

Advanced time series models for rainfall prediction: A case study in Chittoor, Andhra Pradesh

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ABSTRACT

This study presents a comprehensive examination of monthly rainfall data collected in Chittoor district of Andhra Pradesh from January 1990 to December 2022. The primary objective is to develop an accurate predictive model for future rainfall patterns using time-series forecasting techniques. Traditional AutoRegressive Integrated Moving Average (ARIMA) models have been extensively applied in climate studies due to their effectiveness in capturing linear trends. However, ARIMA models often fail to account for seasonal variations inherent in rainfall data. To address this limitation, the QS Test was conducted to determine the presence of seasonality, revealing strong periodic fluctuations in monthly precipitation patterns. Based on this validation, a Seasonal ARIMA (SARIMA) model $SARIMA(1,0,1)(1,1,1)[12]$ was developed and compared against $ARIMA(0,0,3)(2,0,0)[12]$ to assess forecasting accuracy. Model selection was guided by key statistical indicators such as AIC, RMSE, MAE, and residual diagnostics. The SARIMA model demonstrated superior residual independence ($p = 0.6631$), confirming improved white noise behavior and seasonal pattern detection. Additionally, SARIMA achieved a lower AIC (4256.71), RMSE (57.63), and MAE (36.58) compared to ARIMA, reinforcing its enhanced forecasting capabilities.

Keywords: *ARIMA, Forecasting, Rainfall Prediction, SARIMA and Time Series Analysis*