Port Management of Investment in Thai Securities using Engineering Optimization Tools in Telecommunication

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ABSTRACT

Genetic Algorithm (GA) has been a successful tool in optimized communication networks, routing problems, and many optimization problems in telecommunication. In this paper, an example of applying this engineering optimization tools for the field of finance is presented. Genetic Algorithm is employed to manage portfolio in Thai stock exchange. As the procedure of the securities selection for investment may result in investment risk, the method of genetic algorithm is applied to solve the problems to obtain the portfolio which contains least risks in each investment period. The process is done at the required reliance and is also used maximum investment fund in the specified range, in order to attain the appropriate investment fund apportion in the acceptable risk level and effective compensation rate for investor's decision. The results show a promising paradigm yet conservativeness for the investment.

Keywords: Optimization, Genetic Algorithms, Value at risk, Engineering Economics, Engineering Tool

1. INTRODUCTION

For two decades, the emerging of multi-disciplinary of various fields has been enacted. For example, fields of mechanical engineering and the electronic one create a new field, namely, "mechatronics. [7]" Likewise, the fields of finance and engineering are also jointed in using tools in engineering computation to solve financial and investment problems [8-13].

Genetic Algorithm (GA) is considered as an effective tool, which has been employed for solving engineering optimization problems [2, 5]. This paper uses GA to manage portfolio in Thai stock exchange. As the procedure of the securities selection for investment may result in investment risk, the method of genetic algorithm is applied to solve the problems to obtain the portfolio which contains least risks in each investment period. The process is done at the required reliance and is also used maximum investment fund in the specified range, in order to attain the appropriate investment fund apportion in the acceptable risk level and effective compensation rate for investors' decision.. Next section describes brief review on the method of historical simulation.

2. HISTORICAL SIMULATION

This technique is a method for calculation of value at risk or VaR [1]. The method uses distribution of change in prices for calculation in which the distribution of the return in the past that will be repeated in the future. The procedure are as follows:

2.1 Calculate the value of the port using

Mark-to-Market method by summarizing all values of securities:

$$V_p = \sum_{i=1}^{n} V_i \qquad (1)$$

where n is number of securities, V_P is value of the port, and V_i is the value of each security.

2.2 Find weight for each security using formula in [1]:

$$w_i = \frac{V_i}{V_p} \quad \text{where } i = 1,2,3\ldots n \qquad (2)$$

2.3 Find return rate of each security using formula in [1]:

$$R_{i,t} = \ln\left(\frac{P_{i,t} + D_{i,t}}{P_{i,t-1}}\right) \qquad (3)$$

where $P_{i,t}$ is the price of the security i-th at the date t. and $D_{i,t}$ is the dividend yield of the security i-th at the date t.

2.4 Find return rate of the port:

$$R_{p,t} = \sum_{i=1}^{n} w_{i,t} * R_{i,t} \qquad (4)$$

where $w_{i,t}$ is the wieght of the security i-th at the date t. and $R_{p,t}$ is the rate of return of the port at the date t.

2.5 Find return rate of the port at the k-th percentile:

$$k = (1 - \frac{\text{Confidence Level}}{100}) * \text{Number of Day} \quad (5)$$

2.6 Caluclate Diversified VaR and Undiversified VaR:

$$\text{Diversified VaR}_p = - R_{p,k} * V_p \quad (6)$$

$$\text{Undiversified VaR}_p = - \sum_{i=1}^{n} \text{VaR}_i \quad (7)$$

where $R_{p,k}$ is the return rate of the port at the k-th percentile.

3. GENETIC ALGORITHM

This section gives a brief review of GA. Excellent treatment and more detail about foundation of the GA can be found in [2, 3].

A solution commonly used in industrial process control to cope with a time delay phenomenon is employed a Smith predictor shown in Fig. 3. The idea is to eliminate the time delay output of the system. In this paper, parameters are used as follows:

3.1 Initial settings: We assign n securities in consideration and number of genes m. For m = 500 population (per day), initial number of chromosomes is 40; and m = 300 for 30 chromosomes. This calculation is based on the data backed for 100 weeks.

3.2 Objective function: The objective function in this paper can be easily found by equation Eq. (1) = Eq. (6).

3.3 Crossing over: We use the two-point crossing over method by letting the rate of the cross over equal to 0.7.

3.4 Mutation: We use the real value type with the rate of mutation is 0.33.

3.5 Selection: The algorithm uses the stochastic universal sampling [4, 5] with bias = 0 and the minimum distribution between [0,1/N-pointer], where N-pointer equals to number of the selective chromosomes.

3.6 Ending criterion: The run time will be ended at the 1500-th day and the 500-th week.

Next section presents the simulation results.

4. SIMULATION RESULTS

In the simulation, we consider Thai Stock Exchange dividing by investment distribution in a portfolio. The port has three different stocks, and dividing the simulation in three portfolios which have different stocks by using the Genetic Algorithms and the valuing method at risk in Historical simulation. That is for adjusting the amount for investment in each period (as in buy-and-sell time for adjusting investing portfolio without calculation for any loss of commission fee and tax). Also, we select the value at required risk in a period which has different weights of stock investment in the portfolios, that is for finding out the result from efficiency of portfolio management in accepted value at risk to compare with the index values in the stock

exchange (the selected stocks in the different sector), included with the index values in each sector (the selected stocks in the same sector) to show how much the loss can be reduced in the portfolios and how difference result presented in each portfolio.

