Weather Predictions using Support Vector Machine and Rough Set

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***Abstract*:** *Climate modelling and weather prediction, the application of science and technology to predict the state of the atmosphere for a given location is a challenging task for the researchers in this modern age. Now-a-days the soft computing techniques have been evolved which can be used for the prediction of weather with more accuracy and less errors. But, Soft computing technique is a new approach to construct computationally intelligent systems that are supposed to possess humanlike expertise within a specific domain, adapt themselves and learn to do better in changing environments. Hence, this paper tries to analyze soft computing techniques i.e Rough Set and SVM for weather prediction of Delhi and reveals that Rough set exhibits promising result that SVM.*

***Keywords*:** *Support Vector Machine, Rough Set*

I. INTRODUCTION

Data mining is the technique to find out the hidden patterns from the huge volume of data kept together. Rough Set is treated as one of the best way to find the hidden pattern. It uses the technique of reduction of parameters from the existing data set. The use of Rough Set Theory can be used for prediction of weather at a particular time for a given place. Data mining is the process of finding useful information from the present data and is used to find the patterns and correlation among the data to predict which are hard to extract. The ultimate task in use of data mining in weather forecasting is to discover the knowledge from the information system. But, the new thing in data mining is feature reduction. The Rough Set Theory is found to be the best technique for reduction of feature in the sample space. This research uses the data of weather of previous 22 years from Delhi, the capital city of India and the Rough Set theory will be used to predict the future climatic condition.

II. LITERATURE SURVEY

Prediction of natural calamities and hazard which is very important for the Government to save its population and their properties. It helps in taking utmost care for ongoing constructions, transportation, flight operations etc. Adidela [1] et al. have constructed a fuzzy decision tree using

expectation maximization algorithm. A comparison has been done between Rough Soft Set with Multiple Regression Analysis by Amato [2]. An empirical study on meteorological time series data was done by Bautu[3] et al and predicted the weather data. Biradar[4] et al have predicted weather parameters using data mining. Bushara[5] et al forecasted climate in Sudan using techniques of Machine learning. Caskey[6] has explained numerical methods in weather prediction. Jayasingh[7] et al have made use of the soft computing models by hybridizing them for prediction of weather at Delhi. Joseph[8] have shown that the neural networks could perform better. Khajure[9] et al. have shown the future weather forecasting by use of soft computing techniques. Li [10] et al have explained weather forecasting by rough set based fuzzy neural network. The empirical study explains that the use of soft computing techniques in weather prediction is better than the traditional methods of doing the same job. Each soft computing technique has advantages and disadvantages. The present study will test the weather prediction by using Support Vector machine and the Rough Set. The output will be analyzed by different statistical error metrics like accuracy, Absolute Mean Error, Absolute Relative Error, Root Mean Squared Error, and Root Relative Squared Error.

III. DATA

The time series weather data for twenty two years starting from January 1996 to December 2017 has been collected. The data are collected from satellite and different ground stations. The weather parameters are temperature, dew, humidity, pressure, visibility, wind speed etc. Basing upon these weather parameters, the events value is to be produced by use of the predictor parameters. The data collected from the aforementioned The collected data are refined and are made ready for processing in the different models.

IV. SUPPORT VECTOR MACHINE

Support Vector Machine is one effective technique for classification, regression and pattern recognition. It is a supervised learning model with associated learning algorithm.
In the feature space $\emptyset(x)$, the input vector x is mapped.

The SVM is expressed as
$$p(x) = q\,\emptyset(x) + r$$
where r is the bias and q is the weight vector.
Support Vector Machine performs well without help of any priori knowledge.

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V. ROUGH SET

The Rough Set is a methodology for knowledge discovery from relational database. Rough set is capable of discovering structural relationship from noisy data. In Rough Set, union and intersection of sets cannot be computed. Furthermore, the rough membership function is useful in extracting useful information from the time series dataset present for may years.
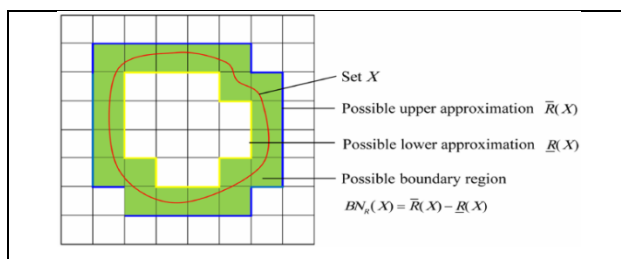
It requires a linear function to classify a linearly separable dataset where as for non linear dataset, it requires a separating two hyper planes.

