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# Evaluating the Performance and Ability Explain of Market Index Returns by Selected Stock Portfolios Based on Throughput Accounting Criteria in Comparison with the New Network Matrix Model

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ABSTRACT

One of the strategies used in active portfolio management is the 'network matrix model,' which can be utilized to construct portfolios with distinct characteristics of stocks or companies. In this study, the data from 156 companies listed on the Tehran Stock Exchange during the period 2011 to 2018 were employed to compare portfolio formation and performance based on the network matrix model and throughput accounting criteria. The performance of these portfolios was compared with the portfolios generated by the new network matrix model (Defensive, neutral, and aggressive stocks) as well as the market portfolio. The results demonstrate that the proposed network matrix model portfolios, based on throughput accounting criteria, outperform the new network matrix model in terms of Sharpe ratio, Sortino ratio, upside potential, and omega criteria. Additionally, portfolios comprised of stocks from companies with high system performance exhibit superior performance in terms of Jensen's Alpha criteria compared to the new network matrix model. Furthermore, they outperform the market portfolio in terms of upside potential and omega criteria. Portfolios consisting of stocks from companies with low system performance exhibit a stronger correlation with the market portfolio in comparison to the new network matrix model.

## 1 Introduction

The efficient market hypothesis (EMH) claims that it is impossible to surpass the market by selecting individual stocks and achieving higher returns than the average market. It also suggests that changes in stock prices are random and follow a random walk process. Consequently, historical information cannot lead to abnormal returns. The hypothesis further asserts that there are no trends in market prices and returns, making it impossible to profit from market trends. However, stock portfolio optimization is a crucial aspect of portfolio management, and stock selection is a critical stage in making sound investments [2]. Therefore, the issue of selecting the optimal

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stock portfolio should be considered by investors, whether natural or legal persons [1]. The primary objective of selecting the optimal stock portfolio is to choose the best combination of stocks with the highest expected returns while maintaining an acceptable level of risk [3]. Moreover, since investors aim to increase the value of their wealth and optimally allocate their resources to earn higher profits, actively managing the portfolio becomes essential. Investors should strive to select a stock portfolio that outperforms the market portfolio [14].

The selection of a stock portfolio can be accomplished using an active portfolio management strategy introduced by Morningstar Financial Services Company in 1992. This strategy is based on stock grouping using the "network matrix model," which considers various characteristics and criteria of stocks and companies. The model aims to identify a set of company stocks and form a portfolio with superior capabilities and returns compared to the market [15]. Consequently, by employing the active portfolio management method and utilizing the network matrix model, it becomes possible to construct a stock portfolio based on different stock and company characteristics. Through performance comparisons, it becomes feasible to determine which stock portfolio selection, based on specific stock or company characteristics, can achieve higher returns [14]. Therefore, this study endeavors to present a proposed new model for stock portfolio selection using the network matrix model based on throughput accounting criteria. This model draws from the theory of constraints and measures company performance from the perspective of value and wealth creation. Furthermore, by comparing its performance with the market portfolio and the portfolio of the new network matrix model, this study aims to facilitate quantitative and qualitative advancements in the analysis, evaluation, and selection of company stocks for portfolio formation, thereby enhancing an active portfolio management strategy.

## 2 Theoretical Foundations and Literature Review

Portfolio selection is one of the most common issues faced by different investors with varying levels of capital, and yet one of the most complex in the financial world. The issue of portfolio selection is a model of balancing risk and return. This involves a set of securities that attempt to determine the proportion of investment in each in order to minimize investment risk and maximize return on investment [28]. In modern portfolio theory, the set of efforts is dedicated to bringing the return of the investor's portfolio closer to the market return and, in the desired situation, to achieve a higher return. In this case, the total market portfolio is an evaluation index whose risk is also measured by the beta risk index (systematic risk), which reflects the sensitivity of the return per share to changes in market returns [24]. If the beta coefficient for a stock is more than one ($\beta > 1$), the return volatility of that stock will be greater than the market fluctuation and it is called high risk (aggressive) stock. Conversely, stocks with a beta of less than one ($\beta < 1$) mean less volatility than market volatility.

These stocks are also called low risk (defensive). A stock with a beta of zero ($\beta = 0$) does not change with market volatility, which means that no relationship can be found between market volatility and the volatility of this stock, and it is called indifferent (neutral) stock. The strategy of grouping stocks in the form of network matrix based on the size of the company and the type of stock (defensive, aggressive and indifferent) is known as the new model of network matrix [20]. Therefore, to select a portfolio based on the new model of the network matrix, the beta coefficient ($\beta$) is used. It changes over time, and this coefficient does not indicate better performance or superiority of stocks over other stocks, but only show the degree of volatility of the returns of two or more stocks relative to the volatility of the market portfolio. Therefore, it seems that the selection of a portfolio based on the beta coefficient (β) criterion can not necessarily lead to the formation of a portfolio with better performance than the market portfolio performance and according to other criteria for evaluating the performance of companies, it is possible to form a stock portfolio that has a higher performance than the portfolio of the new network matrix model and market portfolio. On the other hand, every once in a while, a whole new idea emerges that can make a difference. In the accounting profession, the theory of constraints is the same as change. Some consider accounting based on the theory of constraints as the transfer of a paradigm in management accounting [22]. The main idea of constraint theory is based on managing bottleneck and claims that continuous improvement will be achieved by identifying the production constraints and bottlenecks in the organization. In other words, the main focus of constraint theory is on increasing productivity through recognizing and managing constraints in order to increase the performance of the organization's system or throughput [17]. Constraint theory considers the amounts invested in inventories as a measure of management performance. This theory considers inventories as cash in which the system invests with the intention of selling, and defines the difference between the selling price and the cost of direct materials as "system performance or throughput"[22].

Constraint theory treats direct wage costs and production overhead as a period cost. This is especially true in companies where workers are hired with special skills and cannot be easily fired during a period of declining product demand and re-employed as demand increases. Therefore, the theory of constraints considers these costs as a fixed cost and does not deduct them from the sales amount to calculate the performance of the system (throughput) [17]. Also, in the theory of constraints, buildings and machines (assets) are not considered part of the investment because they have been acquired regardless of the type of production and management performance [23]. System performance (throughput) accounting is a new tool for management accounting that was originally developed to support the theory of constraints [22]. In system performance (throughput) accounting, all costs are fixed, and what matters is the rate at which resources are used to supply raw materials to produce the product. System performance accounting focuses on calculating the rate at which a firm earns (finances) money and aims to focus on maximizing the efficiency per hour of bottlenecks [5]. System performance (throughput), investment in inventories and operating costs are three financial scales that are used in both constraint theory and system performance accounting to evaluate a company's performance. The performance of the system (throughput) is maximized by selling products and services with the highest difference between the selling price and total variable costs (direct material costs) and is also maximized by minimizing the time between consuming resources to produce and receiving money from sales. Therefore, the performance of the system can be determined at the speed set in order to eliminate the delays of constraint theory [22].

