# MonthReportDeptAnalysis_V1

December 10, 2019

## 1 This is monthly report analysis of the open government data. This session does data analysis on existing data and prediction

**Technology used:**

-Jupyter Notebook
-Python3 with numpy,pandas,matplotlib libraries

**Analysis done:**

--Correlation betweeen griviences opened and disposed
--Cumulative data analysis
--Linear Regression
--Post Prediction for one more year
--Inferences

**Revision history:**

Created date: 10-Dec-2019
Created by: Rajaneesh Acharya
Version History: V1.0

[1]:
```
#import numpy and pandas package
import numpy as np
import pandas as pd

#import matplot lib for plotting and let the plotting be inline
%matplotlib inline
import matplotlib.pyplot as plt
#used for date formatting
import matplotlib.dates as mdates
from pandas.plotting import register_matplotlib_converters
register_matplotlib_converters()

#used for creating linear regression, splitting train test data, training,␣
 ↪encoding and getting learning confidence level
```

```
from sklearn.linear_model import LinearRegression as lr
from sklearn.model_selection import train_test_split as ttsplit
from sklearn.metrics import r2_score as r2
from sklearn.preprocessing import LabelEncoder as le

#during report generation ignore warnings.
import warnings
warnings.filterwarnings('ignore')
```

[2]:
```
#Read all the records to MonthlyDeptdatafile.
#Please nore all the delimiter are "^" as delimiters of ";","&" etc will␣
 ↪possibly be in comments
data=pd.read_csv("MonthlyDeptdatafile.csv", sep='^',parse_dates=[[1,2]])
```

[3]:
```
#group the data by organization name in order to seggregate department/state␣
 ↪performance. List out all departments and states
group_data=data.groupby('org_name')

for name,group in group_data:
   print(name, end=', ')
    #print(group)
    #plt.figure()
    #plt.plot(group['Recetpts'])
    #plt.show()
```

```
Central Board of Direct Taxes (Income Tax), Central Board of Indirect Taxes and
Customs, Committee on Petitions Rajya Sabha, Department of Administrative
Reforms and PG, Department of Agriculture Research and Education, Department of
Agriculture, Cooperation and Farmers Welfare, Department of Animal Husbandry,
Dairying, Department of Atomic Energy, Department of Bio Technology, Department
of Chemicals and Petrochemicals, Department of Commerce, Department of Consumer
Affairs, Department of Defence, Department of Defence Finance, Department of
Defence Production, Department of Defence Research and Development, Department
of Economic Affairs ACC Division, Department of Empowerment of Persons with
Disabilities, Department of Ex Servicemen Welfare, Department of Expenditure,
Department of Fertilizers, Department of Financial Services (Banking Division),
Department of Financial Services (Insurance Division), Department of Financial
Services (Pension Reforms), Department of Fisheries, Department of Food and
Public Distribution, Department of Health & Family Welfare, Department of Health
Research, Department of Heavy Industry, Department of Higher Education,
Department of Industrial Policy & Promotion, Department of Investment & Public
Asset Management, Department of Justice, Department of Land Resources,
Department of Legal Affairs, Department of Official Language, Department of
Personnel and Training, Department of Pharmaceutical, Department of Posts,
Department of Public Enterprises, Department of Revenue, Department of Rural
Development, Department of School Education and Literacy, Department of Science
```

and Technology, Department of Scientific & Industrial Research, Department of Social Justice and Empowerment, Department of Space, Department of Sports, Department of Telecommunications, Department of Youth Affairs, Government of Andaman & Nicobar, Government of Andhra Pradesh, Government of Arunachal Pradesh, Government of Assam, Government of Bihar, Government of Chattisgarh, Government of Goa, Government of Gujarat, Government of Haryana, Government of Himachal Pradesh, Government of Jammu and Kashmir, Government of Jharkhand, Government of Karnataka, Government of Kerala, Government of Madhya Pradesh, Government of Maharashtra, Government of Manipur, Government of Meghalaya, Government of Mizoram, Government of NCT of Delhi, Government of Nagaland, Government of Odisha, Government of Puducherry, Government of Punjab, Government of Rajasthan, Government of Sikkim, Government of Tamil Nadu, Government of Telangana, Government of Tripura, Government of Union Territory of Chandigarh, Government of Union Territory of Dadra & Nagar Haveli, Government of Union Territory of Daman & Diu, Government of Union Territory of Lakshadweep, Government of Uttar Pradesh, Government of Uttarakhand, Government of West Bengal, Investment Grievance Redress Cell, Legislative Department, Ministry of Coal, Ministry of Ayush, Ministry of Civil Aviation, Ministry of Corporate Affairs, Ministry of Culture, Ministry of Development of North Eastern Region, Ministry of Drinking Water and Sanitation, Ministry of Earth Sciences, Ministry of Electronics & Information Technology, Ministry of Environment, Forest and Climate Change, Ministry of External Affairs, Ministry of Food Processing Industries, Ministry of Home Affairs, Ministry of Housing and Urban Affairs, Ministry of Information and Broadcasting, Ministry of Labour and Employment, Ministry of Micro Small and Medium Enterprises, Ministry of Mines, Ministry of Minority Affairs, Ministry of New and Renewable Energy, Ministry of Panchayati Raj, Ministry of Parliamentary Affairs, Ministry of Petroleum and Natural Gas, Ministry of Power, Ministry of Railways ( Railway Board), Ministry of Road Transport and Highways, Ministry of Shipping, Ministry of Skill Development and Entrepreneurship, Ministry of Statistics and Programme Implementation, Ministry of Steel, Ministry of Textiles, Ministry of Tourism, Ministry of Tribal Affairs, Ministry of Water Resources, River Development & Ganga Rejuv, Ministry of Women and Child Development, NITI Aayog, National Commission for Scheduled Caste, National Human Rights Commission, O/o the Comptroller & Auditor General of India, Securities and Exchange Board of India, Unique Identification Authority of India,

# 2 Departmentwise griviences filed and disposal analysis

### 2.0.1 Type of analysis:

Plot of griviences filed and disposed every is plotted and correlation of both of them is done fo top 15 departments. If there is a strong cross correlation (off diagonal element) between the rate at which it is filed and disposed off, then it means the griviences are effectively handled.

### 2.0.2 States:

Department of Financial Services (Banking Division)
Department of Telecommunications
Ministry of Railways ( Railway Board)
Department of Posts
Central Board of Direct Taxes (Income Tax)
Ministry of Labour and Employment
Ministry of Home Affairs
Department of Personnel and Training
Department of Revenue
Department of Higher Education
Department of Health & Family Welfare
Ministry of Petroleum and Natural Gas
Central Board of Indirect Taxes and Customs
Department of School Education and Literacy
Department of Defence

### 2.0.3 Observations:

Higher the positive correlation between the rate at which the griviences are filed and disposed, better is the rate at which it is disposed off qualitatively

[4]:
```
# Function to print department header in the report

def print_stateName_header(dept):
    print(dept+":")
    print("")
```

