# rf

December 9, 2024

[2]:

```
# import necessary libraries
import pandas as pd
```

[22]:

```
data = pd.read_csv('df_merged_weekly_all.csv', index_col=0)
data['date'] = pd.to_datetime(data['date'])
data.reset_index(inplace=True)
data
```

[22]:

```
     index     week       date  cases  temperature     pressure  humidity  \
0        0   2016-1 2016-01-10   19.0   303.437143  1012.285714 71.428571
1        1   2016-2 2016-01-17   23.0   303.908571  1012.857143 65.571429
2        2   2016-3 2016-01-24   31.0   302.251429  1014.428571 76.857143
3        3   2016-4 2016-01-31   26.0   302.778571  1011.142857 75.142857
4        4   2016-5 2016-02-07   10.0   303.285714  1012.428571 70.571429
..     …      …        …     …          …           …         …
393    135  2024-32 2024-08-05  226.0   302.210000  1009.000000 75.000000
394    136  2024-33 2024-08-12  205.0   303.050000  1007.000000 70.000000
395    137  2024-34 2024-08-19  209.0   303.620000  1009.000000 67.000000
396    138  2024-35 2024-08-26  162.0   302.490000  1008.000000 73.000000
397    139  2024-36 2024-09-02  103.0   301.380000  1009.000000 83.000000

     precipitation
0             1.02
1             0.00
2            32.85
3            17.05
4             3.70
..             …
393           8.78
394           4.91
395          11.63
396          10.55
397           9.78

[398 rows x 8 columns]
```

[23]:

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 398 entries, 0 to 397
Data columns (total 8 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   index          398 non-null    int64
 1   week           398 non-null    object
 2   date           398 non-null    datetime64[ns]
 3   cases          398 non-null    float64
 4   temperature    398 non-null    float64
 5   pressure       398 non-null    float64
 6   humidity       398 non-null    float64
 7   precipitation  398 non-null    float64
dtypes: datetime64[ns](1), float64(5), int64(1), object(1)
memory usage: 25.0+ KB
```

# 1 Columns

| column | description | type |
|---|---|---|
| week | week corresponding to the specific year | datetime |
| dt | specific date | datetime |
| Cases | Dengue Cases | integer |
| temp | Average temperature in the given week | numeric |
| feels_like | Average feels_life in the given week | numeric |
| pressure | Average pressure in the given week | numeric |
| humidity | Average humidity in the given week | numeric |
| precipitation | Total precipitation in the given week | numeric |

## 1.1 Training data

Data used to be trained range from 2022 to 2023

## 1.2 Testing data

Data used to be tested is 2024 (also used for training)

[28]:

```
# Training the rf model
# defining a function for general looping of n-week aheads
from sklearn.ensemble import RandomForestRegressor
import warnings
warnings.filterwarnings("ignore")

import pandas as pd
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_absolute_error

def train_rf(data, features, target, date_col, n_ahead):
    # Select relevant columns
    rel_col = features + [target] + [date_col]
    data = data[rel_col]

    # Getting the first and last index for the year 2024
    first_2024 = data[data[date_col].dt.year == 2023].index[0]  # First index of 2024
    last_2024 = data[data[date_col].dt.year == 2024].index[-1]  # Last index of 2024

    first_2024subn = first_2024 - n_ahead # Subtract n_ahead weeks from first date of 2024
    last_2024subn = last_2024 - n_ahead  # Subtract n_ahead weeks from last date of 2024

    # Define lags
    env_lags = [1,2,3,4]   #2-week lag for environment features
    cases_lag = range(1, 12)  # 1 to 11 week lags for target variable

    # Create lagged features for environment and target variables
    for lag in env_lags:
        for feature in features:
            data[f'{feature}_lag_{lag}'] = data[feature].shift(lag)

    for lag in cases_lag:
        data[f'{target}_lag_{lag}'] = data[target].shift(lag)

    # Remove any rows with missing values due to lagging
    data = data.dropna()

    # Initialize list for storing predictions
    predict_data = []
    actual_data = []
    # Loop through data to get n-week ahead prediction
    index_begin = first_2024subn
    index_end = last_2024subn
    while index_begin <= index_end:
        rf = RandomForestRegressor(n_estimators=300)  # RandomForestRegressor with 100 estimators (can be tuned)

        # Split data into training and testing sets
        train_data = data[data.index <= index_begin]  # All rows up to index_begin
        test_data = data.iloc[data.index.get_loc(index_begin):data.index.get_loc(index_begin) + n_ahead]  # Next n_ahead rows
        X_train = train_data.drop(columns=[target, date_col])  # Drop target␣
↪and date column for training data
        y_train = train_data[target]
        X_test = test_data.drop(columns=[target, date_col])  # Drop target and␣
↪date column for test data
        y_test = test_data[target]

        # Fit the RandomForest model
        rf.fit(X_train, y_train)

        # Get the last prediction (n-week ahead prediction)
        predict_data.append(rf.predict(X_test)[-1])
        actual_data.append(y_test.iloc[-1])
        # Increment the index to the next week
        index_begin += 1
    MAE = mean_absolute_error(actual_data, predict_data)
    return predict_data, MAE
```

[29]:

