

Reshaping the Investment Risk Management Course Under the Dual Drivers of 'Mathematics + Finance'

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Abstract: With the accelerated globalization and digital transformation of financial markets, risks are becoming more complex and contagious. Traditional investment risk management courses face challenges such as content that is disconnected from the market, an emphasis on theory over practice, and a single evaluation mechanism, making it difficult to meet the industry's demand for interdisciplinary talents. This paper focuses on the dual drivers of "Mathematics + Finance." Through literature analysis and a survey of the current state of the course, it identifies issues such as insufficient coverage of new types of risks, delayed integration of cutting-edge technologies, and weak cultivation of practical abilities. The paper proposes a closed-loop reshaping plan: "Curriculum Outline Revision → Teaching Design Optimization → Evaluation Mechanism Improvement → Continuous Teaching Improvement." The plan strengthens the integration of mathematical tools like mathematical statistics and stochastic processes with financial risk scenarios in the course outline, designs a blended teaching model of "theory lectures + case analysis + experimental teaching + hands-on simulation," and establishes a multi-dimensional evaluation system that combines "formative + summative" and "theory + practice." Furthermore, it relies on feedback from evaluations to dynamically optimize the teaching content. Research shows that this plan can effectively enhance students' mathematical modeling and risk decision-making abilities, promote cross-disciplinary innovation in finance, and provide a feasible reference path for the reform of finance-related courses in universities, contributing to the cultivation of high-quality risk management talents that meet industry demands.

Keywords: Mathematics + Finance; Investment Risk Management; Course Reshaping

1. Introduction

With the accelerated globalization and digital transformation of financial markets, financial risks are exhibiting new characteristics such as complexity, contagion, and uncertainty. Traditional investment risk management courses are increasingly unable to meet the industry's demand for highly qualified talents. On one hand, trends such as the innovation of financial derivatives and the widespread use of algorithmic trading require practitioners to possess solid mathematical modeling skills, enabling them to identify, measure, and control risks through quantitative analysis. On the other hand, existing university courses often face issues such as "emphasis on theory over practice" and "clear disciplinary barriers," which result in graduates needing a considerable amount of time to adapt to job requirements.

The "Mathematics + Finance" dual-driver model deeply integrates the rigor of mathematical tools with the practicality of financial theory, providing a core approach for reshaping investment risk management courses. This model not only bridges the gap between the course content and industry needs but also promotes interdisciplinary innovation in finance, cultivating interdisciplinary risk management talents with both theoretical literacy and practical capabilities. This paper explores the current state of investment risk management courses, the necessity for their reshaping, and specific proposals, aiming to provide a feasible reference path for the reform of financial education in universities.

2. Current State and Core Issues of Investment Risk Management Courses

Although investment risk management courses in universities have established a basic teaching system, they have gradually exposed multiple issues under the background of rapid changes in the financial markets and the deep penetration of technology, making it difficult to match the core talent

needs of the industry.

2.1 Disconnection Between Course Content and Market Demand

2.1.1 Insufficient Coverage of New Types of Risks

The course still centers on traditional risk types such as credit risk and market risk, with a serious lack of theoretical explanations and practical cases on new types of risks, such as cybersecurity risks and algorithmic risks spawned by financial technology, as well as environmental risks in the field of green finance. This results in students having "no applicable knowledge" when faced with real-world scenarios.

2.1.2 Lag in the Integration of Cutting-Edge Technologies

Technologies such as big data, artificial intelligence, and blockchain have become core tools for financial institutions to conduct risk management. However, most courses do not systematically explain the application principles of these technologies in risk identification (e.g., intelligent early warning models) and measurement (e.g., machine learning-based risk control models). Furthermore, there is a lack of hands-on teaching related to these tools, resulting in students having "theory without skills" [1].

2.2 Teaching Mode Emphasizes Theory Over Practice

2.2.1 Weak Cultivation of Quantitative Analysis Abilities

Although the course covers mathematical tools such as the VaR model and Monte Carlo simulations, it mostly stays at the level of formula derivation. It does not guide students to combine real financial data (e.g., stock market volatility data, credit default data) for modeling and analysis, resulting in students struggling to transform mathematical methods into risk decision-making abilities.

