Syllabus and Course Description

Fall/Spring Semester of the Academic Year of 2009

Department of Information Management, National Taiwan University

Course Code No.	Course Title	Instructor	Subject	Level of Course	Credits	Hours per Week
	Chinese: **問題解決之研究方法**	曾國雄 Gwo-Hshiung Tzeng	☐ **required** ■ **elective**	Year: 2009 Class: Graduate Student	3	4 **(1:00pm – 5:00pm)**
	English: **Research Methods for Problems-Solving**	**Course Prerequisites**	No			

Course Objective: The purpose/objective of this course "**Research Methods for problems-solving**" is to teach the **whole frontiers of methods** in "**techniques of idea, logic reasoning and thinking systems**" for students to **understand, solve, and treat all possible problems in real world**. Then the students can **promote** and **expand** their **competence sets and ability** to enhance the **work ability and skill** for **solving** and **treating all faced problems** in different fields/domains in the employment and life. Therefore, this course is aimed at individual issues/objects by using "**multivariate statistical analysis and data mining**" for data process analysis" to understand the existing problems for prospecting the future, then at the understood problems to proceed with "**multi-objective programming**" for plan/design and/or with "**multi-criteria evaluation**" for choose/selection/improvement, propose to solve and analyze the problems in feasible alternatives for finding the "**problems-solving**". The contents of this course are including three parts as follows (see **Fig. 1 Basic Concepts of Course Systems in "Research Methods for Problems- Solving"**).

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Course Outlines: When we solve any problems, do any researches, or make any decisions, we must use the numerical data (qualitative or quantitative data) as a basis for data-analysis/data-mining, forecasting, planning, and evaluation. The data can be crisp or exist fuzzy/vagueness or subjectively multidimensional data using natural language/linguistics by perception (kansei) with response. Therefore, in this course the data sets are included crisp data sets, fuzzy data sets, rough sets, grey hazy sets and so on for treating and solving problems. The contents include: (1) statistical & multivariate analysis and data mining (including evolutionary computation, etc.) for analyzing the data sets to retrieve the patterns/classifiers/features and forecasting in treating, finding and solving any problems, (2) multiple objective decision making (MODM) to plan and design for finding the optimal/best problems for achieving aspired/desired level (including De Novo programming problems), and (3) multiple attribute decision making (MADM) to evaluate/select and improve the alternatives how we can reduce the gaps of each attribute for achieving the aspired/desired levels to get win-win strategy. Fuzzy theory is included five parts: (1) fuzzy sets, (2) fuzzy numbers, (3) fuzzy relations, (4) fuzzy measures, and fuzzy reasoning (fuzzy inferences); and its applications.

Contents of Course as follows:

1. **Statistical & Multivariate Analysis and Data Mining for data processes**

(1) Data processes in statistical & multivariate analysis and data mining

This part includes: (a) data collections by using sampling survey based on multi-attribute/multi-objective sampling design, considering features of physical environment in objective, response by perceptive (kansei) in subjective; (b) statistical testing in single- and multivariate; (c) principle component analysis and factor analysis (including quantification III & IV, MDS, including fuzzy theory), AHP (including fuzzy AHP); (d) cluster analysis (including similarity and dissimilarity, C-means or called K-means, ANN, etc. including fuzzy theory), discriminant analysis (including quantification II, Conjoint analysis, Logit model, Probit analysis, ANN discriminant, including fuzzy theory and fuzzy integral); (e) relation model for forecasting, such as multi-regression analysis, fuzzy regression, time series and fuzzy time series (including ARIMA, fuzzy ARIMA, etc.), fuzzy piecewise regression, interval regression by quadratic programming, quantification I, fuzzy quantification I, grey foresting and grey possibility forecasting, Chaos forecasting, Kalman Filtering forecasting, GMDH, Canonical analysis, etc. including fuzzy theory.

(2) Evolutionary computation and soft computing for classification and identification/patterns

These new methods are developed by computer advance that is the most revolutionary useful tool in the 20^{th} century. These new methods can relax and improve many assumptions in traditional methods, such as assumed independence, linear, etc. in variables/attributes/criteria (statistical & multivariate) for suiting the real world situations. These methods include such as artificial neural network (ANN), genetic algorithm (GA), genetic programming (GP), genetic network programming (GNP), support vector machine (SVM), particle swarm optimization, rough set theory, etc. for classification and identification/patterns.

(3) Logic reasoning including fuzzy reasoning and rough set theory for partitions and identification/patterns.

2. Multiple Objective Decision Making (MODM) for planning and designing the problems

In any situations and in any time or daily activities, persons, business/enterprises, and even to nations are often the face of decision problems to be multi-dimensions of whole consideration for planning and designing the problems to achieve the aspired/desired levels. The contents include vector optimization since 1950s (Koopmans, 1951; Kuhn-Tucker, 1951), goal programming since 1955 (Charnes and Cooper), compromise solution since 1970s (Yu and Zeleney), DEA since 1978 (Charnes, Cooper, and Rhodes), multi-stage multi-objective programming, bi-level and multi-level programming (including fuzzy bi-level and multi-level programming), MC^2 programming, fuzzy MC^2 programming, fuzzy multi-objective programming (including fuzzy goal, fuzzy resource, fuzzy parameters, fuzzy variables), De Novo programming (Zeleny, 1982), fuzzy De Novo programming, fuzzy DEA, multi-objective DEA, Genetic Algorithms for fuzzy combinatorial multi-objective decision-making, TOPSIS for MODM, habitual domain- fuzzy- dynamic multi-level multi-stage multi-objective programming.

3. Multiple Attribute Decision Making (MADM) for evaluating, selecting, or improving the problems

In any situations and in any time or daily activities, persons, business/enterprises, and even to nations are often the face of decision problems to be multi-dimensions of whole consideration for evaluating, selecting and improving the problems to achieve the aspired/desired levels. The contents include multi-attribute utility theory (Von Neumann, 1944; Debrue, 1960), including fuzzy, DEMATEL/FCM/ISM for re-structuring the structural relations for weightings (AHP, ANP, or fuzzy integral), Analytic Hierarchy Process (AHP, fuzzy AHP), Analytic Network Process (ANP, fuzzy, ANP), fuzzy integral, grey relation for evaluation, TOPSIS, VIKOR, PROMETHEE I, II, III, IV, ELECTRE I, II, III, IV, habitual domain for dynamic weightings, fuzzy ANN dynamic multi-attribute decision-making, and so on.

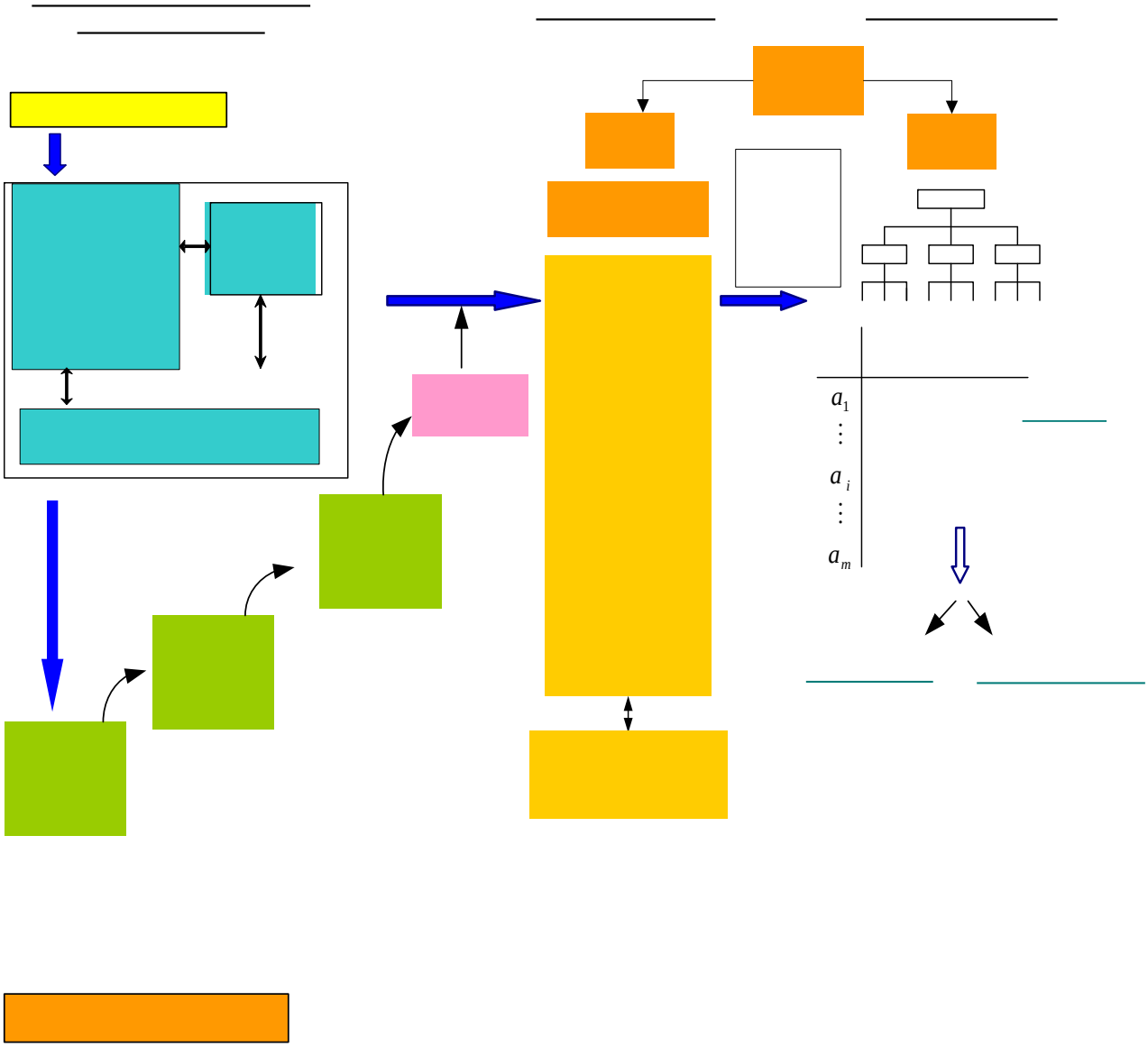

Fig. 1 Concepts of Course Systems in "Research Methods"

