Comparison of Weighted Sum Model and Multi-Attribute Decision-Making Weighted Product Methods in Selecting the Best University in Bangladesh

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of MS in Management Information Systems (MIS)

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APPROVAL

This Thesis/Project titled "Comparison of Weighted Sum Model and Multi-Attribute Decision-Making Weighted Product Methods in Selecting the best University in Bangladesh ", submitted by Pronab Biswas to the Department of Computing and Information System, Under CSE, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of MS in Management Information System and approved as to its style and contents. The presentation was held on 03 February Saturday, 2024.

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I hereby declare that, this project has been done by me under the supervision of **Md Zahid Hasan, Assistant professor, Department of CSE,** Daffodil International University. I also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

selection of the best university plays a crucial role in shaping one's academic and professional career. This research paper focuses on comparing two prominent decision-making methods, namely the WSM and the MADM-WP method, to determine the best university in Bangladesh. The WSM method calculates the overall performance of universities by assigning weights to each attribute and summing the weighted scores. On the other hand, the MADM-WP method utilizes a product-based approach, multiplying attribute scores by their corresponding weights. The comparison between these two methods involves evaluating their effectiveness, accuracy, and suitability in selecting the best university. The findings of this study provide valuable insights for prospective students, educational institutions, and policymakers in Bangladesh.

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CHAPTER 1
Introduction

1.1 Introduction

Selecting the best university is a crucial decision for students as it significantly impacts their academic and professional development. In a country like Bangladesh, where numerous universities offer diverse programs and opportunities, choosing the right institution becomes a challenging task. To aid this decision-making process, various decision-making models have been developed. Two popular methods for evaluating and selecting the best university are the WSM and the MADM-WP method. In this essay, we will compare and analyze these two approaches to determine their effectiveness in selecting the best university in Bangladesh.

The WSM is a decision-making technique that assigns weights to various attributes or criteria and calculates the overall score for each alternative. The attributes or criteria may include factors such as academic reputation, faculty qualifications, infrastructure, research opportunities, affordability, and student satisfaction. The weight of each criterion is multiplied by the corresponding score in the WSM technique, which totalizes the results to determine the overall score for every university. The ideal option is thought to be the university with the highest cumulative score. The WSM method provides a systematic and quantitative approach to decision-making, allowing students to consider multiple factors and their relative importance in a transparent manner.

On the other hand, the MADM-WP method is another widely used technique for decision-making. This method also involves assigning weights to criteria, but instead of summing up the results, it multiplies the scores of each alternative by their corresponding weights. The product of these values represents the performance value for each university. Similar to the WSM method, the university with the highest performance value is considered the best choice. The MADM-WP method allows for flexibility in

decision-making as it accommodates different weighting schemes and can handle both quantitative and qualitative attributes.

Both the Weighted Sum Model and the MADM-WP method have their strengths and weaknesses when applied to university selection in Bangladesh. The WSM method's advantage lies in its simplicity and transparency, as it provides a clear calculation process based on weighted criteria. It enables students to understand how each attribute contributes to the overall evaluation. However, the WSM method may encounter challenges when determining appropriate weights for each criterion, as subjective judgments are involved. In contrast, the MADM-WP method allows for more flexibility in assigning weights, considering the decision maker's preferences. It can accommodate uncertainties and diverse perspectives, making it more adaptable to individual preferences. However, the MADM-WP approach could be more difficult, particularly if there are a lot of criteria or options.

1.2 Problem Statement

The effectiveness of the WSM and MADM-WP approaches for determining Bangladesh's best university is contrasted in this research. The selection of a university is a complex decision involving multiple attributes such as Sponsored Research, Faculty Qualifications (Dr. Faculty), Accreditation, Laboratory, Library, and clubs. The WSM method calculates a weighted sum of attribute scores, while the MADM-WP method calculates the weighted product of attribute scores. This study will evaluate the performance of both methods in terms of accuracy and consistency in selecting the best university, providing valuable insights for decision-makers in the education sector.

1.3 Research Objectives

a) To contrast the WSM and MADM-WP approaches to choosing Bangladesh's top university.
b) To assess their suitability for evaluating multiple attributes, compare their effectiveness in identifying the best university.

1.4 Report Layout

Chapter 1 presents the research introduction, Problem Statement and Research Objectives

Chapter 2 highlights the Related works, Scope and Challenges.

Chapter 3 describes the materials and methodology

Chapter 4 shows the result and Comparison.

Chapter 5 includes the conclusion and future work.

