Forecast of the number of new patients and those who died from COVID-19 in Bahrain

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Abstract—A review of the COVID-19 pandemic in Bahrain has been conducted. Correlations between the parameters describing the coronavirus pandemic have been established. Partially lost data was supplemented by polynomial functions, as well as by linear approximation. The number of those who suffered and those who died from COVID-19 was predicted using SGTM neural-like structure topologies supervised mode.

Keywords—COVID-19, Bahrain, ANN, SGTM neural-like structure, forecast of the number of new patients, forecast those who died from COVID-19, matrix of correlations between parameters, linear approximation

I. INTRODUCTION

The COVID-19 pandemic in Bahrain is part of the 2019 global coronavirus pandemic (COVID-19) caused by severe acute coronavirus 2 respiratory syndrome (SARS-CoV-2). It was confirmed that the virus reached Bahrain on February 21, 2020. The decision to extend the restrictive measures in Bahrain that were introduced due to the danger of the further spread of coronavirus were made by the authorities of the kingdom on 22nd of April. The ban on the work of cinemas, sports facilities, hookah bars, restaurants was prolonged. Bahrain residents will continue to be required to wear masks in public.

Bahrain has set up an appropriate National Working Group, the Bahrain Team, to combat the spread of the COVID-19 virus and has taken steps to ensure the immediate installation of COVID-19 test agents. Bahrain has one of the highest COVID-19 disease revealed by testing rates, so that it was at first praised by the World Health Organization (WHO) for its professional response to this quickly-spreading illness. The Bahrain Kingdom is ready to take further action to avoid the spread of the virus. In addition, the Government of Bahrain provides support to individuals and companies through a comprehensive package of incentives for the economy which sums up to approximately 11.4 billion dollars.

Despite all seemingly responsible attitude to the well-being of its citizens, as a mini-state with direct ties to Saudi Arabia and indirectly to the United States, Bahrain viewed every internal, regional and global problem and threat, including the current pandemic, through an Iranian-Saudi-American prism. The COVID pandemic has highlighted economic, social, and religious issues in the country that the ruling family has been unable to resolve, and often exacerbated in recent years. Moreover, migrant workers - mainly from India, Bangladesh, Pakistan and the Philippines – present nearly 40 percent of the total population. Apart from the skilled and semi-skilled Indian workers segment, the vast majority of migrant workers have low-paid jobs and are at the bottom of the economic ladder. They have no job security, suffer from inadequate medical care. Many of the migrant workers were unable to keep social distancing in their cramped apartments and were forced to go outside in search of food. Because they could not go to grocery stores or order food online, many of them had to beg for food due to insufficient food resources. Bahrain, like some of its neighbors, is said to soon face a day of reckoning in the post-COVID era with a lack of foreign workers who usually do most of the dirty work in the country that Bahraini people are unwilling to do. The coronavirus exposed the status and mistreatment of foreign workers in Bahrain. The unfortunate experience of some of these workers during the COVID lockdown will make them less likely to either stay...
in Bahrain or in neighboring countries to work after COVID-19 measures are loosened a bit. To add salt to the wound, Bahrein citizens do not fare much better than migrant workers during the lockdown.

Bahrain pandemic estimates are based on official statistics from the official resource [4]. The data file contains the following information. The blue streak below presents the time range that is being analyzed. On horizontal axis are situated numbers representing days since the number of people who suspected they got the COVID-19 decease and had it confirmed reached 30 cases a day. On vertical axis the researcher can spot data representing the number of confirmed COVID-19 cases per day.

II. MATERIALS AND METHODS

For short-term forecasts of different actuality, it is necessary to establish correlations between the parameters that describe the spread of COVID-19 in Bahrain. A matrix of correlations between parameters was constructed to demonstrate statistical data dependencies.

As can be summaried from Fig. 1 the largest one is the correlation between total_cases and total_tests (0.99). Also the correlation between total_cases and total_deaths is high and equal to 0.98. The correlation between total_tests and total_deaths is slightly lower and equal to 0.94. Such results can be explained quite easily. The more tests for COVID-19 are performed, the more patients are detected and the more confirmed deaths from this disease are recorded. However, there are other correlations. They can be seen on Fig. 2.

To predict, linear non-iterative SGTM neural-like structure was used [7,8]. Compared to other ANNs, this non-iterative neural network can operate in real time and make predictions with satisfactory accuracy [9, 10]. Its structure is shown in Fig. 3.

As the input of the SGTM, the vector of data was supplied. On the first neuron the first parameter at time i was given. On the second input there is a second parameter at time i given. The predicted parameter was removed from the output at time i + 1. In the next moment of time as the values of all parameters at the time i + 1 were given, the predicted values at the time i + 2 were removed from an output. The number of input neurons is equal to the number of input parameters. The number of neurons at the output is equal to 1, meaning the parameter that is being predicted. The number of neurons in the latent layer is selected experimentally by minimizing the RMS taking into account the range of possible error values. All statistics are divided into training and test sets. Approximately 2/3 of the data is
submitted for training purposes, and testing is carried out on 1/3 of the data.

III. RESULTS AND DISCUSSION

The short-term forecast of new cases of coronavirus infection in Bahrain was carried out by means of RBF SHNM shown in Fig. 4. On 4 inputs of the neural network parameters whose correlation with it exceeds 0.80 were provided. The parameters are listed in the order from the 1st to the 4th neuron: the total number of tests performed; total number of deaths; new tests smoothed; new confirmed cases (total_tests; total_deaths; new_tests_smoothed; new_cases).