Data Processing / Statistical and Multivariate Analysis

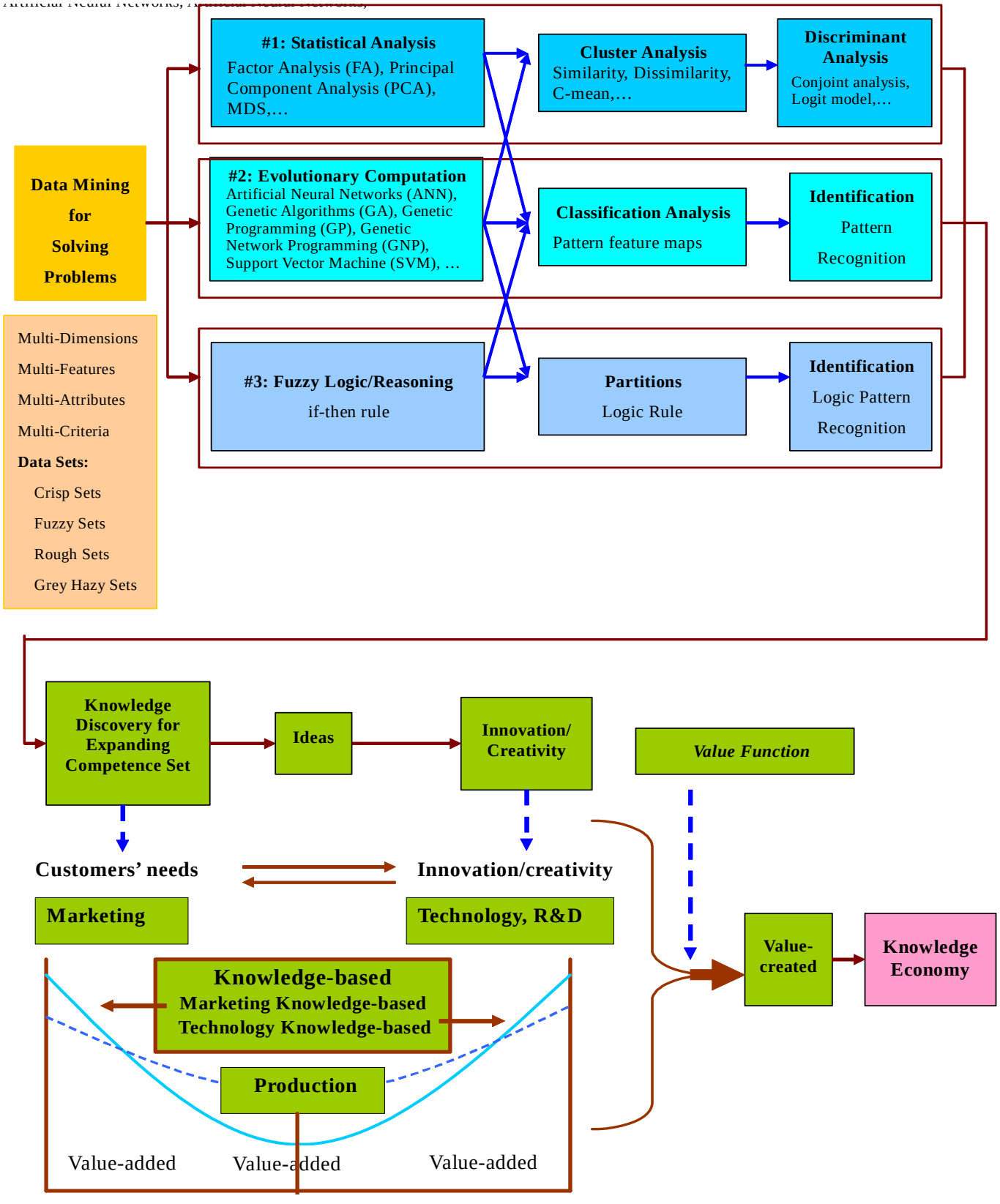

Fig.2 Data Mining Concepts of Intelligent Computation in Knowledge Economy

Grading and Evaluation Criteria	**midterm _____% final _____% class participation _____% other _____% (details _____)**

First Stage: Final examination for testing the concepts of "Research Methods for Problems-Solving and Applications" (50%)

- Final examination: December 9, 2009

Second Stage: "Research Methods" for Problems-Solving and Applications in real cases (50%)

Term Paper (submitted date) (50%)

- Language: English is better.

- Abstract and proposal: December 2, 2009

- Full paper: December 23, 2009

- Final Revised Paper: January 6, 2008

Prescribed Book(s) and Reference Books：

Tzeng, Gwo-Hshiung and Huang, Jih-Jeng (2007), *New Frontiers of Multiple Objective Decision Making*, Kainan University.

Tzeng, Gwo-Hshiung and Huang, Jih-Jeng (2007), *New Frontiers of Multiple Attrative Decision Making*, Kainan University.

曾國雄編著，「統計學問題範例」，鴻儒堂書局，17 頁，民國 70 年。

曾國雄編著 ，「多變量解析應用實例」，民國 69 年，台北市，中興管理顧問，415 頁。

曾國雄編著，「多變量解析與其應用」，民國 67 年，台北市，華泰圖書文物公司，402 頁。

曾國雄編著，「現代統計學」，台北市，鴻儒堂書局，513 頁，1978 年修正。

曾國雄、鄧振源，「多變量分析(一):理論應用篇」，民國 75 年 5 月，松崗電腦圖書公司，491 頁。

曾國雄，個人論文發表文獻。如個人資料(Tzeng's VITA, Journal publications)。

曾國雄等編著，多目標決策分析(I)：多屬性效用之理論與應用講義。

曾國雄等編著，多目標決策分析(II)：多評準決策之理論與應用講義。

曾國雄等編著，多目標決策分析(III)：多目標規劃之理論與應用講義。

中山弘隆、谷野哲三（1994），多目的計劃法之理論與應用，計測字動制御學會。

Keeney, Ralph L. and Raiffa, Howard, (1976), *Decision with Multiple Objectives: Preference and Value Tradeoffs*, John Wiley & Sons.

Hwang, Ching-Lai and Masud, Abu Syed Md. (1979), *Multiple Objective Decision Making: Methods and Applications*, Springer-Verlag.

Saaty, Thomas L. (1980), *The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation*, McGraw-Hill, Inc.

Hwang, Ching-Lai and Yoon Kwangsum (1981), *Multiple Attribute Decision Making : Methods and Applications*, Springer-Verlag, New York.

Chankong, Vira and Haimes, Yacov Y. (1983), *Multiobjective Decision Making: Theory and Methodology*, North-Holland.

Yu, Po-Ling (1985), *Multiple-Criteria Decision Making: Concepts, Techniques, and Extensions*, Plenum Press.

Steuer, Relph E. (1986), *Multiple Criteria Optimization: Theory, Computation, and Application*, Wiley.

Hwang, Ching-Lai and Lin M. J. (1987), *Group Decision Making Under Multiple Criteria*, Springer-Verlag, New York.

Seo, Fumiko and Sakawa, Masatoshi (1987), *Multiple Criteria Decision Making Analysis in Regional Planning: Concepts, Methods, and Application*, D. Reide Publishing Company.

Haimes, Yacov Y., Tarvainen, K., Shima, T. And Thadathil, J. (1990), *Hierarchical Multiobjective Analysis of Large-Scale Systems*, Hemisphere Publishing Corporation.

Yu, Po L. (1990), *Forming Winning Strategies: An Integrated Theory of Habitual Domains*, Springer-Verlag.

Romero, Carlos (1991), *Handbook of Critical Issue in Goal Planning*, Pergamon Press.

Chen, Shu-Jen and Hwang, Ching-Lai, (1992), *Fuzzy Multiple Attribute Decision Making: Methods and Applications*, Springer-Verlag, New York.

Keeney, Ralph L. (1992), *Value-Focused Thinking: A Path to Creative Decision Making*, Harvard University Press.

Lai, Young-Jou and Hwang Ching-Lai, (1992), *Fuzzy Mathematical Programming: Methods and Applications*, Springer-Verlag.

Sakawa, Masatoshi (1993), *Fuzzy Sets and Interactive Multiobjective Optimization*, Plenum Press.

Lai, Young-Jou and Hwang, Ching-Lai, (1994), *Fuzzy Multiple Objective Decision Making: Methods and Applications*, Springer-Verlag.

Saaty, Thomas L. (1994), *Fundamentals of Decision Making and Priority Theory with the Analytic Hierarchy Process*, RWS Publication, Pittsburgh.

Tzeng, G. H., Wang, H. F., Wen, W. P., and Yu, P. L. (1994), *Multiple Criteria Decision Making: Expand and Enrich the Domains of Thinking and Application*, Springer-Verlag.

Sakawa, M. (2000), *Large Scale Interactive Fuzzy Multiobjective Programming*, Physica-Verlag, Heidelberg.

Ehrgott, M. (2000), *Multicriteria Optimization*, Springer-Verlag, Berlin, Heidelberg.

Nishizaki, I. and Sakawa, M. (2001), *Fuzzy and Multiobjective Games for Conflict Resolution*, Physica-Verlag, Heidelberg.

Deb, K. (2001). *Multi-Objective Optimization using Evolutionary Algorithms*, John Wiley & Sons, England.

Osyczka, A. (2002), *Evolutionary Algorithms for Single and Multicriteria Design Optimization*, Physica-Verlag, Heidelberg.

Carlsson, C. and Fuller, R. (2002), *Fuzzy Reasoning in Decision Making and Optimization*, Physica-Verlag, Heidelberg.

Sakawa, M. (2002), *Genetic Algorithms and Fuzzy Multiobjective Optimization*, Kluwer Academic Publishers, Norwell, MA.

Course Description (including outline and course schedule):

- **Sept. 14 (Monday) Over-views**
- **Sept. 21 (Monday) Data processes (Over-view)**
- **Sept. 28 (Monday)** Statistical & multivariate analysis data mining
- **Oct. 5 (Monday)** Data mining (Evolutionary Computation and Soft Computing
- **Oct. 12 (Monday) Multiple Attribute Decision Making (MADM) (Over-view)**
- **Oct. 19 (Monday)** Multi-attribute utility theory and reviews
- **Oct. 26 (Monday)** Multiple attribute evaluation (traditional methods and new methods)
- **Nov. 2 (Monday)** Hybrid MCDM techniques and reviews
- **Nov. 9 (Monday) Multiple Objective Decision Making (MODM) (Over-view)**
- **Nov. 16 (Monday)** MOP for planning and designing the problems and reviews
- **Nov. 23 (Monday)** De Novo programming and reviews
- **Nov. 30 (Monday) Submitted abstract and proposal and overall reviews**
- **Dec. 7 (Monday) Final examination, take home**
- **Dec. 14 (Monday) explain how to answer exam problems and overall reviews**
- **Dec. 21 (Monday) Submit Full paper and repeat over-view for course in applications**
- **Dec 28 (Monday) General comments for full paper and improvement**

- **Jan. 4 (Monday) Submit Final Revised Paper. Paper presentation (Students) and comments**
- **Jan.11 (Monday) Paper presentation (Students) and comments**
- **Jan. 18 (Monday) Paper presentation (Students) and comments**
- **Jan. 25 (Monday) Paper presentation (Students) and comments**

Should the course be lecturing in English, please tick one of the following options:
This course will be one of the IMBA courses. Yes ☐ No ☐

Signature：_____ Date：_____

Final Examination of "Research Methods" for Master Course of Kainan University

First Stage: Concepts of Testing "Research Methods" for Problems-Solving (50%) **2009.05.13**

The purpose of this course "**Research Methods**" for **problems-solving** is to teach the **whole new frontiers** of **methods** in "**techniques in idea, logic reasoning and thinking by systems**" for students to **understand,**

solve, and treat all possible problems in real world. Then the students can **promote** and **expand** their **competence sets and ability** for **solving** and **treating all real problems** in different fields/domains. The contents of this course are including three parts as follows (see **Fig. 1 Basic Concepts of Course Systems in "Research Methods for Problems- Solving"**).

