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Mathematical Modelling to find Pattern for Bronchitis

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Abstract: Bronchitis is a swelling in the bronchial tubes, which carries air inside to Lungs and vice-versa. Many children around the globe affected by this diseases our intention to find the pattern of minimum symptoms for Bronchitis. To find the minimum symptoms for Bronchitis we had taken 10,000 samples from different parts of our states(Odisha) and using correlation technique by comparing with a common symptoms(conditional attributes) taken initially we got 6-disimmilar records .Applying Rough Set Technique(RST) one of the soft technique on the 6-Records ,We got minimum number of symptom for Bronchitis.

Keywords: Bronchitis, Rough Set, Correlation, Soft Computing, Conditional Attributes Bronchial

1 Introduction

Many children across the globe across the globe suffered from Bronchitis [1],After effect of Bronchitis is more sever ,may leads to breathing like asthma, pneumonia, inhalation injury and even anxiety. According to Allen Widysanto et al. [2] chronic productive cough Active smoking and passive inhalation, Pollution due to industrialization can also leads to Bronchitis. In our paper we give more thrust on minimum symptoms which leads to cause Bronchitis. To find the minimum attribute we use RST. Many Researchers had done many Research in this context, Salvatore Greco et. al [3] uses Bayesian Confirmation Measure within Rough Set Approach, Baofeng Shi et.al[4]. uses RST concept for small enterpriser, for attribute reduction and feature selection Xinyuan Luan et.al [5] uses rough set and improved artificial fish swarm algorithm, To find core and reduct , Renu Vashist[6] et.al provide a novel Technique, Renu Vashist [7] et. al provide a novel technique to find core and reduct on consistent dada set, Tian-rui et.al [8], provide a technique to find reduct and core in incompatible information system. For our Research We use Rough Set Technique (RST) for attribute reduction and also use the technique to choose most essential attribute, purposefully we consider 10,000 data set of Bronchitis cases and comparing the data set with a common set of symptoms using correlation [9] technique we get total 6-records.We use RST on these 6-records to get a final conclusion.

1.2 Basics of Rough Set (RST)

Rough Set [8] was developed and extended from traditional Set Theory by Polish Mathematician Z.Pawlak in the year 1982. Rough Basically deals with Vague/ Imprecise data.

Rough Set define by two basic concept Upper Approximation, Lower Approximation.

1.3 Decision Table

Information Table-1

E	C	D
<a,b,c,d,e>	<c_1,c_2,.....c_n>	<d_1,d_2,.....>

E is the Set of records let say <a,b,c,d,e>,C is the conditional attributes and it's values are <c_1,c_2,c_3,.....> D is the decision attributes and it's values are <d_1,d_2,d_3,.....>.

Upper Approximation-: When object of interest probly belongs to the set X. Mathematically define by the formula given below

$$\overline{B} = \{x \mid [x]_B \cap X \neq \varphi\}$$

Lower Approximation-: When object of interest definitely belongs to the target set called as lower approximation mathematically define as

$$\underline{B}(X) = \{x : [x]_B \subseteq X\}$$

Boundary Region-: Boundary Region define as the difference between Upper and Lower Approximation

1.3 Analytical Part-1

We collect the data of Bronchitis from different parts of our states from various medical sources. The data presented in form of a table given below.

Information Table-1

Place	Age	Symptoms	Approximate Number
Kalahandi	<5	< 1. Coughing with or without mucus. 2. Soreness in the chest. 3.Feeling Tired or Fatigue 4. Mild headache. 5.Mild body ache 6.Mild to Severe chest pain>	10,000
	1<age<3	do	7000
	8months<age<1	do	4000
	Below 8months	do	1500
Koraput	<5	do	1500
	1<age<3	do	5000
	8months<age<1	do	3000
	Below 8months	do	900
Bhabanipatana	<5	do	500
	1<age<3	do	1500
	8months<age<1	do	2500
	Below 8months	do	2500
Kendujhar	<5	do	5000
	1<age<3	do	1500
	8months<age<1	do	1500
	Below 8months	do	2500

1.4 Analytical Part-2

For better understanding we rename the conditional and decision attributes presented in form of a table given below.

