Role of Artificial Neural Network in Agriculture Research

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The conventional statistical methods have some restrictive assumptions such as the linearity, normality and independence among input variables. Considering that the violation of these assumptions for independent variables frequently occurs with agricultural data, the methods can have limitations to obtain the effectiveness and validity. This leads to the development of Artificial Neural Networks (ANNs). Soft computing methods specifically applied to agriculture data include probabilistic neural networks and back propagation neural networks. These soft computing models were specifically important because they offer qualitative methods that traditional quantitative tools in statistics and economics cannot quantify because of the complexity in translating the systems into precise functions.

Artificial Neural Networks (ANNs) are a form of soft computing methods which are modelled after the way human brains work. Instead of having to hard code results into a computer (in the form of a hard model or a set of if-then type coding) an ANN is able to ‘learn’. ANNs are set-up with weights that are initially random numbers. In the neural network, as it is trained the network ‘learns’ by adjusting the weights in positive ways when it gets a correct outcome, and in negative ways when it receives an incorrect outcome. ANNs are useful when a model is unknown because they can ‘learn’ from the data. ANNs, however, do not provide a clean model to a problem. It is hard to know how they come to their conclusions, because they are like a “black box”, only providing a final outcome and not what causes the result.

ANNs have, specifically, been shown to be good at grouping things together for classification. ANNs have had some good successes in predicting short-term results and less success for long-term results, partially, because adding the element of time is very difficult. ANNs can deal better with missing data, outliers, and multicollinearity than regression. However, ANNs can be over trained to fit the data they are given, so well, that they are not able to apply their learning to other data. ANNs are much easier to set-up than many of the statistical models, such as regression (with only a small amount of time an ANN can be set-up; with learning and practice they can provide better results, since it is more of an art to setting one up, than a science). Some of the important applications of ANN in clinical medicine have been for diagnosis of diseases. ANN have also been used in to determine prognosis after cardiopulmonary resuscitation, strategies for weaning from respiratory support, tumor stage in oncology, graft outcome after liver transplantation, and prognosis in trauma. Ravdin (1992) studied the prognosis of the breast cancer patients using Neural network models. Ohno-Machado, Walker and Musen (1995) developed a hierarchical architecture of ANN that predicts survival time in a stepwise manner and have shown that ANN can predict survival time more accurately than traditional methods. This method is particularly advantageous when censored data is present and the number of event is small. Predictions are made for the first time interval, then for the second and so on. The system produces a survival estimate for patients at each interval and is able to handle continuous and discrete variables, as well as censored data. Lundin et.al. (1999) evaluated the accuracy of ANN in predicting 5, 10 and 15 year breast cancer
specific survival. The area under the ROC curve (AUC) was used as a measure of accuracy of the prediction model in generating the survival estimates of the patients. The AUC values obtained by ANN were compared with logistic regression. ANN was found to be very accurate in the breast cancer survival prediction and it was observed that ANN can be important tool for cancer survivor prediction. A set of functions for survival analysis using feed forward neural network is available at http://www.stats.ox.ac.uk/pub/swin/survnet.zip

Most of the research on the application of ANN in agriculture science has been done in the last decade. It is mainly in the area of yield prediction, spatial modelling, spatial-temporal forecasting. In this paper we have introduced the basic concepts about neural network. We have also reviewed the work done on the application of ANN in agriculture research. We have demonstrated the application of ANN in agriculture research using real data.