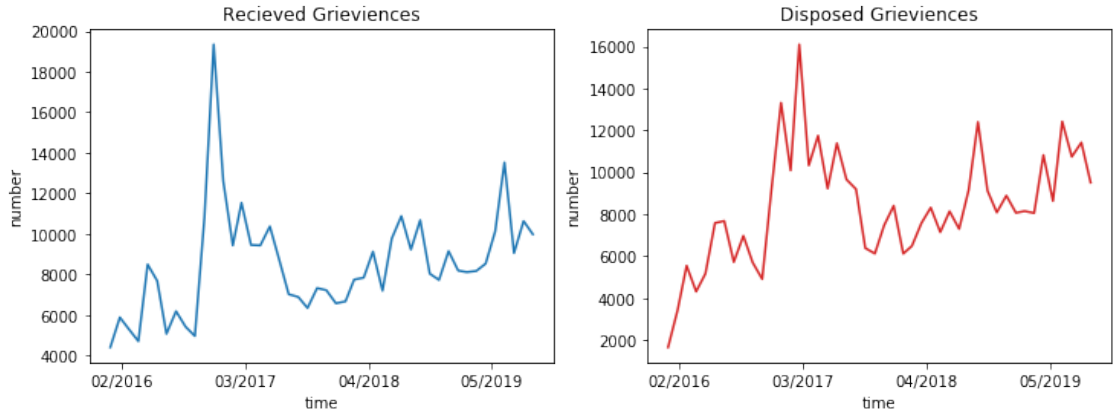
[5]:
```
#Function to plot the departmentwise reciept and disposal of the griviences

def plot_graph(dept_dataframe):
    plt.rcParams['figure.figsize'] = [12, 4]
    fig, ax= plt.subplots(1,2)
    ax[0].plot(dept_dataframe.Year_Month, dept_dataframe.Recetpts)
    ax[1].plot(dept_dataframe.Year_Month, dept_dataframe.Disposals,'tab:red')
    ax[0].set_title('Recieved Grieviences')
    ax[1].set_title('Disposed Grieviences')
    ax[0].set_xlabel('time')
    ax[0].set_ylabel('number')
    ax[1].set_xlabel('time')
    ax[1].set_ylabel('number')
    ax[0].xaxis.set_major_locator(plt.MaxNLocator(4))
    ax[1].xaxis.set_major_locator(plt.MaxNLocator(4))
    _fmt = mdates.DateFormatter('%m/%Y')
    ax[0].xaxis.set_major_formatter(_fmt)
    ax[1].xaxis.set_major_formatter(_fmt)
```

```
    plt.show()
```

[6]:
```
# function to compute correlation between reciept and dispposal of griviences

def print_correlation(dept_dataframe):
    print("Correlation matrix for  "+dept+" between grievences opened and␣
 ↪griviences disposed")
    print("")
    print(np.corrcoef(dept_dataframe.Recetpts,dept_dataframe.Disposals))
    print("")
```

[7]:
```
# List out top 15 department names. Prints the department header, plots the␣
 ↪griviences recieved and disposed and computes the correlation


dept_list = ['Department of Financial Services (Banking Division)', 'Department␣
 ↪of Telecommunications', 'Ministry of Railways ( Railway Board)',
             'Department of Posts', 'Central Board of Direct Taxes (Income␣
 ↪Tax)', 'Ministry of Labour and Employment', 'Ministry of Home Affairs',
             'Department of Personnel and Training', 'Department of Revenue',␣
 ↪'Department of Higher Education', 'Department of Health & Family Welfare',
             'Ministry of Petroleum and Natural Gas', 'Central Board of Indirect␣
 ↪Taxes and Customs', 'Department of School Education and Literacy',
             'Department of Defence']
for dept in dept_list:
    dept_dataframe=group_data.get_group(dept)
    print_stateName_header(dept)
    plot_graph(dept_dataframe)
    print_correlation(dept_dataframe)
```

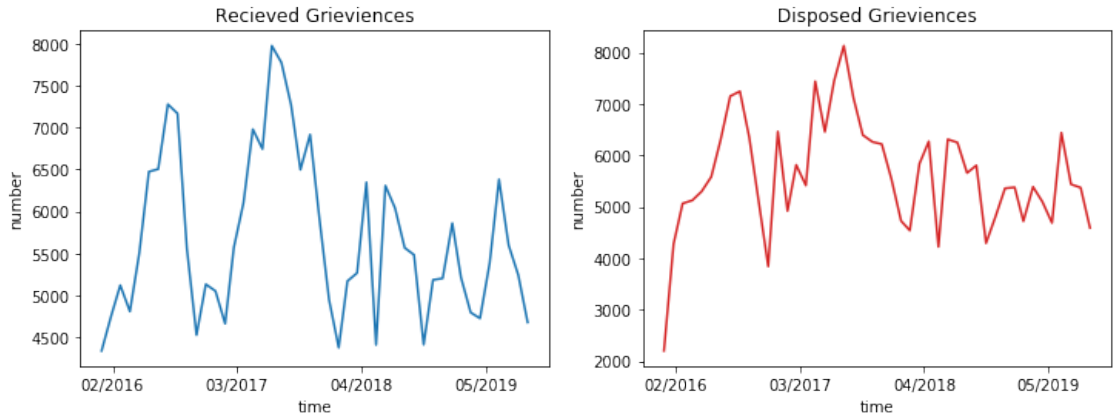
Department of Financial Services (Banking Division):




Correlation matrix for Department of Financial Services (Banking Division) between grievences opened and griviences disposed

```
[[1.         0.59550168]
 [0.59550168 1.        ]]
```

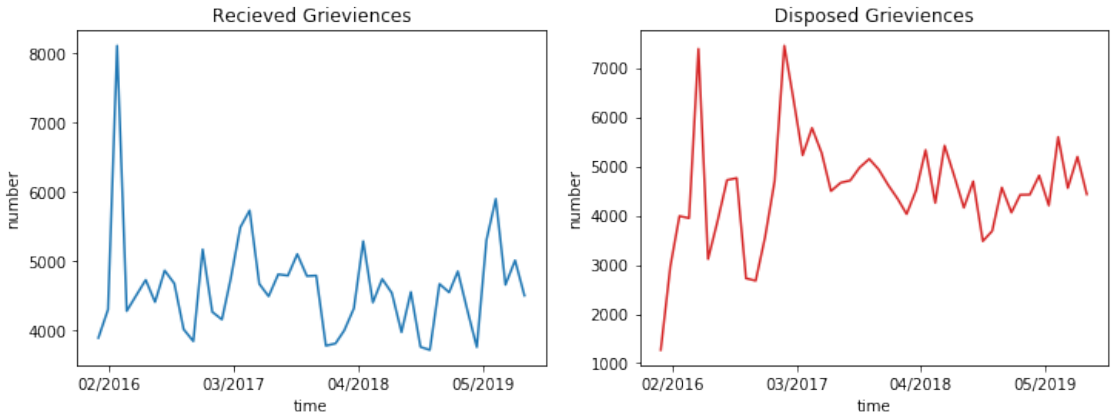
Department of Telecommunications:




Correlation matrix for Department of Telecommunications between grievences opened and griviences disposed

```
[[1.         0.84830562]
 [0.84830562 1.        ]]
```

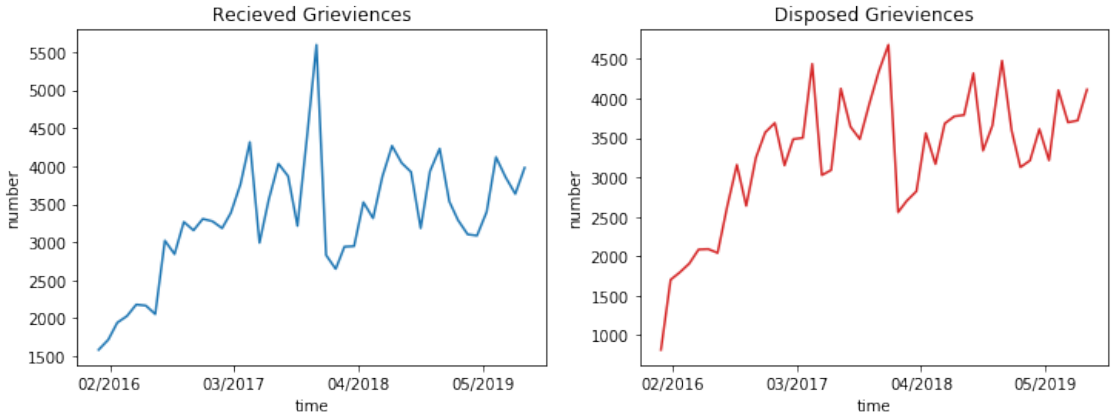
Ministry of Railways ( Railway Board):




