International Journal of Pure and Applied Mathematics
**Volume 93 No. 3 2014, 361-367**
ISSN: 1311-8080 (printed version); ISSN: 1314-3395 (on-line version)
**url:** http://www.ijpam.eu
**doi:** http://dx.doi.org/10.12732/ijpam.v93i3.6
ijpam.eu

# APPLICATION OF GENERALIZED VAGUE SOFT EXPERT SET IN DECISION MAKING

Khaleed Alhazaymeh[1], Nasruddin Hassan[2 §]
[1,2]School of Mathematical Sciences
Universiti Kebangsaan Malaysia
43600 UKM, Bangi Selangor, MALAYSIA

**Abstract:** Generalized vague soft expert sets can be used to analyze decision-making problems. In this work we give an application of this concept which we have earlier introduced, in a decision-making problem.

**AMS Subject Classification:** 03B52, 03E72
**Key Words:** fuzzy sot expert set, generalized fuzzy soft expert set, soft expert set, vague soft set

## 1. Introduction

One of the most important new mathematical tools is soft set theory defined by Molodtsov [1]. Alkhazaleh et al. [2], [3], [4] and Salleh et al. [5] extended their studies on fuzzy soft sets, while Alhazaymeh et. al [6], Hassan and Alhazaymeh [7] and Alhazaymeh and Hassan [8], [9], [10],[11], [12], [13], [14] worked on vague soft sets. Adam and Hassan [15] proposed multi Q-fuzzy parameterized soft set and Varnamkhasti and Hassan [16], [17] applied fuzzy sets to genetic algorithms. In this paper we further apply generalized vague soft expert set to a decision-making problem. Thus decision making problems are now not limited to certainty data such as goal programming [18], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [29] and data envelopment analysis [30], [31], [32].

Received: November 26, 2013


§Correspondence author

## 2. An Application of Generalized Vague Soft Expert Set

In this section, we illustrate an application of generalized vague soft expert set in a decision making problem. We suppose that one of the direct selling companies wishes to evaluate three products from a manufacturer and choose the most suitable product for it to market. Its three alternatives are $U = \{u_1, u_2, u_3\}$, with three parameters $E = \{e_1, e_2, e_3\}$. The parameters $e_i (i = 1, 2, 3)$ stands for “effect of the product”, “utilization of the product” and “ expired date of the product”. Let $X = \{p, q, r\}$ be a set of a committee members. After a few series of consultations, the following generalized vague soft expert set was constructed.

