The use of a neural network model for the analysis of tourism development in the regions of the country

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Abstract. Neurocomputer and neural network technologies are one of the most effective artificial intelligence strategies. A neural network model has been developed, designed to assess the prospects of tourism development in certain regions of the Russian Federation. In particular, the Krasnodar Territory was chosen for analysis as one of the most popular resorts in terms of the level of domestic tourism development. Using the neural network model built in Matlab, the impact of individual economic indicators on the number of tourist visits to this resort was evaluated. This kind of analytical activity is important for adjusting regional policies in the field of tourism and recreational activities and will allow relevant experts to improve the quality of management decisions and strategies being developed. Thus, the competitiveness of the regions increases and a new approach to the development of the recreational sphere is introduced.

1. Introduction

Neurocomputer and neural network technologies are one of the most effective artificial intelligence strategies [1, 2, 3, 4, 5]. Neural networks are implemented according to the principles of construction and the functioning of the human brain. Knowledge in them is not laid down initially, but is acquired automatically during training on examples characterizing the subject area [6, 7, 8, 9, 10]. Neural networks and neurocomputers inherit from its prototype - the brain its useful properties: the ability to extract knowledge from statistical data, the ability to generalize them in the form of laws and patterns of subject areas, the property of intuition as the ability to make correct conclusions and make predictions in cases where ordinary logic is powerless [11, 12, 13, 14, 15].

2. Materials and methods

In the paper, there were used general scientific and special research methods to solve mentioned aim. There are graphical analysis, statistic, techno-economic, expert estimation method. It was studied theoretical and applied papers on the research topic [1-39], also official statistics data. For developing the neural network used Matlab and Nnstar module.
3. Results
As experience has convincingly shown, well-designed and properly trained neural networks are able to independently reveal the laws of nature and society, the laws of business processes, economic, political, social and other kinds of phenomena, to identify the relationships and patterns of subject areas and lay them in mathematical computer models [16, 17, 18, 19, 20]. Neural network mathematical models are able to take into account a large number of factors affecting the simulation result, which is just a characteristic feature of problems arising in the fields of recreation and service. At the same time, neural networks do not require large amounts of statistical information about subject areas, which is typical for alternative regression models [21, 22, 23, 24, 25].

When constructing a mathematical model of a neural network, designed to analyze the development of the recreational sphere of individual regions of the country, various data and statistics in this area were analyzed.

Table 1 presents indicators of the level of income of collective accommodation facilities, investments in fixed assets, the amount of cash income and the number of vacationers in the Krasnodar Territory for 2005-2019

| Year | Revenues of collective accommodation facilities, thnd rub. | Investments in fixed assets, in actual prices, mln rub. | The total cash income of the population of the Russian Federation, mln rubl. | Per capita cash income of the population of the Russian Federation, rub. | Number of vacationers, mln |
|------|----------------------------------------------------------|--------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------|
| 2005 | 18012084                                                 | 113917,00                                              | 13818974                                                          | 8088,3                                                             | 10                       |
| 2006 | 21267743                                                 | 152080,00                                              | 17290064                                                          | 10154,8                                                            | 12                       |
| 2007 | 25481043                                                 | 229714,00                                              | 21311451                                                          | 12540,2                                                            | 13,3                     |
| 2008 | 29494337                                                 | 332532,00                                              | 25244046                                                          | 14863,6                                                            | 16                       |
| 2009 | 29177075                                                 | 377013,00                                              | 28697484                                                          | 16895,0                                                            | 12,1                     |
| 2010 | 31030564                                                 | 492733,00                                              | 32498283                                                          | 18958,4                                                            | 10,6                     |
| 2011 | 32961127                                                 | 676200,00                                              | 35648673                                                          | 20780,0                                                            | 11,1                     |
| 2012 | 36329996                                                 | 658081,10                                              | 39903672                                                          | 23221,1                                                            | 11,9                     |
| 2013 | 38769019                                                 | 791014,43                                              | 44650448                                                          | 25928,2                                                            | 11,8                     |
| 2014 | 52027401                                                 | 689854,12                                              | 47920651                                                          | 27767,0                                                            | 13,8                     |
| 2015 | 47142475                                                 | 540940,76                                              | 53202900                                                          | 30311,0                                                            | 14,1                     |
| 2016 | 48184353                                                 | 923477532                                              | 54325375                                                          | 30539,5                                                            | 16,2                     |
| 2017 | 50853787                                                 | 96237543                                              | 56205132                                                          | 31325,0                                                            | 16,2                     |
| 2018 | 53384498                                                 | 10074332                                              | 58458754                                                          | 33511,5                                                            | 16,9                     |
| 2019 | 55953543                                                 | 10486342                                              | 62080116                                                          | 35115,2                                                            | 17,3                     |

