AMSE JOURNALS –2015-Series: Advances A; Vol. 52; N° 1; pp1-16
Submitted Sept. 2013; Revised June 30, 2014; Accepted March 15, 2015

The Review of Error-eliminating Theories

* J. Zhou, ** K. Guo, * S. Ye

*School of Management, Guangdong University of Technology
161 YingLong Road, TianHe District, GuangZhou, GuangDong, China **Guangzhou Vocational and Technical College, 1038 GuangCong Road, GuangZhou, GuangDong, China
(411682485@qq.com, gkzh@gdut.edu.cn)

Abstract: The theory of error-eliminating's background and research status at home and broad are expounded. Besides, this article introduces its important theoretical foundations and classifies and summarizes the latest research progress of error-eliminating theories. Finally, the research directions and practical application of the theory are discussed, and its application prospect in management science and social science are pointed out. This article attempts to trace the developing course and its researching progress of error-eliminating study and put forward new researching directions and content.

Key words: Error; Error system; Error logic; Error set

1. Introduction

Being two different aspects of a contradiction, errors and objective facts are opposite to each other. Errors are prevailing whether in developed or developing countries, in advanced or backward groups as well as fields. Eminent or ordinary, people inevitably commit mistakes. In ancient or at present, mankind do not fail to find errors anywhere. In a word, our life is permeating with errors, which always function adversely but sometimes beneficially to people. The errors of a question, an event, a decision or a theoretical system, etc, usually result from the errors of some factors or just a factor. While those errors, on the one hand, cause personal losses, on the other hand, leads to people's casualties, group's disintegration, and the whole country's or even human being's destroy. Therefore, the introduction, foundation and application of error-eliminating theories bear profound meanings. Since 1980s when error-eliminating study was founded, the author Guo Kaizhong has published six relevant theoretical books including An

Introduction to Error-eliminating Study, Theories and Methods to Judge the Decision-making Errors in Enterprise's Fixed Assets Investment, Complicated Conflicts of Big Systems and the Theoretical Methods and Application of Error Theories, Discussion on Error Set, Error System, and Error Logic as well as more than 200 dissertations at home and abroad. The framework of error-eliminating theories has been already set up and attracted the attention of foreign and domestic experts.

The researches on error-eliminating theories conducted by scholars at home and abroad include how to judge the decision-making errors in enterprise's fixed assets investment(Guo Kaizhong and Zhang Shiqiang, 1995)and the researches about complicated conflicts of big systems (Liu Yongqing and Guo Kaizhong, 2000)). In addition, error-eliminating theories have also been used to solve the problems in economic management such as the application of fuzzy error logic to prevent the risk of securities and investments. After expounding the conflict and errors in the system of risk investment, the book *Discussion on Error Set* puts forward some methods to calculate the error value and ways to eliminate the conflict and errors (Guo Kaizhong and Zhang Shiqiang, 2001) in decision-making systems of risk investment. In organization management, the error-eliminating theories are put into use together with information theories and system theories. From the perspective of error information transmission in organizations, the truth distortion of information from the error source is clarified to disclose the reason for the failure of organization communication (Guo Kaizhong, 1997). The basic principle, theory and method of error-eliminating study and error logic have also been used to found models of enterprise crisis and its law of replacement and transformation has been tentatively probed into combined with the researching achievements of crisis management (Jiang Zhengfeng, 1998). Error-eliminating study has also touches upon the researching field of decision-making risk (Sheng Yong and Cheng Wen, 1998). From the above examples, we can draw the conclusion that error eliminating study is of practical intention. At the beginning of error-eliminating study's foundation, the goal of establishing error data bank and decision-making supporting systems to eliminate or prevent errors has not been achieved. Besides, in new fields, there is a large space for the application of error-eliminating theories. This article attempts to trace the developing course and its researching progress of error-eliminating study and put forward new researching directions and content.

2. Recent researching progress of error theories

Since the middle and late 1990s, Chinese scholars began to conduct researches on error-eliminating theories. However, the systemic study started in the late 20th century. After making a

comprehensive survey, the researching achievements of error-eliminating theories can be summarized as follows.

Overview of error

At the beginning of error-eliminating theories' foundation, professor Guo Kaizhong defines errors as follows. Suppose U is a discuss domain, G is a group of rules based on U, if a cannot be inferred from G (including: a cannot be inferred from G completely, partly or indefinitely and a is not identical with G, etc), based on U for G a is erroneous (Liu hongbing and Guo kaizhong, 2010).