CHAPTER 2

Literature Review

2.1 Related works

Multi-Criteria Decision-Making (MCDM) in Educational Institutions: The use of different MCDM techniques in the process of choosing educational institutions is examined in this paper. It offers a basis for comprehending the significance of decision-making models in selecting the top university. [18]

Weighted Sum Model in Decision-Making: This research focuses on the principles and applications of the Weighted Sum Model. Its scenarios. [19]

Weighted Product Method in Decision Analysis: This work provides insights into the weighted product method, emphasizing its role in decision analysis. It discusses its mathematical foundation and practical applications. [13]

Evaluation of Universities in Developing Countries: This study specifically looks at the challenges and criteria involved in evaluating universities in developing countries. It sheds light on the unique factors that should be considered in the context of Bangladesh. [12]

Comparative Analysis of Decision-Making Models: This research compares different decision-making models, including the weighted sum model and the weighted product method, in various contexts. It gives a thorough rundown of both their advantages and disadvantages. [7]

Case Studies on University Selection: Several case studies on university selection using different decision-making models can provide practical insights. This work should include case studies from the context of Bangladesh. [8]

Application of Decision-Making Models in Education Policy: This work delves into the broader application of decision-making models in shaping education policies. It discusses how such models contribute to the improvement of educational systems. [9]

2.2 Scope

1.Decision-Making in Education: The scope involves applying decision-making models (WSM and MADMW) to the domain of education, specifically in selecting the best university in Bangladesh. This addresses a critical need for effective decision support in educational institutions.

2.Multi-Criteria Decision Analysis (MCDA): Explore the application of MCDA in the context of university selection. Both the WSM and the weighted product model fall under the umbrella of MCDA, allowing for a comprehensive comparison of their effectiveness in handling multiple criteria.

3.Criteria Identification: Define and identify relevant criteria for evaluating universities. This could include factors such as academic reputation, faculty expertise, infrastructure, research facilities, student satisfaction, and the employability of graduates.

4.Stakeholder Involvement: Consider involving various stakeholders, including students, faculty, administrators, and industry representatives, in the decision-making process. This ensures a comprehensive and diverse set of perspectives in the evaluation of universities.

5.Decision Support System Development: Explore the development of a decision support system that incorporates both the WSM and the weighted product model. This system can assist decision-makers in systematically evaluating and comparing universities based on multiple criteria.

2.3 Challenges

1.Data Availability and Quality: Obtaining and maintaining data that meets each condition is one of the major issues. It can be difficult to guarantee current and accurate data regarding things like faculty credentials, research output, and student happiness.

2.Subjectivity in Criteria Weighting: Talk about the subjectivity that goes into deciding how much weight to give each criterion. Reconciling the varying viewpoints of stakeholders regarding the significance of different elements can be difficult.

3.Model Complexity: Evaluate the weighted product and weighted sum models' levels of complexity. A more sophisticated model may yield more nuanced outcomes, but some decision-makers may find it easier to understand and apply a simpler model.

4.Dynamic Character of Criteria: Universities are living, breathing things that can alter with time. Retaining the relevance of the decision models is difficult when dealing with factors that are dynamic, like faculty makeup changes or infrastructure upgrades.

5.Cultural and regional differences: Taking Bangladesh into account, take into account the cultural and regional differences. Based on cultural viewpoints, different stakeholders may prioritize criteria differently, and the models should take these variances into account.

6.Integration of Qualitative Factors: Discuss the difficulty of incorporating qualitative elements into a model for making quantitative decisions. Even though they may be difficult to measure, factors like the university's standing or the standard of student life are important when making decisions.

7.User Acceptance: Assess how well users accept the decision support system. A successful deployment depends on ensuring that the system is easy to use and that stakeholders are confident in the outcomes.

8.Validation and verification: To guarantee the models' dependability and efficacy in the university selection process, validate and verify the models' outputs against actual findings.

CHAPTER 3
Materials and Methods

3.1 Decision Support System

A computer-based information system called a Decision Support System (DSS) assists organizational decision-making processes. It combines data, analytical models, and interactive interfaces to provide users with insights and recommendations for solving complex problems or making strategic choices. A DSS typically collects and integrates data from various sources, processes it using algorithms and statistical techniques, and presents the results in a user-friendly format. Users can interact with the system, explore different scenarios, and evaluate the potential outcomes of their decisions [21]. DSSs assist in enhancing decision-making efficiency, accuracy, and effectiveness by leveraging technology and data-driven insights [20].

3.1.1 Decision Support System Components

1. Data management: DSS gathers and arranges information from multiple sources, such as real-time data feeds, external sources, and internal databases.

2. Model Management: DSS incorporates mathematical and analytical models to process the data and generate insights. These models can include statistical analysis, optimization algorithms, forecasting techniques, and simulation tools.

3. User Interface: DSS provides a user-friendly interface to interact with the system. It allows users to input decision criteria, manipulate data, and view the results of different scenarios.

4. Knowledge Base: DSS may include a knowledge base that stores information such as rules, best practices, and expert opinions. This knowledge base can be accessed to provide context and guidance during the decision-making process.

5. Decision Analysis: DSS helps users evaluate different alternatives by analyzing data, running simulations, and generating reports. It presents the results in a clear and understandable format to facilitate decision-making.

6. Collaboration and Communication: DSS often includes features that enable collaboration and communication among decision-makers. It allows multiple users to share information, exchange ideas, and collaborate on decisions.

3.1.2 Decision Support System Requirements

1. Needs hardware;
2. Needs software;
3. Needs personnel (designers and users);
4. Intended to assist in making a decision
5. Need to support decision-makers at all stages of the process;
6. Stressing the issue of semi-structured and unstructured data.

