ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Winter Day Patterns and Weather Forecasting for Agricultural Crops over Cuddalore Region.

S Meganathan[1]*, and TR Sivaramakrishnan[2].

[1]SASTRA University, Srinivasa Ramanujan Centre, Kumbakonam, Tamilnadu, India
[2]Former Director, India Meteorological Department, Govt. of India.

ABSTRACT

The principle climatic factors affecting crop production are the same as those influencing all vegetation temperature, length of growing season, moisture conditions, sunlight, and wind. But they must be considered in a different light with respect to crops. Natural vegetation is adapted to the climatic conditions with which it is associated. The emphasis of present work is to provide the weather patterns of winter day for January and February months during winter season have also been extracted using the association rule mining of data mining method. The extracted weather patterns are used for indicating the possible occurrence of extreme cool day before 24 hours and 48 hours over the coastal station Cuddalore (Latitude 11°46' N / Longitude 79°46' E) of south east India. The study exhibits that the proposed data mining model can predict the occurrence of cool day during winter with the help of local weather parameters.

Keywords: Vegetation, data mining, weather pattern.

Corresponding author

ISSN: 0975-8585

INTRODUCTION

The climatic elements that affect livestock indirectly through the feed supply are those that influence plant growth or the spread of insects and diseases. Those that have direct effects are temperature, precipitation, relative humidity, atmospheric pressure, wind, storms, and light. Of those, temperature is the most important. Human comfort is threatened by extremes of temperatures in winter. The effect of extreme cold affects the human life and too much body energy is required to combat the cold. Weather forecasting aids in anticipating heavy power demands and extra maintenance problems.

Data mining technique is one of the emerging tools which find applications on many fields such as business intelligence, credit card fraud detection, market basket analysis, biotechnology and etc [8]. A few attempts on the temperature analysis using data mining technique have been made [5-7]. Recently Sivaramakrishan and Meganathan [1-4] had proposed an idea to get association rule for weather prediction in certain case studies and the results were encouraging. Human comfort needs the lowest minimum during winter monsoon months. The forecast of extreme winter days (cold day) during the corresponding season is relevant for human thermal comfort.

Data and method:

Cuddalore (Latitude 11°46' N / Longitude 79°46' E) is a coastal station of south east India which is considered to this study. The global summary of the surface daily data for the period of 1961-2010 is collected from the National Climatic Data Centre, Asheville, USA at ncdc.noaa.gov. The January and February months were considered for cold day prediction during winter. The atmospherically parametric quantity of Maximum - Temperature, Minimum – Temperature, Dew – Point, Wind-Speed and Visibility were argued for analysis. After applying the data preprocessing techniques finally a sum of 2199 data objects were analyzed for cold day prediction during winter months for mining the relevant task. A best fit ranges of 5 atmospheric constraints describes in [Table 1] as a nominal values of the coastal station after applying the discretization techniques in preprocessing process.

Table 1: Nominal values of weather parameters

Weather parameter	Nominal value range	Winter months for cold day	
		24 hr advance	48 hr advance
Max. temperature in Fahrenheit	T_{LOW}	<85º	<85º
	T_{MED}	85º-96º	85º-96º
	T_{HIGH}	>96º	>96º
Minimum temperature in Fahrenheit	T_{LOW}	<60º	<60º
	T_{MED}	60º-71º	60º-71º
	T_{HIGH}	>71º	>71º
Dew point in Fahrenheit	D_{LOW}	<72	<72
	D_{MED}	66º-72º	66º-72º
	D_{HIGH}	>66	>66
Visibility in mile	V_{LOW}	<6	<6
	V_{MED}	6-10	6-10
	V_{HIGH}	>10	>10
Wind speed in knot	W_{LOW}	<4	<4
	W_{MED}	4-7	4-7
	W_{HIGH}	>7	>7
POST-MIN	LOW	≤67 º(20 ºC)	≤67 º(20 ºC)
	NORMAL	>67 º(20 ºC)	>67 º(20 ºC)

Weather patterns for cold day prediction:

For extreme winter day (cold day) prediction during winter months (January and February) of Cuddalore station, the weather parameters Max-Temp, Min-Temp, Dew-Point, Wind Speed, Visibility with class

ISSN: 0975-8585

labels are extracted. The class label for cold day prediction is 'POST_MIN' which has two values. If the class label value is 'normal' then the day is normal winter day. If the class label value is 'low' then the day is extreme winter day that is cold day. The threshold value for the cold day prediction is 20ºC (67ºF). The sample weather patterns for the cold day(CD) prediction are shown in [Table 2] for 48 hour advance forecasting and [Table 3] for 24 hour advance forecasting. These patterns were generated by the machine learning tool WEKA.

Table 2: Weather patterns for 48 hour advance CD prediction during winter monsoon

ASS Rule ($X \Rightarrow Y$)	SUP ($X \cup Y$)	CONF P(Y/X)
MAX='(84.533333-96.066667]' MIN='(70.666667-inf)' DEWP='(-inf-65.566667]' ==> POST_MIN=low	2	0.90358
MAX='(-inf-84.533333]' DEWP='(71.433333-inf)' VISIB='(5.966667-10.233333]' ==> POST_MIN=low	2	0.90358
DEWP='(71.433333-inf)' VISIB='(5.966667-10.233333]' WDSP='(-inf-3.66]'==> POST_MIN =low	2	0.90358
MAX='(84.533333-96.066667]' MIN='(70.666667-inf)' DEWP='(65.566667-71.433333]' ==> POST_MIN=nor	152	0.8817
MAX='(84.533333-96.066667]' MIN='(70.666667-inf)' DEWP='(71.433333-inf)' VISIB='(-inf-5.966667]' ==> POST_MIN=nor	442	0.67321
MIN='(70.666667-inf)' DEWP='(71.433333-inf)' VISIB='(-inf-5.966667]' ==> POST_MIN=nor	555	0.66768
MAX='(84.533333-96.066667]' MIN='(60.333333-70.666667]' WDSP='(7.333333-inf)' ==> POST_MIN=low	5	0.65499

