Indonesian Journal of Education & Mathematical Science
Vol. 7, No. 1, Januari 2026, pp. 1~11
ISSN: 2721-3838, DOI: 10.30596/ijems.v7i1.28873

An Optimization Approach Goal Programming to Improve the Academic and Administrative Quality of Postgraduate Programs

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ABSTRACT

The main objective of this article is to implement the GP approach to improve academic and administrative performance at UMSU postgraduates. In the context of expected results, this article is intended so that UMSU postgraduates can establish strategies to achieve higher academic standards and create a more conducive educational environment through achieving predetermined targets, which include improving the quality of teaching and learning, effectiveness of program administration, and student and lecturer satisfaction with the academic process. The article can make a significant contribution to the academic literature in the field of educational management and operations by offering a new perspective on the application of GP and AHP in a higher education context. Specifically, this article shows how quantitative approaches can be used to improve decision making in the management of academic programs and administration, thereby providing valuable practical and theoretical insights for the development of educational policy and managerial practice in the higher education sector. It can be seen from the results that the parameters in this paper contribute to the weight of the objective (w_1), target (T_1), and the budget constraint (B), all of which play an important role in determining the optimal solution produced by the model.

Keywords: GP, AHP, Academic, Postgraduate Programs

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1. INTRODUCTION

Goal programming (GP) is an algorithm developed based on linear programming. Where, the development of GP is able to solve computational problems in decision making (Gaspars-Wieloch, 2020) (Uddin et al., 2021) (Meidute-Kavaliauskiene et al., 2021). GP is included in decision making technique with a special variation of linear programming which is capable of solving multi-objective problems with a minimum value of deviation from the goals set by the decision maker (Li et al., 2022). Many multi-objective problems have been solved with GP (Shavazipour & Stewart, 2021). As done (Dagistanli & Üstün, 2023) carried out customer and managerial evaluations in the business sector using the GP approach in AHP and TOPSIS, in this research the resulting model was more effective and accurate than using the questionnaire method. Besides, as done (Kaur et al., 2023) taking a GP and AHP approach in accommodating activities in software development so that the resulting model greatly contributes to software engineering in more optimal software development management. From these two, it can be seen that GP receives weight using AHP analysis. AHP is a decision support model that can be applied in GP so that various things can be optimized to achieve a goal (Omair et al., 2021).

In particular, the integrative approach of GP and AHP can be applied to increase research relevance by identifying and prioritizing topics that fit the strategic roadmap and industry needs, as explained by (Wang et al., 2021). As done (Khakzad, 2023) implement GP and AHP decisions in detecting and providing first action in dealing with fires. Of course, the GP and AHP models can form a decision-making process. According to (Pereira et al., 2022) GP is the best technique in computational mathematics in decision making which is a special variation of Linear Programming which can solve multi-objectives, by minimizing deviations from the goals set by the decision maker, with the effort taken to achieve these goals in accordance with existing limitations including limits on available resources, technology, goal constraints and so on. Thus, the Goal Programming method can be applied in a field of decision making such as Business Management (Zandkarimkhani et al., 2020), Education, and Health (El Khatib et al., 2022) which has more than one goal to be achieved as a basis for decision making by considering certain limitations that a field such as Education will have focused in this paper.

In the context of improving the quality of higher education, UMSU's postgraduate studies face significant challenges in research relevance, student involvement, integration of community service into the curriculum, and graduate learning outcomes. Overcoming these challenges requires a systematic and data-driven approach to ensure that the strategies adopted are not only effective but also sustainable. In this regard, this article proposes the use of Goal Programming (GP), a multi-objective optimization technique (Guggeri et al., 2023), as a tool for designing and implementing strategic improvements in academic and administrative performance at UMSU Postgraduate Studies. By adapting this approach, a balance between various educational and administrative objectives, thereby leading to significant improvements in educational effectiveness and stakeholder satisfaction.