3.1.3 Decision-Making Process Steps

The important stages in the decision-making process are as follows:

1. Intelligence:

- Recognizing decision-making circumstances and characterizing the key elements present in them is the first step in shaping one's perception of the scenario.
- Construct a model that depicts the circumstances One tool to help estimate the anticipated consequences of a decision circumstance is a model.
- Quantitative selection of the best benefits for the given circumstance and the amount of the fee.

2. Design

- It is possible to carry out the process of choosing the particular options that arise from recognizing and creating well-defined procedures.

3. Choosing

- The costs and advantages of any other measures, or the ratings that come from using any alternative measures, should be evaluated using metrics of costs and benefits.
- Create standards for determining which course of action is optimal, such as passing legislation,
  by evaluating the data in order to reach a conclusion.
- Completing the decision-making scenario, or moving forward based on accepted standards.

The aforementioned steps, in full or in part, can be repeated. It is done repeatedly until the problem requiring the decision is fully resolved.

3.1.4. Features and Capabilities of the Decision Support System

1. Supports all organizational actions.
2. Supports many decisions that interact and can be utilized frequently and continually.
3. Data and models are the two key components.
4. Employing large amounts of internal and external data.
5. Capable of conducting goal-seeking and what-if analyses.
6. Making use of certain quantitative models.

3.2. Weighted Sum Model (WSM)

A mathematical formula called the WSM is applied in several disciplines, such as finance, economics, and decision analysis [16]. It is a method for combining multiple factors or variables into a single composite score by assigning weights to each factor [12]. The formula for the Weighted Sum Model is as follows [4]:

WSM = W1 * X1 + W2 * X2 + ... + Wn * Xn

Where:

WSM represents the weighted sum model score.

(W1, W2, ..., Wn) are the weights assigned to each factor.

(X1, X2, ..., Xn) are the scores of each factor.

The weights assigned to each factor represent their relative importance or contribution to the overall score. The values or scores of each factor can be numerical or qualitative, depending on the specific application.

Here's a simple example of the Weighted Sum Model using unique words as factors:
Suppose we want to evaluate the quality of three different alternative based on three factors: storytelling, character development, and language use. We assign the following weights to each factor:

Table 3.1: Weight Value Criteria for Sample Data set of WSM example

Criteria	Weight (%)
Storytelling (W1)	0.4
Character development (W2)	0.3
Language use (W3)	0.3

For each alternative, we rate each factor on a scale from 1 to 10:

Table 3.2: Sample Data set of WSM example

Alternative	Storytelling score (X1)	Character development score (X2)	Language use score (X3)
Alternative 1	8	7	9
Alternative 2	9	8	6
Alternative 3	7	6	8

Now, we can calculate the weighted sum model score for each book:

Table 3.3: Multiplication Alternative Value to Weight Criteria

Alternative	Storytelling score (X1)	Character development score (X2)	Language use score (X3)
Alternative 1	0.4 * 8= 3.2	0.3 * 7=2.1	0.3 * 9=2.7
Alternative 2	0.4 * 9=3.6	0.3 * 8=2.4	0.3 * 6=1.8
Alternative 3	= 0.4 *7=2.8	0.3 * 6=1.8	0.3 * 8=2.4

Table 3.4: Calculate results of WSM

Alternative	WSM values
Alternative 1	3.2 + 2.1 + 2.7 = 7
Alternative 2	3.6 + 2.4 + 1.8 = 7.8
Alternative 3	2.8 + 1.8 + 2.4 = 7

In this example, Alternative 2 has the highest weighted sum model score of 7.8, indicating that it is considered the highest quality alternative based on the assigned weights and scores.

3.2.1 Flow char of WSM

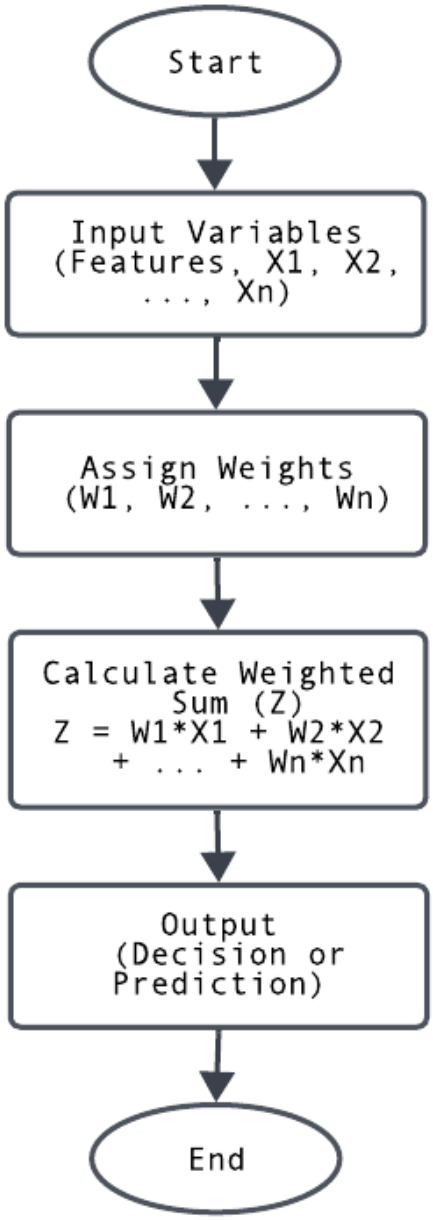

Figure 3.1: Flow chart of WSM

3.3 Multi Attribute Decision Making Weighted Product (MADM-WP)

A decision-making method called MADM is used to assess and rank several options according to various criteria. One method inside MADM that weights the criteria and determines a weighted score for each alternative is the Weighted Product (WP) method. The option deemed best is the one with the highest weighted score. [11]

