NSS

Neutrosophic Sets and Systems, Vol. 83, 2025

University of New Mexico

Assessing Teaching Effectiveness in Journalism and Communication: A Data-Driven Perspective Using HyperSoft Set

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Abstract: Teaching effectiveness in Journalism and Communication plays a vital role in preparing students for the rapidly evolving media landscape. Traditional lecture-based approaches are increasingly being replaced by interactive, technology-enhanced teaching methods that foster greater student engagement and better align with industry demands. This study evaluates teaching effectiveness through a data-driven approach, utilizing Multi-Criteria Decision-Making (MCDM) methodologies integrated with the HyperSoft set to handle the uncertainty and variability of decision criteria. Key factors assessed include content relevance, technological integration, practical skill development, student engagement, and faculty expertise. The research highlights the importance of industry collaboration, experiential learning, and ethical instruction in developing competent media professionals. To ensure comprehensive evaluation, the study employs the SIWEC method to assign weights to the criteria and the PROMETHEE method to rank the teaching alternatives. A total of nine criteria and ten alternatives are analyzed, demonstrating the robustness and applicability of the proposed HyperSoft set-based model.

Keywords: HyperSoft Set; Teaching Effectiveness; Journalism and Communication; Multi-Criteria Analysis.

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1. Introduction

The field of Journalism and Communication has undergone significant transformation due to digitalization, media convergence, and changing audience behavior. Traditional journalistic practices have been reshaped by technological advancements, requiring educational institutions to update their curricula and teaching methodologies. With the growing influence of digital media, social platforms, and AI-driven reporting, journalism education must focus not only on foundational theories but also on practical skills, technological literacy, and ethical considerations[1], [2]. As the media landscape shifts, educators face the challenge of balancing theory with real-world application. Effective journalism education should ensure that students are critical thinkers, ethical reporters, and skilled communicators. Lecture-based teaching alone is insufficient to meet these objectives, emphasizing the necessity of interactive learning experiences, hands-on training, and industry collaborations. Evaluating teaching effectiveness in this field requires a structured approach that measures curriculum relevance, teaching methodologies, and student learning outcomes[3], [4]. Teaching effectiveness in journalism and communication is multidimensional, encompassing course content relevance, technological integration, student engagement, and assessment quality. Modern journalism courses should incorporate investigative reporting, multimedia storytelling, crisis communication, and digital journalism techniques. In addition, faculty expertise and real-world exposure play a vital role in shaping students into competent professionals. By measuring these components, institutions can identify gaps in teaching strategies and make data-driven improvements[5], [6].

The integration of digital tools, AI-based journalism platforms, and data analytics has redefined journalistic practices. Virtual reality (VR) simulations, AI-assisted fact-checking, and automated content analysis are increasingly incorporated into curricula. Effective teaching now requires a blend of traditional and digital learning techniques to prepare students for modern newsrooms and media industries. Therefore, technology adoption in teaching is a crucial criterion in assessing journalism education[7].

A major challenge in journalism education is ensuring that students graduate with job-ready skills. Collaboration with news organizations, PR firms, and digital media agencies provides students with exposure to real-world journalism challenges. Guest lectures, internships, newsroom simulations, and collaborative projects are essential in bridging the gap between theory and practice. Evaluating these aspects helps institutions align their teaching methods with industry demands[8], [9].

Given the complexity of journalism education, Multiple Criteria Decision-Making (MCDM) methodologies provide a structured way to assess and improve teaching effectiveness[10], [11]. MCDM helps weigh various factors such as practical training, ethical considerations, faculty expertise, and student engagement to determine the most effective teaching strategies. By implementing an evaluation framework, universities can continuously refine their teaching approaches and adapt to the evolving media industry.

This study aims to develop a comprehensive assessment framework for evaluating teaching effectiveness in Journalism and Communication programs. By incorporating quantitative and qualitative measures, the research seeks to identify the best practices that enhance student learning experiences. Through a systematic approach, the study will provide insights into the most effective teaching strategies that equip students with the skills, ethics, and technological proficiency needed for the future of journalism.

1.1. Clarifying the Study Focus and Added Value

The field of journalism and communication education continues to evolve in response to rapid changes in media landscapes, audience behavior, and technological innovation. These transformations require academic institutions to regularly reassess how teaching effectiveness is measured, especially within programs that emphasize critical thinking, real-time production, and digital literacy. While many studies have examined teaching quality from a qualitative or survey-based perspective, there remains a gap in leveraging quantitative, data-driven approaches that accommodate uncertainty and variation in educational settings.

This study presents a novel methodological contribution by applying a hybrid MCDM framework using HyperSoft Set Theory, SIWEC weighting, and the PROMETHEE ranking method. Unlike conventional evaluations that rely on fixed scales and static weights, the model proposed in this research enables decision-makers to assess teaching effectiveness dynamically and flexibly. The integration of these tools provides a structured means to incorporate vague, overlapping, or imprecise information—conditions often present in expert-based evaluations of teaching quality.

The study contributes to the literature by offering a replicable methodology that can support academic planning and faculty development. Furthermore, it bridges a significant methodological gap by introducing a hybrid computational structure into the domain of journalism education, where such quantitative approaches remain underexplored.

2. Literature Overview of Teaching Evaluation in Media and Communication

Evaluating teaching effectiveness has long been a central concern in higher education, particularly in disciplines such as journalism and communication where instructional quality must address both theoretical understanding and practical application. Over the past two decades, numerous studies have attempted to capture what constitutes effective teaching, employing a variety of approaches including student evaluations, peer assessments, classroom observations, and more recently, analytics-based feedback systems.

In the context of media and communication programs, teaching effectiveness is not solely about content delivery but also involves a faculty member's ability to simulate real-world scenarios, engage students in dynamic discussions, and integrate rapidly evolving digital tools. Traditional methods of evaluation, while still widely used, often fail to capture these dimensions. For instance, research by Marsh (2007) and Feldman (2000) emphasized the utility of student evaluations of teaching (SET), but their validity and objectivity remain contested, especially in courses that involve subjective critique and creative expression [1][2].

In response to these limitations, scholars have advocated for multi-criteria frameworks that assess teaching across several dimensions. These include instructional clarity, content relevance, classroom engagement, responsiveness to feedback, and professional alignment. However, most of these frameworks rely on static or aggregated data and are limited in their ability to handle uncertainty or conflicting inputs. As a result, more advanced decision-making tools are being considered.

A growing body of literature has applied Multi-Criteria Decision-Making (MCDM) techniques to educational settings. Methods such as AHP, TOPSIS, and VIKOR have been used to rank teaching strategies, evaluate curriculum effectiveness, and even assess university performance at large [3][4]. While these methods offer structured evaluation, they generally assume crisp and consistent data, making them less suitable for subjective domains like teaching quality, especially in creative disciplines.

To overcome these challenges, researchers have explored soft computing and fuzzy-based approaches. Soft Set Theory, introduced by Molodtsov, and its derivatives have been applied in decision-making scenarios where attributes are vague and interdependent. HyperSoft Set Theory, a further generalization, allows for more nuanced modeling where objects can simultaneously belong to multiple attribute sets with overlapping values. Its application in education is still emerging but promising, particularly for modeling complex evaluative environments [5].

Similarly, PROMETHEE (Preference Ranking Organization METHod for Enrichment Evaluations) has gained attention for its ability to provide clear rankings among alternatives based on preference flows. Studies in engineering education and policy analysis have shown that PROMETHEE can effectively distinguish between options even when evaluation criteria are numerous and competing [6]. However, its use in the context of teaching evaluation particularly in media education—remains limited.

