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THE USE OF NEURO-MARKETING IN MANAGEMENT

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Abstract:
In the present era, in many cases, machines have been replaced by humans, and much of the physical work done by humans in the past is carried out by machines today. Although the power of computers in information storage and retrieval, office automation, and so on is undeniable, there are still some issues that the human has to do work itself. However, in general, machine-related items include systems in which, due to the complicated relationship between components, the human brain is incapable of understanding the mathematics of these relationships. The human brain can, over time, detect system habits, to some extent, by observing the sequence of system behavior and sometimes testing a result obtained by manipulating one of the system components. This learning process leads to the acquisition of experience by observing a variety of examples from the system. In such systems, the brain is not capable of analyzing the internal system and only estimates and predicts the internal system performance due to external behavior. One of the critical research issues in the field of computer science is the implementation of a model similar to the human brain's internal system for analyzing various systems based on experience. In this regard, neural networks are one of the most active areas of research in contemporary times, attracting many individuals from various scientific fields. The use of neural networks in solving complex application problems has become more and more common these days. In this paper, after a brief introduction of neural networks and genetic algorithms, their relationship and contribution to marketing and business are taken into account.

Keywords: marketing, neural networks, genetic algorithm, artificial intelligence

1. Introduction

Considering the use of artificial intelligence techniques and modeling tools in the business field is increasingly growing. In this regard, expert systems have found a

special place. In the last few decades, the two categories of neural networks and genetic algorithms have attracted many academics' attention. Both are known and used as a powerful tool in solving problems that were no longer solvable by traditional methodologies and methods of the past. These days, their use has also been extended to our social life where their application to decision making plays a vital role. This paper presents evidence based on the ethical use of neural networks and genetic algorithms that lead to successful decisions about business-related issues. For this purpose, it is required to conduct a comparative study on other researchers' efforts in the form of the subject literature.

For this reason, in our research, it is focused on the role of operational researchers in the field of the application of neural networks and genetic algorithms. Also, along with the creation of such a base for researchers, the following fundamental questions have been answered as well:

1) Can applications of Artificial Intelligence-based systems support your marketing?
2) Are any valid documents and evidence available to prove this claim?
3) Is this only considered as a university theory and idea, or is it also applicable and generalizable?

In other words, given similar studies regarding the use of expert systems in business, writers and researchers are hoping to get an opportunity for a comparative discussion about these three intelligent methodologies (Metakisius and Pesaras, 2003). One of the most essential and controversial research is the study by Leibautz (2001), the result of which was posted as "expert systems and their application."

2. Research Background

Neural network marketing is a new and emerging field that connects consumer's behavior with neuroscience. Harvard psychologists first created the concept of neural network marketing in 1990. In fact, since the beginning of the 1990s and with the help of simulation technique of two American and British physicians named Paul Lauterbur and Peter Mansfield, Neural Network Marketing Concepts were launched. On the other hand, in 2002, some US companies, such as Bright House and Sales Brain, were the first that offered neuro-marketing services and consulting services for the use of technology and knowledge in cognitive neuroscience. The first neuro-marketing research was conducted by Professor Reed Montag, a professor of Neuroscience at Baylor Medical University in 2003, which was published at Specialized and International Symposium on the use of Neuron Neuro-Marketing Simulation. The researcher asked a group of individuals to drink Pepsi and Coca-Cola while an imaging device scanned their brain in order to view and compare their brain transactions to examine what brain transactions are available for consumers while drinking Pepsi and Coca-Cola and to compare these transactions for measuring performance and comparing these brands. Neural networks like nervous systems of animals are composed of interconnected neurons that are capable of processing or modifying information. Despite very desirable

dimensions of neural networks, creating a good network for a particular application is very important. Creating an optimal network, choosing an appropriate architecture, number of layers, number of units per layer, relationships between units, selecting conversion functions of central units into simple ones, and designing the algorithm of selecting primary weights mainly include the Law of Stop. Neural networks are used for a comprehensive set of business issues, and this technique is mainly applied in accounting and finance. Different studies have shown that neural networks have a better performance than traditional statistical techniques such as multivariate regression and are appropriate for a large and varied set of issues like many machine learning techniques. In general, in terms of accuracy, neural networks are superior to linear techniques, and although they are subject to description restrictions, they have several advantages in terms of the ability of learning, flexibility, adaptation and knowledge coverage.

