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Original Paper

Analysis of the Advantages and Capability Shortcomings of Mathematics Graduates Entering the Financial Industry

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Abstract

With the rapid development of the financial industry and the rise of financial technology, mathematics graduates have garnered widespread attention in the financial field due to their unique thinking patterns and knowledge structure. This paper systematically analyzes the advantages and capability shortcomings of mathematics graduates entering the financial industry. The research shows that mathematics graduates possess significant advantages in quantitative analysis ability, modeling thinking, logical reasoning, programming implementation, and risk management. These advantages enable them to excel in positions such as financial derivatives pricing, quantitative investment, and risk control. However, mathematics graduates also have shortcomings, including insufficient financial market intuition, lack of practical operational experience, weak communication and collaboration skills, relative lack of business acumen, and absence of professional qualifications. In response to these issues, this paper proposes improvement suggestions such as curriculum system optimization, school-enterprise collaborative education, practical ability cultivation, soft skills training, and career planning guidance, aiming to provide a reference for the cultivation of mathematics professionals and the career development of students with a mathematical background.

Keywords

Mathematics Major, Financial Industry, Employment Advantages, Capability Shortcomings, Talent Cultivation

1. Introduction

1.1 Research Background

1.1.1 Changes in Talent Demand in the Financial Industry

Since the 21st century, the global financial industry has undergone profound changes. Following the 2008 international financial crisis, financial regulation has become increasingly stringent, and risk management has received unprecedented attention. At the same time, the rapid development of technologies such as big data, artificial intelligence, and blockchain has driven the rise of financial technology (FinTech). Against this backdrop, the demand structure for talent in the financial industry has changed significantly. While talents with traditional finance and accounting backgrounds remain the industry's foundation, new financial talents with quantitative analysis skills, programming abilities, and mathematical modeling capabilities have become scarce resources in the market. Major banks, securities companies, fund companies, and insurance companies have set up quantitative research departments, and hedge funds and quantitative investment companies have a strong demand for talents with backgrounds in mathematics, statistics, and physics.

1.1.2 Employment Difficulties Faced by Mathematics Graduates

For a long time, mathematics has been regarded as a fundamental discipline. Although its graduates have solid thinking training, the number of directly matching job positions is relatively limited. Traditional paths mainly include: primary and secondary school mathematics teachers, researchers in research institutions, and algorithm engineers in the IT industry. However, with the expansion of university enrollment, the number of mathematics graduates has increased year by year, competition for teaching positions has become increasingly fierce, and the threshold for research positions has continuously risen. Many mathematics students face the awkward situation of "unclear professional advantages and mismatched job skills," experiencing certain employment pressures.

1.1.3 The Disciplinary Connection between Mathematics and Finance

There is a natural internal connection between mathematics and finance. From a historical perspective, Louis Bachelier's doctoral dissertation "The Theory of Speculation" in 1900 first applied stochastic processes to financial market analysis; in the 1950s, Harry Markowitz's modern portfolio theory introduced mean-variance optimization; in the 1970s, the option pricing model (Black-Scholes-Merton model) proposed by Fisher Black, Myron Scholes, and Robert Merton directly promoted the birth of the financial engineering discipline. It can be said that every major advance in modern finance has been inseparable from the support of mathematical tools. This disciplinary connection provides a theoretical basis for mathematics graduates to enter the financial industry.

1.2 Research Purpose and Significance

1.2.1 Research Purpose

This paper aims to systematically sort out the advantages and shortcomings of mathematics graduates entering the financial industry. Specific goals include: First, to identify the core advantageous abilities of mathematics graduates in competing for financial positions; Second, to objectively analyze the main shortcomings and deficiencies exposed during their job search and actual work; Third, to propose targeted capability improvement strategies and optimization suggestions for training programs; Fourth, to provide a reference for mathematics students' career planning and university talent cultivation.

1.2.2 Theoretical Significance

This study helps deepen the understanding of the laws of interdisciplinary talent mobility and enriches the application of human capital theory in the financial industry. By analyzing the value transformation of mathematical knowledge and thinking in financial scenarios, it can enhance the understanding of the application value of fundamental disciplines. At the same time, this study provides a theoretical framework for constructing a "Mathematics-Finance" composite talent quality model.

1.2.3 Practical Significance

From a practical perspective, this study has multiple values: For mathematics students, it can clarify the direction of effort and target the supplementation of shortcomings; for university mathematics departments, it can provide a basis for curriculum system reform and talent training program optimization; for employers in the financial industry, it helps to better understand the characteristics of talents with mathematical backgrounds and design reasonable recruitment standards and training programs.

1.3 Domestic and International Research Status

1.3.1 Domestic Research Status

Domestic scholars' research on the employment of mathematics graduates mainly focuses on the following aspects: First, statistical analysis of the overall employment situation of mathematics graduates, using employment quality report data to describe indicators such as employment rate, industry distribution, and salary levels; Second, discussion on the reform of mathematics talent training models, emphasizing the direction of applied and composite talent training; Third, preliminary involvement in the application of mathematical backgrounds in the financial industry, but mostly general discussions lacking systematic in-depth advantage-shortcoming analysis.