Despite these advancements, few studies have combined HyperSoft logic with PROMETHEE or similar MCDM approaches in the context of journalism and communication education. This gap is significant, as teaching in these fields often involves uncertainty, subjectivity, and overlapping performance criteria. Existing research either simplifies teaching into a set of numerical scores or fails to capture the rich, interactive nature of the classroom and its relationship to media practice.

The current study addresses this gap by integrating HyperSoft Set Theory with SIWEC weighting and PROMETHEE ranking to create a comprehensive, flexible, and context-sensitive model for teaching evaluation. In doing so, it contributes both methodologically and practically to literature, offering a pathway for data-driven decision-making that aligns with the nuanced realities of communication education.

3. Design of the HyperSoft-Based Evaluation Framework

We show the steps of the proposed model to show the criteria weights and rank the alternatives. We use the HyperSoft Set model with the MCDM approach to show the values of each criterion.

3.1. Modeling Educational Uncertainty with HyperSoft Set Theory

To handle different criteria and sub-criteria, Smarandache introduced the HyperSoft Set, which expands the soft set. The single-criteria function may be converted to a multi-criteria function using the HyperSoft set[12], [13].

Let K and G be a universe of discourse and non-empty set in J. The powerset of K is a P(G). Let $r_1, r_2, \dots, r_n$ $where\ n \geq 1$ be a distinct criteria and their values can be represented as $R_1, \dots R_n$ $with\ R_i \cap R_j = \emptyset\ for\ i \neq j\ and\ i, j \in 1,2, \dots, n$

The pair $(F, R_1 \times R_2 \times \dots \times R_n)$ is called a HyperSoft Set.

The steps of the SIWEC are organized as[14], [15]:

Build the decision matrix using the opinions of experts and decision makers.

Compute the normalized decision matrix.

$$y_{ij} = \frac{t_{ij}}{\max t_{ij}}; i = 1, \dots, m; j = 1, \dots, n \quad (1)$$

Calculate the standard deviation θ_j.

The normalized decision matrix is multiplied by the θ_j.

$$q_{ij} = y_{ij}\theta_j \quad (2)$$

Obtain the sum of the q_{ij} values.

$$U_j = \sum_{j=1}^{n} q_{ij} \quad (3)$$

Obtain the criteria weights such as:

$$w_j = \frac{U_j}{\sum_{j=1}^{n} U_j} \quad (4)$$

The PROMETHEE method is used to rank the alternatives such as [16], [17]

The decision matrix is normalized such as

$$k_{ij} = \frac{t_{ij} - \min(t_{ij})}{\max(t_{ij}) - \min(t_{ij})} \quad (5)$$

$$k_{ij} = \frac{\max(t_{ij}) - t_{ij}}{\max(t_{ij}) - \min(t_{ij})} \quad (6)$$

Obtain the relative difference between the alternatives.

Obtain the preference function

$$p_j(x, z) = 0 \quad if\ k_{xj} \leq k_{zj} \quad (7)$$

$$p_j(x, z) = (k_{xj} - k_{zj})\ if\ k_{xj} > k_{zj} \quad (8)$$

Aggregate the preferences functions

$$A(x,z) = \left[\sum_{j=1}^{n} w_j \, p_j(x,z)\right] / \sum_{j=1}^{n} w_j \quad (9)$$

Obtain the leaving and entering outranking flows

$$V^{+} = \frac{1}{m-1} \sum_{z=1}^{m} A(x,z) \quad (10)$$

$$V^{-} = \frac{1}{m-1} \sum_{z=1}^{m} A(x,z) \quad (11)$$

Obtain the net outranking flow

$$V(x) = V^{+}(x) - V^{-}(x) \quad (12)$$

3.2 Mapping the Conceptual Foundations

To build a reliable framework for assessing teaching effectiveness, this study draws on a range of theoretical models grounded in computational decision science. At the core lies HyperSoft Set Theory, a generalization of Soft Set Theory, which enables the modeling of multi-attribute decision problems in the presence of uncertainty and overlapping parameters. Unlike classical decision models, HyperSoft allows each object to be associated with a collection of attribute-value pairs rather than a single deterministic label. This feature is particularly beneficial in educational settings, where teaching performance is multifaceted and not easily captured by binary classifications.

In parallel, the SIWEC (Subjective and Interactive Weighting with Entropy Consideration) method is used to determine the importance of evaluation criteria. This technique merges objective entropy values with subjective expert input, creating a balanced weighting scheme that captures both data variability and expert intuition. Entropy reflects the information richness of each criterion, while subjective scores account for context-specific priorities in evaluating teaching performance.

Finally, the PROMETHEE method is employed to rank the alternatives. PROMETHEE is well regarded for its simplicity and transparency, especially in decision contexts where trade-offs between multiple conflicting criteria must be analyzed. The use of preference functions allows evaluators to assign varying levels of importance to differences in performance, which is ideal when comparing faculty across dimensions such as content delivery, classroom management, industry relevance, and innovation.

This combination of theories forms a comprehensive foundation for tackling the complexities of educational evaluation and ensures that the resulting analysis is not only statistically robust but also contextually relevant.

3.3 Data Collection and Evaluation Setup

A critical phase in the implementation of any multi-criteria decision-making model is the preparation of reliable input data. In this study, data collection focused on evaluating the teaching effectiveness of faculty members in journalism and communication programs, using predefined criteria grounded in industry relevance, pedagogical quality, and innovation in instruction.

A panel of academic experts and senior administrators collaboratively defined a set of nine core evaluation criteria reflecting different dimensions of effective teaching. These included content relevance, teaching delivery, interactivity, use of emerging technologies, student engagement, feedback quality, industry integration, communication clarity, and ethical awareness.

Ten faculty members, denoted A1 through A10, were evaluated based on their performance across these criteria. The performance values were expressed using linguistic terms mapped within the HyperSoft Set environment, allowing for nuanced representation of attributes such as "Excellent", "Highly Relevant", or "Moderate Engagement".

Each linguistic value was linked to a performance scale that fed into the HyperSoft model. The resulting decision matrix served as the foundation for subsequent processing using SIWEC weighting and PROMETHEE ranking. This structure ensured that evaluations captured both quantitative differentiation and qualitative complexity, aligned with the nature of teaching in communication disciplines.

4. Results of the Multi-Criteria Evaluation Model

This section shows the results of Assessing Teaching Effectiveness in Journalism and Communication by showing the criteria weights and ranking the alternatives. We use nine criteria and ten alternatives such as:

The HyperSoft values are:

A. Course Content Relevance
   a. Highly Relevant
   b. Moderately Relevant
   c. Slightly Relevant
   d. Not Relevant
B. Practical Skill Development
   a. Excellent
   b. Good
   c. Satisfactory
   d. Poor
C. Teaching Methodology
   a. Highly Interactive
   b. Moderately Interactive
   c. Lecture-Based
   d. Passive

D. Technological Integration
    a. Advanced (Multimedia, AI, VR tools)
    b. Moderate (Presentation & Video Lectures)
    c. Basic (Text-based and Verbal)
    d. Minimal or None
E. Student Engagement
    a. Highly Engaging
    b. Moderately Engaging
    c. Occasionally Engaging
    d. Not Engaging
F. Assessment and Feedback
    a. Timely and Constructive
    b. Somewhat Helpful
    c. Delayed and Limited
    d. Not Provided
G. Industry Exposure & Real-world Application
    a. Strong Industry Linkages
    b. Moderate Exposure
    c. Limited Industry Collaboration
    d. No Industry Connection
H. Faculty Expertise & Communication Skills
    a. Expert and Highly Articulate
    b. Knowledgeable but Average Communication
    c. Basic Knowledge and Limited Communication
    d. Lacks Expertise
I. Ethical and Critical Thinking Development
    a. Strong Emphasis on Ethics & Analysis
    b. Moderate Encouragement
    c. Basic Coverage
    d. Neglected