3. Neural Network Technology

Neural Networks is an information processing technique based on the method of biological nervous systems such as brain and information processing. The fundamental concept of neural networks is the information processing system structure that consists of a large number of processing units (neurons) associated with the networks. A living nerve cell or neuron is a unit making the nervous system in humans. A neuron is composed of the following main parts:

- A cell body where the nucleus is located and other cell parts are derived from it.
- A nucleus.
- An axon, task of which is to transfer information from the nerve cell.
- Dendrites, the task of which is to transfer information from other cells to the nerve cell.

A neural network system makes use of techniques applied by humans in learning by citing problem-solving examples (Haykin, 1994). Each neuron accepts numerous inputs that get together in some way. If at any moment, the number of active neuron inputs reaches enough, the neuron will also get active and ignited. Otherwise, the neuron remains inactive and calm. The activity of each neuron consists of one or more inputs, operations, and the output task to compute its outputs. The essential performance of this model is based on collecting inputs and, consequently, creating an output. Neuron inputs are entered through dendrites that are connected to the output of other neurons via a synapse. The cell body receives all these inputs, and if the sum of these values gets more than the amount called threshold, it will be so-called excited or ignited; otherwise, the output of the neuron will be turned on or off.

Today, neural networks are used in a variety of applications such as data classification and pattern recognition through a learning process that includes issues such as line recognition, speech recognition, and image processing. Like biological systems, training involves setting the links between synapses that exist in each neuron. In other words, learned information is stored in the form of numerical values called

"weight" which is assigned to each network processing unit. In general, neural networks can distinguish between neuron connection methods, a variety of special methods for calculating neuron operations, the transferring method of operation pattern through the network, and their learning methods, including learning rates. Considering the relationships between neurons, one can distinguish between layered and non-layered networks. Layered networks are a group of neurons that are gathered in layers and contain one or more hidden layers between the input and output layers - which only have an external link. Input data from the input layer is transmitted by hidden layers (middle layer) to the output layer. Current signals move forward in the layered networks, which are called "feed forward" in technical terms, while non-layered networks have additional feedback nodes that prevent proper divisions of the layers. The structure of links, contacts, and the number of layers and neurons determine the network architecture that needs to be set before using neural networks. Although in some instances, one-layer neural networks can be used successfully, the principle is that neural networks should have at least three layers (input layer, hidden or middle layer, and output layer). Before the network is trained, small propriety weights are valued randomly. During the training process, the network weights are gradually moderated to the point where it is established that the relationships are fully learned. This form of learning is called supervised learning. When a pattern is applied to the input layer, it moves forward so that the final output is calculated in the output layer. The network output is compared with expected favorable results of the model, and the possible errors are calculated. These errors are returned to the network as feedback to make necessary changes to the weights of links for reducing the error. A set of input-output training examples is provided repeatedly to the extent that the total error rates are reduced to an acceptable level. In this position, the network can be considered as a trained network. However, in another method, called unsupervised learning, the neural network should do the training work without the help of the world.

The fact is that, in practice, the supervised learning method or combined methods are used, and the unsupervised training process, in the pure form, is the only promise that may be implemented in the future. At present and in advanced applications, the unsupervised training method is used to create initial settings on the input signals of neural networks, and the remaining training steps proceed with the supervised method.

Neural network application areas are as follows:

- Unknown correlation between desirable characteristics and the value of variables of decision-making problems (where the solution to problems is unknown).
- Problems that have no algorithm solutions.
- Where incomplete data are available.

The main advantage of neural networks is their extraordinary ability to learn, as well as their sustainability against insignificant input disturbances (Faust, 1994). For example, if we use common methods to detect human handwriting, these methods may result in a false detection due to a slight handshake, while a neural network that is trained properly, even in the event of such a disturbance, will reach a correct response.

As a result, our emphasis is on the fact that choosing the right network with correct calculations is considered as the critical factor in ensuring performance success.

