Meteorological Data Analysis for Arid Region of Karnataka

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Abstract: Meteorological data analysis is one of the time series prediction applications. Analysis of meteorological data give insights to the weather forecast and makes country more prepared for the worst situation like drought and flood. Northern part of Karnataka is usually a drought region. The paper provides insights into application of random forest and decision tree for a region of Karnataka called Raichur. The results of accuracy precision and recall are tabulated for Raichur region. There are 10 input features of climate considered in prediction of rainfall for a region. An accuracy of 96% is obtained after applying random forest to the meteorological data collected from IMD (Indian Meteorological Department). Raichur is an arid region of Karnataka which receives less rainfall. There were 13 input features considered for prediction of rainfall. The data was collected from Indian Meteorological Department (IMD) for a span of 17 years from January 1999 to December 2016 for prediction of rainfall. The decision tree classifier was applied to get an accuracy of 88%. The classification report shows a precision and recall of 0.90 and 0.97. Random forest an ensemble classifier was run through the dataset for an accuracy of 96%. The precision and recall of 1.00 and 0.99 was achieved. For both the algorithms a total of 11159 tuples were considered. There are total 11158 samples. The total training observations are 7810. The total testing samples are 3348. A precision and recall is 0.99 and 0.97 respectively.

The Decision Tree algorithm [1] is applied for the Raichur data for prediction of rainfall. Decision tree is a classification learning technique which uses best split to categorize the data into target classes. Random forest is ensemble of trees which uses random sampling of input. It considers the output of different decision tree. Random forest combines output of different decision tree and then classifies the class target value.

2. Methodology

Supervised learning techniques are a model prepared through a training process. The input data called training data
set is run on a model say a classification model to predict the output. If the predicted output is correct it is classified for the correct class label. This process continues until model achieves desired level of accuracy. One such supervised learning technique is classification. Classification has set of input features along with correct output feature. The algorithm learns by comparing the class label and predicted output.

Decision tree is a classification algorithm. It can be used to solve regression problems also. The algorithm goes as follows. It initially considers entire dataset to be root node. The tree is split based on maximum information gain or minimum impurity. This process is repeated until all nodes are pure, which is the terminal condition. [3]

Random forest [5] is a classification algorithm which is an ensemble technique.

Random forest works as follows. It creates many decision trees. The output of each decision tree is given weightage. The output is calculated decision of different decision tree and weights given to it. The random forest uses random sampling. The advantage of random forest classifier is it wont overfit the data and applicable to categorical data.

Raichur is a region of north Karnataka which has deficient rainfall. Rainfall usually occurs in month of September. The driest months of Raichur are January and February. The data is considered from period of 1999 to 2016. The input features considered are SLP Station Level Pressure (in hpa), MSLP (Mean Sea-Level Pressure) (in hpa), DBT (Dry Bulb Temperature) (in deg. C), WBT (Wet Bulb Temperature)(in deg. C), Dpt (Dew Point Temperature)(in deg. C), RH (Relative Humidity) (In%), VP (Vapour Pressure)(in hpa), DD (Wind Direction) FFF (Wind Speed) (in Kmph), AW (Average Wind Speed) (in kmph). The class label is rainfall in mm. The data is considered for span of 17 years and monthly data is recorded. The missing data values were calculated by taking mean of the previous values.

Decision tree algorithm was used for prediction of rainfall for Raichur region. The data is collected from Indian Meteorological department (IMD) from 1999 to 2016. The input features considered are SLP Station Level Pressure (in hpa), MSLP (Mean Sea-Level Pressure) (in hpa), DBT (Dry Bulb Temperature) (in deg. C), WBT (Wet Bulb Temperature)(in deg. C), Dpt (Dew Point Temperature)(in deg. C), RH (Relative Humidity) (In%), VP (Vapour Pressure)(in hpa), DD (Wind Direction) FFF (Wind Speed) (in Kmph), AW (Average Wind Speed) (in kmph). The algorithms run are decision tree and random forest Regressor. The results of accuracy precision, recall and F1 score are tabulated as follows.

| Algorithm      | Decision tree | Random forest |
|----------------|---------------|---------------|
| Accuracy       | 95%           | 96%           |
| Precision      | 0.98          | 0.99          |
| Recall         | 0.97          | 0.98          |
| F1 score       | 0.98          | 0.98          |

The decision tree for Raichur region is as shown in figure 1.

From the above results it is clear that the factors affecting rainfall of Raichur region are Vapour Pressure, temperature and sea level pressure. The least affecting factors are wind direction and wind speed. The Random forest Regressor
provides a high accuracy of 96%.

4. Conclusion

Meteorological data analysis a field growing rapidly in atmospheric science. Large scale meteorological data is not supporting traditional approach. It requires a comprehensive approach to handle the data. Decision tree algorithm and Random forest is applied to Raichur data. The data is collected from Indian Meteorological department (IMD) from 1999 to 2016. There are total 11158 samples. The rainfall prediction for drought region of Karnataka is having accuracy of 96%. From the above results it is clear that the factors affecting rainfall of Raichur region are Vapour Pressure, temperature and sea level pressure. The least affecting factors are wind direction and wind speed.

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