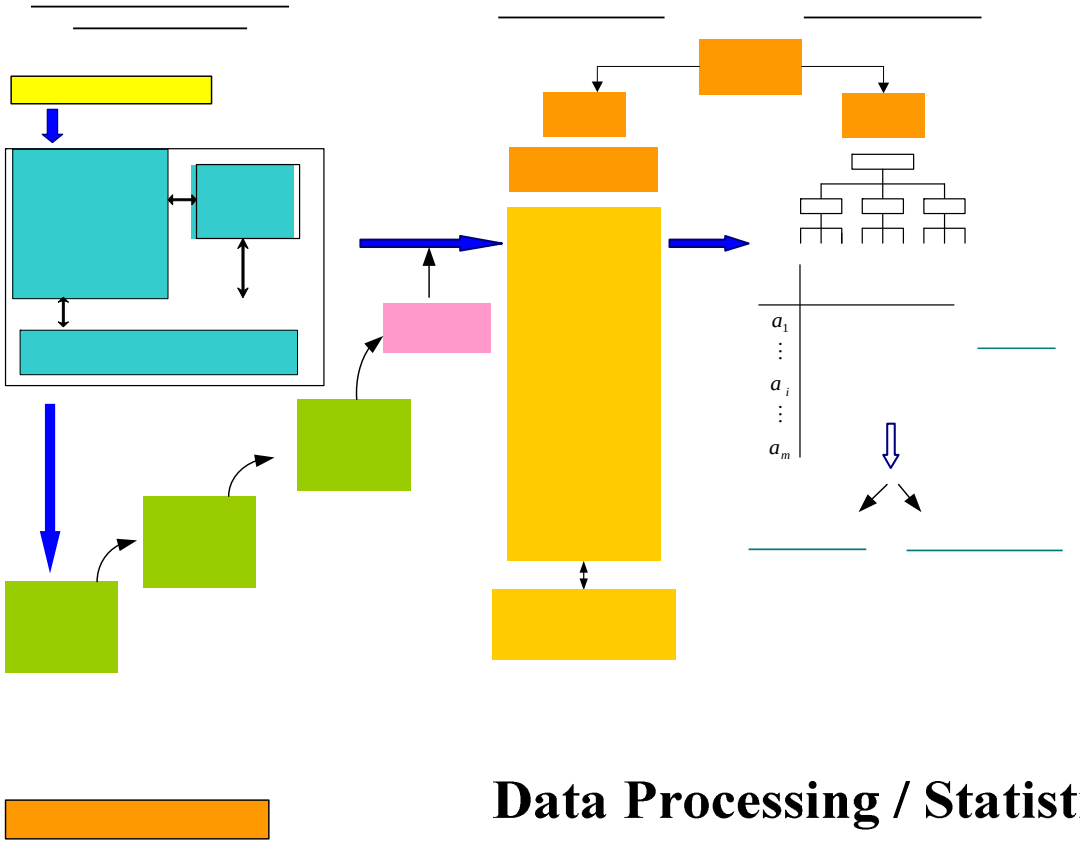

Fig. 1 Basic Concepts of Course Systems in "Research Methods" for Problem-Solving

1. **Data Process**: The main contents include "statistical and multivariate analysis" and "data mining" in evolutionary computation and soft computing for knowledge discovery, the purpose of these techniques is to make analyses and identifications of patterns/clusters/classifications for solving/understanding the problems in knowledge discovery and for prospecting the future in theory and applying to the real cases.
2. **Multiple Criteria Decision Making (MCDM)** refers to making decisions in the presence of multiple, and often simultaneously faced/managed more one, i.e. multiple criteria/objectives with conflicting and non-commensurable criteria in real world. Problems for MCDM are common occurrences in everyday life. Many problems encountered along the way how can we measure, plan/design, evaluate, rank, improve, or select these problems for reducing the gaps to achieve the aspired/desired levels (or grades) forward to number one in practice. The problems of MCDM can be broadly classified into two categories: Multiple Objective Decision Making (MODM) for plan/design and Multiple Attribute Decision Making (MADM) for evaluation/improvement/ selection as follows.

(1). **Plan/Design (MODM)**: The purpose is to focus on analyzing the problems of "plan or design" for multiple objectives/criteria problems to minimize the distance from all objectives/criteria performances (values) to

their goal-level/aspiration-level/ideal-point (called compromise solution), or maximize the achieved level to the goal/aspiration/desired/idea-level (called fuzzy multi-objective programming, including: which goals are fuzzy, parameters are fuzzy, or variables are fuzzy), or how to design to achieve the goal/aspiration/desired-level (called De Novo programming) in theory and apply to the real cases for decision-making in plan and design.

(2) **Evaluation/Improvement/Selection (MADM)**: The purpose is to focus on evaluating each alternative to achieve the degree/grade of level and analyzing the gaps of distance based on network relation map (NRM) by using some techniques, such as DEMATEL, ISM, FCM, SEM, form concept analysis (FCA) and so on for evaluating social network problems (SNPs), etc. And how we can improve and reduce the gaps from performance-values to achieve the aspiration/desired levels in each criterion, and then improve and select the best alternative for making decision in theory and applying to the real cases.

Problem descriptions **Overall (24) + I (686) + II (306) +III (405) +IV (200) = 1621**

We often conduct "**data process analysis**" of objects in problems. This part is to locate in data collection/analysis, information systems (IS) for data mining of knowledge discovery and expanding competence sets, and pattern identifications to understand the problems and prospect the future for making decision. Then we also focus on understanding problems to conduct "**multiple criteria decision making (MCDM)**" including multi-objective programming (multiple objective decision making, **MODM**) and multi-criteria evaluation (multiple attribute decision making, **MADM**)" to propose the problems-solving for alternatives or strategies in finding the problems-solving. This test-exam is to focus on idea, how thinking, how reasoning, and so on. These test-exam processes for problems-solving can be divided into overall, three types and one synthesis/mix type as follows.

[Overall] Idea, thinking and logic reasoning; powerful computation (evolutionary computation and soft computing) **24**

1. **Why idea, thinking** and **logic reasoning** are very **important** in this course "**Research Methods for Problems-Solving**" in real world? {4 + 4 + 3 = **12**}
2. **Please based on "why, how, what" explain** this **new frontiers** course **"Research Methods for Problems-Solving" (see Fig. 1 Basic Concepts of Course Systems)** is different from **traditional text books** of "**Research Methods**" for **practices** in **course design**. **{4 + 4 + 4 = 12}**

[Type I] Data Process in Statistical & Multivariate Analysis and Data Mining of knowledge discovery for Expanding Competence Sets **686**

1. Please **take an example** in any real cases (objects) to **explain** as flowing questions:
{12+8+16 =**36**}

(1) Please based on **Fig.1 to take an example**: **(a) how** can we **preliminarily analyze** and **understand** the characteristics of problems (as **features/attributes/criteria/variables** of objects) in your research? Then, **(b) which/how data** or **information** should be **collected/gathered** or **surveyed** for getting/obtaining the **data**

sets shown as matrix $\boldsymbol{X}$ or shown **information system** as $IS = (U, A, V, f)$ for **knowledge discovery**? **(c)** Why and reasons? [4 + 4 + 4 = 12]

(2) Please take **an example** to explain **which** data set should be collected/gathered as following main three parts: **(a)** real situations/environments of objects which have many features/attributes/ criteria/variables; **(b)** responses in recognition or perception (subjective/intuition) by using natural language (often); **(c)** personal or social attributes in e-era? Why? [4 + 4+4 =8]

[To remind how to use example such as: completely do not pay importance or satisfaction/ attention ← 0,1,2,3,4,5,6,7,8,9,10 →extremely importance or satisfaction]

(3) Please take **an example** to explain: **(a) which** kinds of the survey should **be conducted** in general? **(b)** How make "**questionnaire design**"? And **(c)** how do "**sampling design**" for obtaining **data sets** (including: explain how to design to survey/gather crisp sets and fuzzy sets data)? **(d**) **Why (reasons)**? [To remind how **random sampling** can be considered?]

[4 + 4 + 4 +4= 16]

↓{12 +12+ 79=**111**}

2. (1) Please take **an example** to explain (a) **how** and **why** we often need to use "**Fuzzy Set Theory** or **Rough Set Theory**" and (b) **why** "**Fuzzy Set Theory and Rough Set Theory**" is very **popular** and **important** in recent 20-30 years and future trends prospective to apply to real case for solving and analyzing real problems in **imprecise environment** by natural language (linguistics)**?** [8+8 =16]

References

- Lotfi A. Zadeh (2006), "A New Frontier in Computation: Computation with Information Described in Natural Language Computer Science Division, IEEE on SMC'06, Taipei, Taiwan, October 9, 2006, guest speaker.
- Lotfi A. Zadeh (2008), "Computation with Imprecise Probabilities—A Bridge to Reality", RSCTC'08, University of Akron and Akron, Ohio, October 24, 2008, guest speaker.

(2) Please explain the **basic concepts** and **how/which** applications of **"rough set theory".** And also **how** and **why**, and **which advantage** since Professor Pawlak proposed "rough sets" (in International Journal of Computer and Information Sciences 11(5): 341-356, 1982), rough set theory and its applications in real case are grown as fast as well in "data mining", "multicriteria decision analysis" (Slowinski et al. proposed, please to read power-point and papers in the files of international summer school on MCDM and my papers) and so on**?** [8 + 8 =16]

[Note] Search: http://scholar.google.com Z. Pawlak → many papers

References

- Walczak, B. and Massart, D.L. (1999), Rough sets theory (Tutorial), Chemometrics and Intelligent Laboratory Systems 47(1), 1–16.

Tzeng's papers:

- **Interval multidimensional scaling for group decision using rough set concept**

Expert Systems with Applications, Volume 31, Issue 3, October 2006, Pages 525-530

Jih-Jeng Huang, Chorng-Shyong Ong, **Gwo-Hshiung Tzeng**

Preview PDF (128 K) | Related Articles

- **Rough Set Theory in analyzing the attributes of combination values for the insurance market**, *Expert Systems with Applications, Volume 32, Issue 1, January 2007, Pages 56-64*

Jhieh-Yu Shyng, Fang-Kuo Wang, **Gwo-Hshiung Tzeng**, Kun-Shan Wu

Preview PDF (164 K) | Related Articles

- Yu-Ping Ou Yang, How-Ming Shieh, **Gwo-Hshiung Tzeng**, Leon Yen4, and Chien-Chung Chan (2008), Business Aviation Decision-Making using Rough Sets, RSCTC 2008, Springer-Verlag in the Lecture Notes on Artificial Intelligence (LNAI) series. EI

- Chien-Chung Chan and **Gwo-Hshiung Tzeng** (2008), Dominance-Based Rough Sets Using Indexed Blocks as Granules, **Fundamenta Informaticae** (selected for an additional publication in the special issue of the "Fundamenta Informaticae" entitled "Fundamentals of Knowledge Technology"), **Science Citation Index-Expanded** (SciSearch®), Zentralblatt MAT.