Correlation matrix for Ministry of Railways ( Railway Board) between grievences opened and griviences disposed

```
[[1.         0.23049495]
 [0.23049495 1.        ]]
```

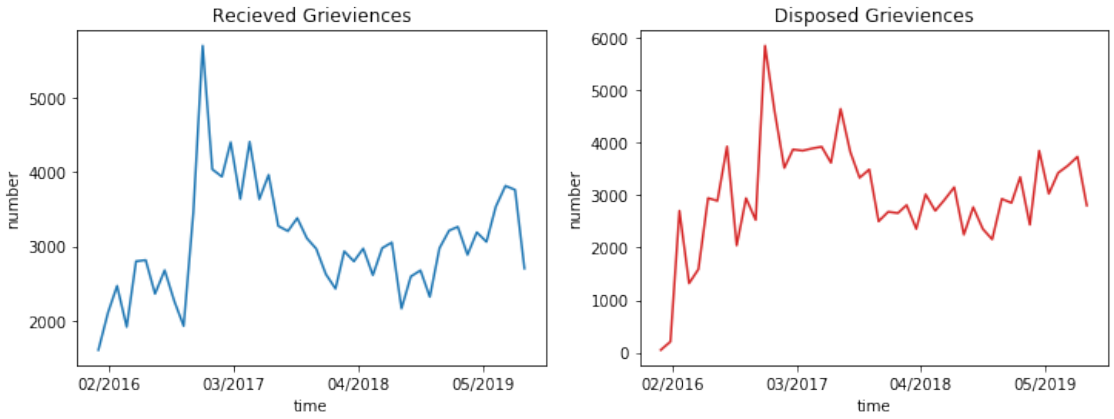
Department of Posts:




Correlation matrix for Department of Posts between grievences opened and griviences disposed

```
[[1.        0.8598838]
 [0.8598838 1.       ]]
```

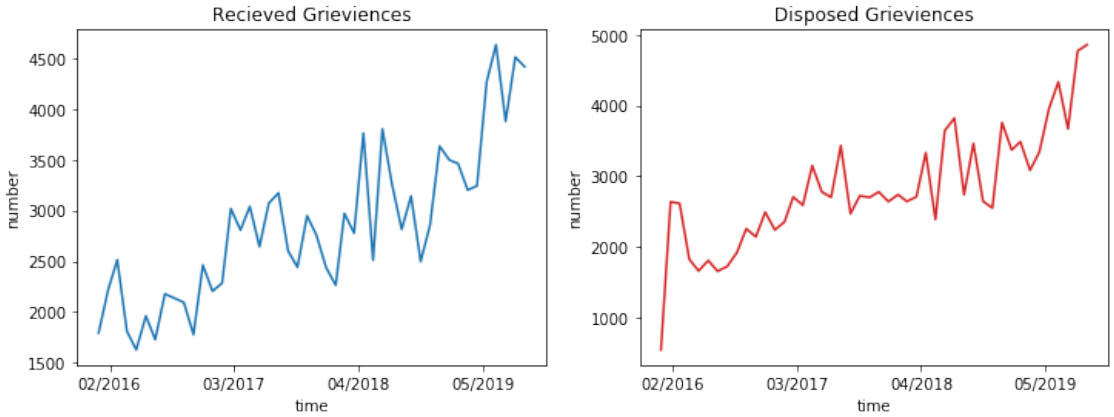
Central Board of Direct Taxes (Income Tax):




Correlation matrix for Central Board of Direct Taxes (Income Tax) between grievences opened and griviences disposed

```
[[1.         0.80226204]
 [0.80226204 1.        ]]
```

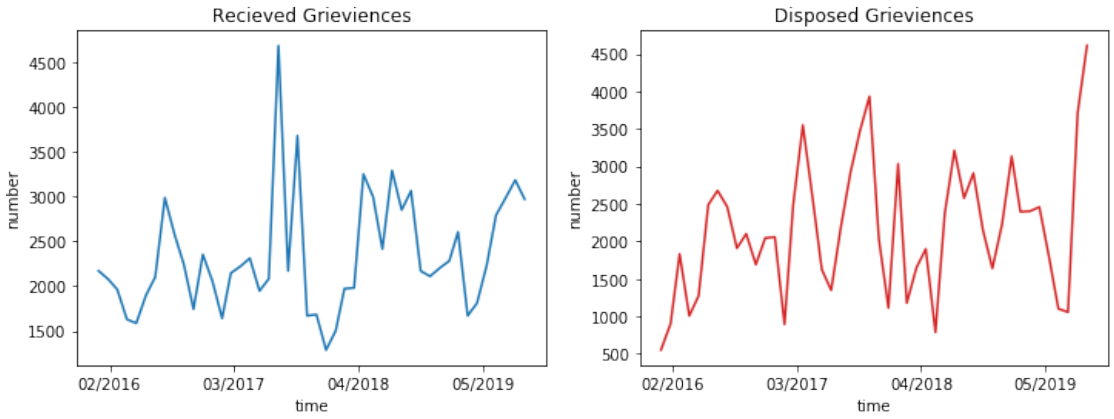
Ministry of Labour and Employment:




Correlation matrix for Ministry of Labour and Employment between grievences opened and griviences disposed

```
[[1.         0.92688548]
 [0.92688548 1.        ]]
```

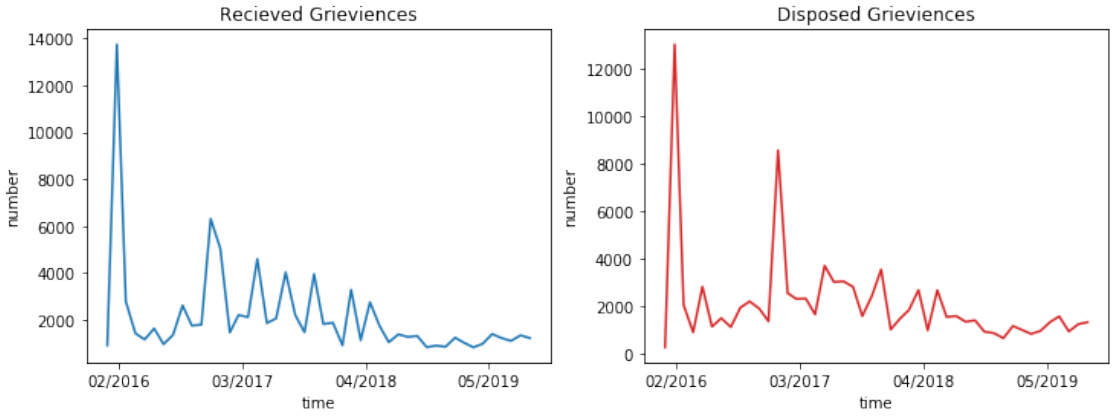
Ministry of Home Affairs:




Correlation matrix for Ministry of Home Affairs between grievences opened and griviences disposed

```
[[1.         0.26762115]
 [0.26762115 1.        ]]
```

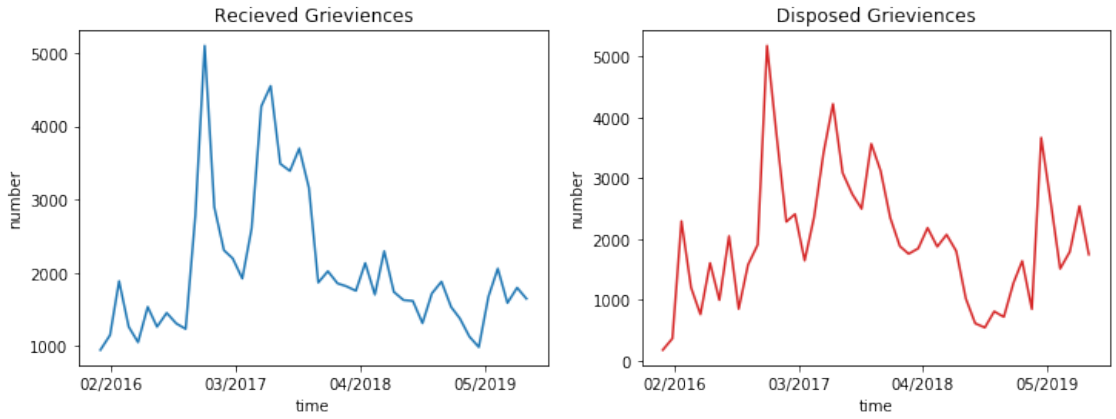
Department of Personnel and Training:




Correlation matrix for Department of Personnel and Training between grievences opened and griviences disposed

```
[[1.         0.81569766]
 [0.81569766 1.        ]]
```

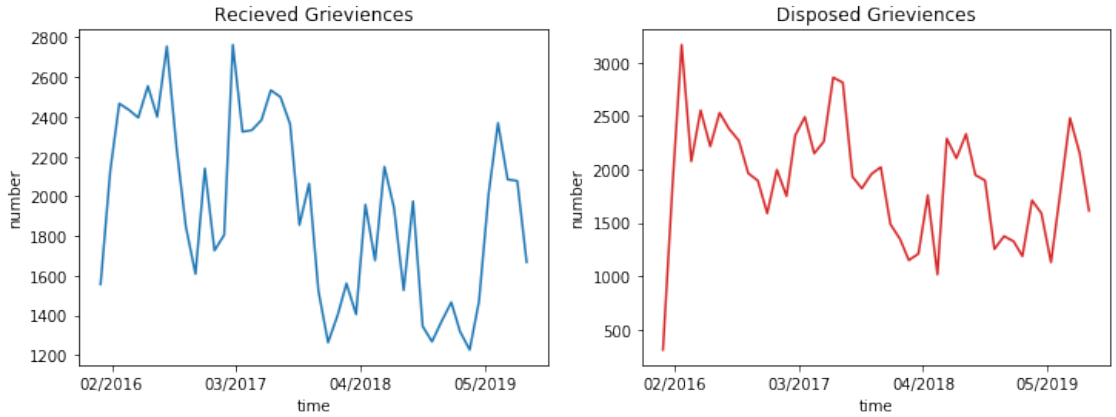
Department of Revenue:




Correlation matrix for Department of Revenue between grievences opened and griviences disposed

```
[[1.         0.77007556]
 [0.77007556 1.        ]]
```

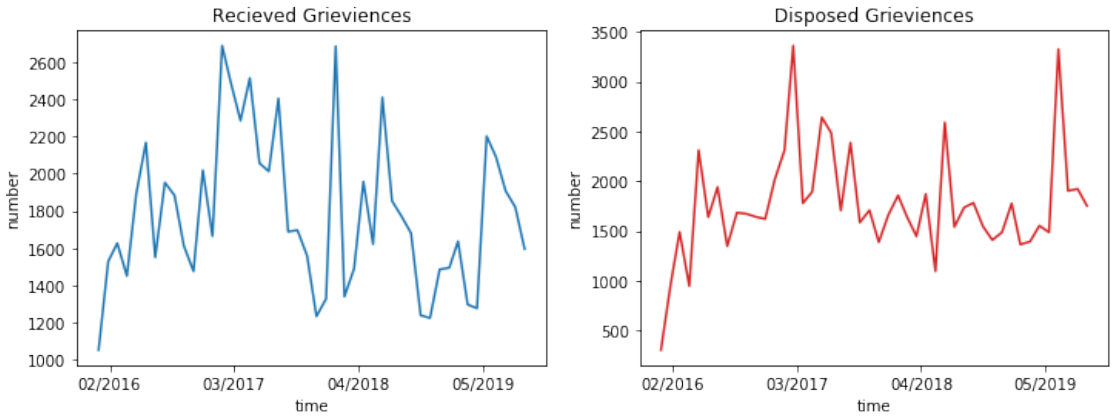
Department of Higher Education:




Correlation matrix for Department of Higher Education between grievences opened and griviences disposed

```
[[1.         0.69581132]
 [0.69581132 1.        ]]
```

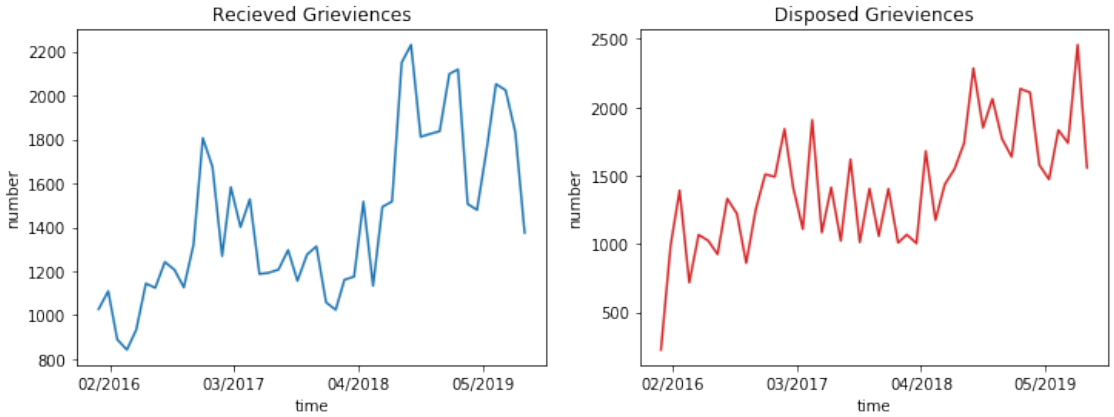
Department of Health & Family Welfare:




Correlation matrix for Department of Health & Family Welfare between grievences opened and griviences disposed

```
[[1.         0.57460172]
 [0.57460172 1.        ]]
```

