Scholar Publishing Group
International Journal of Business Management and Economics and Trade
https://doi.org/10.38007/IJBMET.2026.070101
ISSN 2790-0959 Vol. 7, Issue 1:1-9

Resource Allocation Optimization and Cost Saving Analysis Based on Data Mining

Xinran Tu

CSAT Solutions LP, Houston, Texas, 77047, United States

Keywords: Intelligent Scheduling; Resource Allocation; Data Analysis; Dynamic Optimization

Abstract: Through data analysis methods, it is possible to effectively improve the rationality of resource allocation and reduce cost consumption. This article explores the optimization of resource allocation and cost savings based on data mining. Analyzed the current problems of uneven distribution of resources, low efficiency of conventional allocation methods, and inconsistent cost management goals, and proposed corresponding improvement measures. This includes flexible adjustment of resource allocation through real-time data analysis, enhancing allocation efficiency through intelligent scheduling programs, establishing predictive algorithm models to improve cost management, and promoting cooperation between different departments to ensure synchronization of resources and cost targets. These strategies provide effective solutions for improving resource allocation efficiency and achieving cost savings.

1. Introduction

In the digital age, data has become a key resource driving enterprise development. Faced with complex and massive data, how to efficiently filter out key information, improve resource allocation efficiency, and reduce operating costs is a difficult problem that enterprises must face. Data mining, as a powerful analytical tool, can extract potential patterns and trends from massive amounts of data, providing scientific basis for enterprise strategy formulation. This article aims to explore the practical application of data mining technology in optimizing resource allocation and reducing costs, analyze its core technical points and execution strategies, and deeply discuss the profound role of data mining in modern enterprise management.

2. Overview of Data Mining

2.1 Basic Principles of Data Mining

Data mining refers to discovering hidden and valuable information and knowledge from a large amount of data through the application of algorithms and models. The core of this technology lies in deep analysis of data, revealing the essential connections, trends, and patterns between data, and providing theoretical support for decision-making, promoting the rational allocation of resources,

and reducing costs. Data mining is not just a simple analysis of data, but a comprehensive process that includes multiple stages such as data preprocessing, feature selection, modeling training, and result evaluation. The following are the key steps in the data mining process shown in Table 1.

Table 1 Core steps of data mining process

Step	Content
Data preprocessing	Clean and standardize data to ensure data quality.
Feature Selection	Select key features to improve model performance.
Modeling training	Train the model and learn data patterns.
result evaluation	Evaluate the effectiveness of the model to ensure prediction accuracy.

The core idea of data mining is to extract valuable information through in-depth data exploration, thereby assisting in the rational allocation of resources and effective cost control. This technology not only helps enhance the management efficiency of enterprises, but also brings cost reduction, profit growth, and precise decision-making to various industries, injecting solid technological strength into contemporary management.

