A Hybrid Method for Prediction and Assessment Efficiency of Decision Making Units: Real Case Study: Iranian Poultry Farms

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ABSTRACT

The objective of this article is an evaluation and assessment efficiency of the poultry meat farm as a case study with the new method. As it is clear poultry farm industry is one of the most important sub-sectors in comparison to other ones. The purpose of this study is the prediction and assessment efficiency of poultry farms as decision making units (DMUs). Although, several methods have been proposed for solving this problem, the authors strongly need a methodology to discriminate performance powerfully. Their methodology is comprised of data envelopment analysis and some data mining techniques same as artificial neural network (ANN), decision tree (DT), and cluster analysis (CA). As a case study, data for the analysis were collected from 22 poultry companies in Iran. Moreover, due to a small data set and because of the fact that the authors must use large data set for applying data mining techniques, they employed k-fold cross validation method to validate the authors’ model. After assessing efficiency for each DMU and clustering them, followed by applied model and after presenting decision rules, results in precise and accurate optimizing technique.

Keywords: Artificial Neural Network, Data Envelopment Analysis, Decision Tree, Efficiency, Poultry Meat Farming

1. INTRODUCTION

Recently, agriculture besides petroleum industries has had considerable effect on economic growth and its stability in Iran. Among various sectors in agriculture, poultry meat farming sub-sector has high potential for enhancing the industry, because of having by-product such as egg and manure. Furthermore, consumption of poultry meat is higher in comparison to other meat such as birds, lamb, beef and etc. in Iran. Regarding this sub-sector, the newest strategy is to increase productivity of related companies not only in order to reduce costs but also to enhance
the product. For this purpose, the key processes and hence their decision making units must be evaluated. As far as developing countries are concerned, the efficiency of farms and farmers are valuable issue to economist. Evaluation and measuring the efficiency of poultry meat farm industry is a remarkable subject in these countries. Iran, as developing country, is a major producer related to poultry meat farm. Not only replacement for protein eating the marketplace is outsized, but also segregated from all around the world. Many factors have effects on poultry meat manufacture economically. These factors consist of the choice of manufacture equipment, employee society, cost such as feed, health, water, etc.

Data Envelopment Analysis (DEA) is a broadly used linear programming technique that was developed in operations research and economic literature as a method to determine the relative efficiencies of the decision making units (DMU) (e.g. banks, restaurants, public houses, hospitals, schools, corporate performance), this method originally proposed by (Charnes, Clark, Cooper, & Golany, 1984). Example of these applications were seen in (Bojnec & Latruffe, 2008; Çelebi & Bayraktar, 2008; Cooper, Seiford, & Tone, 2006; Emrouznejad & Anouze, 2010; Samoilenko & Osei-Bryson, 2008). However, in many situations, it is important to assess relative efficiency before, for this purpose we must classify DMUs in order to evaluate and identify decision rules and then to select the best classifier. Therefore it is important to develop the process of classifier selection and identification rules. One of the applications of Data Mining (DM) is to use historical data for training a model and to make prediction of new classifier performance with the trained model. Examples of application cases of DM approaches include neural networks and expert systems (Wu, 2009; Yaghobi, Aryannejad, & Lotfi, 2010). This study aims to improve efficiency of DMUs in chicken industries. The other main aims of this research are included three important objects. In the first place, results yield a favorable classification and selection the best decision rules accuracy rate. Secondly, the results of this study provide insight for selection appropriate classification method for any dataset with many patterns in hybrid structure. Finally, improving decision making performance based on aforementioned results.

2. BACKGROUND

2.1. Cluster Analysis (CA)

Clustering is a popular data mining technique, which involves the partitioning of a set of objects into a useful set of mutually exclusive clusters so that the similarity between the observations within each cluster (i.e., subset) is high, whereas the similarity between the observations from the different clusters is low (Samoilenko & Osei-Bryson, 2008, 2010). Unlike decision trees which assign a class to an instance (supervised method), clustering procedures are applied when instances are divided into natural groups or clusters (unsupervised method). There are different ways to produce these clusters. The groups may be exclusive i.e. any instance belongs to only one group probabilistic or fuzzy i.e. an instance belongs to each group to a certain probability or degree (membership value) hierarchical i.e. there is a crude division of instances into groups at the top level and each of these groups are refined further up to individual instances (Thomassey & Fiordaliso, 2006). In other literature, overview of two general approaches to clustering was provided: hierarchical clustering, partitional clustering (e.g., k-means, k-median) (Samoilenko & Osei-Bryson, 2008).

Examples of application of clustering seen in (Banfield & Raftery, 1992; Ben-Dor, Shamir, & Yakhini, 1999; Dhillon, 2001; Fisher, 1997; Hirschberg & Lye, 2001; Lai, Fan, Huang, & Chang, 2009; Okazaki, 2006; Wallace, Keil, & Rai, 2004).

2.2. Artificial Neural Networks (ANNs)

Another data mining technique is neural networks that are mathematical representations inspired by the function of the human brain. Many types of neural networks have been suggested in the literature for both supervised
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