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Optimization model for human resource allocation in the front office of banks

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Abstract. Human resource allocation plays a pivotal role in enabling banks to adapt swiftly to financial market fluctuations and enhance operational efficacy. Addressing this challenge necessitates a comprehensive approach that accounts for various factors. To ensure optimal use of human resources, our research delves into essential considerations like position headcount, staff availability, employee competencies, and proficiency levels. Our objective is to formulate an integer optimization model, which strategically allocates personnel to distinct roles. Leveraging advanced optimization solvers, we solve this model to identify the most efficient staffing configurations. To validate our approach, we conducted a case study focusing on the front office of the Agricultural Bank of China. The results demonstrate the model's effectiveness in enhancing human resource allocation, ultimately contributing to the bank's operational efficiency and adaptability to market dynamics.

Keywords: optimization model, human resource, integer programming, bank

1. Introduction

In the dynamic banking and financial market environment, efficient resource allocation is essential for banks to enhance operational efficiency and adapt to industry developments. Human resources play a vital role in banking operations. Optimizing human resource allocation not only improves efficiency and reduces costs but also enhances customer satisfaction and market competitiveness. The front office of a bank is particularly crucial as it directly influences customer experience and the bank's reputation. This paper explores a human resource optimization model specifically designed for the front office of banks. Using mathematical modeling, it integrates job skill requirements, employee skills, and skill proficiency to create an optimized allocation model that addresses the dynamic demand for skills in different positions, thereby maximizing effectiveness.

Human resource allocation in banks and financial institutions often involves challenges related to transformation and competition. For instance, Du Shan et al. [1] studied human resource allocation during bank branch transformation by collecting data on business volume and employee numbers, using predictive algorithms to develop a 'branch-specific' model that enhances allocation efficiency. Ye Zhiliang [2] analyzed human resource allocation in fintech and proposed improvements in personnel structuring, training, and salary disbursement. Song et al. [3] investigated talent competition in banks, proposing a model based on ethics, capital, and human resources. Their findings suggested that high ethical standards in banks may lead to talent loss. Wu et al. [4] examined methods for improving human resource management and suggested job role constraints to better utilize personnel at different levels. Liu Yijuan [5] focused on optimizing human resource allocation in commercial banks, discussing guiding principles and potential challenges. Meng Sen et al. [6] analyzed workforce distribution under digital transformation using descriptive statistics and surveys. Wang Zheng [7] studied optimization in private banks, highlighting the need to reduce middle-office personnel, adjust credit staff, and increase multidisciplinary talent.

Artificial intelligence (AI) and algorithmic models are essential tools in solving human resource allocation problems. Yu Yue et al. [8] proposed an AI-based performance prediction model using TS-GABPNN to facilitate efficient workforce deployment. Wei Hao et al. [9] introduced a deep learning-based human resource optimization algorithm (DLSM), which significantly improved human resource distribution. Rokhforoz et al. [10] developed a decentralized Nash bargaining solution (NBS) model for task and resource allocation in banking, transforming task distribution into a game-theoretic problem.

Human resource allocation challenges extend beyond banking to other industries. Pang Changsheng [11] proposed a competency-based model to enhance allocation efficiency. Sinclair-Desgagné B [12] applied static multi-task principal-agent models to study HR management failures in SMEs. Li et al. [13] examined fairness in resource allocation using a stochastic

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mathematical model. Luo et al. [14] analyzed optimal NGO workforce sizes based on governance quality, while Duan [15] studied the relationship between individualism and banking financial structures.

To summarize, human resource optimization models and algorithms should integrate job demands, employee skills, innovation needs, and external factors. Based on financial resource allocation theories, this study collects real-time data to achieve precise workforce distribution. Human resource allocation in the front office of banks involves multiple objectives. This paper investigates the use of multi-objective optimization models to solve human resource allocation challenges. Section 2 provides real-world data on front office roles in the Agricultural Bank of China and their skill requirements. Section 3 establishes an optimization model based on collected data. Section 4 applies the model to a real-world case study, demonstrating its effectiveness.

