A FRAMEWORK OF SUBJECTIVE PERFORMANCE EVALUATION USING FUZZY TECHNIQUE

A Thesis Submitted to the Centre For Graduate Studies in Fulfillment of the requirement for the degree of Doctor of Philosophy
Universiti Malaysia Utara

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ABSTRACT

This research proposes the framework of subjective performance evaluation using fuzzy technique for ranking the attributes of different types of datasets under a multi-criteria environment. Some previous studies on fuzzy techniques have been attempted in assessment and evaluation methods. The techniques such as fuzzy similarity function, fuzzy synthetic decision and satisfaction function have been adopted in these fuzzy evaluation methods. However, research that discover a scaling measurement which can express the subjectivity element and integrate the organisation's objectives and goals into the evaluation processes by utilising the fuzzy rule in the subjective evaluation method seem limited. Hence, this framework uses the application of fuzzy sets, and approximate reasoning to determine the performance evaluation of various characteristics in decision-making. The framework based upon fuzzy sets has initiated the idea of membership set score valued evaluation of each criterion alternative enables to include requirements which are incomplete and imprecise. The approximate reasoning of the method allows decision maker to make the best choice in accordance of human thinking and reasoning processes. The method introduces an approach of normalising data using similarity function which dampens the extreme value that exists in the data. The framework is suitable for dealing with evaluations in situations that involve subjectivity, vagueness and imprecise information, such as the grading system of evaluation which involves many hedges like "*good*", "*bad*" and "*satisfactory*".

The framework is based on fuzzy multi-criteria decision-making that consists of fuzzy rules. The rules developed by the previous methods are unsuitable to be used in the subjective evaluation framework because of differences in certain characteristics. Moreover most methods need extensive learning process in developing the rules. The use of fuzzy rules, which were extracted directly from input data in making evaluation, contributes a better decision in selecting the best choice and less dependent to the domain of expert.

The aim of utilising the multi-criteria combination rule is to capture the main criteria that exist in the alternatives. The fuzzy rules embedded in the framework of subjective evaluation method showed advantages in generalising the evaluation of the performance achievement, where the evaluation process can be conducted consistently in producing good evaluation results with the use of the membership set score.

Ten data sets from previous studies were used to validate the subjective evaluation framework. The properties of fuzzy rules generated in terms of total number of rules, size and length for the best ranking or classification were recorded. The accuracy of the rules generated from the proposed framework was further analysed through the maximum length, minimum length and the rule definition. The rules were used in the subjective evaluation algorithm to evaluate the alternative performance. The accuracy of ranking was compared to several subjective

evaluation methods such as fuzzy performance score evaluation and fuzzy multi-criteria evaluation.

The normalisation operation process which uses the fuzzy similarity reduces the irregular data and produces highly reliable data. The reliability of the data indicates the stability and consistency with which the proposed method generates fuzzy rules and evaluating performance quality or the alternatives. Hence, the suggested framework is able to produce good and precise ranking results in fuzzy environments.

The results from the numerical examples are comparable to other fuzzy evaluation methods, even with the use of small rule size.

ABSTRAK

Tesis ini memperkenalkan kerangkakerja bagi penilaian pencapaian subjektif menggunakan teknik kabur untuk menyusunatur ciri-ciri tertentu yang terdapat pada set data yang berbeza di bawah situasi kriteria pelbagai. Terdapat beberapa kajian lampau mengaplikasikan teknik kabur di dalam kaedah pengukuran dan penilaian. Teknik seperti fungsi kesamaan kabur, keputusan buatan kabur dan fungsi kepuasan telah digunakan di dalam keadah penilaian kabur. Namun, kajian lampau yang berjaya menghasilkan skala pengukuran yang boleh menghuraikan unsur subjektif dan mengintegrasikan matlamat dan objektif organisasi sangat terhad. Oleh yang demikian, kerangkakerja ini menggunakan teknik set kabur dan penaakulan kabur bagi menentukan susunatur penilaian pencapaian untuk sifat tertentu di dalam membuat keputusan. Kerangkakerja berdasarkan set kabur telah mencetus idea skor set keahlian untuk penilaian setiap alternatif kriteria bagi membolehkan matlumat yang tidak lengkap dan tepat diambilkira. Pendekatan penaakulan kabur di dalam kerangkakerja penilaian subjektif membantu pembuat keputusan membuat pilihan yang terbaik sama seperti penaakulan dan pemikiran manusia. Konsep pernormalan data diperkenalkan bagi menghadkan kewujudan nilai ekstrem di dalam set data. Kerangkakerja kajian adalah bersesuaian dengan penilaian yang melibatkan unsur subjektiviti, kabur dan ketidakpastian maklumat seperti penilaian sistem permarkahan yang melibatkan banyak *hedges* seperti "*good*", "*bad*" dan "*satisfactory*".