Therefore, performance evaluation criteria based on system performance (throughput) accounting, regardless of the inherent limitations in calculating traditional performance evaluation criteria such as gross profit ratio, sales return, earnings per share, etc., as well as the possibility of manipulation by management, can be used as a criterion for Portfolio selection to be used. In this study, performance evaluation criteria based on system performance accounting including system performance (throughput), net profit and return on investments based on constraint theory have been used to classify companies in the network matrix and portfolio formation. Then, the risk-adjusted returns of the mentioned portfolios are compared with the portfolios of the new network matrix model and the market portfolio. In previous studies, portfolio selection based on accounting system performance criteria has not been done using the network matrix model.

Therefore, in the following, to some researches that are indirectly related to the subject of the present research and refers to the selection of a portfolio based on the network matrix model or evaluating the performance of companies based on system performance accounting criteria. Mohamadi et al. [14] in a study using the ordinary least squares (OLS) method, the effect of macroeconomic variables including inflation, interest rate, liquidity growth rate, oil price and exchange rate (Rial equity versus dollar) on the performance (Treynor ratio) of stock portfolio based on the theory of the traditional and modern network was investigated. The results showed that macroeconomic variables affected the performance of both traditional and modern networks at the 5% error level. However, the Akaike criterion value for modern network model is less than the traditional network. It indicated that the interpretation of macroeconomic variables in the portfolio of the modern network was better than that of the traditional network. Also, the effect of the macroeconomic variables on the performance of the six portfolios was different.

Panizzolo [18] in a study examined the relationship between production based on the theory of constraints and the operational performance of the manufacturing companies of 61 European companies. The research results indicate that there are many differences and similarities in the adoption of production methods based on the theory of constraints across countries and it is suggested that production managers should adopt some methods of constraint theory instead of other techniques. In particular, the use of bottleneck methodology, safety inventory and string, and the development of a comprehensive production plan based on constraints and the use of non-limiting resources with additional capacity are the most important ways to increase the competitive performance of manufacturing plants.

Vakilifard et al. [30] in a study compared the efficiency of performance evaluation criteria based on postmodern portfolio theory in ranking selected portfolios based on the network matrix model. The results showed that the perspective ratio criterion has the best efficiency for ranking portfolios compared to the Sortino and Omega criteria.

Khan Mohammadi and Hosseini [8] in a study examined the relationship between performance evaluation criteria based on system performance accounting and traditional cost accounting and cash recovery rates in manufacturing companies. The results showed that traditional criteria and system performance accounting criteria have a significant relationship with cash recovery rate. Comparison of correlation coefficients also shows that traditional criteria are more capable of explaining cash recovery rates than system performance accounting criteria. Nikoomaram et al. [15] in a study compared the performance of selected portfolios based on intellectual capital accounting models using the network matrix model with traditional and modern network models. The results of the research show that according to both Treynor and Sharp performance criteria, compared to the traditional and modern network model, there is a greater correlation between portfolios the selection of a portfolio based on Pulic intellectual capital model with market and so it gives to the investor more return. Other models of measuring intellectual capital are not correlated with the market and research hypotheses about those models have not been confirmed. Jarchi [5] in a study examined the relationship between performance evaluation criteria based on traditional theory and performance evaluation criteria based on system performance accounting with cash value added of companies listed on the Tehran Stock Exchange. Findings show that there is a significant relationship between net operating profit based on system performance accounting and traditional and return on traditional investment with cash value added and these criteria can be used to evaluate the economic performance of companies.

Rahnamay Roodposhti and Mousavi Anzahi [23] in a study compared the performance of portfolios obtained from stock grouping by a network model based on new and traditional variables using Sharp and Treynor indices. The results showed that the performance calculated using the Sharp index for growth portfolio and aggressive portfolio shows higher performance than the market portfolio, but only the performance of growth portfolio calculated by the Treynor index shows higher performance than the market. Rahnamay Roodposhti al. [21] in a study by forming two portfolio groups through two models of network matrix including matrix consisting of growth-value stocks and matrix consisting of defensive-aggressive stocks compared the performance of two portfolios using the upside potential ratio (UPR) and examined the coefficient correlation between the performance of these portfolios and the market. The results indicate that a significant positive correlation is observed between both network matrices, while the performance of the matrix consisting of defensive-aggressive stocks has a higher correlation with the performance index of the market portfolio. Khan Mohammadi [7] in a study to evaluate the performance function of system performance accounting based on the theory of constraints to evaluate the economic performance of manufacturing companies. Findings showed that in most cases, the relationship between traditional criteria (net profit, return on investment and return on equity), criteria based on system performance accounting (net profit and return on investment based on system performance accounting) and market value added is significant with the cash recovery rate and the criteria based on system performance accounting have equal or higher explanatory power in explaining the economic performance than other criteria.

Rahnamay Roodposhti et al. [22] in a study evaluated the ability of indicators based on the theory of constraints in explaining the effects of banks' overdue receivables. In this study, using Vuong test, a pairwise comparison between the explanatory power of performance evaluation criteria based on constraint theory including net profit and return on investment based on system performance accounting with competing criteria (traditional, economic and specific performance of the banking industry). The results show that performance evaluation criteria based on the theory of constraints explain a higher proportion of changes in the rate of delinquent claims between Iranian banks than other common indicators. Mansouri [12] in a study investigated the relationship and correlation between traditional performance evaluation criteria and criteria based on the theory of constraints with value creation indicators (market value added and economic value added) in the Tehran Stock Exchange. The results show that performance evaluation criteria based on system performance accounting in explaining value creation indicators (market value added and economic value added) of the tested companies have increasing information content and can be used to evaluate the performance of companies took advantage.

Lopes et al. [11] in a study using performance evaluation methods as a stock selection strategy in the stock market using the price to earnings per share ratio, beta and volatility of earnings per share as input variables and earnings per share, returns of 12, 36 and 60 months were used as output variables of the performance evaluation method over a period of 10 years or 120 months. They found that the portfolio built using performance evaluation methods performed better than the two Brazilian market indicators. Mehra et al. [13] in a study compared the criteria of traditional accounting performance and the theory of constraints of a production process with a continuous process in an industry. The research findings show that business units using a system based on constraint theory can improve their performance more accurately and thus achieve a stable competitive position in the future. Schadler & Eakins [28] in a study using network analysis model based on size (market value) and risk (standard deviation of daily returns) using data from 5000 companies from 1982 to 1997 formed two groups of portfolios and then compared risk-adjusted returns of high-risk with low-risk portfolios. The results showed that by investing in low risk portfolios, higher risk-adjusted returns are obtained.

## 3 Research Methodology and Hypotheses

According to the objectives of the research and the theoretical foundations of the research, the following hypotheses have been developed in this research:

**Hypothesis 1**: The average performance of portfolios selected based on throughput accounting criteria is higher than portfolios selected based on the new network matrix model.

**Hypothesis 2**: The average performance of selected portfolios based on throughput accounting criteria is higher than the performance of the market portfolio.

**Hypothesis 3**: The ability to explain the market index of selected portfolios based on throughput accounting is more than selected portfolios based on the new network matrix model.

