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Research on Comprehensive Experimental Design of Financial Engineering Specialty

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***Abstract*—As a post-course of financial engineering, comprehensive experiment of financial engineering plays an important role in enriching students' professional knowledge of financial engineering. Considering this point, this research studies the comprehensive experimental design of financial engineering from the following aspects: the principles of comprehensive experimental design of financial engineering, the general steps of comprehensive experimental design, and a specific experimental design of correlation measurement based on Copula function. The main purpose of this research is to further consolidate the professional skills of students majoring in financial engineering by means of experimental design, and provide a useful reference for optimizing the experimental teaching system of financial engineering major.**

Keywords—Financial engineering; Experimental design; Engineering thinking; Programming design

I. INTRODUCTION

In recent years, the competition between financial institutions is more intense. In this context, the differentiations of financial products and risk management have become new profit growth points of financial institutions. Accordingly, financial institutions are increasingly demanding talents with solid and excellent financial engineering expertise. At the same time, with the continuous development of Internet finance, financial institutions have further increased their demands for talents in financial engineering with risk management as one of its core tasks [1]. Many colleges and universities have set up financial engineering majors, training a batch of financial engineering graduates. In some colleges and universities, the comprehensive experiment of financial engineering as a post-course of financial engineering plays an important role in enriching students' knowledge of financial engineering. There is no doubt that the students' ability to analyze and abstract the actual financial problems, the ability to model the actual financial problems, and the ability to develop the corresponding procedures for modeling should be the skills of the students majoring in financial engineering. The comprehensive experiment of financial engineering is very necessary for the cultivation of the aforementioned abilities. Through comprehensive experiments of financial engineering, students can be promoted to understand financial engineering better. At the same time, it is also beneficial to the improvement of students' mathematical logic and practical ability. Moreover, the comprehensive experiment of financial engineering is also important to distinguish it from other experimental courses of economics and management. However, from the present comprehensive experimental setting of financial engineering, it cannot highlight the characteristics of financial engineering, and the effect is not good. Wang Xuxia (2014) pointed out that as far as most colleges and universities are concerned, the following problems still exist in the experimental teaching of financial engineering: lack of complete experimental curriculum system, incomplete configuration of software and hardware, and lack of qualified professional teachers [2]. Hong Tiesong and Xi Huan (2015) discussed the content design of financial engineering experiment course for undergraduates based on the perspective of cultivating compound, innovative and applied financial undergraduates. They explored the experimental design of financial engineering to enable the undergraduate students majoring in finance engineering to have both the theoretical basis of financial engineering and the application ability of computer modeling. They pointed out that the present curriculum content is too theoretical, lacking systematic experimental teaching and learning. The computer application ability of the students is not systematically cultivated, and the practical ability is poor [3]. Xing Yu (2016) pointed out that in the training process of financial engineering major in colleges and universities, most of them still stay on the level of training theory and knowledge, but neglect the experimental teaching that cultivates students' practical ability. Song Lingfeng, du Jia and Zhang Yifan (2016) studied the training mode of computer ability of financial engineering specialty in colleges and

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universities, and pointed out that the characteristics of financial engineering training are the combination and cross-cultivation of finance, mathematics and computer. In teaching practice, the two dimensions of finance and mathematics are well integrated, but the dimension of computer ability cultivation is neglected. In the process of computer ability training, there are the following shortcomings: unclear objectives and positioning, lack of continuous and systematic curriculum system, lags of teaching resources and case constructions, single educational mothed [5]. Liu Sheng-nan, Guo Wenjing and Wang Hui (2017) studied the construction of experimental courses in the major of financial engineering, and pointed out that in the current experimental courses of financial engineering, the data analysis ability and the operation ability of programming software have not been systematically cultivated. At present, for the experimental courses for undergraduates majoring in financial engineering, the use of data processing software is seldom introduced, such as Excel, Eviews and Stata. Students majoring in financial engineering rarely have access to Matlab, R language, Pathon and other programming software [6]. Considering the above problems, the comprehensive experiment of financial engineering should reflect the cross-integration of disciplines. There is no doubt that it is very important for the cultivation of innovative people. This study focuses on the comprehensive experimental design of financial engineering specialty and takes the correlation measure based on Copula function as an experimental design case. The main purpose of this research is to further consolidate and enhance the professional skills of students majoring in financial engineering by means of experimental design, and provide a useful reference for optimizing the experimental teaching system of financial engineering major.