2.2 Core Technologies of Data Mining

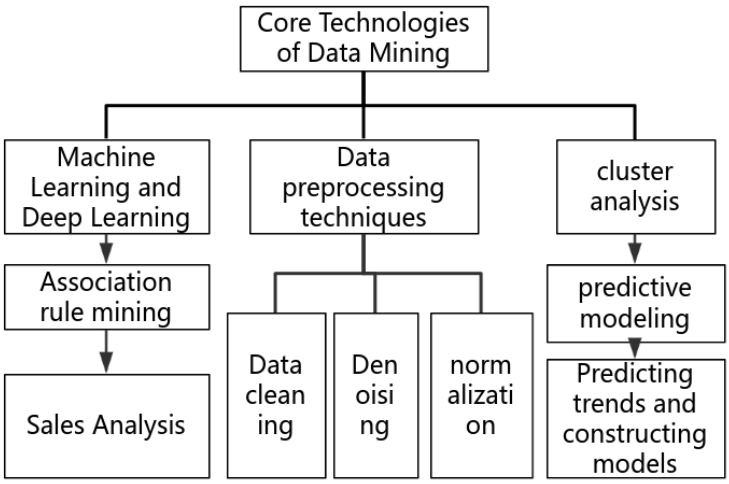

Figure 1 Core Technology Architecture of Data Mining

The key technologies that promote the progress of data mining mainly focus on the following aspects: (1) Machine learning and deep learning. Machine learning relies on specific programs to achieve the "self-learning" ability of computers and predict the results, while deep learning achieves advanced data processing through multi-level network structures. These technologies are widely used in graphic recognition, language processing, and other fields, providing a strong technical foundation for the field of data mining. (2) Data preprocessing technology enhances the accuracy and credibility of mining results through a series of processing steps such as data purification, noise reduction, and standardization, in order to improve the quality and consistency of the data Cluster analysis is a technique that divides data into multiple categories or clusters by studying the

similarity between data entities. It is commonly used in consumer classification, market research, and other situations Association rule mining is a technique that explores the inherent connections between data and reveals frequent combinations of data elements. It is commonly used in product recommendation, market operation analysis, and other areas, which helps improve business efficiency and reduce resource consumption Regression analysis and predictive modeling use mathematical models to explore the interrelationships between variables and use these relationships to predict future trends. As shown in Figure 1, the key technologies of data mining form a mutually supportive technical framework, covering the entire process from data preprocessing to predictive analysis.

3. The Main Issues of Resource Allocation and Cost Savings in Current Data Mining

3.1 Unequal Resource Allocation and Waste Issues

In the current resource utilization and cost control, a key challenge encountered in the field of data mining is the unreasonable allocation of resources and excessive consumption. Due to the lack of effective integration and planning of data resources in some enterprises, excessive investment is often made in the collection, storage, and processing of data, resulting in significant waste of resources due to the lack of accurate demand assessment and rational allocation of resources. Some companies spend a lot of time and money in the data preprocessing stage, but fail to fully utilize the extracted key information, resulting in the potential value of data processing not being fully explored. Overall, the uneven allocation of resources not only increases the operating costs of enterprises, but may also have an impact on the accuracy and efficiency of data mining results, thereby restricting the use of data to guide decision-making by enterprises.

3.2 Inefficiencies and Limitations of Traditional Allocation Methods

The traditional method of allocating data processing resources has low efficiency and limitations, and the core problem lies in the lack of flexibility and intelligent support. Many companies still adopt resource allocation strategies based on past experience or departmental needs, which often overlook the real-time changes and complexity of data mining tasks. This fixed resource allocation model often leads to excessive concentration of resources in certain areas, and cannot be quickly adjusted when demand changes, resulting in unreasonable allocation of resources. The traditional allocation method is still unable to cope with the processing needs of massive data, often unable to fully utilize computing power, resulting in low processing efficiency and high costs. Faced with the continuous growth of data volume and increasingly complex mining tasks, traditional resource allocation methods are obviously unable to meet the needs of enterprises for efficient data processing.

3.3 Mismatch between Cost Control and Optimization Objectives

There is a mismatch between cost control and optimization objectives in current data mining, mainly manifested in the fact that enterprises often neglect the pursuit of data mining quality and effectiveness in their efforts to reduce costs. Usually, in order to save resources and reduce costs, enterprises often make concessions in key steps such as data acquisition, storage, and processing, adopting low-cost technologies or adopting simplified operational processes. But such a strategy may lower the quality of the data, thereby having a negative impact on the accuracy and practical value of the mining results. Although using low-quality data or simplified models can save initial costs, in the long run, it may lead to decision-making errors and waste of resources, ultimately

resulting in an increase in adjustment costs. Excessive focus on cost control may lead to neglecting the introduction of innovative technologies and efficient algorithms, limiting the potential of data mining.

3.4 Contradictions and Conflicts between Resource and Cost Objectives

There are contradictions and conflicts between resource and cost objectives in current data mining, mainly reflected in the difficulty of coordinating resource allocation and cost savings. On the one hand, data mining operations are highly dependent on computing resources, storage capacity, and efficient technical means, especially when dealing with massive amounts of data and advanced model analysis, which often require expensive hardware facilities and professional software tools, undoubtedly increasing the economic burden on enterprises. On the other hand, this contradiction is manifested in the process of data mining. When enterprises attempt to limit resource investment by reducing costs, it may weaken the comprehensiveness and depth of data analysis, thereby reducing the efficiency of data mining and affecting the accuracy of decision-making. On the contrary, if a company chooses to increase its investment in resources, although it can improve the accuracy and quality of data mining, it may also cause operational cost overruns and have a negative impact on the company's financial situation.

