APPENDIX A

SAMPLE SCREEN SHOTS

To start with, first we need to login into the Google Collaborator platform. The Google Collaborator platform is an open source platform and can be accessed by any user. The user can login with their Gmail account. Figure A1 shows the login page of Google Collaborator where the user can login to the website using "sign in" option.

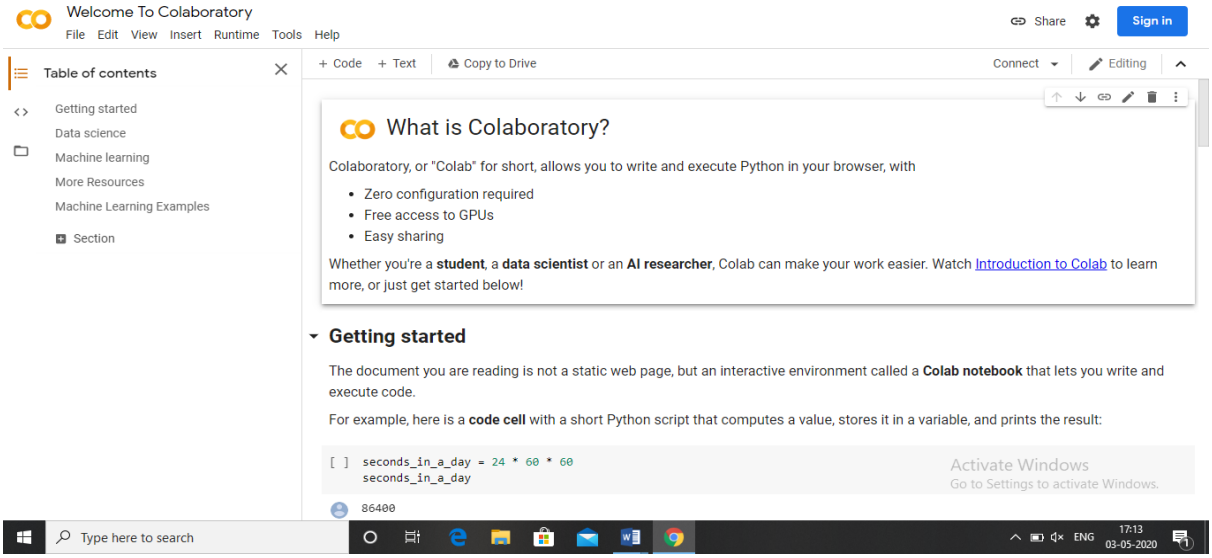


Figure A1 Google Collaborator login page

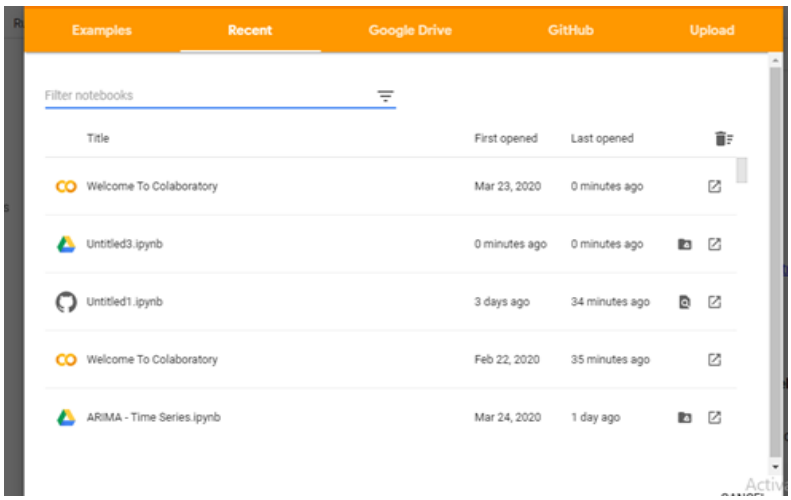


Figure A2 Google Collaborator Files

The Figure A2 shows the files available after the signing process. The user can create a new file by clicking on “new notebook” option.

