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China's foreign trade to ecological environment influence: based on RS and SVM combination model analysis

Jianna Zhao*¹, Man Jiang²

¹School of business and Administration, North China Electric Power University, Baoding 071003, (CHINA)

²Man Jiang, School of business and Administration, North China Electric Power University, Baoding 071003, (CHINA)

Phone : 13932219631; 15028256816

E-mail : zhjnzhf@163.com; 920968499@qq.com

ABSTRACT

This paper based on rough sets (RS) and support vector machine (SVM) model is applied to intelligent combination of foreign trade, the ecological environment problems caused by the evaluation field. First of all, using rough set to foreign trade index system of ecological environment about Jane, and the minimum of lost information, and on the basis of it after reduction of the minimum index set, and to determine the weights of the index. And by using the support vector machine (SVM) evaluation method, using MATLAB software, realize the foreign trade on the ecological environment impact assessment results. Research shows that China's foreign trade environment effect for negative effect.

KEYWORDS

RS; SVM; Foreign trade; Ecological environment.



INTRODUCTION

It is an indisputable fact that foreign trade on the ecological environment will have some impact. But how to reveal this effect scientifically and objectively? How the overall impact on the effects? In this paper, based on the rough sets and SVM which is a model of the combination of intelligence to make an objective evaluation about the foreign trade's impact on the ecological environment from the over all.

In the algorithm based on rough set, the data must be discrete. However, a lot of data is continuous, so we should do discretization pretreatment for those data.

Let $S = (U, A \cup \{d\})$ be a decision table, Theory of the domain $U = \{x_1, x_2, \dots, x_n\}$ is a limited collection of objects, a_1, \dots, a_n is the condition attribute, d is the decision attribute, V_a 's property is the range, $V_d = \{1, \dots, r(d)\}$, $r(d)$ is the number of types of decision-making. Any (a, c) , $a \in A$, $c \in R$ (R is the set of real numbers), c is called breakpoint on a . For $a \in A$, any breakpoints collection $(a, c_1^a), (a, c_2^a), \dots, (a, c_k^a)$ on $V_a = [l_a, r_a] \subset R$ is defined a Category p_a on V_a :
 $p_a = \{[c_0^a, c_1^a], [c_1^a, c_2^a], \dots, [c_{k_a}^a, c_{k_{a+1}}^a]\}$,
 $l_a = c_0^a < c_1^a < \dots < c_{k_a}^a < c_{k_{a+1}}^a = r_a$,
 $v_a = [c_0^a, c_1^a] \cup [c_1^a, c_2^a] \cup \dots \cup [c_{k_a}^a, c_{k_{a+1}}^a]$.

Therefore, arbitrary $p = \cup p_a$ defines a new decision table $S^p = (U, A^p \cup \{d\})$, $A^p = \{d^p : d^p(x) = i \Leftrightarrow a(x) \in [c_i^a, c_{i+1}^a]\}$, for $x \in U, i \in \{0, \dots, k_n\}$, this is, after discretization, the original decision system is replaced by a new decision-making system.^[1]

THE BASIC CONCEPT OF SVM

SVM is based on statistical theory, which is the certain implementation of statistical theory's VC and SRM. A few support vectors representing the whole sample set and then classifying the unknown samples is a signal feature of this method. The principle can be simply described as: looking for an optimal separating hyperplane that could satisfy the requirement of classification, making the hyperplane ensures that the classification accuracy at the same time, maximizing the class interval on both sides of the hyperplane. According to the characteristics of the data, We can introduce the two cases: linear and nonlinear^[2].

ROUGH SETS - SUPPORT VECTOR MACHINE (SVM) COMBINATION EVALUATION MODEL

In the algorithm of support vector machine (SVM), training a SVM is equivalent to solving a quadratic convex programming problems with linear constraints, and its solution is globally unique and optimal. However, SVM itself cannot determine in the data what knowledge is redundant, what are useful. And which is the strengths of rough set method.