$$(F_\mu, Z) = \{((e_1,p,1),\{\tfrac{u_1}{\langle 0.5,0.5\rangle},\tfrac{u_2}{\langle 0.6,0.8\rangle},\tfrac{u_3}{\langle 0,0\rangle}\},0.2),$$
$$((e_1,q,1),\{\tfrac{u_1}{\langle 0.3,0.6\rangle},\tfrac{u_2}{\langle 0.9,0.9\rangle},\tfrac{u_3}{\langle 1,1\rangle}\},0.5),((e_1,r,1),\{\tfrac{u_1}{\langle 0.4,0.8\rangle},\tfrac{u_2}{\langle 0.2,0.2\rangle},\tfrac{u_3}{\langle 0.9,0.9\rangle}\},0.2),$$
$$((e_2,p,1),\{\tfrac{u_1}{\langle 0.2,0.8\rangle},\tfrac{u_2}{\langle 0.4,0.7\rangle},\tfrac{u_3}{\langle 0.5,0.6\rangle}\},0.8),((e_2,q,1),\{\tfrac{u_1}{\langle 0.3,0.4\rangle},\tfrac{u_2}{\langle 0.4,0.5\rangle},\tfrac{u_3}{\langle 0.6,0.8\rangle}\},0.3),$$
$$((e_2,r,1),\{\tfrac{u_1}{\langle 0.1,0.1\rangle},\tfrac{u_2}{\langle 0.8,0.9\rangle},\tfrac{u_3}{\langle 0.3,0.4\rangle}\},0.6)\},((e_3,p,1),\{\tfrac{u_1}{\langle 0.3,0.6\rangle},\tfrac{u_2}{\langle 0.6,0.6\rangle},\tfrac{u_3}{\langle 0.5,0.5\rangle}\},0.9),$$
$$((e_3,q,1),\{\tfrac{u_1}{\langle 0.1,0.2\rangle},\tfrac{u_2}{\langle 0.2,0.6\rangle},\tfrac{u_3}{\langle 0.4,0.6\rangle}\},0.2),((e_3,r,1),\{\tfrac{u_1}{\langle 0.3,0.7\rangle},\tfrac{u_2}{\langle 0.1,0.3\rangle},\tfrac{u_3}{\langle 0.3,0.6\rangle}\},0.5),$$
$$((e_1,p,0),\{\tfrac{u_1}{\langle 0.1,0.1\rangle},\tfrac{u_2}{\langle 0.8,0.9\rangle},\tfrac{u_3}{\langle 0.3,0.3\rangle}\},0.6),((e_1,q,0),\{\tfrac{u_1}{\langle 0.3,0.4\rangle},\tfrac{u_2}{\langle 0.4,0.5\rangle},\tfrac{u_3}{\langle 0.6,0.8\rangle}\},0.8),$$
$$((e_1,r,0),\{\tfrac{u_1}{\langle 0.3,0.7\rangle},\tfrac{u_2}{\langle 0.1,0.3\rangle},\tfrac{u_3}{\langle 0.3,0.6\rangle}\},0.1),((e_2,p,0),\{\tfrac{u_1}{\langle 0.5,0.5\rangle},\tfrac{u_2}{\langle 0.6,0.8\rangle},\tfrac{u_3}{\langle 0,0\rangle}\},0.3),$$
$$((e_2,q,0),\{\tfrac{u_1}{\langle 0.3,0.6\rangle},\tfrac{u_2}{\langle 0.9,0.9\rangle},\tfrac{u_3}{\langle 1,1\rangle}\},0.6),((e_2,r,0),\{\tfrac{u_1}{\langle 0.4,0.8\rangle},\tfrac{u_2}{\langle 0.2,0.2\rangle},\tfrac{u_3}{\langle 0.9,0.9\rangle}\},0.7),$$
$$((e_3,p,0),\{\tfrac{u_1}{\langle 0.3,0.6\rangle},\tfrac{u_2}{\langle 0.6,0.6\rangle},\tfrac{u_3}{\langle 0.5,0.5\rangle}\},0.9),((e_3,q,0),\{\tfrac{u_1}{\langle 0.1,0.2\rangle},\tfrac{u_2}{\langle 0.2,0.6\rangle},\tfrac{u_3}{\langle 0.4,0.6\rangle}\},0.6),$$
$$((e_3,r,0),\{\tfrac{u_1}{\langle 0.3,0.7\rangle},\tfrac{u_2}{\langle 0.1,0.3\rangle},\tfrac{u_3}{\langle 0.3,0.6\rangle}\},0.8)\}.$$

Table 1 and 2 present the agree-generalized vague soft expert set and disagree-generalized vague soft expert set respectively.

Table 1: Agree-generalized vague soft expert set

| $U$ | $u_1$ | $u_2$ | $u_3$ | |
|---|---|---|---|---|
| $(e_1, p)$ | $\langle 0.5, 0.5\rangle$ | $\langle 0.6, 0.8\rangle$ | $\langle 0, 0\rangle$ | 0.2 |
| $(e_1, q)$ | $\langle 0.3, 0.6\rangle$ | $\langle 0.9, 0.9\rangle$ | $\langle 1, 1\rangle$ | 0.5 |
| $(e_1, r)$ | $\langle 0.4, 0.8\rangle$ | $\langle 0.2, 0.2\rangle$ | $\langle 0.9, 0.9\rangle$ | 0.2 |
| $(e_2, p)$ | $\langle 0.2, 0.8\rangle$ | $\langle 0.4, 0.7\rangle$ | $\langle 0.5, 0.6\rangle$ | 0.8 |
| $(e_2, q)$ | $\langle 0.3, 0.4\rangle$ | $\langle 0.4, 0.5\rangle$ | $\langle 0.6, 0.8\rangle$ | 0.3 |
| $(e_2, r)$ | $\langle 0.1, 0.1\rangle$ | $\langle 0.8, 0.9\rangle$ | $\langle 0.3, 0.4\rangle$ | 0.6 |
| $(e_3, p)$ | $\langle 0.3, 0.6\rangle$ | $\langle 0.6, 0.6\rangle$ | $\langle 0.5, 0.5\rangle$ | 0.9 |
| $(e_3, q)$ | $\langle 0.1, 0.2\rangle$ | $\langle 0.2, 0.6\rangle$ | $\langle 0.4, 0.6\rangle$ | 0.2 |
| $(e_3, r)$ | $\langle 0.3, 0.7\rangle$ | $\langle 0.1, 0.3\rangle$ | $\langle 0.3, 0.6\rangle$ | 0.5 |