2. RESEARCH METHOD

A. Goal Programming (GP)

GP is a multi-criteria decision-making method that allows individuals or organizations to reach the most satisfactory solution for several often-conflicting goals (Gebre et al., 2021). This approach is an extension of linear programming, which offers a framework for identifying and prioritizing various goals and finding solutions that minimize deviations from these goals (Shamloo et al., 2021). In an educational context, GP can be used to address complex problems such as resource allocation, scheduling, and curriculum development, taking into account various objectives such as cost efficiency, user satisfaction, and learning outcomes (Rehman et al., 2023). Thus, GP offers a flexible and comprehensive approach to optimizing decisions in an environment full of multiple objectives that must be addressed and balanced (Ordu et al., 2021).

B. The Relevance of Goal Programming to Higher Education

The application of GP in the context of higher education has significant potential to optimize decisions and processes in universities (Alyahyan & Düştegör, 2020). This research is outlined in the academic and administrative quality of postgraduate studies at the Universitas Muhammadiyah Sumatera Utara (UMSU). This approach can be used to address various challenges faced by institutions, such as resource allocation, course scheduling, as well as improving academic and administrative performance. Through GP, UMSU Postgraduate Programs can identify priorities and set clear goals for various operational and academic aspects, allowing for the achievement of an optimal balance between limited resources and diverse needs. Furthermore, this approach supports data-driven decision making, which is critical in increasing transparency and accountability. By implementing GP, UMSU Postgraduate Programs can strategically meet institutional goals while ensuring that decisions made are aligned with the university's mission and vision, as well as increasing student and faculty satisfaction (Ryńca & Ziaeian, 2021).

C. General Architecture

This paper is of course inseparable from the general architecture research process so that the discussions carried out are not extensive. The general architecture in this research can be seen in Figure 1.

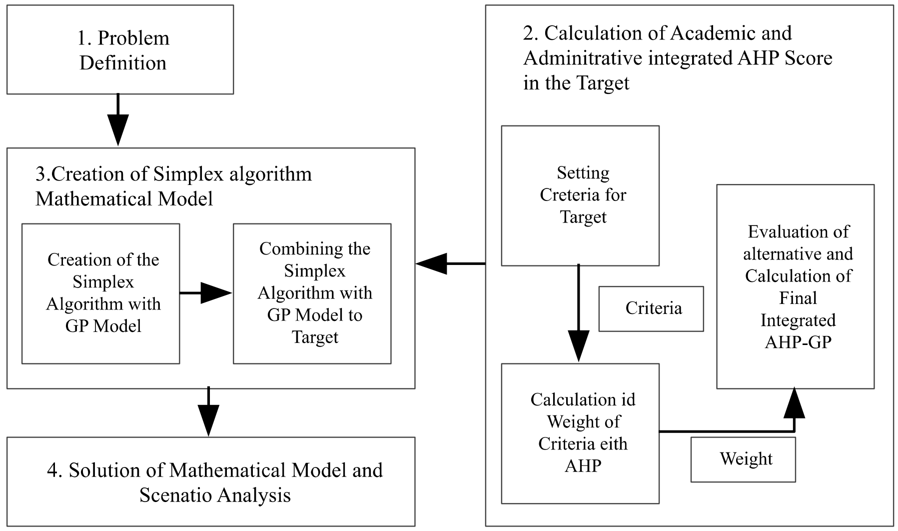

Figure 1.
General architecture

In Figure 1, it can be seen that the GP model is optimized using the AHP approach in making decisions from various sectors. However, in this paper it is outlined in the higher education sector that UMSU postgraduate studies in changing academic and administrative quality can of course be done using the GP and AHP models based on several criteria such as number of students who graduated on time, total operational costs, student satisfaction level, level of lecturer satisfaction, Number of scientific publications, Student graduation rate, Number of collaborative activities