Approximations in Rough Set

There are two approximations defined in Rough Set.
– Upper Approximation
– Lower approximation

- Upper approximation refers to the set of objects which possibly belong to target set.

- Lower approximation refers to the set of objects that positively belong to target set.

A set is treated and termed as rough if its boundary region is non-empty. The membership of Rough Set is shown in the Figure -1.

Figure -1

Rough Set

Set X

Possible upper approximation $\overline{R}(X)$

Possible lower approximation $\underline{R}(X)$

Possible boundary region

$BN_R(X) = \overline{R}(X) - \underline{R}(X)$

VI. METHODOLOGY

The time series weather data of Delhi, the capital city of India, from 2011 to 2015, is used for prediction of useful information like forecasting of future weather values. The prediction of events is done by using Support Vector Machine. The predicted values obtained from the Support Vector Machine are compared with the actual values present in the dataset. The values of MAE, RMSE, RAE and RRSE are computed and kept in a table. Similarly again the five years weather data of Delhi is fed to Rough Set Model and the predicted result is compared with the actual values present in the dataset. The statistical error values like MAE, RMSE, RAE and RRSE are expressed in Table - 1 for observation.

VII. RESULT ANALYSIS

The weather data of Delhi from 2011 to 2015 is used to train SVM and Rough Set Model and predict the weather parameter values. The predicted weather parameter values and actual values are compared and the different statistical error values MAE, RMSE, RAE and RRSE are also computed for both the models. The computed error values i.e. MAE, RMSE, RAE and RRSE which are analyzed for both the models and are represented in Table -1. Also, the graphical illustation for the comparison of these statistical errror parameters of Support Vector Machine and Rough Set is exhibited in Figure 2.

The comparison specially on MAE for both the models reveals in Table – 2 and its graphical illustration between SVM and Rough Set Model is expressed in Figure – 3.

Also, the comparison specially on RMSE for both the models reveals in Table – 3 and its graphical illustration between SVM and Rough Set Model is expressed in Figure – 4.

Table – 1
Comparison of statistical parameters in prediction of weather between SVM and Rough Set Models

Year	2011				2012			
	MAE	RMSE	RAE	RRSE	MAE	RMSE	RAE	RRSE
SVM	0.2118	0.3137	1.0888	1.0084	0.1922	0.2992	1.251	1.0849
Rough Set	0.1054	0.2648	0.5418	0.8511	0.0893	0.2531	0.5822	0.9182
Year	2013				2014			
	MAE	RMSE	RAE	RRSE	MAE	RMSE	RAE	RRSE
SVM	0.177	0.2887	1.2282	1.0807	0.1925	0.2997	1.2168	1.0704
Rough Set	0.0878	0.2455	0.5441	0.8679	0.0919	0.2562	0.5808	0.9148
Year	2015							
	MAE	RMSE	RAE	RRSE				
SVM	0.2107	0.3119	1.1575	1.0371				
Rough Set	0.0899	0.2529	0.4947	0.8417				

Figure – 2

Graphical comparison of SVM and Rough Set Model on the basis of MAE, RMSE, RAE and RRSE
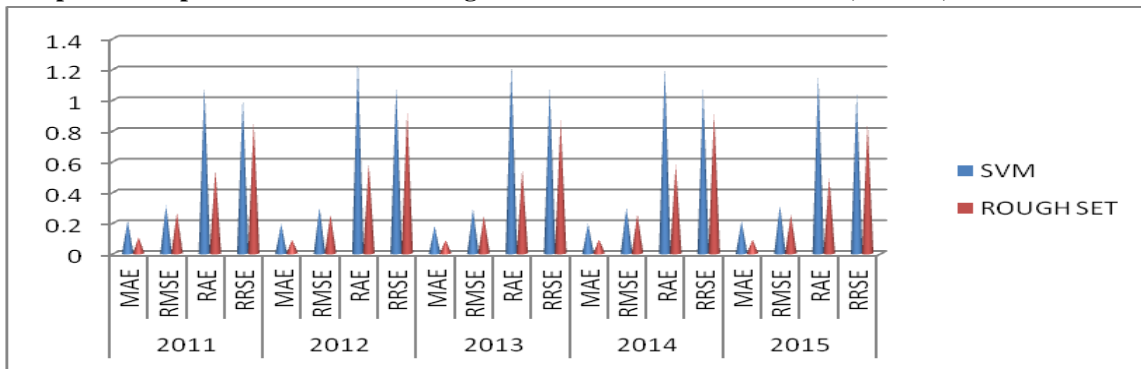
Table – 2