II. THE PRINCIPLES OF COMPREHENSIVE EXPERIMENTAL DESIGN OF FINANCIAL ENGINEERING SPECIALTY

A. *Basic principles of comprehensive experimental design of financial engineering specialty*

1) The principle of fitting in with training scheme: The training scheme of financial engineering specialty is a programmatic document for cultivating financial engineering professionals. Whether the training scheme of financial engineering can be implemented effectively relates to the realization of the training goal of financial engineering major and the training quality of financial engineering graduates. There is no doubt that the training scheme of financial engineering specialty is also a programmatic and guiding document for the construction of the course of comprehensive experimental design for financial engineering specialty. The comprehensive experimental design of financial engineering specialty must fit in with the training scheme and serve the training scheme, which is conducive to the realization of the training goal of financial engineering specialty.

2) The principle of course interactions within course system: The setting of the course system is a complete system of internal courses supporting each other. For the comprehensive experiment of financial engineering, it is necessary to set up the mathematics courses and computer courses in addition to the common courses of economics and management. For example, mathematics analysis, probability theory and mathematical statistics, linear algebra, partial differential equation and so on can be offered in mathematical courses and computer courses such as C programming design, Matlab programming, financial modeling and simulation analysis can be set up. From the corresponding pre-curriculum settings, we can also find that financial engineering majors have higher requirements on mathematical basis, computer program design and modeling capabilities.

3) The dynamic principle: The contents of comprehensive experiment of financial engineering are not fixed, but dynamic and open. First of all, the economic situation is constantly developing and changing, and there are different new economic phenomena and problems in different periods. This means that the comprehensive experimental contents of financial engineering specialty must be constantly adjusted. In addition, new research methods, research techniques and tools in various fields are evolving constantly. This also determines that the comprehensive experimental design of financial engineering should be constantly adjusted. Furthermore, in recent years, with the continuous development of financial markets in China, more and more derivatives appear and more financial engineering cases appear. For example, China Construction Bank has issued asset-backed securities. On July 19, 2011, the first batch of small-loan income rights products began to be sold in ChongQing Financial Assets Exchange [7]. This undoubtedly creates new financing channels for small loan companies, and at the same time opened up the era of financial innovation for small loan companies. In addition, all kinds of standardized derivatives in China timely launch. For example, there are CSI 300 stock index futures, CSI 500 stock index futures, SSE 50 stock index futures and treasury bond futures in China Financial Futures Exchange, SSE 50 ETF options in Shanghai stock exchange, various metal futures contracts in Shanghai Futures Exchange and the derivatives in Zhengzhou Commodity Exchange. This also determines that the comprehensive experimental design of financial engineering should be dynamic and open, and keep pace with the times.

4) The principle of advocating academic integrity: Honesty is the fine tradition. Students majoring in financial engineering should conscientiously comprehend the essence and connotation of honesty and credit, and correctly understand the significance of academic integrity. The importance of academic integrity is self-evident. In the comprehensive experimental design of financial engineering, students' academic integrity should be actively cultivated. During the teaching of the comprehensive experiment of financial engineering, the teacher should tell the students that the experimental results should be real and not be tampered with. It is not necessary to pursue the perfection of experimental results. In contrast, much attention should be paid to the explanation of experimental results.

5) The principle of serving the needs of economic development: The design of comprehensive experiment of

financial engineering needs to adapt to the economic development of one country and serve the economic development. In the process of economic development, many new problems and new phenomena will emerge. All of these can be used as design materials for comprehensive experiment of financial engineering specialty. If the comprehensive experimental design of financial engineering is separated from the needs of economic development, the course is empty and meaningless. The comprehensive experimental design of financial engineering specialty based on the current hot economic problems can not only attract the interest of the students of financial engineering, but also provide some theoretical and model reference for the economic development. It is of great significance.

6) The principle of serving students' development: Any curriculum system should be put into practice and serve the future development of students. The same is true for the comprehensive experimental design of financial engineering. The comprehensive experimental design of financial engineering should take into account the factor of students' development. Considering that the learning situation of each student is different, and the future development objectives are not the same, in the design of comprehensive experiment of financial engineering majors, the students' learning abilities should be taken into account. The students should be taught according to their needs. For example, some students can be encouraged to publish what they have learned in the form of papers so as to cultivate their academic enthusiasm. For those students who are in urgent need of jobs after graduation, their relevant professional knowledge should be consolidated through relevant comprehensive experimental design of financial engineering. At the same time, in order to make the comprehensive experimental design of financial engineering specialty fit the current economic development of one country, the course group members should actively go deep into enterprises to understand the requirements of the employers for the necessary skills of the financial engineering talents, and adjust the curriculum content in time. The comprehensive experimental design of financial engineering is open and dynamic. The comprehensive experimental design should be optimized in teaching practice to serve the needs of students' future development.