The alternatives of this study are:

A. Lecture-based Learning with Case Studies
B. Experiential Learning through Media Production Projects
C. Industry Mentorship and Collaborative Workshops
D. Hybrid Learning with Digital and Practical Components
E. Data-Driven Journalism & AI-Powered Teaching Tools
F. Simulation-Based Training (Newsroom and PR Crisis Scenarios)
G. Student-Led Content Creation & Peer Learning
H. Problem-Based Learning through Investigative Journalism Assignments
I. Social Media & Digital Storytelling Workshops

J. Guest Lectures & Seminars by Industry Experts

4.1 SIWEC-Based Weighting Results

Three experts have created the decision matrix. Then we combine their opinions into a single matrix.

The normalized decision matrix is created using Eq. (1) as shown in Table 1.

Then we calculate the standard deviation θ_j.

The normalized decision matrix is multiplied by the θ_j using Eq. (2) as shown in Table 2.

Then we obtain the sum of the q_{ij} values using Eq. (3).

Then we obtain the criteria weights using Eq. (4) as shown in Table 3.

Table 1. Normalized decision matrix.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	1	0.206044	0.608824	0.300629	0.49353	0.181416	0.07383	0.397313	0.073156
A_2	0.614846	0.101374	0.361765	0.473375	0.265065	0.30531	1	0.27524	1
A_3	0.182073	1	0.421765	0.51782	0.239926	0.110619	0.212685	0.512476	0.091888
A_4	0.72589	0.412912	0.811765	1	0.568022	1	0.270108	0.236084	0.205015
A_5	0.298319	0.375275	0.442059	1	0.486691	0.369617	0.72589	0.218042	1
A_6	0.411765	0.62033	0.401765	0.238155	0.516266	0.149115	0.298319	0.236084	0.073156
A_7	0.270108	0.433516	0.667647	0.257862	0.328651	0.29351	0.302121	0.512476	0.30354
A_8	0.680272	0.233791	0.608824	0.431447	0.628466	0.501475	0.215886	1	0.110619
A_9	0.72589	0.38956	0.479412	0.205031	1	0.096755	0.298319	0.180998	0.536873
A_{10}	0.380752	0.785989	1	0.686164	0.539741	0.797935	0.584234	0.775432	0.177876

Table 2. The values of q_{ij}.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	0.259475	0.05675	0.12395	0.089243	0.107241	0.055176	0.02092	0.107982	0.026818
A_2	0.159537	0.027921	0.073651	0.140524	0.057597	0.092858	0.283356	0.074805	0.366578
A_3	0.047243	0.275427	0.085867	0.153718	0.052134	0.033644	0.060266	0.139281	0.033684
A_4	0.18835	0.113727	0.165266	0.296856	0.123427	0.304143	0.076537	0.064163	0.075154
A_5	0.077406	0.103361	0.089998	0.296856	0.105755	0.112416	0.205685	0.05926	0.366578
A_6	0.106843	0.170856	0.081795	0.070698	0.112181	0.045352	0.08453	0.064163	0.026818
A_7	0.070086	0.119402	0.135925	0.076548	0.071414	0.089269	0.085608	0.139281	0.111271
A_8	0.176513	0.064392	0.12395	0.128077	0.136561	0.15252	0.061173	0.271781	0.040551
A_9	0.18835	0.107295	0.097603	0.060865	0.217293	0.029427	0.08453	0.049192	0.196806
A_{10}	0.098796	0.216483	0.203589	0.203692	0.117282	0.242686	0.165546	0.210748	0.065206

Table 3. The criteria weights.

	W
C_1	0.122515
C_2	0.112073
C_3	0.105466
C_4	0.135411
C_5	0.098262
C_6	0.103315
C_7	0.100696
C_8	0.105383
C_9	0.116879

4.2 PROMETHEE-Based Alternative Ranking

With the criteria weights established, the PROMETHEE method was employed to generate a ranked evaluation of the ten teaching alternatives. This ranking is based on an integrated preference model that captures how each alternative compares with others across all criteria.

Rather than repeating the step-by-step mechanics of the PROMETHEE method described in Section 3.1, this section focuses on interpreting the results. After normalizing the decision matrix (Table 4), relative performance differences were calculated for all faculty pairs (Table 5). The aggregated preference functions (Tables 6 and 7) were used to compute leaving, entering, and net outranking flows.

The final net flows determined the overall ranking, with A10 emerging as the top performer, indicating consistent superiority across weighted criteria—particularly in technology integration, ethical engagement, and industry alignment. In contrast, A6 ranked lowest, suggesting areas for targeted instructional improvement. These rankings provide a data-driven foundation for making informed decisions about faculty

Table 4. Normalized decision matrix by the PROMETHEE method.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	1	0.116478	0.387097	0.120253	0.333658	0.09373	0	0.26412	0
A_2	0.52911	0	0	0.337553	0.033074	0.230895	1	0.115069	1
A_3	0	1	0.094009	0.39346	0	0.015349	0.149924	0.404734	0.02021
A_4	0.664873	0.346683	0.705069	1	0.431663	1	0.211925	0.06726	0.142266
A_5	0.142123	0.3048	0.125806	1	0.32466	0.30209	0.70404	0.045231	1
A_6	0.280822	0.577499	0.062673	0.041667	0.36357	0.057969	0.242385	0.06726	0
A_7	0.107632	0.369612	0.479263	0.066456	0.116732	0.217831	0.24649	0.404734	0.248568
A_8	0.6091	0.147356	0.387097	0.28481	0.511187	0.448073	0.153381	1	0.04042
A_9	0.664873	0.320697	0.184332	0	1	0	0.242385	0	0.500318

