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AN ENHANCED DEA METHOD FOR GROUP EVALUATION – THE EMPIRICAL STUDY OF ANTI-PHISHING EFFICIENCY

Han-Ying Kao[1,*], Chu-Ling Hsu[1] and Chia-Hui Huang[2]

[1]Institute of Networking and Multimedia Technology
National Dong Hwa University
1, Sec. 2, Da Hsueh Rd., Shou-Feng, Hualien, Taiwan
[*]Corresponding author: teresak@mail.ndhu.edu.tw; bhat_celine@hotmail.com

[2]Department of Information Management
Kainan University
No.1 Kainan Road, Luzhu Shiang, Taoyuan 33857, Taiwan
leohuang@mail.knu.edu.tw

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Abstract. *This study proposes a reformed data envelopment analysis (DEA) approach for group evaluation. In the setting where multiple reviewers are involved and who measure all factors independently, how to synthesize the results is a critical issue. This work develops the enhanced DEA model with multiple objective programming (MOP) formulation for integrating the outcomes. Based on general DEA methods, the first objective function is to maximize the average efficiency from all reviewers. Because the mean efficiency tends to converge on the favorable score, we define a balancing objective to minimize the total deviation from the consensus. The case study of anti-phishing efficiency shows the proposed model's feasibility in obtaining consensus from group evaluation.*
Keywords: Data envelopment analysis, Multi-objective programming, Group evaluation, Anti-phishing

1. **Introduction.** Data envelopment analysis (DEA) [1, 2, 3, 4, 5, 6, 7] is a celebrated efficiency evaluation technique, among which the CCR model has been widely used. The DEA CCR ratio model developed by Charnes et al. [2] assesses the relative efficiency of decision-making units (DMUs) by maximizing the ratio of the weighted sum of outputs to that of inputs. Consider n DMUs ($j = 1, 2, \ldots, n$) that require assessment. Each DMU consumes m inputs ($i = 1, 2, \ldots, m$) and produces s outputs ($r = 1, 2, \ldots, s$), denoted by $X_{1j}, X_{2j}, \ldots, X_{mj}$, and $Y_{1j}, Y_{2j}, \ldots, Y_{sj}$, respectively. The efficiency of DMU_k is computed as follows

CCR ratio model

$$\begin{aligned} \max \quad & E_k = \frac{\sum_{r=1}^{s} u_r Y_{rk}}{\sum_{i=1}^{m} v_i X_{ik}} \\ s.t. \quad & \\ & \frac{\sum_{r=1}^{s} u_r Y_{rj}}{\sum_{i=1}^{m} v_i X_{ij}} \le 1, j = 1, 2 \ldots, n \\ & u_r, v_i \ge \varepsilon, r = 1, 2, \ldots, s; i = 1, 2, \ldots, m. \end{aligned} \tag{1}$$

Based on the CCR ratio model, the objective function E_k is maximized for every DMU_k individually. In the model, X_{ik} and Y_{rk}, are the i-th input and r-th output of DMU_k; u_r, v_i are the weights of the outputs and inputs, respectively; ε is a small positive value which ensures all weights to be nonnegative. For computational convenience, frequently