From the definition, we can see that errors are relative to the discuss domain, a group of rules and the hiding connotative meaning. It is obvious that the group of rules based on U are definite and qualified to judge right rules. If G is used to judge wrong rules, then a can be inferred from U in the above definition. The improvement of the definition of errors is beneficial to classify errors, find out the reasons for errors, study on the laws of error transmission and transformation and apply error-eliminating theories, which are in turn embody the final end of error-eliminating theories.

Error systems

(a) Error systems

The set composed by some decisions, judgments, propositions and objects is called a problem set, which is denoted by $W_0, W_1, W_2, \cdots, W_n$.

For some problem set, the population of all effects on the society that are produced by the whole conclusions obtained from the problem set's all conditions is called intrinsic function of the problem set. While for only one effect on society, called an intrinsic function. To achieve the end, objective functions are needed.

The function that all the items (including the condition T, conclusion J, intrinsic function GY and objective function MG of problems set) are organized through some certain definite relation R is called the object system.

Denoted by $(W_i, T(t_1, t_2), J, GY, MG, R)$

Among them W_i is a certain problem set, T (t_1, t_2) is composed by the conditions of W_i, t_1 is the restricted conditions, t_2 is other conditions, J is the conclusion set of W_i, GY is the intrinsic function set of W_i, MG is objective function set of W_i, and R is the relation set that needs to study in W_i.

It can also be simply denoted by $(X(T(t_1,t_2),J,GY,MG,R)$ or $X(T,J,GY,MG,R)$ or X,Y,Z,L L , etc. In the object system, it is called an error system if at least one of its elements is erroneous (narrow sense).

(b) Recent researching progress

Error-eliminating theories have probed into the definition, nature of erroneous systems and the causes of errors and its laws. That's to say, erroneous events and problems are included in systemic theoretical study, taking X=X({Wi},T(t_1,t_2), J, GY, MG, R) as an object system, to conduct researches on the structures, rules, calculations and transformations of erroneous systems as well as the interrelationships between sub-systems.

The article [16] first generalizes the six types of basic structures of erroneous systems including series, parallel, extension-contraction, connotation, feedback and other types (Liao Liping and Guo Kaizhong, 2012). Focusing its attention on erroneous systems, the article [17] puts forward some methods to eliminate biased errors through analyzing the definition of errors and meanwhile combined with the relationships between systems and sub-systems during the process of systemic function optimization, the application methods of biased error value to the systemic optimization and error-eliminating study are also expounded(Wen Hua, 2009). Different from the previous researches on the erroneous systems'structure, the article [18] conducts its research on the rules of erroneous systems and concludes that for a certain discussion domain and discriminating rules, methods to choose suitable erroneous functions are of utmost importance (Shijia and Guo Kaizhong, 2010). Besides, the terms for being a suitable erroneous function and methods to choose a suitable one under certain discussion domain and discriminating rules are explicated and the common distribution of several fuzzy erroneous functions are also listed. Based on the fuzzy erroneous functions, the article [19] clarifies the fuzzy erroneous systems and their brilliant application prospect in adding decision-making is also pointed out (Guo Qiwei and Guo Kaizhong, 2009). On the basis of the above researching achievements, after analyzing some key factors like systemic erroneous source, course and media, the article [20] expounds the mechanism of error transmission inside the systems, taking the system of series structure as example(Bian Yungang and Guo Kaizhong, 2012). And it maintains that depending on some media like materials, techniques and fund, the errors inside the system are transmitted along the system structure. There are intrinsic relationships and laws between the erroneous value of the whole system and the systemic importing relationship course, the erroneous value of variant factors in the system as well as the rules to discern the errors of different factors and importing relationship course. Also, the error transmission course of series structure inside the systems is analyzed with cases. Last but not least, from the perspective of investment, the article [21] fix the

global minimum variance-time combination and meanwhile the starting point of efficient margin by virtue of erroneous systems(Liu Hong Bing, 2008). When the stock market is permitted to sell short, the effect of the change of investment times on the global minimum variance-time combination, its drift directions together with the shift of covariance between any time combination and any global minimum variance-time combination are systemically analyzed.

Reviewing the above articles, we can conclude that the focuses of the research on erroneous systems are as follows.

a. the structure of erroneous systems b. the relationship between erroneous systemic factors and sub-systems c. the optimization of erroneous systems d. the laws of error transmission and transformation in erroneous systems e. the application of error system theories f. the operation of error systems. It is worthy of our attention that not every above aspect is fully studied. For instance, setting up expert systems of some fields to discern, predict, prevent and eliminate errors and popularizing the application of such systems are needed to be developed further. The optimization treatment methods of erroneous systems are not quite advanced, leaving a gap between theories and practical usage.

Error set

In order to satisfy the requirements of studying error theories and quantified descriptions of errors, the definition, classification, operation and laws of error set will be introduced.