Table 3: Weather patterns for 24 hour advance CD prediction during winter monsoon

ASS Rule ($X \Rightarrow Y$)	SUP($X \cup Y$)	CONF P(Y/X)
MAX='(84.533333-96.066667]' DEWP='(71.833333-inf)' WDSP='(3.666667-7.333333]' ==> POST_MIN=nor	104	0.99478
DEWP='(71.833333-inf)' WDSP='(3.666667-7.333333]' ==> POST_MIN=nor	161	0.99467
MIN='(60.333333-70.666667]' DEWP='(71.833333-inf)' ==> POST_MIN=nor	77	0.99461
MAX='(-inf-84.533333]' DEWP='(71.833333-inf)' WDSP='(-inf-3.666667]' ==> POST_MIN=nor	57	0.99436
MAX='(-inf-84.533333]' DEWP='(71.833333-inf)' ==> POST_MIN=nor	118	0.99418
MAX='(84.533333-96.066667]' MIN='(70.666667-inf)' WDSP='(3.666667-7.333333]' ==> POST_MIN=nor	143	0.99265
MAX='(84.533333-96.066667]' DEWP='(65.766667-71.833333]' VISIB='(5.966667-10.233333]' ==> POST_MIN=nor	13	0.98932
MAX='(84.533333-96.066667]' MIN='(70.666667-inf)' DEWP='(65.766667-71.833333]' WDSP='(-inf-3.666667]' ==> POST_MIN=nor	144	0.9864
MAX='(96.066667-inf)' MIN='(60.333333-70.666667]' WDSP='(-inf-3.666667]' ==> POST_MIN=low	2	0.93912
DEWP='(-inf-65.766667]' VISIB='(5.966667-10.233333]' WDSP='(-inf-3.666667]' ==> POST_MIN=low	2	0.93912
MIN='(60.333333-70.666667]' DEWP='(-inf-65.766667]' VISIB='(-inf-5.966667]' ==> POST_MIN=low	212	0.66122

Here the weather pattern is represented in the form of association rules. For instance, the weather pattern in [Table 2] MAX='(84.533333-96.066667]' MIN='(70.666667-inf)' DEWP='(-inf-65.566667]' ==> POST_MIN=low highlighting that the occurrence of the post minimum temperature is less than 20˚ Celsius (67 º Fahrenheit) when the maximum temperature is medium , minimum temperature is high and dew point is low. The support count is 2 out of total objects considered the analysis task. The confidence value is 90 % for certainty of the occurrence of this weather pattern in this prediction task. The support and confidence are used to measure the certainty of the weather pattern.

Validation:

Validation is done to find out the dependability of the generated results and to show whether they can be used in real time for the prediction of cold days. The machine learning algorithm K* achieves an accuracy of 81.9% and 79.3% using cross-validation for 24 hours ahead and 48 hours respectively for cold day forecasting using cross-validation is presented in [Table 4]. The interesting observation here is that there is not much difference between the success rates of 24 hour advance and 48 hour advance forecasts. The same is true for extreme winter day prediction.

Table 4: Statistical summary of winter day prediction

Measures	Cool Day Prediction	
	24 hour before	48 hour Before
Total number of instances	2198	2199
Correctly classified instances	1802	1746
Incorrectly classified instances	396	453
Correctly classified in %	81.9	79.3
Incorrectly classified in %	18.1	20.6
Mean absolute error	0.2156	0.2943
Root mean squared error	0.3523	0.3818
Relative absolute error in %	66.3	89.9
Root relative squared error in %	87.3	94.4

CONCLUSIONS

The data mining technique based on association rule mining for extracting relationships among weather parameters over Cuddalore station was applied to extract the extreme winter day (cold day) patterns during of Tamilnadu coastal region of south east India. The proposed data mining methodology is more useful to apply with threshold values. By using the extracted winter day patterns, the farmers will be benefited to exercise their agricultural operations and take decisions in advance. Crops management can also be regulated properly in Cuddalore region during winter season. As evidenced in the results, the methodology is suitable for monitoring and predicting the temperature days 48 hours ahead. This method promises to be a useful one for tropical coastal stations.

REFERENCES

[1] Sivaramakrishnan TR, Meganathan S. J Theoretical App Info Tech 2011;. 34(2) : 173-177.
[2] Sivaramakrishnan TR, Meganathan S. Archives Des Sciences 2012; 65(3), 8.
[3] Sivaramakrishnan TR and Meganathan S. Res. J App Sci Eng and Tech 2012; 4(13), 1899-1902.
[4] Sivaramakrishnan TR and Meganathan S. Res. J App. Sci Eng Tech 2013; 5(14), 3692-3696.
[5] Kothawale DR, Revadekar JV, Rupa Kumar K. J Earth System Science 2010; 119(1), 51-65.
[6] Lahoz D, Miguel MS. Monografias del Seminario Matematico Garcia de Galdeano 2004; 31,389-397.
[7] Sarah N Kohail, Alaa M El-Halees. Int. J Inf Comm Tech and Res 2011; 1(3),96-100.
[8] Sarawagi S, Thomas S, Agrawal R. Data Mining and Knowledge Discovery Journal 2000; 4(2), 89-125.