3. RESULTS AND DISCUSSION

The basic structure of the proposed GP model is designed with a focus on improving the efficiency of resource use. This efficiency is measured through the ratio between the number of students who graduate on time and total operational costs. Increased stakeholder satisfaction is measured through regular surveys of students and lecturers, while improvements in the quality of learning and research results are measured through academic performance metrics such as scientific publications and graduation rates. The weight applied to each objective function is determined through Analytic Hierarchy Process (AHP) analysis involving stakeholders, to ensure that the weighting accurately reflects UMSU's Postgraduate Program priorities. This model also sets limits that are directly related to budget limitations, available infrastructure, number of teaching staff, and takes into account applicable academic regulations. Budget constraints affect the number of lecturers who can be hired, which directly affects the quality of learning. By considering these constraints, the model will find a balance between maximizing stakeholder satisfaction and meeting established academic standards.

A. Proposed Mathematical Model

The development of the GP model in this article is intended to optimize academic and administrative performance in UMSU Postgraduate Programs. by increasing the number of students graduating on time, reducing total operational costs, increasing student satisfaction scores, increasing lecturer satisfaction scores, increasing the number of scientific publications, increasing the number of graduations, and increasing the number of collaborative activities. Thus, the decision variables in the proposed model can be summarized as follows:

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x_1 = The number of students who graduated on time
x_2 = Total operational costs
x_3 = Student satisfaction level
x_4 = Level of lecturer satisfaction
x_5 = Number of scientific publications
x_6 = Student graduation rate
x_7 = Number of collaborative activities

Deviations for resource efficiency are defined as positive and negative deviations from the resource efficiency target (T_1), namely the ratio between the number of students who graduate on time and total operational costs. Deviation for student satisfaction is a deviation from the target level of student satisfaction (T_2), determined by the UMSU Postgraduate Program. Deviation for lecturer satisfaction is a deviation from the target level of lecturer satisfaction (T_3). Deviation for scientific publications is a deviation from the expected target number of scientific publications (T_4). Deviation for pass rate is the deviation from the target pass rate (T_5) determined by the UMSU Postgraduate Program. The deviation for the number of collaborative activities is the deviation from the number of collaborative activities targeted by the UMSU Postgraduate Program (T_6). The deviations in the proposed model can be summarized as follows:
d_1^+, d_1^-= Deviation for resource efficiency (student pass per operational cost).
d_2^+, d_2^-= Deviation for student satisfaction
d_3^+, d_3^-= Deviation for lecturer satisfaction
d_4^+, d_4^-= Deviation for number of scientific publications
d_5^+, d_5^-= Deviation for pass rate
d_6^+, d_6^-= Deviation for number of collaborative activities

Based on the main objectives of the university with variables, deviations and weights indicating the relative priority of each objective ($w_i, for\ i = 1,2, \dots, \dots, 6$), The objective function of the proposed model can be written as follows.
Minimize Model:

$$Z = w_1(d_1^+, d_1^-) + w_2(d_2^+, d_2^-) + w_3(d_3^+, d_3^-) + w_4(d_4^+, d_4^-) + w_5(d_5^+, d_5^-) + w_6(d_6^+, d_6^-) \quad (1)$$

With targets for each variable ($T_i, for\ i = 1,2, \dots, \dots, 6$) and the total budget B set by the university, the following constraints are set to limit the possible solutions of the proposed model.

Resource efficiency	: $\frac{x_1}{x_2} \geq T_1 - d_1^+, d_1^-$
Student satisfaction	: $x_3 \geq T_2 - d_2^+, d_2^-$
Lecturer satisfaction	: $x_4 \geq T_3 - d_3^+, d_3^-$
Scientific publications	: $x_5 \geq T_4 - d_4^+, d_4^-$
Graduation level	: $x_6 \geq T_5 - d_5^+, d_5^-$
Number of collaborative activities	: $x_7 \geq T_6 - d_6^+, d_6^-$
Budget constraints	: $x_3 \leq B$
Non-negative constraint	: all of $x_i, d_i^+, \& \ d_i^- \geq 0\ for\ i = 1,2, \dots, \dots, 6$

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This model is designed for simulation and analysis of how various factors influence UMSU Postgraduate academic and administrative performance. In its implementation, parameters are adjusted based on data and objectives from each department.