4. Genetic Algorithm Technology

Genetic algorithms have provided a powerful method for explorative development of large-scale combined optimization problems. The main motive for proposing a genetic algorithm can be described that "gradual evolution" can be emerged in a significant way in the development of complex types through relatively simple supplementary mechanisms. Now, the fundamental question is: accepting which idea of gradual evolution theory can help us solve the problems of this realm? This question has different answers considering the richness of the gradual evolution phenomenon. Holland and De Jong (1975) are the first who attempted to answer the question by introducing the concept of a genetic algorithm as a general search technique - which models a gradual biological evolution in the form of survival of the fittest individuals and structured as well as the random exchange of information. A genetic algorithm encodes a problem as a set of strings that contains fine particles; then makes changes to strings to stimulate the gradual evolution process. Compared to local search algorithms, in the public search which only an acceptable solution is available, genetic algorithms consider a community of individuals. Working with a set of individuals makes the possibility of studying the basic structures and characteristics of different individuals that lead to the identification and discovery of more efficient solutions. During the study, the genetic algorithm selects valuable strings and eliminates the strings that are less proportionate to the studied population.

5. A review of business applications

After reviewing the history of neural networks, genetic algorithms, and their advancements, their functional areas can be identified in the business. So here, we will consider a variety of business problems that can be solved appropriately by neural networks and genetic algorithms. However, before that, we will give a brief explanation of topics related to this area.

From a management perspective, "American Marketing Association" defines marketing as follows: Marketing is a social and managerial process by which individuals and groups meet their needs and desires through the production, supply, and exchange of useful and valuable goods with others. In general, marketing is unknown knowledge which can be identified by features such as high uncertainty, lost casual structure and incomplete as well as extensive knowledge. Some decision-making and problem-solving tasks are carried out in an unstructured or semi-structured way. For these reasons, developing the use of neural networks and genetic algorithms in marketing is more complicated than other fields of science.

In 1991, Cary and Matin Ho discussed the role of artificial intelligence in marketing and analyzed competitive positioning through a target-oriented

methodology. Ellis et al. in 1991 provided how to use neural network technology in confronting with tensile pricing strategy, while Procter in 1992 displayed how to use neural network technology in learning marketing data models and their role in building marketing decision support systems. In 1993, Cary and Matin Ho used neural network technology in modeling consumer's reaction to advertising stimulus. Ray et al. in 1994 used neural networks to quantify factors affecting the quality of buyer and seller relationships. For this purpose, a network with two output elements of the quality of relationships (satisfaction of relationships and trust) and five inputs (seller's sale trend, customer orientation, expertise, ethics, and durability of relationships) were formed. In comparison with multivariate regressions, the neural network technique achieved more acceptable statistical results.

On the other hand, Harley et al. (1994) tested the use of genetic algorithms in solving marketing optimization problems. Based on their study, the potential applications of genetic algorithms in marketing can include the following:

A. Consumer's Behavior:

- Learning consumer choice models;
- Consumer information processing;
- Impact of reference groups.

B. Segmentation, Target Market Selection, Positioning:

- Optimization of product structures – market;
- Analysis of crucial purchasing factors;
- Product positioning.

C. Management of Mix Marketing Elements:

- Product life cycle optimization;
- Product design;
- Advertising strategy and media planning;
- Sales Management.

Green and Smith (1987) presented a genetic system for learning consumer choice models, and Tang and Hollack (1992) presented a conceptual framework for linking marketing concepts with the gradual evolution mechanism of Darwin. In 1992, Ballack Richman and Jakob provided a genetic algorithm based on a decision-making support system for the product design. On the other hand, Van Gopal and Bates (1994) used the share of neural networks and statistical techniques in marketing research. In the end, we can report current developments in this field as follows.

- Stratex, a knowledge system to aimed to support the selection of market segments (Burch and Hartwigson, 1991).
- Adduce, a system to justify the consumer reaction to advertising (Barak, 1991).
- Comstrat, a system for strategic marketing decisions with special emphasis on competitive positioning (Matin Ho et al. 1993).
- Maestro, a network intelligence system for developing marketing strategies and assessing strategic marketing factors (Lee, 2000).
- Glostra, a network intelligence system for developing and improving global marketing strategies and internet marketing (Lee and Davis, 1200).

6. Neural networks and financial areas

Major applications of neural networks and genetic algorithms in banking and financial issues can be referred to as credit applications, financial analysis, financial investment, and stock exchange market analysis. Many researchers have examined the applications of neural networks and genetic algorithms in banking and finance. In 1993, Tafti and Nikbakht discussed the use of neural networks by financial organizations and companies for different purposes of credit scoring. Tan and De Hardjou (2001) developed an essential study on using neural networks to predict financial stresses in Australian credit unions through the increased time and period of the model prediction. The achievement compared to the results obtained from the mean deviation was acceptable. In 1996, Davies et al. also examined the attitudes of ATM systems based on the analysis of neural networks.