B. The special principles of comprehensive experimental design of financial engineering specialty

1) The principle of focusing on the main tasks of financial engineering: The design, pricing and risk management of financial products are the main contents of financial engineering [1]. It is necessary for students majoring in financial engineering to have a full understanding of this main task and to reserve the corresponding professional skills. The comprehensive experimental design of financial engineering should be centered around and serve the main tasks of financial engineering. Considering the main tasks of financial engineering, the experimental design of financial engineering can be carried out according to the main contents of financial engineering, such as the design experiment of financial products, the pricing experiment of financial products and the experiment of financial risk management. In this way, the characteristics of the major can be highlighted. Moreover, such settings enable students to understand the main tasks of financial engineering better in the course study of comprehensive experiment of financial engineering specialty, and consequently to reserve corresponding knowledge to enhance their professional skills. It is obvious that the comprehensive experimental design of financial engineering specialty is helpful for the students to improve their knowledge of financial engineering in a better and systematic way.

2) The principle of emphasizing engineering thinking: Financial engineering is an interdisciplinary subject that integrates finance, information technology and engineering methods. One of its important characteristics is that the students majoring in financial engineering should have solid mathematical foundation, good programming and modeling abilities, and certain engineering thinking. As a new interdisciplinary subject, financial engineering has mathematical characteristics, computer advantages and engineering thinking, which should be reflected in the comprehensive experimental design of financial engineering specialty. Comprehensive experimental design of financial engineering should be able to fully train students' mathematical logic ability, fully mobilize the enthusiasm of students in computer programming and modeling.

3) The principle of programming-oriented experimental design: Programming has always been a weakness for economics and management students. With the continuous innovation of financial derivatives, the ability of program design based on actual financial engineering problems will become an important factor for enterprises to select talents. At the same time, it is also a necessary professional skill for senior financial engineering professionals. Derivatives design, financial risk management, quantitative investment and so on put forward higher requirements for program designs. Programming-oriented comprehensive experimental design of financial engineering is conducive to the improvement of professional skills of students majoring in financial engineering, and also lays the foundation for further study at a higher stage.

III. General steps for Comprehensive Experimental Design of Financial Engineering Specialty

A. Introduction of research background and determination of research problems and purpose

The comprehensive experiment of financial engineering is composed of several experiments. Every financial engineering experiment should have its own research background. At the beginning of each financial engineering experiment, it is necessary to introduce the research background, refine the research questions and define the purpose of the research to make the students understand the necessity and purpose of the experiment. By means of this way, it can make students clearly

feel the ability of solving practical financial engineering problems with the knowledge they learnt. The introduction of research background of financial engineering experiment is also a process for students of financial engineering specialty to gradually understand the corresponding experiment. This step is related to the following steps.

B. *Analysis of relevant literature and understanding of relevant theories and models*

Through the introduction of the research background and the extraction of the research problems, the corresponding theory and model should be selected to solve the research problems. Therefore, it is very important to read and analyze classical literature. By reading and analyzing the relevant literature, it makes students majoring in financial engineering have a clear idea that what theory and model should be adopted to solve the practical problems. Moreover, by reading and analyzing relevant documents, the students can have a correct understanding and grasp of the relevant theories and models, which is conducive to the realization of the subsequent experimental steps.

C. *Modeling*

By reading and analyzing the relevant literature, the corresponding theories and models can be understood. The next step is to determine the corresponding model based on the specific experiment and consider the program implementation of key parts. This step is a difficult step. Students can be divided into groups and discuss in groups.

D. *Specific implementation*

Different comprehensive experiments of financial engineering major have different experimental steps. Before the beginning of the experiment, the specific experimental steps of the corresponding experiment should be clarified, and the experiments should be carried out step by step. In each step of the experiment, the experimental results should be well preserved, and the experimental data should not be tampered with. The experimental data and results should be reproducible.

E. *Analyze the results of the experiment and write the report of the experiment*

The experimental results should be explained accordingly in this step. For the experimental results with obvious deviation from the theoretical and reasonable results, the reasons should be analyzed, and there is no need to tamper with the experimental data and results. Due to that different students choose different research objects and use different experimental data, the experimental results of each group of students may be different. In addition, the experimental report should be written in accordance with academic norms.