Existing research has the following shortcomings: Advantage analysis remains at an abstract level, failing to specify positions and work scenarios; shortcoming analysis is mostly a summary of personal experience, lacking a systematic framework; countermeasure suggestions are relatively general and lack operability.

1.3.2 International Research Status

Internationally, especially in financially developed countries such as the United Kingdom and the United States, quantitative finance has developed into a mature field. Numerous studies have shown that graduates with backgrounds in mathematics, physics, and engineering have natural advantages in the financial industry, particularly in derivatives pricing, risk management, and quantitative trading. Many top universities have established interdisciplinary majors such as financial mathematics and computational finance. At the same time, foreign literature has also noted the maladaptation problems faced by "rocket scientists" after moving to the financial industry, including cultural conflicts, communication barriers, and misunderstandings of incentive mechanisms.

1.3.3 Research Review

Synthesizing domestic and international research, it can be seen that the flow of mathematics talent to the financial industry is a common phenomenon, which has both rationality and challenges. Domestic research lags relatively behind, lacking a systematic analytical framework for advantages and shortcomings. This paper attempts to make an effort in this direction and construct a relatively complete analytical system.

1.4 Research Methods and Content Framework

1.4.1 Research Methods

This paper primarily adopts the following research methods: First, the literature research method, systematically reviewing literature from related fields such as mathematics, finance, and human resource management; Second, the comparative analysis method, comparing the differences in knowledge structure and ability characteristics between mathematics majors and finance, economics, and management majors; Third, the logical deduction method, deriving the advantages and shortcomings of mathematical backgrounds based on the competency model; Fourth, the case analysis method, selecting typical financial positions for specific analysis.

1.4.2 Content Framework

This paper is divided into five parts. Part 1 is the introduction, presenting the research background, purpose, significance, current state, and methods. Part 2 analyzes the five major advantages of mathematics graduates entering the financial industry. Part 3 analyzes their five major capability shortcomings. Part 4 proposes capability improvement paths and recommendations. Part 5 is the conclusion and outlook.

2. Analysis of the Advantages of Mathematics Graduates Entering the Financial Industry

2.1 Solid Quantitative Analysis Ability

2.1.1 Precision in Data Analysis

One of the core trainings for mathematics students is the pursuit of extreme precision. In mathematical proofs and calculations, any minor error can lead to a fundamental change in the conclusion. This training shapes mathematics graduates' rigorous attitude towards data: they habitually scrutinize the source, accuracy, and error range of data, maintaining a high degree of prudence when processing financial data. In contrast, some personnel from non-quantitative backgrounds are more likely to blindly accept the surface values of data, ignoring potential problems and biases.

In financial practice, this precision has significant value. For example, when conducting financial statement analysis, practitioners with mathematical backgrounds can keenly identify data contradictions and inconsistencies; when constructing pricing models, they rigorously verify the rationality of each input parameter. Recruitment reports from institutions such as Barclays Capital indicate that quantitative research positions generally regard precision awareness as a core assessment indicator for candidates.

2.1.2 Proficient Application of Statistical Methods

Graduates of mathematics, especially those specializing in probability theory and mathematical statistics, have systematically studied descriptive statistics, inferential statistics, regression analysis, time series analysis, and other content. These methods constitute the basic toolbox for financial data analysis. For example, analyzing the distribution characteristics of asset returns requires the use of statistics such as skewness and kurtosis; testing the effectiveness of investment strategies requires the use of hypothesis testing; calculating Value at Risk (VaR) involves quantile estimation; constructing factor models relies on multiple regression techniques.

Compared to finance students, mathematics students have a deeper understanding of the mathematical principles behind statistical methods. They not only know how to operate but also understand the conditions under which the methods are valid, their potential limitations, and possible directions for improvement. When encountering complex data problems, this depth of theoretical understanding often becomes the key to solving the problem.

2.1.3 Quantitative Interpretation Ability for Financial Data

Mathematics graduates have the ability to convert textual information into quantitative indicators. For example, when reading a company's annual report, they can independently extract key financial data and construct evaluation models; when studying the macroeconomic situation, they can transform qualitative descriptions into operational quantitative variables. This quantitative thinking allows them to quickly grasp the core logic behind the numbers when faced with massive amounts of financial information, rather than getting lost in the sea of information.

2.2 Unique Mathematical Modeling Thinking

2.2.1 Abstraction and Formalization Ability

The core of mathematical modeling is transforming real-world problems into mathematical problems. This process requires two key abilities: first, abstraction ability, the capacity to extract essential elements from complex phenomena while ignoring secondary interference; second, formalization ability, the capacity to describe problems with precise mathematical language. Mathematics students repeatedly train this thinking paradigm during their long-term learning.

In the financial field, this ability is extremely valuable. The complexity of financial markets makes it impossible to grasp all details directly. Excellent quantitative analysts can construct concise and effective models that capture the most important driving factors of the market. For example, when assessing credit risk, the Merton model views a company's equity as a call option on its assets, an insight derived directly from a high degree of abstraction of the company's capital structure. This abstract thinking is precisely a product of mathematical training.