- Chien-Chung Chan and **Gwo-Hshiung Tzeng** (2008), Computing Approximations of Dominance-Based Rough Sets by Bit-Vector Encodings, RSCTC 2008, Springer-Verlag in the Lecture Notes on Artificial Intelligence (LNAI) series. **EI**

- Jhieh-Yu Shyng, How-Ming Shieh, Gwo-Hshiung Tzeng, Shu-Huei Hsieh, Using FSBT Technique with Rough Set Theory for Personal Investment Portfolio Analysis, **European Journal of Operational Research (Accepted, No. EJOR-D-07-01409R3)**

Using FSBT technique with Rough Set Theory for personal investment portfolio analysis

*European Journal of Operational Research, **In Press, Corrected Proof**, Available online 29 March 2009,*

Jhieh-Yu Shyng, How-Ming Shieh, **Gwo-Hshiung Tzeng**, Shu-Huei Hsieh

Preview PDF (219 K) | Supplementary Content | Related Articles

(3) How the traditional "**Multivariate Analysis**", such as "Discriminant Analysis", "Logit Model (or Conjoint Analysis) etc." had been big change, and change to new development by "**soft computing**" and "**evolutionary computation**", i.e., combined "fuzzy integral" technique or "Support Vector Machine", and change to use, such as "Artificial Neural Network (ANN), Genetic Programming (GP), Two-Stage Genetic Programming (TSGP), Genetic Network Programming (GNP)" and combined SVM (support vector machine) for increasing the distinguished quality and so on? **Why? based on the presentation PowerPoints of Professor** 古月敬之 Jinglu Hu (Takayuki Furuzuki) on Nov. 3-4, 2008; **(4)** Please read the following papers, and then summarize to describe the **basic points** (including concepts and theory of methods) and **comment** these papers, and these papers which are the **best contributions** respectively? **(5)** Please take one example to explain **how** to **do creating/developing some new paper** to improve/combine methods or use/create new method(s) based on the **presentation PowerPoints** of Professor Takayuki Furuzuki?

[(3+3+3=**9**) + (3+3+4=**10**) + (6) + ((6+6)x4=48) + (6)= **79**]

- **A real-valued genetic algorithm to optimize the parameters of support vector machine for predicting bankruptcy**, *Expert Systems with Applications, Volume 32, Issue 2, February 2007, Pages 397-408*, Chih-Hung Wu, **Gwo-Hshiung Tzeng**, Yeong-Jia Goo, Wen-Chang Fang

  Preview PDF (392 K) | Related Articles

- **A Novel hybrid genetic algorithm for kernel function and parameter optimization in support vector regression**, *Expert Systems with Applications, Volume 36, Issue 3, Part 1, April 2009, Pages 4725-4735*, Chih-Hung Wu, **Gwo-Hshiung Tzeng**, Rong-Ho Lin

  Preview PDF (845 K) | Related Articles

Huang, J. J., Tzeng, G. H., Ong, C. S. (2007), Marketing segmentation using support vector clustering, **Expert Systems with Applications**, 32(2): 313-317.

Huang, J. J., Ong, C. S. and **Tzeng, G. H. (2005)**, "Building Credit Scoring Models Using Genetic Programming", **Expert Systems With Applications, 29(1):** 41-47**.**

Huang, J. J., Tzeng, G. H. an**d** Ong, C. S. (2006), "Two-Stage Genetic Programming (2SGP) for the Credit Scoring Model", **Applied Mathematics and Computation.** 174(2): 1039-1053.

3. Based on **Fig.2 Data Mining Concepts of Intelligent Computation in Knowledge Economy**

{57+80=**137**}

(1) Please explain the **basic concepts of theory** in traditional "**multivariate analysis**" methods, including: **(a)** Principle Component Analysis (**PCA**, including **Fuzzy PCA**), Factor Analysis (FA, including **Fuzzy** FA), Multi-dimension Scale (MDS), Quantitative Theory III & IV; **(b)** "Cluster Analysis" (including similarity and dissimilarity), "C-mean and Fuzzy C-mean", **(c)** "Discriminant Analysis", "Logit Model (Conjoint Analysis)"; **(d)** "**L**inear **S**tructure **E**quation **M**odel (**LISEM**, or called **SEM**); **(e)** please take **an example** to **explain how** use **these** methods for applying to **marketing problems** or **finance problems or other problems**? **(f) How** use/introduce **new hybrid intelligent computation** methods to solve these problems for comparing these traditional methods? [Why (reasons)?]

{[(6+6+3x3 =**21**) + ((3+3) + (3+3) = **12**) + (6+4=**10**) + (**4**) + (**4**) + (3+3 = **6**) = **57]}**

(2) Please read the following papers, **(a)** then summarize to describe the **basic points** (including basic concept and theory of **methods**) and **(b) comment** these papers, **(c)** these papers **which** are the **best contributions** respectively? Why? **(d) How improve** these papers for developing some new and good papers (idea)? As follows: [4x4x5(five papers) = **80**]

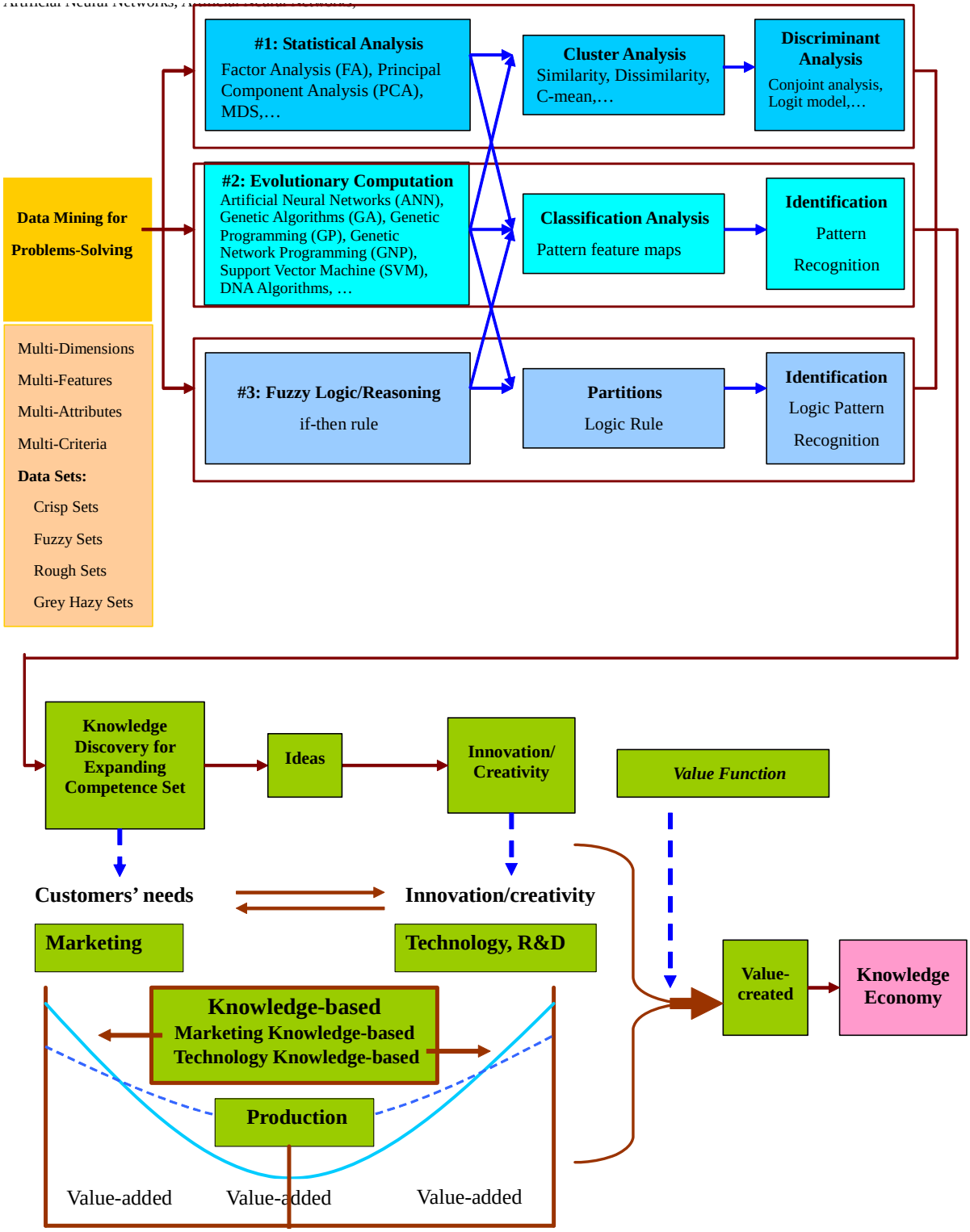

Fig.2 Data Mining Concepts of Intelligent Computation in Knowledge Economy

曾國雄，曹勝雄，廖耀東，「台北都會區土地使用形態與環境品質之研究」，都市與計劃，第十九卷，第一期，頁33-52，民國81年。

曾國雄、李銘輝，「台北縣觀光遊憩類型特性之分析」，台銀季刊，第四十二卷，第一期，頁383-408，民國80年3月。

Shee, Daniel Y. and Tzeng, G. H. (2002), "The Key Dimensions of Criteria for the Evaluation of ISPs: An Exploratory Study, **Journal of Computer Information System,** 42(4): 112-121.

Tzeng, G. H., Jen, W. and Hu, K. C. (2002), "Fuzzy Factor Analysis for Selecting Service Quality Factors: A case of the Service Quality of City Bus Service", **International Journal of Fuzzy Systems**, 4(4): 911-921.

Chen, M. F., Tzeng, G. H. and Ding, C. G. (2008), "Combing fuzzy AHP with **MDS** in identifying the preference similarity of alternatives", **Applied Soft Computing,** 8(1): 110-117.