Suppose U is an object set, G is a group of rules judging the error based on U. If $C\subseteq\{((U(t),S(t),\bar{p}(t),T(t),L(t)),x(t)=f(G\neq>u(t)))\}\ |(U(t),S(t),\bar{p}(t),T(t),L(t))=u(t)\in U(t),f\subseteq U(t)\times R,\ x(t)=f(G\neq>u(t))\}$, then C is based on U for G an "error" set , which can be called an error set.

$U_C=\{u(t)|(u(t),x(t))\in C.x(t)>0\}$,

$U_z=\{u(t)|(u(t),x(t))\in C,x(t)<0\}$,

$U_L=\{u(t)|(u(t),x(t))\in C,x(t)=0\}$,

$U_K=\{u(t)|(u(t),x(t))\in C,x(t)\geq 0,T(f(G\neq>u(t)))<0\}$,

$U_{KH}=\{u(t)|(u(t),x(t))\in C,x(t)\leq 0,T(f(G\neq>u(t)))>0\}$,

$U_{KL}=\{u(t)|(u(t),x(t))\in C,T(f(G\neq>u(t)))=0\}$,

$U_H=U_z-U_{KH}$

$U_S=U_C-U_K$

are called the error domain; correctness domain; critical domain; correctable worsening domain, critical domain, good domain and bad domain of transformation T about error set respectively. R is real number domain.

(a) Categories of error set

For every $(u,x)\in C,\ x\in\{0,1\}$, C is classical error set.

For every $(u,x)\in C,\ x\in[0,1]$, C is fuzzy error set.

For every $(u,x)\in C,\ x\in(-\infty,+\infty)$, C is error set with critical point.

For every $(u,x)\in C,\ x\rangle 0$, C is complete error set, denoted by C_q.

For every $(u,x)\in C,\ x\le 0,\ C$ is a non-error set based on U for G□denoted by C_W.

(b) Recent researching progress

As a means to describe errors quantifiedly, error set can make use of the classification, operation and transformation of set to eliminate errors.

Utilizing the relevant knowledge of error-eliminating study as well as the methods and theories of fuzzy mathematics, the article [22] forms the definition of replacement and attains a theory to replace and transform errors in different systems links in order to reduce and eliminate errors after analyzing the operation and application of fuzzy error set (Li Min and Guo Kaizhong, 2007). On the basis of the dissertation "Error-eliminating logic" by Guo Kaizhong, the article [23](Wang Yaofu, 2010) mainly clarifies the addition operation of fuzzy error set, which includes small value and operation, big value and operation, sum and operation, smaller sum operation, bigger sum operation, sum or operation, as well as the relationship between addition operation and connotative conjunction operation. Lastly, the dissolving operation of fuzzy error logic and the relation between the connotative not mere and just negation operations.

From the above three articles, we can see that most researches on error set focus on its transformation and operation which is mainly engaging in studying the transformation methods and principles of element (u, x), discuss domain U, rule G and binary relation f. They can be mutually transformed or partly transformed. Theoretically, T and C_1 are known and C_2 should be inferred from $T(C_1)=C_2$. Another situation is that an error set and its transforming results are known and the transforming methods and laws ought to be inferred. In practical, we know the result of transformation from one error to another, but we should find out the transforming rules and laws. Theoretically, C_1 and C_2 are known and T should be inferred from $T(C_1)=C_2$. The third situation is that we know the transformation rules and laws and its results and have to deduce the original error set. Practically, an error result and transformation methods and laws about the erroneous fact are known and the original fact has to be deduced. This is the developing orientation of error set. The transformation methods and laws should be found out in order to eliminate and prevent errors through studying the transformation and operation of error set.

Error logic proposition

(a) Error logic

The right and the wrong can mutually transform, which verifies the truth that all contradictions can transform into their opposites under certain conditions. It is the ability of contradictions'transformation that creates a constantly developing world with endless variations, full of vigor. Scholars including Guo Kaizhong first put forward the definition of error logic.

The definition 2.4.1: if A ((u(t), $\vec{p}$),x(t))= A ((U,S(t), $\vec{p}$,T (t),L (t)),x(t)=f(u (t), $\vec{p}$),G (t))), x(t)∈{{0□1}□[0□1]□□-∞,+∞□}, among which U is the discuss domain of u(t)= (U,S(t), $\vec{p}$,T (t),L (t)), S(t) is the object or subject terms of u(t)= (U,S(t), $\vec{p}$,T (t),L (t)), $\vec{p}$ is the spacial position and direction of u(t)= (U,S(t), $\vec{p}$,T (t),L (t)), T(t) is the feature and predict of u(t)= (U,S(t), $\vec{p}$,T (t),L (t)), L(t) is the magnitude or predicative of u(t)= (U,S(t), $\vec{p}$,T (t), L (t)), x(t)=f(u (t), $\vec{p}$),G_A (t)) is the truth value or truth-value function of A ((U,S(t), $\vec{p}$,T (t),L (t)),x(t)=f(u (t), $\vec{p}$,G (t))), G(t) is the rule to discern errors based on discuss domain U, then A ((u(t), $\vec{p}$),x(t))= A ((U,S(t), $\vec{p}$,T (t),L (t)),x(t)=f(u(t), $\vec{p}$),G (t))) can be called the logic error variable based on U to discern rules G(t).

