

Genetic algorithm applied on the performance appraisal system of mutual fund managers in Taiwan

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Abstract

This research studies the performance appraisal system of mutual fund managers in Taiwan. 147 mutual fund managers were investigated in examining the performance appraisal system of mutual fund managers. This article describes using a Genetic Algorithm to evaluate the optimal performance in appraising mutual fund managers in the asymmetric information market in Taiwan. The optimum performance using this method of evaluation can be used to promote the performance of mutual fund managers. It also could enhance the developing of fund markets. From the research, the four most important results concluded are as follows: fund managers prefer to be evaluated annually, the optimal reward timing is quarterly, performance reward is the best way to encourage employees, and the career life for mutual fund managers is from 5 to 10 years.

Keywords: performance appraisal, mutual fund managers, genetic algorithm.

1 Introduction

Mutual funds are legal entities, which are regulated by the Securities and Exchange Commission under the investment company Act of 1940 (the Act). In particular, the disinterested directors must be independent of the fund's investment advisor, principal underwriter, and broker [Act, section 10(a)]. The mutual funds managed are important for investors in many countries. The typical growth fund manager has great latitude in the types of stocks held, the timing of purchases and sales, the fund diversification, the industry concentration of the



portfolio, and a host of other factors that go into determining the returns to client investments [2].

In the mutual fund market, where there is little literature regarding fund managerial appraisal and related research, performance appraisal plays an important evaluation role for an organization, and it can provide critical information to individuals, managers and organizations. Performance appraisal can also help organizations to observe their mutual fund managers more effectively. In particular, organizations have begun to develop appraisal systems based on competency models, which focus on the skills people need to be effective in their current and future jobs [11].

Researchers have pointed out, job performance is the most widely studied criterion variable in organizational behavior and human resource management literature [1]. It follows the human capital theory that managers with greater human capital (intelligence, etc.) should produce better performance and receive better compensation [10]. Similarly, agency models, such as those of a manager's portfolio risk choices, will partly depend upon his or her risk-taking preference, because the volatility of a manager's pay is affected by the portfolio's performance [3,6,7,11].

A fund's performance, risk and fees are significantly impacted by its manager's characteristics [10]. However, since most performance appraisal system ignore other dimensions of manager's characteristics, such as task types and work behavior, they can consider managers' other motivating factors. This is because fund managers are both implicitly and explicitly rewarded on the basis of relative performance [9]. While total return is important, investors may use performance rank as proxy for explicit comparisons of total return. The performance measure is the rank of each manager's annual returns relative to all other managers within the same investment object [5].

2 Methodology

By utilizing related literature and interviews with experts of mutual fund managers simultaneously, this study used questionnaires in its analysis, then applied a genetic algorithm. What variables there are, focused on a variety of areas including (1) demographics; (2) performance evaluation; (3) operations; (4) customer-orientation; (5) evaluated performance; (6) reward methods; and (7) optimum reward timing.

2.1 Designed questionnaire

This research questionnaire included operational definition of variables, statements and scale (method of measurement). We can see this table of designed surveys.



Table 1: Questionnaire framework.

Operational definition of variables	Statements	Method of measurement
Mutual fund managers have preconceived notions regarding roles of performance appraisal	1. The period and purpose of performance evaluation 2. Effective methods of reward 3. Reward time 4. The average career lifespan 5. The willing acceptance of risk 6. Poor performance of mutual fund managers required transfer to research positions 7. Liquid reserve, for financial security 8. Whether or not fund risk and rewards are equal 9. People being evaluated should assist in establishing and participating the evaluation process	Multiple choice, ordinal scale and ranking
Mutual fund managers have preconceive notions regarding the degree of satisfaction with each pertaining to performance evaluation	1. The artificial-orientation variables have a total of three items: customer satisfaction, customer net increase, and customer diversity. 2. The customer-orientation variables have a total of seven items: individual credentials and evaluation, personal integrity, team cooperation, group contribution, company loyalty, and company policy. 3. The operational fund variables have a total of eleven items: managing the scale of the fund, growth rate, rate of return, earning ratio, turnover rate, the rate of net value increase, the consistency of net value, seasonal ranking, accumulated ranking, benchmark, and comparison with similar funds.	Likert scale of five points
The fundamental data regarding mutual fund managers	Gender, age, company serviced, fund types (according to the area), fund scales, customer resources, education, work experience, tenure, salary, monthly performance rewards, working hours per day and working days per week.	Multiple choice, ordinal scale and Ranking



2.2 Genetic algorithm

Genetic algorithm (GA) is a group of methods used to solve problems. These algorithms were inspired by the processes of neo-Darwinian evolutionary theory. It is a powerful and broadly applicable stochastic search and optimization technique based on gene inheritance and survival of the fittest. Before we can determine the best solution, we must transform each question into a corresponding function, called an evaluation. By way of artificial operation processes, such as initialization, crossover and mutation, the best solution for evaluation can be obtained.

