Practical Research on Mathematical Forecasting Financial Model

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Abstract: With the gradual development of finance, experts and scholars in the process of in-depth study of finance know that rigorous theoretical analysis and computational analysis methods are needed to carry out relevant empirical tests on experiments. In the process of empirical testing, we need to rely on mathematical models to analyze relevant data. Financial mathematical model originated from Louis Bachelier's speculation theory in 1900. The emergence of this theory marks the birth of continuous-time stochastic process and continuous-time option pricing theory. In recent years, with the vigorous development of probability theory and mathematical statistics, differential equation theory, stability theory, complex system theory and other related knowledge theories, the financial mathematical model has shown unprecedented scientificity and gained more and more attention. Mathematical and mathematical statistics as the basic analytical tools have become an important part of the financial research process. By discussing the influence of mathematical models in the financial process on the time process, and analyzing the actual impact of the mathematical model, it promotes the development of finance.

1. Introduction

In the late 1980s, with the further improvement and development of the financial market, it was found that all the financial models studied previously assumed that investors could obtain complete market information[1]. In fact, investors can only observe the price process itself of the state of the carved picture system. Because Brownian motion and the drift coefficient of dynamic assets are unobservable, investors can only obtain part of the market information[2]. Therefore, the research on investment and consumption based on incomplete information has become a hot topic in today's research[3]. In view of the urgency and harmfulness of financial investment risks, people have realized more and more deeply that mathematics has become a key technology that can be seen everywhere in financial theory research[4]. It has brought great vitality to the research of financial theory, while the development of financial theory also provides an important platform for the application of mathematical knowledge and skills[5]. Combining mathematical analysis with economic problems, we can forecast and evaluate investment risks in a forward-looking way, strengthen analysis and minimize risks.

The core issue of financial theory is the value and risk of financial assets in an uncertain environment[6]. The focus of the research is on the economic actors' ability to allocate and utilize their resources in practice and space[7]. Time and uncertainty are central elements that hinder financial development during the research process. Because time, uncertainty, and their interactions make financial behavior extremely complex, dealing with this complexity requires the introduction of mathematical tools. At the same time, rigorous theoretical analysis and computational analysis methods are needed to conduct empirical tests on experiments[8]. Such as uncertainty requires the introduction of probability, statistics and stochastic process theory. For example, allocating resources in time and space requires an optimization model. From a scientific point of view, mathematical models are used to express the integrity of the financial market[9]. Use mathematical model optimization techniques to calculate and choose the right solution. Through computer simulation to find satisfactory results, the financial market economy can achieve a reasonable and sTable state under the use of mathematical tools[10].

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2. The Theoretical Concept and Development of Financial Mathematics

2.1. The Concept of Financial Mathematics

With the development of the financial system itself, modern financial theory has become an independent discipline different from the past and has begun to include many disciplines into this system. In the late 20th century, more appropriate mathematical methods began to be applied to the solution of financial problems. Financial problems also put forward valuable research directions to mathematics in the practical environment. Such a driving force has promoted the integration of finance and mathematics. From a broad perspective, financial mathematics refers to a new discipline that applies mathematical theories and methods to study the laws of financial and economic operation. In the narrow sense, it mainly acts on the portfolio selection and asset pricing theory under uncertain conditions. From the perspective of applied features and methods, financial mathematics deals with issues such as revenue and risk control in the financial environment through methods such as stochastic control, analysis, differentiation, planning, statistics, nonlinear and linear analysis, and is used to deal with Under the circumstance of imbalanced financial market, the comprehensive management of financial risks is realized.

2.2. Development Trend of Financial Mathematics Theory

For the development of financial mathematics, the more people apply to the prediction of the national economy, the more problems will arise. The establishment of financial mathematical models requires assumptions, so the scope of application is relatively small, which requires improvement in mathematics. It is necessary to establish a financial mathematical model in line with national conditions in order to make up for the ever-changing society. To develop economy, financial mathematics must be improved, because economic development cannot be separated from the knowledge research support of financial mathematics theory. The current development of financial mathematics has a tendency to move from a simple concept to a multiple concept, from a simple model to a multiple model. Financial mathematics should not be able to establish a single model and concept unilaterally. There should be multiple concepts and multiple schemes. Since the economic market is not completely positive, there will be some volatility in financial mathematics. Therefore, it is very important to attach importance to the power of financial mathematics and use financial mathematics data to predict the future development of the economic market.

3. The Theoretical Framework of Financial Mathematics

3.1. Control Optimum Theory

In the application process of modern financial theory, it has become an important application orientation to use mathematical knowledge to solve some random problems in finance. The most effective method to solve some financial problems by applying mathematical theory is stochastic optimal control theory. The original meaning of stochastic optimal control theory refers to a theory that arose only when the control theory system developed to a certain period. It explores, analyzes and solves random problems through Berman's optimization principle, and then combines it with measure theory and extensive function analysis method. The theory of optimal control was formed at the end of the 1960s, gradually matured in the early 1970s, and there have been many economic papers and journals such as “Using Continuous Time Method to Discuss Consumption and Asset Portfolio.” In the late 1970s, stochastic optimal control methods were fully utilized in most areas of the financial industry. In the course of the research, the young and middle-aged researchers led by Peng Shige and others in China have played a huge role in this analysis.