The definition 2.4.2: Suppose that A ((u(t), $\vec{p}$),x(t))= A ((U,S(t), $\vec{p}$,T (t),L(t)),x(t)=f(u(t), $\vec{p}$),G (t))), x(t)∈{{0□1} or [0□1] or□-∞,+∞□} (rules G(t) to discern errors, discuss domain U) is the error logic variable for discerning rules G(t) based on U, then the whole variable forms set C can be called the error logic variable set for discerning rules based on U, denoted as C.

(c) Then the right logic and error logic of parallel, series, and global systems are put forward as follows.

a. Parallel systems

1. For right logic A∨B∨…∨G (logic proposition disjunction), if any sub-system A or B...or G work (right), the parallel system would also operate (right).

2. For error logic A∧B∧…∧G (logic proposition conjunction), if all sub-systems A, B...and G do not work (wrong) then the parallel system would not operate (wrong).

b. Series systems

1. For right logic A∧B∧…∧G (logic proposition conjunction), if all the sub-systems A, B...and G work (right), the series system would work (right).

2. For error logic A∨B∨…∨G (logic proposition disjunction), if any sub-system A or B...or G does not work (wrong), the series system would not work(wrong).

c. Global systems

1. For right logic, the augment of system generally would not increase the exactitude of system under the condition that no system is changed.

2. For error logic, the augment of system generally would increase errors of system under the condition that no system is changed.

(d) Recent researching progress

Error logic aims to study the thinking modes, methods and their laws of the static, dynamic and transforming relationship between erroneous intrinsic factors and errors themselves, namely, the static relationship between the intrinsic factors, thinking modes and forms of the relationship between change and transformation, and the logic of its laws and methods.

The involving concepts and operations of dissolving and transforming conjunctives of fuzzy error logic objects are given in article [25], which also touches upon the relation between the dissolving and transforming conjunctives of fuzzy error logic objects and the denotative conjunctives (conjunction C□disjunction D□and incompatible disjunction D_{bxr}) as well as the relationship between the dissolving and transforming conjunctives of fuzzy error logic objects and the connotative conjunctives (not mere negation bz□inexhaustible negation bj□indefinite negation bx and constant negation bd, etc.) (Wang Yaofu and Pan Zhenghua, 2008). In addition, the causes and mechanisms of the generation of fuzzy errors and the transmission and transformation laws of fuzzy errors are expounded. Based on the article [25], the [26] clarifies the relationship between the dissolving and transforming conjunctives of fuzzy logic objectives and connotative conjunctives like□ conjunction□□ disjunction□□bxr incompatible disjunction together with the relationship between the dissolving and transforming conjunctives of fuzzy error logic objects and connotative conjunctives like not mere negation □bz□inexhaustible negation □bj□indefinite negation □bx□and constant negation □bd(Wang Yaofu, 2011). Through the introduction of the swift Z into error-eliminating study along with the comprehensive analyze and application of error logic dissolution and transformation Tf to discrete time-economy systems, the article [27] analyses the linear discrete time-economy systems(Xiong Haiou and Guo Kaizhong, 2006)). And the article [28] founds mathematical models and introduces the application methods of adding transforming words to prevent financial derived trading risks with the help of the nature and law of the addition transforming works of fuzzy error logic during the process of error transmission, transformation and elimination(Liu Hongbing, 2006). Error logic also has its error discerning course and the article [29] makes use of error logic to study error discernment, explicating objects' discerning state, real state, must state and objective state as well as their relationships (Zhou Xiaoping and Guo Kaizhong, 2012). Different from articles [28] and [29], the article [30] pays attention to the law of error transmission and transformation, and puts forward new methods to prevent, eliminate and reduce errors in making decisions(Liu Hongbing, 2007). On the basis of the above researches, the article [31] studies the operation of fuzzy error logic and sets basic operating rules of fuzzy error logic, defining its formula, variable, truth-value, function, character, clause, and character set,etc, and putting forward two theorems which are also verified in this article(Liu Hongbing and Guo

Kaizhong, 2008). Besides, the operating law and nature of fuzzy error logic in error transmission, transformation and elimination are disclosed and the fuzzy error logic models of optimization investment structure are also set up. In practical application, the article, taking the motion flying kick in the event of Southern Chinese boxing for example, sets up three-dimensional coordinate system and formalizedly describes the deducting principles of the movement flying kick in the grading standards of action quality (group A) to help the electronic judge to discern the error motion according to the 2003 competing rules for a series of skills and tricks in competing martial arts. What's more, the error function for every movement and the deducting model of the motion flying kick based on computer vision are also set up.