It was also taken into account that the input data is partially lost. For a better prognosis using SGTM, it is necessary to restore this data. Two methods were used to restore total_tests. The first method is a polynomial of the second degree with the value of the approximation reliability of 0.998. The second method is a linear approximation between two adjacent known values. The results of supplementing the lost data are shown on Fig. 4 a) adding lost data (polynomial approximation); b) adding lost data (linear approximation).

A linear approximation was used to recover the lost data between two adjacent reliably known points new_tests and new_tests_per_thousand. The results of the addition of lost data are shown in Fig. 5.

Data from April 4, 2020 to August 18, 2020 submitted to the neural network input. Experimentally, the number of neurons of the latent layer was set to 4, the degree of the approximating polynomial – to 6. The criterion for assessing the halt of the learning process was the minimum average frame-reduced error. From the output of the SGTM the new cases of coronavirus infection in Bahrain predicted are removed at the next moment of time. In the RBF forecasting mode, the ANN forecast the following 12 values. The results of the forecast are presented on Figure 6. 137 vectors were used to train the neural network, and 19 were used for the short-term forecast.
The root mean square error (SQRlern) is 0.75%, and the forecast (SQRforecast) is 0.96%. The result of the short-term forecast suggests that the number of new cases of coronavirus infection in Bahrain is approaching its plateau.

The COVID-19 pandemic was an unexpected test for everyone in Bahrain. However, like in a number of other countries, the situation is being controlled. But more and more often people talk about a possible second wave. A new reason for the increase in the number of infections lies in the fact that a lot of people around the world have begun to travel again. Vacationers usually spend time in crowded places, do not take the pandemic seriously and attend parties, which increases the risk of infection.

For long-term prognosis for the next 68 days of the total cases covid-19, the method of time windows was used. Data from April 4, 2020 to August 30, 2020 was submitted to the neural network input. Experimentally, the number of neurons of the latent layer was set to 2, the degree of the approximating polynomial – to 4. The results of the forecast are presented on Figure 7.

The root mean square error (SQRlern) is 0.49%.

A short-term forecast of the number of new deaths was made. For this purpose new_cases and previous values of total_deaths were submitted to the RNF ANN. Data was submitted to the neural network input from March 17, 2020 (the date when the first patient died) to August 15, 2020. The neural network was tested for the next 22 days. The number of latent layer neurons was experimentally determined as 2 and degree of the approximating polynomial - 3. The results of the short-term prediction of the number of new deaths from COVID-19 in Bahrain are shown in Figure 8.

The root mean square error (SQRlern) is 0.64% and the forecast (SQRforecast) is 0.68%. The accuracy of forecasts is satisfactory. Given the results of short-term predictions of new infections and new deaths from coronavirus in Bahrain, the following conclusions can be made.

Despite the awaited second wave of coronavirus, the expected number of deaths in Bahrain still remains unchanged. This can be explained by a fact that, in principle, any virus is capable of mutating, (changing). Under a favorable scenario, it can become weaker because of its mutation - that is, less dangerous for people. For this, a significant part of the population must develop immunity to it. This “immunity development” may slowly be happening to the population of Bahrain.
A long-term forecast for the next 60 days of deaths from covid-19 was made. Data from April 17, 2020 to August 30, 2020 was submitted to the neural network input. Experimentally, the number of neurons of the latent layer was set to 2, the degree of the approximating polynomial to 6. The results of the forecast are presented on Figure 9. 164 vectors were used to train the neural network, and 70 were used for the forecast.

![Figure 9. Long-term prognosis for the next 60 days of deaths from COVID-19 in Bahrain a) in general, b) daily](image)

The root mean square error (SQRlern) is 0.76%. The accuracy of forecasts is satisfactory.

**CONCLUSION AND FUTURE WORK**

1. The use of non-iterative SGTM showed high accuracy of real-time short-term predictions

2. Despite the fact that the number of patients is decreasing, the number of deaths will be significant.

3. The number of patients with the crown virus is approaching its plateau.

There will be a local outbreak of coronavirus in the next 2 weeks. It will be short-lived and will reflect the cyclical nature of the pandemic. According to the results of the long-term prognosis, the number of coronavirus patients will be decreasing daily. At the end of October, it will be about 100 people a day.

The number of deaths from coronavirus on a daily basis will be slowly decreasing. There will be a slight increase in the number of deaths in mid-October. It will be the result of a cyclical outbreak of the disease.

The number of people living with coronavirus in the world is approaching 11 million, more than half a million have died from a new disease called COVID-19, and almost 6 million have recovered. In some cases, the disease is mildly affecting general health state. But doctors and scientists around the world are saying that in most cases, “victory” over the disease only means that the person has survived. But the consequences can be so severe that it will take weeks and months to fully recover. Because the new virus affects not only the lungs, but also the cardiovascular and digestive systems, and even the patient’s nervous system, leaving many people disabled.

The coronavirus outbreak (COVID-19) has already caused humanity suffering and significant economic shock. Bahrain’s declining output is being felt around the world, reflecting Bahrain’s growing role in global supply chains, as well as in the financial and tourism markets. Outbreaks in other parts of the world have similar effects, albeit on a smaller scale.

**REFERENCES**


