Performance Evaluation and Comparison of Integer-Valued Time Series Models for Measles Outbreak Detection in Cavite

Vio Jianu C. Mojica  
*Department of Physical Sciences and Mathematics, University of the Philippines Manila*  
*Mathematics and Statistics Department, De La Salle University*

Frumencio F. Co  
*Mathematics and Statistics Department, De La Salle University*

An ideal outbreak detection algorithm must be able to generate alarms early into an outbreak while providing optimal sensitivity and specificity so as to mitigate mortality and other potential costs of investigation and response to these events. One particular disease of interest is measles, which is a highly contagious disease that exhibited periodic outbreaks in the Philippines. The performance of the NGINAR(1) and ZINGINAR(1) models for measles outbreak detection was examined through the use of simulated datasets and an actual application to reported measles cases in the Cavite province from 2010 to 2017. The models were evaluated based on their goodness-of-fit as well as the sensitivity, specificity, and timeliness of the detection thresholds they have generated. Comparisons were done against ARIMA models and the popular Poisson INAR(1) model. Results show that INAR models have considerably higher probabilities of detection than ARIMA models, particularly for outbreaks of small magnitudes. The Poisson INAR(1) generates the most alarms and thus, has the highest sensitivity metrics. The NGINAR(1) and ZINGINAR(1) models, however, have lower false positive rates with outbreak detection capabilities comparable to the Poisson INAR(1). The NGINAR(1) model may be chosen as the best model considering its simplicity and its balance of sensitivity, specificity, and timeliness which is optimal for a disease such as measles.

*Keywords: NGINAR(1), ZINGINAR(1), measles, outbreak detection, Cavite*