4. Optimization Strategies for Resource Allocation and Cost Savings Based On Data Mining

4.1 Dynamic Adjustment and Optimization Based On Real-Time Data Analysis

With the continuous development of big data technology and data mining methods, the decision-making methods of enterprises in resource allocation and cost management are undergoing profound changes. Especially in the production and operation process, dynamic adjustment and optimization strategies based on real-time data analysis have become the core strategy to improve resource utilization efficiency and reduce costs. By mining and processing massive amounts of historical and real-time data, enterprises can obtain precise resource allocation guidance and assist decision-makers in implementing faster and more effective adjustments. The dynamic adjustment strategy supported by data mining can be roughly divided into three levels: firstly, real-time collection and monitoring of data, which involves real-time tracking of the utilization status of various resources in enterprise operations, including human resources, materials, equipment utilization efficiency, etc. Secondly, data analysis tools are used to process and explore the captured real-time data, and predictive algorithms are applied to anticipate future resource demands, providing data support for rational resource allocation. Thirdly, it is real-time optimization of resource allocation decisions based on analysis results. The system can automatically perform adjustments when detecting resource shortages or surpluses to achieve optimal utilization of resources. For example, a manufacturing enterprise has adopted a resource optimization and allocation system based on real-time data analysis. The system can monitor production line operations, inventory management, logistics transportation, and other links in real-time, quickly identifying resource bottlenecks and waste phenomena in the production process. The system predicts the resource requirements for the next stage by analyzing the working status of production equipment and material consumption data, and automatically adjusts resource allocation based on production arrangements and inventory status. For this process, enterprises can execute real-time optimization allocation of resources based on the following formula:

$$\text{optimal resource allocation} = \sum_{i=1}^{n} (R_i \cdot \frac{C_i}{E_i}) \tag{1}$$

Among them, represents the allocation ratio of the i-th resource (such as manpower, materials, equipment, etc.), represents the cost of the resource, and represents the efficiency or utilization rate of the resource. The goal of this formula is to find the optimal allocation plan for each resource by comprehensively considering cost and efficiency, thereby maximizing overall benefits, reducing waste, and improving production efficiency.

4.2 Introducing Intelligent Scheduling Algorithms to Improve Resource Allocation Efficiency

Introducing intelligent scheduling algorithms is one of the effective ways to improve resource allocation efficiency. This intelligent resource management system aggregates various resource information in real-time, such as machine operation status, employee working hours, material storage quantity, etc., to create a comprehensive resource information database. The system utilizes real-time tracking of this information to accurately grasp the utilization status of resources, thereby providing decision support for optimizing resource allocation. On the basis of information collection, intelligent allocation algorithms reveal hidden patterns in resource allocation through comprehensive analysis of historical data. Based on data such as the operating frequency and maintenance interval of production machines, the system can predict the demand trend of resources in the future. The system can also synchronously capture changes in the external environment, such as market demand fluctuations, logistics delivery time requirements, etc., in order to flexibly adjust resource allocation strategies. The core function of intelligent allocation algorithms is to implement real-time optimization. In the actual scheduling process, the system automatically formulates resource allocation plans based on real-time data. For example, the production plan will be automatically adjusted taking into account factors such as equipment load, employee efficiency, and production line capacity. The system will evaluate the requirements of different production processes and adjust allocation based on the current status of resources. During peak production periods, the system prioritizes the allocation of machines and manpower to ensure smooth production; During low peak periods, the system reduces resource investment to prevent resource surplus. In order to achieve dynamic optimization configuration of resources, the intelligent scheduling system evaluates the optimization effectiveness of resource allocation using the following formula:

$$E = \sum_{i=1}^{n} (\eta_i \cdot \omega_{\eta_i} - \gamma_i \cdot \omega_{\gamma_i}) \tag{2}$$

