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Stock Market Financial Risk Prevention and Portfolio Optimization Based on MATLAB 7

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Abstract: Investment decision of stock market is the important content researched in the fields of economic management. Aiming at the problem of Financial Risk in Stock Market and Investment Portfolio Optimization, it was researched start from the stock market financial risk measurement and management theory, by making use of the expectation and variance of the proceeds, it was measured that the portfolio expected return and financial risk. Based on this, it was built that the stock market portfolio to optimize the target model, finally it was called that the minimize constraints function to resolve the most optimal solution with MATLAB 7. It can provide investors with a more scientific portfolio construction method in order to gain maximum benefit under a certain risk, or to minimize risks under a certain income.

Keywords: Financial risk, MATLAB 7, portfolio optimization, stock market

INTRODUCTION

Since the 1980s, with the development of financial innovation and the world's financial liberalization, financial markets become more turbulent. Financial risk management is more and more valued, which has increasingly become the subject of global concern. In the current society, everyone owns more or less some assets, these assets may be housing, land, bank deposits, stocks, bonds, futures, foreign exchange, gold, collectibles, mineral, plant, machinery and equipment and even the corporate brand, etc (Zhou, 2010; Chen *et al*., 2011; Zhang, 2009). For tangible or intangible assets, the asset holder is always hoping to continue to expand over time. But due to natural disasters, inflation and other factors in this process will make assets depreciate, volatilize, recession, even bankrupt. This requires financial expertise to maintain preserving the value of the asset, reasonably arranging for the asset structure and guarding against financial risks is very important.

In this study, it was researched start from the stock market financial risk measurement and management theory, by making use of the expectation and variance of the proceeds, it was measured that the portfolio expected return and financial risk. Based on this, it was built that the stock market portfolio to optimize the target model, finally it was called that the minimize constraints function to resolve the most optimal solution with MATLAB 7. It can provide investors with a more scientific portfolio construction method and the related invest suggestion.

Financial risks and their classification: Finance risk is defined and can use it to calculate and compare. Risk is the probability can't achieve the expected return; the financial risk is the possibility of a certain amount of financial assets expected revenue losses in future periods. Zero risk means no risk glance funds deposited in a bank there is no risk (unless the bank failures), but if the price increases or inflation factors, there is still a risk because the bank certificates of deposit due the actual value is lower than the value of your deposit.

Financial risks can be divided according to their nature: technical risk, credit risk, market risk, operational risk, decision-making risk, etc., (He *et al*., 2005; Zhang, 2008; Zhuo, 2011):

- **Technical risks:** The risks posed due to technical immaturity and construction defects.
- **Credit risk:** The risks posed by parties to the transaction a party to breach.
- **Market risk:** The market price changes and sales changes cause risks.
- **Operational risks:** Includes legal risks, goods send risks, system risks, fraud, theft risks, etc.
- **Decision-making risks:** Provide uncertainty information for decision making, but still have to make decisions, which leads to risk.

Prevention measures for financial risk: To guard against and defuse financial risks generally take the following three measures:

Diversification of investment: Don't put the investment focus on a project; otherwise it will cause the loss of military destruction in the event of unavoidable risk. As the saying goes foxy person

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Table 1: The table of three stocks' expected profit, the variance of income and the stock

Project					
Company	Expected profit (%)	Variance of profit	Cov. (A, B)	Cov. (B, C)	Cov. (C, A)
A	60	D (A) = 180	35		
B	20	D (B) = 110		105	
C	50	D (C) = 180			-30

Cov.: Covariance

has more than one hideout, even the hare will disperse nest to escape the disaster. Diversification of investments can reduce the risk from probability analysis (Zhu, 2008). Assuming that the failure of individual investment risk is 0.5, if the funds are divided into three parts to each distinguish investment and these three investment projects are unrelated, the probability of failure of all the three investments is 0.5/8 = 0.0625, so the risk is reduced. The diversification of investment requires not focus on a goal, but should be dispersed. How to disperse and arrange the ratio of the dispersion, there exist optimization problems (Chen and Yang, 2011; Wu, 2010; Yao and Chen, 2008).