2.2.2 Model Construction and Solution Ability

Mathematical modeling requires not only constructing models but also solving them. Mathematics students have systematically studied courses such as differential equations, optimization theory, and numerical methods, mastering a variety of model-solving techniques. For problems with analytical solutions, they can use analytical techniques to obtain exact expressions; for problems that cannot be solved analytically, they can design numerical algorithms to obtain approximate solutions.

The most representative example of model solving in finance is option pricing. The Black-Scholes model transforms the partial differential equation satisfied by the option price into the heat equation, obtaining the pricing formula using analytical methods. For more complex derivatives, such as American options or exotic options, analytical solutions often do not exist, requiring numerical methods such as finite difference methods, Monte Carlo simulation, or binomial tree models. The training in mathematics enables graduates to make reasonable choices among different methods and understand the error characteristics and convergence properties of various methods.

2.2.3 Model Validation and Correction Awareness

Mathematics students are well aware that models are only approximations of reality, and any model has assumptions and limitations. Therefore, they possess a strong awareness of model validation: the need to test model performance through historical backtesting, identify key parameters through sensitivity analysis, and detect model deviations through comparison with actual market data.

This awareness of validation and correction is crucial for financial practice. One lesson from the 2008 financial crisis was that many institutions blindly trusted complex models and failed to recognize their failure under extreme market conditions in a timely manner. Risk management personnel with mathematical backgrounds are more inclined to conduct stress tests and scenario analyses on models to assess their robustness under different market environments. This prudent attitude is the foundation of effective risk management.

2.3 Rigorous Logical Reasoning Ability

2.3.1 Training Advantages in Deductive Reasoning

The core activity of mathematics learning is theorem proving. A complete mathematical proof starts from known premises, applies logical rules, and reaches a definite conclusion through a finite number of deductive steps. This deductive reasoning training shapes the thinking habits of mathematics graduates: they value the completeness of the reasoning chain, can distinguish between sufficient and necessary conditions, and can identify logical fallacies and circular arguments.

In financial analysis and decision-making, this logical ability has direct value. For example, when constructing an investment thesis, each step of reasoning from raw information to the investment decision needs to be clearly articulated; when conducting risk assessment, the causal chain of risk sources needs to be traced; when writing research reports, the rigor and persuasiveness of the argumentation need to be ensured. Practitioners lacking logical training are prone to the dilemma of "conclusion first, argumentation cobbled together."

2.3.2 Sensitivity to Conditional Assumptions

Mathematical theorems usually have clear preconditions; changing the preconditions may lead to a qualitative change in the conclusion. Mathematics students develop a high sensitivity to conditional assumptions during their learning process: they habitually ask, "Under what conditions does this conclusion hold?" and "What if the conditions are not met?"

This habit is particularly valuable in financial analysis. Financial models and strategies are often built on specific assumptions, such as frictionless markets, investor rationality, and normal distribution of returns. However, real markets often deviate from these assumptions. Practitioners with mathematical backgrounds can identify the direction and extent of deviations from assumptions and judge the applicable boundaries of model conclusions. For example, when the market experiences severe volatility, they can realize that risk measures based on normal distribution may significantly underestimate tail risk, thereby adopting more conservative risk control measures.

2.3.3 Reductio ad Absurdum Thinking and Risk Anticipation

Reductio ad absurdum is commonly used in mathematical proofs: assume the conclusion is false, derive a contradiction, and thus confirm the correctness of the conclusion. This paradigm of "thinking from the opposite side" can be transferred to financial risk management. Mathematics graduates are accustomed to thinking about "under what circumstances would the strategy fail?" and "what conditions would trigger losses?" This reverse thinking is an effective method of risk identification.

In contrast, many practitioners from non-mathematical backgrounds tend to engage in "forward thinking," focusing more on scenarios where the strategy succeeds and giving insufficient consideration to failure scenarios. In favorable circumstances, this thinking bias may not be exposed; but when the market turns, investors lacking risk anticipation may suffer significant losses. The reductio ad absurdum thinking cultivated by mathematical training provides a cognitive habit for risk anticipation.

2.4 Solid Programming and Computing Ability

2.4.1 Application of Numerical Computing Tools

Modern mathematics programs generally offer courses in numerical analysis, scientific computing, etc. Students systematically learn numerical computing tools such as MATLAB, Python (including scientific computing libraries like NumPy, SciPy, Pandas), and R. These tools highly overlap with the technology stack required for quantitative finance. The development of high-frequency trading systems, quantitative backtesting platforms, and risk management systems all rely on these technologies.

The advantage of mathematics graduates lies not only in mastering tool syntax but also in understanding the mathematical principles behind the algorithms. For example, when using gradient descent to optimize portfolio weights, they can understand the impact of learning rate selection on convergence speed, identify potential local optima issues, and adjust algorithm parameters as needed. This depth of "understanding the principles" gives them an advantage when debugging code and optimizing performance.