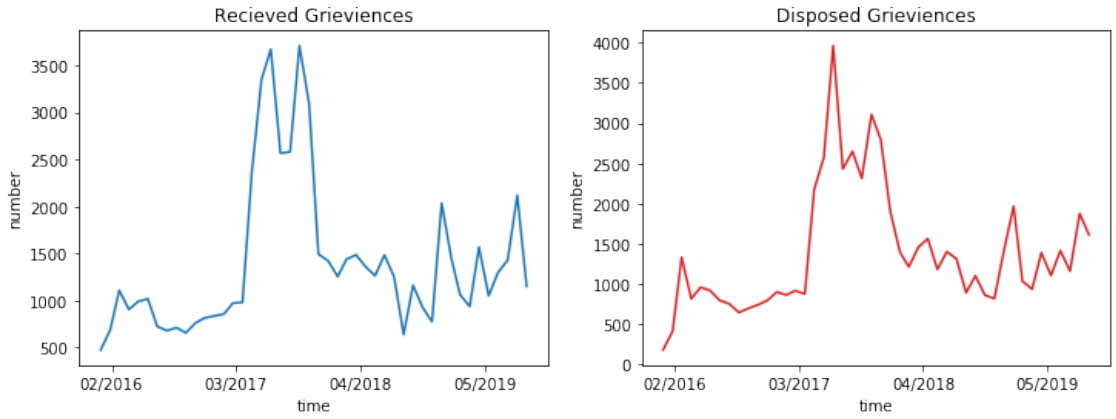
Ministry of Petroleum and Natural Gas:




Correlation matrix for Ministry of Petroleum and Natural Gas between grievences opened and griviences disposed

```
[[1.         0.76244879]
 [0.76244879 1.        ]]
```

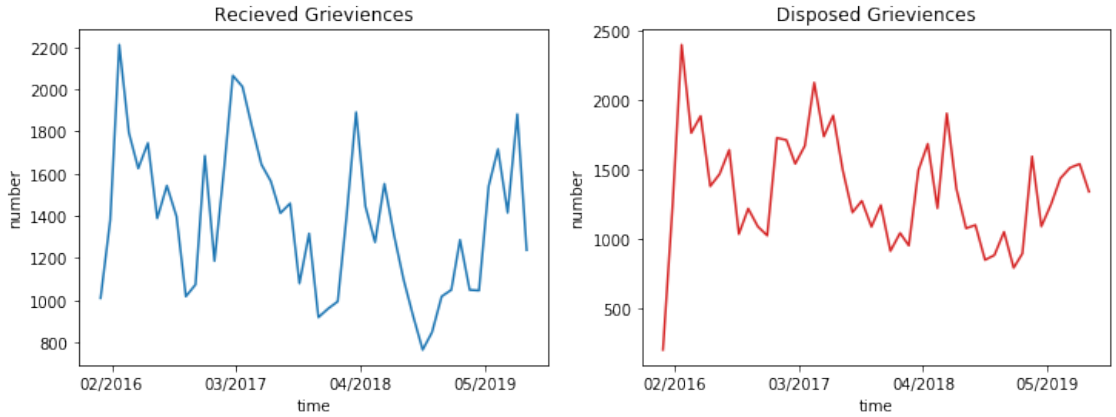
Central Board of Indirect Taxes and Customs:




Correlation matrix for Central Board of Indirect Taxes and Customs between grievences opened and griviences disposed

```
[[1.         0.89173293]
 [0.89173293 1.        ]]
```

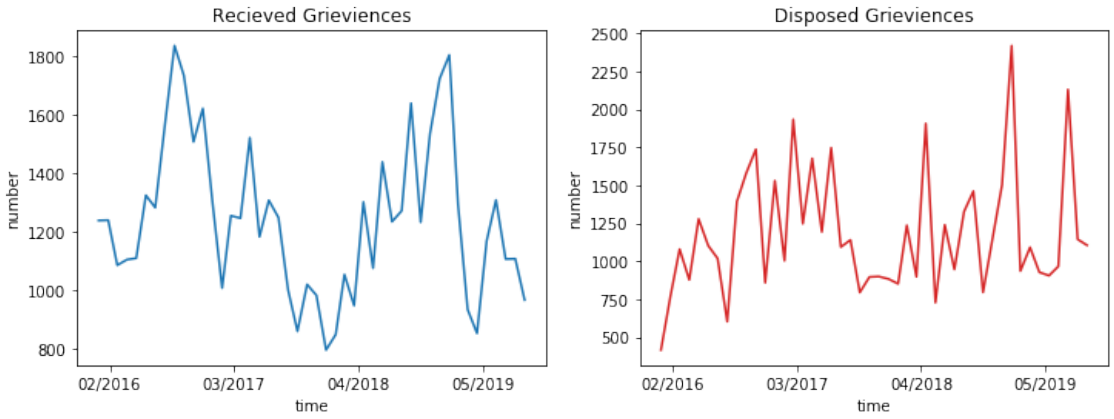
Department of School Education and Literacy:




Correlation matrix for Department of School Education and Literacy between grievences opened and griviences disposed

```
[[1.         0.68872915]
 [0.68872915 1.        ]]
```

Department of Defence:




Correlation matrix for Department of Defence between grievences opened and griviences disposed

```
[[1.         0.44552301]
 [0.44552301 1.        ]]
```

# 3 Department cumulative analysis for griviences filed and disposed

### 3.0.1 Type of analysis:

Cumulative plot of griviences filed and disposed from 2016 till 2019 October. for top 15 departments. Here trend using linear regression is also given. The blue line represent cumulative reciept of grievences. The orange line gives the cumulative disposal of griviences. The dash blue and orange line represents predicted values respectively.

### 3.0.2 States:

Department of Financial Services (Banking Division)
Department of Telecommunications
Ministry of Railways ( Railway Board)
Department of Posts
Central Board of Direct Taxes (Income Tax)
Ministry of Labour and Employment
Ministry of Home Affairs

```
Department of Personnel and Training
Department of Revenue
Department of Higher Education
Department of Health & Family Welfare
Ministry of Petroleum and Natural Gas
Central Board of Indirect Taxes and Customs
Department of School Education and Literacy
Department of Defence
```

### 3.0.3 Observations:

More the gap of disposed and grieviences filed over a period of time, lower is the rate of addressing. It calls for improved productivity or having more man power to address the grieviences or citizen connect of the government.

[8]:
```
# Data preprocessing of the dataframe as prediction does not take date and␣
↪change data from monthly to cumulative

def preprocess_Dataframe(dept_dataframe):
    encoder =le()
    dept_dataframe['new_date']=dept_dataframe.iloc[:,0]
    dept_dataframe.iloc[:,0]=encoder.fit_transform(dept_dataframe.iloc[:,0])
    dept_dataframe.iloc[:,2]=dept_dataframe.Recetpts.cumsum(skipna=True)
    dept_dataframe.iloc[:,3]=dept_dataframe.Disposals.cumsum(skipna=True)
    dept_dataframe.set_index('Year_Month')
    return dept_dataframe
```

[9]:
```
# Train linear regression model

def create_model(dept_dataframe, train_test_size):
    date=dept_dataframe.iloc[:,[0]]
    output=dept_dataframe.iloc[:,[2,3]]
    traindata_input, testdata_input, traindata_output, ␣
↪testdata_output=ttsplit(date,output,test_size=train_test_size)
    statewise_linearRegression=lr()
    statewise_linearRegression.fit(traindata_input, traindata_output)
    return [statewise_linearRegression, testdata_input, testdata_output]
```

[10]:
```
# Predict for future date using model

def predict_tickets(start_Month, end_Month, increment):
    year_month_range=np.arange(start_Month, start_Month+end_Month, increment)
    futurepredict_input=pd.DataFrame({'Year_Month':year_month_range})
    future_preddata_output=statewise_linearRegression.
↪predict(futurepredict_input)
```

```
    return future_preddata_output
```