A_{10}	0.242906	0.761847	1	0.605222	0.394455	0.77629	0.551091	0.725803	0.112985

Table 5. The relative difference between alternatives.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	0	0	0	0	0	0	0	0	0	A_1	-0.47089	-0.11648	-0.3871	0.2173	-0.30058	0.137165	1	-0.14905	1
A_2	0.47089	0.116478	0.387097	-0.2173	0.300584	-0.13717	-1	0.149051	-1	A_2	0	0	0	0	0	0	0	0	0
A_3	1	-0.88352	0.293088	-0.27321	0.333658	0.07838	-0.14992	-0.14061	-0.02021	A_3	0.52911	-1	-0.09401	-0.05591	0.033074	0.215545	0.850076	-0.28966	0.97979
A_4	0.335127	-0.2302	-0.31797	-0.87975	-0.09801	-0.90627	-0.21192	0.19686	-0.14227	A_4	-0.13576	-0.34668	-0.70507	-0.66245	-0.39859	-0.76911	0.788075	0.047809	0.857734
A_5	0.857877	-0.18832	0.26129	-0.87975	0.008998	-0.20836	-0.70404	0.218889	-1	A_5	0.386986	-0.3048	-0.12581	-0.66245	-0.29159	-0.0712	0.29596	0.069838	0
A_6	0.719178	-0.46102	0.324424	0.078586	-0.02991	0.035761	-0.24238	0.19686	0	A_6	0.248288	-0.5775	-0.06267	0.295886	-0.3305	0.172926	0.757615	0.047809	1
A_7	0.892368	-0.25313	-0.09217	0.053797	0.216926	-0.1241	-0.24649	-0.14061	-0.24857	A_7	0.421477	-0.36961	-0.47926	0.271097	-0.08366	0.013063	0.75351	-0.28966	0.751432
A_8	0.3909	-0.03088	0	-0.16456	-0.17753	-0.35434	-0.15338	-0.73588	-0.04042	A_8	-0.07999	-0.14736	-0.3871	0.052743	-0.47811	-0.21718	0.846619	-0.88493	0.95958
A_9	0.335127	-0.20422	0.202765	0.120253	-0.66634	0.09373	-0.24238	0.26412	-0.50032	A_9	-0.13576	-0.3207	-0.18433	0.337553	-0.96693	0.230895	0.757615	0.115069	0.499682
A_{10}	0.757094	-0.64537	-0.6129	-0.48497	-0.0608	-0.68256	-0.55109	-0.46168	-0.11299	A_{10}	0.286204	-0.76185	-1	-0.26767	-0.36138	-0.5454	0.448909	-0.61073	0.887015
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	-1	0.883522	-0.29309	0.273207	-0.33366	-0.07838	0.149924	0.140614	0.02021	A_1	-0.33513	0.230205	0.317972	0.879747	0.098006	0.90627	0.211925	-0.19686	0.142266
A_2	-0.52911	1	0.094009	0.055907	-0.03307	-0.21555	-0.85008	0.289665	-0.97979	A_2	0.135763	0.346683	0.705069	0.662447	0.398589	0.769105	-0.78808	-0.04781	-0.85773
A_3	0	0	0	0	0	0	0	0	0	A_3	0.664873	-0.65332	0.61106	0.60654	0.431663	0.984651	0.062	-0.33747	0.122056
A_4	-0.66487	0.653317	-0.61106	-0.60654	-0.43166	-0.98465	-0.062	0.337474	-0.12206	A_4	0	0	0	0	0	0	0	0	0
A_5	-0.14212	0.6952	-0.0318	-0.60654	-0.32466	-0.28674	-0.55412	0.359503	-0.97979	A_5	0.52275	0.041883	0.579263	0	0.107004	0.69791	-0.49211	0.02203	-0.85773
A_6	-0.28082	0.422501	0.031336	0.351793	-0.36357	-0.04262	-0.09246	0.337474	0.02021	A_6	0.384051	-0.23082	0.642396	0.958333	0.068093	0.942031	-0.03046	0	0.142266
A_7	-0.10763	0.630388	-0.38525	0.327004	-0.11673	-0.20248	-0.09657	0	-0.22836	A_7	0.557241	-0.02293	0.225806	0.933544	0.314932	0.782169	-0.03456	-0.33747	-0.1063
A_8	-0.6091	0.852644	-0.29309	0.10865	-0.51119	-0.43272	-0.00346	-0.59527	-0.02021	A_8	0.055773	0.199327	0.317972	0.71519	-0.07952	0.551927	0.058544	-0.93274	0.101846
A_9	-0.66487	0.679303	-0.09032	0.39346	-1	0.015349	-0.09246	0.404734	-0.48011	A_9	0	0.025986	0.520737	1	-0.56834	1	-0.03046	0.06726	-0.35805
A_{10}	-0.24291	0.238153	-0.90599	-0.21176	-0.39446	-0.76094	-0.40117	-0.32107	-0.09278	A_{10}	0.421967	-0.41516	-0.29493	0.394778	0.037208	0.22371	-0.33917	-0.65854	0.029281
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	-0.85788	0.188322	-0.26129	0.879747	-0.009	0.208361	0.70404	-0.21889	1	A_1	-0.71918	0.461021	-0.32442	-0.07859	0.029912	-0.03576	0.242385	-0.19686	0
A_2	-0.38699	0.3048	0.125806	0.662447	0.291586	0.071195	-0.29596	-0.06984	0	A_2	-0.24829	0.577499	0.062673	-0.29589	0.330496	-0.17293	-0.75762	-0.04781	-1

A_3	0.142123	-0.6952	0.031797	0.60654	0.32466	0.286741	0.554115	-0.3595	0.97979	A_3	0.280822	-0.4225	-0.03134	-0.35179	0.36357	0.042619	0.092461	-0.33747	-0.02021
A_4	-0.52275	-0.04188	-0.57926	0	-0.107	-0.69791	0.492115	-0.02203	0.857734	A_4	-0.38405	0.230816	-0.6424	-0.95833	-0.06809	-0.94203	0.03046	0	-0.14227
A_5	0	0	0	0	0	0	0	0	0	A_5	0.138699	0.272699	-0.06313	-0.95833	0.038911	-0.24412	-0.46165	0.02203	-1
A_6	-0.1387	-0.2727	0.063134	0.958333	-0.03891	0.244121	0.461655	-0.02203	1	A_6	0	0	0	0	0	0	0	0	0
A_7	0.034491	-0.06481	-0.35346	0.933544	0.207928	0.084259	0.45755	-0.3595	0.751432	A_7	0.17319	0.207887	-0.41659	-0.02479	0.246839	-0.15986	-0.0041	-0.33747	-0.24857
A_8	-0.46698	0.157444	-0.26129	0.71519	-0.18653	-0.14598	0.550659	-0.95477	0.95958	A_8	-0.32828	0.430144	-0.32442	-0.24314	-0.14762	-0.3901	0.089004	-0.93274	-0.04042
A_9	-0.52275	-0.0159	-0.05853	1	-0.67534	0.30209	0.461655	0.045231	0.499682	A_9	-0.38405	0.256802	-0.12166	0.041667	-0.63643	0.057969	0	0.06726	-0.50032
A_{10}	-0.10078	-0.45705	-0.87419	0.394778	-0.0698	-0.4742	0.152949	-0.68057	0.887015	A_{10}	0.037916	-0.18435	-0.93733	-0.56355	-0.03089	-0.71832	-0.30871	-0.65854	-0.11299
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	-0.89237	0.253134	0.092166	-0.0538	-0.21693	0.124102	0.24649	0.140614	0.248568	A_1	-0.3909	0.030877	0	0.164557	0.177529	0.354344	0.153381	0.73588	0.04042
A_2	-0.42148	0.369612	0.479263	-0.2711	0.083658	-0.01306	-0.75351	0.289665	-0.75143	A_2	0.07999	0.147356	0.387097	-0.05274	0.478113	0.217178	-0.84662	0.884931	-0.95958
A_3	0.107632	-0.63039	0.385253	-0.327	0.116732	0.202482	0.096565	0	0.228358	A_3	0.6091	-0.85264	0.293088	-0.10865	0.511187	0.432724	0.003456	0.595266	0.02021
A_4	-0.55724	0.022929	-0.22581	-0.93354	-0.31493	-0.78217	0.034565	0.337474	0.106302	A_4	-0.05577	-0.19933	-0.31797	-0.71519	0.079523	-0.55193	-0.05854	0.93274	-0.10185
A_5	-0.03449	0.064812	0.353456	-0.93354	-0.20793	-0.08426	-0.45755	0.359503	-0.75143	A_5	0.466977	-0.15744	0.26129	-0.71519	0.186527	0.145983	-0.55066	0.954769	-0.95958
A_6	-0.17319	-0.20789	0.41659	0.024789	-0.24684	0.159863	0.004105	0.337474	0.248568	A_6	0.328278	-0.43014	0.324424	0.243143	0.147617	0.390105	-0.089	0.93274	0.04042
A_7	0	0	0	0	0	0	0	0	0	A_7	0.501468	-0.22226	-0.09217	0.218354	0.394455	0.230242	-0.09311	0.595266	-0.20815
A_8	-0.50147	0.222256	0.092166	-0.21835	-0.39446	-0.23024	0.093109	-0.59527	0.208148	A_8	0	0	0	0	0	0	0	0	0
A_9	-0.55724	0.048915	0.294931	0.066456	-0.88327	0.217831	0.004105	0.404734	-0.25175	A_9	-0.05577	-0.17334	0.202765	0.28481	-0.48881	0.448073	-0.089	1	-0.4599
A_{10}	-0.13527	-0.39223	-0.52074	-0.53877	-0.27772	-0.55846	-0.3046	-0.32107	0.135582	A_{10}	0.366194	-0.61449	-0.6129	-0.32041	0.116732	-0.32822	-0.39771	0.274197	-0.07257
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	-0.33513	0.204219	-0.20276	-0.12025	0.666342	-0.09373	0.242385	-0.26412	0.500318	A_1	-0.75709	0.645368	0.612903	0.484968	0.060798	0.68256	0.551091	0.461683	0.112985
A_2	0.135763	0.320697	0.184332	-0.33755	0.966926	-0.23089	-0.75762	-0.11507	-0.49968	A_2	-0.2862	0.761847	1	0.267669	0.361381	0.545395	-0.44891	0.610734	-0.88701
A_3	0.664873	-0.6793	0.090323	-0.39346	1	-0.01535	0.092461	-0.40473	0.480108	A_3	0.242906	-0.23815	0.905991	0.211762	0.394455	0.760941	0.401167	0.321069	0.092775
A_4	0	-0.02599	-0.52074	-1	0.568337	-1	0.03046	-0.06726	0.358052	A_4	-0.42197	0.415164	0.294931	-0.39478	-0.03721	-0.22371	0.339166	0.658542	-0.02928
A_5	0.52275	0.015897	0.058525	-1	0.67534	-0.30209	-0.46165	-0.04523	-0.49968	A_5	0.100783	0.457047	0.874194	-0.39478	0.069796	0.4742	-0.15295	0.680572	-0.88701
A_6	0.384051	-0.2568	0.121659	-0.04167	0.63643	-0.05797	0	-0.06726	0.500318	A_6	-0.03792	0.184347	0.937327	0.563555	0.030885	0.718321	0.308706	0.658542	0.112985
A_7	0.557241	-0.04891	-0.29493	-0.06646	0.883268	-0.21783	-0.0041	-0.40473	0.25175	A_7	0.135274	0.392235	0.520737	0.538766	0.277724	0.558459	0.304601	0.321069	-0.13558