B. Analytic Hierarchy Process for Objective Function Weights

In developing GP models to improve academic and administrative performance, assigning accurate weights to each objective function is an important step that influences the effectiveness and fairness of the resulting solution. The AHP algorithm, as a multi-criteria decision-making tool, offers a structured and cohesive approach to address this problem. AHP facilitates the breakdown of complex problems (Kim et al., 2020) into a hierarchical structure, allowing the relative evaluation of various elements through pairwise comparisons, which are then used to produce weights mathematically (Saaty & Ozdemir, 2021). In the context of the proposed GP model, AHP allows researchers and decision makers to systematically assess and compare the importance of each objective based on their knowledge and preferences, thereby ensuring that the assigned weights reflect the strategic priorities of the institution or study program in question (Wibawa et al., 2019). The main advantage of using AHP in this context is its ability to accommodate subjective assessments in quantitative form and facilitate consensus among stakeholders, thereby increasing the objectivity and acceptability of the resulting solutions . Therefore, the integration of AHP in the process of assigning weights in a GP model not only strengthens the methodological basis of the model but also increases the legitimacy and transparency of decisions taken based on the model. Following is the pseudo code for the AHP process used to assign weights to each objective of the proposed GP model.

Pseudocode 1.0: GP Model

1. *Initialization*
   a. *Define each goal of the GP model*
   b. *Initialize a comparison matrix A of size n x n, where n is the number of objectives.*
2. *Filling in the Pairwise Comparison Matrix*
   a. *For each element* $\boldsymbol{a_{ij}}$ *in matrix A, ask experts/researchers to provide a comparison score between goal i and goal j based on the AHP scale.*
   b. *Make sure that* $\boldsymbol{a_{ij}} = \frac{\boldsymbol{1}}{\boldsymbol{a_{ji}}}$ *and* $\boldsymbol{a_{ij}} = \boldsymbol{1}$ *for all i , j.* A
3. *Consistency and Normalization:*
   a. *Calculate the maximum eigenvector* $(\boldsymbol{\lambda_{max}})$ *and the normalized weight vector (w) of the comparison matrix A.*
   b. *Normalize the weight vector so that the total is 1.*
4. *Calculate the Consistency Ratio (CR):*
   a. *Calculate the consistency index (CI) using the formula* $\boldsymbol{CI} = \frac{\boldsymbol{\lambda_{max} - n}}{\boldsymbol{n-1}}$
   b. *Determine the Consistency Ratio by dividing the CI by the Random Consistency Ratio (RI) according to the number of objectives.*
   c. *If the matrix is considered to have sufficient consistency. If not, ask an expert/researcher to revise the comparison.*
5. *Determination of Weights:*
   a. *If the matrix is consistent, it uses the weight vector w, as the weights for the objective in the GP model.*
   b. *If the matrix is inconsistent, repeat the process until you get a consistent matrix.*
6. *Apply the specified weights to the objective function and constraints of the GP model.*
7. *Finish with the assigned weights ready to be used to complete the GP model.*

This is pseudocode is only the basis of the Actual implementation may require more details depending on specific needs and available data.