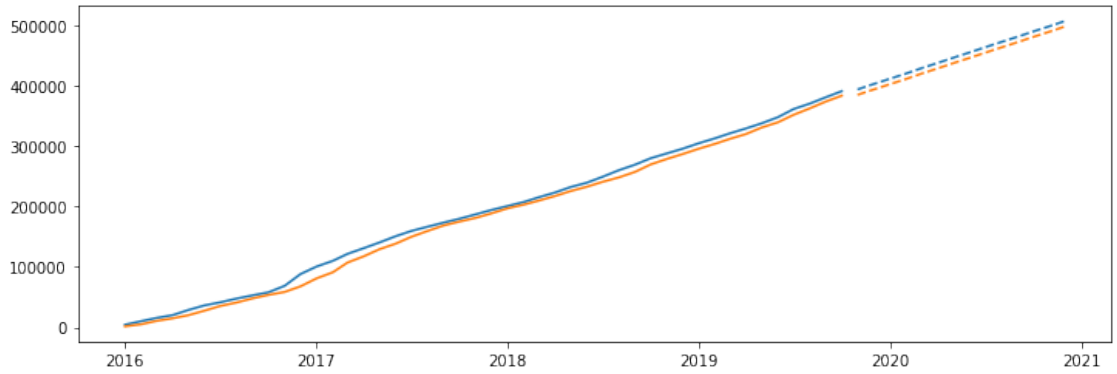
[11]:
```
# Plot the as is cumulative data in continuous line and predicted data in dash␣
 ↪line

def plot_graph(dept_dataframe, future_daterange,future_preddata_output):
    plt.plot(dept_dataframe.new_date, dept_dataframe.iloc[:,[2,3]])
    plt.gca().set_prop_cycle(None)
    plt.plot(future_daterange,future_preddata_output,'--')
    plt.show()
```

[12]:
```
#Print department header

def print_header(dept, testdata_output, preddata_output):
    print(dept+":")
    print("")
    print("Learning Confidence = "+str(r2(testdata_output, preddata_output)))
    print("")
```

[13]:
```
#takes the list of department and iterates through each of the department and␣
 ↪prints the header, creates a linear regression model
# trains he model and uses the trained model to predict. Finally plots the data

dept_list = ['Department of Financial Services (Banking Division)', 'Department␣
 ↪of Telecommunications', 'Ministry of Railways ( Railway Board)',
             'Department of Posts', 'Central Board of Direct Taxes (Income␣
 ↪Tax)', 'Ministry of Labour and Employment', 'Ministry of Home Affairs',
             'Department of Personnel and Training', 'Department of Revenue',␣
 ↪'Department of Higher Education', 'Department of Health & Family Welfare',
             'Ministry of Petroleum and Natural Gas', 'Central Board of Indirect␣
 ↪Taxes and Customs', 'Department of School Education and Literacy',
             'Department of Defence']
for dept in dept_list:
    dept_dataframe=group_data.get_group(dept)
    dept_dataframe=preprocess_Dataframe(dept_dataframe)
    ret = create_model(dept_dataframe, 0.25)
    statewise_linearRegression=ret[0]
    testdata_input=ret[1]
    testdata_output=ret[2]
    preddata_output=statewise_linearRegression.predict(testdata_input)
    print_header(dept, testdata_output, preddata_output)
    future_preddata_output=predict_tickets(46, 14, 1)
    future_daterange=pd.date_range('2019/10/01', periods = 14, freq = 'M')
    plot_graph(dept_dataframe, future_daterange,future_preddata_output)
```

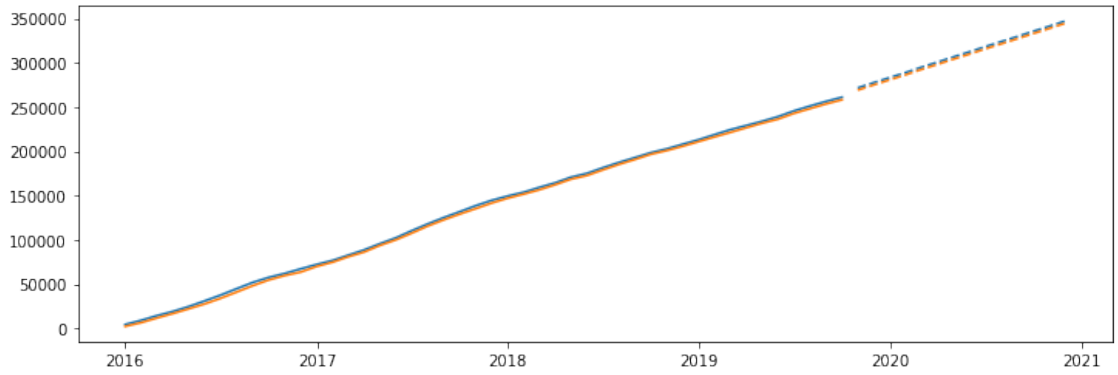
Department of Financial Services (Banking Division):

Learning Confidence = 0.9967999708108699



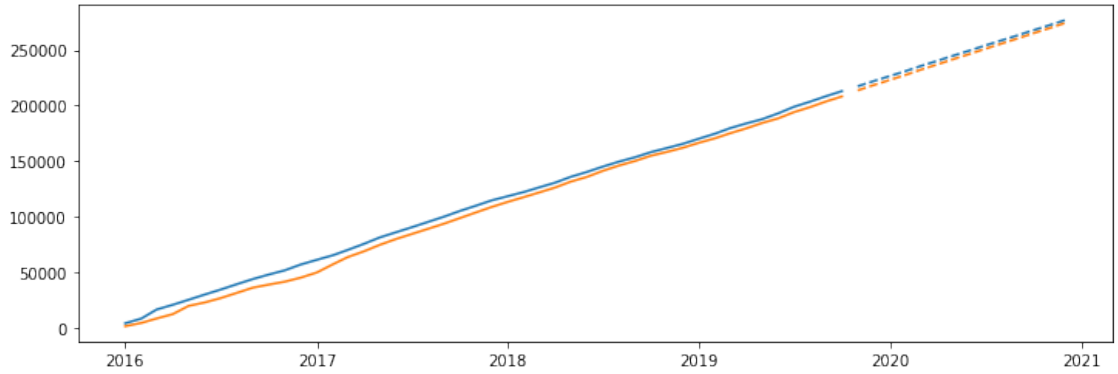

Department of Telecommunications:

Learning Confidence = 0.9980999003746136



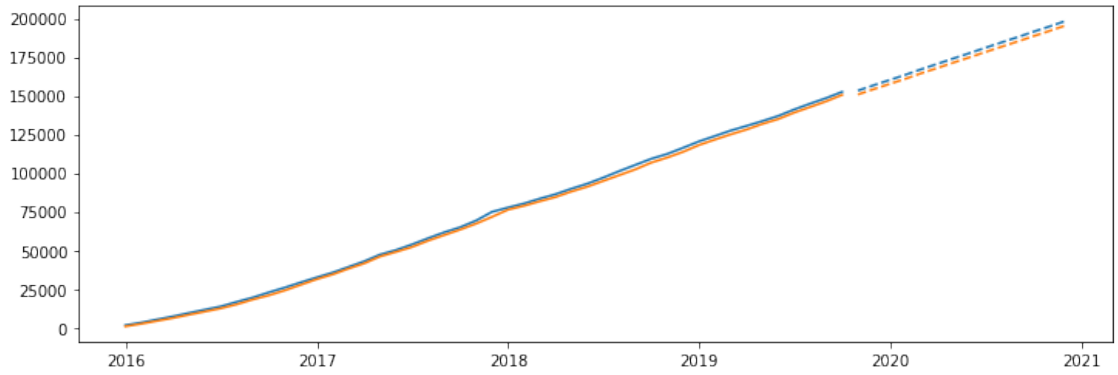

Ministry of Railways ( Railway Board):

