Weather Statistical Modelling for Analyzing the Hybrid Power System

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Hybrid Power System is a combination of different power resources and storage. For example, the combination of Solar Panel, Wind Turbine, Diesel Generator and Battery. The power production of the renewable energy resources, Solar Panel and Wind Turbine, is depended on the Weather (Wind Speed and Solar Irradiation). So, it is important to make a very good model for Wind Speed and Solar Irradiation.

The objective of this research is to make a statistical model of wind speed and solar irradiation using ARIMA Model and R Language Programming. We use R language in RStudio editor for making the model of wind speed and solar irradiation. R is a language and environment for statistical computing and graphics. It is a GNU project which is similar to the S language and environment which was developed at Bell Laboratories (formerly AT&T, now Lucent Technologies) by John Chambers and colleagues. R can be considered as a different implementation of S. There are some important differences, but much code written for S runs unaltered under R. R provides a wide variety of statistical (linear and nonlinear modelling, classical statistical tests, time-series analysis, classification, clustering, …) and graphical techniques, and is highly extensible. The S language is often the vehicle of choice for research in statistical methodology, and R provides an Open Source route to participation in that activity. RStudio is a visual editor for R. This software are integrated with R, but we can use the easy toolbox that already set for all function and facilities.

ARIMA models are, in theory, the most general class of models for forecasting a time series which can be made to be “stationary” by differencing (if necessary), perhaps in conjunction with nonlinear transformations such as logging or deflating (if necessary). A random variable that is a time series is stationary if its statistical properties are all constant over time. *A stationary series has no trend, its variations around its mean have a constant amplitude, and it wiggles in a consistent fashion*, i.e., its short-term random time patterns always look the same in a statistical sense. The latter condition means that its *autocorrelations* (correlations with its own prior deviations from the mean) remain constant over time, or equivalently, that its *power spectrum* remains constant over time. A random variable of this form can be viewed (as usual) as a combination of signal and noise, and the signal (if one is apparent) could be a pattern of fast or slow mean reversion, or sinusoidal oscillation, or rapid alternation in sign, and it could also have a seasonal component.

The seasonal part of an ARIMA model has the same structure as the non-seasonal part: it may have an AR factor, an MA factor, and/or an order of differencing. In the seasonal part of the model, all of these factors operate across *multiples of lag s* (the number of periods in a season). A seasonal ARIMA model is classified as an ARIMA(p,d,q)x(P,D,Q) model, where P=number of seasonal autoregressive (SAR) terms, D=number of seasonal differences, Q=number of seasonal moving average (SMA) terms.

In this research we will use dummy variable to solve the seasonal problem of monthly. ARIMA is not design to solve multiseasonal data. So, we have to use external regression to solve the problem. If we use general external regression such as in exponential smoothing or Fourier terms, it is not possible to model the seasonal monthly. Because the frequency (number of observation) is not same. There are 31, 30, 29 or 28 monthly frequency to use. So, to solve this problem we will use dummy variable for the monthly season.

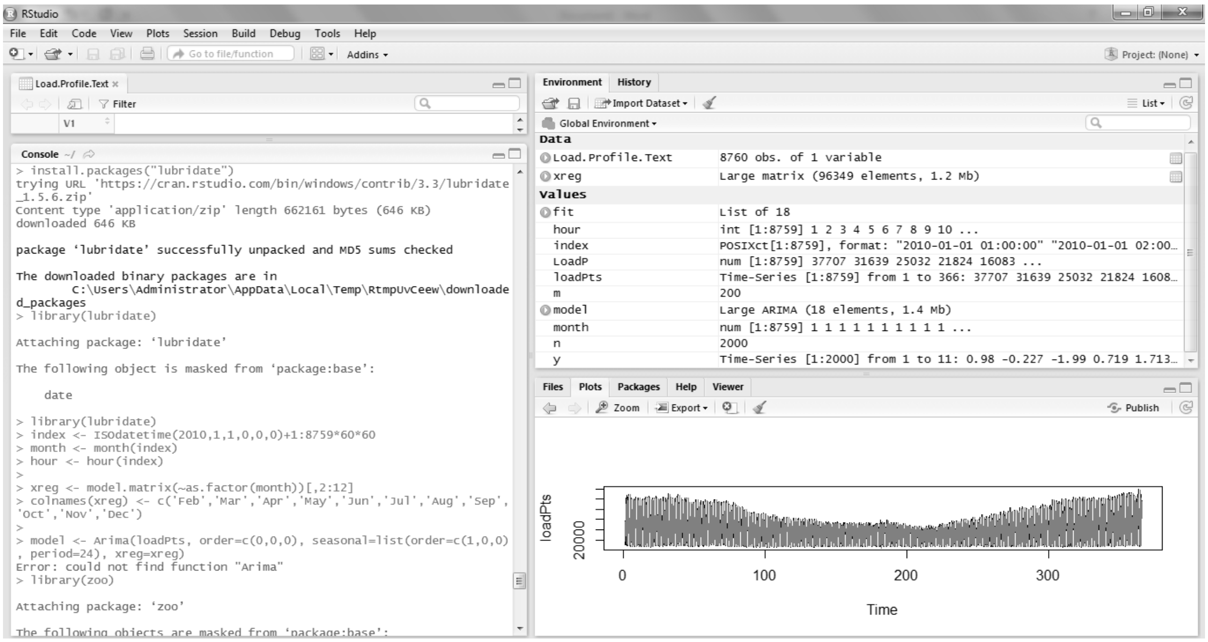

Figure 1: RStudio

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