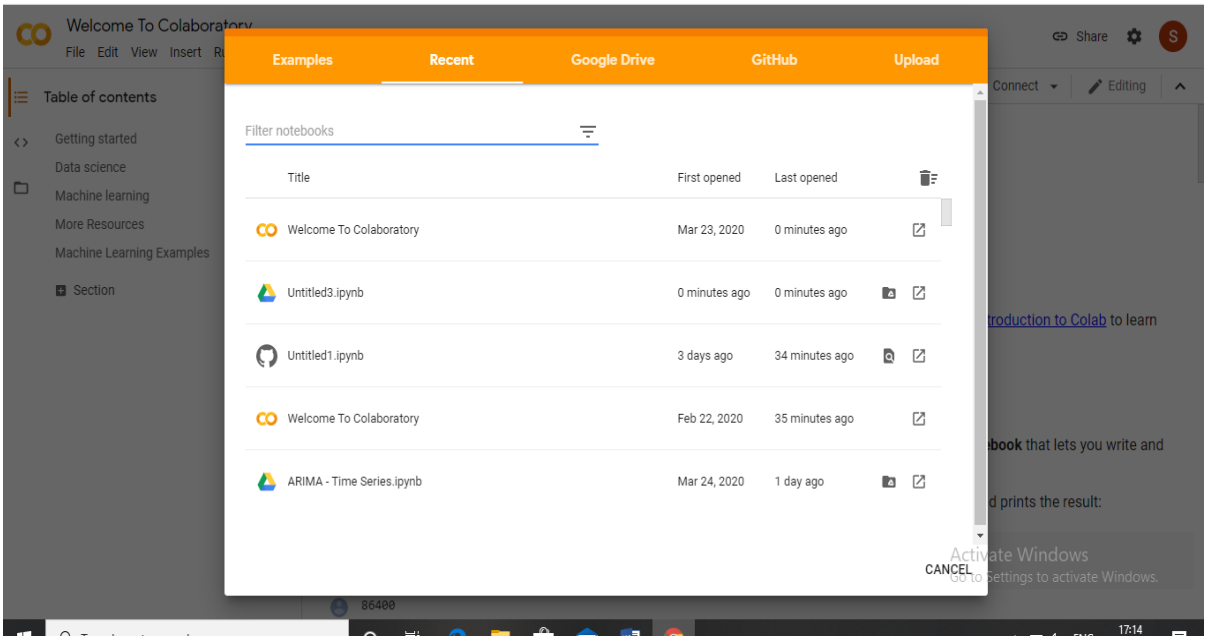


Figure A3 Google Collaborator Files

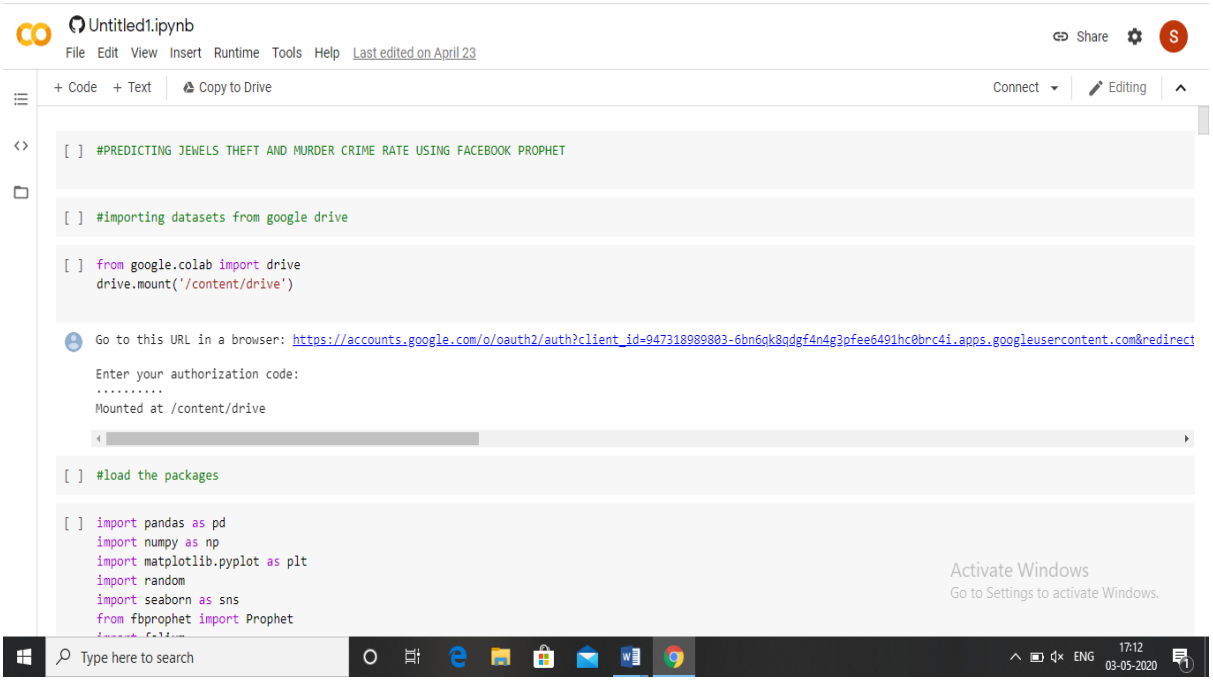


Figure A4 Google drive mount

Figure A4 represents the Google drive mount. The crime datasets are stored in Google drive which contains nearly 10 L crime records. Therefore, to access these records we need to mount them using authentication code.