2. Analysis of job requirements and skill matching in banking

2.1. Job skill requirements

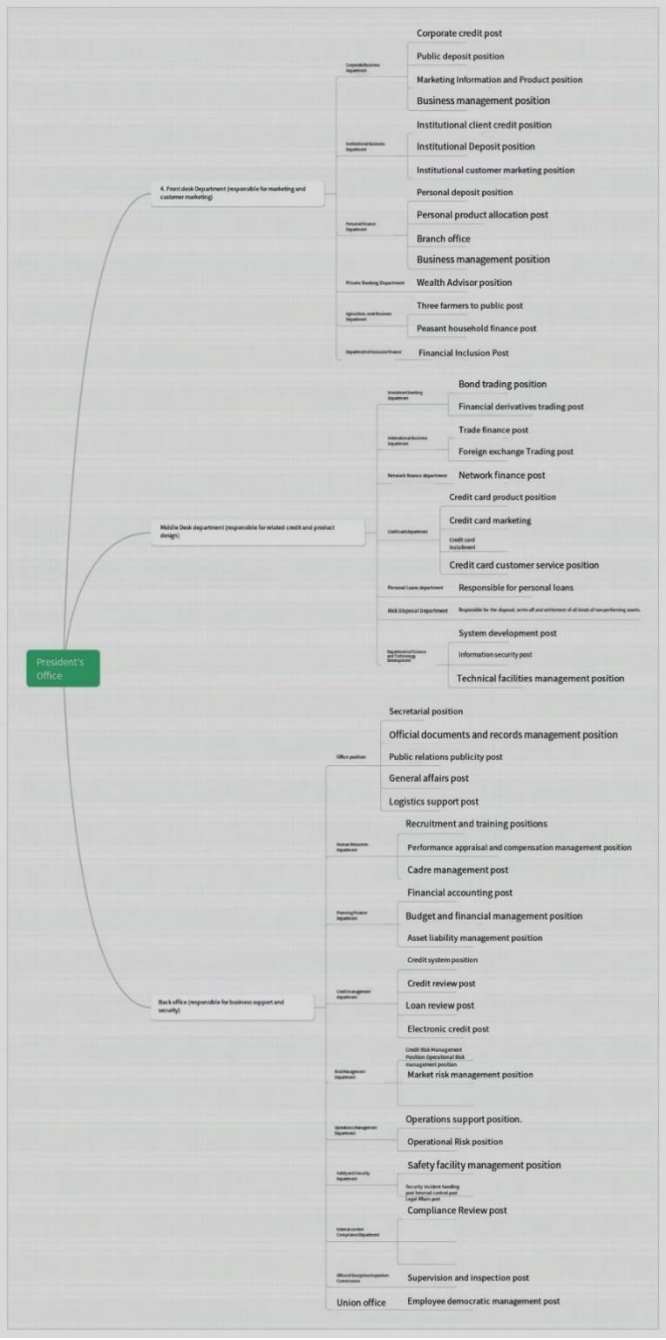

Figure 1. Structure of banking department positions

The front office of a bank can be segmented into six sub-departments, each encompassing three to four positions with diverse skill sets and staffing needs (As shown in Fig.1). The Corporate Credit Position demands proficiency in credit analysis, financial statement evaluation, and risk assessment. Meanwhile, the Corporate Deposits Position necessitates skills in risk evaluation, market expansion, data analysis, and client relationship management. The Market Information & Product Position specializes in market analysis, product conception, and business coordination, while the Business Management Position requires expertise in business coordination, management, and asset allocation. The Institutional Client Credit Position emphasizes financial statement evaluation and risk management, whereas the Institutional Deposits Position focuses on market expansion, client relationship management, and product promotion. The Government & Public Sector Marketing Position needs skills in market expansion, demand analysis, and effective communication. The Personal Deposits Position, on the other hand, requires abilities in market expansion, client relationship management, and product promotion. The Personal Product Allocation Position specializes in demand analysis. Furthermore, the Online Branch Office Position demands management, organizational coordination, and data analysis skills. The second Business Management Position (distinct from the earlier mentioned one within the Corporate context) emphasizes business coordination, management, and process optimization. The Wealth Advisor Position necessitates expertise in demand analysis, asset allocation, and a deep understanding of investment products. The Rural Corporate Banking Position demands skills in market expansion, client relationship management, and policy support project implementation. The Rural Finance Position specializes in risk control, product promotion, and demand analysis. Lastly, the Inclusive Finance Position requires abilities in market research, policy interpretation, and data analysis. Each of these positions plays a crucial role in the overall operation of the bank's front office.

2.2. Employee skill evaluation

Data analysis reveals that risk assessment and data analysis are the most sought-after skills in banking roles, serving as cornerstones for banking professionals. Collectively, essential competencies encompass ten categories: financial analysis, market & client management, product & business development, organizational management, IT support, policy & strategy formulation, communication & documentation, data optimization, legal compliance, and asset acquisition.

3. Human resource optimization model for bank front office

3.1. Problem description

This study aims to optimize human resource allocation in Chinese banks, emphasizing efficiency. It considers job roles, personnel count, and skill requirements. Assuming each position demands multiple skills with different priorities and employees possess varying skill proficiencies, the study develops a human resource-job matching model to ensure optimal staffing.

3.2. Parameters and decision variables

$$x_{ij}\begin{cases}1\ the\ ith\ person\ goes\ to\ do\ the\ jth\ position\\0\ the\ ith\ person\ will\ not\ do\ the\ jth\ position\end{cases}$$

m: $The\ quantity\ of\ abilities$

n: $Number\ of\ position\ and\ number\ of\ people, equal\ number\ of\ positions\ and\ number\ of\ people$

a_{jk}: $The\ jth\ position\ requires\ the\ kth\ ability\ then\ a_{jk}=1, if\ not, a_{jk}=0$

b_{ik}: $The\ level\ at\ which\ the\ ith\ person\ possesses\ the\ kth\ ability, b_{ik}\geq 0$

c_{ik}: $The\ ith\ person\ possess\ the\ kth\ ability\ then\ c_{ik}=1, if\ not, c_{jk}=0$

3.3. Optimization model

$$max\sum_{j=1}^{n}\sum_{i=1}^{n}\sum_{k=1}^{m}a_{jk}b_{ik}x_{ij} \tag{1}$$

$$s.t.=\begin{cases} \sum_{j=1}^{n} x_{ij}=1,\ i=1\ldots\ldots n \\ \sum_{i=1}^{n} x_{ij}=1,\ j=1\ldots\ldots n \\ \sum_{i=1}^{n} a_{jk}c_{ik}x_{ij}=1,\ j=1\ldots\ldots n, k=1\ldots\ldots m \\ x_{ij}=\{1,0\},\ i=1\ldots\ldots n, j=1\ldots\ldots n \end{cases} \tag{2}$$

Equation (1) represents the objective function, aiming to maximize allocation efficiency, while Equation (2) defines the constraint conditions.

4. Case study

This study focuses on the assessment of skills in five key positions within the Agricultural Bank of China's front office: corporate credit, corporate deposits, market information & product, business management, and institutional client credit. The evaluation examines five individuals with diverse skill sets, categorizing their abilities from A (highest) to C (lowest). The first individual demonstrates proficiency in A-level risk control, C-level client relationship management, C-level data analysis, and B-level management. The second individual excels in A-level financial statement analysis, B-level market analysis, B-level business coordination, and C-level management. The third individual showcases A-level data analysis and market expansion, B-level credit analysis, and C-level product design. The fourth individual stands out in A-level product promotion, B-level financial statement analysis, B-level process optimization, and B-level risk assessment. Lastly, the fifth individual possesses A-level financial statement and credit analysis, B-level client relationship management, and B-level product design skills.Overall, this study highlights the importance of diverse skill sets within the front office of the Agricultural Bank of China to effectively manage various tasks and responsibilities.

According to the optimization model, the most effective allocation of positions within the company is as follows. Employee 5 should be assigned the corporate credit position due to their exceptional A-level credit analysis and financial statement analysis skills, which make them the most qualified for the role. Employee 3 is the ideal candidate for the corporate deposits position, as their A-level market expansion and data analysis abilities align perfectly with the requirements of the position. Employee 2 is best suited for the market information & product position; despite lacking product design expertise they excel in B-level market analysis and business coordination skills. Employee 4 should be placed in the business management position, as their strengths in product promotion and process optimization are a great match for the responsibilities of the role. Lastly, employee 1 is the perfect fit for the institutional client credit position, given their A-level risk control skills and solid proficiency in data analysis, making up for slightly weaker data skills. By allocating positions based on individual strengths and skills, the company ensures optimal performance and success in each role.

Effective job allocation aligns employee skills with job requirements, enhancing human resource efficiency in the bank's front office. This strategic approach leads to improved performance and productivity among staff members.

5. Conclusion

This study delves into the complexities of human resource allocation in the front office of banks, recognizing that each position necessitates a unique set of skills with varying levels of proficiency among personnel. By evaluating the skill requirements for different roles and matching them with the proficiency levels of available staff, this research aims to enhance allocation efficiency. Through the development of an integer programming model, which is implemented using Excel, optimal human resource allocation strategies are formulated based on job-specific skill requirements. The model proves effective in maximizing efficiency and practicality in resource allocation decisions. While this study focuses primarily on skill requirements and proficiency levels, it acknowledges that other factors such as costs, legal policies, and employee preferences play a significant role in human resource allocation. Future research will delve further into incorporating these additional factors to provide a more comprehensive understanding of optimal resource allocation strategies in the banking sector.

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