2.2.2 Insufficient Proportion of Practical Sessions

Traditional teaching primarily relies on "teacher lectures + classroom questioning," with case analysis mostly being static interpretations. There is a lack of dynamic practical sessions, such as simulated trading and risk disposal exercises. According to a survey, in most universities, the proportion of practical hours for this course is less than 20%, making it difficult for students to deepen their understanding of theory through practice [2].

2.3 Single Evaluation Mechanism

The existing course evaluation mainly relies on final closed-book exams, with the assessment focusing on memorization of risk management theories and simple formula calculations, while neglecting the evaluation of students' data analysis abilities, model-building capabilities, and risk decision-making skills. This "results-focused, process-ignored" evaluation method not only fails to comprehensively reflect students' overall competencies but also struggles to guide students in actively improving their practical skills [3].

3. The Necessity of Reshaping the Course Driven by the "Mathematics + Finance" Dual-Driver Model

The "Mathematics + Finance" dual-driver model is not simply a combination of two disciplines. Instead, it empowers each field through the "quantitative support" of mathematical tools and the "practical orientation" of financial theory. This approach fundamentally addresses the existing issues of the course while meeting the dual demands of theoretical innovation and industry practice.

3.1 The Inevitable Requirement to Enhance Students' Core Competitiveness

The financial industry's demand for risk management professionals has shifted from "mastering theory" to "solving problems." On one hand, mathematical tools (such as mathematical statistics, stochastic processes, and linear algebra) help students quantify risk—for example, by analyzing the correlation of asset portfolios through covariance matrices or predicting the probability of extreme risks through Monte Carlo simulations. On the other hand, financial theory provides scenario support for mathematical modeling, preventing the model from detaching from the actual characteristics of risks.

The combination of these two can cultivate students' core ability to "extract mathematical logic from risk problems and solve financial risks with mathematical models," enabling them to quickly adapt to job demands after graduation ^[4].

3.2 Key Pathways to Ensure the Course Keeps Up with Industry Dynamics

The rapid changes in financial markets require continuous updates to course content. Mathematical tools have the "data-driven" characteristic, allowing students to access real-time financial market data (such as real-time stock prices and exchange rate fluctuations) through programming tools like Python and R, and use mathematical models (e.g., GARCH model) to analyze the latest risk trends. At the same time, the integration of "Mathematics + Finance" can promptly incorporate cutting-edge content from financial technology—for example, constructing credit risk assessment models using machine learning algorithms or designing cross-border payment risk control solutions with blockchain technology—ensuring that the course content aligns with industry developments ^[5].

3.3 An Important Vehicle for Promoting Interdisciplinary Innovation in Finance

The development of traditional finance disciplines is often limited by a single disciplinary perspective. However, mathematics, as a "universal analytical tool," can break down disciplinary barriers and promote the integration of finance with mathematics, computer science, and other fields. For example, applying fractal geometry to study the fluctuation patterns in financial markets or using stochastic analysis for option pricing risk measurement—these interdisciplinary studies not only enrich the financial theory system but also cultivate new research directions for the finance discipline, enhancing its competitiveness ^[6].

4. Reshaping the Investment Risk Management Course Under the "Mathematics + Finance" Dual-Driver Model

Based on the main line of "Curriculum Outline Revision → Teaching Design Optimization → Evaluation Mechanism Improvement → Continuous Teaching Improvement," a course reshaping plan with a "theory → practice → feedback" closed-loop is constructed to achieve the goals of "localizing mathematical tools, contextualizing financial practice scenarios, and systematizing ability development."

4.1 Aligning with "Mathematics + Finance," Revising the Curriculum Outline

With the core concept of combining "quantitative + qualitative," the course content system is restructured into three main sections: "Theory Module + Practice Module + Cutting-Edge Module." The specific design is shown in the table below:

Table 1: Reconstruction of the Course Content System

Module	Core Content	Mathematical Tool Support	Financial Practice Scenarios
Theory Module	Portfolio Risk Management, Credit Risk Measurement, Market Risk Prevention and Control	Mathematical Statistics (Mean, Variance), Stochastic Processes (Brownian Motion), Linear Algebra (Matrix Operations)	Stock Portfolio Risk Optimization, Corporate Credit Default Risk Assessment
Practice Module	Financial Data Analysis, Risk Modeling and Validation, Simulated Risk Disposal	Python/R Programming, SQL Data Query, VaR Model, Monte Carlo Simulation	Portfolio Risk Prediction Based on A-shares Data, P2P Platform Credit Risk Model Construction
Cutting-Edge Module	FinTech and Risk Management, Green Finance Risk, Cross-Border Financial Risk	Machine Learning (Logistic Regression, Decision Trees), Blockchain Technology, Fractal Geometry Evaluation	Intelligent Risk Control Model Design, Green Bond Credit Risk, Cross-Border Payment Exchange Rate Risk Prevention and Control