The following is the formula for the MADM-WP method:

$WP = \prod(w_{ij}^{r_{ij}})$

Where:

WP is the weighted product score for a specific alternative.

w_{ij} is the alternative's performance rating j on criterion i.

r_{ij} is the weight assigned to criterion i (i = 1, 2, ..., n) for alternative j (j = 1, 2, ..., m).

$\prod$ denotes the product of the values.

Here's an example to illustrate how the Weighted Product (WP) method works:

Suppose you are evaluating three alternatives (A, B, C) based on four criteria (C1, C2, C3, C4). You have assigned the following weights to the criteria:

Table 3.5: Weight Value Criteria for Sample Data set of MADM-WP example

Criteria	Weight (%)
C1	0.3
C2	0.2
C3	0.4
C4	0.1

The performance ratings of each alternative on each criterion:

Table 3.6: Sample Data set of MADM-WP example

Alternative	C1	C2	C3	C4
Alternative A	8	7	6	9
Alternative B	6	8	7	6
Alternative C	7	6	8	7

To calculate the weighted product score for each alternative, you apply the formula:

Table 3.7: Reappointment Value Alternative to Weight Criteria.

Alternative	C1	C2	C3	C4
Alternative A	(8^0.3) =1.87	(7^0.2) =1.48	(6^0.4) =2.05	(9^0.1) =1.25
Alternative B	(6^0.3) =1.71	(8^0.2) =1.52	(7^0.4) =2.18	(6^0.1) =1.20
Alternative C	(7^0.3) =1.79	(6^0.2) =1.43	(8^0.4) =2.30	(7^0.1) =1.22

Table 3.8 Calculate results of MADM-WP

Alternative	MADM-WP values
Alternative A	1.87 * 1.48 * 2.05 * 1.25 =7.09
Alternative B	1.71 * 1.52 * 2.18 * 1.20 =6.80
Alternative C	1.79 * 1.43 * 2.30 * 1.22 =7.18

In this example, Alternative WP(C) has the highest weighted product scores of 7.16, indicating that it is considered the highest quality alternative based on the assigned weights and scores.

3.3.1 Flow char of MADM-WP

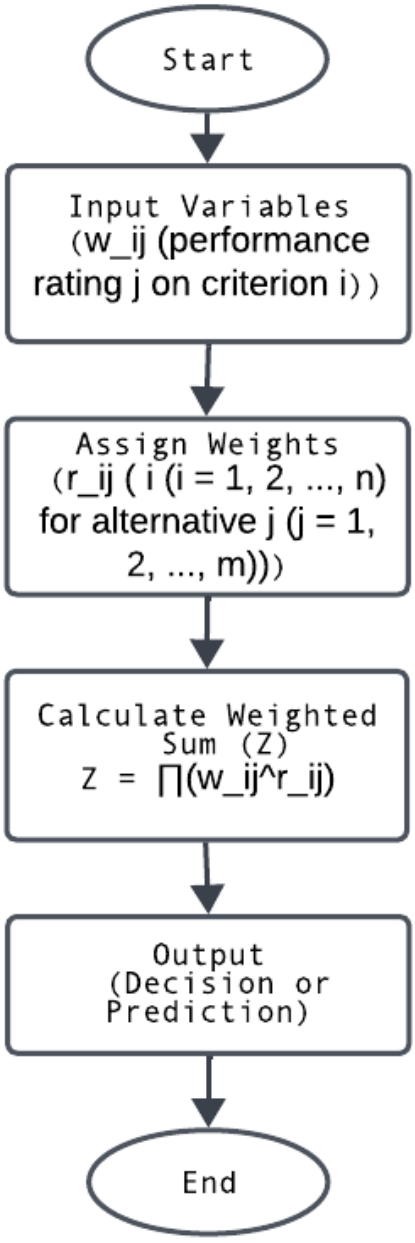

Figure 3.2: Flow chart of MADM-WP

3.4 Research Steps

The following research techniques were used in the conduct of this study:

a. Literature Review: Examine the entire corpus of research on decision-making models, with a focus on WSM and MADM-WP in particular. Examine research on ranking systems, university selection, and decision-making in educational settings. Determine each method's advantages, disadvantages, and uses.

b. Data collection: Identify the criteria and attributes used for evaluating universities (e.g., sponsored research, faculty qualifications (Dr. Faculty), accreditation, laboratories, libraries, and clubs.).

Collect data for multiple universities in Bangladesh based on these criteria.

Ensure the data is reliable and relevant to the context.

c. Methodology: Describe the methodology for applying both WSM and MADM-WP to the collected data. Explain the steps involved in the application of each method.