Table 2: Disagree-generalized vague soft expert set

| $U$ | $u_1$ | $u_2$ | $u_3$ | |
|---|---|---|---|---|
| $(e_1, p)$ | $\langle 0.1, 0.1\rangle$ | $\langle 0.8, 0.9\rangle$ | $\langle 0.3, 0.3\rangle$ | 0.6 |
| $(e_1, q)$ | $\langle 0.3, 0.4\rangle$ | $\langle 0.4, 0.5\rangle$ | $\langle 0.6, 0.8\rangle$ | 0.8 |
| $(e_1, r)$ | $\langle 0.3, 0.7\rangle$ | $\langle 0.1, 0.3\rangle$ | $\langle 0.3, 0.6\rangle$ | 0.1 |
| $(e_2, p)$ | $\langle 0.5, 0.5\rangle$ | $\langle 0.6, 0.8\rangle$ | $\langle 0, 0\rangle$ | 0.3 |
| $(e_2, q)$ | $\langle 0.3, 0.6\rangle$ | $\langle 0.9, 0.9\rangle$ | $\langle 1, 1\rangle$ | 0.6 |
| $(e_2, r)$ | $\langle 0.4, 0.4\rangle$ | $\langle 0.2, 0.2\rangle$ | $\langle 0.9, 0.9\rangle$ | 0.7 |
| $(e_3, p)$ | $\langle 0.3, 0.6\rangle$ | $\langle 0.6, 0.6\rangle$ | $\langle 0.5, 0.5\rangle$ | 0.9 |
| $(e_3, q)$ | $\langle 0.1, 0.2\rangle$ | $\langle 0.2, 0.6\rangle$ | $\langle 0.4, 0.6\rangle$ | 0.6 |
| $(e_3, r)$ | $\langle 0.3, 0.7\rangle$ | $\langle 0.1, 0.3\rangle$ | $\langle 0.3, 0.6\rangle$ | 0.8 |

We subtract the false-membership function from the truth-membership function and we mark the highest numerical grade in each row as shown in Table 3 and Table 4 for agree-generalized vague soft expert set and disagree-generalized vague soft expert set respectively. Then, we calculate the score of each product in agree-generalized and disagree-generalized vague soft expert sets by taking the sum of the products of these numerical grades with the corresponding values of $\lambda$. We calculate the final score by subtracting the scores of the potential marketing products in the agree-generalized vague soft expert set from the scores in the disagree-generalized vague soft expert set. The marketing product with the highest score is the desired product to be marketed through direct selling by the company.

Table 3: Agree-generalized vague soft expert set

| $U$ | $u_1$ | $u_2$ | $u_3$ | $\lambda$ |
|---|---|---|---|---|
| $(e_1, p)$ | $\underline{0}$ | -0.2 | 0 | 0.2 |
| $(e_1, q)$ | -0.3 | $\underline{0}$ | $\underline{0}$ | 0.5 |
| $(e_1, r)$ | -0.4 | $\underline{0}$ | $\underline{0}$ | 0.2 |
| $(e_2, p)$ | -0.6 | -0.3 | $\underline{-0.1}$ | 0.8 |
| $(e_2, q)$ | $\underline{-0.1}$ | $\underline{-0.1}$ | -0.2 | 0.3 |
| $(e_2, r)$ | $\underline{0}$ | -0.1 | -0.1 | 0.6 |
| $(e_3, p)$ | -0.3 | $\underline{0}$ | $\underline{0}$ | 0.9 |
| $(e_3, q)$ | $\underline{-0.1}$ | -0.4 | -0.2 | 0.2 |
| $(e_3, r)$ | -0.4 | $\underline{-0.2}$ | -0.3 | 0.5 |

The scores of $u_i$ are computed by using the data in Table 3.
$\text{score}(u_1) = (0 * 0.2) + (-0.1 * 0.3) + (0 * 0.6) + (-0.1 * 0.2) = -0.05$,
$\text{score}(u_2) = (0 * 0.5) + (0 * 0.2) + (-0.1 * 0.3) + (0 * 0.9) + (-0.2 * 0.5) = -0.13$,
$\text{score}(u_3) = (0 * 0.5) + (0 * 0.2) + (-0.1 * 0.8) + (0 * 0.9) = -0.08$,

