Quantitative financial techniques in the personal investment sector

Xinrui Wu[1,*], Linlin Li[2], Yaya Huang[3], Shiying Deng[4], Shuyu Liu[5]

[1]School of Economics, Wuhan University of Technology, Wuhan, China

[2]School of Economics and Management, Tianjin University of Science and Technology, Tianjin, China

[3]College of Humanities, Hangzhou Normal University, Hangzhou, China

[4]Southeast University, Nanjing, China

[5]Jilin University of Finance and Economics, Changchun, China

*Corresponding author: 1372626528@qq.com

Abstract. Quantitative finance techniques are techniques for analysing, modelling and trading financial market data using mathematical, statistical and computer-based tools. In the field of personal investment, quantitative finance techniques are widely used, including quantitative investment, quantitative risk management and quantitative asset pricing. This paper will introduce the background, basic concepts, principles and methods of quantitative finance techniques, and illustrate their advantages and challenges in the field of personal investment with concrete examples.

Keywords: quantitative fintech, personal investing, quantitative investing, quantitative risk management, quantitative asset pricing.

1. Introduction

The origins of quantitative finance techniques can be traced back to the early 19th century, when Scottish botanist Robert Brown observed the movement of particles within pollen on a pond. In the late 19th century, the French stockbroker Jules Augustin Frédéric Regnault used the concept of 'random wandering'. In the late 19th century, the French stockbroker Jules Augustin Frédéric Regnault used the concept of 'random walk' to explore the modern theory of stock price movements[1].

In the early 20th century, the French mathematician Louis Bachelier set an important milestone in the world of derivatives with the publication of his doctoral thesis, The Theory of Speculation, in which he modelled the stochastic process now known as Brownian motion and used it to evaluate stock options. After the mid-20th century, ec onomists laid the foundations of financial market theory, including Friedrich Hayek's work on efficient markets, Harry Markowitz's modern portfolio theory, and Eugene Fama's efficient market hypothesis, Myron Scholes and Robert Merton proposed the Black-Scholes equation, and quantitative methods and advanced calculations were widely used in derivatives markets. since the 21st century, quantitative financial techniques have been widely used in various markets, including equities, bonds, structured products, derivatives, commodities, venture capital and private equity[2]. Advances in technology and the development of machine learning have driven the evolution of quantitative finance, with electronic trading platforms supporting the expansion of global equity, bond and credit markets. Niche markets such as cryptocurrencies and ESG investments are attracting quantitative talent, and the development of new tools, products and services is providing more opportunities for quantitative analysts.

2. Basic concepts and principles of quantitative financial techniques

2.1. Definition of quantitative finance techniques

Quantitative finance techniques are techniques that use mathematical, statistical and computer-based tools to analyse, model and trade data from the financial markets. Through the study and

analysis of historical data, quantitative finance techniques can identify patterns that exist in financial markets and develop investment strategies and trading strategies based on these patterns and patterns.

2.2. Principles of quantitative finance techniques

The principles of quantitative finance technology mainly include data acquisition, data processing, modelling and trade execution. First, individual investors need access to reliable, complete, timely and low-cost financial market data, including prices, volumes, and financial indicators of various financial instruments such as stocks, bonds and options. This data is then cleaned, processed and stored to extract useful information and signals. Next, individual investors can use statistical and mathematical models to build quantitative models to analyse and forecast the financial markets. Finally, based on the models built, individual investors can develop trading strategies and execute trades automatically through computer programmes.

3. Application of quantitative financial techniques in the field of personal investment

3.1. Quantitative investments

Quantitative investing is a widely used strategy in the field of personal investing. Individual investors can use historical data and quantitative models to develop investment strategies based on mathematical and statistical analysis. These strategies can be based on multiple factors, such as financial indicators, market factors, technical indicators, etc., to predict market movements and the performance of assets.

Through quantitative investing, individual investors are able to use the high-speed computing and big data processing capabilities of computers to analyse vast amounts of market data and extract effective signals and patterns from it. This automated analysis process helps individual investors to identify opportunities and trends in the market, optimise their portfolios and develop trading strategies[3].

The advantage of quantitative investing is that it eliminates the influence of emotion and bias on investment decisions. Human investors are often distracted by emotional and psychological factors, leading to impulsive trading or overtrading. Quantitative investing, on the other hand, avoids these problems through data and model-based decision making, improving investment efficiency and returns.

3.2. Quantifying risk management

Quantitative risk management is a vital part of the individual investment universe. Individual investors can use mathematical models and statistical methods to measure, assess and control the various risks present in their portfolios.

Quantitative risk management involves the management of market risk, credit risk, liquidity risk and operational risk. Of these, the most commonly used and important is market risk management, which is the assessment and control of the potential for losses arising from fluctuations in the price of financial assets[4].