Kerangkakerja yang dicadangkan ini adalah berdasarkan kepada keputusan kriteria pelbagai kabur yang turut mempunyai petua kabur. Petua yang dibangunkan oleh kaedah lampau adalah tidak sesuai digunakan di dalam kerangka penilaian subjektif ini disebabkan oleh perbezaan di dalam beberapa kriteria. Tambahan pula kebanyakan kaedah itu memerlukan proses latihan yang berulang-ulang untuk membentuk petua. Penggunaan petua kabur yang dijana dari data input di dalam penilaian menyumbang kepada keputusan yang lebih baik dalam membuat pilihan dan mengurangkan kebergantungan terhadap pandangan pakar.

Tujuan petua kombinasi kriteria pelbagai adalah untuk mengenalpasti kriteria penting yang wujud di dalam alternatif. Petua kabur yang digunakan dalam kaedah penilaian subjektif telah menunjukkan keberkesanan di dalam mengitlak penilaian prestasi pencapaian iaitu proses penilaian boleh dijalankan secara konsisten dengan penggunaan darjah skor set keahlian.

Sepuluh set data daripada kajian lampau digunakan untuk mengesahkan kerangkakerja penilaian subjektif. Jumlah bilangan, saiz dan panjang petua kabur yang dijanakan untuk susunatur atau pengkelasan terbaik dicatatkan. Ketepatan petua yang dijanakan dari kaedah ini selanjutnya dianalisa melalui panjang maksima, panjang minima dan definisi petua. Petua kabur digunakan dalam kerangkakerja penilaian subjektif untuk menilai pencapaian prestasi alternatif. Ketepatan susunatur dibandingkan dengan beberapa kaedah penilaian kabur lain seperti penilaian skor pencapaian kabur dan penilaian kabur kriteria pelbagai.

Proses operasi pernormalan yang menggunakan fungsi kesamaan didapati dapat mengurangkan ketidaktentuan data dan boleh menghasilkan data yang lebih baik dengan tahap kebolehpercayaan yang tinggi. Kebolehpercayaan data menunjukkan kestabilan dan konsisten kerangkakerja dalam menjana petua dan menilai kualiti pencapaian atau alternatif. Oleh yang demikian kerangkakerja berupaya menghasilkan keputusan penilaian yang tepat, dan baik di dalam keadaan kabur.

Dapatan daripada contoh berangka menunjukkan keputusan perbandingan susunatur pencapaian yang setanding dengan kaedah penilaian kabur lain walaupun mengguna petua yang bersaiz kecil.

ACKNOWLEDGEMENTS

بسم الله الرحمن الرحيم

In the name of Allah, the Most Merciful and Most Compassionate. Praise to Allah s.w.t. for granted me strength, courage, patience and inspirations in completing this work.

My deepest appreciation and gratitude to my supervisors, Prof. Dr. Hajjah Ku Ruhana Ku Mahamud and Dr. Azuraliza Abu Bakar for their virtuous guidance, sharing their intellectual experiences, and giving their motivation and support that lead the way in so many aspects of the research work. Without their constant support and guidance, this thesis would never have been completed.

I am grateful to the Universiti Teknologi MARA for the scholarship, study leave and allowances that enabled me to pursue this doctoral programme.

I would like to thank En. Mohd Asri Mohd. Noor (UiTM, Arau) who patiently read this thesis.

Special appreciation to my mother, Amnah bt. Shaharuddin; my wife Norlidah Mohd Yasin; my daughters Intan Filzah Mahmod, Nurul Nadiah Mahmod, Siti Azhani Mahmod; my sons Fakhrul Ariffin Mahmod and Shahrul A'izzat Mahmod for their loves and prayers in making this dream came true. I LOVE YOU...

Mahmod Othman
AUGUST 2005

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LIST OF ABBREVIATIONS

UTQ	University Teaching Quality
FCR	Fuzzy Credit Rating
RBPDA	River Basin Planning Alternatives
PSAPIA	Passenger Services of Asia-Pacific International Airports
ASI	Airline Safety Index
WS	Weapon System
PTPBO	Privatisation of Taiwan Public Bus Operation
SFO	Spent Fuel Storage Options
IRIS	Iris Flower Species
RT	Rice Taste

CHAPTER 1

INTRODUCTION

Conventional evaluation systems are representatives of structured systems that employ objective and subjective measures of evaluation. Objective measures are quantifiable measure of performance: for example, cars/hour, parts/hour, bottles/hour, etc., which are normally defined by procedures. Subjective evaluation measures are less quantifiable, for example; leadership, presentation, and problem-solving skills. In some organisations the criteria for the evaluation are less quantifiable and subjective, for example in the teaching service and research (Horowits & Zappe, 1995).

In practice, evaluation of performance usually uses subjective criteria. In doing so, they have to depend on their wisdom, experience, professional knowledge and information, which is difficult to define and/or describe exactly. Analysing with incomplete data, a lot of uncertainties will confuse decision-makers and complicate decision-making under unknown situations.

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