The stimulated program can arrange N stocks in the portfolio (the stocks are selected by the investors who want to invest in their portfolios). As we determine the domain for the same capital in each stock of the portfolio, so that the capital can not be adjusted to reach out of the highest investing weight in each stock of the portfolio as we define. We want the portfolio to get the risk value at the convincing level, and arrange the balance of the investment portfolio arrangement to be the reserved capital for the next period through the processing time is in conservative fashion.

In the simulations, we have two ports with three securities for each one, which are KBANK, BBL, and KTB for the first port and BBL, KGI, and SHIN. The abbreviations of the port are the standard of the names of the Thai securities. With 95 percent confidential and the data back for 300 days and 100 weeks. The results show as follows:

4.1 The first port: KBANK, BBL, and KTB (pure banking group

Figures 1-6 are simulated based on information obtained from Thai Stock Market from June 2, 1992 to July 14, 1998.

Fig. 1: *Profit-loss scenario of the first port vs the SET index of bank group for 300 days*

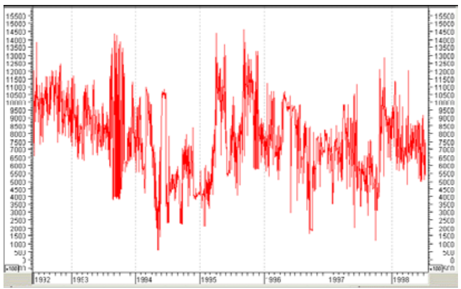

Fig. 2: *Money (in Baht) in investment port per day for 300 days*

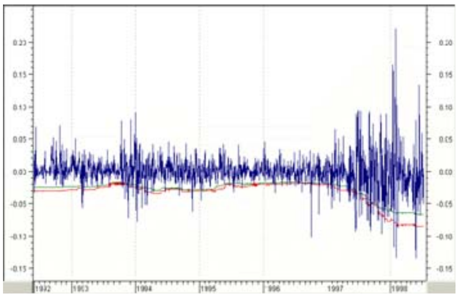

Fig. 3: *Back Testing for 300 days using the method in* [1, 6]

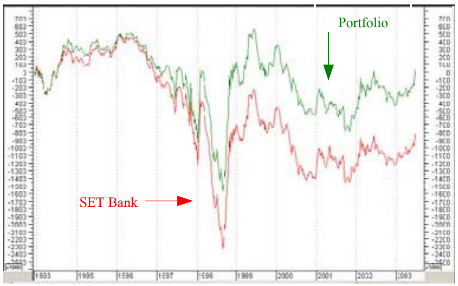

Fig. 4: *Profit-loss scenario of the first port vs the SET index of bank group for 100 week*

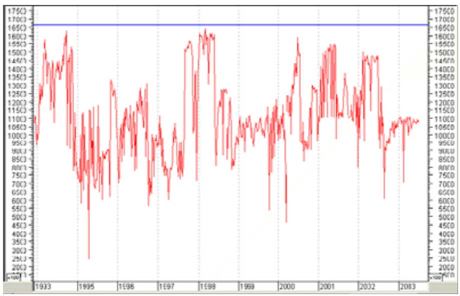

Fig. 5: *Money (in Baht) in investment port per day for 100 weeks*

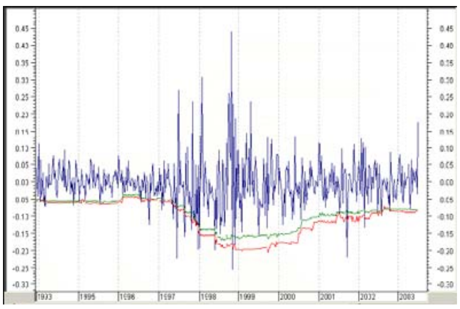

Fig. 6: Back *Testing for 100 weeks using the method in* [1, 6]

4.2 The second port: BBL, KGI, SHIN (mixed group between banking and communication groups)

Figures 7-12 are simulated based on information obtained from Thai Stock Market from June 2, 1992 to July 14, 1998. As we have seen from those Figures obtained in the simulation in both groups of the ports of investment that the port investment using GA outperforms the SET index.

