

COMPARISON OF RAINFALL PATTERNS BASED ON THE SOLAR AND LUNAR CALENDARS IN TOBACCO GROWN AREAS

N.H.W.B. Herath¹, P. Wijekoon^{1*} and R. Abesekara²

¹*Department of Statistics and Computer Science, Faculty of Science, University of Peradeniya, Sri Lanka*

²*Ceylon Tobacco Company PLC, Sri Lanka*

**pushpaw@pdn.ac.lk*

Yala and Maha, rainy seasons in Sri Lanka are based on solar calendar system, and it was noted that the pattern of rainfall has been changed reasonably in recent years. Solar calendar is based on the sun, and lunar calendar is mainly based on the transaction of the moon. A lunar month consists of 28 days or 29 days with some additional hours. Therefore, the lunar year consists of 348 days (29*12 moths), and a 17 day (365-348) difference exists in lunar calendar with compared to the solar calendar.

The objective of this study is to fit copulas to the rainfall duration and severity data for selected stations nearby tobacco grown areas in Sri Lanka for two calendar systems, solar and lunar, and compare the results to identify the most reliable calendar system to predict rainfall with more accuracy. The study was entirely based on secondary data taken from the Ceylon Tobacco Company from 6 different depots (Galewela, Theldeniya, Ududumbara, Polonnaruwa, Melsiripura, and Na-Ula). Daily rainfall data of solar calendar collected for the period of 5 years from 2008 to 2012 were used, and then the rainfalls of lunar months were constructed for selected stations. Monthly and Seasonal Rainfall data were prepared according to the both solar and lunar calendars. The results obtained by performing a preliminary analysis were arranged in a tabular manner and represented graphically for all the data. The time series analysis, trend analysis, and bivariate copula regression were utilized to examine periodic changes and the patterns of rainfall for both calendar systems.

Time series plots have shown a clear difference between the two calendar systems. The lunar calendar system presented a kind of pattern compared to the solar calendar system on monthly rainfall during the first half of the selected years with a shift of rainfall peaks. When comparing the time series models, lunar calendar system models show closer values than the solar calendar system models to predict seasonal rainfall data in a particular year.

For copula regression the 3-month standardized Precipitation Index (SPI) was calculated and used it to identify the rainfall duration, and the corresponding rainfall severity. According to the chi-square goodness of fit test, it was found that the rainfall duration follows exponential distribution, and rainfall severity follows gamma distribution for both calendars for all the stations. Then the best fitted joint distribution of bivariate copula for rainfall duration and rainfall severity was identified as Gumbel-Hougaard copula based on maximum loglikelihood for each station for both calendar systems. Finally, it was revealed that the rainfall values of Galewela, Theldeniya, and Ududumbara follow a lunar calendar with more accuracy, and rainfall values of Polonnaruwa, Melsiripura, and Na-Ula follow solar calendar system. These fitted models are useful for making probability statements regarding the return periods in the future.