Where E represents the overall resource allocation efficiency. η_i represents the utilization efficiency of the i-th type of resource, and ω_{η_i} represents the weight coefficient of the utilization efficiency of the i-th type of resource. γ_i represents the cost of the i-th resource, and ω_{γ_i} represents the cost weight coefficient of the i-th resource. N is the total number of resource types. When market demand changes or production plans are adjusted, the system can quickly respond and readjust resource allocation plans. The implementation of intelligent scheduling system has gradually achieved precision and flexibility in resource allocation, ensuring that various resources can be effectively utilized at the appropriate time and place.

4.3 Building Predictive Models to Optimize Cost Control and Resource Allocation

When optimizing data mining based resource allocation and cost control prediction models, specific processes must be followed, and effective execution of each step is key to ensuring prediction accuracy and improving resource allocation efficiency. Firstly, data preprocessing. At this

stage, due to the fact that the raw data often contains missing values, noise, or inconsistent data, cleaning and normalization operations are indispensable. The focus of cleaning work is to remove duplicate information, supplement missing data, or use interpolation techniques to process incomplete data. Secondly, feature engineering. This step involves in-depth analysis of the data, screening out indicators closely related to cost management and resource allocation. When dealing with production scheduling tasks, key indicators may include production time, equipment utilization, order volume, inventory level, etc. The selection of these indicators will have a direct impact on the predictive ability of the model, so careful screening is needed for specific issues. Thirdly, predictive models. Different prediction problems and data characteristics are suitable for using different models. Common models include linear regression, decision trees, random forests, and support vector machines (SVM). In practical operation, in order to improve the external effectiveness of the model, cross validation can be used to evaluate its performance and prevent overfitting from causing inaccurate predictions. Fourth, use the trained prediction algorithm to predict future resource allocation and cost management, and optimize decisions based on algorithm feedback. For example, algorithms may predict a shortage of a certain resource or an overspend on a certain cost, providing management with decision-making basis and assisting them in making more accurate decisions. As shown in Figure 2, the entire process constitutes a cyclic iterative loop, with each link closely interconnected to ensure the high efficiency and accuracy of the prediction results.

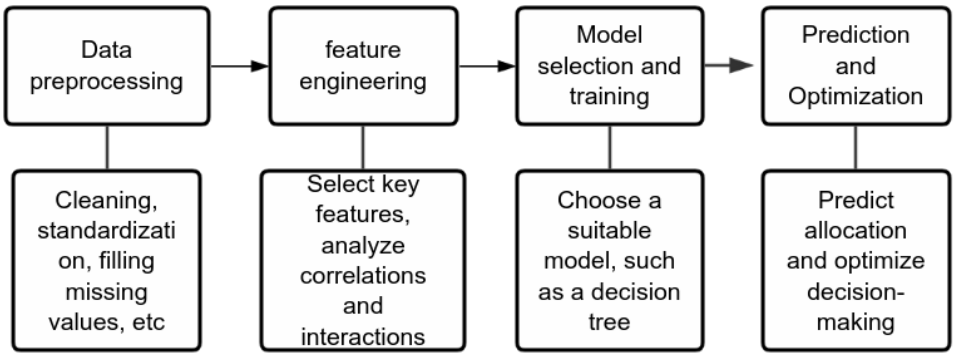

Figure 2: Optimization Process of Resource Allocation and Cost Control Prediction Model Based on Data Mining

4.4 Promoting Cross Departmental Collaboration to Facilitate Resource and Cost Goal Coordination

To promote cross departmental collaboration and coordinate resource and cost objectives, it is necessary to first establish clear goals and frameworks, and clarify the specific responsibilities of each department in resource utilization and cost control. Due to the fact that each department often has its own business focus and priority direction, resource integration often becomes complex. Therefore, the first step in cross departmental collaboration is to reach a consensus on goals through internal communication within the organization. Regularly organizing cross departmental consultation meetings is an effective way to achieve this goal, allowing departments to exchange information and jointly analyze the current status of resource utilization and the implementation of cost control goals. During the meeting, department heads and relevant responsible persons can communicate their respective needs, challenges, and solutions to ensure that resource allocation and cost control are in sync. In order to efficiently balance resource allocation and cost control,