4. Forecasting models {154+80=**234**}

(1) Please take **an example** to explain: **(i)** concepts, **(ii)** basic theory, **(iii)** assumption(s), **(iv)** purpose of methods, and (v) how applications (you can take **one example** to explain in **real case**), and **(vi)** comparing **how/which** different function/advantage in uses/applications, **(vii) how judgment** the methods can be used and **which method** is better, as following forecasting models respectively: **(a)** Multi-regression Model (including using original and standardized data, assumption(s), approximate limit(s), etc.), **(b)** Fuzzy Multi-regression Model, **(c)** Interval Regression Analysis by Quadratic Programming, **(d)** Fuzzy Piecewise regression Model, **(e)** Fuzzy Multiple Objective Programming in Interval Piecewise Regression Model, **(f)** Grey Forecasting, **(g)** Possibility Grey Forecasting, **(h)** ARIMA and Fuzzy ARIMA, **(i)** Artificial Neural Network, **(j)** Support Vector Machine (SVM), **(k)** Stochastic Process for forecasting, **(l)** Markov Chain forecasting. **(2 scores) x (7answer items (i)~(vii)) x (11 methods (a)~(l)) = 154**

(2) Please read the following five papers, and then (a) summarize to describe the basic points (including basic concepts and theory of methods) and **(b)** comment these papers, these six papers which are the best contributions respectively? **(c)** How improve these four papers for developing new and good papers again (idea)? As follows: {[(4+4) + (4+4)] x **5** = **80**}

Tzeng, G. H. (1989), Modeling Energy Demand and Socioeconomic Development of Taiwan, The Energy Journal, 10(2): 133-153.

Yu, J. R., **Tzeng, G. H.,** Li, H. L. (2005), "Interval Piecewise Regression Model with Automatic Change-Point Detection by Quadratic Programming", International **Journal of Uncertainty, Fuzziness and Knowledge-Based Systems, 13(3):** 347-361.

Yu, J. R., **Tzeng, C. H.** (2008), "A Fuzzy Multiple Objective Programming in Interval Piecewise Regression Model", **International Journal Uncertainty, Fuzziness and Knowledge-Based Systems.** (**Accepted**).

Chen, H. C., Hu, Y. C., Shyu, Joseph Z., Tzeng, G. H. (2005), Comparing Possibility Grey Forecasting with Neural Network-based Fuzzy Regression by an Empirical Study, **Journal of Grey System,** 8(2):93-106.

Tseng, F. M., Yu, H. C., and **Tzeng, G. H. (2002),** Combining neural network model with seasonal time series ARIMA model, **Technological Forecasting and Social Change**, 69(1): 71-87.

Huang, C. Y., Tzeng, G. H. (2008), Multiple generation product life cycle predictions using a novel two-stage fuzzy piecewise regression analysis method, **Technological Forecasting and Social Change**, **75(1):** 12-31.

5. Many methods can be used to measure "relations" among criteria/attributes, such as measuring

"**correlations**" and "**SEM**" each other criteria/attributes, measuring "**impact relations**" each other criteria/attributes, or measuring "**structure relations**" each other criteria/attributes, and so on for building "**networ**k **relations map (NRM)**", Questions: {70+18+80=**168}**

(1) Please list all methods of measuring "**relations**" and take an example to explain the **basic theory and concept**, **implications**, **functions**, **uses for applying/solving which problems and so on** in each method, why (reasons)? [2scores x 5answer-items x 7methods = 70]

(2) Please refer **Fig.2** and use the concepts of **"smile curve"** to explain: **(a) which** and **how** methods and **why** can be used to build **"network relations map (NRM)"** in multi-criteria analysis, and then **(b)** how evaluate the marketing situations based on **"network relations map"**? **(c)** How set the **strategic planning** to improve and reduce the **gaps** for achieving/satisfying the customers' needs by using innovation/creativity to increase the value-added, why (reasons)? [6 x 3 = 18]

(3) Please read the following papers, and then (a) summarize to describe the basic points (including basic concepts and theory of methods) and (b) comment these papers, these papers which are the best contributions respectively? (c) How improve these papers for developing some new and good papers again (idea)? {[(4+4) + 4 + 4] x **5** = 80}

Lu, C. S., Lai, K. H. and Cheng, T. C. E. (2007), Application of Structural Equation Modeling to Evaluate the Intention of Shippers to Use Internet Services in Linear Shipping, **European Journal of Operational Research**, 180(2): 845-867.

Chiu, Y. J., Chen, H. C., Shyu, Joseph Z., Tzeng, G. H. (2006), Marketing Strategy Based on Customer Behavior for the LCD-TV, **International Journal and Decision Making, 7(2/3): 143-165.**

Tzeng, G. H., Chiang, Chiang, C. H., Li, C. W. (2007), Evaluating Intertwined Effects in E-learning Programs: A Novel Hybrid MCDM Model Based on Factor Analysis and DEMATEL, **Expert Systems With Applications, 32**(**4): 1028-1044.**

Hsu, C.Y., Chen, K. T., Tzeng, G. H. **(2008),** FMCDM with Fuzzy DEMATEL Approach for Customers' Choice Behavior Model, **International Journal of Fuzzy Systems,** 9(4): 236-246.

Huang, C. Y., Shyu, Joseph Z., Tzeng, G. H. (2007), Reconfiguring the innovation policy portfolios for Taiwan's SIP Mall industry, **Technovation,** 27(12): 744-765.

Ou Yang Y. P., Shieh, H. M., Leu, **J. D., Tzeng, G. W. (2008),** A novel hybrid MCDM model combined with DEMATEL and ANP with applications**, International Journal of Operations Research, 5(3), 1-9.**

Ou Yang, Y. P., Leu, J. D., **Tzeng, W. H.** (2009), A VIKOR-Based Multiple Criteria Decision Method for Improving Information Security Risk, **International Journal or Information Technology and Decision Making (Accepted**)

[Type II] Plan and Design for Multiple Objective Decision Making (MODM) **306**

1. Main basic methods of **MODM** (multiple objective decision making) are including such as: **(a)** "**Goal**

Programming", **(b)**"**Compromise Solution**" (including with and without weightings), **(c)** "**Fuzzy Multi-Objective Programming**" (including goal fuzzy and parameter fuzzy, without and with weightings), **(d)** "**Two Phase Fuzzy Multi-Objective Programming"**, **(e) "Two/Bi-Level Multi-Objective Programming**", **(f)** "**Multi-Level Multi-Objective Programming**", **(g)** "**Multi-stage Dynamic Multi-Objective Programming**", **(h)** "**Fuzzy + Multi-level and Multi-stage Dynamic Multi-Objective Programming**", **(i)** "**De Novo Programming**", **(j)** "**De Novo Win-Win Game**" and so on. The **algorithm** development is very fast in "**evolutionary computation**" for "Multi-objective Optimal Programming Problem" since 1989, such as "GA in search, Opt. and Machine Learning" by Goldberg, D.E. (1989); "GA + Data Structure = Evolutionary Programming" by Michalewicz, Z. & Schoenauer, M. (1992, 1994, 1996); "Multi- Objective Optimization using Evolutionary Algorithms" by Deb, K. (2001). {16+150+58=**224**}

(1) Please take an example to explain the basic concepts/ideas of multi-objective optimization problem (including: (a) "**decision space**", (b) "**objective space**", (c) "**trade-offs"**, (d) "**Pareto optimal solutions** (or called "non-inferior solutions, non-dominated solutions, efficient solutions, and so on)".

[4 scores x 4 ((a)~(d)) =16]

(2) Please take an example to explain above **(a) ~ (j)** methods: **(i)** basic concept, (ii) basic theory, **(iii)** purpose (implications) of method, **(iv)** how to solve these models, and (v) to explain how applications in real world case (you can take example or real case as following **papers**)?

[3 x 5 x 10 = 150]

(3) Please read the following papers, and then **(a)** summarize to describe the **basic points**, including basic concepts and theory of methods, and **(b)** comment these papers, these papers which are the best contributions respectively? **(c)** How improve these papers for developing some new and good papers again (idea, including how to introduce new "Evolutionary Computation" and by using "Evolutionary Computation" and "Soft Computing" methods for solving these problems)? **(d)** Please take an example to explain how to build a real case in multi-objective programming by using genetic algorithms or other new algorithms. {[(4+4) + (3+3) + (4)] x **3** + 4 = 58}

Tzeng, G.-H., Tang T.-I., Hung, Y.-M., Chang, M.-L. (2006), Multiple-objective planning for a production and distribution model of the supply chain: case of a bicycle manufacturer, **Journal of Scientific & Industrial Research**, 65, 309-320.

Tzeng, G. H., Cheng, H. J., Huang, T. D. (2007), Multi-objective Optimal Planning for Designing Relief Delivery Systems, **Transportation Research Part E: Logistics and Transportation Review,** 43(6): 673-686.

Huang, J. J., Ong, C. S., **Tzeng, G. H. (2005),** Building Credit Scoring Models Using Genetic Programming", **Expert Systems With Applications, 29**(**1**): 41-47.

Huang, J. J., Tzeng, G. H., Ong, C. S. (2006), Optimal fuzzy multi-criteria expansion of competence sets using multi-objectives evolutionary algorithms, **Expert Systems with Applications**, 30(4): 739-745.

[(14) + (8) + 60 = **82**] ↓

2. **Break-through** the traditional **habitual domain (HD, proposed by Professor P.L. Yu in 1980s)**, the **environment is dynamic**, **technology is progress**; **resources** can be **substituted/shared, alliance/wining coalition, cooperative** and can be **innovative/creative**, and so on. Therefore, questions:

   (1) How based on basic consideration in **De Novo Programming**, **(a)** take an example to explain **how** use the basic concept of "**De Novo programming**" and **(b)** "**De Novo Win-Win game**" to apply to the real case of enterprise in **business strategies** as **alliance/wining-coalition**, or **mergers** and **acquisitions (M&A)**, or **joint ventures**, or **win-win game** and so on for obtaining the "**win-win strategies**"?
   6+8=14

   (2) Please explain **how** can **break-through** "**habitual domain (HD)**" to pursue the **goals for achieving aspirated/desired level** forward to **number-one** of the world, **and** how can **improve** the problems to enhance/promote the business competitiveness? 4+4=8

   (3) Please read the following papers, and then **(a)** summarize to describe the **basic points** (including **basic concepts** and **theory** of methods) and **(b) comment** these papers, these papers which are the best contributions respectively? **(c)** How based on above concepts (De Novo Programming as these papers) to **improve these papers** for **developing some or one new and good paper(s)** which focus on horizontal integration, or vertical integration, or others with strategic alliances or **wining-coalition**, and so on for promoting the industries forward to achieving number-one of the world in competitiveness?
   [(4+4) + 6 + 6] x 3= 60

Ong, C. S., Huang, J. J., and Tzeng, G. H. (2005), Motivation and Resource Allocation for Strategic Alliance through De Novo Perspective, **Mathematical and Computer Modeling,** 41(6-7): 711-721.

Huang, J. J., **Tzeng, G. H.,** Ong, C. S. (2006), Choosing Best Alliance Partners and Allocating Optimal Alliance Resources Using the Fuzzy Multi-Objective Dummy Programming Model, **Journal of Operational Research Society,** 57(10): 1216-1223.