The region has a favorable economic and geographical position, has favorable agro-climatic, natural and cultural-recreational resources, which provides a solid basis for the development of hotel-tourist and tourist-recreational activities [26, 27, 28, 29].

Among the opportunities it should be noted the possibility of the region joining international transport corridors, the use of innovative technologies, attracting investment in the economy, as well as the growing interest of Russian and foreign tourists in the resorts of the Krasnodar Territory. All these
advantages allow the region to use in the future a model of sustainable tourism development as an approach that ensures long-term growth and development of the economy, social sphere and ecology. At the same time, there are weaknesses that impede the development of its economy.

Among the unresolved issues that hinder the development of the sanatorium and resort complex of the region are:
- the need for investment in research and improving the environmental situation in resorts;
- improvement of beaches and surrounding areas;
- lack of efficiency in the use of natural resources;
- insufficient level of training and qualification of specialists of tourist and sanatorium complexes;
- seasonality of the enterprises of the tourist and sanatorium complex;
- underdeveloped engineering and transport infrastructure

To develop a neural network, the Nnstart tool of Matlab was used. For the neural network, the Bayesian regularization algorithm was used. Network learning results are presented in the figure.

Revenues of collective accommodation facilities, investments in fixed assets, the total cash income of the population of the Russian Federation, per capita cash income of the population of the Russian Federation were used as input data for the neural network [36, 37, 38, 39]. Number of vacationers was used as output data. To forecast the data, we used the sim command and indicated the data for 2020. A graphical analysis of the regression in Matlab is presented in the Figure 1 and 2.

sim (net,[58.753375;10.875642;65.755965;3.52493]). As a result of the forecast, we get the number of vacationers in the Krasnodar Territory for 2020. i.e. 17.4 mln.

![Figure 1. A graphical analysis of regression in Matlab (training the network).](image-url)
The annually increasing tourist flow indicates interest in the region. However, there are few natural resources to keep a modern tourist, who is constantly looking for new travel experiences. Krasnodar Territory is a multinational region with a rich culture and history, which may be interesting for tourists. Therefore, in order for the Russian tourist to give preference to domestic resorts, and for foreign tourists the region becomes attractive and competitive, it is necessary not only to expand the infrastructure, but also to support its historical and cultural fund.

It is necessary to ensure the integrated development of the sanatorium and resort and tourist complex of the Krasnodar Territory by solving the following tasks:
- increase the investment attractiveness of the resorts of the Krasnodar Territory;
- ensure the year-round functioning of tourist facilities;
- increase the competitiveness of the spa and tourist complex of the Krasnodar Territory;
- develop tourist-recreational and auto tourist clusters based on the rational use of natural healing resources;
- apply advanced advertising and information technologies in the promotion of tourist services.

4. Conclusions
A neural network model has been developed, designed to assess the prospects of tourism development in certain regions of the Russian Federation. In particular, the Krasnodar Territory was chosen for analysis as one of the most popular resorts in terms of the level of domestic tourism development. Using the neural network model built in Matlab, the impact of individual economic indicators on the number of tourist visits to this resort was evaluated. This kind of analytical activity is important for adjusting regional policies in the field of tourism and recreational activities and will allow relevant experts to improve the quality of management decisions and strategies being developed. Thus, the competitiveness of the regions increases and a new approach to the development of the recreational sphere is introduced.
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