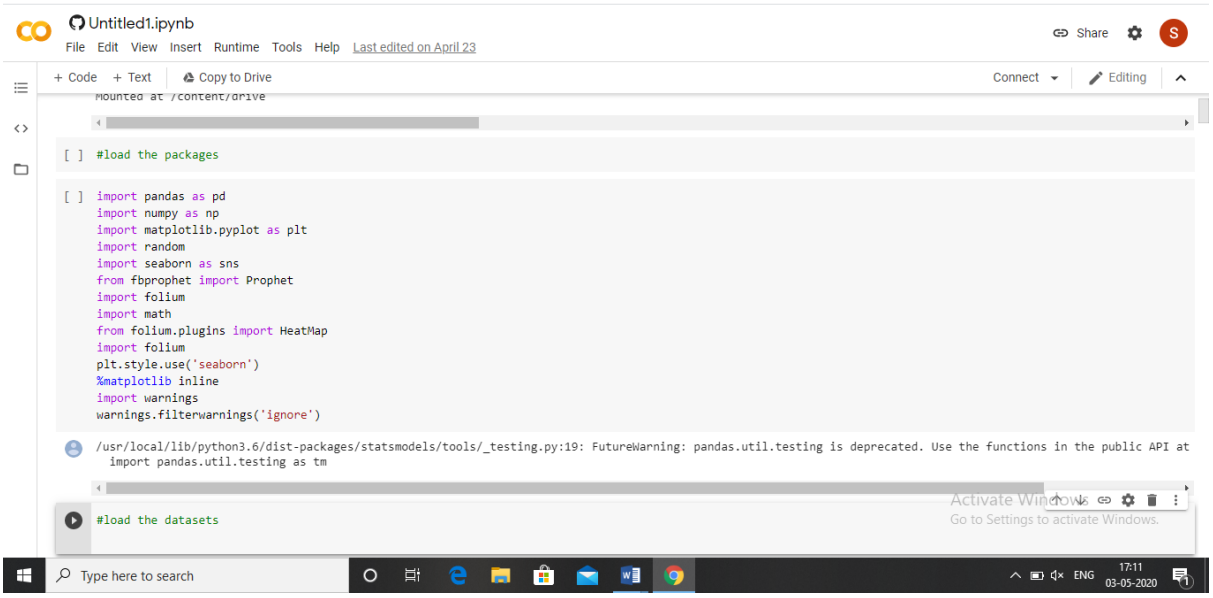


Figure A5 Loading packages

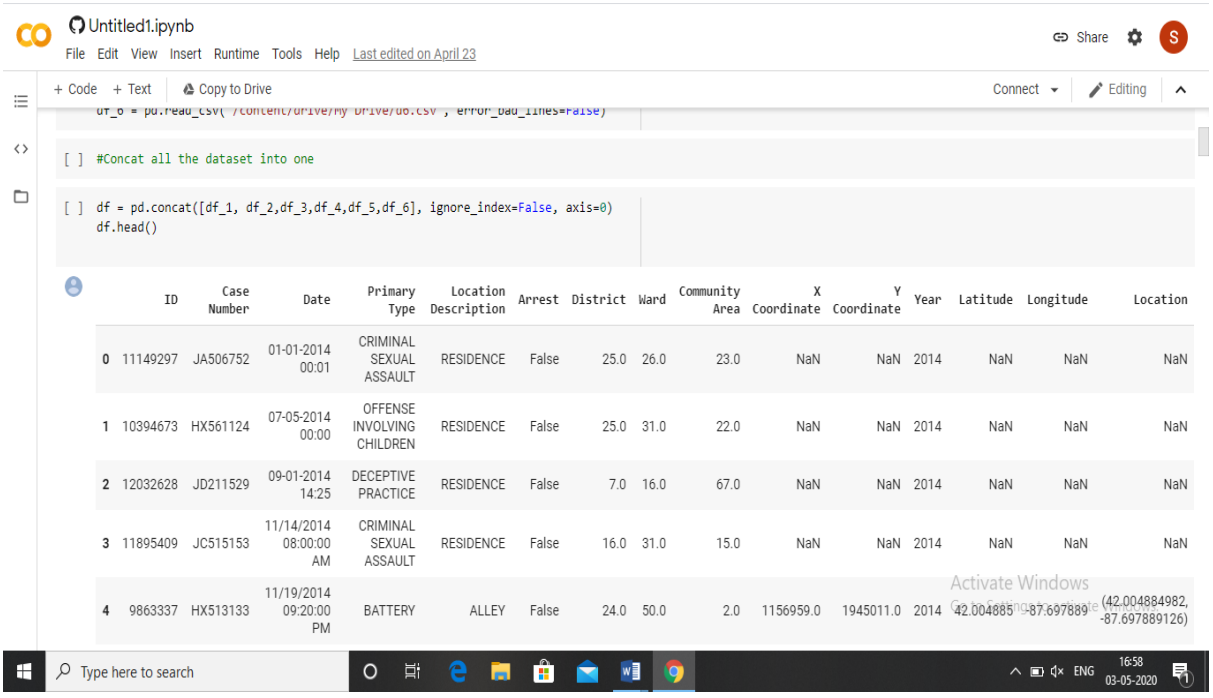


Figure A6Loading of datasets

Figure A5 represents the loading of packages required to perform this project. The necessary packages are imported such as numpy, pandas, Prophet, seaborn for system implementation.

Figure A6 represents the loading of datasets. The crime datasets contain a summary report of crimes from 2014 to 2019. All these records are concatenated into one csv file for better use.

