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# PORTFORIO ANALYSIS WITH QUANTIFICATION THEOREM

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## Abstract

This paper presents a new portfolio analysis technique of quantification theory by deriving expected values. For a instance,the simple mean was used to analysis expected value for stock profits. But,we consider the method of expected value for stock profit is obtained from quantification theory. We imagine the simple mean can't reflect the present market. Markowits theorem wasn't very useful in reality finance problem,because the solution of matrix is too big and complex. In recently,we can use Markowits theorem for this kind of problems by using advanced computer system. This theorem is known a simple conception which has been planed for minimizeing a variance of RISK under constant expected values[1]. And the quantification theory is also known as an useful method to analysis descrete data. In finally,we analyse the expected value to the point of various factors: exchanging rate,type of industry,classification of climate, and other factors. We think it will be more powerful method for portfolio than the present method. Lagrange condition to a quadratic program is a linear inquality, that's why we consider algorithm to solve quadratic programing is an simplex method[2] by adding complementary slackness conditions. As a programing,we use JAVA [3] language to collect stock data. This language is a very useful and it has object oriented. Especially,If we may use the internet communications,the ability of JAVA has the function of data transfer. Recently,we has been broadcasted stock data in various sites. We can get data easily whenever we want.

## 1 Introduction

Markowits Portfolio Method is able to be descreibed simply by the following:

$$\sum_{j=1}^{n}\sum_{k=1}^{n}\sigma_{jk}x_jx_k \rightarrow Minimize \tag{1}$$

$$\sum_{j=1}^{n} r_jx_j = p \tag{2}$$

$$\sum_{j=1}^{n} x_j = 1 \tag{3}$$

$$x_j \geq 0(j = 1\cdots n) \tag{4}$$

## 2 Model Exprementaion

We assume the following factor infuluence to a value judgement of stock.Analysis by quantification is good on solving these descrete analysis.We assume the following model.

A: exchange rate $A_1$,$A_2$,$A_3$; B: type of industry $B_1$,$B_2$,$B_3$,$B_4$. The return per unit amount of investment to company $m$ is

$$r_{ij}^m = u^m + a_i^m + b_j^m + e_{ij}^m \tag{5}$$

We can get estimates $\widehat{u^m}$,$\widehat{a_i^m}$,$\widehat{b_j^m}$of $u^m$,$a_i^m$,$b_j^m$from a few years of data. And each probability of $A_i$,$B_j$are $P(A_i) = p_i$,$P(B_j) = q_j$.

We can predict $r_{ij}^m$ by

$$\widehat{r_{ij}^m} = \widehat{u^m} + \widehat{a_i^m} + \widehat{b_j^m} \tag{6}$$

Thus we have the following estmentes and corresponding probabilies

| | 1 | $\cdots$ | $n-1$ | $n$ | $P_r$ |
|---|---|---|---|---|---|
| $A_1B_1$ | $\widehat{r_{11}^1}$ | $\cdots$ | $\widehat{r_{11}^{n-1}}$ | $\widehat{r_{11}^n}$ | $p_1q_1$ |
| ≀ | ≀ | ≀ | ≀ | ≀ | ≀ |
| $A_3B_4$ | $\widehat{r_{34}^1}$ | $\cdots$ | $\widehat{r_{34}^{n-1}}$ | $\widehat{r_{34}^n}$ | $p_3q_4$ |
| *invenst%* | $x_1$ | $\cdots$ | $x_{n-1}$ | $x_n$ | |

A vector of investor possesces invenstment is $X = (x_1, x_2, \cdots, \cdots x_n)$

$$\sum_{m=1}^{n} x_m = 1 \tag{7}$$

Total return for the case $A_iB_j$ and its probability are

$$r_{ij} = \sum_{m=1}^{n} \widehat{r_{ij}^m} x_m \qquad P_r = p_i q_j \tag{8}$$

and its expectation is

$$\begin{aligned} E(R) &= \sum_i \sum_j r_{ij} p_i q_j \\ &= \sum_i \sum_j (\sum_m \widehat{r_{ij}^m} x_m) p_i q_j \\ &= \sum_m (\sum_i \sum_j \widehat{r_{ij}^m} p_i q_j) x_m \end{aligned} \tag{9}$$

We have variance of R by the following procedure

$$\begin{aligned} E(R^2) &= \sum_i \sum_j r_{ij}^2 p_i q_j \\ &= \sum_i \sum_j (\sum_m \widehat{r_{ij}^m} x_m)^2 p_i q_j \\ &= \sum_i \sum_j (\sum_m \widehat{r_{ij}^m} x_m)(\sum_l \widehat{r_{ij}^l} x_l) p_i q_j \\ &= \sum_m \sum_l (\sum_i \sum_j \widehat{r_{ij}^m} \widehat{r_{ij}^l} p_i q_j) x_m x_l \end{aligned} \tag{10}$$

$$\begin{aligned} V(R) &= \sum_m \sum_l \widehat{r^{ml}} x_m x_l - (\sum_m \widehat{r^m} x_m)^2 \\ &= \sum_m \sum_l \widehat{r^{ml}} x_m x_l - \sum_m \widehat{r^m} x_m \sum_l \widehat{r^l} x_l \\ &= \sum_m \sum_l \widehat{r^{ml}} x_m x_l - \sum_m \sum_l \widehat{r^m} \widehat{r^l} x_m x_l \\ &= \sum_m \sum_l (\widehat{r^{ml}} - \widehat{r^m} \widehat{r^l}) x_m x_l \end{aligned} \tag{11}$$

Finally we solve the following problem;

$$V(R) \rightarrow Minimize \tag{12}$$

$$E(R) = C \tag{13}$$

$$\sum_m x_m = 1 \tag{14}$$

$$x_m \geq 0 \cdots (m = 1, \cdots, n) \tag{15}$$

# 3 References


1)Hiroshi Konno,Rizai Kougaku [1995] Nikka-Giren Pub

2) Iwaro Takahashi,NumericalAnalysis [1965] Hirokawa Pub

3) Fumio Mizoguchi,Masato Oowada,JAVA [1996]Baifu-Kan Pub