IV. A SPECIFIC CASE: THE EXPERIMENTAL DESIGN OF CORRELATION MEASUREMENT OF CSI 300 INDEX BASED ON COPULA FUNCTION

Considering the principle of comprehensive experiment design of financial engineering specialty in the second part and the general steps of comprehensive experiment design in the third part, this part explores the design of comprehensive experiment of financial engineering specialty based on correlation measurement of CSI 300 index by using Copula function. The experimental design can be expanded from the following five parts: research background of the experiment, understanding of relevant theories and models by analyzing relevant literature on correlation measurement based on the Copula function, the model construction of the experiment, the specific implementation of the experiment, the analysis of the experimental results and the writing of the experimental report.

A. *Research background of the experiment on correlation measurement of CSI 300 index based on Copula function*

The CSI 300 index plays an important role in China's capital market, and its change is an important reference for investors and hedgers in their decision-making. Under the background of financial deepening and liberalization, financial innovation is a new profit growth point for financial institutions, and the CSI 300 index has become the underlying or reference benchmark for more financial derivatives. Reducing the correlation between CSI 300 index and its weighted stocks and improving the ability of anti-manipulation of CSI 300 index have gradually been put on the agenda by the majority of researchers. This experiment studies the correlation between CSI 300 Index and its weighted shares, and has important theoretical and practical significance.

In addition, the use of Copula function instead of simple linear correlation function in the research process is because that when using Copula function to research the relationship between two financial variables, there is no need to make specific assumptions about the distributions of data series. Moreover, Copula function has good description ability for the non-linear correlation of financial time series. Through the experiment on correlation measurement of CSI 300 index based on Copula function, the anti- manipulation ability of CSI 300 index can be understood, and the corresponding suggestions should also be put forward.

B. *Understanding relevant theories and models by analyzing of relevant literature on correlation measurement based on Copula function*

There is lots of research on the correlation measurement based on Copula function, each of which introduces the related theories and models. Therefore, the relevant theories and models are not repeated here, but some references are given, as shown in TABLE I. The titles of some relevant references are listed in TABLE I.

TABLE I. REFERENCES ON CORRELATION MEASUREMENT BASED ON COPULA FUNCTION

Research on structural correlation of HS 300 stock index based on AR (n)-XARCH-Copula model
A measure of risk correlation based on copula model
The Copula-GARCH model of conditional dependence: an international stock market application
The volatility spillover effects between HS 300 Stock Index Future and Spot Market Based on MODWT from a time-varying Perspective
Research on the tail risk spillover between shanghai and shenzhen stock markets based on MODWT and time-varying Clayton Copula

C. The Model Construction of the experiment on correlation measurement of CSI 300 index based on Copula function

Copula function has a good ability to describe the non-linear correlation between financial time series, and AR term can deal with the self-correlation of financial time series. While GARCH model can deal with the ARCH effect of financial time series. Therefore, this experiment can construct AR-GARCH-Copula model to study the correlation between CSI 300 index and its weighted shares.

D. The Specific implementation of the experiment on correlation measurement of CSI 300 index based on Copula function

The specific implementation of the experiment on the correlation measurement of CSI 300 index based on the Copula function can be divided into the following steps: the sample selection, the analysis of the characteristics of the time series of return rate, the fitting of marginal distributions of Copula function, the determination of the type of Copula function adopted, running the program to get the correlation, the analysis of the experimental results and the writing of the experimental report.

1) The sample selection: The source and time range of the data must be explained. For example, during the experiment on the correlation measurement of CSI 300 index based on the Copula function, select the top five weighted stocks of CSI 300 index, and analyze the correlation between the top five weighted stocks and CSI 300 index. Specifically, the time series of the closing price of the five stocks (Ping An, China Merchants Bank, CITIC Securities, Minsheng Bank and Vanke) are selected to calculate the daily return of CSI 300 index and these five stocks respectively, and six time series of return rate can be obtained. During the experiment, the sample time range from January 2015 to December 2016. The data is obtained from the data base of CSMAR.

2) The analysis of the characteristics of the time series of return rate and the fitting of time series: One premise of using Copula function to measure correlation is that there is no autocorrelation and ARCH effect in time series. Therefore, studying the characteristics of the six time series mentioned above and processing them accordingly are the precondition for the following experimental steps. In view of this, this part mainly studies the stability, autocorrelation and ARCH effect of the six time series mentioned above, and chooses the appropriate AR-GARCH model to deal with the autocorrelation and ARCH effect of the time series. The test results are shown in TABLE II.