Since the present study intends to present a new model using financial variables to form a stock portfolio and its results can be used in the field of practice and investment analysis, so it is practical in terms of purpose. Because the quantitative data collected in this study is related to events that have occurred in the past, it is temporally retrospective research in terms of descriptive data collection and quantitative research. In addition, because this research reaches an overall conclusion through analysis and inference from partial observations, it is inductive in terms of reasoning. The library method has been used to compile the theoretical foundations and research background and the documentary method has been used to collect the data required to test the hypotheses. Theoretical foundations, research background and financial and non-financial data required for statistical tests of this research have been recorded and collected through the Fish tool. In order to perform calculations and prepare the financial data required for the research, Excel 2016, TopSis SolVer 2014 and MATLAB 2013 software were used and STATA 15 software was used for statistical analysis of the data. To test the hypotheses, inferential statistical methods including Shapiro-Wilk test to examine the normality of variables and non-parametric Mann–Whitney U test to compare the average performance of different portfolios were used. In this study, in terms of easier access to information of companies listed on the Tehran Stock Exchange and the high reliability of this information, the statistical population includes all companies listed on the Tehran Stock Exchange from 2011 to 2018. Statistical sampling was performed by targeted (systematic) elimination method and the following limitations were considered for selecting statistical sample companies:

1) Have been listed on the Tehran Stock Exchange since the beginning of 2008 and have a continuous presence in the stock exchange until the end of 2018;

2) Their fiscal year ends at the end of December of each year;

3) Have not changed their activity or changed their financial year during the research period;

4) The subject of their activity is production.

After applying the above restrictions to the statistical population, 156 companies were selected as the statistical sample.

## 4 Research Modelling

As mentioned before, the network matrix is one of the active portfolio management strategies that can be used to classify companies from two dimensions and select the portfolio based on different characteristics of the company or stocks. To select a portfolio based on the " new network matrix model" at the beginning of each year of the research period, the beta coefficient (β) as a systematic stock risk index using the information of the last 36 months related to the simple daily return of stock price and daily return of market index is calculated. Companies are then divided into three groups based on beta (β) values. Companies that $\beta>1$ are classified as "Aggressive stocks", companies that $\beta<1$ are classified as "Defensive stocks" and companies that $\beta=1$ are classified as "neutral stocks". Then, the size of the companies is calculated based on the market value of the total shares of the companies and is arranged from small to large and is quarter with the help of Excel software. Companies whose market value is in the first quarter, as a "small company"; Companies whose market value is in the second and third quarters are classified as "medium company" and companies whose market value is in the fourth quarter are classified as "big company". As a result, a new network matrix portfolio is formed with 9 separate portfolios as shown in Fig.1.

Aggressive ⟷ Defensive

Stocks Characteristics: **Beta Coefficient (β)**

| Companies Size (Big ↕ Small) | | | |
|---|---|---|---|
| Big | Aggressive - Big | Neutral - Big | Defensive - Big |
| | Aggressive - Medium | Neutral - Medium | Defensive - Medium |
| Small | Aggressive - Small | Neutral - Small | Defensive - Small |

**Fig. 1**: New Network Matrix Portfolio

To select a portfolio based on the "proposed model based on system performance accounting", at the beginning of each year of research period the throughput criteria, net profit based on system performance accounting and return on investments based on system performance accounting as described later are calculated and then the companies are ranked in terms of system performance using the TOPSIS method. Companies are then sorted from small to large based on scores calculated by the TOPSIS method, and are quartered using Excel software. Companies whose system performance rank is in the first quarter, as "low system Performance Company" and companies whose system performance rank is in the second and third quarters, as "medium system Performance Company" and finally, companies with a system performance ranking in the fourth quarter are classified as "high system performance companies". Then, like the new network matrix, companies are classified by size. As a result, the network matrix based on system performance is formed with 9 separate portfolios as described in Fig.2. Of course, it is necessary to mention that the stock weight of each company is considered equal in the portfolios of two models.

Low ⟷ High

Company' System Performance

| Companies Size (Big ↕ Small) | | | |
|---|---|---|---|
| Big | Low performance - Big | Medium performance - Big | High performance - Big |
| | Low performance - Medium | Medium performance - Medium | High performance - Medium |
| Small | Low performance - Small | Medium performance - Small | High performance - Small |

**Fig. 2**: System Performance-Based Network Matrix Portfolio

The variables required to form the portfolios of the new and proposed network matrix model based on system performance are calculated as follows:

**Beta coefficient (β)**: Beta coefficient is a criterion for comparing the intensity of all changes in a company's return with the return of the market index, which is calculated as described in Equation (1) [20].

$$\beta = \frac{Cov_{i,m}}{\sigma_m^2} \quad (1)$$

Where in:

$\mathrm{Cov}_{i,m}$ = Covariance of monthly returns of stocks i and the market over a period of 36 months

$\sigma_m^2$ =The variance of the monthly market returns over a 36-month period

**Throughput (T):** To calculate the throughput, the total variable costs, which according to the concepts of constraints theory are the same as direct materials, must be deducted from sales. Since the direct materials used in the sold goods are considered, by adding the direct materials used in production by reducing (increasing) the share of direct materials in the inventory of the goods at the end of the period compared to the beginning of the period (including goods in process and manufactured goods) according to the estimated percentage of direct materials in the production costs of the product based on the cost information of the research period is obtained as described in relation (2) [4].

$$TVC_{i,t} = MC_{i,t} + \left[\frac{\sum_{t-6}^{t} MC_{i,t}}{\sum_{t-6}^{t} PC_{i,t}} \times \left(IN_{i,t} - IN_{i,t-1}\right)\right] \quad (2)$$

Where in:

$TVC_{i,t}$ = Total variable costs (direct materials of goods sold) of company i in year t

$MC_{i,t}$ = Cost of direct materials consumed of company i in year t

$PC_{i,t}$ = Production costs of company i in year t

$IN_{i,t}$ = Inventory of goods (goods under construction and manufactured goods) of company i in year t

After estimating the direct materials used in the goods sold, by deducting the total variable costs (direct materials of the goods sold) from the sales, the throughput is calculated as described in Equation (3).

$$T_{i,t} = Sale_{i,t} - TVC_{i,t} \quad (3)$$

Where in:

$T_{i,t}$ = Throughput of company i in year t

$Sale_{i,t}$ = Sale of company i in year t

**System Performance Accounting Net Profit (NPT):** To calculate system performance accounting net profit, operating costs based on system performance accounting (direct wage cost, production overhead and operating costs) are deducted from the throughput [4].

$$NPT_{i,t} = T_{i,t} - OE_{i,t} \quad (4)$$

Where in:

$NPT_{i,t}$ = Net profit based system performance accounting of company i in year t

$OE_{i,t}$ = Operating costs based system performance accounting of company i in year t

**Return on investment based on system performance accounting (ROIT):** based on the methodology of constraint theory to calculate investments, direct wages and overhead allocated to goods in process and manufactured goods inventory at the end of the period by estimating the share of conversion cost in the cost of production is determined and deducted from the total assets of the system as described in Equation (5).