Discuss any assumptions or limitations associated with the methodologies.

d. Data analysis: Use the weighted sum model to assess and rank colleges.

Utilize the Weighted Product approach for Multi-Attribute Decision-Making and compare the outcomes with WSM.

e. Findings and Discussion: Clearly and succinctly summarize the analysis's findings. Talk about any differences or contradictions between the two techniques. Think about how the results may affect college applicants' choices.

f. Documentation System: Creating a study report to maintain written material or other formats that outline the entire system, from the beginning to the end, is how the documentation system is created at this step.

3.5 Explain data set

It looks like you have a dataset of three universities (X, Y, and Z) with various attributes.

Table 3.9: Sample Data set of university

University	Dr. Faculty	Library	clubs	Sponsored Research	Accreditation	Lab
X	115	1	17	39	4	33
Y	101	1	15	7	9	61
Z	95	1	8	8	8	8

Here's an explanation of each column in Table 4.1:

1. University: This column represents the name or identifier of each university (X, Y, and Z).

2. Dr. Faculty: This column indicates the number of faculty members with a doctorate in each university. For example, University X has 115 faculty members with a doctorate.

3. Library: This column represents the number of libraries in each university. All three universities (X, Y, and Z) have 1 library each.

4. Clubs: This column shows the number of clubs or student organizations present in each university. For instance, University X has 17 clubs.

5. Sponsored Research: This column indicates the amount of sponsored research conducted by each university. University X has 39 units of sponsored research.

6. Accreditation: This column reflects the accreditation status of each university. It seems to be a numerical value, with higher numbers potentially indicating a higher level of accreditation. For instance, University X has an accreditation score of 4.

7. Lab: This column represents the number of labs in each university. University X has 33 labs.

This dataset provides information about the academic and research characteristics of three universities (X, Y, and Z) based on the number of faculty with doctorates, the presence of libraries and clubs, the extent of sponsored research, accreditation status, and the number of labs. Each row corresponds to a specific university, and each column represents a different attribute or aspect of the university.

CHAPTER 4

Result Analysis

4.1 Result Analysis

4.1.1: Explain Weight Value Criteria

Weighted criteria are often used in decision-making processes to reflect the relative importance of different factors. The total weight across all criteria is typically 1.0 or 100%, indicating the overall importance distribution among the various factors being considered. The weight distribution refers to expert opinion.

Table 4.1: Weight Value Criteria for Sample Data set of university

Criteria	Weight (%)
Dr. Faculty	0.1
Library	0.1
clubs	0.2
Sponsored Research	0.2
Accreditation	0.2
Laboratory	0.2

Here's an explanation of the Weight Value Criteria in Table 4.1:

1. Dr. Faculty (Weight: 0.1): This criterion assesses the quality or qualifications of the faculty members with a weight of 0.1, indicating that it contributes 10% to the overall evaluation. The higher the expertise and qualifications of the faculty, the more positively it influences the assessment.

2. Library (Weight: 0.1): This criterion evaluates the quality and resources available in the library. It carries a weight of 0.1, signifying that it accounts for 10% of the overall evaluation. A well-equipped and accessible library is considered valuable in academic settings.

3. Clubs (Weight: 0.2): This criterion assesses the presence and quality of clubs or extracurricular activities. With a weight of 0.2, it contributes 20% to the overall evaluation. Extracurricular activities are often seen as important for a holistic education experience.

4. Sponsored Research (Weight: 0.2): This criterion evaluates the institution's involvement in sponsored research projects. It has a weight of 0.2, indicating that it carries 20% of the overall evaluation. Active participation in research is often considered a sign of academic vitality.

5. Accreditation (Weight: 0.2): This criterion likely assesses whether the institution or program is accredited by relevant accrediting bodies. Accreditation is a formal recognition of quality. With a weight of 0.2, it holds a 20% importance in the overall evaluation.

6. Laboratory (Weight: 0.2): This criterion evaluates the quality and availability of laboratory facilities. Given a weight of 0.2, it contributes 20% to the overall evaluation. Well-equipped laboratories are often crucial for programs in science and technology.

To calculate the overall score for an institution or program, you would multiply the score achieved in each criterion by its corresponding weight, then sum up these weighted scores across all criteria. This provides a comprehensive evaluation that takes into account the relative importance of each criterion in the decision-making process.

4.1.2: WSM Implementation

This section describes the implementation of the WSM approach in the system designed to calculate which university in Bangladesh is the best. WSM uses multiplication value data weighting criteria with preset criteria for all alternatives to determine the value of each candidate. Next, to find the value of each alternative WSM, the product of multiplying the data value criteria by the criteria weights is added. For an alternate method of choosing Bangladesh's top university, see this sample data of the institution.

Table 4.2: Sample Data set of university

University	Dr. Faculty	Library	clubs	Sponsored Research	Accreditation	Lab
X	115	1	17	39	4	33
Y	101	1	15	7	9	61
Z	95	1	8	8	8	8

Three samples of university data are provided in Table 4.2 above as an alternative for choosing Bangladesh's top university. The following is a discussion of the procedures to determine the WSM value of the various alternatives.