Individual investors can use methods such as sensitivity analysis, variance-covariance, historical simulation and Monte Carlo simulation to quantify and manage market risk. These methods can help individual investors determine the exposure risk of a portfolio, assess the correlation between different portfolios and develop appropriate risk control strategies.

Through quantitative risk management, individual investors are able to better understand their risk appetite and set reasonable investment objectives and risk budgets. Individual investors can choose appropriate risk management methods and tools based on their own risk appetite and target returns to ensure that their portfolios operate within an acceptable risk range.

3.3. Quantitative asset pricing

Quantitative asset pricing is one of the key techniques used in the field of personal investment. Individual investors can use mathematical models and statistical methods to estimate or forecast the price or rate of return of financial assets.

The objective of quantitative asset pricing is to find the intrinsic linkages and patterns among financial assets, so as to identify pricing biases or anomalies in the market and provide a basis for investment decisions. Individual investors can use different pricing models, such as the binomial tree model, the Black-Scholes-Merton model and the Monte Carlo simulation method, to price and value different types of financial assets.

Through quantitative asset pricing, individual investors can obtain forecasts and estimates of the prices or yields of financial assets. The results of these forecasts can help individual investors to identify arbitrage opportunities or investment opportunities that exist in the market and to develop investment strategies accordingly.

4. Advantages and challenges of quantitative financial techniques in the field of personal investment

4.1. Advantages

Quantitative finance technology has many advantages in the field of personal investment. Firstly, it uses the high speed computing and big data processing power of computers to be able to extract valid signals from the vast amount of information available and construct optimised portfolios based on these signals. By automating, systematising and standardising the trading process, individual investors can increase the efficiency and profitability of their investments. Compared to traditional manual trading methods, quantitative finance technology enables faster access, analysis and execution of trades, reducing the interference of human emotions and biases in investment decisions. Secondly, quantitative financial technology uses mathematical models and statistical methods to measure, assess and control various risks in financial markets. Individual investors can use quantitative risk management tools and techniques to understand their risk exposure and risk tolerance, and take appropriate risk hedging or diversification measures to improve the safety and stability of their investments[5]. In addition, quantitative finance techniques can be applied to quantify asset pricing, which is the use of mathematical models and statistical methods to estimate or forecast the price or rate of return of financial assets. By identifying pricing deviations or anomalies in the market, individual investors can gain access to investment opportunities and arbitrage opportunities, thereby enhancing their investment returns.

4.2. Challenges

While quantitative finance techniques offer a wide range of advantages in the personal investment arena, they also face a number of challenges. Firstly, individual investors need to have a degree of programming skills, a foundation in financial literacy, mathematical skills and a basic understanding of the English language. These skills and knowledge are necessary to understand and apply quantitative financial technology, and individual investors need to continue to learn and improve their professionalism.

Secondly, data is the foundation of quantitative finance technology and individual investors need access to reliable, complete, timely and low-cost data resources, as well as effective data cleaning, processing and storage. Accurate and reliable data is critical to the construction and analysis of quantitative models. In addition, individual investors need to build and maintain complex mathematical models to analyse and forecast financial markets. This requires individual investors to have the ability to understand and apply different pricing models and analytical methods. Finally, quantitative finance technology is constantly developing and evolving, and individual investors need

to be constantly educated and updated on the latest quantitative finance technology developments to keep up with market changes and innovations.

5. Conclusion

The application of quantitative financial techniques in the personal investment sector can help individual investors to develop effective investment strategies and risk management strategies to improve the efficiency and profitability of their investments. However, individual investors need to overcome a number of challenges when applying quantitative financial technology and to continuously learn and update their knowledge. As technology continues to develop, the application of quantitative financial technology in the personal investment sector will become more widespread and sophisticated. Individual investors should actively explore and apply quantitative financial technology to enhance their investment capabilities and competitiveness.

References

[1] Wang Zhanfeng, Wu Yaohua, Zhao Lincheng. Selection and estimation of a LASSO-type variable in a censored regression model [J]. Applied Probability Statistics,2010,26(1): 66-80.

[2] Wang De-Jin, Duan Ji-Hua. Information analysis of the relationship between stock price and trading volume [J]. Statistics and Information Forum,2003,18(3): 39-42.

[3] Chen Xiaohong, Peng Wanlu, Tian Meiyu. Research on stock price and volume prediction based on investor sentiment [J]. System Science and Mathematics,2016,36(12): 2294-2306.

[4] Wang Zunle. Markov chain analysis and prediction of stock volume [J]. Career Circle, 2007(13): 13-14.

[5] Wang Na, He Yiyue, Zhang Shan. Modeling intraday stock trading distribution prediction based on LSTM neural network [J]. Fortune Life, 2020,18: 9-11.