departments need to have access to unified and real-time updated data resources. For example, departments such as production, finance, and procurement should exchange information on inventory status, production progress, cost expenditures, etc., in order to comprehensively consider the overall situation when making decisions. Cross departmental cooperation also needs to rely on a scientific review mechanism. Departments can be evaluated based on indicators such as resource conservation effectiveness and cost control performance. The design of performance evaluation should reflect overall goals as much as possible, rather than simply focusing on individual achievements of individual departments, in order to stimulate team collaboration rather than individualism. To measure the achievement of specific goals, the following formula can be used as a reference：

$$E = \frac{\sum_{i=1}^{n}(R_i \cdot \omega_{R_i} + C_i \cdot \omega_{C_i})}{\sum_{i=1}^{n}(\omega_{R_i} + \omega_{C_i})} \tag{3}$$

Among them, E represents the overall collaborative efficiency, measuring the optimization effect of cross departmental collaboration. And respectively represent the actual contributions of the i-th department in resource allocation and cost control. And is the weight coefficient of each department in resource allocation and cost control, representing the relative importance of each department in optimizing resources and costs. N is the total number of departments. This formula can quantify the overall benefits of cross departmental collaboration and help evaluate and optimize the coordination effect of resources and cost goals by adjusting the weights and performance evaluations of each department.

5. Conclusion

Data mining technology has great potential in optimizing resource allocation and cost savings. With the precise analysis of numerous data, enterprises can discover potential patterns and trends, and then formulate more accurate and appropriate strategies. The application of data mining not only improves the efficiency of resource allocation, but also helps enterprises identify and reduce unnecessary costs, creating higher economic benefits for the enterprise. In the future, with the continuous development of fields such as machine learning and deep learning, data mining will play a more important role in resource management and cost control, bringing higher efficiency and benefits to enterprises.

References

[1] *Xu J. Efficient trajectory optimization and resource allocation in UAV 5G networks using dueling-Deep-Q-Network s. Wireless Networks, 2023, 30(7):6687-6697.*

[2] *R. Prabhu, S. Rajesh. An Advanced Dynamic Scheduling for Achieving Optimal Resource Allocation. Computer Systems Science & Engineering, 2023, 44(1):281-295*

[3] *Ankit Kumar, Neeraj Varshney, Surbhi Bhatiya, Kamred Udham Singh. Replication-Based Query Management for Resource Allocation Using Hadoop and MapReduce over Big Data. Big Data Mining and Analytics, 2023, 6(4):465-477*

[4] *Zhihao Yang, Anupam Trivedi, Ming Ni, Haoming Liu, Dipti Srinivasan. Distribution Locational Marginal Pricing Based Equilibrium Optimization Strategy for Data Center Park with Spatial-temporal Demand-side Resources. Journal of Modern Power Systems and Clean Energy, 2023, 11(6):1959-1970*

[5] *Hao D, Xinpeng F, Jinping J. Consensus-based distributed fixed-time optimization for a class of resource allocation problems. Journal of the Franklin Institute, 2022, 359(18):11135-11154.*

[6] *Xiu, L. (2025, June). Research on Personalized Recommendation Algorithms in Modern Distance Education Systems. In 2025 IEEE 3rd International Conference on Image Processing and Computer Applications (ICIPCA) (pp. 2019-2024). IEEE.*

[7] *Xu, D. (2025). Integration and Optimization Strategy of Spatial Video Technology in Virtual Reality Platform. International Journal of Engineering Advances, 2(3), 131-137.*

[8] *Huang, J. (2025). Adaptive Reuse of Urban Public Space and Optimization of Urban Living Environment. International Journal of Engineering Advances, 2(4), 9-17.*

[9] *Zhou, Y. (2025). Using Big Data Analysis to Optimize the Financing Structure and Capital Allocation of Energy Enterprises. Economics and Management Innovation, 2(7), 8-15.*