Step 1: Determine the Weight Value Criteria

Table 4.3 displays the weight values determined by the expert opinion as follows:

Table 4.3: Weight Value Criteria for Sample Data set of university

Criteria	Weight (%)
Dr. Faculty	0.1
Library	0.1
clubs	0.2
Sponsored Research	0.2
Accreditation	0.2
Laboratory	0.2

Step 2: Use the formula to determine the value of WSM

As indicated in Table 4.4 below, first multiply each alternative criterion's value by the weight value criteria.

Table 4.4: Multiplication Alternative Value to Weight Criteria

University	Dr. Faculty	Library	clubs	Sponsored Research	Accreditation	Lab
X	115*0.1=11.5	1*0.1=0.1	17*0.2=3.4	39*0.2=7.8	4*0.2=0.8	33*0.2=6.6
Y	101*0.1=10.1	1*0.1=0.1	15*0.2=3	7*0.2=1.4	9*0.2=1.8	61*0.2=12.2
Z	95*0.1=9.5	1*0.1=0.1	8*0.2=1.6	8*0.2=1.6	8*0.2=1.6	8*0.2=1.6

Step 3: The Value of Every WSM Alternative Achieved

Then, as indicated in Table 4.5, add the outcome of multiplying the alternative criteria's value by the weight value criteria for the WSM value.

Table 4.5: Calculate results of WSM

University	WSM value
X	11.5+0.1+3.4+7.8+0.8+6.6=30.2
Y	10.1+0.1+3+1.4+1.8+12.2=28.6
Z	9.5+0.1+1.6+1.6+1.6+1.6=16

Based on Table 4.5 alternatives that have the highest WSM value are ‘ X ’ University and the lowest WSM value are ‘ Z ’ University.

4.1.2.1: Expansion of WSM Results

Table 4.6: Results of WSM

University	WSM value
X	30.2
Y	28.6
Z	16

The WSM values indicate the performance or ranking of each university based on the criteria used in the weighted score model. Typically, these models assign weights to different criteria based on their importance, and then the scores for each criterion are multiplied by their respective weights and summed up to obtain a weighted total score.

With information on the specific criteria and weights used in this WSM, it's easier to provide a detailed interpretation. However, in a general sense, a higher WSM value suggests better performance or ranking according to the specified criteria. If you have more details about the criteria and weights used in the WSM, I can provide a more in-depth interpretation.

Figure 4.1: Bar Diagram of WSM results.

4.1.3: MADMWP Implementation

In this section, the MADMWP method's implementation in a system designed for the calculating process of identifying Bangladesh's top universities is presented. Each alternative's MADMWP value is determined by multiplying the result reappointment by the weight criterion raised from the data value criteria. Value criteria must at least equal one because if there is a value of zero criterion, the MADMWP method's calculation will yield zero results. This occurs as a result of the multiplication operator used in this approach, which produces zero as the result when a value is multiplied by zero [3]. As an alternative for choosing Bangladesh's top university, below is the institution's sample data.

Table 4.7: Sample Data set of university

University	Dr. Faculty	Library	clubs	Sponsored Research	Accreditation	Lab
X	115	1	17	39	4	33
Y	101	1	15	7	9	61
Z	95	1	8	8	8	8

Three sample data from the university are included in Table 4.8 above as an alternative for choosing Bangladesh's top university. Here is a discussion of the procedures to determine the MADMWP value of the different options.

Step 1: Determine the Weight Value Criteria

Table 4.8 displays the weight values determined by the expert opinion as follows:

Table 4.8: Weight Value Criteria for Sample Data set of university

Criteria	Weight (%)
Dr. Faculty	0.1
Library	0.1
clubs	0.2
Sponsored Research	0.2
Accreditation	0.2
Laboratory	0.2

Step 2: Use the formula to determine the value of MADM WP

Since the data stored there is zero, raise the value of each alternative criterion using the weight value criteria after changing the value to one, as indicated in Table 4.9 below.

Table 4.9: Reappointment Value Alternative to Weight Criteria.

University	DR. Faculty	Library	clubs	Sponsored Research	Accreditation	Lab
X	115^0.1=1.61	1^0.1=1	17^0.2=1.76	39^0.2=2.08	4^0.2=1.32	33^0.2=2.01
Y	101^0.1=1.59	1^0.1=1	15^0.2=1.72	7^0.2=1.48	9^0.2=1.55	61^0.2=2.28
Z	95^0.1=1.58	1^0.1=1	8^0.2=1.52	8^0.2=1.52	8^0.2=1.52	8^0.2=1.52

Step 3: The Value of Every MADMWP Alternative Achieved

The value of MADMWP is then obtained by multiplying the alternative result reappointment criterion value by the value weighting criteria, as shown in Table 4.10 below.

Table 4.10: Calculate results of MADMWP

University	MADMWP value
X	1.61*1*1.76*2.08*1.32*2.01=15.64
Y	1.59*1*1.72*1.48*1.55*2.28=14.30
Z	1.58*1*1.52*1.52*1.52*1.52=8.43

Based on table 4.10 alternatives that have highest MADMWP value is ‘ X ’ University and the lowest MADMWP value is ‘ Z ’ University.