Fig. 7: *Profit-loss scenario of the first port vs the SET index of bank group for 300 days*

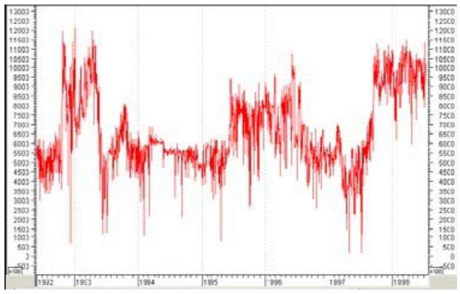

Fig. 8: *Money (in Baht) in investment port per day for 300 days*

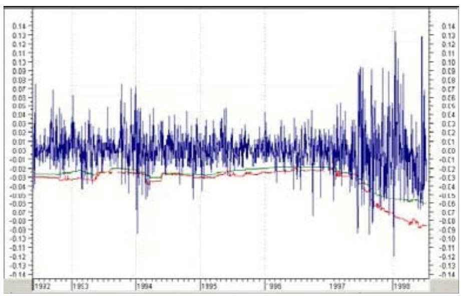

Fig. 9: *Back Testing for 300 days using the method in* [1, 6]

Fig. 10: *Profit-loss scenario of the first port vs the SET index of bank group for 100 weeks*

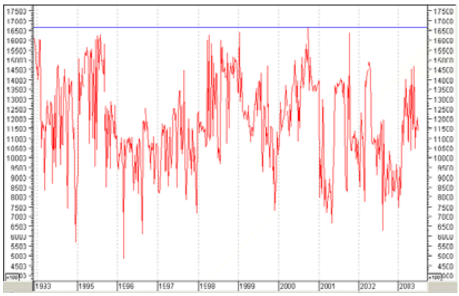

Fig. 11: *Money (in Baht) in investment port per day for 100 weeks*

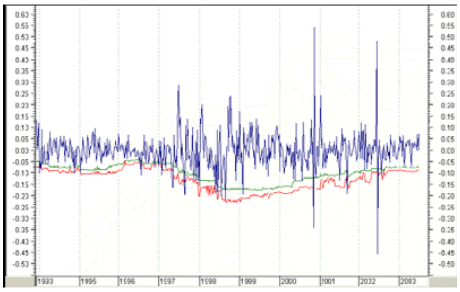

Fig. 12: *Back Testing for 100 weeks using the method in* [1, 6]

5. CONCLUDING REMARK

This paper presents genetic algorithms for port management in Thai Stock Exchanges. Based on the historical simulation approach and the backed data in the market place, the simulation results show that the port of investments using GA outperforms the SET index compared to the same group. The back test [1, 6] yields the satisfactory results to verify the validity of the models.

Even though the port management using GA outperforms the SET index of the same group, but the profit gains in the periods of consideration are not quite impressive [14-16]. This is because the strategy is focused on minimum risk scenario rather than maximum profit. Nevertheless, the proposed scheme can be used to understand the trend of the direction of the near-future price. Combining this proposed technique with consideration of the solid foundation of company performance would definitely raise the profit.

The paper also shows that engineering tools can be employed to solve problems in finance; this would be the trend in merging fields between finance and engineering in the era of inter/multi-disciplinary. It would be challenged that such problems in other fields can be solved by using engineering tools in telecommunication.

6. REFERENCES

[1] P. Jorion, *Value at Risk*, 2nd edition, McGraw-Hill, 2001.

[2] J.Holland, *Adaptaion in Natural and Artificial Systems*, Ann Arbor:University of Michigan Press, 1975.

[3] D.E. Goldberg, *Genetic Algorithms in Search Optimization, and Machine Learning*, Addison-Wesley, 1989.

[4] KF. Man ,K.S. Tang and S.K wong ,*Genetic Algorithms Concepts and Designs* London ,U.K. Springer-veriay ,1989.

[5] M.Gen and R.Cheng, *Genetic Algorithms and Engineering Design*, WILEY- INTERSCIENCE, 1997.

[6] C. Christopher, *Time Series Forecasting*, Chapman & Hall / CRC, 2001.

[7] *www.engr.colostate.edu/~dga/mechatronics/ resources.Html*

[8] Mark P. Everson, Christophe G.E. Mangin, Cody Stumpo, JoAnn M.Sxhwartz and David A. Ostrowski, *Evaluating Strategies for Foreign Exchange Risk Reduction*, IEEE, 2002.

[9] Shigeo Mori and Kotaro Hirasawa, *A Stock Price Prediction Model by Using Genetic Network Programming*, SIEC Annual Conference in Sapporo,August4-6, 2004

[10] Jacqueline Shoaf and James A. Foster, *The Efficient Set GA for Stock Portfolios* ,IEEE, 1998

[11] Miyasaka, *Making the Portfolio by Applying Genetic Algorithm*, (in Japanese), Master's thesis, Dept. of Production and Information Systems, Tokyo Metropolitan Institute of Technology, 1999

[12] Takabayashi, *Fund and Rebalance by applying Genetic Algorithm*, (in Japanese), Proceedings of JAFEE's winter, Japanese Association of Financial Econometrics and Engineering, 1995, pp.94-103

[13] Rui Jiang, and K. Y. Szeto, *Extraction of Investment Strategies based on Moving Averages:A Genetic Algorithm Approach*,IEEE, 2003

[14] H. M. Markowitz. *Portfolio selection*. *Journal of Finance*, 1(7):77–91, 1952.

[15] H. M. Markowitz. *Portfolio Selection: efficient diversification of investments*. John Wiley & Sons, 1959.

[16] H. M. Markowitz. *Portfolio Selection*, Basil Black well, he. Cambridge, MA, 1991.