

UBAH SUAIAAN PERLUASAN-TOPSIS UNTUK KEPUTUSAN MULTI-KRITERIUM LINGUISTIK KABUR

(Modification of TOPSIS-extension for Fuzzy Linguistic Multi-Criteria Decision)

ZAMALI TARMUDI¹ & ABU OSMAN MD TAP²

ABSTRAK

Dapat diperhatikan bahawa kata putus dalam masalah multi-kriterium yang dibuat secara linguistik kabur adalah lebih mudah serta 'mesra pengguna' berbanding dengan menggunakan nilai skala yang bersifat kuantitatif. Dalam kajian ini diusulkan pendekatan pemboleh ubah linguistik kabur untuk dimanfaatkan dalam kaedah ubah suaian perluasan-TOPSIS (*Technique for Order Preference by Similarity to Ideal Solution*) secara mengurangkan daripada sebelas kepada tiga potongan- α . Analisis dimulai dengan mengkuantitikan pemboleh ubah linguistik kabur melalui nombor kabur segi tiga untuk diterapkan dalam gabungan kaedah perluasan-TOPSIS dan pengaturcaraan tak linear. Selanjutnya, pengiraan dibuat untuk mendapatkan tiga nilai potongan- α , iaitu $\alpha = 0$, $\alpha = 0.5$ dan $\alpha = 1.0$, sebelum proses penyahkaburan dan pemangkatan dapat dilakukan bagi mengenal pasti alternatif yang terbaik. Di akhir kajian diberi contoh penggunaan pemboleh ubah linguistik kabur dan ubah suaian yang diusulkan berserta pengiraan yang berkaitan dalam masalah multi-kriterium pemilihan. Dapatan pengiraan menunjukkan, ia memberi manfaat dari aspek penjimatan masa pengiraan dan dapat mengurangkan kerumitan proses pemutusan tanpa menjejaskan ketepatan dapatan kajian.

Kata kunci: nombor kabur; pemboleh ubah linguistik; pembuat keputusan multi-kriterium; TOPSIS

ABSTRACT

It is observed that decision making for a multi-criteria problem is easier and user friendly by using a fuzzy linguistic approach compared to the numeric scales. In this paper, the advantage of linguistic variables is utilised in a modification of Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)-extension by reducing the α -cuts from eleven to three levels. In the first place, the linguistic variables are quantified through triangular fuzzy numbers employed in both TOPSIS-extension and non-linear programming; afterwards the three α -cuts, namely $\alpha = 0$, $\alpha = 0.5$, $\alpha = 1.0$, are calculated before the defuzzifying and ranking process was made to identify the best alternative under consideration. A hypothetical example in a multi-criteria decision-making problem is provided to demonstrate the applicability and practicability of the proposed modification method. Based on the numerical calculations, it is found that the method is beneficial to reduce the decision process complexity and is less time consuming, giving a similar result without loss of any originality.

Keywords: fuzzy numbers; linguistic variables; multi-criteria decision making; TOPSIS

