

A FOURIER SERIES MODEL FOR THE PERIODIC MONTHLY PRECIPITATION OF BAYOMBONG, NUEVA VIZCAYA

ORVILLE D. HOMBREBUENO
DR. WILFREDO A. DUMALE JR.

Executive Summary

The Weather Monitoring System (WMS) project of the Nueva Vizcaya State University (NVSU) has installed field monitoring system (FMS) devices all over the province of Nueva Vizcaya. These FMS devices were designed in Japan and gather various weather data such as precipitation, relative humidity, air temperature, solar radiation, wind speed, wind direction, soil temperature, soil moisture, and electrical conductivity. These weather data will serve as information for local agricultural purposes, in tune to the purpose of the WMS – a localized climate change adaptation strategy for the province of Nueva Vizcaya.

The FMS in Bayombong, Nueva Vizcaya was the first device installed in the province and it has gathered weather data from 2012 up to the present. Having these data and to realize the purpose of the WMS, a preliminary mathematical modeling of the precipitation data was carried out by the researchers.

The main objective of the study was to come up with a Fourier series model that will best describe and represent the periodic monthly precipitation of Bayombong. Specifically, the study sought to: 1) describe the monthly precipitation of Bayombong using the available WMS data; 2) perform mathematical modeling with the monthly precipitation of Bayombong and generate Fourier series models for the periodic monthly precipitation of Bayombong; 3) define which Fourier series model best describes the periodic monthly precipitation of Bayombong; 4) describe the periodic monthly precipitation of Bayombong using the obtained Fourier series model.

The available data is hourly precipitation in millimeters (mm) from 2012 to 2015. There were missing data. The performances of the `na.interp` function of the forecast package and the functions of the `imputeTS` package of R – used to address issues of missing data – were tested using MAE, RMSE, R^2 , and by comparing the graphs of the imputes to choose the most appropriate function to be used in addressing the missing data. The `seasplit` function – with algorithm set to interpolation and option set to `stine` – of the `imputeTS` package was the most appropriate and was used. Afterwards, to describe the monthly precipitation of Bayombong from 2012 to 2015, the cumulative hourly precipitation for each month were computed to represent the monthly precipitation.

Next, to generate Fourier series models, fast Fourier transform (FFT) was applied to the data and as a result, 6 cosine and 6 sine terms were identified to compose the first Fourier series model. To come up with other models, backward elimination stepwise time series regression was performed. The term with the highest p-value was the one eliminated. As a result, 11 more Fourier series models were generated.

Now, to define which Fourier series model best describes the periodic monthly precipitation of Bayombong, the criteria is that the model, after backward elimination results to a model that shows significant lags in the correlogram of the autocorrelation function (acf) of its residuals, is the one. With this, the Fourier series model that best describes the periodic monthly precipitation of Bayombong is the second to the last model generated. It is composed of the mean term, a cosine and a sine term. The cosine and sine terms of the model are the first harmonic in a Fourier series with base period 12.

Finally, the obtained Fourier series model for the periodic monthly precipitation of Bayombong identified the months of January, February, March, April, November and December as dry months and the rest as wet months considering the 150mm precipitation mark to be the boundary for classifying dry and wet months. The model also revealed a peak in the month of August and a lowest point in the month of February.

In conclusion, the study will serve as basis for modeling endeavors to be carried out by the WMS in the future when there is enough data to do forecasting. Thus, help the WMS realize its purpose.