Table for Renaming of the conditional attributes and decision attributes

Conditional Attribute	Re Name of Conditional Attributes	Values of Conditional attributes	Renaming of Values of Conditional attributes	Decision Attributes d	Renaming the Values of Decision attribute d
Coughing with or without mucus.	1	Significant	p	Note able	aa
Soreness in the chest.	2	Insignificant	q	Point less	bb
Feeling Tired or Fatigue	3				
Mild headache	4				
Mild body ache	5				
Mild to Severe chest pain	6				

Decision Table

E	1	2	3	4	5	6	d
E_1	p	p	p	p	p	p	aa
E_2	q	q	q	q	q	q	bb
E_3	p	q	P	q	p	q	bb
E_4	p	P	P	q	q	q	aa
E_5	p	p	q	q	p	p	aa
E_6	q	q	p	q	p	p	bb

otherwise Indispensable. Indiscernibility relation denoted as IND (conditional attribute).

IND (1) = {{E_1,E_3,E_4,E_5},{E_2,E_6}},

IND (2) = {{E_1,E_4,E_5},{E_2,E_3,E_6}}

IND (3) = {{E_1,E_3, E_4,E_6},{E_2,E_5}}

IND (4) = {{E_1}{E_3, E_4,E_6,E_2,E_5}}

IND (5) ={{E_1,E_3, E_5,E_6},{E_2,E_4}}

IND (6) ={{E_1,E_5,E_6},{E_2,E_3,E_4}}

IND(1,2)={{E_1,E_4,E_5},{E_2,E_6},{E_3}}

IND(1,3)={{E_1,E_3,E_4},{E_2},{E_5},{E_6}}

IND(1,4)={{E_1},{E_3,E_4,E_5},{E_2,E_6}}

IND(1,5)={{E_1,E_3,E_5},{E_2},{E_4},{E_6}}

IND(1,6)={{E_1,E_5},{E_2},{E_3,E_4},{E_6}}

IND(2,3)={{E_1,E_4},{E_2},{E_3,E_6},{E_5}}

IND(2,4)={{E_1},{E_2,E_3,E_6},{E_4,E_5}}

IND(2,5)={{E_1,E_5},{E_2},{E_3,E_6},{E_4}}

IND(2,6)= {{E_1,E_5},{E_2,E_3},{E_4},{E_6}}

IND(3,4)= {{E_1},{E_2,E_5 },{E_3,E_4,E_6}}

IND(3,5)= {{E_1,E_3,E_6},{E_2},{E_4}{E_5}}

IND(3,6)={{E_1,E_6},{E_2},{E_3,E_4},{E_5}}

IND(4,5)= {{E_1},{E4,E2},{E_3,E_5,E_6}}

IND(4,6)= {{E_1},{E4,E_2,E_3},{E_5,E_6}}

IND(5,6)= {{E_1,E_5},{E_4,E_2},{E_3}{E_5,E_6}}

IND(1,2,3)={{E_1,E_4},{E_2},{E_3},{E_5},{E_6}}

IND(1,2,4)={{E_1},{E_2,E_6},{E_4,E_5},{E_3}}

IND(1,2,5)={{E_1,E_5},{E_2},{E_4},{E_6}, {E_3}}

IND(1,2,6)={{E_1,E_5},{E_2},{E_4},{E_6}, {E_3}}

IND(2,3,4)={{E_1},{E_2},{E_3,E_6},{E_4},{E_5}}

IND(2,3,5)={{E_1},{E_2},{E_3,E_6},{E_4},{E_5}}

IND(2,3,6)={{E_1},{E_2},{E_3},{E_4},{E_5},{E_6}}

IND(3,4,5)= {{E_1},{E_2},{E_3,E_6},{E_4},{E_5}}

IND(3,4,6)= {{E_1},{E_2},{E_3,E_4},{E_5},{E_6}}

IND(4,5,6)={{E_1},{E_2,E_4},{E_3},{E_5,E_6}}

IND(1,2,3,4)={{E_1},{E_2},{E_3},{E_4},{E_5},{E_6}}

IND(1,2,3,5)={{E_1},{E_2},{E_3},{E_4},{E_5},{E_6}}

IND(1,2,3,6)={{E_1},{E_2},{E_3},{E_4},{E_5},{E_6}}

IND(2,3,4,5)={{E_1},{E_3,E_6},{E_2},{E_4},{E_5}}

IND(2,3,4,6)={{E_1},{E_2}{E_3},{E_4},{E_5},{E_6}}

IND(3,4,5,6)= {{E_1},{E_2}{E_3},{E_4},{E_5},{E_6}}

We will have the following reduct set given below

1.(1,2,3,4) 2. (1,2,3,5) 3.(1,2,3,6) 4.(2,3,4,6) 6. (2,3,6)

as the above 5 cases written above as set of R reduct we get after analyzing the decision table .