[10] *Zhang, Q. (2025). Use Computer Vision and Natural Language Processing to Optimize Advertising and User Behavior Analysis. Artificial Intelligence and Digital Technology, 2(1), 148-155.*

[11] *Wang, Y. (2025). Research on Early Identification and Intervention Techniques for Neuromuscular Function Degeneration. Artificial Intelligence and Digital Technology, 2(1), 163-170.*

[12] *Wu, H. (2025). The Challenges and Opportunities of Leading an AI ML Team in a Startup. European Journal of AI, Computing & Informatics, 1(4), 66-73.*

[13] *Ren, B. (2025). Cross Modal Data Understanding Based on Visual Language Model. European Journal of AI, Computing & Informatics, 1(4), 81-88.*

[14] *Shen, D. (2025). Innovative Application of AI in Medical Decision Support System and Implementation of Precision Medicine. European Journal of AI, Computing & Informatics, 1(4), 59-65.*

[15] *Liu, X. (2025). Use Generative Al and Natural Language Processing to Improve User Interaction Design. European Journal of AI, Computing & Informatics, 1(4), 74-80.*

[16] *Liu, F. (2025). Localization Market Expansion Strategies and Practices for Global E-commerce Platforms. Strategic Management Insights, 2(1), 146-154.*

[17] *Hu, Q. (2025). Research on the Combination of Intelligent Management of Tax Data and Anti-Fraud Technology. Strategic Management Insights, 2(1), 139-145.*

[18] *Hua, X. (2025). Key Indicators and Data-Driven Analysis Methods for Game Performance Optimization. European Journal of Engineering and Technologies, 1(2), 57-64.*

[19] *Ren, B. (2025). Deep Learning and Anomaly Detection in Predictive Maintenance Platform. European Journal of Engineering and Technologies, 1(2), 65-71.*

[20] *Hui, X. (2025). Research on the Application of Integrating Medical Data Intelligence and Machine Learning Algorithms in Cancer Diagnosis. International Journal of Engineering Advances, 2(3), 101-108.*

[21] *Hui, X. (2025). Utilize the Database Architecture to Enhance the Performance and Efficiency of Large-Scale Medical Data Processing. Artificial Intelligence and Digital Technology, 2(1), 156-162.*

[22] *Jingzhi Yin. Research on Financial Time Series Prediction Model Based on Multi Attention Mechanism and Emotional Feature Fusion. Socio-Economic Statistics Research (2025), Vol. 6, Issue 2: 161-169*

[23] *Dingyuan Liu. Measuring the Sensitivity of Local Skill Structures to AI Substitution Risks Based on Occupational Task Decomposition. Socio-Economic Statistics Research (2025), Vol. 6, Issue 2: 177-184*

[24] Yiting Hong. An Efficient Federated Graph Neural Network Framework for Cross-Enterprise Business Analysis. Socio-Economic Statistics Research (2025), Vol. 6, Issue 2: 170-176.

[25] Jiahe Sun. Research on Financial Systemic Risk Measurement Based on Investor Sentiment and Network Text Mining. Socio-Economic Statistics Research (2025), Vol. 6, Issue 2: 185-193.

[26] Thanh-Huyen Truong. Research on the Mechanism of E-commerce Model Innovation Driven by Digital Technology. International Journal of Big Data Intelligent Technology (2025), Vol. 6, Issue 2: 171-178

[27] Qi, Y. (2025). Data Consistency and Performance Scalability Design in High-Concurrency Payment Systems. European Journal of AI, Computing & Informatics, 1(3), 39-46.

[28] Li, J. (2025). High-Performance Cloud-Based System Design and Performance Optimization Based on Microservice Architecture. European Journal of AI, Computing & Informatics, 1(3), 77-84.

[29] Huijie Pan. Discussion on Low-Latency Computing Strategies in Real-Time Hardware Generation. International Journal of Neural Network (2025), Vol. 4, Issue 1: 48-56.

[30] Huijie Pan. Discussion on Low-Latency Computing Strategies in Real-Time Hardware Generation. International Journal of Neural Network (2025), Vol. 4, Issue 1: 57-64.