A_8	0.055773	0.173341	-0.20276	-0.28481	0.488813	-0.44807	0.089004	-1	0.459898	A_8	-0.36619	0.614491	0.612903	0.320411	-0.11673	0.328217	0.39771	-0.2742	0.072565
A_9	0	0	0	0	0	0	0	0	0	A_9	-0.42197	0.441149	0.815668	0.605222	-0.60554	0.77629	0.308706	0.725803	-0.38733
A_{10}	0.421967	-0.44115	-0.81567	-0.60522	0.605545	-0.77629	-0.30871	-0.7258	0.387333	A_{10}	0	0	0	0	0	0	0	0	0

Table 6. The preference values.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	0	0	0	0	0	0	0	0	0	A_1	0	0	0	0.2173	0	0.137165	1	0	1
A_2	0.47089	0.116478	0.387097	0	0.300584	0	0	0.149051	0	A_2	0	0	0	0	0	0	0	0	0
A_3	1	0	0.293088	0	0.333658	0.07838	0	0	0	A_3	0.52911	0	0	0	0.033074	0.215545	0.850076	0	0.97979
A_4	0.335127	0	0	0	0	0	0	0.19686	0	A_4	0	0	0	0	0	0	0.788075	0.047809	0.857734
A_5	0.857877	0	0.26129	0	0.008998	0	0	0.218889	0	A_5	0.386986	0	0	0	0	0	0.29596	0.069838	0
A_6	0.719178	0	0.324424	0.078586	0	0.035761	0	0.19686	0	A_6	0.248288	0	0	0.295886	0	0.172926	0.757615	0.047809	1
A_7	0.892368	0	0	0.053797	0.216926	0	0	0	0	A_7	0.421477	0	0	0.271097	0	0.013063	0.75351	0	0.751432
A_8	0.3909	0	0	0	0	0	0	0	0	A_8	0	0	0	0.052743	0	0	0.846619	0	0.95958
A_9	0.335127	0	0.202765	0.120253	0	0.09373	0	0.26412	0	A_9	0	0	0	0.337553	0	0.230895	0.757615	0.115069	0.499682
A_{10}	0.757094	0	0	0	0	0	0	0	0	A_{10}	0.286204	0	0	0	0	0	0.448909	0	0.887015
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	0	0.883522	0	0.273207	0	0	0.149924	0.140614	0.02021	A_1	0	0.230205	0.317972	0.879747	0.098006	0.90627	0.211925	0	0.142266
A_2	0	1	0.094009	0.055907	0	0	0	0.289665	0	A_2	0.135763	0.346683	0.705069	0.662447	0.398589	0.769105	0	0	0
A_3	0	0	0	0	0	0	0	0	0	A_3	0.664873	0	0.61106	0.60654	0.431663	0.984651	0.062	0	0.122056
A_4	0	0.653317	0	0	0	0	0	0.337474	0	A_4	0	0	0	0	0	0	0	0	0
A_5	0	0.6952	0	0	0	0	0	0.359503	0	A_5	0.52275	0.041883	0.579263	0	0.107004	0.69791	0	0.02203	0
A_6	0	0.422501	0.031336	0.351793	0	0	0	0.337474	0.02021	A_6	0.384051	0	0.642396	0.958333	0.068093	0.942031	0	0	0.142266
A_7	0	0.630388	0	0.327004	0	0	0	0	0	A_7	0.557241	0	0.225806	0.933544	0.314932	0.782169	0	0	0
A_8	0	0.852644	0	0.10865	0	0	0	0	0	A_8	0.055773	0.199327	0.317972	0.71519	0	0.551927	0.058544	0	0.101846
A_9	0	0.679303	0	0.39346	0	0.015349	0	0.404734	0	A_9	0	0.025986	0.520737	1	0	1	0	0.06726	0
A_{10}	0	0.238153	0	0	0	0	0	0	0	A_{10}	0.421967	0	0	0.394778	0.037208	0.22371	0	0	0.029281
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	0	0.253134	0.092166	0	0	0.124102	0.24649	0.140614	0.248568	A_1	0	0.030877	0	0.164557	0.177529	0.354344	0.153381	0.73588	0.04042
A_2	0	0.369612	0.479263	0	0.083658	0	0	0.289665	0	A_2	0.07999	0.147356	0.387097	0	0.478113	0.217178	0	0.884931	0
A_3	0.107632	0	0.385253	0	0.116732	0.202482	0.096565	0	0.228358	A_3	0.60091	0	0.293088	0	0.511187	0.432724	0.003456	0.595266	0.02021
A_4	0	0.022929	0	0	0	0	0.034565	0.337474	0.106302	A_4	0	0	0	0	0.079523	0	0	0.93274	0
A_5	0	0.064812	0.353456	0	0	0	0	0.359503	0	A_5	0.466977	0	0.26129	0	0.186527	0.145983	0	0.954769	0
A_6	0	0	0.41659	0.024789	0	0.159863	0.004105	0.337474	0.248568	A_6	0.328278	0	0.324424	0.243143	0.147617	0.390105	0	0.93274	0.04042
A_7	0	0	0	0	0	0	0	0	0	A_7	0.501468	0	0	0.218354	0.394455	0.230242	0	0.595266	0
A_8	0	0.222256	0.092166	0	0	0	0.093109	0	0.208148	A_8	0	0	0	0	0	0	0	0	0
A_9	0	0.048915	0.294931	0.066456	0	0.217831	0.004105	0.404734	0	A_9	0	0	0.202765	0.28481	0	0.448073	0	1	0
A_{10}	0	0	0	0	0	0	0	0	0.135582	A_{10}	0.366194	0	0	0	0.116732	0	0	0.274197	0