Table 4: Disagree-generalized vague soft expert set

| $U$ | $u_1$ | $u_2$ | $u_3$ | $\lambda$ |
|---|---|---|---|---|
| $(e_1, p)$ | $\underline{0}$ | -0.1 | 0 | 0.6 |
| $(e_1, q)$ | $\underline{-0.1}$ | $\underline{-0.1}$ | -0.2 | 0.8 |
| $(e_1, r)$ | -0.3 | $\underline{-0.2}$ | -0.3 | 0.1 |
| $(e_2, p)$ | $\underline{0}$ | -0.2 | $\underline{0}$ | 0.3 |
| $(e_2, q)$ | -0.3 | $\underline{0}$ | $\underline{0}$ | 0.6 |
| $(e_2, r)$ | $\underline{0}$ | $\underline{0}$ | $\underline{0}$ | 0.7 |
| $(e_3, p)$ | -0.3 | $\underline{0}$ | $\underline{0}$ | 0.9 |
| $(e_3, q)$ | $\underline{-0.1}$ | -0.4 | -0.2 | 0.6 |
| $(e_3, r)$ | -0.4 | $\underline{-0.2}$ | -0.3 | 0.8 |

Compute the scores of $u_i$ by using the data in Table 4.
$\text{score}(u_1) = (0 * 0.6) + (-0.1 * 0.8) + (0 * 0.3) + (0 * 0.7) + (-0.1 * 0.6) = -0.14$,
$\text{score}(u_2) = (-.1*0.8)+(-0.2*0.1)+(0*0.6)+(0*0.7)+(0*0.9)+(-0.2*0.8) = -0.26$,
$\text{score}(u_3) = (0 * 0.3) + (0 * 0.6) + (0 * 0.7) + (0 * 0.9) = 0$.
The final score of $(u_i)$ as follows:
$\text{score}(u_1) = -0.05 + 0.14 = 0.09$,
$\text{score}(u_2) = -0.13 + 0.26 = 0.13$,
$\text{score}(u_3) = -0.08 + 0 = -0.08$,
Thus the management committee decision is to choose product $u_2$.

## 3. Conclusion

Research and the development of the application of vague soft set in decision-making problems are ongoing. This new application not only provide a significant addition to existing theories for handling uncertainties, but also leads to potential areas of further research and pertinent applications.

**Acknowledgments**

We are indebted to Universiti Kebangsaan Malaysia for funding this research under the the grant BKBP-FST-K005560.

**References**

[1] D.A.Molodtsov, Soft set theory-first result,*Computers and Mathematics with Applications,* **37**(1999), 19-31.

[2] S. Alkhazaleh, A. R. Salleh and N. Hassan, Soft multisets theory, *Applied Mathematical Sciences,* **5** (72) (2011), 3561 - 3573.

[3] S. Alkhazaleh, A. R. Salleh and N. Hassan, Possibility fuzzy soft set, *Advances in Decision Sciences*, Article ID **479756**, 18 pages doi:10.1155/2011/479756.

[4] S. Alkhazaleh, A. R. Salleh and N. Hassan, Fuzzy parameterized interval-valued fuzzy soft set, *Applied Mathematical Sciences,* **5** (67) (2011), 3335-3346.

[5] A. R. Salleh, S. Alkhazaleh, N. Hassan and A.G. Ahmad, Multiparameterized soft set, *Journal of Mathematics and Statistics*, **8** (1) (2012), 92-97.

[6] K. Alhazaymeh, S. Abdul Halim, A. R. Salleh and N. Hassan, Soft intuitionistic fuzzy sets, *Applied Mathematical Sciences*, **6** (54) (2012), 2669-2680.

[7] N. Hassan and K. Alhazaymeh, Vague soft expert set theory, *AIP Conference Proceedings,* **1522** (2013), 953-958 ; doi: 10.1063/1.4801233.

[8] K. Alhazaymeh and N. Hassan, Generalized vague soft set and its applications, *International Journal of Pure and Applied Mathematics,* **77** (3) (2012), 391-401.

[9] K. Alhazaymeh and N. Hassan, Possibility vague soft set and its application in decision making, *International Journal of Pure and Applied Mathematics,* **77** (4) (2012), 549-563.

[10] K. Alhazaymeh and N. Hassan, Interval-valued vague soft sets and its application, *Advances in Fuzzy Systems,* Article ID **208489**, 7 pages. doi:10.1155/2012/208489.

[11] K.Alhazaymeh and N.Hassan, Possibility interval-valued vague soft set, *Applied Mathematical Sciences,* **7** (140) (2013), 6989-6994.