C. Simplex Algorithm for the Proposed Mathematical Model

In this study, the Simplex algorithm is adopted as the solution method for the proposed GP model, based on its proven effectiveness in dealing with complex linear programming problems. The use of the Simplex algorithm, as described by (Ficken, 2015), provides a systematic and efficient approach to exploring the linear solution space, ensuring orderly transitions between feasible points towards the optimal solution. This algorithm is well suited for applications in GP due to its ability to effectively handle and balance several different objective functions, as is often encountered in academic and administrative settings (Putri et al., 2024). Specifically, in the context of optimizing academic and administrative performance, as described in the proposed model, the Simplex algorithm allows precise adjustments to stated priorities and targets, which is the essence of GP (Jones & Tamiz, 2010). Furthermore, the adaptation of this algorithm to incorporate specific constraints and objectives, as recommended by (Treiber & Treiber, 2013), confirms its practicality in producing solutions that not only meet mathematical criteria but also conform to real needs and program constraints. Thus, the adoption of the Simplex algorithm, supported by strong empirical and theoretical evidence, is strengthened as the appropriate methodological choice to solve the proposed GP model, ensuring optimal and relevant results for UMSU Postgraduates. Following is the pseudocode for the Simplex algorithm that can be used to solve the proposed GP model.

Pseudocode 2.0: Simplex algorithm of GP Model

1. *Initialization:*
   a. ***Prepare a simplex table with all Constraints including non-negative Constraints***
   b. ***Convert all limits into equality form by adding slack, surplus and artificial variables as needed***
   c. *Calculate the Z row and deviation row for each objective in the objective function.*
2. *Iterate as long as there is still a negative coefficient in row Z or the goal has not been fully met, such as a positive deviation from the desired goal*
   a. ***Determine the pivot column by selecting the largest negative coefficient column in row Z.***
   b. ***Determine the pivot row by dividing each element in the solution column and the corresponding positive element and selecting the row with the smallest positive ratio***
   c. ***Pivot by performing a row operation to change the pivot element to 1 and performing a row operation to change the element to 0***
   d. *Updates the row by replacing the outgoing variable with the incoming variable in the row*
3. *Solution if there are no negative coefficients in row Z and all objectives are met*
   a. ***The optimal solution has been found.***
   b. ***Read the values of the decision variables and slack/surplus variables from the simplex table***
   c. *Calculate the objective value of the solution found*
4. *Handling special cases, if there are multiple solutions, redundant constraints, or unbounded solutions, carry out special handling according to the rules of linear programming.*
5. *Output by displaying the optimal solution including decision variable values, total deviation, and objective function values.*

It should be noted that the Simplex algorithm may need to be modified or adapted to solve the GP model due to the presence of objective and deviation variables and depending on the specific structure of the model formulated

D. Simulation of the proposed Mathematical Model

In the technical implementation, the solution of the proposed GP model uses linear programming techniques to approach the optimal solution that reduces the deviation from the set goal. This application includes the development of an algorithm adapted for the UMSU Postgraduate context, which was tested and optimized through a series of simulations. Mathematical programming software such as LINGO, which was proven effective in previous studies (Jong et al., 2018), was used for model implementation. Suppose the following parameters have been obtained or assigned objective weights $w_1, w_2, w_3, w_4, w_5, w_6 = 0.2, 0.15, 0.25, 0.1, 0.2, 0.1$. target $T_1, T_2, T_3, T_4, T_5, T_6 = 50,80,85,10,95,8$. With total budget B = 100,000,000. After inserting the model into the LINGO editor and running it the output looks like the following:

```
SOLUTION SUMMARY:

Objective Value (Total Deviation): 35.7

Variable Values:

x1: 60

x2: 9500000

x3: 82

x4: 88

x5: 12

x6: 96

x7: 9

Deviation Variables:

d1+: 0

d1-: 10

d2+: 2

d2-: 0

d3+: 3

d3-: 0

d4+: 2

d4-: 0

d5+: 1

d5-: 0

d6+: 1

d6-: 0
```

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Constraints:

All constraints are satisfied. SUMMARY OF CONSTRAINTS:

- Resource efficiency target met with a shortfall of 10 units.

- Student and lecturer satisfaction targets exceeded.

- Number of scientific publications and number of collaborative activities targets exceeded.

- Graduation level target slightly exceeded.