2.4.2 Algorithmic Thinking and Implementation Ability

An algorithm is a sequence of steps to solve a problem. Courses in discrete mathematics, operations research, and numerical analysis systematically train students' algorithmic thinking: how to decompose complex problems into subproblems, how to design efficient data structures, and how to evaluate the time and space complexity of algorithms.

In quantitative finance, algorithmic thinking is crucial. For example, when developing a trading strategy, data cleaning rules, signal generation logic, position management algorithms, and risk control processes need to be designed; when constructing an investment portfolio, optimization problems with constraints need to be solved, requiring the selection of appropriate optimization algorithms (such as quadratic programming, conic optimization, etc.). Mathematics graduates can independently complete the entire process from problem analysis to algorithm implementation.

2.4.5 Rapid Learning Ability for FinTech Tools

Financial technology is developing rapidly, with new tools and platforms constantly emerging. From traditional Wind and Bloomberg terminals to the open-source QuantLib library and commercial all-in-one quantitative platforms (such as RiceQuant, JoinQuant), the financial technology stack is continuously evolving.

Mathematics graduates have cultivated the ability to quickly master new mathematical software and programming languages through long-term learning. They are accustomed to reading technical documentation, learning new tools through cases, and transferring existing knowledge to new environments. This learning transfer ability enables them to keep pace with the iteration of financial technology and maintain sustained competitiveness. Conversely, if one only masters the operation of specific commercial software but lacks general programming ability, career development space will be constrained.

2.5 Systematic Risk Management Literacy

2.5.1 Probabilistic Thinking and Cognition of Uncertainty

Mathematics students, especially those specializing in probability theory, have a systematic understanding of randomness and uncertainty. They understand the Law of Large Numbers – the average outcome of a large number of independent random events tends to stabilize; they understand the Central Limit Theorem – the sum of a large number of independent random variables approximately follows a normal distribution; they are also aware of the fat-tail characteristic of distributions – the probability of extreme events may be higher than predicted by a normal distribution.

This probabilistic thinking constitutes the ideological foundation of financial risk management. The essential characteristic of financial markets is the uncertainty of returns and losses. Practitioners with mathematical backgrounds can describe risk in probabilistic language: not simply saying an event "might happen," but providing probability estimates whenever possible; not pursuing deterministic predictions, but constructing probabilistic scenarios and formulating corresponding response plans.

2.5.2 Risk Measurement and Quantitative Techniques

Modern financial risk management has become highly model-based and quantitative. Mainstream risk measurement indicators include: Value at Risk (VaR), measuring the maximum possible loss over a given holding period and confidence level; Expected Shortfall (ES), measuring the average loss exceeding VaR; Greeks (Greeks), measuring the sensitivity of derivative values to various risk factors.

The calculation of these risk measures is essentially a mathematical problem. VaR calculation involves quantile estimation, ES involves conditional expectation calculation, and Greeks involve partial derivative solutions. Mathematics majors' knowledge of multivariate calculus, probability theory, and statistical inference provides direct support for understanding and calculating these indicators. Risk management personnel with mathematical backgrounds can better understand the underlying assumptions, calculation methods, and limitations of various risk measures, avoiding misuse and abuse.

2.5.3 Methodology of Stress Testing and Scenario Analysis

Stress testing and scenario analysis are important tools in risk management, used to assess portfolio performance under extreme but possible market conditions. This methodology has high similarity with sensitivity analysis and parametric perturbation analysis in mathematics.

Mathematics graduates can use methods from numerical analysis to design stress testing plans: how to select stress scenarios (based on historical extreme events or constructed through parameter extremization), how to efficiently calculate losses under stress scenarios (using revaluation techniques to reduce computational costs), and how to interpret stress test results (distinguishing systemic risk from idiosyncratic risk). Systematic mathematical training gives them a significant advantage in this area.

3. Analysis of the Capability Shortcomings of Mathematics Graduates Entering the Financial Industry

3.1 Insufficient Financial Market Intuition and Industry Understanding

3.1.1 Lack of Financial Practice Experience

The curriculum for mathematics majors is centered on pure mathematics, applied mathematics, and probability and statistics, basically not covering financial market knowledge. Most mathematics students have not systematically studied courses such as Money and Banking, Securities Investment, or Corporate Finance during their university years, lacking basic understanding of the operational mechanisms of financial markets. This lack of knowledge structure manifests during job hunting as: inability to understand the specific responsibilities of recruitment positions, difficulty answering financial knowledge interview questions, and unawareness of the business differences among different financial institutions.

After entering the industry, this shortcoming becomes further prominent. For example, a quantitative analyst with a mathematical background may know how to calculate the theoretical price of an option, but may not understand the business logic of an options market maker – why selling options requires collecting a premium, why bid-ask spreads exist, or how to manage risk through delta hedging. There is an obvious "last mile" distance between theoretical knowledge and practical application.