Learning Confidence = 0.9995859327493223



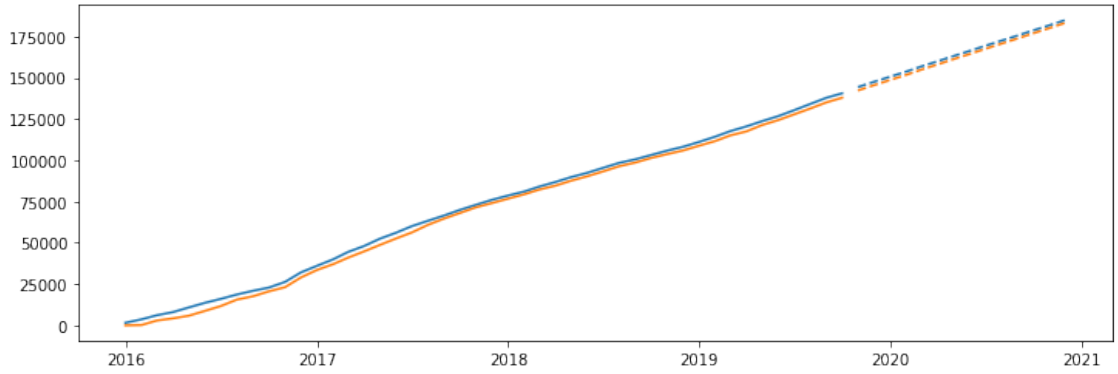

Department of Posts:

Learning Confidence = 0.9985504984757638



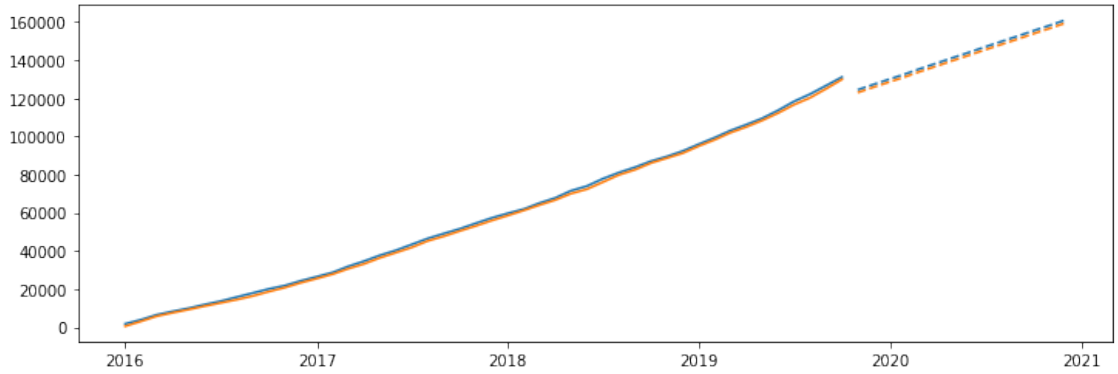

Central Board of Direct Taxes (Income Tax):

Learning Confidence = 0.9919742697065439



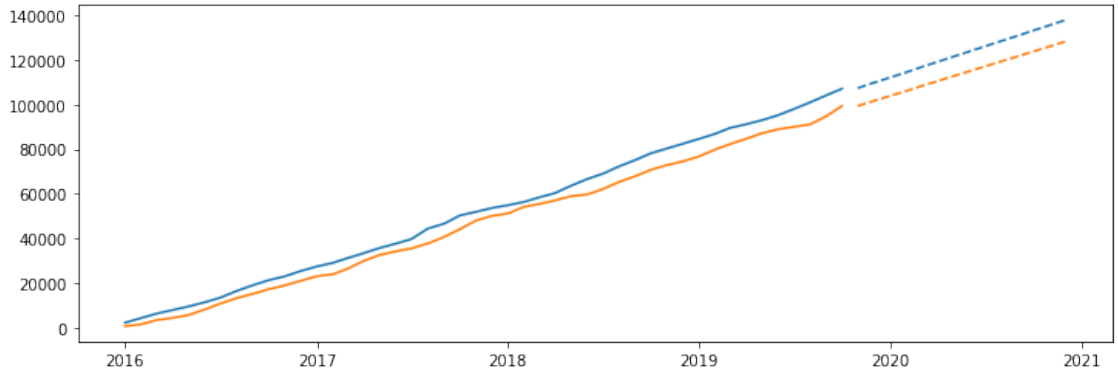
Ministry of Labour and Employment:

Learning Confidence = 0.98985606512328



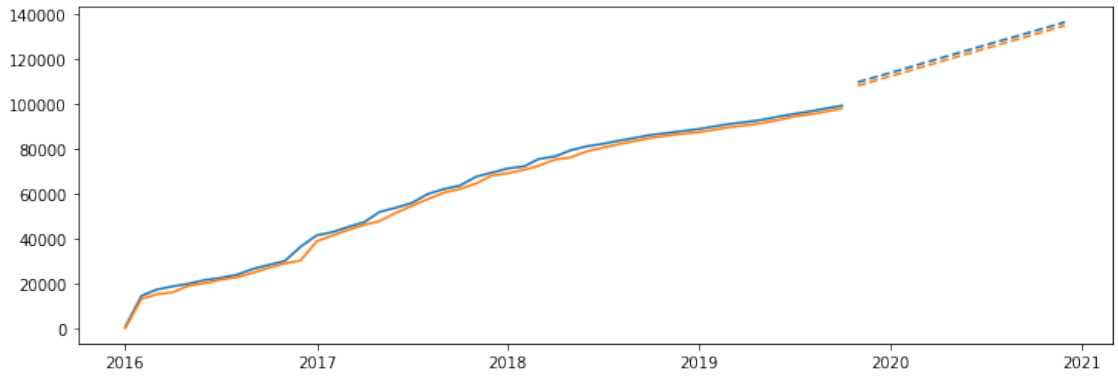

Ministry of Home Affairs:

Learning Confidence = 0.9977891665885714



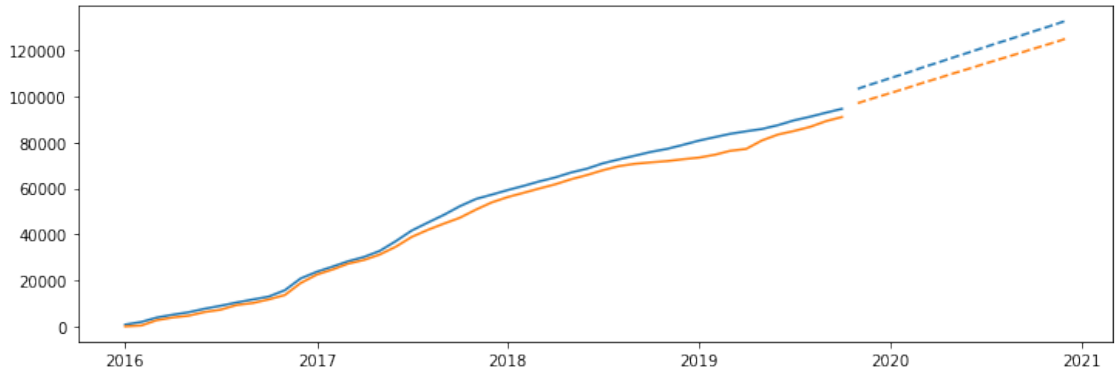

Department of Personnel and Training:

