FORECASTING DROUGHT WITH ARIMA MODEL AND STANDARDIZED PRECIPITATION INDEX (SPI)

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RESEARCH HIGHLIGHTS

Drought forecasting is an important forecasting procedure for preparing and managing water resources for all creatures. Natural disasters across the regions such as flooding, earthquakes, droughts etc. have caused damages to life as a result of which numerous researches have been conducted to assist in reducing the phenomenon. Consequently, therefore, this study considered using Auto-Regressive Integrated Moving Average (ARIMA) model in forecasting drought using Standardized Precipitation Index (SPI) as a forecasting tool which was used to measure and classify drought. The models are developed to forecast the SPI series. Results indicated the forecasting ability of the ARIMA models which increases as the timescales. The study is aimed at using ARIMA method for modeling SPI data series. The studies used data set made up of 624 months, obtained from 1954 to 2008. In the analysis only SPI3 series was non-seasonal while others have seasonality and Seasonal ARIMA was carried out, SPI12 was significant compared with the forecasting accuracy alongside the diagnostic checking having a minimum error of RMSE and MAE in both testing and training phases. The research contributes to the discovering of feasible forecasting of drought and demonstrates that the established model is good and appropriate for forecasting drought.

RESEARCH OBJECTIVES

The aim of the study is to apply ARIMA model for drought forecasting using standardized precipitation index (SPI) as the main data set which is seldom used to measure and classify droughts. The purpose of the study is to use the data which is made up of 54 years of series (1954 to 2008) for the analysis. In the analysis, the SPI data was classified into SPI3, SPI6, SPI9 and SPI12 for the purpose of analysis and comparison.

The study has as its objective the suitability of SPI data series for modeling using ARIMA model. Similarly, its ability to forecast drought based on all the SPI's and its forecasting capability. Consequently, using different data series, we obtain the best ARIMA model for each of the series.

This work is significant in exploring the potential of ARIMA model in drought forecasting, which is an important area of study. The paper, therefore, contributed significantly in examining a possible drought forecasting based on ARIMA model. The study is a demonstration that the ARIMA model is a good model for drought forecasting which can be applied for that purpose. Monitoring drought is vital for planning, management as well as for drought prediction.

MATERIALS AND METHODS

ARIMA model is one of the most effective forecasting models which have been used in various fields particularly in natural disasters such as flooding, earthquakes, and droughts using different datasets such as rainfall which, suffers from the limitations to capture data involving SPI data series (1). This study is therefore motivated by using different data sets of SPI series to obtain the best ARIMA model in each of the series (2).

Forecasting is a process in which statements are made about the actual outcome of events which are not yet observed. It is a decision-making tool or planning tool used to help the management or many businesses in its effort to handle the uncertainties of the future, which relies mainly on data obtained from the past and present and then carry out analysis of the trends.

Shijin et al. (3) described forecasting as a vital study field in evaluating the hydrological data series. Raicharoen (4) stated that time series forecasting is an act of knowing the future when

the past is understood. Time series forecasting is extensively used, and it becomes an vital method to drought forecasting (5).

RESULTS

SPI data corresponding to 3, 6, 9 and 12 months is applied as their corresponding Standardized Precipitation Indexes (SPIs) were computed. The time series of each were also calculated. The main motive while the overall precipitation for the periods of these months were considered was for of the arrangement of droughts for a short, medium and long-term periods with respect to SPI3, SPI6 together with SPI9 and SPI12 respectively. For the development of model, the data is made up of 624 months which were used to develop the model and this was divided into two parts from 1954 to 1998 (80%) was used for training and data from 1999 to 2008 (20%) was used for testing. The analysis was based on PACF and ACF in the input of the SPI data sets.

The performance of the models was assessed using the forecasting performance evaluation of RMSE and MAE. Based on these measures, the best ARIMA results in each of the SPIs for the training and testing phases were obtained. The paper contributed to the exploration of possible drought forecasting which is based on ARIMA model. The result is a demonstration that the ARIMA model is good for drought forecasting.

FINDINGS

This study uses SPI series for drought forecasting. Since SPI is universally agreed as the most widely applied methods which are similar to drought forecasting, the accuracy and reliability of estimating the SPI are very significant. The study, therefore, proposes the use of the ARIMA technique for modeling SPI data series. The ARIMA models were trained and tested by applying different SPI data series. It was discovered that SPI3 was the only series that is non-seasonal, the remaining three (SPI6, SPI9, and SPI12) have seasonality and Seasonal ARIMA test was carried out.

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