4.1.3.1: Expansion of MADMWP Results

Table 4.11: Results of MADMWP

University	MADMWP value
X	15.64
Y	14.30
Z	8.43

Based on these results, University X has the highest MADMWP value, followed by University Y and then University Z. Therefore, according to the MADMWP analysis, University X is the most preferred or has the best overall performance among the three universities.

It's important to note that the interpretation may vary depending on the context of the specific attributes being evaluated and the criteria used for the MADMWP analysis. The higher MADMWP value suggests a better performance or preference, but the exact meaning depends on the details of the evaluation criteria and the weights assigned to each attribute.

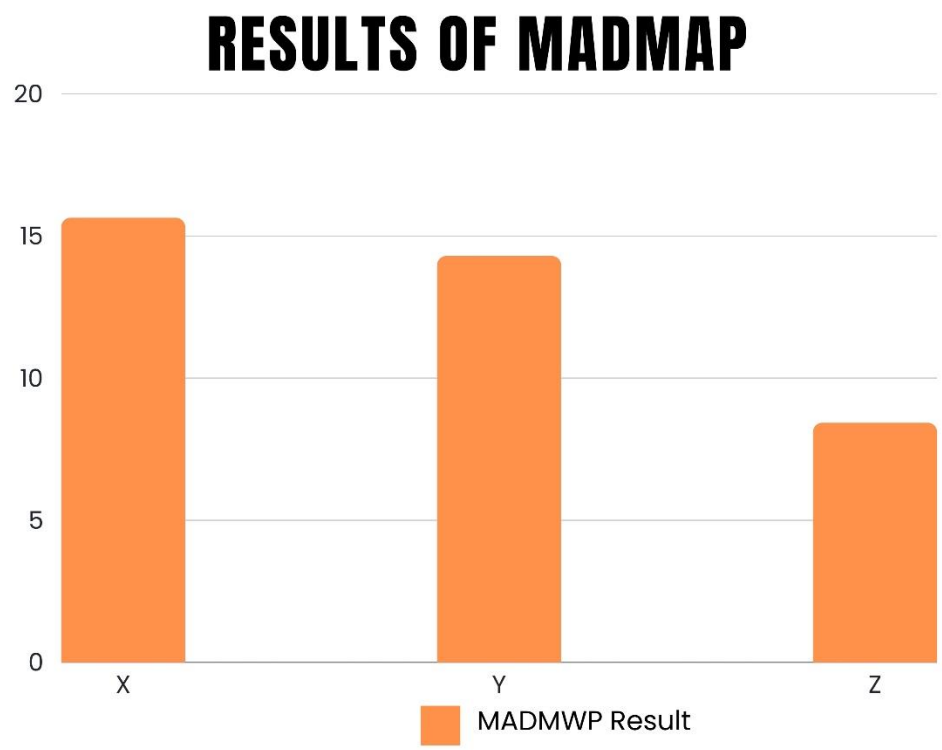

Figure 4.2: Bar Diagram of MADMWP results.

4.2 Comparison

To compare the results between the two models, we can look at the values for each university in both tables.

Here's a comparison of the universities based on the WSM and MADMWP result

Table 4.12: Results of WSM and MADMWP

University	WSM Result	MADMWP Result
X	30.2	15.64
Y	28.6	14.30
Z	16	8.43

Now, analyze the results:

1.University X:

WSM Value: 30.2

MADMWP Value: 15.64

Interpretation: University X has a higher WSM value compared to MADMWP, suggesting that it performs relatively better in the WSM model.

2.University Y:

WSM Value: 28.6

MADMWP Value: 14.30

Interpretation: Similar to University X, University Y also has a higher WSM value than MADMWP, indicating better performance in the WSM model.

3.University Z:

WSM Value: 16

MADMWP Value: 8.43

Interpretation: Once again, University Z has a higher WSM value compared to MADMWP, indicating better performance in the WSM model.

Here, based on the provided values, all three universities (X, Y, and Z) perform better in the WSM model compared to the MADMWP model.