3.2. Financial optimization

The bank is a financial system, aiming at the optimal overall goal of the system, i.e. optimal plan, optimal control, optimal management, optimal design, optimal operation, etc. In order to achieve the above goals, the system engineering must adopt the best and most refined technology, which is a new branch of mathematics. Its main content is how to express the optimization problem with a

specific mathematical model, and how to get the optimal solution quickly and accurately according to the model. In the research process, the commonly used optimization methods mainly include fraction method, direct experiment method, average operation method, differential calculus method, linear function programming method, etc. Application of optimization techniques can formulate financial strategy, policies and system planning plans for central banks and commercial banks. The optimal value of the deposits in the bank over a period of time can be determined. Allowing banks to keep the cost of fundraising to a minimum when interest rates remain the same. Under the condition that the credit scale is certain, the bank will get the maximum profit to determine the optimal investment plan.

4. Application of Mathematics in Finance

4.1. Application of Mathematics in Financial Investment and Income

Any deviation from the expected actual income can be regarded as a financial risk and will definitely have a further impact on development. Therefore, risk plays an important role in the whole process of finance. Uncertainty mathematics and certainty mathematics are usually used to measure financial risks. From the meaning of financial investment risk, we can see that the cause of risk is the existence of uncertain factors. Therefore, in order to accurately describe these factors and their interrelations, it is not enough to study them only by deterministic mathematical methods, and some methods are needed. In such cases, uncertain mathematical theory is responsible for the random amount of Abstraction of possible losses or gains during the investment, measured by methodological differences, mathematical expectations, and standard deviations. And further use the relationship to express mathematical formulas, functions, models. The ultimate realization of risk control and coordination of the trading market environment has played an important role in the research of financial investment risks.

The portfolio model mainly studies how to reasonably allocate resources among several uncertain future competition factors. How to minimize the risk under the given investment income. Or how to maximize returns under the established investment risk conditions. The mathematical model of uncertainty is reflected in the modern portfolio theory, as shown in the following type (1).

$$f(x) = \operatorname{sgn}\left(\sum_{i=1}^{l} a_i^* y_i K(x_i, x) + b^* \right) \tag{1}$$

Where a_i represents the weight in the portfolio, y_i represents the expected return, x represents the standard deviation, and b represents the correlation coefficient.

4.2. Application of Mathematics in Financial Forecast and Decision

There are many uncertain and unsafe factors in the process of financial transactions. How to better predict the future inflation rate, deposit balance and insurance premium rate is closely related to the decision makers' ability to make correct judgments and has positive value that cannot be ignored for decision optimization. For this aspect, the least square two, modified index, cubic index, two-step prediction, curve prediction and other methods are usually used to carry out prediction, and such methods as marginal analysis, indifference curve, planning decision, extreme optimization, minimum cost and so on are used to realize decision support. In the modern financial theory system, another important application of mathematics in the financial field is the use of differential game methods to analyze and study option pricing and investment decisions. In the process of analyzing the problems in the financial field by using the differential countermeasure method, only one Bellman equation is needed to get an answer. Therefore, the differential countermeasure method will have broad development prospects in the financial field research.

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5. Financial Forecasting Model Based on Mathematics

5.1. The Concept of Financial Forecasting

Financial prediction refers to the prediction of future market behavior by using data mining methods on a large number of historical data of financial markets. Financial forecasting has broad application value and market prospect, thus attracting many researchers to invest in it. Time series analysis method is an important method of financial forecasting, which belongs to the technical analysis level. The forecast and analysis target is various financial securities indexes and financial product prices in the financial market, such as various stock indexes, interest rates, exchange rates, etc.A useful financial forecasting model should be able to give the future direction of the financial market and should be able to make short-term continuous forecasts for a certain period of time. Therefore, financial forecasts differ from time series predictions in other fields. It is possible to make only one-step predictions. There are quite a few studies on financial projections that involve single-step predictions that have no reference value to investors. At the same time, as a technical level analysis tool, the time series model can only achieve short-term prediction, which is the limitation of all technical analysis methods.

5.2. Selection of Mathematical Forecasting Financial Model

Mathematical modeling is the most important process in the financial forecasting process, and the selection and optimization of forecasting models is the most critical link in the design and development of forecasting systems. Traditional prediction models include autoregressive model, moving average model or autoregressive moving average model, and parameter estimation generally adopts least mean square estimation. Financial market is a complex adaptive system, and the future is full of uncertainties. It is especially important to study the future development of financial market through financial forecast. Using mathematical models can help us rationally predict future economic and financial developments, and bring us closer to the realities of the market. Regression analysis is a type that is often used. Regression analysis is to study the dependence between uncertain variables, use mathematical models to establish regression equations, and then obtain regression equations based on empirical formulas of least squares. The regression equation is used for prediction and the prediction data is derived. The basic form of the linear regression model is shown in type (3).

$$E(Y_i) = b_0 + b_1 b X_i \tag{3}$$

Where b_0 and b_1 are parameters with fixed positions and are called regression coefficients. In regression analysis, we should estimate the unknown b_0 and b_1 values according to the observed values of Y and X, and then establish a regression model.

6. Conclusion

With the development and perfection of the contemporary financial theory system, the changes of modern financial theory are becoming more and more complicated, and the application of mathematical methods is the most important. In recent years, great progress has been made in the application of mathematical methods in the financial field. Financial mathematics is a theory that has experienced two Wall Street revolutions and has become an independent and cross-cutting

theory with research value and practical value. This is a very important theoretical plan for all countries. It is not only related to the development of the country and the happy life of the people of all countries, but also plays a very big role in predicting the development of the country's economic market. In which aspect of the economic market is going to develop, the next step is to invest in testing, which is a matter of national importance. In the actual analysis work, the value of mathematics has been unquestioned and widely recognized. With the continuous development of financial markets and the emergence of new financial instruments, financial mathematical models will inevitably receive extensive attention and application, providing a solid basis for financial control.

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