='Airtel')*

*plt.xlabel('Number of Days')*

*plt.ylabel('Kbps')*

*plt.title('Comparison between two operator of Uploading speed')*

*plt.legend()*

*plt.show()*

1. Python code for comparison of upload speed between same operator of 4G and 3G.

*import matplotlib.pyplot as plt*

*import csv*

*import re*

*from io import StringIO*

*x\_airtel4g = []*

*y\_airtel4g = []*

*with open('csvname\_airtel.csv','r') as csvfile:*

*plots = csv.reader(csvfile, delimiter=',')*

*for row in plots:*

*try:*

*print(row)*

*x\_airtel4g.append(int(row[0]))*

*s=[float(s) for s in re.findall(r'[-+]?\d\*\.\d+|\d+',row[2])]*

*#print(s)*

*y\_airtel4g.append(s[0])*

*except:*

*continue*

*x\_airtel3g = []*

*y\_airtel3g = []*

*with open('csvname\_airtel3g.csv','r') as csvfile:*

*plots = csv.reader(csvfile, delimiter=',')*

*for row in plots:*

*print(row)*

*x\_airtel3g.append(int(row[0]))*

*s=[float(s) for s in re.findall(r'[-+]?\d\*\.\d+|\d+',row[2])]*

*#print(s)*

*y\_airtel3g.append(s[0])*

*# print(x\_airtel)*

*# print(y\_airtel)*

*plt.plot(x\_airtel4g,y\_airtel4g, label='Airtel4G')*

*plt.plot(x\_airtel3g,y\_airtel3g, label='Airtel3G')*

*plt.xlabel('Number of Days')*

*plt.ylabel('Kbps')*

*plt.title('Comparison of upload speed between same operator of 4G and 3G')*

*plt.legend()*

*plt.show()*

**References**

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