3.1.2 Lag in the Formation of Market Intuition

Financial markets are not just collections of mathematical models but also complex mappings of human behavior and social psychology. Successful financial practitioners typically possess a certain market intuition – sensitivity to changes in market sentiment, grasp of the rhythm of price movements, and quick judgment of the impact of major events. This market intuition cannot be directly obtained from books or courses; it needs to be gradually formed through long-term immersion in the market, repeated practice, and continuous reflection.

Mathematics graduates are at a disadvantage compared to finance graduates in this dimension. Finance students, through simulated trading, case analysis, and internship practices, are exposed to the market earlier and gradually cultivate market feel. Mathematics students typically only begin to engage with real markets after entering the industry, and the development of market intuition lags relatively behind. In scenarios requiring rapid decision-making (such as high-frequency trading, short-term operations), this gap is particularly evident.

3.1.3 Lack of Knowledge of Financial Systems and Regulatory Environment

Modern financial markets operate within specific legal systems and regulatory frameworks. Laws and regulations such as securities law, company law, bankruptcy law, and banking regulations constitute the institutional constraints on financial activities. Understanding these systems is a prerequisite for understanding financial practice.

Mathematics courses do not cover legal and institutional content at all, leading to a serious lack of institutional knowledge among graduates with mathematical backgrounds. They may not understand why certain transactions require specific legal document support, why the third-party depository system changed fund flows, or why the Basel Accord affects capital adequacy management. This lack not only affects the depth of business understanding but may also introduce operational risks in scenarios involving compliance review.

3.2 Lack of Practical Financial Operation Experience

3.2.1 Unfamiliarity with Mainstream Financial Software

The financial industry has developed a series of standardized business software and terminals. The Bloomberg terminal is a standard tool for global financial practitioners, providing functions such as real-time quotes, news, and data analysis; the Wind terminal is a mainstream tool in the domestic financial market; Reuters (Refinitiv) Eikon has advantages in specific markets. In addition, various trading systems, settlement systems, and risk control systems also have their own proprietary interfaces and processes.

Mathematics graduates are almost never exposed to these professional software during university. The annual fee for a Bloomberg terminal is as high as tens of thousands of dollars, and schools cannot equip all students with it; although the Wind terminal has an educational version, its usage is limited. This leads to job seekers with mathematical backgrounds showing unfamiliarity with industry tools during interviews or internships. In contrast, finance students, through lab courses, finance labs, and internship practices, have a certain degree of familiarity with these tools.

3.2.2 Lack of Understanding of Business Processes and Operational Norms

The conduct of financial business follows strict processes and norms. For example, a standardized process involves: customer needs communication, plan design, internal approval, trade execution, clearing and settlement, file management, and other steps. Each step has clear operational requirements, time limits, and review standards.

Mathematics graduates lack concepts of these operational details. They may focus on the effectiveness of a strategy while ignoring its feasibility of execution; they may pursue mathematical perfection while overlooking practical constraints. For example, a theoretically optimal investment portfolio may be infeasible due to liquidity constraints; a mathematically rigorous pricing model may be inapplicable in practice due to data availability limitations. This "theory-practice gap" needs to be gradually bridged in actual work.

3.2.3 Insufficient Practical Experience in Trade Execution and Risk Control

The development and implementation of quantitative strategies involve not only the logic of the strategy itself but also the practical aspects of trade execution and risk control. Slippage control, transaction cost calculation, use of algorithmic trading, adherence to stop-loss discipline, handling of abnormal situations – these are all key factors affecting the final performance of a strategy.

If mathematics students lack trading experience in real or simulated markets, they often underestimate the importance of these practical aspects. They may overly focus on the theoretical Sharpe ratio of a strategy while neglecting transaction friction costs at the execution level; they may perform excellently in backtesting but face slippage erosion in live trading. This disconnect requires continuous adjustment and optimization in practice.

3.3 Relatively Weak Communication, Collaboration, and Interpersonal Skills

3.3.1 Difficulty in Translating Professional Terminology

Mathematics students are accustomed to using precise mathematical language for communication. Although this language is rigorous, it can create barriers in interdisciplinary communication. The financial industry is a highly collaborative environment, where traders, salespeople, researchers, risk control personnel, and technical staff each have their own discourse systems and thinking habits.

A challenge faced by practitioners with mathematical backgrounds is how to translate complex quantitative content into language that colleagues from non-quantitative backgrounds can understand. For example, how to explain the principle of a statistical arbitrage strategy to a trader, how to explain the meaning of a risk measure to management, or how to articulate the risk characteristics of a product's return structure to a client. Without effective "translation" and "rephrasing," even good ideas may struggle to gain recognition and support.

3.3.2 Need to Strengthen Team Collaboration Awareness

Mathematics learning tends to favor individual study. Solving a difficult problem or proving a theorem is usually an individual activity, not requiring much collaboration. This learning style may cultivate a habit of working independently but also weakens team collaboration awareness to some extent.