Core we get from the above set of reduct will be, $\bigcap 1.(1,2,3,4)\ 2.(1,2,3,5)\ 3.(1,2,3,6)\ 4.(2,3,4,6)\quad 5..(2,3,6) = \{3\}$, So from above analysis we have the conditional attribute {3} is most significant attribute for analysis i.e. Feeling Tired or Fatigue along with conventional conditions of Bronchitis.

Analytical Part-3

We get conditional attribute {3} is most essential attribute and to know the dispensable attribute we compare the reduct element (2, 3, 6), {(2,3,4,6) , we get conditional attribute

{4} is the dispensable attribute. So by dropping the conditional attribute {4} from the decision table we have the following Result.

Reduce Decision Table

E	1	2	3	5	6	d
E_1	p	p	p	p	p	aa
E_2	q	q	q	q	q	bb
E_3	p	q	P	p	q	bb
E_4	p	P	P	q	q	aa
E_5	p	p	q	p	p	aa
E_6	q	q	p	p	p	bb

From the Reduce Decision table Record we have the following Reduct (2,3,5),(2,3,6), as we get 2- set of reduct i.e. (2,3,5),(2,3,6) so the core in this case will be $\text{Core} = \bigcap \text{Reduct} = \bigcap\{(2,3,6),(2,3,5)\} = (2,3).$ Now it is clear that attribute (2,3) most essential attribute that we infer from the reduce decision Table. Now by keeping the conditional attribute (2,3) leaving the rest of the attributes we have the following result

Reduce Decision Table-2

E	2	3	d
E_1	p	p	aa
E_2	q	q	bb
E_3	q	P	bb
E_4	P	P	aa
E_5	p	q	aa
E_6	q	p	bb

E_1 and E_4 Records are same and E_3 and E_6 are also same now we merge the records (E_1 , E_4),(E_3,E_6) to make it single record the table appears as follows.

Reduce Decision Table-3

E	2	3	d
E_1	p	p	aa
E_2	q	q	bb
E_3	q	P	bb
E_5	p	q	aa

From Reduce decision Table-3 we infer the following using strength of Rough Set When Condition is 2 it's value is p decision is aa 100%, similarly calculating Condition is 2 it's value is q decision is aa is Null. For condition is 3 and it's value is p decision value is aa 50% ,similarly conditional value is p and decision value is bb is 50%, conditional value is q decision value is aa 50%, conditional value is q and decision value is bb also 50%. From the above analysis it is clear that conditional attribute 2 is most significant attribute.

Rule Derivation using Reduce Decision Table-3 will be as follows

Rule-1 $(2 \to \text{p}) \& (3 \to \text{p}), \text{Decision is aa}$

Rule-2 $(2 \to \text{q}) \& (3 \to \text{q}), \text{Decision is bb}$

Rule-3 $(2 \to \text{q}) \& (3 \to \text{p}), \text{Decision is bb}$

Rule-4 $(2 \to p) \& (3 \to q)$, Decision is aa

2.1 Statistical Validation

We consider the Following Assumption

H_0 (Null Hypothesis)-: The Two conditional attribute (2, 3) i.e. Soreness in the chest, Feeling Tired or Fatigue not essential Attributes for Bronchitis
H_1 (Alternate Hypothesis)-: The Two Conditional attribute (2,3)) i.e. Soreness in the chest, Feeling Tired or Fatigue essential Attributes for Bronchitis. We had taken survey by taking observed samples of Bronchitis cases from various medical sources. The sample observed from 10 different places are as follows 25,35,45,15,75,65,85,5,55,95 and expected samples 10 days are 10%,10%,10%,5%,15%,15%,15%,2%,10%,20%.Now the expected result day wise 50,75,50,25,25,25,75,50,25,10.

$\chi^2 = \dfrac{\sum (E_i - O_i)^2}{E_i} = 14.47$. $\chi^2(9,0.95)$ =3.325 tabular values as calculated chi square value is greater than the tabulated chi square value so Null Hypothesis is rejected, Alternate Hypothesis is accepted.

2.2 Future Scope

This method can be extended to the field of Entertainment, Business and Sports, Social Sciences.

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