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	0	0.461021	0	0	0.029912	0	0.242385	0	0	A_1	0	0.188322	0	0.879747	0	0.208361	0.70404	0	1
A_2	0	0.577499	0.062673	0	0.330496	0	0	0	0	A_2	0	0.3048	0.125806	0.662447	0.291586	0.071195	0	0	0
A_3	0.280822	0	0	0	0.36357	0.042619	0.092461	0	0	A_3	0.142123	0	0.031797	0.60654	0.32466	0.286741	0.554115	0	0.97979
A_4	0	0.230816	0	0	0	0	0.03046	0	0	A_4	0	0	0	0	0	0	0.492115	0	0.857734
A_5	0.138699	0.272699	0	0	0.038911	0	0	0.02203	0	A_5	0	0	0	0	0	0	0	0	0
A_6	0	0	0	0	0	0	0	0	0	A_6	0	0	0.063134	0.958333	0	0.244121	0.461655	0	1
A_7	0.17319	0.207887	0	0	0.246839	0	0	0	0	A_7	0.034491	0	0	0.933544	0.207928	0.084259	0.45755	0	0.751432
A_8	0	0.430144	0	0	0	0	0.089004	0	0	A_8	0	0.157444	0	0.71519	0	0	0.550659	0	0.95958
A_9	0	0.256802	0	0.041667	0	0.057969	0	0.06726	0	A_9	0	0	0	1	0	0.30209	0.461655	0.045231	0.499682
A_{10}	0.037916	0	0	0	0	0	0	0	0	A_{10}	0	0	0	0.394778	0	0	0.152949	0	0.887015
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	0	0.204219	0	0	0.666342	0	0.242385	0	0.500318	A_1	0	0.645368	0.612903	0.484968	0.060798	0.68256	0.551091	0.461683	0.112985
A_2	0.135763	0.320697	0.184332	0	0.966926	0	0	0	0	A_2	0	0.761847	1	0.267669	0.361381	0.545395	0	0.610734	0
A_3	0.664873	0	0.090323	0	1	0	0.092461	0	0.480108	A_3	0.242906	0	0.905991	0.211762	0.394455	0.760941	0.401167	0.321069	0.092775
A_4	0	0	0	0	0.568337	0	0.03046	0	0.358052	A_4	0	0.415164	0.294931	0	0	0	0.339166	0.658542	0
A_5	0.52275	0.015897	0.058525	0	0.67534	0	0	0	0	A_5	0.100783	0.457047	0.874194	0	0.069796	0.4742	0	0.680572	0
A_6	0.384051	0	0.121659	0	0.63643	0	0	0	0.500318	A_6	0	0.184347	0.937327	0.563555	0.030885	0.718321	0.308706	0.658542	0.112985
A_7	0.557241	0	0	0	0.883268	0	0	0	0.25175	A_7	0.135274	0.392235	0.520737	0.538766	0.277724	0.558459	0.304601	0.321069	0
A_8	0.055773	0.173341	0	0	0.488813	0	0.089004	0	0.459898	A_8	0	0.614491	0.612903	0.320411	0	0.328217	0.39771	0	0.072565
A_9	0	0	0	0	0	0	0	0	0	A_9	0	0.441149	0.815668	0.605222	0	0.77629	0.308706	0.725803	0
A_{10}	0.421967	0	0	0	0.605545	0	0	0	0.387333	A_{10}	0	0	0	0	0	0	0	0	0

Table 7. The combined preference function.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	0	0	0	0	0	0	0	0	0	A_1	0	0	0	0.029425	0	0.014171	0.100696	0	0.116879
A_2	0.057691	0.013054	0.040826	0	0.029536	0	0	0.015707	0	A_2	0	0	0	0	0	0	0	0	0
A_3	0.122515	0	0.030911	0	0.032786	0.008098	0	0	0	A_3	0.064824	0	0	0	0.00325	0.022269	0.085599	0	0.114517
A_4	0.041058	0	0	0	0	0	0	0.020746	0	A_4	0	0	0	0	0	0	0.079356	0.005038	0.100251
A_5	0.105103	0	0.027557	0	0.000884	0	0	0.023067	0	A_5	0.047412	0	0	0	0	0	0.029802	0.00736	0
A_6	0.08811	0	0.034216	0.010641	0	0.003695	0	0.020746	0	A_6	0.030419	0	0	0.040066	0	0.017866	0.076289	0.005038	0.116879
A_7	0.109328	0	0	0.007285	0.021316	0	0	0	0	A_7	0.051637	0	0	0.036709	0	0.00135	0.075875	0	0.087827
A_8	0.047891	0	0	0	0	0	0	0	0	A_8	0	0	0	0.007142	0	0	0.085251	0	0.112155
A_9	0.041058	0	0.021385	0.016284	0	0.009684	0	0.027834	0	A_9	0	0	0	0.045708	0	0.023855	0.076289	0.012126	0.058403
A_{10}	0.092755	0	0	0	0	0	0	0	0	A_{10}	0.035064	0	0	0	0	0	0.045203	0	0.103674
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	0	0.099019	0	0.036995	0	0	0.015097	0.014818	0.002362	A_1	0	0.0258	0.033535	0.119127	0.000963	0.093631	0.02134	0	0.016628
A_2	0	0.112073	0.009915	0.00757	0	0	0	0.030526	0	A_2	0.016633	0.038854	0.074361	0.089702	0.039166	0.07946	0	0	0
A_3	0	0	0	0	0	0	0	0	0	A_3	0.081457	0	0.064446	0.082132	0.042416	0.101729	0.006243	0	0.014266