This algorithm has been used successfully to perform TSP, job shop, flow shop, and optimization problems. The use of GA for instruction scheduling has been driven by the encouraging results thus far [8].

The operation of GA contains four patterns: Selection, Operators, Population and Evaluation. They relate as follows:

1. Selection: to select better filial generations according to the results of preceding evaluations.
2. Operators: to apply reproduction, crossover and mutation to create new chromosomes.
3. Population: to separate filial generations and parental generations for evaluation.
4. Evaluation: to compute the qualities of each species by using previous evaluation.

The basic GA could be described as follows:

```
GA()
{
    Initialize population
    Evaluation;
    While (terminative condition)
    {
        Selection;
        Crossover;
        Mutation;
        Fitness;
    }
}
```

2.2.1 Selection

The principle behind GA is essentially Darwinian natural selection: both parents and offspring have the same chance of competing for survival. An evident advantage of this approach is that the GA performance can often (but not always) be improved. This is because genes are constantly evaluated within the context of a larger individual.



2.2.2 Crossover

The role of crossover in the GA is to combine genes with pieces from fit solutions. A simple way to achieve crossover would be to choose two random cut-points, and generate the offspring by combining a segment from one parent to the left part of the first cut-point with a segment from the other parent to the right part of the cut-point. The crossover probability was 0.85 in this research.

2.2.3 Mutation

Mutation operates on a single string and generally changes a gene at random. In this paper, the mutation probability used was 0.002.

In this research, we try to use GA to determine the optimal achievement estimate system for mutual funds in Taiwan.

The details in the proposed genetic algorithm system are as follows:

Step 1. Initialize the first population

This study focused on 49 effective surveys, and chose 30 sets of data from that, to be the initial population.

$$G_i = (A_1, A_2, \dots, A_{PopsizE}), PopsizE = 30$$

$$A_i = (a_{i1}, a_{i2}, \dots, a_{in}), i = 0, 1, \dots, PopsizE, n = 21$$

PopsizE: the amount of individuals in every population. In this paper, PopsizE is 30.

n: the amount of the genes in every individual. In this article, n = 21.

Step 2. Fitness function

Fitness function is employed to measure the adaptability of the species. We compare each individual unit of PopsizE (in this case A = 1 thru DD=30). If the value of the fitness function of A is larger than B, then A is more fit than B. The fittest sample is chosen using the method. The fitness function of this research is defined as follows:

$$Fitness(PopsizE) = \max \sum_{i=1}^{PopsizE} \sum_{j=1}^n q_{ij} W_{ij}$$

i=1,2,...,30(PopsizE)

PopsizE: The popsize is 30 in every generation.

n: In the first part, n = 21(21 questions per survey)

j = survey question; i = fitness

q_{ij} : The score of a sample survey question combined with it fitness level.

W_{ij} : The weight of a sample survey question combined with it fitness level.

Step 3. Calculate the probability of the chromosome to be chosen, P_i



$$P_i = \frac{f(A_i)}{\sum_{i=1}^{Popsiz} f(A_i)}, \quad i = 1, \dots, Popsiz$$

f : Fitness function

In this paper, we employ the random「 Roulette Wheel Selection」 to calculate the probability.

Step 4. Reproduction

The reproduction operator selects individuals from the current population by the value of their fitness function. These (individuals) will take part in the next generation only if the fitness value of the individual is greater.

Step 5. Crossover

We use a two-point crossover to replaces two randomly selected subparts of an individual with two randomly selected subparts from another individual.

Step 6. Mutation

The mutation operator randomly transforms the value of an attribute into another value found within its domain. In this paper, the mutation probability was 0.002.

3 Data analysis and findings

This research performs algorithms in order to seek out optimum performance, and assesses the optimization by using the aforementioned formulas. The results are as follows:

1. The time period for rational performance assessment is one year.

We found the most appropriate time period for the application of performance appraisal assessment is one year. Shorter or longer periods were inappropriate, this is also confirmed by relevant suggestions many scholars and experts have put forward.