$$IT_{i,t} = ASSETS_{i,t} - \left[\frac{\sum_{t-6}^{t} CC_{i,t}}{\sum_{t-6}^{t} PC_{i,t}} \times IN_{i,t}\right] \quad (5)$$

Where in:

$IT_{i,t}$ = Investment based on system performance accounting (adjusted assets) of company i in year t

$CC_{i,t}$ = Conversion costs (direct labor costs and production overhead) of company i in year t

Then, by dividing the net profit based on system performance accounting calculated in the previous stage on investment based on system performance accounting (adjusted assets), the return on investment based on system performance accounting will be obtained [3].

$$ROIT_{i,t} = \frac{NPT_{i,t}}{IT_{i,t}} \quad (6)$$

Where in:

$ROIT_{i,t}$ = Rate of investment based on accounting for system performance of company i in year t

After forming network matrixes and portfolio formation based on the new network model and the proposed network model based on performance accounting criteria, at the beginning of each year of the research period, the performance of the formed portfolios should be measured based on portfolio performance evaluation criteria. The two variables required to measure portfolio performance are risk and return. Therefore, the risk and return of each of the nine portfolios formed based on the two models of the network matrixes, at the end of each year of the research period based on the monthly returns of stocks in the portfolio, is calculated as follows.

**Portfolio return ($r_p$):** is equal to the product of the annual return of each share in the weight of that share in the portfolio, which is calculated as described in Equation (7) [15].

$$r_p = \sum_{i=1}^{n} W_i R_i \tag{7}$$

Where in:

$W_i$ = Weight of shares i in the portfolio

$R_i$ = Annual stock returns i in the portfolio based on the average monthly stock price returns.

**Portfolio risk ($\sigma_p^2$):** According to the number and percentage of each share in each portfolio, portfolio risk is calculated using Markowitz (1952) model as described in Equation (8) [21].

$$\sigma_p^2 = \sum_{i=1}^{n} W_i^2 \sigma_i^2 + \sum_{\substack{i=1 \\ i\neq j}}^{n} \sum_{j=1}^{n} W_i W_j Cov_{i,j} \tag{8}$$

Where in:

$W_j$ = W Stock weight j in portfolio

$\sigma_i^2$ = Variance of monthly stock price returns i during period t

$Cov_{i,j}$ = Covariance of monthly returns of stock prices i and j during period t

**Portfolio Beta ($\beta_p$):** Portfolio beta is calculated based on Sharp (1960) Capital Asset Pricing Model (CAPM) as described in Equation (9) [21].

$$\bar{r}_{p,t} = \bar{r}_f + \beta_p(\bar{r}_{M,t} - \bar{r}_f) \Rightarrow \beta_p = \frac{(\bar{r}_{p,t} - \bar{r}_f)}{(\bar{r}_{M,t} - \bar{r}_f)} \tag{9}$$

Where in:

$\bar{r}_{p,t}$ = Average monthly portfolio returns over period t

$\bar{r}_f$ = Average risk-free rate of return (annual interest rate on government bonds) during the research period

$\bar{r}_{M,t}$ = Average monthly returns of market portfolio during period t

**Return of the market portfolio ($r_M$):** The return of the market portfolio is calculated through the geometric average monthly return of the total index of Tehran Stock Exchange.

$$r_M = \prod_{m=1}^{n} \left(\frac{I_m}{I_{m-1}}\right)^{\frac{1}{n}} - 1 \tag{10}$$

Where in:

$I_m$ = Total stock index at the end of the month

$I_{m-1}$ = Total stock index at the beginning of the month

After calculating the risk, return and beta of the 9 portfolios formed in each of the network matrixes models as well as the return of the market portfolio, the criteria for evaluating the portfolio performance based on modern portfolio theory and postmodern portfolio theory are as follows for each portfolio in each one of the nine cells of network matrixes models (new and proposed based on constraint theory) for each year during the research period is calculated as follows:

**A) Sharpe Ratio Criterion (RVAR):** Sharpe Ratio Criterion (reward to variability ratio) measures the portfolio surplus return for each unit of risk [26].

$$RVAR = \frac{\overline{TR}_p - \bar{R}_f}{SD_p} \tag{11}$$

Where in:

$\overline{TR}_p$ = Average monthly portfolio returns during the year t

$\bar{R}_f$ = Average risk-free rate of return (interest rate on account of government bonds) per month during the research period

$SD_p$ = Standard deviation of monthly portfolio returns during the year t

**B) Treynor ratio criterion (RVOL):** Treynor ratio criterion (reward to volatility ratio) used the beta coefficient as a systematic risk criterion to measure portfolio risk [26].

$$RVOL = \frac{\overline{TR}_p - \bar{R}_f}{\beta_p} \tag{12}$$

Where in:

$\beta_p$ = Systematic portfolio risk index during the year t

**C) Jensen's alpha criterion (α):** is the difference between the expected rate of return of the portfolio and what is expected to be achieved if the portfolio is on the capital market line (CML) [26].

$$\alpha_p = \bar{R}_{p,t} - \left[\bar{R}_f - \left(\bar{R}_{M,t} - \bar{R}_f\right) \beta_p\right] \tag{13}$$

**D) Sortino ratio criterion (SOR):** The Sortino ratio criterion represents the average return of the portfolio over the minimum acceptable return (MAR), which is adjusted with a degree of downside risk of portfolio [9].

$$SOR = \frac{\overline{TR}_p - MAR}{DD} \tag{14}$$

Where in:

MAR = Average risk-free rate of return (interest rate on account of government bonds) per month during the research period

DD = Undesirable deviation from the average risk-free rate of return based on the monthly return on the portfolio as described in relation (15):

$$DD = \left[\frac{1}{n-1}\sum_{i=1}^{n}\left(Max\left\{o, \overline{r_{f,m}} - r_{p,m}\right\}\right)^2\right]^{\frac{1}{2}} \tag{15}$$

Where in:

$r_{p,m}$ = Portfolio returns in month m

$\overline{r_{f,m}}$ = Average monthly risk-free rate of return during the research period

**E) Upside potential ratio criterion (UPR):** The Upside Potential Ratio criterion can be defined as the result of dividing the Upside potential (additional return over the minimum acceptable return) on the downside risk [8]. The relation of calculating the Upside potential criterion is as follows:

$$UPR = \frac{\sum_{T=1}^{T} t^{+}\ \frac{1}{T}(R - MAR)}{[\sum_{T=1}^{T} t^{-} \frac{1}{T}(R - MAR)^2]^{\frac{1}{2}}} \tag{16}$$

Where in:

T = Number of courses (in this study 12 months)

R = Monthly return rate of the portfolio

In relation (16) if R> MAR, t + = 1 and if R <MAR or R = MAR, t + = 0. Also if R <MAR or R = MAR, t- = 1 and if R> MAR, t- = 0.