A_4	0	0.073219	0	0	0	0	0	0.035564	0	A_4	0	0	0	0	0	0	0	0	0
A_5	0	0.077913	0	0	0	0	0	0.037885	0	A_5	0.064045	0.004694	0.061093	0	0.010514	0.072105	0	0.002322	0
A_6	0	0.047351	0.003305	0.047637	0	0	0	0.035564	0.002362	A_6	0.047052	0	0.067751	0.129768	0.006691	0.097326	0	0	0.016628
A_7	0	0.07065	0	0.04428	0	0	0	0	0	A_7	0.06827	0	0.023815	0.126412	0.030946	0.08081	0	0	0
A_8	0	0.095558	0	0.014712	0	0	0	0	0	A_8	0.006833	0.022339	0.033535	0.096844	0	0.057022	0.005895	0	0.011904
A_9	0	0.076132	0	0.053279	0	0.001586	0	0.042652	0	A_9	0	0.002912	0.05492	0.135411	0	0.103315	0	0.007088	0
A_{10}	0	0.026691	0	0	0	0	0	0	0	A_{10}	0.051697	0	0	0.053457	0.003656	0.023113	0	0	0.003422
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	0	0.003461	0	0.022283	0.017444	0.036609	0.015445	0.077549	0.004724	A_1	0	0.028369	0.00972	0	0	0.012822	0.02482	0.014818	0.029052
A_2	0.0098	0.016515	0.040826	0	0.04698	0.022438	0	0.093256	0	A_2	0	0.041424	0.050546	0	0.00822	0	0	0.030526	0
A_3	0.074624	0	0.030911	0	0.05023	0.044707	0.000348	0.062731	0.002362	A_3	0.013187	0	0.040631	0	0.01147	0.020919	0.009724	0	0.02669
A_4	0	0	0	0	0.007814	0	0	0.098295	0	A_4	0	0.00257	0	0	0	0	0.003481	0.035564	0.012424
A_5	0.057212	0	0.027557	0	0.018329	0.015082	0	0.100616	0	A_5	0	0.007264	0.037278	0	0	0	0	0.037885	0
A_6	0.040219	0	0.034216	0.032924	0.014505	0.040304	0	0.098295	0.004724	A_6	0	0	0.043936	0.003357	0	0.016516	0.000413	0.035564	0.029052
A_7	0.061437	0	0	0.029568	0.03876	0.023787	0	0.062731	0	A_7	0	0	0	0	0	0	0	0	0
A_8	0	0	0	0	0	0	0	0	0	A_8	0	0.024909	0.00972	0	0	0	0.009376	0	0.024328
A_9	0	0	0.021385	0.038566	0	0.046293	0	0.105383	0	A_9	0	0.005482	0.031105	0.008999	0	0.022505	0.000413	0.042652	0
A_{10}	0.044864	0	0	0	0.01147	0	0	0.028896	0	A_{10}	0	0	0	0	0	0	0	0	0.015847
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	0	0.051668	0	0	0.002939	0	0.024407	0	0	A_1	0	0.021106	0	0.119127	0	0.021527	0.070894	0	0.116879
A_2	0	0.064722	0.00661	0	0.032475	0	0	0	0	A_2	0	0.03416	0.013268	0.089702	0.028652	0.007356	0	0	0
A_3	0.034405	0	0	0	0.035725	0.004403	0.00931	0	0	A_3	0.017412	0	0.003354	0.082132	0.031902	0.029625	0.055797	0	0.114517
A_4	0	0.025868	0	0	0	0	0.003067	0	0	A_4	0	0	0	0	0	0	0.049554	0	0.100251
A_5	0.016993	0.030562	0	0	0.003823	0	0	0.002322	0	A_5	0	0	0	0	0	0	0	0	0
A_6	0	0	0	0	0	0	0	0	0	A_6	0	0	0.006658	0.129768	0	0.025221	0.046487	0	0.116879
A_7	0.021218	0.023299	0	0	0.024255	0	0	0	0	A_7	0.004226	0	0	0.126412	0.020431	0.008705	0.046073	0	0.087827
A_8	0	0.048208	0	0	0	0	0.008962	0	0	A_8	0	0.017645	0	0.096844	0	0	0.055449	0	0.112155
A_9	0	0.028781	0	0.005642	0	0.005989	0	0.007088	0	A_9	0	0	0	0.135411	0	0.03121	0.046487	0.004767	0.058403
A_{10}	0.004645	0	0	0	0	0	0	0	0	A_{10}	0	0	0	0.053457	0	0	0.015401	0	0.103674
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	0	0.022887	0	0	0.065476	0	0.024407	0	0.058477	A_1	0	0.072328	0.064641	0.06567	0.005974	0.070519	0.055493	0.048653	0.013206
A_2	0.016633	0.035941	0.019441	0	0.095012	0	0	0	0	A_2	0	0.085382	0.105466	0.036245	0.03551	0.056347	0	0.064361	0
A_3	0.081457	0	0.009526	0	0.098262	0	0.00931	0	0.056115	A_3	0.02976	0	0.095551	0.028675	0.03876	0.078617	0.040396	0.033835	0.010844
A_4	0	0	0	0	0.055846	0	0.003067	0	0.041849	A_4	0	0.046529	0.031105	0	0	0	0.034153	0.069399	0
A_5	0.064045	0.001782	0.006172	0	0.066361	0	0	0	0	A_5	0.012347	0.051223	0.092198	0	0.006858	0.048992	0	0.07172	0
A_6	0.047052	0	0.012831	0	0.062537	0	0	0	0.058477	A_6	0	0.02066	0.098856	0.076311	0.003035	0.074213	0.031085	0.069399	0.013206
A_7	0.06827	0	0	0	0.086792	0	0	0	0.029424	A_7	0.016573	0.043959	0.05492	0.072955	0.02729	0.057697	0.030672	0.033835	0
A_8	0.006833	0.019427	0	0	0.048032	0	0.008962	0	0.053753	A_8	0	0.068868	0.064641	0.043387	0	0.03391	0.040048	0	0.008481
A_9	0	0	0	0	0	0	0	0	0	A_9	0	0.049441	0.086025	0.081953	0	0.080202	0.031085	0.076487	0
A_{10}	0.051697	0	0	0	0.059502	0	0	0	0.045271	A_{10}	0	0	0	0	0	0	0	0	0

Table 8. The ranks of alternatives.

	Ranks
A_1	7
A_2	5
A_3	9
A_4	2
A_5	3
A_6	10
A_7	8
A_8	4
A_9	6
A_{10}	1

4.3. Insights and Meaning Behind the Results

While numerical outputs provide the backbone of quantitative decision models, the true value lies in the interpretation and insights they offer. In this study, the integration of HyperSoft Sets, SIWEC weighting, and PROMETHEE ranking produced a set of prioritized alternatives representing the effectiveness levels of faculty members in journalism and communication programs.

The results reveal that Faculty Member A10 consistently ranks at the top, indicating strong performance across all the criteria evaluated. This suggests a balanced teaching profile, possibly marked by effective communication skills, updated content knowledge, and engagement with professional media practices. In contrast, A6 occupies the lowest position in the ranking, which may reflect gaps in instructional clarity, classroom engagement, or curriculum relevance.

One particularly interesting observation is the concentration of mid-ranked faculty members with small variations in their net flow scores. This suggests that while some individuals stand out positively or negatively, a majority operate within a narrow performance band. For administrators, this pattern may indicate the need for targeted faculty development interventions rather than broad reforms.

Moreover, the weight distribution derived from the SIWEC method showed that criteria related to industry integration and content relevance carried more decision weight than general classroom discipline or time management. This aligns with current trends in journalism education, where the ability to bridge academic theory with professional practice is increasingly valued.

Overall, the results reflect not only individual performance levels but also broader institutional priorities, offering a multi-dimensional view of what constitutes effective teaching in communication-related disciplines.

5. Discussion and Analysis

Then we show the sensitivity analysis to obtain the stability of the ranks of the alternatives. The sensitivity analysis is conducted with two parts. In the first part we change the criteria. In the first part, we put the first criterion with 20% weights and other criteria have the same weight. Then we put the second criterion with 20% weights and other criteria have the same weight. Then we rank the alternatives as shown in Table 9.

Table 9. Ranks of the alternatives under different weights in the first part.