Participation in insurance: Risks can be devastating in terms of personal. But for insurance companies is the small probability of a value. So one million insurance is the purpose of the insurance company. Once the applicant at risk, the insurance company will make as part of the compensation or terms of full compensation according to insurance. Of course, the insured need to pay insurance premiums to the insurance company. The amount of insurance money shall be equal to the expected loss.

Collect the information of the authenticity and reliability of the investment: When decision-makers not fully grasp environmental information for investment or their understanding of the investment environment information is untrue, the risk of the investment decision-making is very big. For example, investors should be aware of changes in bank interest rates, the financial statements of listed companies, the stock price moving averages, candle line maps, popularity index and development of the industry trend information and so on, in order to make decision of stock trading (Chen *et al*., 2011; Zhang, 2009; He *et al*., 2005).

RELEVANT TERMINOLOGY AND CALCULATION METHODS

Expected profit: The expected profit is the weighted average number of events of uncertain income, this "right" value of the size of each income probability. Such as buying a stock, the bid price for 10 RMB, the probability of rising to 15 RMB end of the year is 0.1, the probability of rising to 12 RMB is 0.2, equal probability is 0.7 and then the stock's expected profit is:

$$0.1(15-10)+0.2(12-10)+0.7(10-10)=0.9$$

Written in the general form of the mathematical expectation for discrete random variables (Zhang, 2008; Zhuo, 2011; Zhu, 2008) is:

$$E(X)=\sum_{i=1}^{n} x_i p_i \tag{1}$$

In the function (1), p_i is the probability for a discrete random variable X values x_i.

The variance and standard deviation: Variance (Zhang, 2008; Zhuo, 2011; Zhu, 2008) measures the fluctuations of the random variable; it is a random variable X and mathematical expectation of deviation square average to express:

$$D(X)=V\mathrm{ar}(X)=E\{[X-E(X)]^2\}=\sum_{i=1}^{n}(x_i-E(X))^2 p_i \tag{2}$$

Standard deviation as the square root of the variance:

$$sigma(X)=sqrt(V\mathrm{ar}(X)) \tag{3}$$

Covariance: Covariance is to describe the amount of the relationship between two random variables. If exist two random variables X, Y their covariance (Zhang, 2008; Zhuo, 2011; Zhu, 2008) is described in formula (4):

$$C\mathrm{ov}(X,Y)=E\{[X-E(X)][Y-E(Y)]\} \tag{4}$$

The portfolio optimization: An investor has 50 million, planning for 3 years investment to three kinds of stock of three companies. Based on market analysis and statistical projections, these three stocks' expected return, the variance of income and the stock of this company covariance are shown in Table 1.

Example 1: In the case of the expected return of the three years is not less than 40%, find out the investment distribution proportion when the variance of portfolio return is minimal.

Example 2: Set the standards deviation of the investment income is less than 10, find out the investment distribution proportion when the expected return is maximal.

```
function z=varmin(x)
z=180*x(1)^2+110*x(2)^2+150*x(3)^2+70*x(1)*x(2)+210*x(1)*x(3)-60*x(2)*x(3);
```

Fig. 1: Vermin.m objective function file

```
A=[-.6,-.2,-.5];b=-.4;
Aeq=[1,1,1];beq=1
lb=[0;0;0];ub=[1;1;1];
x0=[0;0;0]
options=optimset('fmincon');
options=optimset('largescale','off');
[x,fval]=fmincon(@varmin,x0,A,b,Aeq,beq,lb,ub,[],options)
D=sqrt(fval)
```

Fig. 2: Main1.m main calling function file

```
x =

    0.1432
    0.3811
    0.4757


fval =

   60.8617


D =

    7.8014
```

Fig. 3: Operation result of scheme 1

```
function z=earnmax(x)
z=-0.6*x(1)-0.2*x(2)-0.5*x(3);
```