Huang, C. Y. and Tzeng, G. H. (2007), "Post-Merger High Technology R&D Human Resources Optimization Through the De Novo Perspective", in: Advances in Multiple Criteria Decision Making and Human Systems Management: Knowledge and Wisdom, Edited by Young Shi, David L. Olson, Antonie Stam, IOS Press, pp.47-64.

[Type III] Evaluation/Selection for Multiple Attribute Decision Making (MADM) **405**

In evaluation/selection problems for **MADM** (Multiple Attribute Decision Making), generally we should get/build the "**structure relations**" (or called **"network relations map (NRM)"**) among criteria for deciding the preference weightings (**AHP** or **fuzzy AHP**, **independence**; **ANP** or **fuzzy ANP**, **dependence** and **feedback**; **fuzzy integral**, **inter-relationship**) among criteria, and combined the performance matrix data for evaluating the alternatives (**SWA, Grey Relation, TOPSIS, VIKOR, PROMETHEE, ELECTRE, Fuzzy Integral, ANN**

(Artificial Neural Network), Rough Set Theory for MCDM/MADM, etc.). Then we can find the **synthetic index** or **patterns for scorings**, and evaluate each alternative to achieve the **degree of aspired/desired level** and analyze the **gaps** of distance from performance-value to **achieve the aspired/desired levels** in each criterion, and then select or improve the optimal alternatives or set the strategies for **reducing the gaps** in making decision to achieve "**win-win**" **strategies** in theory and applying to the real cases.

1. Please **(1)** explain the concepts/ideas, purpose, functions and why we need to take these methods such as **SEM/LISEM** (Linear Structure Equation Model), **ISM** (or Fuzzy ISM), **DEMATEL** (or Fuzzy Cognitive Map) etc. for building/re-structuring the "**network relations map (NRM)**"? And **(2)** compare these methods which method is better? Why (reasons)? **(3)** Please read the following papers, and then (a) summarize to describe the basic points (including basic **concepts** and **theory** of methods) and (b) **comment** these papers, these papers **which** are the best contributions respectively? (c) How improve these papers for developing some new and good papers again (idea) for problems-solving in real problems?

   [4+4+4] + [4+4] + [(4+4) + (4 + 4)+ 6]x**4**= 108}

   Yu, R. and Tzeng, G. H. (2006), A soft computing method for multi-criteria decision making with dependence and feedback, Applied Mathematics and Computation, 180(1), 63-75.

   Liou, James J. H., Tzeng, G. H., Chang, H. C. (2007), Airline safety measurement using a hybrid model, Journal of Air Transport Management, 13(4), 243-249.

   Huang, C. Y., Shyu, J. Z., Tzeng, G. H. (2007), Reconfiguring the innovation policy portfolios for Taiwan's SIP Mall industry, Technovation, 27(12), 744-765.

   Yang, J. L., Chiu, H. N., Tzeng, G. H., Yeh, R. H. (2008), Vendor selection by integrated fuzzy MCDM techniques with independent and interdependent relationships, Information Science,

   Ou Yang Y. P., Shieh, H. M., Leu, **J. D., Tzeng, G. W. (2008),** A novel hybrid MCDM model combined with DEMATEL and ANP with applications**, International Journal of Operations Research, 5(3), 1-9.**

   Ou Yang, Y. P., Leu, J. D., **Tzeng, W. H.** (2009), A VIKOR-Based Multiple Criteria Decision Method for Improving Information Security Risk, **International Journal or Information Technology and Decision Making (Accepted**)

2. Please **(1)** explain basic concept, theory, purpose and so on of fuzzy integral and combine other methods for solving real problems in following papers; **(2)** read the following papers, then **(a)** summarize to describe the **basic points** (including basic concepts and theory of methods) and **(b)** How based on above concept (setting the strategies by alliance/innovation/creativity for achieving aspired/desired levels as targets) to **comment** and **improve these four papers** for **developing some new and good (high level) papers** again for problems-solving in real problems? {[(4+4) + (4+4)] x 5 = 80}

   Tzeng, G. H., Ou Yang, Y. P., Lin, C. T., Chen, C. B. (2005), Hierarchical MADAM with Fuzzy Integral for Evaluating Enterprise Intranet Web Sites, **Information Sciences, 169**(**3-4)**, 409-426.

   Chiou, H. K., Tzeng, G. H. (2002), Fuzzy Multiple-Criteria Decision-Making Approach for Industrial Green Engineering", **Environmental Management,** 30(6), 816-830.

Evaluating sustainable fishing development strategies using fuzzy MCDM approach

Omega, Volume 33, Issue 3, June 2005, Pages 223-234

Hua-Kai Chiou, **Gwo-Hshiung Tzeng**, Ding-Chou Cheng

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Liou, James J. H. and Tzeng, G. H. (2007), A non-additive model for evaluating airline service quality, Journal of Air Transport Management, 13(3), 131-138.

Liou, James J.H., Yen. Leonn, **Gwo-Hshiung Tzeng (2008)**, Building an effective safety management system for airlines, *Journal of Air Transport Management*, 14(1): 20-26.

Chu, M. T., Shyu, Joseph Z., Tzeng, G. H. (2007), Using Non-Additive Fuzzy Integral to Assess Performances of Organization Transformation via Communities of Practice, **IEEE Transactions on Engineering Management,** 54(2), 327-339.

3. Please explain **(1) basic new concepts**, **theory**, **purpose** and so on of **TOPSIS** and **VIKOR** methods and **combine other methods** (as weighs by **AHP** or **ANP**, **and based on DEMATEL or ISM for building the NRM**) for solving real problems; **(2)** Why TOPSIS method can not be used to ranking? **(3)** Why DEMATEL technique becomes a hot hybrid MCDM method, such as "Combined DEMATEL technique with a novel MCDM method for evaluating/improving the …"? **(4)** Why our paper "Opricovic, S., Tzeng, G. H. (2004), Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS, European Journal of Operational Research, 156(2), 445-455" can be highly cited in the world? **(5)** Please read the following papers, then **(a)** summarize to describe the **basic points** (including basic concept and theory of methods) and **(b) comment** these papers, these papers which are the best contributions respectively? **(c)** How based on above concept for setting the strategies to **reduce gaps** by alliance/innovation/ creativity for achieving **aspired/desired levels in each criterion**) to **comment** and **improve these papers** for **developing some new and good (high level) papers** again for problems- solving in real problems?

(3x3x2 + 8) + (4) + (6) + (6) +[(3+3) + (3+3)+4]x6 = 126

Chen, M. F., Tzeng, G. H. (2004), Combining grey relation and TOPSIS concepts for selecting an expatriate host country, Mathematical and Computer Modelling, 40(13), 1473-1490.

Opricovic, S., Tzeng, G. H. (2004), Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS, European Journal of Operational Research, 156(2), 445-455.

Opricovic, S., Tzeng, G. H. (2007), Extended VIKOR method in comparison with outranking methods, European Journal of Operational Research, 178(2), 514-529.

Kuo, M. S., Tzeng, G. H., Huang, W. C. (2007), Group decision-making based on concepts of ideal and anti-ideal points in a fuzzy environment, Mathematical and Computer Modelling, 45(3-4), 324-339.

Chu, M. T., Shyu, J., Tzeng, G. H., Khosla, R. (2007), Comparison among three analytical methods for knowledge communities group-decision analysis, Expert Systems with Applications, 33(4), 1101-1024.

Yu-Ping Ou Yang, Jun-Der Leu, **Gwo-Hshiung Tzeng** (2009), A VIKOR-Based Multiple Criteria Decision Method for Improving Information Security Risk, **International Journal or Information Technology and Decision Making**, Vol.8, No.2, 2009 **(Accepted, SCI, IF: 0.718, 2007).**

A value-created system of science (technology) park by using DEMATEL

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Wen-Shiung Lee, **Gwo-Hshiung Tzeng**, Jyh-Liang Guan, Kuo-Ting Chien, Juan-Ming Huang

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4. Please **(1)** explain **basic concept**, **theory**, **purpose** and so on of **fuzzy operations** in **Fuzzy MCDM** techniques and combine other methods (as **AHP** (fuzzy AHP) or **ANP (fuzzy ANP)** or **Fuzzy Integral** based on **Network relations-map** (NRM) among criteria) for solving real problems; **(2)** read the following papers, then **(a)** summarize to describe the **basic points** (including basic concepts and theory of methods) and **(b) comment** these papers, these papers which are the best contributions respectively? **(c)** How based on above concept (setting the strategies to **reduce gaps** by alliance/innovation/creativity for achieving **aspired/desired levels**) to **comment** and **improve these papers** for **developing some new and good (high level) papers** again for problems-solving in real problems? As follows:

{[(3+3+3) x 3] + [(3+3) + (3+3) + 4] x 4 = 91}

Hsieh, T.Y., Lu, S.T., Tzeng, G.H. (2004), Fuzzy MCDM approach for planning and design tenders selection in public office buildings, International Journal of Project Management, 22(7), 573-584.

Chiou, H. K., Tzeng, G. H., Cheng, D. C. (2005), Evaluating sustainable fishing development strategies using fuzzy MCDM approach, Omega **(International Journal of Management Science), 33(3)**, 223-234.

Chou, T. Y., Chou, S. T., Tzeng, G. H. (2006), Evaluating IT/IS investments: A fuzzy multi-criteria decision model approach, European Journal of Operational Research, 173(3), 1026-1046.

Ou Yang, Y. P., Shieh, H. M., Jun-Der Leu, J. D., Tzeng, G. H. (2008), A novel hybrid MCDM model combined with DEMATEL and ANP with applications, International Journal of Operations Research, **5(3), 1-9.**

[Type IV] Mixed Problems and Rough Set Theory **200**

1. DEA method

DEA method is to use the performance evaluation of multi-inputs and multi-inputs for measuring productive efficiency by using mathematical programming including **non-network DEA**, **Network DEA, MOP DEA, MOP Network DEA**. This method is proposed by Charnes, A., Cooper, W.W. and Rhodes, E. (called CCR model) in 1978; through Banker, R.D., Charnes, A. and Cooper, W.W. (called BCC model in 1984; to imprecise data in DEA by Cooper, C.C., Park, K.S., and Yu, G. in 1999; Chiang, C.I. and Tzeng G.H. also proposed the **Multiple Objective Programming (MOP)** Approach to DEA (**MOP DEA**) in 2000; and 2000 after many papers of **Fuzzy DEA, Fuzzy Network DEA** were published for performing and improving the future under uncertainty environment; in recent **Network DEA** was also proposed by Fare et al.

{[3x6=18] + [3x6=18] + [(3+3) + (3+3) + 4] x **5** (select five papers)= 116}

(1) Please explain **how/why** to produce these different approaches (DEA, MOP DEA, Fuzzy DEA Network DEA, MOP Network DEA, Fuzzy Network DEA, etc.) in **(a)** basic concept/idea of theory, and **(b)** for treating or solving which different problems or which methods suit the real problems, why (reasons) ? (3x6=18)

(2) Please take **an example** in real world/case, we will use which approach for suitably treating/solving the practical problems? Why your approach can be best for achieving research purpose? Please explain the why reasons. (3x6=18)

(3) Please read the following papers, and then **(a)** summarize to describe the **basic points** (including basic concepts and theory of methods) and **(b) comment** these papers, these papers which are the best contributions respectively? **(c)** How based on above concepts to **improve these papers** for **developing some new and good papers** for problems-solving in real problems?