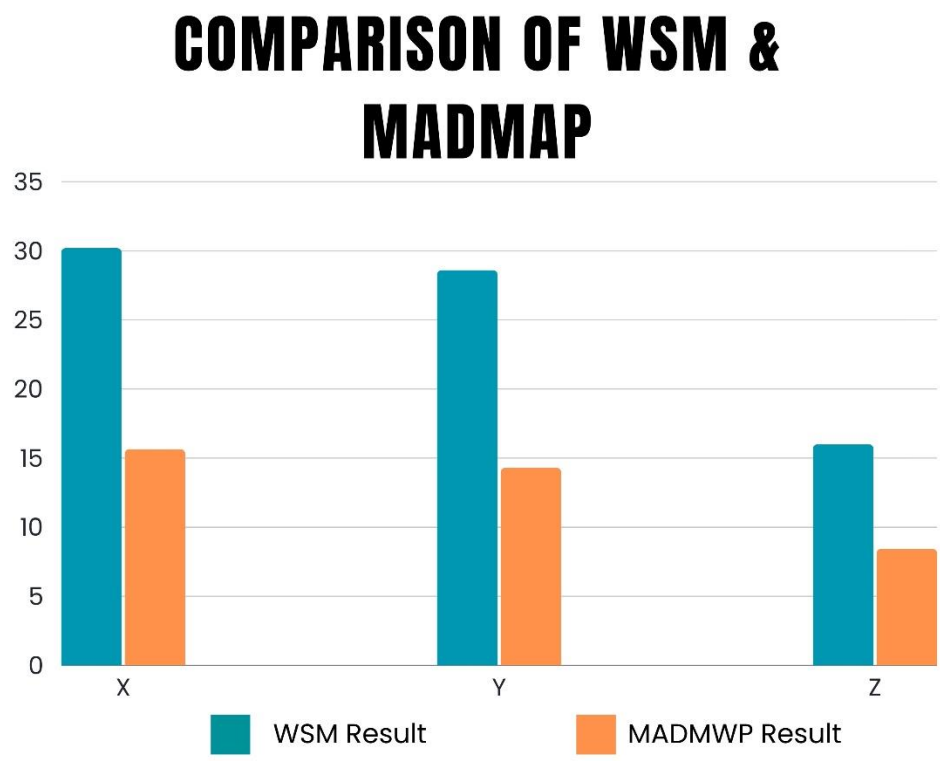

Figure 4.3: Bar Diagram of WSM and MADMWP results comparison.

CHAPTER 5
Conclusion and Future Work

5.1 Conclusion

The comparison of the WSM and MADM-WP methods in selecting the best university in Bangladesh has provided valuable insights into the decision-making processes for prospective students and stakeholders. The study aimed to assess the effectiveness, advantages, and limitations of these two prominent decision-making models in the context of higher education institutions.

The results of the study showed that each of the two approaches WSM and MADM-WP has certain advantages and disadvantages, and the tastes and particular needs of the decision-makers will determine which approach is best. The weighted sum method (WSM), which uses attribute scores to aggregate them, was a simple and understandable approach. It enables decision-makers to give attribute weights according to their relative relevance; the weighted scores are added to determine the conclusion. This method is clear and simple to comprehend, making it useful for various people.

The weighted product of attribute scores is calculated using the MADM-WP technique, which, on the other hand, shows a distinct approach by taking the multiplicative influence of attribute values into account. When there are significant relationships between the traits and the decision-makers wish to highlight the value of coordination between several criteria, this approach works well. However, individuals unfamiliar with the complexities of multiplicative decision models may find the MADM-WP technique more difficult and confusing.

The application of these approaches to the process of choosing Bangladesh's top institution brought to light how crucial it is to precisely define the criteria and allocate weights in a way that takes into account the opinions of all relevant parties. It became clear that the accuracy of the input data and the applicability of the chosen qualities are critical components of both methods' effectiveness. As a result, those in charge of making

decisions must carefully examine the particular circumstances and take into account the distinctive features of Bangladesh's higher education system.

The study also underlined the necessity of ongoing model adaptation and refinement to deal with shifting priorities and conditions. To improve the criteria and weights used in university selection procedures, stakeholders should actively participate in providing input, updating data, and identifying emerging trends in the education industry.

In conclusion, the analysis of the differences between the Multi-Attribute Decision-Making Weighted Product approach and the Weighted Sum Model adds to the body of knowledge already available on decision-making processes in the higher education industry. Although there are benefits to both approaches to choosing the finest university, the decision-maker's preferences and particular needs should guide their selection. To increase decision-making models' applicability and efficacy in Bangladesh's competitive and dynamic higher education environment, this research highlights more investigation and improvement of these models.

5.2 Future Work

In the future, there are several areas where work is needed to find the best university.
Here are some potential avenues for future work:

1. Extension to Other Countries:

Expand the scope of the research to include universities in neighboring countries or regions. This cross-cultural comparison can provide insights into the applicability and effectiveness of the models in diverse educational contexts.

2. Incorporation of Qualitative Data:

Explore the integration of qualitative data, such as student testimonials, alumni success stories, and faculty feedback. Qualitative insights can add a human perspective to the decision-making process and capture aspects that quantitative metrics may miss.

3. Integration of Machine Learning Algorithms:

Consider incorporating machine learning algorithms to analyze historical data trends and predict future university performance. This could enhance the predictive capabilities of the models and adapt to changing patterns in education.

4. Development of a Decision Support System (DSS):

Design and develop a user-friendly decision support system that integrates WSM and MADM-WP methods. The DSS could serve as a practical tool for stakeholders, including students, parents, and university administrators, to make informed decisions.

5. Socio-Economic Impact Assessment:

Evaluate the socio-economic impact of universities on the surrounding communities and the nation. This could involve incorporating community engagement, economic contributions, and social responsibility criteria into the decision-making process.

6. Stakeholder Involvement:

Engage a range of stakeholders in the decision-making process, such as employers, business executives, and legislators, to help shape the models' criteria. This cooperative method may result in an assessment that is more thorough and balanced.

7. Comparison with Other Decision-Making Models:

Extend the comparison to include additional decision-making models commonly used in educational contexts. This broader comparison can provide a more comprehensive understanding of the strengths and limitations of various methodologies.

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