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Vector Autoregressive (VAR) model for forecasting water level in Attanagalu Oya

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Flood is one of the major natural hazards in the world. Sri Lanka also undergoes flooding incidents every year. Both natural and human-induced activities such as precipitation, unplanned infrastructures, water drainage, lack of vegetation cause floods. High precipitation is one of the main reasons for flooding. Generally, most flood incidents occur in monsoon periods and inter monsoon periods. Attanagalu Oya, one of the tributaries of Kelani river and downstream of Kelani river cause to flood in the Gampaha district, Sri Lanka. According to the literature, the water level in Attanagalu Oya has not been studied using the multivariate time series approach. Therefore, this study aims to develop a Vector Auto Regressive (VAR) model to forecast the water level in Attanagalu Oya. The fitted model might be useful to identify the flood incidents that occur due to overflowing Attanagalu Oya. The model is fitted for daily water level and rainfall data for ten years. Water level data at the Dunamale gauging station of Attanagalu Oya and rainfall data at the Henarathgoda station were obtained from the Irrigation Department and Meteorological Department respectively. The analysis was carried out using R statistical software. Missing and unusual values of rainfall data were cleaned using the average values. Cross-correlations were calculated to identify lags of the rainfall data that might be useful to predict the water level. Results indicated the significant correlations at lags 1,2 and 3 as expected in this context as it takes 1-2 days to raise the water level after rain. The best VAR model must be chosen by selecting the optimal autoregressive order which is selected based on the minimum Akaike's Information Criterion (AIC). The lowest AIC score was achieved at the order of 8. Hence, VAR (8) model was selected as the best model. Results indicated that the rainy season occurred in southwest monsoon (May-September) and second inter monsoon (October-November) periods. The water level is also increased in those periods. According to the observed values of 2019 significant increase in water level could be seen from mid-September to November and the beginning of December. Forecasted results also showed an increase in water level in those periods. Also, the model accuracy was examined using mean absolute percentage error (MAPE) and root mean squared error (RMSE). Accuracy test results showed that the MAPE and RMSE values for forecasted rainfall are 2.907063 and 16.13093 and the water levels are 0.7730767 and 0.9059733 respectively. Hence, those values indicated that the model is adequate for forecasting. Findings of this study are vital to Agricultural Department to plan their cropping calendar, and urban council to plan various development and construction activities and warn the community in Attanagalu Oya basin for staying alert in the periods in which the water level is increased. Besides, this study is continued to improve the accuracy of the existing VAR model and to advance the existing model by considering other factors such as temperature and humidity.

Keywords: Attanagalu Oya, Flood, Multivariate time series, Rainfall, Water level

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