However, the financial industry is one that highly relies on teamwork. The development of quantitative strategies often requires close cooperation among the investment research team (providing fundamental information), the quantitative team (building models), the IT team (implementing systems), the trading team (executing strategies), and the risk control team (monitoring risk). Practitioners with mathematical backgrounds, if accustomed to working alone or not skilled at sharing information and coordinating actions with others, may find it difficult to integrate into the team, affecting overall effectiveness.

3.3.4 Lack of Non-Technical Communication Skills

Communication needs in the financial industry go far beyond information transmission, including non-technical aspects such as persuasion, negotiation, and relationship maintenance. For example, fund managers need to do roadshows to attract capital from investors; investment bankers need to coordinate price expectations between buyers and sellers to facilitate transactions; researchers need to recommend investment ideas to trading teams to influence their decisions.

These scenarios have high demands for soft skills such as oral expression, public speaking, interpersonal understanding, and emotional management. However, mathematics education provides almost no training in these skills. Mathematics graduates perform well in technical communication (e.g., explaining model assumptions, discussing algorithm details) but may struggle with non-technical communication. If career development involves roles such as business development, client relations, or team management, this shortcoming becomes a significant constraint.

3.4 Relative Lack of Business Acumen and Economic Intuition

3.4.1 Weak Financial Statement Analysis Ability

Company financial statements (balance sheet, income statement, cash flow statement) are fundamental materials for financial analysis. Analysis of profitability, solvency, operating capacity, and growth capability all depend on understanding and interpreting financial statements. However, the mathematics curriculum typically does not include accounting content.

Many mathematics graduates, when handed a set of financial statements, cannot quickly identify key items, do not understand the interrelationships between items, and do not master common financial ratio analysis methods. This puts them at a clear disadvantage in fundamental analysis-related positions (such as equity research, credit analysis). Even when engaged in quantitative analysis, understanding financial statements helps in designing more effective fundamental quantitative strategies.

3.4.2 Lack of Macroeconomic Analysis Framework

The macroeconomic cycle has a systemic impact on financial markets. Factors such as the tightness of monetary policy, expansion or contraction of fiscal policy, and changes in the international trade environment all significantly affect asset prices. Understanding the operational logic of the macroeconomy requires mastering basic theories such as national income accounting, the IS-LM model, the AD-AS model, and the Phillips curve.

Mathematics graduates typically have not systematically studied macroeconomics. They may not understand how central bank monetary policy operations transmit to asset prices, are unclear about the meaning and impact mechanisms of macroeconomic indicators such as PMI, CPI, and PPI, and are unfamiliar with the stage division and characteristic identification of economic cycles. This shortcoming makes them lack competitiveness in macro strategy research positions.

3.4.3 Shallow Understanding of Business Logic

The essence of finance is to serve the discovery and exchange of value in the business world. Whether it is equity investment, bond issuance, mergers and acquisitions, or asset securitization, behind them lie specific business activities – business operations, market competition, consumer behavior, industry chain distribution, etc. Understanding business logic is the foundation for understanding the value of financial products.

Mathematics students often lack perceptual understanding of the operational logic of the business world.

They may not understand why certain industries have oligopolies while others are perfectly competitive, are unclear about the sources of a company's competitive advantage (technological patents, brand effects, network externalities, economies of scale, etc.), and are unfamiliar with commonly used company valuation methods such as comparable company analysis and precedent transaction analysis. This lack of business acumen limits their development in positions such as investment banking, PE/VC, and industrial funds.

3.5 Unclear Career Positioning and Lack of Professional Qualifications

3.5.1 Lack of Understanding of Segmented Financial Industry Positions

The financial industry contains numerous segmented fields and positions: investment banking (origination, execution, underwriting), securities research (aggregate research, industry research, strategy research), asset management (public funds, private funds, separate accounts), wealth management, risk management, compliance and internal control, financial technology, etc. Different positions have vastly different ability requirements.

Due to a lack of deep understanding of the industry, mathematics students often face confusion in career positioning and choice. They may be unclear about the specific work content of positions such as quantitative research, derivatives pricing, and risk management, unaware of the career development paths and salary structures of various positions, and uncertain about which positions match their abilities and interests. This information asymmetry leads to a lack of targeted job searching, making it easy to "cast a wide net" with limited results.

3.5.2 Lack of Professional Qualifications in the Financial Industry

The financial industry has developed a series of professional qualification certification systems. Domestically, securities qualification, fund qualification, and futures qualification are legal requirements for practice; certificates such as CPA (Certified Public Accountant), CFA (Chartered Financial Analyst), and FRM (Financial Risk Manager) are endorsements of professional ability. Internationally, certifications such as CFA, FRM, SOA (Society of Actuaries), and CQF (Certificate in Quantitative Finance) are highly recognized in the industry.

Mathematics students typically do not plan for exams for these certificates during their university years. In contrast, many finance students start preparing for relevant exams from their sophomore or junior year, and by graduation may have passed some subjects or even hold certificates. In job search competition, the lack of relevant certificates not only affects resume screening pass rates but also lacks comparative advantage under equal conditions.

3.5.3 Lack of Internship Experience, Insufficient Job Search Competitiveness

The financial industry is highly practice-oriented, and internship experience carries extremely high weight in recruitment. Top financial institutions typically require candidates to have 2-3 internships in relevant fields for their campus recruitment positions. Internships are not only proof of ability and interest but also opportunities for network building and career exploration.

However, the curriculum for mathematics majors usually does not include internship credits, and students often lack the motivation to actively seek internships; on the other hand, mathematics courses are demanding, making it difficult to find time for internships. This results in mathematics graduates generally having weaker internship experience than finance students. The lack of internship experience on their resumes puts them at a disadvantage as early as the resume screening stage.

4. Paths and Suggestions for Improving the Capabilities of Mathematics Graduates

4.1 Curriculum System Optimization and Interdisciplinary Cultivation

4.1.1 Offering Financial Mathematics Related Courses

University mathematics departments should actively adapt to market demand by offering courses in financial mathematics, financial engineering, quantitative investment, and related directions. Specific suggestions include: offering "Introduction to Financial Mathematics," covering issues such as financial derivatives pricing and portfolio selection; offering "Foundations of Quantitative Investment," covering strategy development, backtesting evaluation, risk control, etc.; offering "Financial Time Series Analysis," teaching the application of time series models in finance. Courses should emphasize the integration of theory and practice, possibly introducing real data and cases.

4.1.2 Encouraging Minors and Double Degrees

Mathematics students should be encouraged to minor in a second degree in finance, economics, or statistics. A minor can be completed on weekends or during winter/summer breaks, expanding knowledge without affecting major studies. A double degree requires more systematic investment but results in more solid knowledge mastery. Through a minor or double degree, students can systematically study core courses such as Money and Banking, Securities Investment, Corporate Finance, Financial Statement Analysis, Macroeconomics, and Econometrics, making up for the systematic lack of financial knowledge.

4.1.3 Developing Interdisciplinary Textbook Resources

Currently, the market lacks introductory finance textbooks suitable for mathematics students. Traditional finance textbooks assume readers have some financial foundation, making the learning curve steep for mathematics students; financial mathematics textbooks written by mathematics departments often overly focus on mathematical derivation, neglecting financial intuition. University teachers can collaborate to write introductory finance textbooks suitable for students with mathematical backgrounds, maintaining mathematical rigor while emphasizing the economic meaning of financial concepts.

4.2 School-Enterprise Cooperation and Industry-Education Integration

4.2.1 Establishing Internship Bases in Financial Institutions

Universities should establish long-term cooperative relationships with financial institutions such as banks, brokerages, fund companies, and insurance companies to set up internship bases. Incorporate internships into training plans, set internship credits, and require students to complete a specified duration of industry internship. Schools provide platform resources, and students obtain internship opportunities through competition. Financial institutions can also discover and reserve talent through internships, achieving a win-win situation.

4.2.2 Hiring Industry Mentors and Practical Lectures

Establish industry mentor programs, hiring financial industry practitioners as external mentors to provide students with career planning guidance and practical knowledge. Regularly invite financial industry experts to give lectures on topics including: financial market overview, introduction to major financial institution businesses, career development paths for various positions, job preparation and interview skills, etc. Practical lectures can bridge the gap between classroom teaching and industry practice, helping students establish an overall understanding of the industry.

4.2.3 Conducting Financial Competitions and Project Practice

Organize students to participate in various financial competitions, such as the "CFFEX Cup" National College Student Financial Knowledge Competition, quantitative investment competitions, financial risk management case competitions, etc. Competition experience not only enriches resumes but also tests and enhances abilities in practice. Schools can internally organize simulated trading competitions, using simulated funds to make trading decisions in real market environments, exercising market intuition and trading discipline.

4.3 Construction of a Practical Ability Cultivation System

4.3.1 Building Quantitative Laboratories

Universities should invest in building quantitative finance laboratories, equipped with Bloomberg terminals, Wind terminals, various databases (such as CSMAR, WRDS), and quantitative trading platforms (such as JoinQuant, RiceQuant). Laboratories are open to students, supporting course teaching, project research, and personal practice. In the laboratory, students can access real market data, develop backtesting strategies, simulate trading decisions, and accumulate practical experience.

4.3.2 Developing Case Teaching Resources

Teachers should collect and develop financial practice cases for classroom teaching. Case sources include: publicly published academic papers, industry research reports, regulatory penalty cases (revealing compliance risks), financial risk event analyses (such as the collapse of Long-Term Capital Management, the Credit Suisse crisis). Case analysis helps students understand the application of theory in practice, cultivating problem analysis and solution design abilities.

4.3.3 Integrating Internal and External Practical Resources

Connect with quantitative research projects or risk management consulting projects from financial institutions, with the university organizing teams and completing them under the guidance of supervisors. The project-based learning approach exposes students to real business problems, experiencing the complete process from problem understanding, solution design, to result presentation. Project outcomes can serve as a portfolio of work to demonstrate practical abilities.

