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Rainfall Forecasting with Seasonal Adjustment

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Time Series Analysis is helpful in understanding past and current patterns of change and provides important clue for predicting future patterns. Weather forecasting is one of the challenging tasks in the area of Time Series Analysis. The purpose of this paper is to evaluate seasonal factors and predict the amount of quarterly rainfall in Kolkata based on the past dataset using Regression Models and to compare the estimated values with the actual observations.

Keywords : Forecast, Rainfall, Regression, Seasonal Index, Time Series.

1. INTRODUCTION

Measurement and prediction of change using statistical methods is a very important tool for decision making. Seasonal variation is a component of a time series which is defined as the repetitive and predictable movement around the trend line in one year or less. The term seasonality [1-2] indicates some factors which occur regularly within the same time of the year (day, week, month and quarter or six-month period) and exerts an unquestionable influence on economic and social activities. Seasonality is quite common in economic time series as well as geophysical and ecological time series. It has application in retail sales, employment sector, agriculture, construction, transportation, tourist trips *etc.*. There are several main reasons for studying seasonal variation: (1) to understand seasonal pattern. (2) seasonal adjustment of data (3) prediction of the future trends.

Seasonal adjustment of a time series is the application of certain mathematical techniques to remove periodic infra-annual variations from these series. In recent years a lot of methodologies have been evolved for analyzing time series such as Exponential Smoothing, ARIMA, Seasonal Model, Non-Linear Models, ARCH-GARCH Model, State Space Models and Kalman Filter [3-13]. These Models have been studied extensively in the areas of economic studies for the last thirty five years.

Over the past decade notable research works have also been done in the areas of climatology and hydrology especially in the field of rainfall prediction or distribution and calculation of seasonal effects. Among the statistical methods, Bayesian hierarchical model [14] and Non homogeneous Hidden Markov Model and statistical coherence analysis [15] have been applied. Studies that use Autoregression based techniques namely ARMA, ARIMA, SARIMA [16-18] have been successfully attempted. In addition to the statistical methods, works based on SVM [19], ANN [20-26], Association rule mining [27], fuzzy logic [28-30] and K-Nearest Neighbour methods [31] are investigated. Notable works using various soft computing techniques [32-33] have been proposed. In this paper we used different regression based techniques for forecasting rainfall with seasonal adjustment.

This paper is organized as follows: Section 2 defines objective of our work. Section 3 specifies dataset used for experiments. We have presented our procedural details in Section 4. Experimental results are discussed in Section 5. Section 6 summarizes our conclusion and gives some direction for future work.

Table 11
Error Estimation

Methods	**RMSE= SQRT(MSE)**
Method1	204.783
Method2	390.889
Method3	221.485
Method4	261.135
Method 5/Expo/ Additive (Eqn. 1)	253.8869
Method 5/Expo/ Multiplicative (Eqn. 1)	261.135
Method 5/Expo/ Additive (Eqn. 2)	236.3293
Method 5/Expo/ Multiplicative (Eqn. 2)	252.1312
Method 6	228.183

6. CONCLUSIONS AND FUTURE WORK

Though accurate forecasting or prediction is a very difficult task, the purpose of our investigation is to analyze different regression based models and find out which one shows higher percentage of accuracy. We have also compared our results with the output obtained by applying Multiple Linear Regression [34] on the same dataset. Our study has revealed that method 1 gives best result in comparison to others. Problem may arise in calculating seasonal index using method 2, if amount of rainfall in any quarter/month is nil. Reason for this is that the calculation of link relative of any period, previous period's data is required. But this problem is absent in other methods.

Compared to the multiplicative model, additive model performs better though the error rates are still high. In all the cases in model 5, prediction for third and fourth quarter is too high. From the graphs, it can be concluded that none of the methods predicts rainfall for quarter 2 (March-June) correctly. The reason for this may be the variation in actual time of arrival of monsoon. Generally, in March West Bengal receives occasional showers with thunderstorms and it continues till the arrival of south-west monsoon in June. The rainfall from the monsoon winds is also variable in nature.

Above methods can be used to calculate seasonal index for each month and for computing monthly forecast. These models can be extended to observe the variation of rainfall in different places in a particular year and for the detection of changes in seasonality over the time.

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