```
# Perform Initial Testing
target="cases"
features=["temperature","humidity","precipitation"]
date = 'date'
prediction_1_week, MAE_1_week = train_rf(data, features, target, date, 1)
prediction_4_week, MAE_4_week = train_rf(data, features, target, date, 4)
prediction_12_week, MAE_12_week = train_rf(data, features, target, date, 12)
```

[30]:

```
print(f'The Mean Absolute Error of the 1-Week Ahead Model is {MAE_1_week}')
print(f'The Mean Absolute Error of the 4-Week Ahead Model is {MAE_4_week}')
print(f'The Mean Absolute Error of the 12-Week Ahead Model is {MAE_12_week}')
```

```
The Mean Absolute Error of the 1-Week Ahead Model is 3.2783333333333333
The Mean Absolute Error of the 4-Week Ahead Model is 8.935568181818182
The Mean Absolute Error of the 12-Week Ahead Model is 8.662348484848485
```

[203]:

```
prediction_1_week[:5]
```

[203]:

```
[np.float64(19.88),
 np.float64(17.99),
 np.float64(16.11),
 np.float64(20.52),
 np.float64(21.62)]
```

[204]:

```
prediction_4_week[:5]
```

[204]:

```
[np.float64(29.92),
 np.float64(27.83),
 np.float64(13.77),
 np.float64(13.2),
 np.float64(21.46)]
```

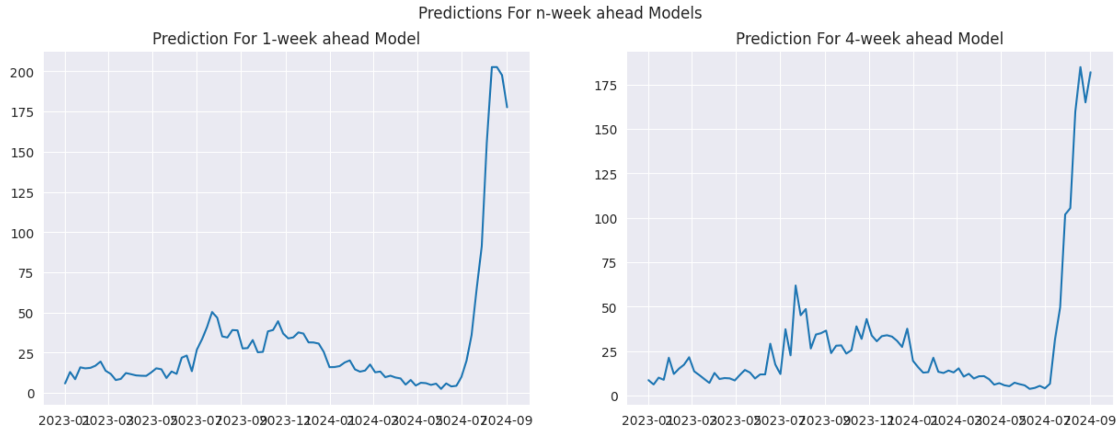
## 2 Visualization

[34]:

```
import matplotlib.pyplot as plt
first_2024 = int((data['date'].dt.year==2023).idxmax())
last_2024 = int(data.loc[data['date'].dt.year == 2024].index[-1])
date = data.loc[first_2024:last_2024]['date']
```

[35]:

```
fig, ax = plt.subplots(1,2, figsize=(15,5))
ax[0].plot(date,prediction_1_week)
ax[0].set_title('Prediction For 1-week ahead Model')
ax[1].plot(date,prediction_4_week)
ax[1].set_title('Prediction For 4-week ahead Model')
plt.suptitle('Predictions For n-week ahead Models')
plt.show()
```

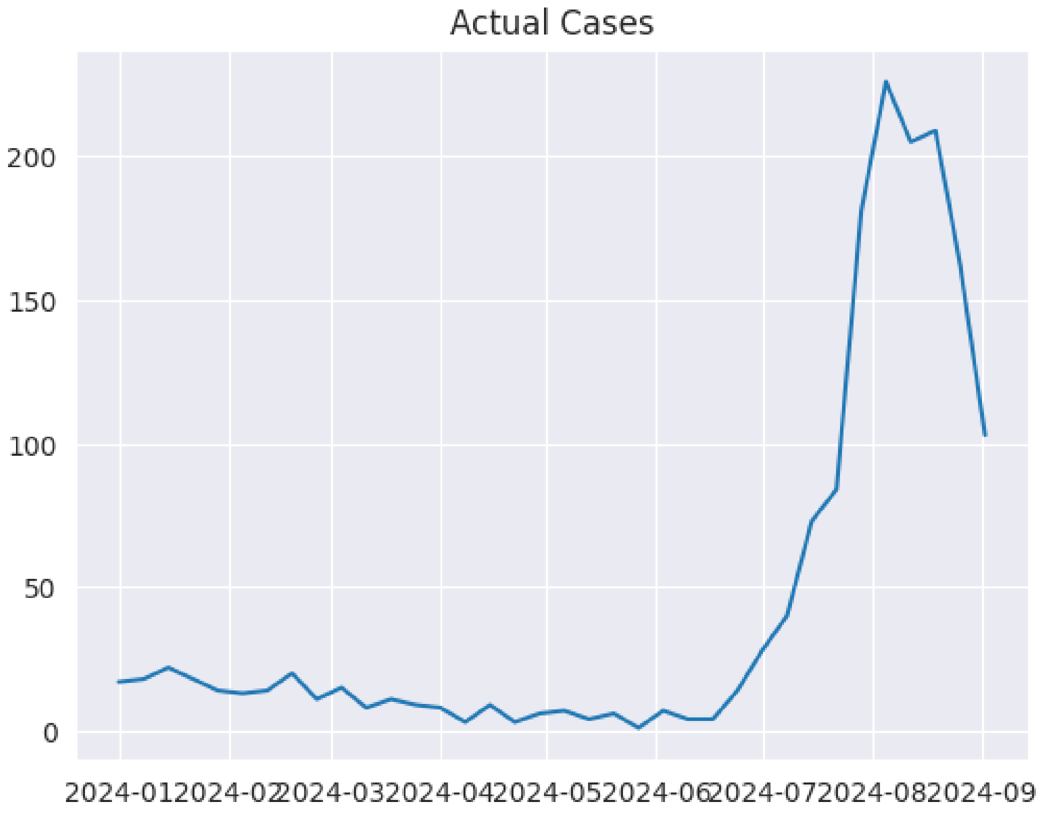


[36]:

```
actual_2024 = data[data['date'].dt.year == 2024]
plt.plot(actual_2024['date'], actual_2024['cases'])
plt.plot()
plt.title('Actual Cases')
```

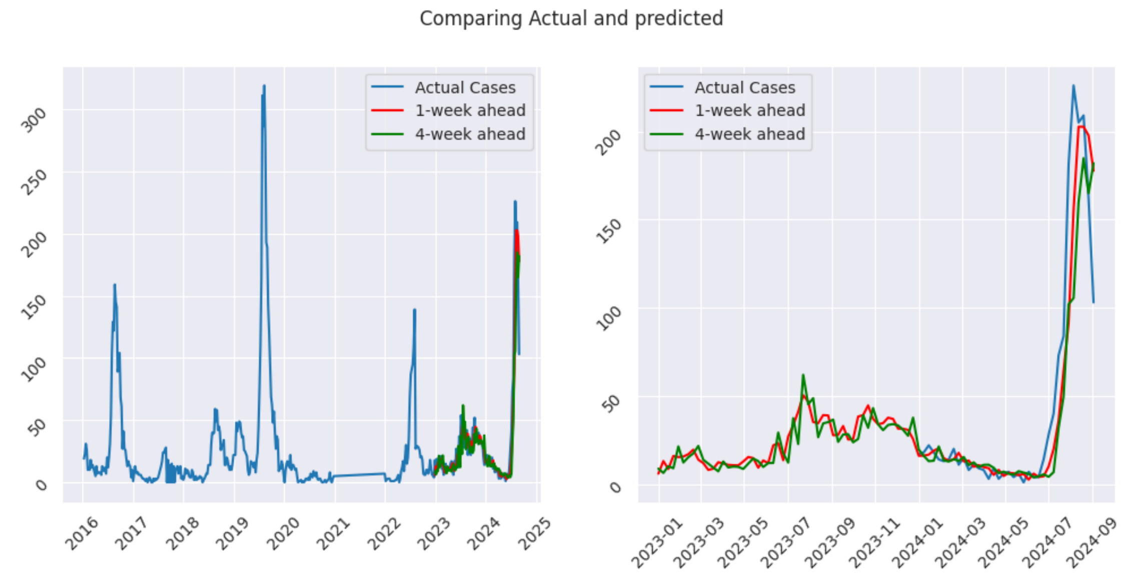
[36]:

```
Text(0.5, 1.0, 'Actual Cases')
```



[38]:

```
fig, ax = plt.subplots(1,2, figsize=(12,5))
ax[0].plot(data['date'], data['cases'], label = 'Actual Cases')
ax[0].plot(date, prediction_1_week, color = 'red', label = '1-week ahead')
ax[0].plot(date, prediction_4_week, color = 'green', label = '4-week ahead')
ax[0].tick_params(labelrotation=45)
ax[0].legend()
ax[1].plot(actual_2024['date'], actual_2024['cases'], label = 'Actual Cases')
ax[1].plot(date, prediction_1_week, color = 'red', label = '1-week ahead')
ax[1].plot(date, prediction_4_week, color = 'green', label = '4-week ahead')
ax[1].tick_params(labelrotation=45)
ax[1].legend()
plt.suptitle('Comparing Actual and predicted')
plt.show()
```


Comparing Actual and predicted
Actual Cases
1-week ahead
4-week ahead
0
50
100
150
200
250
300
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Actual Cases
1-week ahead
4-week ahead
0
50
100
150
200
2023-01
2023-03
2023-05
2023-07
2023-09
2023-11
2024-01
2024-03
2024-05
2024-07
2024-09

[ ]: