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Research Article

ARTIFICIAL NEURAL NETWORK AND THEIR APPLICATION IN THE PREDICTION OF ABSENTEEISM AT WORK

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ABSTRACT

The high competitiveness in the market, professional development combined with the development of organizations and the pressure to reach increasingly audacious goals, create increasingly overburdened employees and end up acquiring some disturbance in the state of health related to the type of work activity, including depression considered the evil of the 21st century. Taking employees to absenteeism. Absenteeism is defined as absence to work as expected, represents for the company the loss of productivity and quality of work. The purpose of this paper was to apply an artificial neural networks to prediction of absenteeism at work. The database used in the experiment has 38 attributes and 2,243 records from documents that prove that they are absent from work and was collected from January 2008 to December 2016. The methodological synthesis of the paper consists of the modeling of an Artificial Neural Network (ANN), the 38 attributes were reduced to 17 attributes through the Rough Sets, these attributes were used in the experiments to prediction of absenteeism. ANN they are models consisting of simple processing units, called artificial neurons, these models are inspired by the structure of the brain and aim to simulate human behavior, such as learning, association, generalization and abstraction when submitted to training. The experiments with the ANN presented the expected results in prediction of absenteeism at work. Therefore, it is concluded that the ANN can be applied in the prediction of absenteeism at work and in other problems similar to that presented in this paper.

INTRODUCTION

Absenteeism is considered the absence of an employee in his work environment and can be defined as temporary incapacity to work (Johns, 2003; Johns, 2008; Johns, 2010; Addae, Johns, & Boies, 2013; Miraglia & Johns, 2015). Most research on the causes of absenteeism has focused on individual characteristics such as attitudes, experiences, personal profiles and illness. However, in recent years, research has revealed the strong impact of the social context in the domain of absenteeism with influenced levels of analysis as high as nations, societies and social classes (Russo, Miraglia, Borgogni & Johns, 2013). In this way, the study of absenteeism transcends the work environment. It was also observed that co-workers influence the absentee behavior (Brummelhuis, Johns, Lyons & Hoeven, 2016). In this context, the prediction of absenteeism becomes important in decision making avoiding loss of productivity and quality at work (Martiniano, Ferreira, Affonso & Sassi, 2012).
Artificial Neural Networks are models inspired by the structure of the brain to simulate human behavior in processes such as learning, adaptation, association, fault tolerance, generalization and abstraction when submitted to training (Haykin, 1999).

In these networks, learning takes place through a set of simple processing units called artificial neurons. An important feature of artificial neural networks is their ability to learn from incomplete and subject to noise. In a conventional computing system, if a part fails, in general the system as a whole deteriorates, whereas in artificial neural networks, fault tolerance is part of the architecture due to its distributed nature of processing. If a neuron fails, its erroneous output is overwritten by the correct outputs of its neighboring elements. Thus, at first, an artificial neural networks exhibits a smooth degradation of performance rather than a catastrophic failure (Haykin, 1999). The advantage of ANN includes their high tolerance for noisy data, as well as their ability to classify patterns in which they have not been trained. Artificial neural networks can be used when there is little knowledge of the relationships between attributes, classes, are suitable for continuous value inputs, and outputs, unlike most algorithms,

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are successful in a wide variety of real world problems, including classification (Affonso, Rossi, Vieira & Carvalho, 2017), and prediction (Ferreira, Martiniano, Ferreira, Ferreira & Sassi, 2016). In addition, parallelization techniques can be used to accelerate the computational process, several techniques have been recently developed for the extraction of rules from trained artificial neural networks. These factors contribute to the usefulness of artificial neural networks for numerical classification and prediction (Haykin, 1999).

Tkác & Verner (2016) present in their study two decades of research in artificial neural networks applied in business. The survey covers 37 periodicals and business-related areas ranging from auditing and accounting to marketing. Currently, there is great interest in the models of artificial neural networks to solve unconventional problems, in recent years artificial neural networks have emerged as an alternative for numerous applications in several areas of knowledge.

The Rough Sets Theory was proposed by Zdzislaw Pawlak in 1982 (Pawlak, 1982) as a mathematical model to represent knowledge and to treat uncertainty. An important concept in Rough Sets is the reduct. A reduct is a minimal set of attributes that can represent an object with the same accuracy as the original set of attributes. Elimination of redundant attributes can help in the identification of strong, non-redundant classification rules (Jensen, 2005). The purpose of this paper was to apply an artificial neural network to prediction of absenteeism at work.

METHODOLOGY

The database used in the experiment has 38 attributes and 2,243 records from documents that prove that they are absent from work and was collected from January 2008 to December 2016. The 38 attributes were reduced through the Rough Sets to 17 attributes used to compose the database in the experiment are presented below: reason for absenteeism through the international classification of diseases, and reasons for absenteeism not ascertained by the international classification of diseases (Medical follow-up allowance, medical or dental consultation, physical examination and physiotherapy). The International Classification of Diseases and Related Health Problems also known as International Classification of Diseases (ICD 10) is published by the World Health Organization (WHO) and aims to standardize the coding of diseases and other problems related to health. ICD 10 provides codes relating to the classification of diseases and a wide variety of signs, symptoms, abnormalities, complaints, social circumstances and external causes for injury or illness. Each health status is assigned a unique category to which an ICD 10 corresponds (WHO, 2017).

The others attributes are: code of name, frequency of individual absenteeism, day of the week, month, absenteeism per month, absenteeism time in days and hours, service time in year, Years of age, months and days, number of children, achievement of work goals, monthly workload, daily workload, medical and hospital expenses. The Figure 1 shows the experimental method. The database was divided into two parts one for training with 60% or 1,346 records and another with 40% or 897 records.

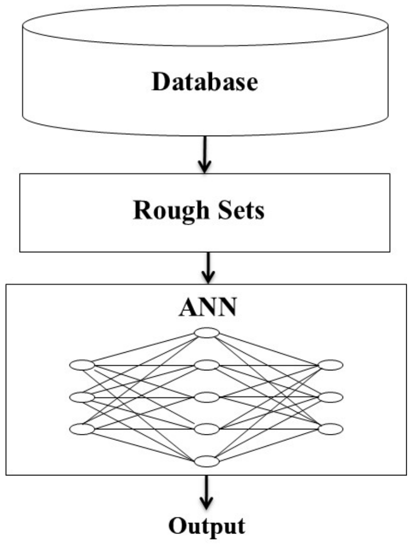

Figure 1 Experimental method.

The parameters used in the artificial neural network were number of input neurons equal to 17, number of hidden layers equal to 2, number of neurons in the hidden layer equal to 10, initial rate of learning equal to 0.7 with decay of 1% every 100 epochs, initial moment factor equal to 0.7 with decay of 1% every 100 epochs, the criterion of stop was the maximum number of epochs equal to 1,000. The training of the ANN was in sequential and time processing time was 65 seconds. The output of the ANN was the prediction of absenteeism quantified on days.

RESULTS AND DISCUSSION

Figure 2 shows ANN performance in the training phase. The x-axis represents 1,346 records. The y-axis represents the curves of training (Desired output and Network output).

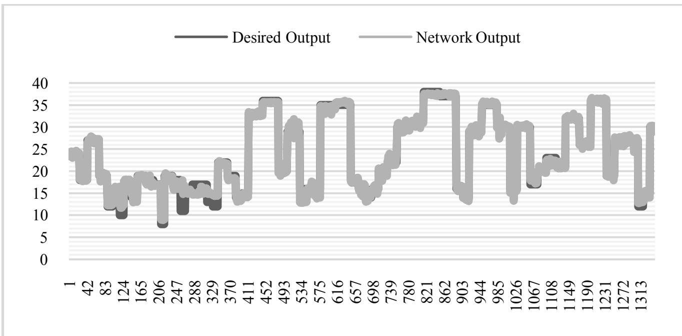

Figure 2 ANN performance in the training phase.

Figure 3 shows ANN performance in the test phase. The mean error in the prediction of absenteeism was 0.95, the minimum error was 0.001 and the maximum error was 8.79 days in the test phase of the ANN. The x-axis represents 897 records. The y-axis represents the curves of test (Desired output and Network output).

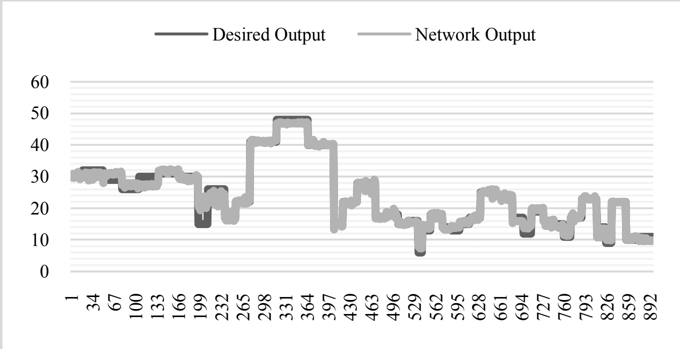

Figure 3 ANN performance in the test phase.

Figure 4 shows the Root Mean Square error during the training (0.0176) and testing (0.0198). The x-axis represents the 1,000 epochs. The y-axis represents the curves of training and testing errors.

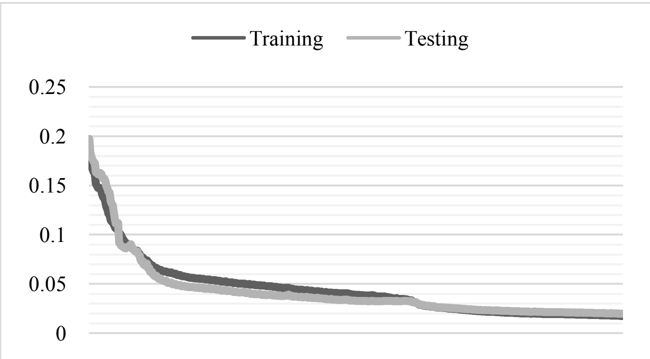

Figure 4 Root Mean Square error during the training and testing.

Table 1 shows the weights from the input layer (17 inputs).

Table 1 Weights from the input layer.

To the 1th hidden layer	bias	1th neuron	2th neuron	3th neuron	4th neuron	5th neuron	6th neuron	7th neuron	8th neuron	9th neuron	10th neuron	11th neuron	12th neuron	13th neuron	14th neuron	15th neuron	16th neuron	17th neuron
1th neuron	-312.799	-0.0495615	0.153808	-0.332975	-716.964	110.094	-0.0264256	0.374954	0.0578599	0.0254127	-213.919	-335.992	-218.019	0.454466	0.113477	675.079	0.110026	0.656399
2th neuron	-0.77516	-0.0318017	-0.0201647	124.226	133.435	-123.664	-0.0344765	0.497801	0.0703842	-0.259593	-0.0529664	-489.331	-138.188	0.427892	0.00665603	0.701199	0.0832661	-121.264
3th neuron	-312.992	0.136646	-0.152998	0.524452	-303.573	544.965	0.162548	0.656399	0.0845093	-0.736908	0.598553	0.484682	-0.54402	318.317	-0.0636819	-279.259	-0.533227	355.194
4th neuron	163.948	-0.127492	0.022097	-0.598021	-239.987	-387.111	-0.208502	0.0800596	-0.174507	0.0499237	-0.347924	-122.571	-198.448	-64.776	0.566026	-449.444	115.307	-192.568
5th neuron	-348.268	0.0102995	0.119677	0.11137	187.626	-241.103	0.106182	0.0923066	0.0450819	0.358992	0.0259921	-256.167	116.583	0.688727	-0.049405	0.265505	-0.109905	-483.265
6th neuron	-343.545	0.344493	-0.155846	197.516	126.444	-0.695088	0.143958	0.48578	-0.0149295	-106.878	-102.718	90.577	-283.249	434.642	-0.0481414	0.458286	-0.678616	0.58883
7th neuron	0.0393206	-0.0882415	0.0468686	0.0441529	-405.165	402.718	-0.157124	-0.380704	-0.249523	0.109176	-0.713377	-320.199	-0.00348757	-363.004	0.0681792	0.240365	0.576908	122.589
8th neuron	-82.485	-0.0466568	0.0573985	234.172	-230.037	123.558	0.10155	111.182	0.349122	0.448933	-0.262794	0.651534	130.287	107.814	0.099503	120.223	-0.0147834	0.658545
9th neuron	20.402	-0.071267	-0.129243	-0.643199	-99.297	-521.301	-0.0380236	0.211743	-0.0967401	-0.476736	-0.227016	-883.643	-499.845	-0.447334	-0.0307292	-0.114129	0.150244	0.280369
10th neuron	-166.109	0.028848	-0.0239706	0.352465	0.749481	-0.945465	0.010483	0.83032	0.0312899	-0.74046	-0.0998267	-0.973223	-484.534	0.763793	-0.0420182	0.265928	-0.118018	0.115899

The experiments presented in this section were elaborated, executed and tested during four months.

CONCLUSIONS

The study shows that it is possible to the prediction absenteeism apply an artificial neural networks, it was possible to reduce the number of attributes with the Rough Sets and still obtain a good result in the predictions of absenteeism at work, so it is concluded that the purpose of the paper was reached, in previous experiments the large number of attributes made it difficult to solve the prediction of absenteeism at work, in addition to increasing the computational cost. As future studies intends to carry out the validation phase of the experiment with the artificial neural network, it is also intended to the prediction absenteeism at work weekly and monthly.

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