Therefore, the SVM combined with rough set is very meaningful. We use rough set to determine the weights of information systems, We first preprocess the data by using rough set, and then input the data which is preprocessed after rough set into support vector machine model, so it can learn from each other and improve the processing speed of the system.

THE SAMPLE SELECTION OF ENVIRONMENTAL EFFECT AND THE DETERMINATION OF THE INDEX SYSTEM

SAMPLE SELECTION

The paper select to relevant data for the period 2003-2008 of import and export in China as the research object, it analysis of China's foreign trade from five aspects of environmental effect which include economies of scale, product effect, structural effect, technology effect, the income effect.

The 2003-2008 products import and export data come from 《China statistical yearbook》. Export trade statistics come from the “Yearbook of China's Foreign Trade”. All kinds of pollutant emissions data come from the *China Environment Yearbook*.

TABLE 1 : Pollutant emissions (Unit : million tons)

	2003	2004	2005	2006	2007	2008
SO ₂	2158.5	2254.9	2549.4	2588.8	2468.1	2231.2
Industrial wastewater	4329000	4824000	5245000	5368000	5568000	2416511
Industrial waste gas	160863	237696	268988	330990	388169	403866
Industrial waste	88840	120030	134449	151541	175632	190127

CO ₂	416000	507000	508200	620000	672000	270000
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TABLE 2 : Import and export volume of foreign trade

Year	RMB (One hundred million yuan)			
	Total imp and exp	Total exp	Total imp	The difference
2003	70483.5	36287.9	34195.6	2092.3
2004	95539.1	49103.3	46435.8	2667.5
2005	116921.8	62648.1	54273.7	8374.4
2006	140971	77594.60	63376.86	14217.7
2007	166740.2	93455.6	73284.6	21071
2008	179921.5	100394.9	79526.5	20868.4

INDEX DESIGN

This establishment of evaluation index system follows economies of scale, product effect, structural effect, technology effect, the income effect five aspects. The specific indicators are classified by the above five areas and system shown in TABLE 3.

TABLE 3 : The evaluation index system of evaluation

Income Effect Indicators	X1	Export Eco-efficiency	Direct Indicators
	X2	Import Eco-efficiency	Direct Indicators
	X3	Environmental Utilization of Trade Exports	Direct Indicators
Products Effect Indicators	X4	Raw Material Utilization of Export Products	Inverse Indicators
	X5	Consumption Rate of Export Products	Inverse Indicators
	X6	Import and Export Ratio of Productive Virtual Water	Direct Indicators
Technical Indicators Effects	X7	Foreign Trade Reactivity of Technology Diffusion	Direct Indicators
	X8	Environment Index of Import and Export Trade	Direct Indicators
	X9	Resources Benefit of Import and Export	Direct Indicators
Structure Effect Indicator	X10	Import Change Rate of Polluting Products (including waste)	Inverse Indicators
	X11	Export Effect Rate of New High-tech Product	Direct Indicators
	X12	Export Change Rate of Environmental Protection Technology	Direct Indicators
Scale Effect Indicator	X13	SO2 Emissions	Inverse Indicators
	X14	CO2 Emissions	Inverse Indicators
	X15	The Net Emissions of "Three wastes"	Inverse Indicators

Using the correlation analysis method to find out large correlation index, to avoid the interference of multicollinearity between indicators. Specific as follows: on the basis of quantitative analysis of evaluation index correlation, filtering evaluation index and the index's correlation coefficient is above 0.9. Using Eviews6.0 to complete the analysis process. Correlation analysis results are shown in TABLE 4.^[3]