**F) Omega ratio criterion (Ω):** This criterion divides high returns of the target rate of return into returns lower than the target rate of return [27]. The following formula describes how to calculate it:

$$Omega\ (\Omega) = \frac{\frac{1}{n}\sum_{i=1}^{n} Max[0,(R-MAR)]}{\frac{1}{n}\sum_{i=1}^{n} Min[0,(R-MAR)]} \tag{17}$$

Where in:
Omega = Portfolio omega criteria for year t

After calculating the performance of portfolios based on the criteria of modern portfolio theory (Sharpe, Treynor & Jensen's alpha) as well as postmodern portfolio theory (Sortino, Upside potential & Omega) at the end of each year of the research period, the average performance of 9 and 3 portfolios each network model is compared with other network model portfolios and separately with the market portfolio during the research period through statistical tests.

# 5 Data Analysis

## 5.1 Descriptive Statistics

Table 1 show descriptive statistics of research variables that include information about central tendency indexes (mean and median), dispersion index (standard deviation, skewness and kurtosis) and also the results of Shapiro-Wilk test to evaluate the normality of portfolio performance evaluation criteria in different network models to select the appropriate statistical method.

**Table 1:** Descriptive Statistics of Research Variables

| Network models | | **NNMP** | **TAMP** | **NNMP** | **TAMP** | **NNMP** | **TAMP** |
|---|---|---|---|---|---|---|---|
| Criteria Portfolio' performance | | **(RVAR)** | | **(RVOL)** | | **(ALPHA)** | |
| Mean | | -4.285975 | 0.008481 | -0.009653 | 0.019775 | 0.011007 | 0.024833 |
| Median | | -1.898950 | 0.121900 | -0.008550 | -0.002500 | -0.006350 | 0.003450 |
| Std. Deviation | | 11.7471908 | 4.2670907 | 0.1601129 | 0.0741673 | 0.0586863 | 0.0694851 |
| Skewness | | -4.234085 | -0.2583519 | -0.9384943 | 3.013157 | 0.9875187 | 2.47636 |
| Kurtosis | | 26.95958 | 1.911453 | 24.98283 | 15.73563 | 3.516412 | 12.84129 |
| **Tests of Normality** | Statistic | 0.6175 | 0.9491 | 0.5284 | 0.7074 | 0.9161 | 0.7855 |
| | df | 72 | 72 | 72 | 72 | 72 | 72 |
| | Sig. | 0.0000 | 0.0056 | 0.0000 | 0.0000 | 0.0001 | 0.0000 |
| | Result | non-normal | non-normal | non-normal | non-normal | non-normal | non-normal |
| Network models | | **NNMP** | **TAMP** | **NNMP** | **TAMP** | **NNMP** | **TAMP** |
| Criteria Portfolio' performance | | **(SOR)** | | **(UPR)** | | **(OMEGA)** | |
| Mean | | .271800 | .414058 | .917389 | 1.140329 | 1.587471 | 2.381124 |
| Median | | -.179000 | .019050 | .474200 | .726900 | .714550 | 1.027150 |
| Std. Deviation | | 1.6487149 | 1.0355258 | 1.6457710 | 1.5420120 | 2.3360730 | 3.8561085 |
| Skewness | | 5.862018 | 2.122836 | 6.29661 | 5.252605 | 3.720196 | 4.922681 |
| Kurtosis | | 43.23464 | 8.706 | 47.73466 | 37.15306 | 20.16965 | 33.23976 |
| **Tests of Normality** | Statistic | 0.4521 | 0.7668 | 0.3974 | 0.5006 | 0.5907 | 0.4999 |
| | df | 72 | 72 | 72 | 72 | 72 | 72 |
| | Sig. | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | Result | non-normal | non-normal | non-normal | non-normal | non-normal | non-normal |
| **NNMP:** New Network Matrix' Portfolios | | | | | | | |
| **TAMP:** Throughput Accounting Matrix ' Portfolios | | | | | | | |

**Source:** Research Findings

## 5.2 Inferential Statistics

Considering that in Table 1 the significance level of Shapiro-Wilk test for all performance evaluation criteria in the two groups of portfolios is less than the acceptable level of research error which is considered 0.05, as a result The null hypothesis of Shapiro-Wilk test can be rejected and it can be concluded that the distribution of performance evaluation criteria of portfolios in the two groups is not normal with

95% confidence. Therefore, non-parametric statistical methods, namely U-Mann-Whitney test, should be used to test the equality of the average performance evaluation criteria of the formed portfolios. The statistical hypotheses of U-Mann-Whitney nonparametric test to compare the average performance of 9 portfolios formed in the proposed network matrix model based on system performance evaluation criteria with 9 portfolios formed in the new network matrix model during 8 years in the first hypothesis of the research are as follows:

$$\begin{cases} H_0: \mu_{\mathbf{TAMP}} = \mu_{\mathbf{NNMP}} \\ H_1: \mu_{\mathbf{TAMP}} \neq \mu_{\mathbf{NNMP}} \end{cases}$$

The results of Mann-Whitney U test for testing the first hypothesis of the research are described in Table 2.

**Table 2:** Comparison of the Performance of TAMP (9 Portfolio) with the Performance of NNMP (9 Portfolio)

| Mann-Whitney U test statistics | | | | | | | |
|---|---|---|---|---|---|---|---|
| Test' Statistics | | RVAR | RVOL | ALPHA | SOR | UPR | Omega |
| Mann-Whitney U | | 1922.000 | 2167.000 | 2168.000 | 2088.500 | 2030.500 | 2066.500 |
| Wilcoxon W | | 4550.000 | 4795.000 | 4796.000 | 4716.500 | 4658.500 | 4694.500 |
| Z | | -2.677 | -1.698 | -1.694 | -2.012 | -2.243 | -2.100 |
| Asymp. Sig. (2-tailed) | | 0.0074 | 0.0895 | 0.0902 | 0.0442 | 0.0249 | 0.0358 |
| Results | | **Significantly Different** | Not Statistically Different | Not Statistically Different | **Significantly Different** | **Significantly Different** | **Significantly Different** |
| Mean Rank | **NNMP** | 63.19 | 66.60 | 66.61 | 65.51 | 64.70 | 65.20 |
| | **TAMP** | 81.81 | 78.40 | 78.39 | 79.49 | 80.30 | 79.80 |

**Source:** Research Findings

As can be seen in Table 2, the significance level of Mann-Whitney U test statistic for Sharpe (RVAR), Sortino (SOR), Upside potential (UPR) and Omega criteria is less than 0.05, so the hypothesis $H_0$ is rejected and it is concluded that the average performance of the portfolios formed in the two models are significantly different. Since the mean ranks of throughput Accounting Matrix' portfolios (TAMP) for the above criteria are higher than the mean ranks of the performance of the new network matrix' portfolios (NNMP), so we can concluded in 95% confidence level that the average performance of the throughput Accounting Matrix' portfolios (TAMP) evaluation criteria is higher and has better performance than the new network matrix' portfolios (NNMP).