TABLE II. THE CHARACTERISTICS OF THE TIME SERIES OF RETURN RATE

Stock code	Stationarity	Autocorrelation	ARCH effect
CSI 300	Stable	Higher order autocorrelation	Yes
601318	Stable	Higher order autocorrelation	Yes
600036	Stable	Higher order autocorrelation	Yes
600030	Stable	Higher order autocorrelation	Yes
600016	Stable	Higher order autocorrelation	Yes
000002	Stable	Higher order autocorrelation	Yes

According to the test results in TABLE II, the appropriate AR-GARCH model is selected to fit the time series, and the fitting results are checked to judge whether the autocorrelation and ARCH effects have been eliminated. The fitting results and test results are shown in TABLE III.

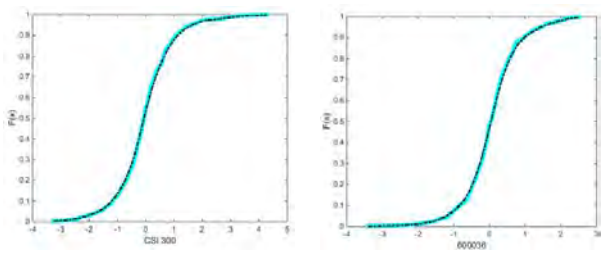
As shown in TABLE III, after treatment, there is no autocorrelation and ARCH effects in the residual series of return rate, and the subsequent experimental steps can be carried out to convert the corresponding series to 0-1 distribution.

TABLE III. FITTING MODEL AND SUMMARY OF RESULTS FOR CSI 300 INDEX AND ITS WEIGHTED STOCKS

Stock code	Fitting Model	Autocorrelation	ARCH effect
CSI 300	AR(28)-GARCH(1,1)-GED	Uncorrelated	No
601318	AR(20)-TARCH(6,2)-Gaussian	Uncorrelated	No
600036	GARCH(1,2)-GED	Uncorrelated	No
600030	GARCH(4,4)-Student's t	Uncorrelated	No
600016	AR(5)- AR(14)-PARCH(4,5)-Gaussian	Uncorrelated	No
000002	AR(2)- AR(37)-TARCH(5,4)- GED	Uncorrelated	No

3) The fitting of marginal distributions of Copula function: The residual time series of return rate of CSI 300 index and its weighted stock are extracted respectively after fitting, and then need to be converted to 0-1 distributions as the marginal distributions of Copula function.

When the distribution function of samples is unknown, the cumulative empirical distribution function in MATLAB can be used to obtain the empirical distribution of samples, or the kernel density function can be used to estimate the distribution. The distribution graphs drawn by the above two methods are shown in Fig.1 (taking the daily return series of CSI 300 index and the daily return series of 600036 as examples). In Fig.1, (a) refers to the daily return series of CSI 300 index and (b) refers to the daily return series of 600036.



(a) (b)

Fig. 1. The marginal distribution of Copula function

As shown in Fig.1, two time series' distribution curves obtained by using kernel density functions respectively conform to ones obtained by using their empirical distribution functions, which indicates that data transformed by the kernel density function can be well used in copula theory. At this step, the marginal distribution characteristics need to be checked. It is required that the marginal distribution be 0-1 uniform and there is no autocorrelation. After satisfying this condition, the following experimental steps can be carried out.

4) The determination of the type of Copula function: The frequency distribution histogram can intuitively show the linkage relationship between the two time series. Frequency distribution histogram can be regarded as the estimation of the joint density function of the two series, and the corresponding Copula function can be selected accordingly. In this step, we find that the frequency histograms of CSI 300 index series and its weighted stock time series show symmetrical tails. Therefore, the *t*-Copula function is selected to measure the correlation in this experiment.

5) Running the program to get the correlation: In this step, the parameters in t-Copula function are estimated, and the unknown parameters in Copula function can be estimated by using 'copulafit' function in Matlab, as shown in TABLE IV. The estimated results are shown in TABLE IV. Then we can get the correlation between the daily return rate of CSI 300 index and the return rate of its weighted shares under normal and extreme conditions, as shown in TABLE V and TABLE VI, respectively.