4.2 Optimizing Teaching Design Based on the Outline

A blended teaching model of "theory lectures + case analysis + experimental teaching + hands-on simulation" is adopted to deeply integrate mathematical tools with financial practice:

4.2.1 Theory Lectures: Focusing on "Principles + Derivations"

The derivation process of mathematical models is demonstrated through multimedia animations (e.g., the calculation logic of the VaR model and the derivation steps of the Black-Scholes option pricing model), combined with financial scenarios to explain the conditions under which the models are applicable. For example, when explaining the GARCH model, the data from the 2008 financial crisis is used to illustrate the model's advantage in capturing "volatility clustering" risks, helping students understand "why this model is used."

4.2.2 Case Analysis: Emphasizing "Problem + Modeling"

Typical financial risk cases are selected (e.g., the Luckin Coffee financial fraud risk, the Silicon Valley Bank liquidity risk) to guide students in completing the full process of "risk identification → data collection → mathematical modeling → solution proposal" in groups. For example, when analyzing the Silicon Valley Bank case, students are required to calculate the bank's risk exposure using the liquidity coverage ratio (LCR) formula and analyze the impact of interest rate fluctuations on the bank's assets and liabilities using a linear regression model.

4.2.3 Experimental Teaching: Strengthening "Tools + Hands-on Practice"

A financial laboratory is established, introducing financial databases such as Wind and Tushare, with practical courses like "Financial Data Analysis Experiment" and "Risk Modeling Experiment." For example, students are tasked with using Python to scrape stock market data, plotting risk volatility curves with Matplotlib, constructing machine learning-based risk control models using the Scikit-learn library, and verifying the model's accuracy.

4.2.4 Hands-on Simulation: Creating "Scenario + Decision-Making"

Collaborating with securities companies and insurance firms to develop a "simulated risk management platform," students take on roles such as "risk analyst" and "investment manager" to formulate risk disposal plans in simulated scenarios (e.g., stock market crash, credit default). For example, when the simulation platform generates a "bond default warning," students are required to calculate the default loss rate using mathematical models and propose asset sell-off or hedging strategies.

4.3 Improving the Evaluation Mechanism Based on Teaching

A multi-dimensional evaluation system is constructed, combining "formative evaluation + summative evaluation" and balancing "theory assessment + practical assessment." The specific weight distribution is shown below:

Table 2: Course Evaluation System

Evaluation Type	Assessment Content	Weight	Assessment Method
Formative Evaluation	Laboratory Reports (Data Modeling and Analysis), Case Analysis Reports (Risk Solutions), Class Participation (Model Discussion and Questions)	50%	Laboratory Report Scoring (based on data accuracy and model rationality), Case Report Defense (based on logical completeness and solution feasibility)
Summative Evaluation	Theoretical Knowledge (Principles of Risk Management, Conditions for the Application of Mathematical Models), Comprehensive Practice (Modeling and Decision-Making for Complex Risk Scenarios)	50%	Final Written Exam (including model calculation questions, case analysis questions), Comprehensive Practical Assessment (completing risk disposal tasks on the simulation platform)

4.4 Continuously Improving Teaching Based on Evaluation Results

First, regularly summarize students' performance in each evaluation stage, identify weak areas, and strictly correspond to the "multi-dimensional evaluation system" outlined in the paper. Distinguish between formative (e.g., lab reports, case analysis) and summative (e.g., written exams, comprehensive practice) data to ensure that the collected content covers both "theoretical understanding + practical ability" objectives. For example, if most students score poorly in the "machine learning-based risk control model" experiment, it indicates that the difficulty of this section may be too high or there is insufficient hands-on guidance, necessitating an analysis of the results.