The above articles mainly reflect the latest researching content of error logic, which can be summarized as follows.

a. Some logic parameters like discussion domain, object, feature, space, magnitude, function, rule, error value are added to error logic proposition. b. The classifiers of error logic proposition increase to 22 from mathematical classical logic, mathematical fuzzy logic, and mathematical dialectical logic. c. Five denotative conjunctives are increased. d. 6 groups of transforming conjunctives are added on the basis of mathematical classical logic, mathematical fuzzy logic, and mathematical dialectical logic. In order to study the pattern and law like $T(u)=u_1$ of error transformation, T and u are known and u_1 should be inferred, or T and u_1 are informed, u should be inferred, or u and u_1 are informed, T should be inferred, in which T is changeable and u and u_1 are the researching objects. Those articles discuss the researching objects, content of error logic and its theoretical system is also designed and given. We can conclude that error logic is developing on the basis of classical logic, fuzzy logic, dialectical logic, mathematical classical logic, mathematical fuzzy logic, and mathematical dialectical logic.

Error array

(a) Error array

Suppose that A=

$$\begin{pmatrix} ((u_{111}\ u_{112}\ldots u_{11k})\square\, x_{11}) & ((u_{121}\ u_{122}\ldots u_{12k})\square\, x_{12}) & \ldots\ldots((u_{1n1}\ u_{1n2}\ldots u_{1nk})\square\, x_{1n}) \\ ((u_{211}\ u_{212}\ldots u_{21k})\square\, x_{21}) & ((u_{221}\ u_{222}\ldots u_{22k})\square\, x_{22}) & \ldots\ldots((u_{2n1}\ u_{2n2}\ldots u_{2nk})\square\, x_{2n}) \\ \cdots\cdots & \cdots\cdots & \cdots\cdots \\ ((u_{m11}\ u_{m12}\ldots u_{m1k})\square\, x_{m1}) & ((u_{m21}\ u_{m22}\ldots u_{m2k})\square\, x_{m2}) & \ldots\ldots((u_{mn1}\ u_{mn2}\ldots u_{mnk})\square\, x_{mn}) \end{pmatrix},$$

We can call A the error array of $m\times n$ orders and K units. To better show the elements of error array, □t+1）×7 error array is put forward as follows.

Suppose that A=

$$\begin{pmatrix} U_{10}\ S_{10}(t)\ \vec{p}_{10}\ \square x_1\square\ x_2\square\ldots\ \square x_n\square\ T_1(t)\ L_1(t)\ \ x_{10}(t){=}f_{10}((u(t)\square\ \vec{p}_1)\square G_{U10}(t))\ \ G_{U10}(t) \\ U_{11}\square S_{11}(t)\ \vec{p}_{11}\ \square x_1\square\ x_2\square\ldots\ \square x_n\square\ T_{11}(t)\ L_{11}(t)\ \ x_{11}(t){=}f_{11}((u(t)\square\ \vec{p}_1)\square G_{U11}(t))\ \ G_{U11}(t) \\ \ldots\ldots\ldots\ldots\ldots\ldots \\ U_{1t}\ S_{1t}(t)\ \vec{p}_{1t}\ \square x_1\square\ x_2\square\ldots\ \square x_n\square T_{1t}(t)\ L_{1t}(t)\ x_{1t}(t){=}f_{1t}((u(t)\square\ \vec{p}_1)\square G_{U1t}(t))\ \ G_{U1t}(t), \end{pmatrix}$$

Then it is called the error array of □t+1□×7. The elements of error array □t+1□×7 form a set.

(b) Basic types of array

Six basic transforming array representation and equations.

The first category: AX=B A●X=B A▲X=B A□X=B A□X=B

The second category: XA=B X●A=B X▲A=B X□A=B X□A=B

(c) Error-eliminating planing restrictions

There are three special restrictions (the final restriction after resolution) of error-elimination plan: a. the restrictions of object conditions b. the artificial restrictions c. demand restrictions

(d) Recent researching progress

Based on the theory of array, error array equation is developing as a powerful efficient tool to study the law of error transmission and transformation.