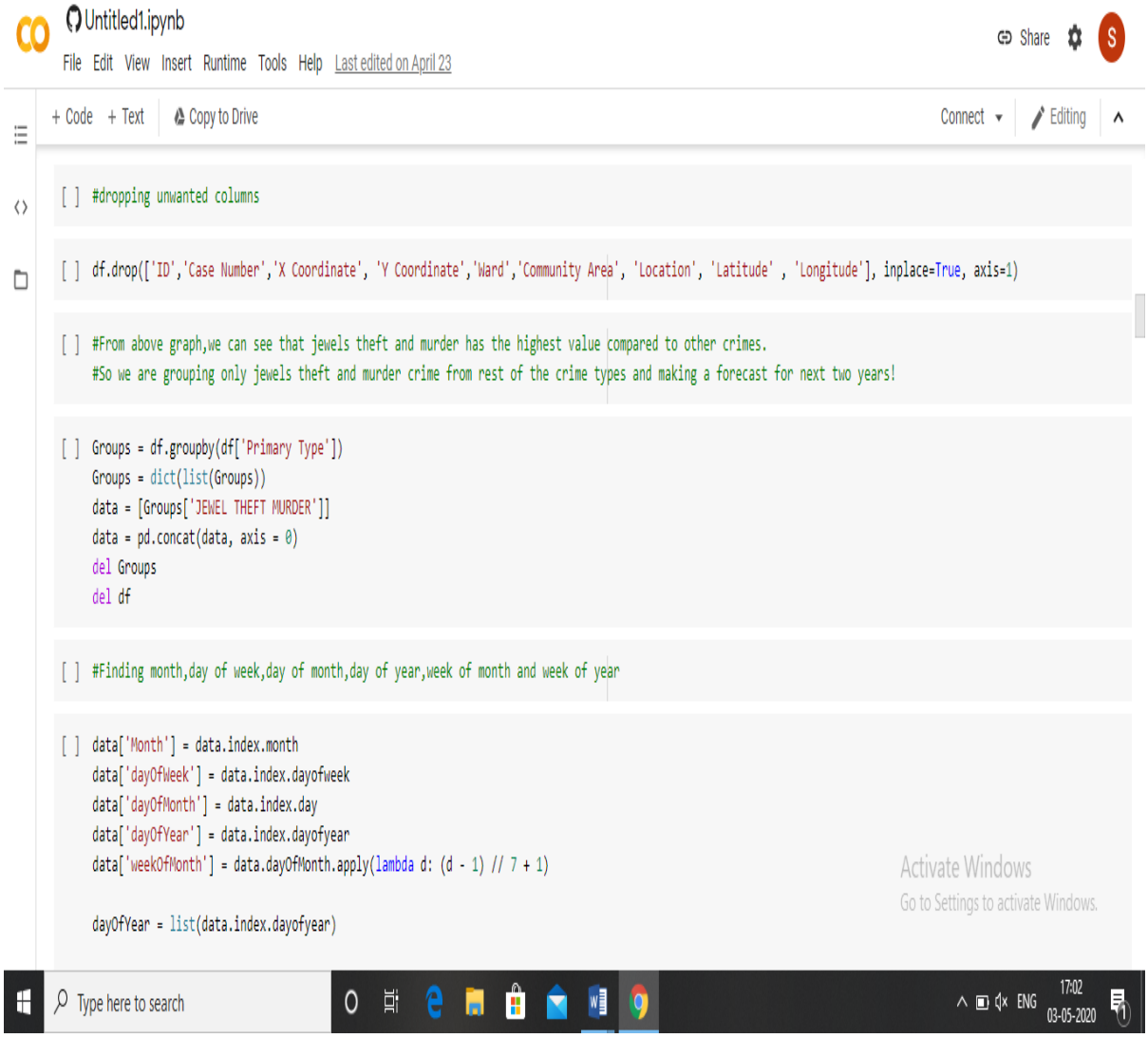


Figure A7 Jewel theft murder crimes

Figure A7 represents the grouping of jewel theft murder crimes. The crime datasets contain many crime types but since our project focuses only on jewel theft murder crimes, we are grouping them.