4.4 Soft Skills Training and Comprehensive Quality Improvement

4.4.1 Offering Business Communication Courses

Mathematics departments can offer business communication courses specifically tailored for the major, covering: technical report writing (how to explain models to non-professional readers), data analysis presentation (how to visualize effectively), presentation skills (how to conduct roadshows and morning meeting reports), workplace communication (how to interact effectively with traders, salespeople, management). Courses adopt a workshop format, where students complete assignments and receive feedback, improving through practice.

4.4.2 Organizing Case Analysis and Mock Interviews

Regularly organize business case analysis activities. Given a business problem or investment decision (such as whether a certain company is worth investing in, whether a certain M&A deal is reasonable), students analyze in small groups, submit reports, and conduct defenses. Case analysis and defense train business sensitivity and oral expression skills. At the same time, organize mock interviews, inviting financial industry practitioners to act as interviewers, helping students familiarize themselves with the interview process and improve test-taking skills.

4.4.3 Cultivating Team Collaboration Awareness

Increase the weight of group work in daily teaching and project assessment. Set team tasks, with members completing them together, submitting a team outcome, and receiving a unified score. Cultivate students' ability to clarify division of labor, communicate effectively, coordinate resources, resolve disagreements, and deliver collectively. Besides group projects, encourage students to join finance-related clubs, such as investment associations, quantitative clubs, etc., to exercise collaboration skills in club activities.

4.5 Career Planning Guidance and Qualification Certification

4.5.1 Establishing a Tiered Career Guidance System

Provide tiered career guidance for students at different grade levels: lower grades (freshman, sophomore) focus on industry awareness, helping students understand the financial industry landscape; upper grades (junior, senior) focus on job preparation, coaching resume revision, written tests, interviews, and internship applications. One-on-one consultations provide targeted help for students with special needs. Establish an alumni mentor network, inviting alumni working in the financial industry to share experiences, provide career advice, and internal referral opportunities.

4.5.2 Systematically Planning Qualification Certification Exams

Mathematics students should plan for financial qualification certification exams early. Specific suggestions: take basic certificates such as securities qualification and fund qualification in sophomore year; start preparing for the CFA Level I exam in junior year; prepare for FRM in senior year or first year of graduate school. Schools can provide exam preparation resources, organize group study and mock tests, reducing individual preparation costs. Passing qualification certifications both systematically imparts financial knowledge and adds plus points to resumes.

4.5.3 Establishing a Job Search Support Service System

Establish a dedicated financial job search support system for mathematics majors, including: creating a financial industry recruitment information dissemination channel, timely pushing campus recruitment, off-campus recruitment, and internship opportunities; inviting HR and business heads to campus for presentations; organizing written test preparation (mainly for aptitude tests, financial written tests);

building an interview question bank; organizing mock interviews; providing guidance services for resume revision and cover letter writing. A comprehensive job search support system can significantly improve students' job search efficiency and success rate.

5. Conclusion

Mathematics graduates entering the financial industry is an inevitable trend of interdisciplinary integration and a reasonable choice for talent mobility. This paper systematically analyzes the advantages and shortcomings of mathematics graduates in this transition process.

In terms of advantages, mathematics graduates' quantitative analysis ability, mathematical modeling thinking, logical reasoning ability, programming and computing ability, and risk management literacy give them natural competitiveness in positions such as quantitative investment, derivatives pricing, financial engineering, and risk control. These abilities highly align with the deep quantitative trend of the financial industry and are the "moat" of talents with mathematical backgrounds.

In terms of shortcomings, the challenges facing mathematics graduates are equally significant. Issues such as insufficient financial market intuition and industry understanding, lack of practical financial operation experience, weak communication and collaboration skills, lack of business acumen, unclear career positioning, and lack of professional qualifications are evident in the initial stages of job seeking and career development. If these shortcomings are not addressed promptly, they may offset the competitiveness brought by advantages.

In response to the above issues, this paper proposes capability improvement paths from five dimensions: curriculum system optimization (strengthening financial mathematics content), school-enterprise cooperation (strengthening internships and practice), practical ability system construction (building laboratories and case libraries), soft skills training (communication and collaboration cultivation), and career planning and qualification certification (certificate planning and job search guidance). Universities and students need to work together to systematically address the shortcomings.

It should be noted that this paper is mainly based on literature research and theoretical analysis, and the identification of advantages and shortcomings needs further empirical testing. Future research can use questionnaire surveys to collect large-sample data from mathematics graduates and employers to quantitatively assess the importance of various advantages and shortcomings; can conduct longitudinal studies to observe the development trajectory of the same cohort of students from enrollment to several years after employment, exploring key influencing factors; can conduct cross-disciplinary comparisons, systematically comparing mathematics graduates with graduates of finance, economics, management, etc., to reveal the relative advantages and disadvantages of each major.

Overall, mathematics graduates entering the financial industry is a viable and promising path. As long as one recognizes one's own advantages, supplements capability shortcomings, and systematically plans career development, a mathematical background can fully find a suitable position in the financial industry and realize personal value. For universities, actively adapting to market changes and promoting interdisciplinary talent cultivation reform is the only way to improve mathematics graduates' employment quality and student satisfaction.

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