[12] K.Alhazaymeh and N.Hassan, Generalized interval-valued vague soft set, *Applied Mathematical Sciences,* **7** (140) (2013), 6983-6988.

[13] K.Alhazaymeh and N.Hassan, Generalized vague soft expert set, *International Journal of Pure and Applied Mathematics,* (in press).

[14] K. Alhazaymeh and N. Hassan, Mapping on generalized vague soft expert set, *International Journal of Pure and Applied Mathematics*, (in press).

[15] F. Adam and N. Hassan, Multi Q-fuzzy parameterized soft set and its application, *Journal of Intelligent and Fuzzy System,* (in press).

[16] M. Varnamkhasti and N. Hassan, A hybrid of adaptive neuro-fuzzy inference system and genetic algorithm, *Journal of Intelligent and Fuzzy Systems,* **25** (3) (2013), 793-796.

[17] M. Varnamkhasti and N. Hassan, Neurogenetic algorithm for solving combinatorial engineering problems, *Journal of Applied Mathematics,* Vol. (2012), Article ID **253714**, 12 pages. doi:10.1155/2012/253714.

[18] N. Hassan, K.B. Hassan, S.S Yatim and S.A. Yusof, Optimizing fertilizer compounds and minimizing the cost of cucumber production using the goal programming approach, *American-Eurasian Journal of Sustainable Agriculture*, **7** (2) (2013), 45-49.

[19] N. Hassan, H.H.M. Hamzah and S.M.M. Zain, A goal programming approach for rubber production in Malaysia, *American-Eurasian Journal of Sustainable Agriculture*, **7** (2) (2013), 50-53.

[20] N. Hassan, N. Ahmad and W.M.W. Aminuddin, Selection of mobile network operator using analytic hierarchy process, *Advances in Natural and Applied Sciences*,**7** (1) (2013), 1-5.

[21] N. Hassan, A.H.M. Pazil, N.S. Idris and N.F. Razman, A goal programming model for bakery production,*Advances in Environmental Biology*, **7** (1) (2013), 187-190.

[22] N. Hassan, S. Safiai, N.H.M. Raduan and Z. Ayop, Goal programming formulation in nutrient management for chilli plantation in Sungai Buloh Malaysia, *Advances in Environmental Biology*, **6** (12) (2012), 4008-4012.

[23] N. Hassan and B.A. Halim, Mathematical modelling approach to the management of recreational tourism activities at Wetland Putrajaya (in Malay), *Sains Malaysiana*, **41** (9) (2012), 1155-1161.

[24] N. Hassan and L.L. Loon, Goal programming with utility function for funding allocation of a university library, *Applied Mathematical Sciences*, **6** (110) (2012), 5487-5493.

[25] N. Hassan, L.W. Siew and S.Y. Shen, Portfolio decision analysis with maximin criterion in the Malaysian stock market, *Applied Mathematical Sciences*, **6** (110) (2012), 5483-5486.

[26] N. Hassan and S. Sahrin, A mathematical model of nutrient management for pineapple cultivation in Malaysia, *Advances in Environmental Biology*, **6** (5) (2012), 1868-1872.

[27] N. Hassan and Z. Ayop, A goal programming approach for food product distribution of small and medium enterprises, *Advances in Environmental Biology*, **6** (2) (2012), 510-513.

[28] N. Hassan and S.B.M. Basir, A goal programming model for scheduling political campaign: A case study in Kabupaten Kampar, Riau, Indonesia (in Malay), *Journal of Quality Measurement and Analysis*, **5** (2) (2009), 99-107.

[29] N. Hassan, D.F. Azmi, T.S. Guan and L.W. Hoe, A goal programming approach for library acquisition allocation, *Applied Mathematical Sciences*, **7** (140) (2013), 6977-6981.

[30] N. Hassan and M.M. Tabar, The relationship of multiple objectives linear programming and data envelopment analysis, *Australian Journal of Basic and Applied Sciences*, **5** (11) (2011), 1711-1714.

[31] N. Hassan, M.M. Tabar and P. Shabanzade, Resolving multi objectives resource allocation problem based on inputs and outputs using data envelopment analysis method, *Australian Journal of Basic and Applied Sciences*, **4** (10) (2010), 5320-5325.

[32] N. Hassan, M.M. Tabar and P. Shabanzade, A ranking model of data envelopment analysis as a centralized multi objective resource allocation problem tool, *Australian Journal of Basic and Applied Science*, **4** (10) (2010), 5306-5313.