	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9
A_1	7	9	8	8	7	8	8	8	8
A_2	5	5	5	5	6	5	4	5	4
A_3	9	7	9	7	9	9	9	9	9
A_4	2	2	2	2	2	2	2	2	3
A_5	4	3	3	3	3	3	3	4	2
A_6	10	10	10	10	10	10	10	10	10
A_7	8	8	7	9	8	7	7	7	7
A_8	3	4	4	4	4	4	5	3	5
A_9	6	6	6	6	5	6	6	6	6
A_{10}	1	1	1	1	1	1	1	1	1

In the second part, we increase the first criterion wights by 10% and decrease the other to obtain the sum of the weights equal 1. Then we rank the alternatives under these cases. We show the ranks of the alternatives in the second part in Table 10. We show the ranks of the alternatives in two parts are stable under different weights of criteria.

Table 10. Ranks of the alternatives under different weights in the second part.

	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9
A_1	7	7	7	7	7	7	7	7	7
A_2	5	5	5	5	5	5	5	5	5
A_3	9	9	9	9	9	9	9	9	9
A_4	2	2	2	2	2	2	2	2	2
A_5	3	3	3	3	3	3	3	3	3
A_6	10	10	10	10	10	10	10	10	10
A_7	8	8	8	8	8	8	8	8	8
A_8	4	4	4	4	4	4	4	4	4
A_9	6	6	6	6	6	6	6	6	6
A_{10}	1	1	1	1	1	1	1	1	1

The outcomes of the PROMETHEE-based ranking revealed meaningful insights into faculty teaching performance. The analysis showed clear differentiation among the ten faculty members, with A10 emerging as the highest ranked and A6 occupying the lowest position. These results underscore the capability of the hybrid evaluation model to identify areas of strength and concern within academic teams.

A key insight is the centrality of industry integration and student engagement, which received the highest weights during the SIWEC phase. This suggests that evaluators and decision-makers place significant value on how well faculty members bridge academic content with real-world media practices. This alignment is crucial in journalism education, where rapid technological and societal shifts demand that educators remain professionally relevant.

In practical terms, the model offers several applications. Academic administrators can use the ranking results to inform merit-based recognition, identify professional development needs, and align faculty strengths with course assignments. For instance, faculty scoring lower in areas like digital tools or feedback quality could benefit from targeted training or mentorship programs.

Moreover, the use of HyperSoft and PROMETHEE ensures transparency and consistency in evaluation—traits often missing from traditional peer or student-based assessments. The ability to trace each ranking to specific criteria and preferences enhances stakeholder trust and fosters a culture of accountability.

The model's adaptability also allows it to be scaled for use across departments or integrated into larger institutional quality assurance frameworks. Its flexibility in handling overlapping, vague, and multidimensional criteria makes it particularly well-suited for disciplines that combine theory with

5.1. Interpretation and Analysis of Ranking Outcomes

While quantitative models such as PROMETHEE offer clear numerical rankings of alternatives, the strength of such methods lies not only in generating output but in enabling meaningful interpretation of those results. In this study, the PROMETHEE-based ranking revealed notable variations in teaching performance across the evaluated faculty members. These variations offer insights into both individual teaching profiles and broader institutional trends.

Faculty member A10 emerged as the top-ranked alternative, indicating consistent strength across multiple evaluation criteria. This result suggests that this individual not only met but exceeded expectations in areas such as content relevance, student engagement, digital competence, and integration of real-world media practices. Their high net flow score indicates positive dominance over other alternatives, reflecting a well-rounded teaching style aligned with modern educational standards.

In contrast, A6 was positioned at the lowest end of the ranking. This placement may highlight gaps in one or more critical areas, such as adaptability to new teaching technologies, lack of feedback responsiveness, or insufficient integration of professional experiences. Such outcomes provide valuable feedback for faculty development planning and targeted interventions.

What is particularly important is the concentration of middle-ranking faculty (A3, A4, A5, A7) with marginal differences in net flow values. This pattern suggests the presence of a performance plateau, where several educators demonstrate similar strengths but may benefit from specialized development in niche areas such as creative pedagogy or media innovation. This result also reflects a relatively stable baseline of teaching quality, which can serve as a foundation for strategic improvement.

These findings not only provide a snapshot of individual performance but also indicate where institutional support can yield the highest impact. Rather than aiming for broad, undifferentiated reform, academic leaders can now apply targeted measures based on data-driven insights.

5.2 Practical Reflections for Educational Decision-Makers

The outcomes of this research carry several practical implications for those involved in academic planning and quality assurance. First, the model provides department heads and faculty committees with a structured and defensible approach to evaluating teaching effectiveness. By grounding evaluations in both data patterns and expert judgment, the model reduces bias and ensures fairness in faculty assessments.

Second, the approach enables academic leaders to identify specific development needs at the individual level. For example, a faculty member scoring low on innovation or industry alignment can be supported through targeted training, professional workshops, or mentorship programs. This personalized development path ensures that faculty improvement strategies are resource-efficient and context-sensitive.

Third, the model supports a culture of continuous improvement. By applying the evaluation process periodically, departments can track changes in performance over time, recognize improvement, and address emerging weaknesses proactively. This process fosters accountability while reinforcing professional growth.

Finally, beyond internal evaluation, the model may be adapted for external benchmarking across institutions. By calibrating the evaluation criteria and methods, universities can compare teaching standards across journalism programs, contributing to sector-wide development and curriculum alignment.

6. Recognizing Boundaries and Proposing Future Expansion

Despite its contributions, the current study acknowledges several limitations that should be addressed in future work.

First, the evaluation was limited to expert judgment. While expert input ensures validity and depth, it excludes other important perspectives—particularly those of students and alumni.

Incorporating direct feedback from learners and stakeholders could provide a more balanced view of teaching effectiveness.

Second, the model was applied in a controlled analytical setting using a hypothetical or pilot dataset. Although this approach demonstrates methodological potential, its real-world applicability remains to be tested. Future studies should validate the model using actual institutional data across various academic contexts and cultures.

Third, while the PROMETHEE method offers clear advantages in interpretability and decision support, it does not account for temporal variation. Teaching effectiveness may evolve over time due to training, course design changes, or external factors. Introducing a longitudinal or dynamic evaluation layer would add significant analytical power.

Future research can build on this study by:

a. Applying the model across multiple departments and universities.
b. Integrating student performance outcomes to measure instructional impact.
c. Comparing the model with alternative MCDM approaches (e.g., ELECTRE, MACBETH) to evaluate stability and sensitivity.
d. Developing a user-friendly decision support system that automates the evaluation process and provides visual analytics for academic leadership.

7. Conclusions

The assessment of teaching effectiveness in journalism and communication requires a methodology that can accommodate both qualitative complexity and analytical rigor. This study developed a robust evaluation framework that responds to this need by combining linguistic flexibility with structured decision-making tools. Through the integration of HyperSoft Set Theory, SIWEC weighting, and the PROMETHEE ranking approach, the model offers a practical mechanism for capturing diverse teaching attributes and translating them into meaningful performance indicators. Each component of the model contributes to a more precise, transparent, and context-aware evaluation process. The proposed framework provides more than just rankings. It facilitates strategic insights that can support faculty development, guide resource allocation, and reinforce a culture of continuous improvement. Its adaptability also means that it can be extended beyond journalism education to suit other disciplines where teaching excellence must be assessed holistically. This research contributes to both the theoretical advancement of multi-criteria evaluation models and their practical application in higher education. It encourages institutions to adopt more nuanced and data-informed approaches to academic quality assurance, aligned with the demands of modern

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Received: Nov. 4, 2024. Accepted: March 31, 2025