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EXPLOTARY ANALYSIS OF RAINFALL FOR AGRICULTURE

LITERATURE SURVEY

1. **SURVEY**

Rainfall forecasting has gained utmost research relevance in recent times due to its complexities and persistent applications such as flood forecasting and monitoring of pollutant concentration levels, among others. Existing models use complex statistical models that are often too costly, both computationally and budgetary, or are not applied to downstream applications. Therefore, approaches that use Machine Learning algorithms in conjunction with time-series data are being explored as an alternative to overcome these drawbacks. To this end, this study presents a comparative analysis using simplified rainfall estimation models based on conventional Machine Learning algorithms and Deep Learning architectures that are efficient for these downstream applications. Models based on LSTM, Stacked-LSTM, Bidirectional-LSTM Networks, XGBoost, and an ensemble of Gradient Boosting Regressor, Linear Support Vector Regression, and an Extra-trees Regressor were compared in the task of forecasting hourly rainfall volumes using time-series data. Climate data from 2000 to 2020 from five major cities in the United Kingdom were used. The evaluation metrics of Loss, Root Mean Squared Error, Mean Absolute Error, and Root Mean Squared Logarithmic Error were used to evaluate the models' performance. Results show that a Bidirectional-LSTM Network can be used as a rainfall forecast model with comparable performance to Stacked-LSTM Networks. Among all the models tested, the Stacked-LSTM Network with two hidden layers and the Bidirectional-LSTM Network performed best. This suggests that models based on LSTM-Networks with fewer hidden layers perform better for this approach; denoting its ability to be applied as an approach for budget-wise rainfall forecast applications.

SURVEY 2:

Investigating climatology and predicting rainfall amounts are crucial for planning and mitigating the risks caused by variable rainfall. This study utilized two multivariate polynomial regressions (MPR) and twelve machine learning algorithms, namely three artificial neural networks (ANN), four adaptive neuro-fuzzy inference system (ANFIS) and five support vector machine (SVM) algorithms, to estimate monthly and annual rainfalls in a tropical location. The ground measured rainfall data were collected from the Nigerian Meteorological Agency (NIMET), Lagos spanning 31 years (1983–2013) spatially distributed across Nigeria. The proposed models employed geoclimatic coordinates such as longitude, latitude, and altitude as input variables. Analyses based on general performance index (c) showed that the adaptive neuro-fuzzy inference system (ANFIS) model's algorithms

outscored the MPR, ANN and SVM models in the ten months of the year. Its the generalized bell-shaped algorithm (ANFIS-GBELL) performed best for January, April, May, July, October and annual rainfalls, the Gaussian algorithm (ANFIS-GAUSS) for November and December, the subtractive clustered algorithms (ANFIS-SC) for August and September rainfalls, and fuzzy c-means algorithms (ANFIS-FCM) for June rainfall. Also, the multivariate polynomial regression of second order (MPR-2) model performed best for February and March rainfalls. These models' algorithms have general performance index ranging from 0.906 to 0.996 and they are thereby proposed for the estimation of rainfall amounts over Nigeria.

3.survey 3

Accurate and timely rainfall prediction is very important in hydrological modeling. Various prediction methods have been proposed in recent years. In this work, information regarding the short-to-long time variation inside original rainfall time series is explored using Ensemble Empirical Mode Decomposition (EEMD) based analysis on three rainfall datasets collected by meteorological stations located in Kunming, Lincang and Mengzi, Yunnan Province, China. Considering both with prediction accuracy and time efficiency, a novel combined model based on the information extracted with EEMD is then proposed in this paper. This model adopts various supervised learning methods for different components of input data, which employs Support Vector Regression (SVR) for short-period component prediction, while Artificial Neural Network (ANN) for long-period components prediction. Our research shows better performances than traditional methods that provides new thinking in rainfall prediction area.

Survey 4:

Accurate rainfall prediction has become very complicated in recent times due to climate change and variability. The efficiency of classification algorithms in rainfall prediction has flourished. The study contributes to using various classification algorithms for rainfall prediction in the different ecological zones of Ghana. The classification algorithms include Decision Tree (DT), Random Forest (RF), Multilayer Perceptron (MLP), Extreme Gradient Boosting (XGB) and K-Nearest Neighbour (KNN). The dataset, consisting of various climatic attributes, was sourced from the Ghana Meteorological Agency spanning 1980 – 2019. The performance of the classification algorithms was examined based on precision, recall, f1-score, accuracy and execution time with various training and testing data ratios. On all three training and testing ratios: 70:30, 80:20 and 90:10, RF, XGB and MLP performed well, whereas KNN performed least across all zones. In terms of the execution time of the models, Decision Tree is consistently portrayed as the fastest, whereas MLP used the most run time.

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