**Table 3:** Comparison of the Performance of "High System Performance" (3 Portfolio) with the Performance of NNMP (9 Portfolio)

| Mann-Whitney U test statistics | | | | | | | |
|---|---|---|---|---|---|---|---|
| Test' Statistics | | RVAR | RVOL | ALPHA | SOR | UPR | Omega |
| Mann-Whitney U | | 526.000 | 713.500 | 614.000 | 613.000 | 592.000 | 609.000 |
| Wilcoxon W | | 3154.000 | 3341.500 | 3242.000 | 3241.000 | 3220.000 | 3237.000 |
| Z | | -2.860 | -1.273 | -2.115 | -2.124 | -2.301 | -2.158 |
| Asymp. Sig. (2-tailed) | | 0.0042 | 0.2029 | 0.0344 | 0.0337 | 0.0214 | 0.0310 |
| Results | | **Significantly Different** | Not Statistically Different | **Significantly Different** | **Significantly Different** | **Significantly Different** | **Significantly Different** |
| Mean Rank | **NNMP** | 43.81 | 46.41 | 45.03 | 45.01 | 44.72 | 44.96 |
| | **TAMP HP** | 62.58 | 54.77 | 58.92 | 58.96 | 59.83 | 59.13 |

**Source:** Research Findings

Therefore, the first hypothesis of the research is confirmed. Also, the portfolios of the proposed network model based on throughput Accounting (TAMP) regardless of company size (small, medium and large) are divided into three groups of portfolios (high, medium and low system performance). Then due to the no normality distribution of the performance criteria in the two samples, their performance' average separately compared with the nine portfolios of the new network matrix model by Mann-Whitney U test during the research period, that results of which are described in Tables 3, 4 and 5.

As can be seen in Table 3, the significance level of Mann-Whitney U test statistic for Sharpe (RVAR), Jensen's alpha (ALPHA), Sortino (SOR), Upside potential (UPR) and Omega criteria is less than 0.05, so the $H_0$ hypothesis is rejected and it is concluded that the average performance of the portfolios formed in the two models are significantly different. Since the mean rank of the three portfolios of the throughput Accounting Matrix' portfolios (TAMP) with high system performance (small, medium and large size) for the above criteria is higher than the mean rank of the nine portfolios of new network matrix' portfolios (NNMP), so at 95% confidence level, it can be concluded that the average performance of the portfolios of the throughput Accounting Matrix' portfolios (TAMP) with high system performance (small, medium and large) is higher and better performance than the nine portfolios of new network matrix' portfolios (NNMP).

**Table 4:** Comparison of the Performance of "Medium System Performance" (3 Portfolio) with the Performance of NNMP (9 Portfolio)

| **Mann-Whitney U test statistics** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Test' Statistics | | RVAR | RVOL | ALPHA | SOR | UPR | Omega |
| Mann-Whitney U | | 665.000 | 706.000 | 725.000 | 734.500 | 702.000 | 720.500 |
| Wilcoxon W | | 3293.000 | 3334.000 | 3353.000 | 3362.500 | 3330.000 | 3348.500 |
| Z | | -1.684 | -1.337 | -1.176 | -1.096 | -1.371 | -1.214 |
| Asymp. Sig. (2-tailed) | | 0.0922 | 0.1813 | 0.2395 | 0.2732 | 0.1705 | 0.2247 |
| Results | | Not Statistically Different | Not Statistically Different | Not Statistically Different | Not Statistically Different | Not Statistically Different | Not Statistically Different |
| Mean Rank | **NNMP** | 45.74 | 46.31 | 46.57 | 46.70 | 46.25 | 46.51 |
| | **TAMP MP** | 56.79 | 55.08 | 54.29 | 53.90 | 55.25 | 54.48 |

**Source:** Research Findings

**Table 5:** Comparison of the Performance of "Low System Performance" (3 Portfolio) with the Performance of NNMP (9 Portfolio)

| **Mann-Whitney U test statistics** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Test' Statistics | | RVAR | RVOL | ALPHA | SOR | UPR | Omega |
| Mann-Whitney U | | 731.000 | 747.500 | 813.000 | 741.000 | 736.500 | 737.000 |
| Wilcoxon W | | 3359.000 | 3375.500 | 3441.000 | 3369.000 | 3364.500 | 3365.000 |
| Z | | -1.125 | -0.986 | -0.432 | -1.041 | -1.079 | -1.075 |
| Asymp. Sig. (2-tailed) | | 0.2604 | 0.3243 | 0.6661 | 0.2980 | 0.2807 | 0.2826 |
| Results | | Not Statistically Different | Not Statistically Different | Not Statistically Different | Not Statistically Different | Not Statistically Different | Not Statistically Different |
| Mean Rank | **NNMP** | 46.65 | 46.88 | 47.79 | 46.79 | 46.73 | 46.74 |
| | **TAMP LP** | 54.04 | 53.35 | 50.63 | 53.63 | 53.81 | 53.79 |

**Source:** Research Findings

As can be seen in Tables 4 and 5, the significance level of Mann-Whitney U test statistic for all portfolio performance evaluation criteria is greater than 0.05, so the $H_0$ hypothesis is not rejected and it is concluded that the average portfolio performance has not significant difference between the two models. Therefore, it can be concluded at 95% confidence level that the average performance of the proposed throughput Accounting Matrix' portfolios (TAMP) that have medium system performance (TAMP MP) and low system performance (TAMP LP) (small, medium and large size) with the average performance of the portfolios of the new network matrix model (NNMP) is equal.

Also, the statistical hypotheses of Mann-Whitney non-parametric test to compare the average performance of 9 portfolios formed in the proposed throughput Accounting Matrix' portfolios (TAMP) with market portfolio performance over 8 years in the second hypothesis of the research are as follows:

$$\begin{cases} H_0: \mu_{\mathbf{TAMP}} = \mu_{MP} \\ H_1: \mu_{\mathbf{TAMP}} \neq \mu_{MP} \end{cases}$$

The results of Mann-Whitney U test for testing the second hypothesis of the research are as described in Table 6.