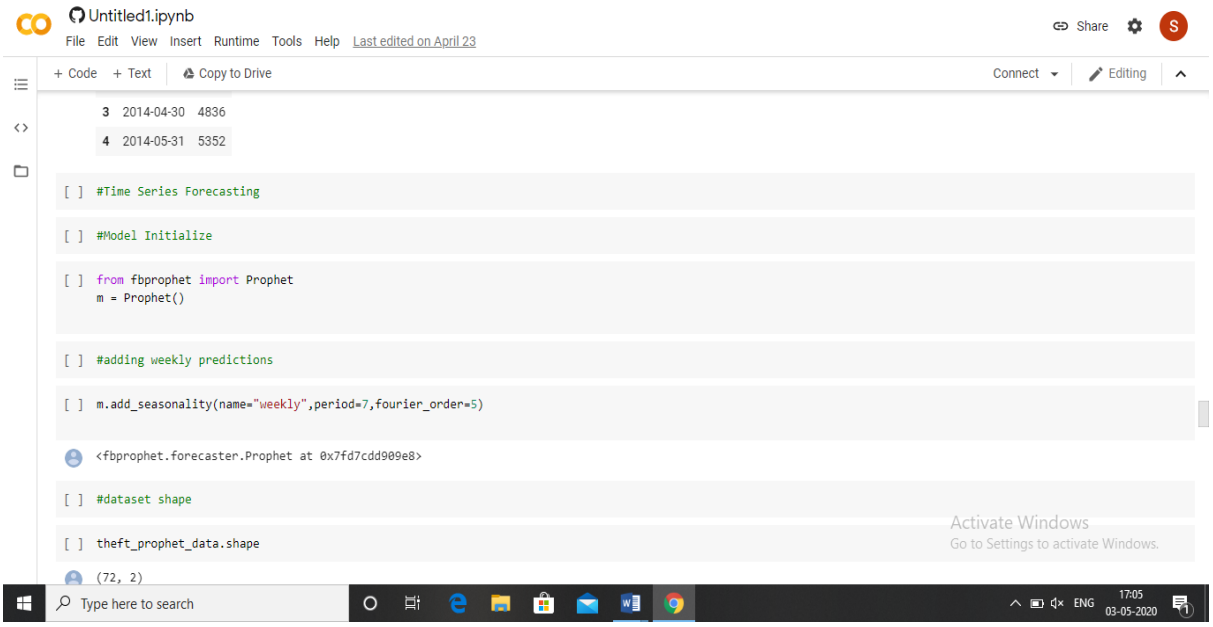


Figure A8Model Initialize

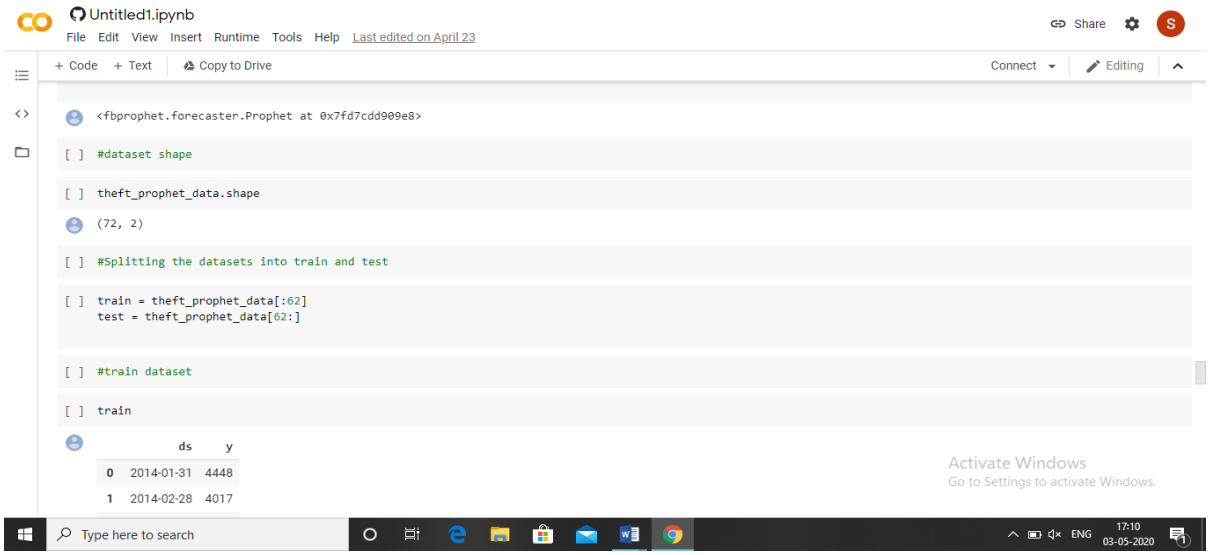


Figure A9 Train test data

Figure A9 represents the splitting of train test data. 90 % of the data is used for training and 10% of data is used for testing.

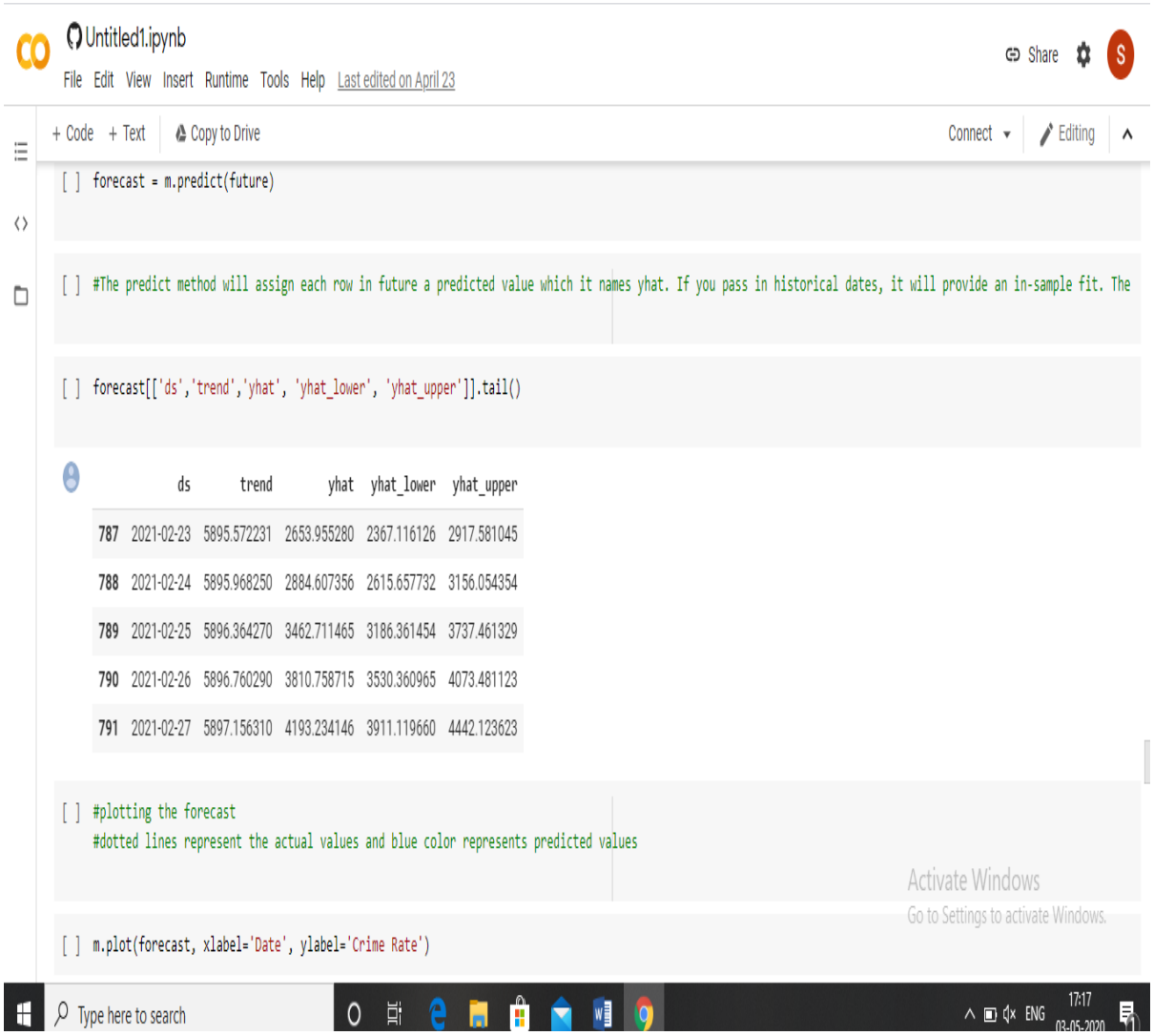


Figure A10 Forecasted values

Figure A10 represents the predicted values (yhat) using time series forecasting. The forecasting is done for training data and it produces forecasted values for next two years of future.