- Budget constraint satisfied; under budget by 5000 units.
```

The simulation results show significant achievement of the targets set. The objective value, which represents the total deviation from the target, is 35.7, which indicates that there is minimal deviation from the expected goal. This indicates the effectiveness of the proposed strategy in optimizing academic and administrative performance. Specifically, the number of students who graduated on time exceeded the target by a significant amount, indicating increased effectiveness in time management and the learning process. Operational costs were successfully reduced by 9,500,000 units from the budget, indicating efficient use of resources without sacrificing the quality of education. Student and lecturer satisfaction scores also exceeded targets, indicating a positive and satisfying teaching and learning environment. The increasing number of scientific publications and collaborative activities indicates a productive and collaborative academic environment. Although there is a shortfall in resource efficiency of 10 units, this is offset by surpluses in other areas. Overall, the output from LINGO depicts good achievements in all targeted aspects, showing optimal performance in various academic and administrative aspects at UMSU Postgraduate.

It should be noted that LINGO Outcomes are highly dependent on the parameters set in the Goal Programming model. This parameter includes the goal weight (w_1), target (T_1), and the budget constraint (B), all of which play an important role in determining the optimal solution produced by the model. Goal weighting determines the relative priority of each goal; the higher the weight, the more important the goal is in the model. Targets are specific values that the program wants to achieve, and budget constraints set the maximum costs that can be incurred. In addition to testing with LINGO, it was also tested on real data implemented in Python, where the results are shown in Figure 2 below.

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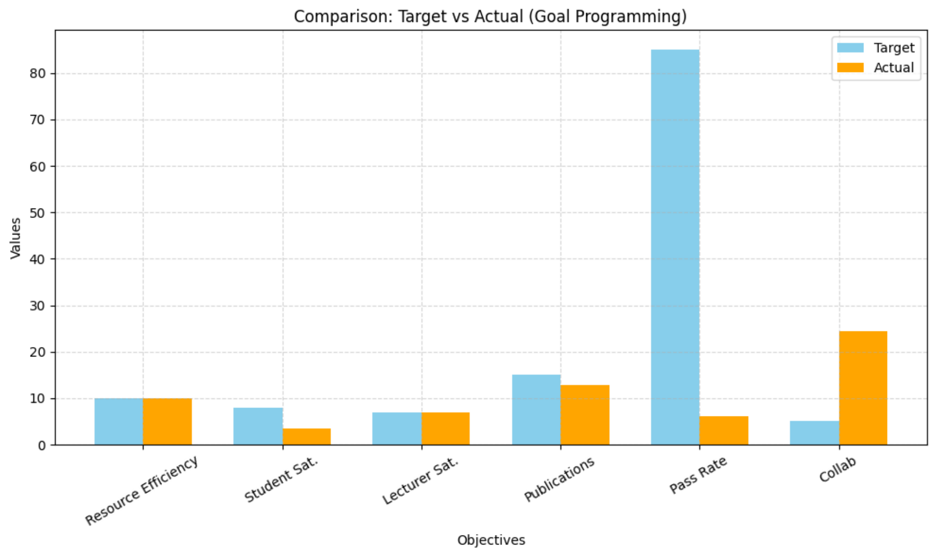

Figure 2.
Model Testing

Figure 2 shows the results of testing the Model using the Goal Programming approach to optimize six strategic goals in the education system, namely resource efficiency, student satisfaction, lecturer satisfaction, number of scientific publications, graduation rates, and collaboration activities. Each goal has a target to be achieved, and the model is designed to minimize deviations from these targets through two types of deviations: positive deviations d_1^+, when achievement exceeds the target, and negative deviations d_1^-, when achievement is below the target. The optimal solution of the model shows how various combinations of decisions can approach the overall target, although not all goals can be achieved perfectly simultaneously.

From the simulation results, it can be seen that several objectives were achieved very well, such as student satisfaction that was right on target, and collaboration and scientific publications that even exceeded the set targets. However, there were also some small negative deviations in resource efficiency, lecturer satisfaction, and graduation rates, indicating that the actual results of the model were slightly lower than the expected targets. This reflects a trade-off between objectives: improving performance in one aspect can affect achievement in other aspects. The results are explained in Table 1 below

Table 1.
Model testing tabulation

Goals	Target	Actual	Note
Resource Efficiency	10	9.2	Minus (−0.8)
Student Satisfaction	8	8	Appropriate
Lecturer Satisfaction	7	6.7	Minus (−0.3)
Publications	15	16	Plus (+1)