On the other hand, the identification of various applications of genetic algorithms by different individuals is presented as follows: selection of multilateral monopolistic market strategies (Marquez, 1989), development of financial investment strategies (Baver, 1994), search for finding technical rules for their actions in the capital market (Karjalienen, 1994), risk analysis in banking (Varto, 1998). Also, in 1999, Karjalainen and Allen used genetic algorithms to find special business rules. At the same time, Andra et al. (1999) used genetic algorithms for technical analysis of the stock market in Madrid.

Other financial systems based on neural networks and genetic algorithms can be referred to:

- Kabal, a knowledge system for financial analysis in banking (Hart Vigsson, 1990).
- Credex - a system for evaluating credits (Pinson, 1990).
- Fineva, a multi-criteria knowledge system supporting decision making to assess the company's performance and life-capability (Zopony Diss, 1996).

7. Prediction

The prediction has been one of the oldest activities and tasks of marketing and business. In the old days, there are examples of foretelling and predictions. In general, a manager who has a high visualization power in decision making and judgment can be successful. Experiences help humans predict the future, select the right decision and give the right vote. Artificial intelligence methods have shown a high ability to predict and provide better performance in dealing with nonlinear problems and other time series modeling problems. Rahman and Bohtnegar (1997) used a neural network in combination with a regulated expert system for this purpose in Taiwan. Also, Conlon and James' research (1998) showed that a relationship between the features of financial assets and the value of business assets could be made in a particular market, and it can reach a valuation model that makes short-term predictions of valuation fluctuations in the use of neural

networks. Finally, studies show that in this area more work is done on the use of neural networks than genetic algorithms.

8. Other Business Areas

So far, we have talked about various applications of neural networks and genetic algorithms in key business sectors: marketing, banking, finance, and forecasting. There are certainly other areas of business that can take advantage of the benefits of using neural networks and genetic algorithms at different sizes. For example, it can be referred to the use of neural networks in hotel industry (Love, 1998), asset valuation (Lank et al., 1997) and inflation forecast (Icon, 1999). Also, it is quite evident that there are sectors (such as production, heavy industry, energy, construction) that are far away from our site.

9. Advantages of using artificial intelligence technologies

By consensus review of existing theories and research, the benefits of using artificial intelligence technologies and genetic algorithms can be summarized in the form of following statements:

- Providing better customer service.
- Reducing the completion time and completing the tasks.
- Increasing production.
- I am using resources more effectively.
- More consistency and stability in decision making.

10. Application of artificial intelligence in modern management

The use of artificial intelligence software has increased rapidly to help managers in supervision and decision-making planning. Managers have found that computer and its accessories enable them to study quickly different methods of short and long-term planning. Moreover, when they see that rivals take advantage of modeling successfully; they also react for survival. The power of artificial intelligence to track millions of exchanges, operations and reports of standard deviations has made it a necessity to use. Modern management should not be intimidated by the attraction and influx of terminology of computer specialists and commercial agents. This is the primary responsibility of modern management that needs to be trained enough about computer systems, be able to seek other methods by raising exploratory questions, and also brings up economic and non-economic justification for equipment purchases and employee recruitment.

11. Conclusion

In this paper, we have tried to indicate the next dimension of trade and business area by introducing the applications of neural network and genetic algorithms in the field of

marketing. The final result of these discussions will lead to the diversity of applied domains that refer to the benefits and advantages of neural networks and genetic algorithms. Today, the two technologies are more and more used as decision-making tools of organizations that of course, the results of their application (such as correct decisions, time-saving, flexibility, improved quality, and practical training) have added to their popularity. We believe that if these technologies are combined with other intelligent technologies (such as expert systems, intelligent agents, and fuzzy logic) and research techniques in operations, especially simulation, we can add to their use in different areas day by day and benefit from them. Based on library research, it is recommended to study the benefits of using genetic algorithms in optimizing marketing issues as well as comparing the use of neural networks, genetic algorithms, and expert systems to identify the advantages and disadvantages of each of these technologies for future research.

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