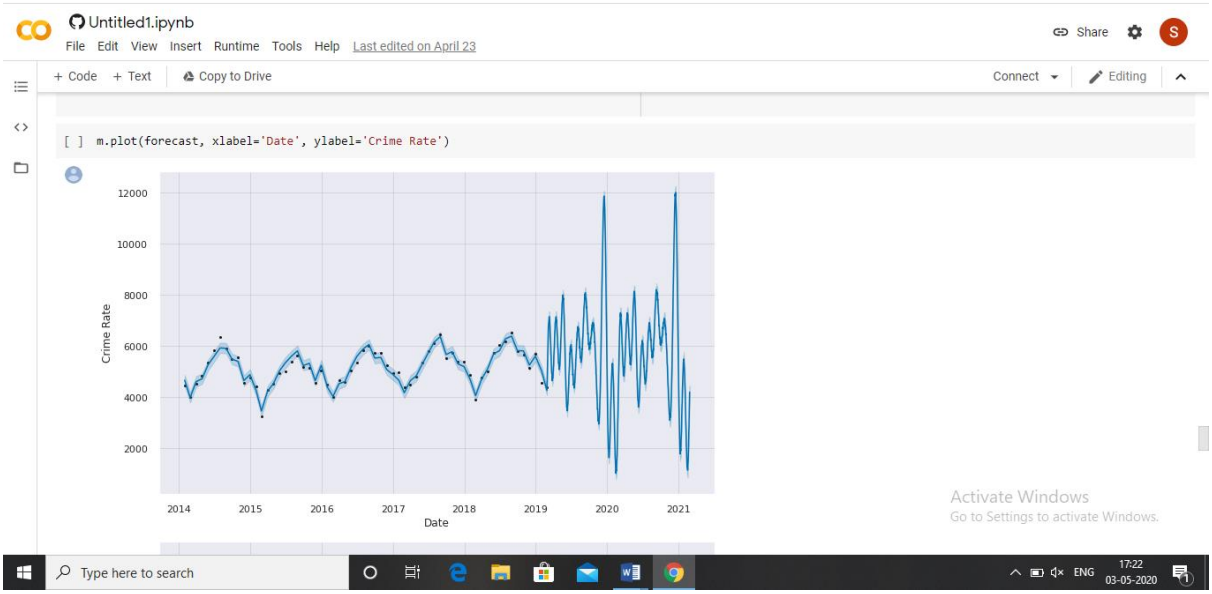


Figure A11 Visualization of forecasted values

Figure A11 represents the visualization of forecasted values. The black dotted lines represent the actual values and blue lines represent the predicted values. We can see that the actual values quite matches with the forecasted values and it also foreseeing into the future producing crime rates.

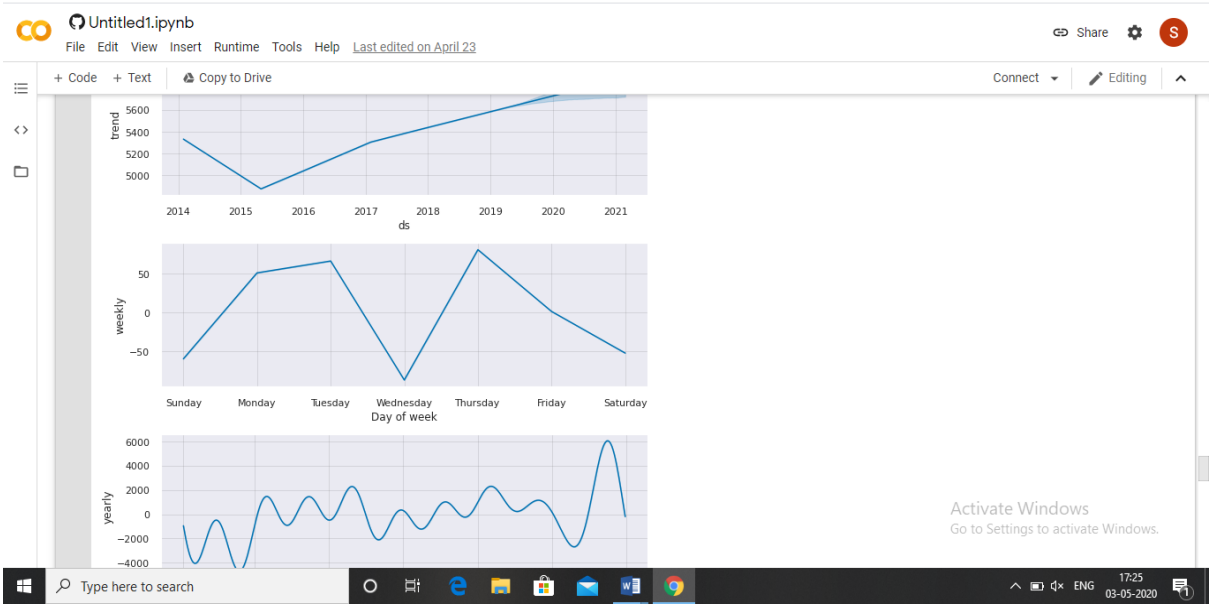


Figure A12 Forecasting components

Figure A12 represents the visualization of forecasting components. It gives an insight analysis about the trend, weekly seasonality and monthly seasonality.