Next, adjust teaching strategies to address weak areas, focusing on two core issues: first, the "knowledge gaps" of individual students (e.g., difficulty in applying mathematical models); second, the "industry demand gap" in the overall course (e.g., the absence of new risk content). This helps provide targeted directions for optimization. If the difficulty of model teaching is too high, "basic programming training prerequisite courses" can be added. If practical guidance is insufficient, videos showing the steps of model construction can be recorded for students to review after class, allowing for targeted improvements.

Finally, optimization actions closely follow the "course reshaping plan" in the paper, including specific measures in three areas: content (adding cutting-edge modules), methods (strengthening hands-on practice), and resources (upgrading databases). These measures avoid vagueness. Each semester, organize teachers to participate in financial institution research (e.g., visiting the risk control departments of banks or the risk management departments of securities companies), collect the latest industry risk cases and tools, update the course case library and experiment content, and invite industry experts to participate in teaching discussions. This ensures that the course reshaping direction aligns with industry needs. Throughout the semester, dynamic updates should be made, and "the next round of evaluation data comparison" can be used to verify the effectiveness of optimizations (e.g., improved student modeling ability scores). If the expected results are not achieved, the process will re-enter the feedback analysis stage, forming a continuous improvement loop that aligns with the core requirement of "continuous teaching improvement" outlined in the paper.

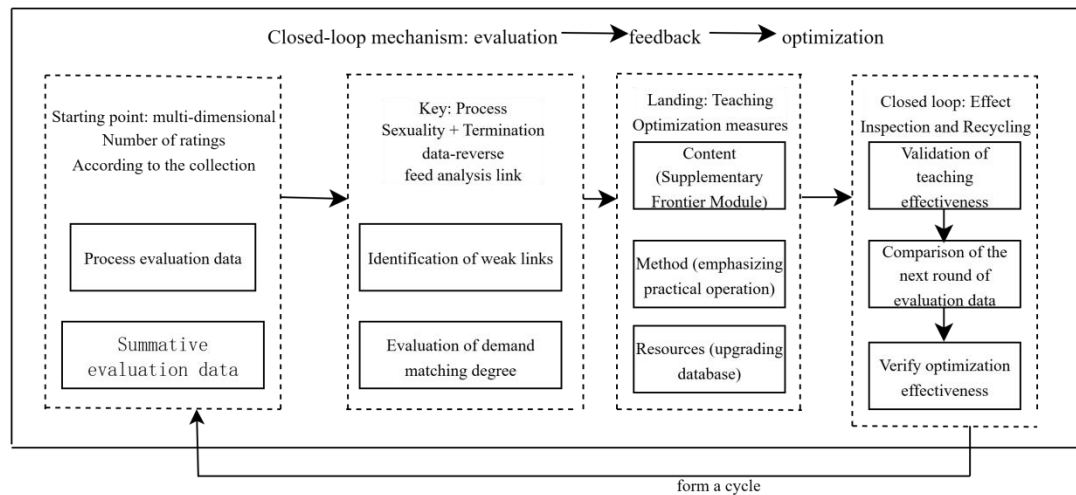


Figure 1: Continuous Improvement of the Teaching Mechanism

5. Conclusion and Outlook

The reshaping of the investment risk management course under the "Mathematics + Finance" dual-driver model, through "content reconstruction, teaching optimization, and evaluation improvement," addresses issues such as the disconnection between traditional courses and industry needs, as well as insufficient practical ability training. It not only supports interdisciplinary innovation in finance but also cultivates interdisciplinary risk management talents with both theoretical literacy and practical capabilities for the industry.

Looking ahead, the course reshaping can be further deepened: on one hand, stronger collaboration with financial technology companies can be established, introducing real-world risk management projects (e.g., optimizing bank credit risk models) to implement practical teaching under "industry-education integration"; on the other hand, the "AI + Teaching" model can be explored, where intelligent teaching systems provide personalized learning plans for students—e.g., offering foundational modeling courses to students with weak mathematical backgrounds or providing complex risk scenario training to students with strong practical abilities. It is believed that through continuous optimization, this course will become a typical example of financial education reform, providing talent support for the high-quality development of the financial industry.

Funded Project

Harbin Normal University Higher Education Teaching Reform Research Project: "Reshaping the Investment Risk Management Course under the 'Mathematics + Finance' Dual-Driver Model," Project Number: XJGY202509

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