[(3+3) + (3+3) + 4] x **5** **= 80**

Yu, J. R., **Tzeng**, G. H., Chiang, C. I., Sheu, H. J. **(2007)**, Raw material supplier ratings in the semiconductor manufacturing industry through fuzzy multiple objectives programming to DEA, **International Journal of Operations and Quantitative Management**, *Volume* **13**, *Number* **4**, *December* 2007, *pp*. 101-111.

Yu, J.R., Tzeng, Y.C., Tzeng, G.H., Yu, T.Y. and Sheu, H.J. (2004), A Fuzzy Multiple Objective Programming to DEA with Imprecise Data, ***International Journal of UNcertanity, Fuzziness and Knowledge-Based System***, 12(5), 591-600.

Tsai, H. C., Chen, C. M., Tzeng, G. H. (2006), The comparative productivity efficiency for global telecoms, International Journal of Production Economics, 103(2), 509-526.

Chiang, C. I. and **Tzeng, G. H.** (2000)**,** A Multiple Objective Programming Approach to Data Envelopment Analysis, Shi, Y. and Zeleny, M. (eds) "New Frontiers of Decision Making for the Information Technology Era", **World Science Publishing Company,** pp. 270-285.

Guo, P., Tanaka, H. (2001), Fuzzy DEA: a perceptual evaluation, Fuzzy Sets and Systems, 119(1), 149-160.

Cooper, W. W., Park, K. S., Yu, Gang (1999), IDEA and AR-IDEA: Models for Dealing with Imprecise Data in DEA, Management Science 45(4), 597-607.

2. Rough Set Theory

Rough set theory was proposed by Pawlak in 1982. Please based on following paper explain **(1)** the basic concept, theory, and applications of rough set theory? **(2)** How many measures for measuring the quality? **(3)** How much methods can show the causal effects in the rule clusters? **(4)** Please read the following papers, and then **(a)** summarize to describe the **basic points** (including basic concepts and theory of methods) and **(b) comment** these papers, these papers which are the best contributions respectively? **(c)** How based on above concepts to **improve these three papers** for **developing some new and good papers** for problems-solving in real problems? [(4+4) + (4+4) + 4] x **3** = 60]

Walczak, B., Massart, D. L. (1999), Rough set theory (Tutorial), Chemometrics and Intelligent Laboratory Systems, 47(1), 1-16.

Shyng, J. Y., Wang, F. K., Tzeng, G. H., Wu, K. S. (2007), Rough Set Theory in analyzing the attributes of combination values for the insurance market, Expert Systems with Applications, 32(1), 56-64.

Fan, T. F., Liu, D. R., Tzeng, G. H. (2007), Rough set-based logics for multicriteria decision analysis, European Journal of Operational Research, 182(1), 340-355.

Huang, C. Y., **Tzeng,** G. H., Chan, C. C., Wu, H. C. (2008), Semiconductor Market Fluctuation Indicators and Rules Derivations by using the Rough Set Theory, **International Journal of Innovative Computing, Information and Control** (Accepted) (IF: 0.713)

Chan, C. C. and **Tzeng, G H.** (2008), Dominance-Based Rough Sets Using Indexed Blocks as Granules, **Fundamenta Informaticae** (selected for an additional publication in the special issue of the Fundamenta Informaticae entitled "Fundamentals of Knowledge Technology"), **Science Citation Index-Expanded** (SciSearch®), Zentralblatt MAT.

Chan, C. C. and **Tzeng, G H.** (2008), (2008), Computing Approximations of Dominance-Based Rough Sets by Bit-Vector Encodings, RSCTC 2008, Springer-Verlag in the Lecture Notes on Artificial Intelligence (LNAI) series. **EI**

Using FSBT technique with Rough Set Theory for personal investment portfolio analysis

*European Journal of Operational Research, **In Press, Corrected Proof**, Available online 29 March 2009,*

Jhieh-Yu Shyng, How-Ming Shieh, **Gwo-Hshiung Tzeng**, Shu-Huei Hsieh

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3. Please based on Fig. 2 take "**marketing or financial issues**" as an example: **(1)** explain the basic concepts Fig. 2 for marketing or financial issues? and **(2)** how combine with data mining or other methods for analyzing the marketing or financial patterns of consumer behaviors? (3) How consider the non-additive

value function for enhancing value-created to introduce overall “Knowledge Economy”, “Knowledge Management”, and “Strategy Planning”? Why (reasons)?
[(6) + (6) + (4+4+4) = **24**]

Second Stage: “Research Methods” for Applications (50%)
Term Paper (submitted date)
- Language: English is better.
- Full paper: May 31, 2009
- Final Revised Paper: June 10, 2009 for submitting to conferences or journals
Paper form shows as follows.

論文範例格式

自行設定一研究主題「最近」或「即將」發展之新方法或新理論

English Title for Paper Writing Technique

曾國雄
開南管理學院傑出講座教授暨國立交通大學管理學院傑出講座教授
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摘要

中文摘要必須精簡而不必分段落，但必含如：(1)背景與問題：為什麼要研究本主題（背景或動機），本主題中有哪些問題值得研究？(2)目的(purpose)：本研究之目的是為解決什麼問題，以達到什麼目的？(3)方法：為解決此問題，本研究採取何種方法來解決或處理本問題？(4)例證與結果：以…為例，以證明(show)本方法之可行性(feasibility)與有效性，又本結果可以證明什麼？
關鍵字：重要字，供索引查。

Abstract: The abstract should be translated from Chinese into English abstract. The content of abstract must be consistent in Chinese and English and need beautiful language for submitting to journal publication.

Keywords: Important words, search index.

1.緒論

此節含摘要內容，**可分段落**，**不必分小節**，但必含如下內容：

(1) 背景與問題：為什麼要研究本主題（背景或動機），本主題中有哪些問題值得研究？但須比「摘要」的學法更詳細；

(2) 目的：本研究之目的是為解決什麼問題，以達到什麼目的？但須比「摘要」的學法較詳細；

(3) 文獻回顧：精簡點出過去如何解決或是處理此問題，稍評述此處理方法有無缺失；

(4) 方法：前人之處理方式有無缺失，因此本研究提出何種方法來解決或處理此問題將更具效果；

(5) 例證(案例)：本研究為證明(show)本方法之可行性與有效性，以...（應用例）為例；

(6) 結果與貢獻：本例證結果為符合人類實際之思維行為，可證明本方法具可用性與有效性等(精簡點到為止；

(7) 全文結構：精簡幾行說明全文的結構。.

2.XX 方法（如 Fuzzy De Novo 規劃法）發展之檢討分析

此節相當於「文獻回顧」,但期刊知名學者常使用很漂亮的標題或用語,內容方面則如：De Novo 規劃法(Zeleney, 1981, 1986, 1990;曾國雄等,民 87)之特色為打破傳統認為資源限制是固定、不可改變的，因此無法達到傳統多目標規劃之非劣解(non-inferior solution)的思維方式，認為隨著科技之進步，可使用不同的思維、不同的設計(design)方式，使其達到理想解(ideal solution)或理想水準(aspiration/desired level)。但在實務狀況中，未來的規劃設計均是在模糊環境(fuzzy environment)下進行，而為解決及處理此問題，Li and Lee (1990a, 1990b)提出了模糊 De Novo 方法（含目標模糊、資源限制模糊、參數係數模糊等），在方法處理上又跨出了一大步，....，依此一直推論下去，至你提出之新基本理念為止。

3.XX 新方法模式之構建與演算法

3~8 行精簡說明本節之目的、內容等。

3.1 XX 新方法模式之構建

依上節所提出之新基本觀念，提出本新方法模式之構建，並說明新方法模式的內含意義及模式的特色、貢獻。

3.2 XX 新方法模式之演算法

本問題常如同資源分配或人力資源指派等組合最佳化問題，屬於 NP-hard 問題。處理此類問題無法以傳統之啟發式(heuristic approach)，而必須使用 Meta-heuristic 法，如 GA 或 GA＋SA 等方法(Goldberg, 1989; Michalewicz, 1996; Abboud et al., 1998) ，並說明此演算法之基本觀念、優點與步驟。

4.實證分析：以....為例證

3~8 行精簡說明本節之目的，如為證明(show)本方法為能符合實際人類行為有效性與可應用性，並以 XX 為例證說明內容等。

4.1 問題描述

簡述本問題，是....（什麼）問題，設計規劃未來的資源分配（或人力資源指派）問題在模糊環境下是 NP-hard 問題，所以採用 XX 新方法模式。。

4.2 XX 新方法模式之應用

（依前節之模式，以實際資料處理）

4.3 結果之分析與討論

(此之**討論**非常重要)

5.結論

此結論必須與「緒論」相呼應，求出模式應用結果，並以有力證據證明本方法能符合實際人類行為之有效性、可應用性等。

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Zeleney, M. (1986), "Optimal System Design with Multiple Criteria: De Novo Programming Approach", *Engineering Cost Production Economics*, 10(1): 89-94.

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Fuzzy MCDM Techniques for Designing the Aspired/Desired Product

Abstract

Keywords

1. Introduction

2. **The Concepts of the Best Product Design in Innovation/Creativity**
   (Products for satisfying the customers' needs)
3. **Building the Fuzzy MCDM Model for Evaluating the Product Design**
   3.1 Scenario writings
   3.2 Building the hierarchy and network relevance systems (criteria → DEMATEL for weightings by fuzzy AHP/ANP/fuzzy integral)
   3.3 Evaluation processes
   (1) Finding the weightings in criteria
   (2) Measuring the performance in alternatives (many kind of different product designs)
   (3) Reducing the gaps for achieving aspired/desired product (how innovation/ creativity)
4. **An Empirical Case: Case of ….**
   4.1 Problems descriptions
   4.2 Results and analyses
   (1) Weightings
   (2) Performance matrix
   (3) Synthesis for alternatives
   (4) Analyzing the gaps and how reducing the gaps for achieving aspired/desired level
   4.3 Discussions
5. **Conclusions [or Conclusions and Remarks, or Concluding Remarks]**

References

論文寫作字體使用注意事項

1. 英文字母***小寫斜字體***，表示**元素**或**變數**：如 $a,b,c,...;\quad x_1,x_2,...,x_n.$
2. 英文字母***小寫粗斜字體***表示**向量**，如 $\boldsymbol{a}=(a_1,a_2,...,a_n),\quad \boldsymbol{x}=(x_1,x_2,...,x_n).$
3. 英文字母***大寫斜字體***，表示**集合**，如 $A\subseteq B,\ x\in X$。
4. 英文字母***大寫粗斜字體***，表示**矩陣**，如

$$\boldsymbol{X}=\left[x_{ij}\right]_{m\times n}\qquad \boldsymbol{A}=\left[a_{ij}\right]_{m\times n}$$

5. 上、下標字號，比原文字小 2~3 號字。
6. **阿拉伯數字**、括號，**無需使用斜字體**。
7. **文內所使用的符號**與**公式內所定義的符號**，在**大小及字體**上，**皆應一致**。

原則上，英文字體採用**Times New Roman**字體。

Highly Cited Paper (March 13, 2009) ESI
Dear ***Dr. Gwo-Hshiung Tzeng***, Researcher ID: B-2775-2009
Your article entitled **"Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS"** as published in the **"EUROPEAN JOURNAL OF OPERATIONAL RESEARCH"** on July 16th, 156(2), 445-455, 2004 has been recently identified by **Thomson Reuters' *Essential Science Indicators*℠** to be

one of the **most cited papers** in the **field of Economics (Top 1%)**.

scienceWATCH

2004: July 16th 2004 – MCDM (Multiple Criteria Decision Making)

EUROPEAN JOURNAL OF OPERATIONAL RESEARCH: Gwo-Hshiung Tzeng, ID: B-2775-2009

EUROPEAN JOURNAL OF OPERATIONAL RESEARCH – 2004

July 2004

Gwo-Hshiung Tzeng talk with *ScienceWatch.com* and answers a few questions about MCDM paper in the field of Economics. The author has also along images of their work.

