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# RAINFALL PREDICTION IN VARIOUS PARTS OF BHUTAN WITH MACHINE LEARNING

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# 1 Problem Statement

Rainfall is one of the most complex and difficult elements of the hydrology cycle to understand and to model due to the complexity of the atmospheric processes that generate rainfall and the tremendous range of variation over a wide range of scales both in space and time. Heavy rainfall prediction is a major problem for meteorological department as it is closely associated with the economy and life of human. It is a cause for natural disasters like flood and drought which are encountered by people across the globe every year.

Accuracy of rainfall forecasting has great importance for countries like Bhutan whose economy is largely dependent on hydro-power project and agriculture. Due to dynamic nature of atmosphere, Statistical techniques fail to provide good accuracy for rainfall forecasting. Thus, accurate rainfall prediction is one of the greatest challenges in operational hydrology. On a worldwide scale, large numbers of attempts have been made by different researchers to predict rainfall accurately using various techniques. But due to the nonlinear nature of rainfall, prediction accuracy obtained by these techniques is still below the satisfactory level.

## 1.1 Aims

To predict rainfall in various part of Bhutan using Machine Learning.

## 1.2 Scope and Limitations

Scope

- It would help agricultural industries to keep crops safe and ensure the production of seasonal fruits and vegetables by updated rainfall prediction.
- It is significant for the flood management authorities as more precise and accurate prediction for heavy monsoon rains will keep the authorities alert and focused for an upcoming event that of which the destruction could be minimized by taking precautionary measures.
- The rainfall prediction will impressively help in dealing with the increasing issue of water resource management, as water is a scarce resource and it needs to get saved for the benefit of human beings themselves.
- I will also help the people to manage and plan their social activities accordingly.

Limitations

- Rainfall predictions can be used for those places that have datasets.
- Since rainfall depends upon many features, it would be difficult to accurately predict rainfall with limited features.

## 2 Literature Review

Rainfall prediction remains a serious concern and has attracted the attention of governments, industries, risk management entities, as well as the scientific community. Rainfall is a climatic factor that affects many human activities like agricultural production, construction, power generation, forestry and tourism, among others. To this extent, rainfall prediction is essential since this variable is the one with the highest correlation with adverse natural events such as landslides, flooding, mass movements and avalanches. These incidents have affected society for years. Therefore, having an appropriate approach for rainfall prediction makes it possible to take preventive and mitigation measures for these natural phenomena [1].

Rainfall is a crucial phenomenon within a climate system, whose chaotic nature has a direct influence on water resource planning, agriculture and biological systems. Within finance, the level of rainfall over a period of time is vital for estimating the value of a financial security. Over recent years, scientists' abilities in understanding and predicting rainfall have increased, due to numerous models developed for increasing the accuracy of rainfall prediction[2].

As global warming has increased so has earth's temperature and due to which our local region's yearly rainfall patterns have also been affected and this harms the population living in the areas, as farmers and other people who heavily rely on rainfall for all their water based needs, so in these regions accurate predictions of rainfall is of utmost importance while there are many ways of predicting them one chosen for this study is by observing and collecting the previous year rainfall data (in mm) and then predicting the rainfall(in mm) for the coming year , though it is not a full proof method and may become inefficient due to any given factor such as a "sudden increase in co2 levels" ,it is cheap and may help in counties where seasons are consistent and which are way behind the world in terms of technological advancements such as rural areas of counties[3].

Two widely used methods for rainfall forecasting are: Statistical methods and Numerical Weather Prediction (NWP) model. Nature of rainfall data is non-linear. Frequency, intensity and amount are main characteristics for time series rainfall. These values can be varied from one position on earth to other position of earth and from one time to other time. Every statistical model has some drawbacks. Combination of AR and MA together forms a general and useful class of the time series model known as ARMA model. ARMA model is only useful for stationary time-series data and forecasting of short term rainfall. The statistical approaches do not have the ability to identify nonlinear patterns and irregular trend in the time series[4].

Meteorological elements, such as temperature, wind and humidity, profoundly affect many aspects of human livelihood. They provide analytical support for issues related to urban computing such as traffic flow prediction, air quality analysis, electric power generation planning and so on. The most common method currently utilized in meteorology is the use of physical models to simulate and predict meteorological dynamics known as numerical weather prediction, or NWP. The advantage of NWP is that it is based on the numerical solution of atmospheric hydro thermo dynamic equations and is able to obtain high prediction accuracy if the initial solution is appropriately chosen[5].

### 3 References

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