Comparison - SVM Model and Rough Set Model using MAE

Year	SVM	Rough Set
2011	0.2118	0.1054
2012	0.1922	0.0893
2013	0.177	0.1321
2014	0.1925	0.0919
2015	0.2107	0.0899

Figure – 3

Graphical representation of SVM and Rough Set Model on the basis of MAE
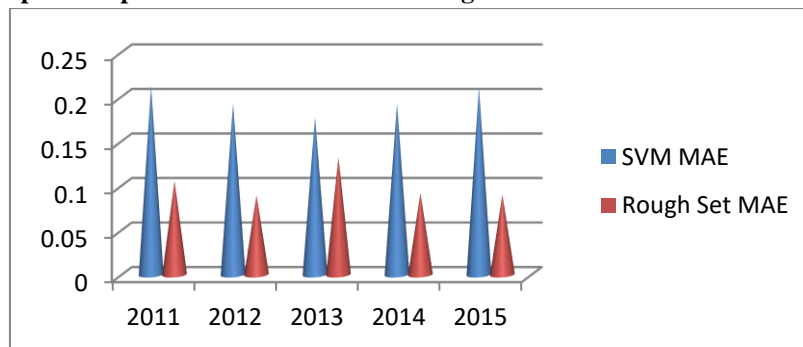
Table – 3

Comparison between SVM and Rough Set on the basis of RMSE

Year	2011	2012	2013	2014	2015
SVM	1.384	1.487	1.3327	1.1321	1.1321
Rough Set	0.2752	0.2498	0.2483	0.2539	0.2644

Figure – 4

Graphical comparison of SVM and Rough Set on the basis of RMSE
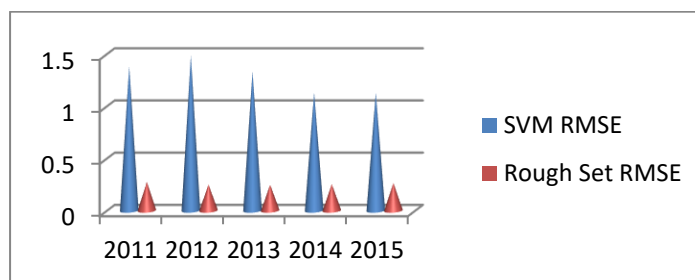
From the above result analysis, it is revealed that the statistical error values MAE and RMSE for Rough Set is less than that of SVM. The less the error values of MAE and RMSE, the better the model. So, it is concluded that the prediction of weather parameter in Rough Set model is better than Support Vector Machine Model.

VIII. CONCLUSION

Forecasting of weather at a particular location for a future time is very complex equation which is a current area of research for meteorological Department and weather researchers. The use of soft computing techniques has made the job easy and more accurate than the previous methods of prediction of weather. The Rough Set is a new approach for weather prediction with more accuracy. In this paper, we have used the Support Vector machine and Rough Set Theory of soft computing techniques and calculated the different statistical error values obtained from each case. After comparative study, it is observed that Rough Set gave more accurate result than SVM. So, the newly proposed Rough Set model may be used for weather prediction as well as other prediction problems like crop prediction, solar energy prediction, stock market prediction, medical diagnosis etc.

FUTURE SCOPE

This paper narrates the promising results of Rough Set and SVM for climate modeling and weather prediction of Delhi. This forecasting problem can also be enhanced further with the better accuracy using hybrid models of Rough set and SVM in predictions of weather, stock market, electricity production, business production etc.

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