TABLE IV. PARAMETER ESTIMATION RESULTS OF T-COPULA FUNCTION

Stock code	Parameter 1	Parameter 2
601318	0.7452	7.7328
600036	0.5943	3.8494
600030	0.8338	6.2727
600016	0.5640	6.3073
000002	0.5847	6.1976

TABLE V. KENDALL RANK CORRELATION COEFFICIENTS UNDER NORMAL CONDITIONS

Stock code	601318	600036	600030	600016	000002
Kendall	0.5353	0.4051	0.6277	0.3815	0.3976

TABLE VI. TAIL CORRELATION COEFFICIENTS IN EXTREME CASES

Stock code	601318	600036	600030	600016	000002
R	0.2889	0.3180	0.4426	0.1948	0.2109

As can be seen from TABLE V and TABLE VI, the Kendall rank correlation coefficients of CSI 300 index and its weighted shares are 0.5353, 0.4051, 0.6277, 0.3815 and 0.3976, respectively, under normal conditions, and the tail correlation coefficients are 0.2889, 0.3180, 0.4426, 0.1948 and 0.2109, respectively, in extreme cases. R in TABLE VI refers to the tail correlation coefficient.

6) The analysis of the experimental results of the correlation measurement of CSI 300 index based on Copula function and the writing of the experimental report

a) Experimental results analysis: For the CSI 300 index, which has a special benchmarking role In Chinese capital market, the correlation coefficient is slightly higher. The higher correlation coefficient means that under normal or extreme conditions, the price fluctuations of the weighted stocks have a greater probability of influencing the changes of CSI 300 index, which undoubtedly reduces the anti-manipulation of CSI 300 index and increases the speculation and risk of the stock market. Index manipulation is possible. The influence of speculators on CSI 300 index will not only harm the interests of many small and medium-sized investors, but also seriously damage the order of the stock market. Therefore, it is necessary to reduce the artificial interference of CSI 300 index and improve its ability of anti-manipulation. Reducing the correlation between CSI 300 index and its weighted stocks is undoubtedly a better way to solve the problem from the source. In the process of selecting index component stocks, we should not only refer to the traditional selection criteria, but also consider whether there is a low correlation between the selected stocks and the index. In addition, we should strengthen the monitoring of the index operation, remove the component stocks with strong correlation with the index or reduce its weight, so as to improve the anti-interference ability of the index. The regulatory authorities should make joint efforts to maintain the smooth operation of CSI 300 index.

b) Write an experimental report on correlation measurement of CSI 300 index based on Copula function: The experimental report can be written in groups, and the team members should divide their work reasonably. The contents of the experiment report should include all the above contents, and be concise and neat in typesetting.

V. SUMMARY

In recent years, with the development of financial market in China, financial engineering as a new interdisciplinary discipline has been set up in more and more universities. In this context, this research studies the comprehensive experimental design of financial engineering from the following aspects: the principles of comprehensive experimental design of financial engineering, the general steps of comprehensive experimental design, and a specific experimental design of correlation measurement based on Copula function. The main purpose of this research is to further consolidate and enhance the professional skills of students majoring in financial engineering by means of experimental designs, and provide a useful reference for optimizing the experimental teaching system of financial engineering major.

REFERENCES

[1] Zheng Zhenlong, Chen Rong. Financial Engineering [M].Higher Education Press,2012. (In Chinese)

[2] Wang Xuxia. The Reform path of Financial Engineering Experiment Teaching [J]. Chinese and Foreign entrepreneurs, 2014 (14): 168-168. (In Chinese)

[3] Hong Tiesong, Xi Huan. Discussion on the Design of the content frame of undergraduate Financial Engineering Experiment Teaching [J]. Journal of higher Education, 2015 (21): 226-227. (In Chinese)

[4] Xing Yu. Reflections on Experimental Teaching of Financial Engineering Specialty under the background of artificial Intelligence [J]. Modernization of Education, 2017,4 (33): 138-140. (In Chinese)

[5] Song Lingfeng, du Jia, Zhang Yifan. Research on computer ability training Model of Financial Engineering undergraduate Specialty in Colleges and Universities [J]. Journal of Science and Technology Entrepreneurship, 2016,29 (17): 56-58. (In Chinese)

[6] Liu Sheng-nan, Guo Wenjing, Wang Hui. Thoughts on strengthening the Construction of Experimental courses for Financial Engineering Specialty in China [J]. Modern Business Industries, 2017,38 (36): 166-167. (In Chinese)

[7] Hu Yinyi. The micro-credit company's financing "bottleneck" and the right of return on assets evaluation [J]. Reform2013 (6):135-143.(In Chinese).