The Fuzzy Entropy Method Differentiating Types of the Same Illness

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Abstract: Using fuzzy entropy, we establish the model differentiating types of the same illness.Further,we give a case of illness.

Keywords: Fuzzy entropy, set of signs, sign expression.

1.Introduction

We usually meet thus illnesses which have similar、weak typical sign expressions in clinical diagnosis.It brings definite difficulty to differentiating the types of illness.In this paper,we give a valid diagnosis method in terms of fuzzy entropy. When a life system has a change from a normal state to abnormal state, the degree of non-organization and non-sequence in the system increase. Hence, the fuzzy entropy increase.

2.Model of differential diagnosis

2.1 Matrix of fuzzy relation between sign expressions and illnesses.

Let $D=\{D_1,D_2,\cdots,D_n\}$ denote the set of types of illness.From clinical experience, we get the signs set $S=\{s_1,s_2,\cdots,s_m\}$.There are k sign expressions for each s_i (The value of k probably different for different signs). i.e.,$s_i=\{s_{i1},s_{i2},\cdots,s_{ik}\}$. Let the number of all sign expression be q.

The relation between illness and its sign expression is a non-fixed. We can establish the relation using fuzzy statistics.

Now, we establish the matrix $R_{q\times n}=(r_{pj})$ of fuzzy relations between illnesses and their sign expressions ($p=1,2,\cdots,q;j=1,2,\cdots,n$). Let the sign expression s_{ii} be

located in p-th row of matrix, then $r_{pJ}=\frac{c}{d}$. Where c denotes the number of the patients with sign expression s_{11} in the pattients suffering from illness D_J. The d denotes the number of the patients suffering from illness D_J.

2.2 Differential diagnosis

First, we can get the set $\{s_{11}\}$ of sign expressions from a patient. The value of sign expression s_{11} to diagnosing illness D_J could be described by tthe membership dagree $\mu D_J(s_{11})$. If $\mu D_J(s_{11})$ is greater, then the value of sign expression s_{11} to diagnosing illness D_J will be greater. The value of sign expression set $\{s_{11}\}$ to diagnosing illness D_J can be described by fuzzy entropy

$$H(D_J)=\frac{2}{\sqrt{m}}\left(\sum_{i=1}^{m}(\mu D_J(s_{11})-\mu OD_J(s_{11}))^2\right)^{\frac{1}{2}}$$

where,

$$\mu OD_J(s_{11})=\begin{cases}0, & \text{if } \mu D_J(s_{11})<0.5\\ 1, & \text{if } \mu D_J(s_{11})\geq 0.5\end{cases}$$

The $\mu D_J(s_{11})$ can be obtained from the matrix of fuzzy relation between sign expressions and illnesses. Supposing that s_{11} is located in p-th row of matrix, then $\mu D_J(s_{11})=r_{pJ}$. From above, we can get $\mu OD_J(s_{11})$. Hence, we get $H(D_J)$. If $H(D_{J_O})=\max\{H(D_1),H(D_2),\cdots,H(D_n)\}$, then the patient suffers from illness D_{J_O}.

3. Case of illness

Now, there is a patient, the male sex. We have known that this patient suffers from chronic blocked consumption from his symptoms. But, this illness has three types: pulmonary emphysema type, bronchitis type and mixed type. The sign expressions of these three types are similar. In the following, we differentiate the type of this illness using above model.

We get this patient's sign expression set $S=\{s_{11}, s_{21}, s_{32}, s_{42}, s_{51}, s_{62}, s_{71}, s_{81}, s_{92}, s_{10.2}, s_{11.2}, s_{12.2}, s_{13.2}, s_{14.1}, s_{15.2}, s_{16.2}, s_{17.2}, s_{18.2}, s_{19.2}, s_{20.2}, s_{21.2}\}$. Here, the meaning of each s_{11} is omitted. The set of illness types is $D=\{D_1$(pulmonary emphysema type), D_2(bronchitis type), D_3(mixed type)$\}$. Using above method, we get the matrix of fuzzy relation between sign expressions and illnesses as follows

	D_1	D_2	D_3
S_{11}	0.7940	0.2842	0.9020
S_{21}	0.9212	0.3333	0.6818
S_{32}	0.1548	0.6278	0.4167
S_{42}	0.2846	0.7751	0.5435
S_{51}	0.7623	0.2690	0.6923
S_{52}	0.2745	0.7200	0.4423
S_{71}	0.8780	0.1667	0.7500
S_{81}	0.8663	0.1524	0.6538
S_{82}	0.0850	0.7455	0.3334
$S_{10.2}$	0.2490	0.8776	0.1875
$S_{11.2}$	0.2490	0.7947	0.0189
$S_{12.2}$	0.8382	0.1527	0.5294
$S_{13.2}$	0.3224	0.8547	0.5455
$S_{14.1}$	0.7767	0.1685	0.6818
$S_{15.2}$	0.1842	0.5065	0.4423
$S_{16.2}$	0.2332	0.8500	0.4375
$S_{17.2}$	0.0837	0.7353	0.4000
$S_{18.2}$	0.1867	0.7607	0.1176
$S_{19.2}$	0.2384	0.8800	0.5000
$S_{20.2}$	0.1481	0.8223	0.0010
$S_{21.2}$	0.1422	0.8812	0.4792

From above matrix,we get

$H(D_1)=0.4040$, $H(D_2)=0.4812$, $H(D_3)=0.7148$.

Hence,this patient suffers from mixed chronic blocked consumption.This result consist with clinical diagnosis.

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