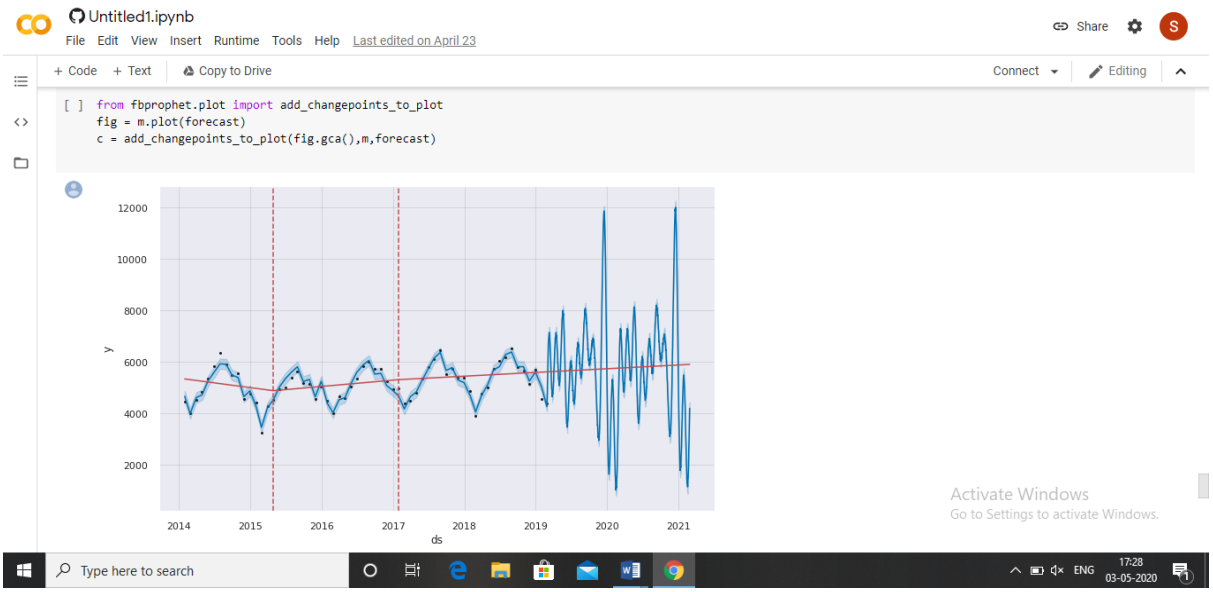


Figure A13 Trend change points

Figure A13 represents the visualization of trend change points. The red line shows the trend change point at which the rate is allowed to change.

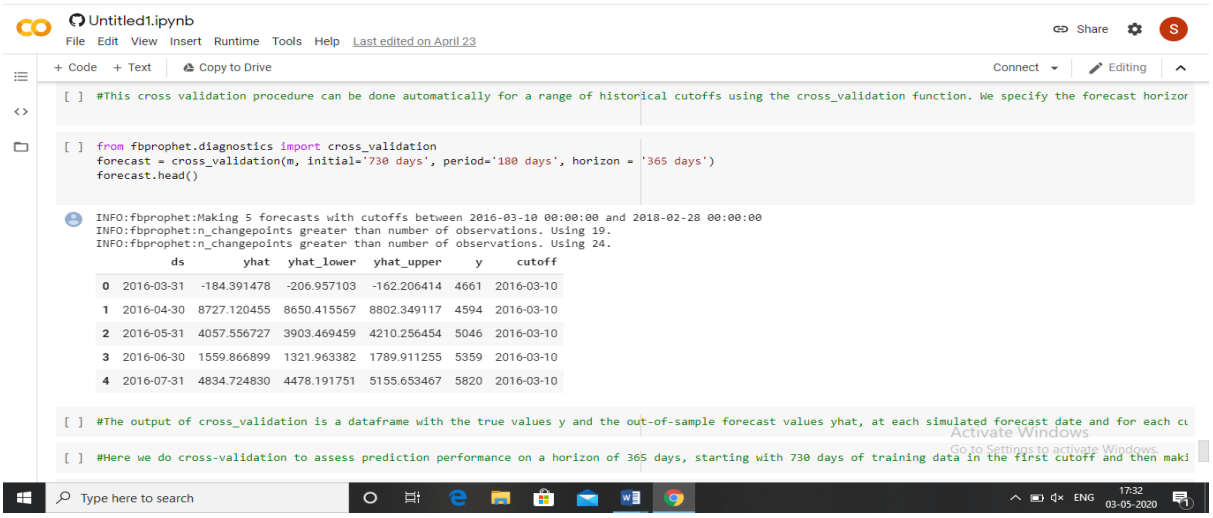
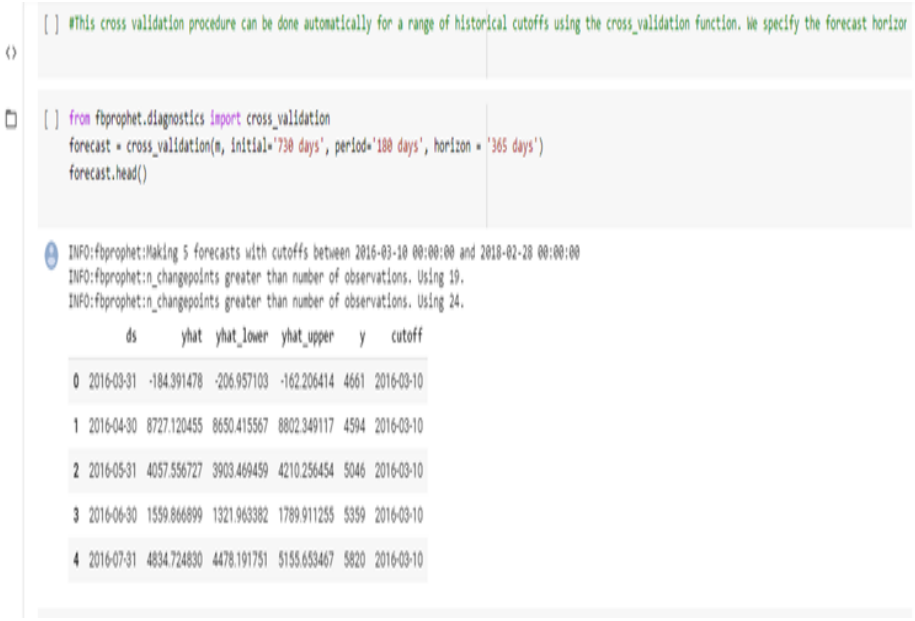


