Symptoms of lung cancer using fuzzy cognitive MAPs(FCMs)-An analysis

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Abstract

Cancer is a disease which is caused by an uncontrolled division of abnormal cells in the part of the body. Since the cells in the tissue of lung grow abnormally, it is called malignant carcinoma. This malignant can spread beyond the lung by metastasis to the adjoining tissue (or) other parts. Lung cancer is one of the most common cancers in the word which has a huge number of diagnosed patients and cause most cancer death. Here we have proposed the most contributing impactful symptoms of lung cancer using FCMs. FCMs is a Fuzzy approach graph modelling based on specialist opinion. This is the non statistical approach to study the problem with general information.

Keywords

Fuzzy Cognitive Maps (FCMs) and symptoms of lung cancer.

AMS Subject Classification

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1. Introduction

Fuzzy cognitive map is powerful and useful tool for medical diagnosis. In fuzzy cognitive map, the relation between the nodes of a mental landscape can be used to evaluate strength of impact of these node. Fuzzy cognitive maps were introduced by Bart Kosko [4] in 1986. Fuzzy cognitive map is a soft computing technique which has been use to model simulate various and completely different areas. Fuzzy cognitive modelling approach is symbolic presenting abstract knowledge and is based on human expert. Vasantha Kandasamy and Florentin Smarandache has analysed the social aspects of migrant labour living with HIV/AIDS using fuzzy theory and Neutrosophic cognitive maps by Xiquan, Phoeniz [11]. After a number of authors [1, 4, 7–9] had studied the FCMs to find solution for various real life problems. By consulting we have collected the data's from patients in Thanjavur Cancer Care Research Centre. Lung cancer is due to the growth of uncontrolled and abnormal cells in one (or) both lung which lines the air passages. The growth of lung cancer is deeply associated with cigarette smoking approximately 90% of lung cancers is due to the use of tobacco. The tobacco smoke having more than 4,000 chemical compounds, many of which are cancer causing carcinogen. Lung cancer mainly affects older people rare in youngsters. The rising rates of lung cancer sharply related age and the most diagnosed patients caused by Lung cancer is 70 to 74 [2]. In all cancer the most commonly diagnosed cancer worldwide is lung which is 1.6 million, in 12.7% of the total cancer affected people. The most common causes of cancer death are lung cancer 1.38 million, in 18.2% of the total cancer affected people [5]. The American cancer society for lung cancer in the united states estimated that nearly about 2, 34,030 new cases of lung cancer (1, 21,680 in males & 1, 12,350 females) were reported in the year 2008 and about 1, 54, 050 deaths from lung cancer 83, 550 in male and 70,500 in female were reported in the same year [3]. The current study examined a contribution of symptoms and analyses the most impactful symptom of lung cancer using fuzzy cognitive maps.

2. Preliminaries

In this section, we recall some standard definitions from [10] which are very useful to this work.

Definition 2.1. *A FCM is a directed graph with concepts like polices, events etc., as nodes and casualties as edges. It represents casual relationships between concepts.*

Definition 2.2. *Consider the nodes/concepts $c_1, c_2, \ldots, c_n$ of the FCM. Suppose the directed graph is drawn using edge weight $e_{ij} \in \{-1, 0, 1\}$. The matrix E is defined by $E = \{e_{ij}\}$, where $\{e_{ij}\}$ is the weight of the directed graph c_i, c_j. E is called adjacency of FCM, also known as the connection matrix of the FCM. It is important to note that all matrices associated with an FCM are always square matrices with diagonal entries are zero.*

Definition 2.3. *An FCM is said to be cyclic if it has feedback.*

Definition 2.4. *Let $c_1 c_2, c_2 c_3, \ldots, c_i c_j$ be a cycle. When c_i is switched on if the casuality flows through the edges of the cycle and if it again causes c_i. We say that the dynamical system goes around and around. This is true for any node c_i for $i = 1, 2, \ldots, n$. The equilibrium state for this system is called the hidden pattern.*

Definition 2.5. *When there is a feedback in an FCM, that is, when the casual relations flow through a cycle in a revolutionary way, FCM is called dynamical system.*

Definition 2.6. *Let $c_1, c_2, \ldots, c_n$ be the nodes of the FCM. Let $c_1 c_2, c_2 c_3, \ldots, c_i c_j$ be the edges of the FCM. Then the edges form a directed cycle. An FCM is said to be cycle if it possesses a directed cyclic. An FCM is said to be acyclic if it does not possesses any directed cycle.*

Definition 2.7. *Let $c_1, c_2, \ldots, c_n$ be the nodes of the FCM. Let $A = \{a_1, a_2, \ldots, a_n\}$, where $a_i \in \{0, 1\}$. A is called instantaneous state neutrosophic vector and it denotes the on-off state position of the node at an instant*

$$a_i = 0 \quad if \quad a_i \quad is \text{ off (no effect)};$$
$$a_i = 1 \quad if \quad a_i \quad is \text{ on (has effect)}.$$

Definition 2.8. *When the nodes of the FCM are fuzzy sets, then they are called as fuzzy nodes.*