**Table 6:** Comparison of the Performance of TAMP (9 Portfolio) with the Market Portfolio Performance

| **Mann-Whitney U test statistics** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Test' Statistics | | RVAR | RVOL | ALPHA | SOR | UPR | Omega |
| Mann-Whitney U | | 280.000 | 228.000 | 239.000 | 287.000 | .000 | .000 |
| Wilcoxon W | | 316.000 | 2856.000 | 2867.000 | 323.000 | 36.000 | 36.000 |
| Z | | -0.128 | -0.962 | -0.786 | -0.016 | -4.619 | -4.619 |
| Asymp. Sig. (2-tailed) | | 0.8979 | 0.3359 | 0.4320 | 0.9872 | 0.0000 | 0.0000 |
| Results | | Not Statistically Different | Not Statistically Different | Not Statistically Different | Not Statistically Different | **Significantly Different** | **Significantly Different** |
| Mean Rank | **TAMP** | 40.61 | 39.67 | 39.82 | 40.51 | 44.50 | 44.50 |
| | **MP** | 39.50 | 48.00 | 46.63 | 40.38 | 4.50 | 4.50 |

**Source:** Research Findings

**Table 7:** Comparison of the Performance of "High System Performance" (3 Portfolio) with the Market Portfolio Performance

| **Mann-Whitney U test statistics** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Test' Statistics | | RVAR | RVOL | ALPHA | SOR | UPR | Omega |
| Mann-Whitney U | | 72.000 | 81.000 | 94.000 | 72.000 | .000 | .000 |
| Wilcoxon W | | 108.000 | 381.000 | 394.000 | 108.000 | 36.000 | 36.000 |
| Z | | -1.044 | -0.653 | -0.087 | -1.044 | -4.178 | -4.178 |
| Asymp. Sig. (2-tailed) | | 0.2963 | 0.5139 | 0.9306 | 0.2963 | 0.0000 | 0.0000 |
| Results | | Not Statistically Different | Not Statistically Different | Not Statistically Different | Not Statistically Different | **Significantly Different** | **Significantly Different** |
| Mean Rank | **MP** | 13.50 | 18.38 | 16.75 | 13.50 | 4.50 | 4.50 |
| | **TAMP HP** | 17.50 | 15.88 | 16.42 | 17.50 | 20.50 | 20.50 |

**Source:** Research Findings

**Table 8:** Comparison of the Performance of "Medium System Performance" (3 Portfolio) with the Market Portfolio Performance

| **Mann-Whitney U test statistics** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Test' Statistics | | RVAR | RVOL | ALPHA | SOR | UPR | Omega |
| Mann-Whitney U | | 96.000 | 75.000 | 76.000 | 92.000 | .000 | .000 |
| Wilcoxon W | | 132.000 | 375.000 | 376.000 | 392.000 | 36.000 | 36.000 |
| Z | | 0.000 | -0.914 | -0.870 | -0.174 | -4.178 | -4.178 |
| Asymp. Sig. (2-tailed) | | 1.0000 | 0.3608 | 0.3841 | 0.8618 | 0.0000 | 0.0000 |
| Results | | Not Statistically Different | Not Statistically Different | Not Statistically Different | Not Statistically Different | **Significantly Different** | **Significantly Different** |
| Mean Rank | **MP** | 16.50 | 19.13 | 19.00 | 17.00 | 4.50 | 4.50 |
| | **TAMP MP** | 16.50 | 15.63 | 15.67 | 16.33 | 20.50 | 20.50 |

**Source:** Research Findings

As can be seen in Table 6, the significance level of the Mann-Whitney U test statistic for upside potential (UPR) and omega criteria is less than 0.05, so hypothesis $H_0$ is rejected and it is concluded that the mean the performance of the portfolios formed in the two models are significantly different. Since the mean ranks of throughput Accounting Matrix' portfolios (TAMP) for the above criteria are higher than the mean ranks of the performance of the market portfolio (MP), so we can conclude in 95% confidence level that the average performance of the throughput Accounting Matrix' portfolios (TAMP) evaluation criteria is higher and has better performance than the market portfolio (MP). Therefore, the second hypothesis of the research is confirmed. Also, the results of comparing the average performance of the three portfolios with high, medium and low system performance with the performance of the market portfolio during 8 years are described in Tables 7, 8 and 9.

**Table 9:** Comparison of the Performance of "Low System Performance" (3 Portfolio) with the Market Portfolio Performance

| **Mann-Whitney U test statistics** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Test' Statistics | | RVAR | RVOL | ALPHA | SOR | UPR | Omega |
| Mann-Whitney U | | 80.000 | 72.000 | 73.000 | 77.000 | .000 | .000 |
| Wilcoxon W | | 380.000 | 372.000 | 373.000 | 377.000 | 36.000 | 36.000 |
| Z | | -0.696 | -1.044 | -1.001 | -0.827 | -4.178 | -4.178 |
| Asymp. Sig. (2-tailed) | | 0.4862 | 0.2963 | 0.3169 | 0.4083 | 0.0000 | 0.0000 |
| Results | | Not Statistically Different | Not Statistically Different | Not Statistically Different | Not Statistically Different | **Significantly Different** | **Significantly Different** |
| Mean Rank | **MP** | 18.50 | 19.50 | 19.38 | 18.88 | 4.50 | 4.50 |
| | **TAMP LP** | 15.83 | 15.50 | 15.54 | 15.71 | 20.50 | 20.50 |

**Source:** Research Findings

As can be seen in Tables 7, 8 and 9, the significance level of Mann-Whitney U test statistic for optimal Upside potential (UPR) and omega in all three groups of three portfolios with high, medium and low system performance are less than 0.05, so the $H_0$ hypothesis is rejected and it is concluded that the average performance of the portfolios formed in the two models are significantly different.
Since the mean rank of the three portfolios of the throughput Accounting Matrix' portfolios (TAMP) in all three groups of triple portfolios have high, medium and low system performance (small, medium and large size) for the above criteria is higher than the mean rank of the market portfolio (MP), so at 95% confidence level, it can be concluded that the average performance of the portfolios of the throughput Accounting Matrix' portfolios (TAMP) with high system performance (TAMP HP), medium (TAMP MP) and low system (TAMP LP) (small, medium and large size) is higher and better performance than the market portfolio (MP). To test the third hypothesis, the correlation coefficient (R) between the average annual performance evaluation criteria (Sharpe, Treynor, Jensen's alpha, Sortino, Upside potential & Omega) of the 9 portfolios formed in the proposed throughput Accounting Matrix' portfolios (TAMP) and new network matrix' portfolios (NNMP) is calculated separately with the performance of the market portfolio (MP) for 8 years and then if the value of correlation coefficient (R) is significant by comparing its value in two models of network matrix (TAMP& NNMP) regarding rejection or non-rejection the third hypothesis. The statistical hypothesis of the third hypothesis is as follows:

$$\begin{cases} H_0: \rho_{TAMP} \leq \rho_{MNMP} \\ H_1: \rho_{TAMP} > \rho_{MNMP} \end{cases}$$

The results of Pearson correlation coefficient test for testing the third hypothesis of the research are described in Table 10. As can be seen in Table 10, the correlation coefficient with the market portfolio performance for the Sharpe (RVAR), Treynor (RVOL), Sortino (SOR) and upside potential (UPR) criteria for triple portfolios with low system performance (small, medium and large size) (TAMP LP) formed in the proposed throughput Accounting Matrix' portfolios (TAMP) is greater than the correlation coefficient of the nine portfolios formed in the new network matrix' portfolios (NNMP), which shows the ability to further explain the market index by triple portfolios with low system performance (small, medium and large size) (TAMP LP) formed in the proposed network matrix model is based on system performance. Therefore, the third hypothesis of the research is confirmed.