Learning Confidence = 0.9531847259279806



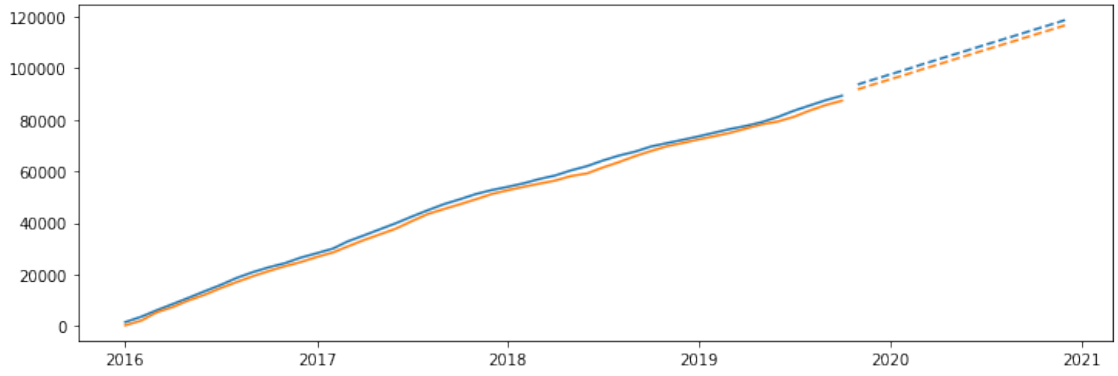

Department of Revenue:

Learning Confidence = 0.9744103659878407



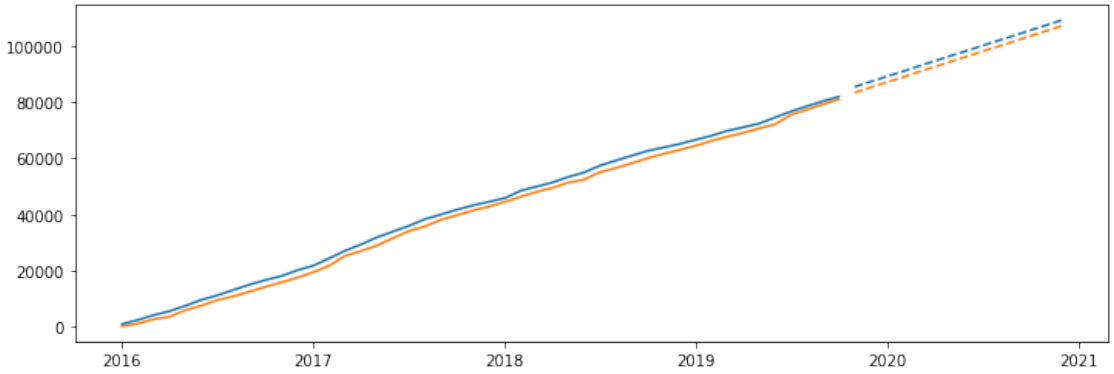

Department of Higher Education:

Learning Confidence = 0.9922157835915232



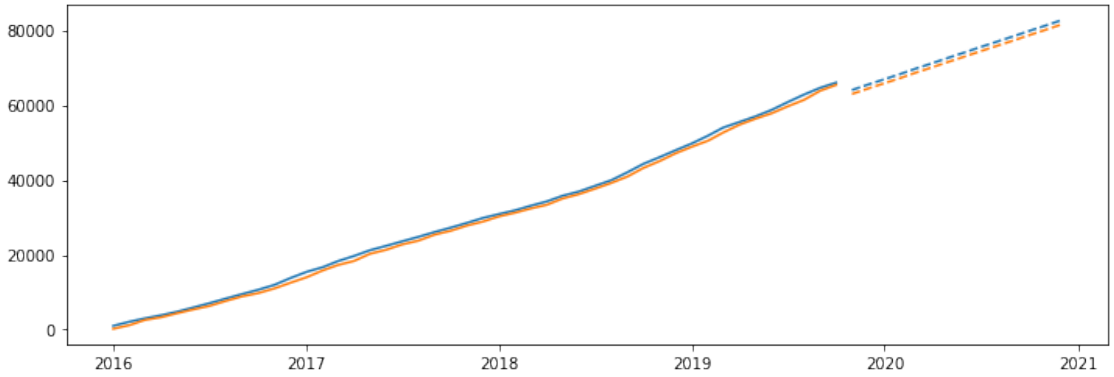
Department of Health & Family Welfare:

Learning Confidence = 0.9985083372742607



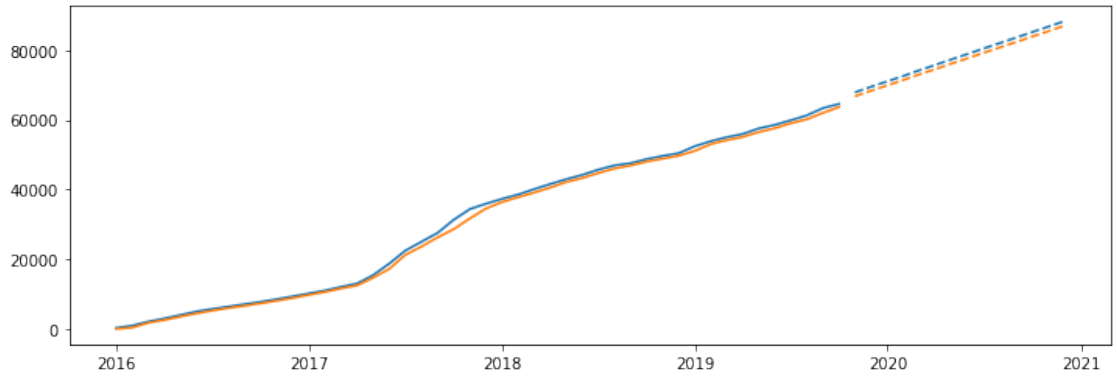

Ministry of Petroleum and Natural Gas:

Learning Confidence = 0.9907361104328645



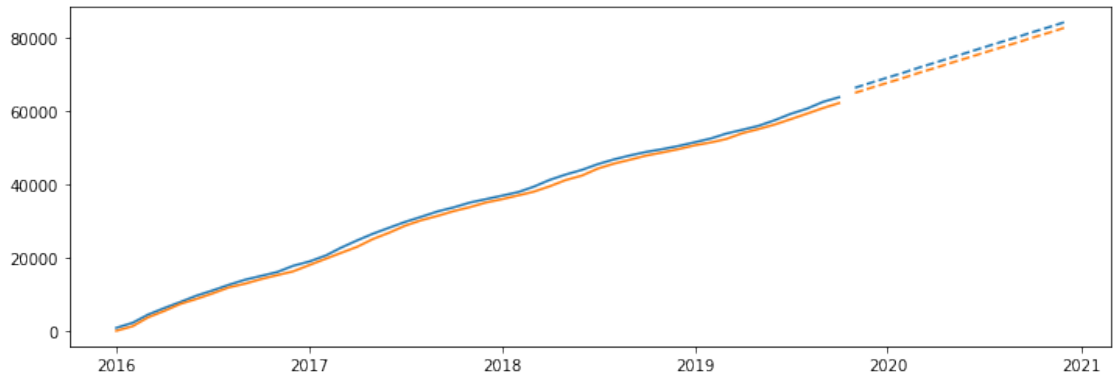

Central Board of Indirect Taxes and Customs:

Learning Confidence = 0.9808376126586291




Department of School Education and Literacy:

Learning Confidence = 0.9942497330136345




Department of Defence:

Learning Confidence = 0.9982016534441867