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Model of the forecasting cash withdrawals in the ATM network

Sergey Nemeshaev and Alexander Tsyganov

The National Research Nuclear University MEPhI (*Moscow Engineering Physics Institute*), *Russian Federation*

sergey.nemeshaev@gmail.com, *a2tsy-kaf22@yandex.ru*

Abstract

To increase the economic efficiency of the self-service devices networks operated by banks and processing companies, possibly due to the use of mathematical models and algorithms in the cash-in-transit forecasting process. In this article the issues are considered to improve the cash drawing forecast accuracy using the model for the neural networks. Special focus is on the description of data pre-processing.

Keywords: bank, replenishment, forecasting, statistics

1 Introduction

Nowadays, the banks are developing and offering actively the services to the public in connection with the card payment system. Not only the services range is expanding but also the network of the bank branches and outlets, and the ATMs. One of the forms of the customer service offering by the banking systems is a cash withdrawal through the ATMs network [1]. Nowadays, the self-service devices already have a wide range of different functions: cash withdrawals (various currencies at the multi-currency ATMs), bank account replenishment, payment of various services (cellular service, utilities payments, etc.). All of these services mean the constant ATMs replenishment and emptying, or rather different cartridges installed in them. In this regard, sooner or later you have to fill up the cartridges with different currencies sorted par value. It is not effective just to send CIT vehicle and replace the cartridges randomly. You need to determine the optimal date and amount of the filled funds par value, and only then to hire an armored car delivery. As the number of ATMs increased the work for the department responsible for the cash delivery vehicle is increased too. The problem that has appeared is to computerize the ATM cycles research, the processing the resulting statistical information on withdrawals and depositions, and to make decisions on the timing and amount of future cash collection.

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2 Applicability of neural network technology for the business forecasting problems

The neural networks are the adaptive systems to process and analyze the data, which are the mathematical structure that simulates some aspects of the human brain's operations, and demonstrate such brain's possibilities as the ability to non-formal learning, generalizing, and clustering the unclassified information, the ability to make forecasts on the basis of presented time series. Their main difference from other methods, such as expert systems, is that the neural networks do not require pre-known model in principle, and build it with their own recourses only on the basis of presented information. This is precisely why the neural networks and genetic algorithms come into practice there where you need to solve the problem of forecasting, classification, management - in other words, in the field of human activity where there are the bad algorithmic problems whose solution required a permanent work of the group of qualified experts, or adaptive automation systems which the neural networks are [2].

The neural networks are being used increasingly frequently in the real-world business applications. In some field, such as fraud detection and risk assessment, they became the undisputed leaders among the methods used. Their use in the forecasting systems and market research systems is constantly growing.

It should be noted that as far as the economic, financial and social systems are very complex and are the result of actions and reactions of different people, it is very hard (and may be impossible) to create a full mathematical model taking into account all the possible actions and reactions. It is almost impossible to approximate in detail the model based on such traditional parameters as utility or profit maximization.

In the systems with such complexity it is the natural and the most effectively to use the models simulating directly the behavior of society and the economy. And it is just the thing that the neural networks methodology is able to offer.

Also the neural networks can be used to solve other problems. The main predetermining conditions for their use are the presence of the "historical data", using which the neural network that can be trained, as well as the impossibility or failure of the use of more formal methods [3].

3 Selecting a network architecture

Based on the specifications of the basic models for the neural networks and to solve the problem of the demand forecasting the multilayer neural network model was selected.

The multilayer neural networks are flexible in solving various problems, and consume low resource for training. As well as they are fairly easy to understand their structure and working principles. Choose the network architecture with 2 hidden layers, and this will reduce the total number of neurons in the hidden layers. The number of neurons in them shall be determined by the experimentally obtained formula for the first hidden layer: $(inputs + outputs) * 2 - outputs$, for the second hidden layer $(inputs + outputs) * 2 - outputs$, where $inputs$ are the number of the neural network inputs, and the $outputs$ are the number of outputs (in our case - 1, since it is necessary to receive the unique predicted value of the next day withdrawals).

As the activation functions of the hidden layers neurons and the output functions we select the hyperbolic tangent.

The problem to select the network architecture has been solved experimentally in a medium Matlab. For different input data sets the different architecture MNS have been generated. The described above architecture had the smallest margin in the test sample