

**Universiti Teknologi MARA**

**Outliers in Bilinear Time Series Model**

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## ABSTRACT

This study has two main objectives: Model building and detection of outliers in BL(1,1,1,1) models in time-domain framework.

In model building, the Box-Jenkins approach was closely followed. In the identification stage, time-domain based nonlinearity tests were considered to distinguish nonlinearity data set from linear time series data. In general, identifying the order of bilinear model including BL(1,1,1,1) model is not possible yet due to the complexity of form taken by the moments of bilinear model. In the estimation stage, the nonlinear least squares method were used to estimate the parameters of BL(1,1,1,1) models. In the diagnostic stage, the residuals were examined to check the adequacy of model. In addition, the Akaike's information criteria, the Akaike's Bayesian information criteria and Schwarz's criterion were used for model comparison purposes.

Outliers exist due to many possibilities such as misrecording, disaster or changes of nature. The occurrence of four types of outliers; the additive outlier (AO), innovational outlier (IO), level change (LC) and temporary change (TC), in data from BL(1,1,1,1) models were considered in the study. Their features were studied so that different patterns caused by each type of outliers were distinguishable. Further, the measures of outlier effect for AO, IO, LC and TC were derived using the least squares method. Their variances were obtained using bootstrap method. The detection of outliers was carried out by examining the maximum value of the standardized statistics of the outlier effects. The outlier detection procedure for identifying the type of outlier at time point  $t$  was proposed. Simulation studies were carried out to study the performance of the procedure in BL(1,1,1,1) models. It was found out that, in general, the proposed procedure performed well in detecting outliers. As for illustration, the proposed procedure was applied on three hydrological data.