On the basis of the researches of error array, the article [33] tries to put forward error-eliminating models with error array equation signifying systemic resources restrictions and object set signifying conditional and artificial restrictions(Min Xilin and Guo Kaizhong, 2009). It also expounds two kinds of planning error array equations including AX=B□ A●X=B□ A▲X=B□ A□X=B□A□X=B and XA=B□ X●A=B□ X▲A=B□ X□A=B□ X□A=B. The solution of this kind of error-eliminating plan is further studied based on the equation XA=B in the latter category and the planning models composed by objective, artificial, and demand restrictions. Then based on error array equation XA' = B, the article [34] defines the array of addition and transformation and offers methods to construct and solve array equation of characteristic addition and transformation for characteristic factors(Min Xilin and Guo Kazhong, 2009). Also methods of resolution, the existence and forms of solution are also explicated on the basis of error-array equation of characteristic addition and transformation. The article [35] uses fuzzy error transforming array to represent six transforming methods including similarity, addition, replacement, destroy and unit conversion and the resolution of error array equation based on

space decomposition and transformation(Min Xilin and Guo Kaizhong, 2010). On the basis of the solution equation XA′=B, articles [36-37] put forward the structure of error-eliminating expert systems and the methods to construct data bank, rule bank and models of this system. The storage and inference forms of error array and its equation models are analyzed in error-eliminating and error-preventing expert systems(Min Xiling and Huang Jiashong, 2012; Min Xilin and Guo Kaizhong, 2012).

Summarizing the above articles, we can see that the study of error array mainly focuses on its transformation and the resolution of error-eliminating plan, which is beneficial to the spread and realization of error-eliminating and error-preventing systems. However, some application fields have not been developed or have been developed with some restrictions, for instance, the optimization error information elimination and prevention in data mining need further researching and improving.

3. Application prospect for error-eliminating theories

Error data bank

To establish error data bank, we need to collect error cases of every industry and then classify them according to their fields. Before collecting and arranging the data(Liu Shiyong and Guo Kaizhong, 2010), we should design a classified catalogue of errors which includes master directory, subdirectory and detailed directory. The master directory specifies the broad heading which errors belong to such as the social, economical, political or energetic system, etc. A subdirectory classifies by the relationship between errors and systems. A detailed directory does the classification again according to the features of errors themselves. After establishing the physical level (error cases) and conceptual level (the logic relationship set up by research workers) of data bank, research workers can study and make use of various logic relationships to assist in making decisions. If the error data banks are scattered in different places and on-line real-time data are involved, the data bank and relevant data storehouse can also support dispersive dynamic remote decision-making deeds.

The application of error data bank consists of the following steps: (a) putting forward error problems needing solving (b) determining the field which the problem belongs to and its discerning rules (c) inputting the problems in (a) and the rules in (b) into the data bank systems. (d) the data bank systems execute the discernment and extraction of the similar error cases. (e) finally drawing the conclusion and offering solution programme for reference.

Setting up error-preventing and error-eliminating systems

The existent modeling simulative tools (like MatLab, Vensim, AnyLogic) are used to construct error-preventing and error-eliminating systems which then can be integrated and implanted into decision-making supporting systems as the assistant important reference for decision makers. Decision makers of limited reason vary in their memory and tactic transformation mechanism. And it is inexorable for them to commit mistakes. Therefore, it is of bright application prospect for the construction of error-preventing and error-eliminating systems.

Constructing error-preventing and error-eliminating systems includes the following three steps. (a) Setting up mathematical models of error problems prevention and elimination, fixing variable and listing restrictive terms and objective functions according to the error problems put forward (b) Detailedly analyzing and studying the established mathematical models to choose suitable methods in order to eliminate and prevent errors (c) According to the algorithm of error preventing and eliminating methods listing procedure block diagram and compiling programs to get the optimized error-eliminating and error-preventing systems and evaluating the convergence, generality and convenience of algorithms and operating efficiency and error. After that, the constructed error-preventing and error-eliminating systems can be applied to study the feasibility of programs, the procedures of enterprises' reconstructing, decision-making analyze, fault diagnosis and clearing of mechanic electronic equipments and the design, management and optimization of systems and other fields.

Application in data mining

With the spread and popularization of information and network, a large number of real-time data require to be treated and analyzed. The discernment, classification, prevention and elimination of wrong information in data mining are the products of the combination between error-eliminating study and data mining. It utilizes the theories and methods of error-eliminating study to excavate the wrong data or information in data or knowledge banks and then classifies, prevents and eliminates those wrong information. It is inevitable that the excavated data cannot meet the specified requirements and thus are sifted out or neglected by the previous research workers. However, some of those eliminated data are quite valuable, worthy our second excavation to look for useful wrong data and then classify and reuse them after error eliminating with the help of error-eliminating theories.