2. The most effective reward method is the performance bonus.

The amount of the performance bonus can directly reflect the performance of the mutual fund manager's professional behavior.

3. The main purpose for assessment is to increase personal achievement and performance.

Self-respect is a personal achievement to prove out this research and assess its main purpose, while at the same time, realizing a sense of approval from others, thus giving play to the potential energy derived from it.



4. The most effective timing for reward is one season.

Timely reward is a main method used to raise performance, one season is considered the best period to give rewards. Longer or shorter reward opportunity time periods are less effective.

5. Per capita job market's career life-span for mutual fund managers is from five to ten years.

The mutual fund manager exists in a high pressure environment. This comes from financial institutions and customers at the same time. Competition forces rapid change, thus causing professional burnout, so the average mutual fund manager's career is usually from five to ten years.

6. When evaluation time is shortened, the will for bearing risk decreases.

If the evaluation time is shortened, undue pressure for short term gains becomes the manager's priority, undermining their ability to accurately access risk.

7. If it is agreed that the manager's performance is not good, he should be transferred to the job of background researcher.

Poor performance by a fund manager requires that he/she transfer to a research role. We should not deny the opportunity for a mutual fund manager to return to his/her original duties at an appropriate time.

8. It is very important to be concerned with liquid reserve when investing.

The mutual fund manager decides how much liquidity should be held in reserve, and prepares the appropriate amount. This allows the mutual fund manager to be free of unnecessary worry while making investment decisions.

9. It is very important to be concerned with when the securities are bought and sold.

When the investment risk exceeds the safety standard, the mutual fund manager should prevent losses by changing its investment tactics in a timely manner.

10. It is very important to consider both risk and return.

In the investment market, getting high returns usually comes with high risk. The investment fund managers need to pay attention to investors and market trends when evaluating risk and return, in order to grasp highly lucrative and effective investment tactics.

11. When creating any appraisal system, the person assessed should participate in its creation.

The person assessed should participate in making the appraisal system of performance, in order to show its fairness.



4 Conclusions

According to the results of this study, the performance evaluations of mutual fund managers were sorted using seven variables: (1) fund operations; (2) artificial-orientation; (3) customer-orientation; (4) demographics; (5) reward timing; (6) reward method; and (7) evaluated performance. The variable of fund operations is the most important item for performance evaluations, with the second key item being the variable of artificial-orientation; so the investment company should carefully consider these two items when evaluating the performance of mutual fund managers.

According to the research results, domestic funds have a significant influence on this study. (1) One year is the optimum time period for rational performance when it is assessed. (2) The most effective reward method is the performance bonus. (3) The main purpose that the performance is assessed is to increase personal achievement. (4) The most effective timing for reward is one season. (5) Per capita career lifespan of mutual fund managers is from five to ten years. (6) When assessment time is shortened, the will for bearing risk goes down. (7) Agreement if performance is not good, and transfer to researcher. (8) It is very important to be concerned with liquid reserves when investing. (9) It is very important to be concerned about security when trading. (10) It is very important to be concerned with both risk and return. (11) Agreement in the creation of an appraisal system; with the person being assessed participating in its creation.

The two recommendations are as follows:

1. The change and shake-out of mutual fund managers should be fast:

Because a mutual fund manager must take the large risks and make important decisions, change and shakeout time must be short. If the mutual fund managers' performance is not good, we suggest that an investment company transfer them to research temporarily instead of dismissing their ability on the spot, thereby avoiding the problem of any drawn-out change.

2. Ideals in design of performance evaluation:

The ideal items for performance evaluation must include the following factors: "net value of fund"; "scale of fund"; "rate of reward"; "rate of liquidity"; "turnover rate"; "performance compared to the Benchmark"; "ranking of similar funds"; and the performance evaluation timing must be one year.

Incentives must be fair, ranking of performance and reward should have a positively related correlation, so that the performance evaluation can encourage mutual fund managers.

Follow-up research can be used in other analytic ways, and it can increase understanding and help to compare more suitable consultations by using deep analysis. The resources for collected data and additional samples can be acquired from different channels, for example: e-mail, telephone interviews, expert interviews and others related literature etc. In this research process, the job quality of mutual fund managers had no relationship within any geographic limits. Therefore, in the related analysis and research, it should break through



geographic limits. Using deep research; this method can increase reliability and validity. This study's center-point aims at the expert's opinion on the variables of performance evaluation; we suggest that follow-up research should include additional variables to prove the optimum models of performance evaluation.

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