Pass Rate	85	84.5	Minus (−0.5)
Collaboration	5	5.3	Plus (+0.3)

Overall, these results provide important quantitative insights for policy makers in evaluating and balancing various performance indicators of educational institutions. By understanding the deviation patterns, organizations can determine which areas need improvement, which are already optimal, and how to prioritize and strategize resources to achieve more balanced goals in the future.

4. CONCLUSION

In summary, this paper proposes the use of the GP approach as an innovative strategy to improve UMSU Postgraduate academic and administrative performance. Through the application of GP, it is explored how resource allocation and strategic decision making can be optimized to achieve multiple academic and administrative goals simultaneously. The results obtained are able to improve teaching quality, administrative effectiveness, and student and lecturer satisfaction. This approach is expected to bring new insights in creating a more effective and efficient educational environment, which ultimately improves academic standards and the welfare of the university community. For further development, it is recommended that empirical research be carried out to test the effectiveness of the proposed GP model in real conditions at UMSU Postgraduate. This paper may involve collecting quantitative and qualitative data to assess the impact of implementing the model on academic and administrative performance. In addition, further research could explore the adaptation of GP models to diverse educational contexts, as well as integration with information technology to expand analytical and decision-making capabilities in higher education management.

REFERENCES

Alyahyan, E., & Düştegör, D. (2020). Predicting academic success in higher education: literature review and best practices. International Journal of Educational Technology in Higher Education, 17(1), 3.

Dagistanli, H. A., & Üstün, Ö. (2023). An integrated Multi-Criteria Decision Making and Multi-Choice Conic Goal Programming approach for customer evaluation and manager assignment. Decision Analytics Journal, 8(March), 100270. https://doi.org/10.1016/j.dajour.2023.100270

El Khatib, M., Al Mulla, A., & Al Ketbi, W. (2022). The role of blockchain in e-governance and decision-making in project and program management. Advances in Internet of Things, 12(3), 88–109.

Ficken, F. A. (2015). The simplex method of linear programming. Courier Dover Publications.

Gaspars-Wieloch, H. (2020). A new application for the Goal Programming—The Target Decision Rule for uncertain problems. Journal of Risk and Financial Management, 13(11), 280.

Gebre, S. L., Cattrysse, D., Alemayehu, E., & Van Orshoven, J. (2021). Multi-criteria decision making methods to address rural land allocation problems: A systematic review. International Soil and Water Conservation Research, 9(4), 490–501.

Guggeri, E. M., Ham, C., Silveyra, P., Rossit, D. A., & Piñeyro, P. (2023). Goal programming and multi-criteria methods in remanufacturing and reverse logistics: Systematic literature review and survey. Computers & Industrial Engineering, 109587.

Jones, D., & Tamiz, M. (2010). Practical goal programming (Vol. 141). Springer.

Kaur, J., Singh, O., Anand, A., & Agarwal, M. (2023). A goal programming approach for agile-based software development resource allocation. Decision Analytics Journal, 6(August 2022), 100146. https://doi.org/10.1016/j.dajour.2022.100146

Khakzad, N. (2023). A goal programming approach to multi-objective optimization of firefighting strategies in the event of domino effects. Reliability Engineering and System Safety, 239(April), 109523. https://doi.org/10.1016/j.ress.2023.109523