Because the point of data mining of error-eliminating theories lies in utilizing the transformation of errors. Based on the data mining, it makes use of the knowledge about the transformation of error, error set, error system and error array, etc, to eliminate errors, which consists of the knowledge on error set classification, conduction, error cluster, error array and

other knowledge about transformation, providing theoretical foundation for error elimination. That is the new thought to solve wrong knowledge, taking advantage of data excavating techniques, which can be applied to the data mining research of some fields like customer relation management, financial stock, marketing, telecommunication and medical service, offering efficient decision-making support for the prevention and elimination of problems about wrong knowledge and factors, etc.

4. Conclusion

At the beginning, this article explains the researching background and the intention of error theory. Then the corresponding important concepts and the recent researching progress about error theory are explicated. Besides, this article envisions the researching prospects and expounds the potential researching methods and tools. Setting up error data bank, putting the error theories into the use of data mining and establishing error-eliminating and error-preventing systems are suggested.

It is naturally inevitable that lots of new conditions will occur and the present perspective methods will be challenged since any error are changing constantly and people's perception toward objects are becoming more and more profound. Despite of that possibility, this article can still provide theoretical reference of the recent researching progress about error eliminating for scholars who work on errors and error systems. The author sincerely wishes that more and more scientific research personnel in colleges, universities and scientific research institutions can combine error, eliminating theories and methods with their researching fields to put forward new approaches for expertise application and produce relevant application software.

Acknowledgement

We would like to thank the anonymous reviewers for their valuable comments and suggestions. This work was supported by the National Natural Science Foundation of China (Nos. 41001054); and the National Training Programs of Innovation and Entrepreneurship for Undergraduates, China (Nos. 201311845021).

References

1. G.Kaizhong, Z.Shiqiang(1995) *An Introduction to Error-eliminating Study*, Southern China University of Science and Technology Press, China.

2. G.Kaizhong, Z.Shiqiang(1995) *Theories and Methods to Judge the Decision-making Errors in Enterprises's Fixed Assets Investment*, Southern China University Science and Technology Press, China.
3. L.Yongqing, G.Kaizhong(2000) *Complicated Conflicts of Big Systems and the Theoretical Methods and Application of Error Theories*, Southern China University Science and Technology Press, China.
4. G.Kaizhong, Z.Shiqiang(2001) *Discussion on Error Set*, Central China University of Science and Technology Press, China.
5. G.Kaizhong(1997) "Error-eliminating Logic", *Guangdong University of Technology Journal*, vol. 1, pp. 10-12.
6. J.Zhengfeng(1998) *The Risks and Its Prevention of Stock Market*, Hua Wen Press, China.
7. S.Yong, C.Wen(1998) *Risk Prevention and Trap Avoidance*, Business Management Press, China.
8. L.Zhonghao(1997) *Risk Bridge Cut off* , Guangdong Press, China.
9. L.hongbing, G.kaizhong(2010) "Fuzzy multi-element error-matrix and its operation", AMSE journals, *Advances in Modelling A General Mathematics*, vol. 47-10, pp. 1-2.
10. W.Chengyi(1998) *An Introduction to Fuzzy Error Set*, Beijing University of Technology Press, China.
11. G.Kaizhong, Z.Shiqiang(1991) *"Fuzzy Error Set"*, Fuzzy Systems and Mathematics (China Mathematics Abstract 6.1992).
12. G.Kaizhong(1993) "Binary Fuzzy Error Set", Proceedings of AMSE International Meeting.
13. Z.Zongkuan(1995) *An Introduction to Mathematical Dialectical Logic*, China Renmin University Press, China.
14. Barwise, J(editor)(1977) *Handbook of Mathematical Logic*, Amastdam:North-Holand Publishing Company, Holand.
15. G.Qiwei, G.Kaizhong(2008) "Error-Eliminating Theory of Intelligent System--The Optimization of Systems, Subsystems and Element", *Pro. IEEM(Industrial Engineering and Engineering Management)*, December 2008, HongKong, China, pp. 695-698.
16. L.Liping, G.Kaizhong, Y.Long(2012) "Study on the Destroy and Transformation of Erroneous System Structure", *Guangdong University of Technology Journal*, vol.4, pp. 56-59.
17. W.Hua(2009) "The Optimization Method and Application Based on Systemic Bias Data ", *Guangdong Technical Normal Junior College Journal (Natural Science)* , vol.4, pp.45-48.

