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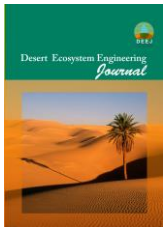

Modeling SPI Drought Index Using ARIMA Stochastic Model (A Case Study of Behbahan City)

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Extended Abstract

Introduction: As one of the greatest natural disasters faced by mankind since time immemorial, drought can be defined as a long period of reduced precipitation (a season or a year, for instance) occurring in almost all climate zones, including areas with high and low precipitation rates. Moreover, drought is a globally intensifying phenomenon, with no region or country in the world remaining safe from its consequences. On the other hand, the extent, frequency, intensity, and duration of drought are increasing in many parts of the world due to climate change. In addition, the phenomenon influences a diverse range of biophysical resources in catchment areas, including the discharge and sedimentation of rivers. Therefore, awareness of the drought status, prediction of drought, and zoning of its severity can significantly reduce the risk of its potential damage.

Materials and Methods: Covering an area of 3516 km^2, Behbahan is located in the southeast of Khuzestan province between 50˚ to 50˚ 21′ east longitude and 30˚ 30′ to ˚31 north latitude. Various indicators have so far been developed for monitoring drought, each of which considers one or more parameters contributing to drought. As a widely applied drought index worldwide, The Standardized Precipitation Index (SPI) time series can be used to describe the intensity of historical and current drought events at a site and to estimate the potential prospective magnitude of drought.

Auto-correlated integrated ARIMA model is frequently used in analyzing time series. The model was first proposed by Box and Jenkins when studying time series, inspiring many related models that have since been developed and applied in various branches of geosciences. To investigate and predict drought in Behbahan City, this study sought to model annual SPI time series, six-month SPI, and nine-month SPI using the ARIMA model.

Results: The results indicated that the ARIMA (5,0,11) was the best choice for modeling annual drought index time series in the validation stage, with its errors being R^2=0.64 and RMSE=0.81 MAE=0.66 and MAPE=213.27 errors. The ARIMA (2,0,5) was also found to be the best model for modeling the six-month SPI drought index time series, where the R^2 value of the model was equal to 0.50 (greater than that of other models), and its RMSE, MAE, and MAPE errors were reports as 0.84, 0.64 and 100.31, respectively (less than those of other models). Moreover, due to the non-normality of the residuals of the selected models, a suitable model was not found for modeling the nine-month SPI time series. Therefore, other methods such as wavelet analysis are recommended to be used in this regard.

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Discussion and Conclusion: As a complex and often underestimated phenomenon, drought strongly influences different aspects of human life. Therefore, early prediction of drought plays a crucial role in strategic planning and management of water resources. In this regard, time series models are considered a suitable tool for predicting climatic events. This study used the time series of the SPI index to model drought in Behbahan City at annual, six-month, and nine-month scales, seeking to identify appropriate models in this regard. It appears that managers and relevant decision-makers should take similar studies into account to access a clear analysis of the region and develop optimal plans for the management of water resources. This is especially important in Iran, where a large area of the country is characterized by arid and semi-arid climates. Considering that the phenomenon of drought can be predicted and managed, it is necessary to implement basic measures to reduce the adverse effects of drought in the coming years.

Keywords: Behbahan, Drought, Modeling, SPI index, Time Series.