Rujukan

- Abo-Sinna M. A. & Amer A. H. 2005. Extensions of TOPSIS for multi-objective large-scale nonlinear programming problems. *Applied Mathematics and Computation* **162**: 243 – 256.
- Chen M. F. & Tzeng G. H. 2004. Combining grey relation and TOPSIS concepts for selecting an expatriate host country. *Mathematical and Computer Modelling* **40**: 1473 – 1490.
- Chen S. M. 1996. Evaluating weapon systems using fuzzy arithmetic operations. *Fuzzy Sets and Systems* **77**: 265 – 276.
- Chen T. C. 2000. Extension of the TOPSIS for group decision-making under fuzzy environment. *Fuzzy Sets and Systems* **114**: 1 – 9.
- Cheng S., Chang C. W. & Huang G. H. 2003. An integrated multi-criteria decision analysis and inexact integer linear programming approach for solid waste management. *Engineering Applications of Artificial Intelligence* **16**: 543 – 554.
- Ching H. C., Kuo L. Y. & Chia L. H. 1999. Evaluating attack helicopters by AHP based on linguistic variable weight. *European Journal of Operational Research* **116**: 423 – 435.
- Chu T. C. 2002a. Facility location selection using fuzzy TOPSIS under group decisions. *International Journal of Uncertainty, Fuzziness and Knowledge-based Systems* **10**: 687 – 701.
- Chu T. C. 2002b. Selecting plant location via a fuzzy TOPSIS approach. *The International Journal of Advanced Manufacturing Technology* **20**: 859 – 864.
- Chu T. C. & Lin Y. C. 2003. A fuzzy TOPSIS method for robot selection. *The International Journal of Advanced Manufacturing Technology* **21**: 284 – 290.
- Deng H., Yeh C. H. & Willis R. J. 2000. Inter-company comparison using modified TOPSIS with objective weights. *Computers and Operations Research* **27**: 963 – 973.
- Feng C. M. & Wang R. T. 2001. Considering the financial ratios on the performance evaluation of highway bus industry. *Transport Reviews* **21**: 449 – 467.
- Feng C. M. & Wang R. T. 2000. Performance evaluation for airlines including the consideration of financial ratios. *Journal of Air Transport Management* **6**: 133 – 142.
- Golec A. & Kahya E. 2007. A fuzzy model for competency-based employee evaluation and selection. *Computers & Industrial Engineering* **52**(1): 143-161.
- Hwang C. & Yoon K. 1981. *Multiple attribute decision making: Methods and application*. New York. Springer.
- Ismail E. & Ferrell Jr. W. G. 2003. A methodology for selection problems with multiple, conflicting objectives and both qualitative and quantitative criteria. *International of Production Economics* **86**:187 – 199.
- Kaufmann A. & Gupta M. M. 1991. *Introduction to Fuzzy Arithmetic and Applications*. New York: Van Nostrand Rienhold.
- Olcer A. I. & Odabasi A. Y. 2005. A new multiple attributive group decision making methodology and its application to propulsion/manoeuvring system selection problem. *European Journal of Operational Research* **166**: 93 – 114.
- Olson D. L. 2004. Comparison of weights in TOPSIS models. *Mathematical and Computer Modelling* **40**: 721 – 727.
- Opricovic S. & Tzeng G. H. 2004. Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS. *European Journal of Operational Research* **156**: 445 – 455.
- Saaty T. L. 1980. *The Analytic Hierarchy Process*. New York, NY: McGraw-Hill.
- Tsaur S. H., Chang T. Y. & Yen C. H. 2002. The evaluation of airline service quality by fuzzy MCDM. *Tourism Management* **23**: 107 – 115.
- Tzeng G. H., Lin C. W. & Opricovic S. 2005. Multi-criteria analysis of alternative-fuel buses for public transportation. *Energy Policy* **33**: 1373 – 1383.
- Victor B. K. & Chao Y. W. 2007. Evaluation of knowledge portal development tools using a fuzzy AHP approach: The case of Taiwanese stone industry. *European Journal of Operational Research* **176**: 1795 – 1810.
- Wang L. X. 1997. *A Course in Fuzzy Systems and Control*. Englewood Cliffs, NJ: Prentice-Hall.
- Wang Y.-M. & Elhag T.M.S. 2006. Fuzzy TOPSIS method based on alpha level sets with an application to bridge risk assessment. *Expert Systems with Application* **31**: 309 – 319.
- Zadeh L. A. 1965. Fuzzy Sets. *Informat. Control* **8**: 338 – 353.
- Zadeh L. A. 1975. The concept of a linguistic variable and its application to approximate reasoning I, II, III. *Information Sciences* **8**: 199 – 251, 301 – 357, 43 – 80.
- Zamali T. & Abu Osman M. T. 2004. Pendekatan set kabur sebagai medium pemutusan. Prosiding Seminar Kebangsaan Sains Pemutusan, Pulau Pinang, pp. 117 – 123.
- Zamali T., Abu Osman M. T. & Lazim M. A. 2010. Computing with Words Approach for Fuzzy Group Decision-Making, IEEE Colloquium on Humanities, Science and Engineering Research (CHUSER 2010), KL, 5-7 Dec., pp. 928 – 932.

Ubah suaian perluasan-TOPSIS untuk keputusan multi-kriterium linguistik kabur

- Zamali T., Lazim M. A. & Abu Osman M. T. 2011. New computation approach for fuzzy group decision-making, IEEE Colloquium on Humanities, Science and Engineering Research (CHUSER 2011), Penang, 5-6 Dec., pp. 844 – 848.
- Zamali T., Lazim M. A. & Abu Osman M. T. 2012. Sustainable decision-making model for municipal solid-waste management: Bifuzzy approach. *J. Sustain. Sci. Manage.* **7**(1): 56 – 68.
- Zimmermann H. J. 1991. *Fuzzy Set Theory and Its Application*. 2nd Revised Ed. Boston: Kluwer.

¹*Jabatan Matematik
Fakulti Sains Komputer dan Matematik
Universiti Teknologi MARA Sabah
Beg Berkunci 71
88997 Kota Kinabalu
Sabah, MALAYSIA
Mel-e: zamalihj@sabah.uitm.edu.my**

²*Jabatan Sistem Maklumat
Kuliyah Teknologi Maklumat dan Komunikasi
Universiti Islam Antarabangsa Malaysia
Peti Surat 10
50728 Kuala Lumpur, MALAYSIA
Mel-e:abuosman@kict.iium.edu.my*