Definition 2.9. *Suppose $AE = \{a_1, a_2, \ldots, a_n\}$ is a vector which passed into dynamical system E, then $AE = \{a'_1, a'_2, \ldots, a'_n\}$ after upholding and updating vector. Suppose, we get $\{b'_1, b'_2, \ldots, b'_n\}$, denoted by $\{a'_1, a'_2, \ldots, a'_n\} \rightarrow \{b'_1, b'_2, \ldots, b'_n\}$. Thus the symbol $\rightarrow$ means that the resolvent vector has been threshold and updated.*

Definition 2.10. *A sequence of FCM states keeps repeating indefinitely. This sequence is known as a limit cycle.*

Algorithm approach in FCM

Step 1 Read the input vector $A(t)$.

Step 2 Given the connection matrix E.

Step 3 Calculate the output vector $O(t) = A(t) \star E$.

Step 4 Apply the threshold to output vector $O(t) = A(t+1)$.

Step 5 If $A(t+1) = A(t)$ Stop, else go to Step 1.

3. Methodology

To analyze the symptoms of lung cancer, we have discussed and interviewed with 100 patients both male and Female in different ages in Thanjavur Cancer Treatment Center, so we took the following characteristics with the experts' view.

C_1- Coughing especially if it persists or becomes intense.
C_2- Pain in the chest or back unrelated to pain from coughing.
C_3- Shortness of breath.
C_4- Harsh sounds with each breath.
C_5- Coughing up phlegm or mucus especially if it is tinged with blood.
C_6- Change in the voice or being hoarse.
C_7- Coughing up blood.

Performance of FCM model to the study

Based on the diagram of the experts' opinion is drawn as follows:
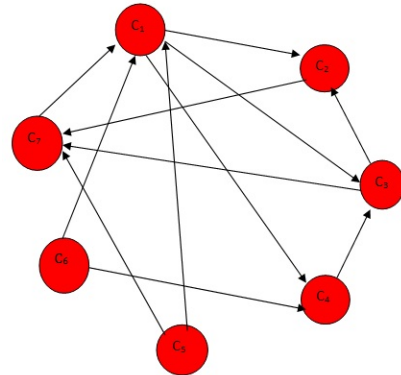
The corresponding directed matrix E is given as

$$E = \begin{pmatrix} 0 & 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

The cycle commences with the following vector:

Let us begin with the nodes C_7 is in the ON state i.e, coughing up blood and all other nodes are in the OFF state. Input vector

$$A_1 = (0000001).$$

The effect of A_1 on the dynamical system E is given by

$$A_1 \star E = (1000000)$$
$$\rightarrow (1000001) = A_2$$
$$A_2 \star E = (1111000)$$
$$\rightarrow (1111001) = A_3$$
$$A_3 \star E = (1221002)$$
$$\rightarrow (1111001) = A_4 = A_3,$$

where $\rightarrow$ corresponds to the threshold and the resulting state vector change.

The hidden pattern is the fixed point of (1111001) which implies that first, second, third fourth and seventh attributes come to ON state.

Let us start with the node C_3 is in the ON state i.e, Shortness of breath and all other nodes are in the OFF condition.

Let the input vector $B_2 = (0010000)$.

The effect of B_1 on the dynamical system E is given by

$$B_1 \star E = (0100001)$$
$$\rightarrow (0110001) = B_2$$
$$B_2 \star E = (1100002)$$
$$\rightarrow (1110001) = B_3$$
$$B_3 \star E = (1211002)$$
$$\rightarrow (1111001) = B_4$$
$$B_4 \star E = (1221002)$$
$$\rightarrow (1111001) = B_5 = B_4.$$

The hidden pattern is the fixed point of (1111001) which implies that first, second, third, fourth and seventh attributes come to ON state.

Finally, The hidden pattern is the fixed point of (1111001) which implies that first, second, third, fourth and seventh attributes come to ON state.

	Input	Limit Point
1	(1 0 0 0 0 0 0)	(1 1 1 1 0 0 1)
2	(0 1 0 0 0 0 0)	(1 1 1 1 0 0 1)
3	(0 0 1 0 0 0 0)	(1 1 1 1 0 0 1)
4	(0 0 0 1 0 0 0)	(1 1 1 1 0 0 1)
5	(0 0 0 0 1 0 0)	(1 1 1 1 1 0 1)
6	(0 0 0 0 0 1 0)	(1 1 1 1 0 1 1)
7	(0 0 0 0 0 0 1)	(1 1 1 1 0 0 1)

4. Conclusion

However the results by FCMs gives when coughing up blood is ON state, then breathe are ON state. Even though various symptoms influence the risk of lung cancer directly and indirectly we can conclude that the coughing up blood is the most impactful symptom.

Suggestion:

We have referred [6] and discussed the exports of lung cancer. Stop smoking, avoid second hand smoking, eating variety of fruits and vegetables, regular exercise, avoiding carcinogens at work are the suggestion to control lung cancer. So, when a men or women have symptoms of lung cancer, should go for check up to control it if the disease is in early-stage.

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