TABLE 4 : Correlation Analysis Results

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15
X1	1.00	0.31	-0.61	-0.64	0.84	0.69	-0.72	-0.61	0.45	-0.25	0.51	-0.23	0.23	0.24	0.01
X2	0.31	1.00	-0.90	0.15	0.64	0.26	-0.37	-0.90	0.98	-0.69	0.86	0.22	0.83	0.36	0.20
X3	-0.61	-0.90	1.00	0.16	-0.82	-0.51	0.47	0.99	-0.93	0.57	-0.89	-0.09	-0.61	-0.14	0.08
X4	-0.64	0.15	0.16	1.00	-0.16	-0.53	0.35	0.19	0.11	0.23	-0.02	0.09	0.28	0.20	0.31
X5	0.84	0.64	-0.82	-0.16	1.00	0.52	-0.64	-0.80	0.76	-0.27	0.74	-0.16	0.53	0.33	0.08
X6	0.69	0.26	-0.51	-0.53	0.52	1.00	-0.72	-0.50	0.36	0.00	0.61	0.01	0.12	0.11	-0.01
X7	-0.72	-0.37	0.47	0.35	-0.64	-0.72	1.00	0.45	-0.43	0.12	-0.71	-0.33	-0.54	-0.48	-0.40
X8	-0.61	-0.90	1.00	0.19	-0.80	-0.50	0.45	1.00	-0.92	0.59	-0.87	-0.10	-0.59	-0.12	0.11
X9	0.45	0.98	-0.93	0.11	0.76	0.36	-0.43	-0.92	1.00	-0.64	0.87	0.07	0.81	0.42	0.22
X10	-0.25	-0.69	0.57	0.23	-0.27	0.00	0.12	0.59	-0.64	1.00	-0.38	-0.03	-0.61	-0.39	-0.26

X11	0.51	0.86	-0.89	-0.02	0.74	0.61	-0.71	-0.87	0.87	-0.38	1.00	0.40	0.74	0.28	0.15
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Specific analysis as follows: A strong correlation present in (X2) and (X3), (X8), (X9), the correlation coefficient are 0.9, 0.9 and 0.98.

(X3)and (X8), (X9) exist strong correlation, the correlation coefficient are 0.99 , -0.93.

(X8)and (X9) exist strong correlation, the correlation coefficient is -0.92.

(X14) and (X15) exist strong correlation, the correlation coefficient is 0.96.^[4]

By the correlation analysis and judgment, after excluding evaluation indicators which have low collinearity and significance, the following 11 indicators were selected:(X1), (X4), (X5), (X6), (X7), (X9), (X10), (X11), (X12), (X13), (X14).

Evaluate the environmental effects of China's foreign trade by combination model

The determination of environmental effects' weight based on rough sets

The standardization process about model input variables

Before using the evaluation model, you must standardize the sample data firstly and convert the data between the interval [0,1].

Determine weight

Determining the weight of each factor, screen decision attribute by using the knowledge reduction function of rough set, then solve the problem of weight attribution.

EVALUATION RESEARCH

According to the index system established in this article, using support vector machines evaluation method and MATLAB to realize evaluation results. According to the setting of model, the environmental effects are divided into positive and negative categories,1 represents a positive environmental effect,0 represents the negative environmental effects,and then determine the final model input data by combining with the weight data and the data of indicators standardized. From the realization of MATLAB, to predict that the number of support vector belonged to Y=1 is 5,and when the support vector belongs to Y=0,the number is 6,the number of negative effect's support vectors is bigger than the positive effect's. The environmental effects of foreign trade in our country is negative effect analyzed with the data from 2003 to 2008.

CONCLUSIONS

This article achieves good research results by choosing a lot of trade and environment data as the evaluation material of research, taking the evaluation mode designed as a guide and use evaluation mode for the corresponding evaluation studies. The conclusion as follows:

(1) This combination is an excellent model for the evaluation of the sample results,by using rough set,not only determine the weights of indicators more objectively, it also has a powerful information extraction ability at studies of the evaluation model.

(2) The evaluation results indicate: the SVM algorithm is suitable to research and treatment nonlinear data,and it can make classified evaluation of environmental effects in China's foreign trade.

POLICY RECOMMENDATIONS

If our country want to eliminate the negative impact of the trade for our country environment, the government and enterprises must improve the technology content of exports, and through taxation, developing environmental protection industry to reduce the pollution intensity of per unit of product, increase the positive technical effect. In addition, the low pollution intensity should be encouraged to export more products and industry, minimize the negative effects of trade on the environment while realizing the industrial structure adjustment.^[5,6]

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