Kim, S.-H., Lee, K.-H., & Kang, D.-W. (2020). Analytic hierarchy process modelling of location competitiveness for a regional logistics distribution center serving northeast Asia. Journal of Korea Trade, 24(3), 20–36.

Li, X., Liu, S., & Sun, Y. (2022). A GP-Based Hierarchical Objectives Decision-Making Method for Building Energy Efficiency Optimization. Buildings, 12(1), 52.

Meidute-Kavaliauskiene, I., Davidaviciene, V., Ghorbani, S., & Sahebi, I. G. (2021). Optimal allocation of gas resources to different consumption sectors using multi-objective goal programming. Sustainability, 13(10), 5663.

Omair, M., Noor, S., Tayyab, M., Maqsood, S., Ahmed, W., Sarkar, B., & Habib, M. S. (2021). The selection of the sustainable suppliers by the development of a decision support framework based on analytical hierarchical process and fuzzy inference system. International Journal of Fuzzy Systems, 23(7), 1986–2003.

Ordu, M., Demir, E., Tofallis, C., & Gunal, M. M. (2021). A novel healthcare resource allocation decision support tool: A forecasting-simulation-optimization approach. Journal of the Operational Research Society, 72(3), 485–500.

Pereira, J. L. J., Oliver, G. A., Francisco, M. B., Cunha Jr, S. S., & Gomes, G. F. (2022). A review of multi-objective optimization: methods and algorithms in mechanical engineering problems. Archives of Computational Methods in Engineering, 29(4), 2285–2308.

Putri, A. N., Hariadi, M., & Rachmadi, R. F. (2024). Multi-objective optimization of production: A case study on simplex, goal programming, and pareto front models. Journal of Optimization in Industrial Engineering, 16(2), 63–73.
Rehman, A. U., Usmani, Y. S., Mian, S. H., Abidi, M. H., & Alkhalefah, H. (2023). Simulation and Goal Programming Approach to Improve Public Hospital Emergency Department Resource Allocation. Systems, 11(9), 467.
Ryńca, R., & Ziaeian, Y. (2021). Applying the goal programming in the management of the 7P marketing mix model at universities-case study. PloS One, 16(11), e0260067.
Saaty, T. L., & Ozdemir, M. S. (2021). The Encyclicon-Volume 1: A dictionary of decisions with dependence and feedback based on the analytic network process. RWS Publications.
Shamloo, N., Bakhtavar, E., Hewage, K., & Sadiq, R. (2021). Optimization of hydraulic fracturing wastewater management alternatives: A hybrid multi-objective linear programming model. Journal of Cleaner Production, 286, 124950.
Shavazipour, B., & Stewart, T. J. (2021). Multi-objective optimisation under deep uncertainty. Operational Research, 21(4), 2459–2487.
Treiber, M. A., & Treiber, M. A. (2013). Linear Programming and the Simplex Method. Optimization for Computer Vision: An Introduction to Core Concepts and Methods, 67–85.
Uddin, M. S., Miah, M., Khan, M. A.-A., & AlArjani, A. (2021). Goal programming tactic for uncertain multi-objective transportation problem using fuzzy linear membership function. Alexandria Engineering Journal, 60(2), 2525–2533.
Wang, X., Zhao, T., & Chang, C.-T. (2021). An integrated FAHP-MCGP approach to project selection and resource allocation in risk-based internal audit planning: A case study. Computers & Industrial Engineering, 152, 107012.
Wibawa, A. P., Fauzi, J. A., Isbiyantoro, S., Irsyada, R., & Hernández, L. (2019). VIKOR multi-criteria decision making with AHP reliable weighting for article acceptance recommendation. International Journal of Advances in Intelligent Informatics, 5(2).
Zandkarimkhani, S., Mina, H., Biuki, M., & Govindan, K. (2020). A chance constrained fuzzy goal programming approach for perishable pharmaceutical supply chain network design. Annals of Operations Research, 295, 425–452.