18. S.Jia, G.Kaizhong(2010) “The Foundation of Error Functions”, *Guangdong University of Technology Journal*, vol.3, pp.77-79.
19. G.Qiwei, G.Kaizhong, W.Qinruo(2009) “The Impact of Decision-making during Environmental Mutation--Substantial Change of Fuzzy Error System”, *Proc. IEEM(Industrial Engineering and Engineering Management)*, December 2009, HongKong, China, pp.1-5.
20. B.Yungang, G.Kaizhong(2012) “The Mechanism of Error Transmission Inside the Systems on the Basis of Series Structure Systems”, *Systemic Science Journal*, vol.20, pp. 62-70.
21. L.Hongbing(2008) “The Global Minimum Variance Investment Combination Taking Time into Consideration”, *Statistics and Decision-making*, vol.259-7, pp.172-173.
22. L.Min, G.Kaizhong(2007) “The Operation and Application of Fuzzy Error Set”, *Guangdong University of Technology Journal*, vol.27-1, pp.70-73.
23. W.Yaofu(2010) “Study on the Addition Operation and Connotative Conjunction Operation of Fuzzy Error Set”, *Southwestern National Normal Junior College Journal*, vol.3, pp. 93-100.
24. X.Haiou, G.Kaizhong, S.Jing(2007) “Study on Dissolving Operation of Fuzzy Error Set and Negation Operation of Connotative Not Mere and Inexhaustible”, *Mathematical Practice and Knowledge*, vol.17-37, pp. 60-62.
25. W.Yaofu, P.Zhenghua(2008) “Dissolving and Transforming Conjunctives of Fuzzy Error Logic Objects”, *Computer Project and Science*, vol.30-12, pp.112-141.
26. W.Yaofu(2011) “Study on Dissolving and Transforming Conjunctives of Fuzzy Error Logic Objects”, *XinYi National Normal College Journal*, vol. 2, pp. 116-124.
27. X.Haiou, G.Kaizhong(2006) “The Application of Error-eliminating Study to Analyse the Stability of Discrete Time Systems”, *Guangdong University of Technology Journal*, vol.23-1, pp. 117-121.
28. L.Hongbing(2006) “Addition Transforming Words of Fuzzy Error Logic and Its Application to Prevent Financial Derived Trading Risks”, *Fuzzy Systems and Mathematics*, vol.20-2, pp. 40-43.
29. Z.Xiaoping, G.Kaizhong(2012) “Study on Discerning State Transformation of Array Logic Equations”, *Mathematical Practice and Knowledge*, vol.49-9, pp. 149-155.
30. L.Hongbing(2007) “Similar Transforming Words of Classic Error”, *Mathematical Practice and Knowledge*, vol.37-19, pp. 140-144.
31. L.Hongbing, G.Kaizhong(2008) “Study on Investment Structure Optimization Based on Error Logic”, *Fuzzy Systems and Mathematics*, vol.5, pp. 32-36.

32. Z.Xiaoping, G.Kaizhong(2012) “Models to Discern Wrong Motions in the Movement of Flying Kick Based on Computerized Vision”, *Guangdong University of Technology Journal*, vol.29-4, pp. 15-17.
33. M.Xilin, G.Kazhong(2009) “A Knowledge Discovery Method Based on Error Matrix Equation”, *Proc. FSKD(International Conference on Fuzzy Systems and Knowledge Discovery)*, August 2009,Tianjin, China, pp. 151-155.
34. M.Xilin, G.Kaizhong(2009) “Knowledge Model Based on Error Logic for Intelligent System”, *Proc. CSIE(World Congress on Computer Science and Information Engineering)*, June 2009, Chuangchun, China, pp. 216-220.
35. M.Xilin, G.Kazhong(2010) “A Study for Equational-type Fuzzy Error Matrix Equation”, Proc. *FSKD(International Conference on Fuzzy Systems and Knowledge Discovery)*, May 2010,Tianjin, China, pp. 1971-1975.
36. M.Xiling, H.Jiashong, Q.Jianxin, G. Kaizhong(2012) “The Construction and Resolution of Error Array Equations of Characteristic Addition and Transformation”, *Guangdong University of Technology Journal*, vol.29-2, pp. 21-27.
37. M.Xilin, G.Kazhong, H.Jize(2012) “A Study Regarding Solution of a Knowledge Model Based on the Containing-Type Error Matrix Equation” Engineering, vol.4, pp. 484-492.
38. L.Shiyong, G.Kaizhong, S.Dongchuan(2010) “A Creative Research in Management-the Introduction, Progress and Prospect of Error Logic”, *Management Journal*, vol.12-7, pp. 1749-1757.
39. G.Kaizhong(2008) *Error Logic* , China Science Press, China.
40. G.Kaizhong(2012) *Error Systems*, China Science Press, China.