



## Multiportfolio optimization in Tehran Stock Exchange

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### Abstract

The majority of portfolio optimization problem studies are conducted under a single portfolio framework. When multiple portfolios are managed together, some issues such as market impact costs must be dealt with properly. It would better to use multiportfolio optimization framework to manage market impact effects of trading in multiple portfolios. In this research I\* model is used to model market impact for two accounts including three assets in TSE. Results show market impact cost has decreased when using multiportfolio optimization framework in compare to classic solution.

**Keywords:** portfolio, optimization, multiportfolio optimization

## 1 Introduction

The aim of this study is to apply multiportfolio optimization framework regarding portfolio selection in Tehran Stock Exchange. Regarding Harry Markowitz which was about the theory of portfolio selection decision making in financial industry has been based on a significant concept that is portfolio optimization. There were some innovation in the management of portfolio investment that has been introduced firstly by Markowitz such as incorporating risk in portfolio investment decision and application of a disciplined quantitative framework.

In order to solve the problem of portfolio selection using the tool of optimization, the classic single-period single-account mean-variance optimization (MVO<sup>1</sup>) problem was formulated by Markowitz. It considered the fact that portfolio should be chosen with the smallest amount of risk by investor in order to achieve a particular target return objective. Considering diversification and financial decision making as quantitative trade of between portfolio return and risk are two important areas in which addressed by Markowitz. [Markowitz, 1952]

During the past 60 years there have been many efforts to fill the gap of Markowitz's theory and apply it to real world financial industry. This has been done through introduction of several new different risk measures which consider some the real world factors in portfolio optimization. Also during the past decade some topics such as dealing with the optimization problem of multiple account in the same time and solving portfolio optimization problem in multi period framework came into consideration. [Kolm and Tütüncü. Et al, 2013].

Trading cost is an important part of the objective function modern portfolio rebalancing technique which relies on optimization. The actual price of an asset is usually different from the expectation, that's due to the fact that buying or selling activities may change the asset market price up or down. [Savelsbergh et al. 2010].

In this study multiportfolio optimization framework is proposed in which one financial adviser provides services regarding portfolio selection and position to 2 accounts simultaneously form 3 assets in TSE.

The aggregation of trades under the multiportfolio framework inevitably leads to market impact costs that take as arguments the aggregated buying and aggregated selling orders submitted by the financial advisor. Therefore, fairness and client satisfaction must be taken into account. [Iancu and Trichakis (2014)] in a study presented a model that performed MPO regarding fairness and client satisfaction which step5 formula is as following:

$$\begin{aligned} & \max \{f(u_1(\mathbf{x}_1) - t_1, u_2(\mathbf{x}_2) - t_2, \dots, u_n(\mathbf{x}_n) - t_n)\} \\ & \text{s.t. } \mathbf{x}_i \in \mathbf{X}_i, \quad \forall i \in I \\ & \quad \mathbf{x}_i^T \Sigma \mathbf{x}_i \leq \kappa_i \cdot \sigma_i, \quad \forall i \in I \end{aligned}$$

The five steps optimization schemes have been designed to perform on behalf of the advisor to assist in the process of portfolio selection decision making through providing optimal portfolio position in each account. In this study we use I\* model for market impact cost function and step5 formula is as follows:

$$\begin{aligned} & \max \left\{ \min \left\{ \frac{\sum_{j=1}^4 \bar{r}_j \frac{x_{kj} p_j}{C_k} - \sum_{j=1}^4 t_{kj} - U_k^{IND}}{U_k^{IND}} \right\} \right\} \\ & \sum_{i=1}^4 \sum_{j=1}^4 \frac{x_{ki} p_i}{C_k} \frac{x_{kj} p_j}{C_k} \text{cov}(\bar{r}_i, \bar{r}_j) \leq k_k \sigma_k \\ & t_k = \sum_{j=1}^4 \frac{x_{kj}}{\sum_{a=1}^2 x_{aj}} \theta_j \left( \frac{\sum_{a=1}^2 x_{aj}}{ADV} \right)^{y_j} \end{aligned}$$

## 2 Main results

In this study we proposed and implement five steps optimization model and the findings indicate that when we optimize multiple portfolio simultaneously, market impact cost decreases and on the other hand utility increases. The results table is as following:

account	market impact cost			utility			improve
	step2	step4	step5	step2	step4	step5	
1	5.65E-06	1.44E-05	1.29E-05	0.032994349	0.032985609	0.032987063	4.40874E-03%
2	8.70E-06	1.92E-05	1.72E-05	0.032991299	0.032980812	0.032982752	5.88045E-03%

### 3 References

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