Article Title: Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS
Authors: Serafim Opricovic and Gwo-Hshiung Tzeng
Journal: European Journal of Operational Researcn
Volume: 156
Issue: 2
Pages: 441-455
Year: July 2004

SW: Why do you think your paper is highly cited?

We propose and explain a novel compromise ranking method, also known as VIKOR (VIšekriterijumsko KOmpromisno Rangiranje) for comparison with the TOPSIS (Total Order Preference by Similarity to the Ideal Solution) method in the MCDM (Multiple Criteria Decision Making). We can use the basic concept of the VIKOR method and combine DEMATEL (Decision Making Trial and Evaluation Laboratory) technique for extending the VIKOR method to evaluate the rankings and improve the gaps of performances for achieving the aspired/desired levels (values).

We also compared VIKOR with TOPSIS methods and found that the VIKOR method can be used to rank alternatives and to improve the gaps of each criterion for achieving the aspired/desired level. Therefore, this paper will likely become an important source in solving MADM (Multiple Attribute Decision Making) problems for evaluating, improving, or selecting alternatives in order to achieve the aspired/desired levels (values) based on the DEMATEL technique combined with the VIKOR method. I think this paper and many other related papers from my research group have also been highly cited because they can be extensively applied toward solving practical problems in the real world.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

The MCDM methods VIKOR and TOPSIS are based on an aggregating/synthesizing function representing "closeness/gap to ideal or to aspired/desired level," an idea which originated in the compromise programming method outlined by P. L. Yu and M. Zeleny in 1971. Linear normalization in VIKOR and vector normalization in TOPSIS is used to eliminate the units of criteria functions.

A new discovery of VIKOR method for compromise ranking or improving/reducing the gaps of each criterion determines a compromise solution, providing a maximum "group utility" for the "majority" and a minimum of an individual regret for the "opponent." The TOPSIS method determines a solution with the shortest distance to the ideal solution and the greatest distance from the negative-ideal solution.

A comparative analysis of these two methods is illustrated with a numerical example, showing the similarity and some differences. We also discovered that TOPSIS can not be used in rankings, but can be used to measure the achieved level and to analyze/improve how we can get the minimal gaps in each criterion.

We further developed a hybrid new method which combined DEMATEL technique with the VIKOR method to probe how to use qualitative and quantitative measurements for real problems to create/improve plan indexes and criteria, as well as how to help these indexes achieve the aspired/desired levels for each criterion based on the basic concept outlined in this paper.

SW: Would you summarize the significance of your paper in layman's terms?

This useful compromise ranking/improving method (named VIKOR) was developed for the multicriteria optimization of complex systems. However, few papers discuss conflicting (competing) criteria with dependence and feedback in the compromise/solution method. Our paper proposed VIKOR as one applicable technique to implement within MCDM to provide decision makers with an improved method to rank the projects/alternatives and to understand their inherent gaps, in order to improve the large gaps in control items and also to achieve the aspired levels; it has therefore been receiving international attention.

VIKOR is used to help decision-makers make decisions and has set an essential foundation in the compromise ranking study of MCDM. In addition, quite a few papers and researchers have utilized VIKOR combined with other methods to apply to any field in solving real problems of MADM for evaluating, improving, or selecting the best alternatives to achieve aspired/desired levels throughout the world.

SW: How did you become involved in this research and were any particular problems encountered along the way?

I first became involved with MCDM research in 1973, when I studied for a Doctoral Course in Management Science at Osaka University in Japan. In the real world, decision-makers often simultaneously faced/managed more then one, i.e., multiple criteria/objectives with conflicting and non-commensurable criteria.

Some problems encountered along the way were how could we measure, evaluate,

rank, improve, or select these problems for reducing the gaps in order to achieve the aspired/desired levels (or grades) forward to number only one in practical terms. Traditional methods are unsuitable when dealing with these problems so as to reduce or improve the gaps in each dimension/criterion. Thus, the basic concept of this research proposes a novel VIKOR method to minimize the normalized gap/regret.

SW: Where do you see your research leading in the future?

Our research in hybrid MADM methods will continue to be a leader in relaxing and improving the assumption/hypotheses of past approaches for satisfying and meeting real world/situations. I'm currently teaching two related courses: "Research Methods for Problems-Solving" and "New frontiers of Multiple Criteria Decision Making."

I will also be publishing a series of four related books, co-authored along with my student Dr. Jih-Jeng Huang, for Taylor & Francis Publishers. Our research offers significant methods for decision-makers from government and business, and also for the person whose daily life could be improved through solutions to problems at hand, whereby an individual can reach the aspired/desired level and deduce which solution/alternative is the closest to the aspired/desired level (ideal point). I believe that the results of this research will lead individuals toward a better future.

SW: Do you foresee any social or political implications for your research?

I believe that our research of the proposed VIKOR method discussed in this article, combined DEMATEL/ISM technique, can be applied to any field for the purpose of building a network relationship map (NRM) relative to any social or political implication across various viewpoints, dimensions/aspects, or criteria/alternatives.

These concepts can be extended to evaluation, ranking, improving or selecting the best alternative through a novel hybrid MCDM model which addresses dependent relationships among criteria—using a DEMATEL technique along with an analytical network process—to decide the relative weights of criteria, showing inter-dependence and feedback in the real world. There, the VIKOR method is used to evaluate and improve the gaps in each criterion and reduce the gaps in order to achieve the aspired/desired level.

Gwo-Hshiung Tzeng (Researcher ID: B-2775-2009)

- Distinguished Chair Professor, Department of Business and Entrepreneurial Administration, Kainan University;
- Chair Professor (Emeritus), Institute of Management of Technology, National Chiao Tung University.

Distinguished Research Awards

- Distinguished Research Award of the National Science Council, Taiwan, 1985-1986.
- Distinguished Research Award of the National Science Council, Taiwan, 1993-1994.
- Distinguished Research Award of the National Science Council, Taiwan, 1995-1996.

- Distinguished Research Fellow (Highest Honor Offered) by the National Science Council, Taiwan, 1997-2000.
- Distinguished Research Fellow (Highest Honor Offered) by the National Science Council, Taiwan, 1997-2000.
- Distinguished Research Fellow (Highest Honor Offered) by the National Science Council, Taiwan, 2000—2003.
- National Distinguished Chair Professor, Award of the Ministry of Education Affairs, Taiwan, 2000-2003.
- **Fellow, IEEE Member**, 30 September 2002.
- **Pinnacle of Achievement Award 2005** (Top 100 Educators Pinnacle of Achievement Award, 009 of 100), the International Biographical Center at its Headquarters in Cambridge, England).\
- **Special Speaker of ISME** (one hour) and **Contribution Award (March 2006)**
- **MCDM Edgeworth-Pareto Award** presented by International Society on Multiple Criteria Decision Making, June 23, 2009,

Distinguished Professor Award

Ministry of Education Affairs, Taiwan (National Chiao Tung University), 1992.

The MCDM Conference Chairman Award

For the most gracious hospitality, and for the outstanding leadership and resourcefulness in organizing, managing and chairing the Tenth International Conference on MCDM, Taipei, Taiwan, July 1992.
International Society on Multiple Criteria Decision Making.

The MCDM Edgeworth-Pareto Award (June 2009)

As the highest distinction that the International Society on Multiple Criteria Decision Making bestows upon a researcher who, over his career, has established a record of creativity to the extent that the field of MCDM would not exist in its current form without the far-reaching contributions from this distinguished scholar.
The MCDM Edgeworth-Pareto Award Presented to Gwo-Hshiung Tzeng by International Society on Multiple Criteria Decision Making, June 23, 2009,

Co-Chairmen of ICIS (1992)
Co-Chairmen of International Conference on Information and Systems, September 3-6, 1992, Dalian, China.

Co-Chairmen of 36 ICCIE (2006)
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General Co-Chair of WEHIA 2008 & The 7th CIEF 2008
Joint Conference of 2008 Winter Workshop on Economics with Heterogeneous Interacting Agents and the 7th International Conference on Computational Intelligence in Economics and Finance, December 5~7, 2008, Kainan University, Taoyuan, Taiwan

Highly Cited Paper (March 13, 2009) ESI
Dear ***Dr. Gwo-Hshiung Tzeng***, Researcher ID: B-2775-2009
Your article entitled **"Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS"** as published in the **"EUROPEAN JOURNAL OF OPERATIONAL RESEARCH**" on July 16th, 156(2), 445-455, 2004 has been recently identified by **Thomson Reuters' *Essential Science Indicators*SM** to be one of the **most cited papers** in the **field of Economics**.

CiteAlert (July 24, 2009)
Extended VIKOR method in comparison with outranking methods
Opricovic, S., Tzeng, G.-H.
European Journal of Operational Research
volume 178, issue 2, year 2007, pp. 514 - 529

Publications

New Books will be published in Taylor & Francis
A series of books
New Frontiers of Research Methods for Problems-Solving

- **NEW FRONTIERS OF MULTIPLE ATTRIBUTE DECISION MAKING (1/4)**
- **NEW FRONTIERS OF MULTIPLE OBJECTIVE DECISION MAKING (2/4)**
- **NEW FRONTIERS OF FORECASTING MODEL (3/4)**
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2009

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Chung-Wei Li**, Gwo-Hshiung Tzeng (2009).** Identification of Interrelationship of Key Customers' Needs Based on Structural Model for Services/Capabilities Provided by a Semiconductor-Intellectual-Property Mall, **Applied Mathematics and Computation (Accepted, IF: 0.961, 2008)**

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