Figure A14 Model evaluation



```
[ ] #This cross validation procedure can be done automatically for a range of historical cutoffs using the cross_validation function. We specify the forecast horizor

[ ] from fbprophet.diagnostics import cross_validation
    forecast = cross_validation(m, initial='730 days', period='180 days', horizon = '365 days')
    forecast.head()

INFO:fbprophet:Making 5 forecasts with cutoffs between 2016-03-10 00:00:00 and 2018-02-28 00:00:00
INFO:fbprophet:n_changepoints greater than number of observations. Using 19.
INFO:fbprophet:n_changepoints greater than number of observations. Using 24.
```

	ds	yhat	yhat_lower	yhat_upper	y	cutoff
0	2016-03-31	-184.391478	-206.957103	-162.206414	4661	2016-03-10
1	2016-04-30	8727.120455	8650.415567	8802.349117	4594	2016-03-10
2	2016-05-31	4057.556727	3903.469459	4210.256454	5046	2016-03-10
3	2016-06-30	1559.866899	1321.963382	1789.911255	5359	2016-03-10
4	2016-07-31	4834.724830	4478.191751	5155.653467	5820	2016-03-10

Figure A15 Model evaluation values

Figure A14 and A15 represents the model evaluation. But A15 gives the clear output of the cross validation with the values of the forecasted data. The model built is tested for errors using cross validation performance metrics which proves efficiency and nature of the model.

APPENDIX B

SAMPLE CODING

In this appendix the sample coding which are used for our implementation process and analysis process for the forecasting the crime scene in jewel theft murder are documented. First starts with the initialization of the model which is the forecasting model, face book prophet tool used. Face book prophet model is initialized code is mentioned below. Followed by the splitting the testing and training data for the model evaluation, model fit method, future data, forecasted values, visualization of the forecasting crime rate in jewel theft murder, testing of data and the trend change points, last the forecasting model evaluation code is mentioned.

```
#Model Initialize
from fbprophet import Prophet
m = Prophet()
m.add_seasonality(name="weekly",period=7,fourier_order=5)
theft_prophet_data.shape
#Splitting train test data
train = theft_prophet_data[:62]
test = theft_prophet_data[62:]
train
#Model fit
m.fit(train)
#Future dates
future = m.make_future_dataframe(periods=730)
future
```

```
#Forecasted values
forecast = m.predict(future)
forecast[['ds','trend','yhat', 'yhat_lower', 'yhat_upper']].tail()
#Visualization
m.plot(forecast, xlabel='Date', ylabel='Crime Rate')
fig=m.plot_components(forecast)
#Testing data
test
test = test.set_index("ds")
test = test['y']
import matplotlib.pyplot as plt
test.plot()
#Trend change points
from fbprophet.plot import add_changepoints_to_plot
fig = m.plot(forecast)
c = add_changepoints_to_plot(fig.gca(),m,forecast)
#Model Evaluation
from fbprophet.diagnostics import cross_validation
forecast = cross_validation(m, initial='730 days', period='180 days', horizon = '365
days')
forecast.head()
from fbprophet.diagnostics import performance_metrics
df_p = performance_metrics(forecast)
df_p.head()
from fbprophet.plot import plot_cross_validation_metric
fig = plot_cross_validation_metric(forecast, metric='mape')
```

APPENDIX C

SYSTEM REQUIREMENTS

In this appendix system requirements which will be most important for our work to process are mentioned. We have mentioned the hardware specifications, software specification and the browsers and the source of the crime data which we used are mentioned below.

HARDWARE SPECIFICATION

- Processor (CPU) with 8GB RAM.
- Internet Connection
- Keyboard and Mouse or some other compatible pointing device

SOFTWARE SPECIFICATION

- Windows 10 or Higher
- Google Collaboratory

BROWSERS

- Chrome
- Edge
- Mozilla Firefox
- Internet Explorer
- Safari

DATASETS

- Kaggle
- Data.gov
- Data world
- Knoema

APPENDIX D

PUBLICATIONS

[1] Srinidhi V, Saranya P, M Ashok, presented a paper titled "An Affirmative Learning Techniques to analyse the crime Scene in Jewel Theft Murder" in the "International Conference on Research Advancements & Challenges in Engineering Sciences (ICRACE'20)" organized by Velammal Institute of Technology, Chennai on 6th and 7th of March 2020.

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[17] Panagiotis Stalidis, Theodoros Semertzidis, Member, IEEE and Petros Daras, Senior Member, IEEE Examining Deep Learning Architectures for Crime Classification and Prediction" 3 Dec 2018