Fig. 4: Earnmax.m objective function file

Scheme 1: set investment allocation ratio for the company A is x(1), for the company (B) is x(2) for the company C is x(3). Use of random variable A, B and the variance to calculate formula (5):

$$D(A,B) = D(A) + D(B) + 2Cov(A,B) \tag{5}$$

The variance of portfolio returns can be calculated as follows:

$$\begin{aligned} Z &= D(x(1)A, x(2)B, x(3)C) = D(x(1)A) + D(x(2)B) + D(x(3)C) \\ &+2Cov(x(1)A, x(2)B) + 2Cov(x(1)A, x(3)C) + 2Cov(x(3)C, x(2)B) \\ &= 180x(1)^2 + 110x(2)^2 + 150x(3)^2 + 70x(1)x(2) + 210x(2)x(3) - 60x(1)x(3) \end{aligned}$$

According to optimization requirement, the portfolio variance is the objective function, so that the smallest available can be described by formula (6):

$$\begin{aligned} &\min Z \\ s.t. &\begin{cases} x(1) + x(2) + x(3) = 1 \\ 0.6x(1) + 0.2x(2) + 0.5x(3) \geq 0.4 \\ x(1), x(2), x(3) \geq 0 \\ x(1), x(2), x(3) \leq 1 \end{cases} \end{aligned} \tag{6}$$

Preparing of the objective function file, file is named varmin.m, which is showed in Fig. 1.

Preparing of the main calling function file, file is named main1.m, which is showed in Fig. 2.

Run the main calling function main1.m, getting the investment allocation, minimum variance and minimum standard deviation showed in Fig. 3 of scheme 1, which meet the minimum objective function and constraints.

Scheme 2: The objective function was changed to the expected return required to achieve that the objective function is maximal. According to the formula (1) and first off the constraints, can be described by formulas (7):

```
function [c,ceq]=varcon(x)
c=180*x(1)^2+110*x(2)^2+150*x(3)^2+70*x(1)*x(2)+210*x(1)*x(3)-60*x(2)*x(3)-100;
ceq=0;
```

Fig. 5: Varcon.m nonlinear constraints function file

```
options=optimset('maxfunevals',2000,'largescale','off');
Aeq=[1,1,1];beq=1
lb=[0;0;0];ub=[1;1;1];
x0=[0;0;0]
[x,fval]=fmincon(@earnmax,x0,[],[],Aeq,beq,lb,ub,@varcon,options)
```

Fig. 6: Main2.m main calling function file

```
x =

    0.4479
    0.1608
    0.3914


fval =

   -0.4966
```

Fig. 7: Operation result of scenario 2

$$\max Z_1 = 0.6x(1) + 0.2x(2) + 0.5x(3)$$
$$s.t.\begin{cases} x(1) + x(2) + x(3) = 1 \\ 180x(1)^2 + 110x(2)^2 + 150x(3)^2 + 70x(1)x(2) \\ +210x(2)x(3) - 60x(1)x(3) \le 100 \\ x(1), x(2), x(3) \ge 0 \\ x(1), x(2), x(3) \le 1 \end{cases} \quad (7)$$

Preparing of the objective function file, file is named earnmax.m, which is showed in Fig. 4. Preparing of the nonlinear constraints function file, file is named varcon.m, which is showed in Fig. 5. Preparing of the main calling function file, file is named main2.m, which is showed in Fig. 6. Run the main calling function main2.m, getting the investment allocation and maximum variance showed in Fig. 7, which meet the maximum objective function and constraints.

CONCLUSION

The analysis in 5 shows that the expected return of scheme 2 (49.66%) is higher than the expected return of scheme 1 (40%). Because the proportion of the stock A in scheme 2 has increased, the stock B is reduced. But the variance of the expected return has also increased, variance of scenario 1 is 60.86, variance for scheme 2 is 100. Choose what proportion of an investment in the analysis of the results of these two actually better, depends entirely on the risk appetite of investors. Economists risk preference is divided into three categories of people, risk love, risk neutral and risk evader; most people are risk evader. Risk neutral and risk evader are willing to select scheme 1 and risk lovers are willing to select scheme 2.

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