**Table 10:** Comparison of the Correlation Coefficient TAMP & NNMP Performance with the Performance of the Market Portfolio

| Pearson's correlation coefficient | | | | | | | |
|---|---|---|---|---|---|---|---|
| Network matrix' models | | 9 Portfolios | | 3 Portfolios | | | Superior model |
| | | NNMP | TAMP | TAMP HP | TAMP MP | TAMP LP | |
| RVAR | Pearson Correlation | 0.7147* | 0.6257 | 0.4843 | 0.2868 | 0.8706** | TAMP LP |
| | Sig. (2-tailed) | 0.0464 | 0.0970 | 0.2239 | 0.4911 | 0.0049 | |
| | N | 8 | 8 | 8 | 8 | 8 | |
| RVOL | Pearson Correlation | 0.5440 | 0.4474 | 0.1168 | 0.1494 | 0.8904** | TAMP LP |
| | Sig. (2-tailed) | 0.1634 | 0.2663 | 0.7830 | 0.7241 | 0.0030 | |
| | N | 8 | 8 | 8 | 8 | 8 | |
| ALPHA | Pearson Correlation | 0.9534** | 0.8820** | 0.7005 | 0.7659* | 0.9490** | NNMP |
| | Sig. (2-tailed) | 0.0002 | 0.0037 | 0.0530 | 0.0267 | 0.0003 | |
| | N | 8 | 8 | 8 | 8 | 8 | |
| SOR | Pearson Correlation | 0.7860* | 0.7714* | 0.6757 | 0.6300 | 0.8718** | TAMP LP |
| | Sig. (2-tailed) | 0.0204 | 0.0250 | 0.0659 | 0.0941 | 0.0048 | |
| | N | 8 | 8 | 8 | 8 | 8 | |
| UPR | Pearson Correlation | 0.7620* | 0.7116* | 0.5997 | 0.6544 | 0.8696** | TAMP LP |
| | Sig. (2-tailed) | 0.0280 | 0.0478 | 0.1161 | 0.0783 | 0.0050 | |
| | N | 8 | 8 | 8 | 8 | 8 | |
| Omega | Pearson Correlation | 0.8460** | 0.7630* | 0.6296 | 0.7092* | 0.8608** | TAMP LP |
| | Sig. (2-tailed) | 0.0081 | 0.0277 | 0.0944 | 0.0488 | 0.0061 | |
| | N | 8 | 8 | 8 | 8 | 8 | |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | | | | |
| *. Correlation is significant at the 0.05 level (2-tailed). | | | | | | | |

**Source:** Research Findings

Finally, to select the superior model of portfolio formation, the average performance of 9 and 3 portfolios, the proposed network matrix model with low, medium and high system performance (small, medium and large size) with average portfolio performance the nine models of new network matrix model and market portfolio performance during the research period (2011-2018) have been compared through Kruskal-Wallis test, the results of which are described in Table 11.

**Table 11:** Comparison of the Performance of TAMP with NNMP & Market Portfolio

| Kruskal-Wallis Test Statistics | | | | | | | |
|---|---|---|---|---|---|---|---|
| Test' Statistics | | RVAR | RVOL | ALPHA | SOR | UPR | Omega |
| Kruskal-Wallis H | | 12.179 | 5.528 | 7.022 | 7.289 | 30.238 | 29.458 |
| df | | 5 | 5 | 5 | 5 | 5 | 5 |
| Asymp. Sig. (2-tailed) | | 0.0324 | 0.3549 | 0.2190 | 0.2001 | 0.0001 | 0.0001 |
| Results | | **Significantly Different** | Not Statistically Different | Not Statistically Different | Not Statistically Different | **Significantly Different** | **Significantly Different** |
| Mean Rank | **NNMP** | 93.08 | 99.22 | 99.26 | 97.58 | 100.75 | 101.78 |
| | **TAMP** | 121.92 | 117.57 | 117.35 | 119.51 | 124.30 | 123.80 |
| | **MP** | 117.75 | 140.81 | 135.38 | 120.63 | 5.88 | 5.63 |
| | **TAMP HP** | 138.75 | 120.23 | 132.79 | 133.29 | 136.83 | 136.13 |
| | **TAMP MP** | 117.63 | 117.96 | 115.75 | 114.40 | 120.92 | 119.73 |
| | **TAMP LP** | 109.38 | 114.52 | 106.50 | 110.83 | 115.15 | 115.54 |

**Source:** Research Findings

As can be seen in Table 11, the significance level of Kruskal-Wallis H test statistic for Sharpe

(RVAR), upside potential (UPR) and Omega criteria is less than 0.05, so $H_0$ hypothesis is rejected and the result It is found that the average performance of the portfolios formed in the 6 models are significantly different. Since the mean rank of the portfolios of the proposed throughput Accounting Matrix' portfolios (TAMP) that have high system performance (with small, medium and large size) for the above criteria is greater than the other portfolios, so at 95% confidence level, it can be concluded that the average performance of the portfolios of the throughput Accounting Matrix' portfolios (TAMP) with high system performance (TAMP HP), is higher and better than other portfolios in other models and market portfolios.

## 6 Discussion and Conclusion

One of the active portfolio management strategies is the network analysis model, which uses it to classify companies' stocks based on various characteristics such as growth or value, defensive or aggressive stocks, etc., and based on that, portfolio formed. The purpose of this study is to present a proposed new model of stock portfolio selection using the network matrix model based on accounting system performance criteria (throughput, net profit and return on investment) which is based on the theory of constraints and measure the company's performance based on value-added and wealth creation perspective. The results show that the average performance of the portfolios formed according to the proposed model of network analysis based on system performance accounting is higher than the new model of network analysis, in terms of criteria sharpe, sortino, upside potential and omega. Also, portfolios formed of stocks of high-performance system companies have higher performance in terms of Sharpe, Jensen's alpha, Sortino, upside potential and Omega criteria compared to the new network model. In addition, the portfolios formed according to the proposed network analysis model based on system performance accounting have higher performance than the market portfolio in terms of upside potential and omega criteria.

Finally, by comparing all portfolios to select the Superior portfolio model, portfolios consisting of stocks of high-performance system companies have better performance in terms of Sharpe, upside potential and omega criteria, compared to other formed portfolios and market portfolios. Therefore, it can be concluded that companies that have been able to achieve higher system performance with proper management of their system constraints and optimal investment in inventories and assets and control of operating costs, in the future will have a better risk-adjusted return on capital. In addition, the results of comparing the performance correlation of the formed portfolios according to the proposed model of network analysis based on system performance accounting in comparison with the new network analysis model show that portfolios consisting of stocks of companies with low system performance have a stronger correlation with performance of market portfolio.

Based on the research findings, it can be suggested to investors that due to the higher performance of portfolios formed based on the proposed model of network analysis based on accounting performance criteria compared to the new model of network analysis, to form their portfolios, using the evaluation criteria Performance based on system performance accounting (throughput, net profit and return on investment), which shows the management of constraints and the ability of the company to create added value and cash in the future, as a criterion for classifying and selecting stocks to form a portfolio. In particular, use the stocks of companies with high system performance to gain more returns. It is also suggested to investors who want to get a return commensurate with the return of the market portfolio as an alternative model to use the proposed model of network analysis based on accounting system performance criteria and by forming a portfolio of shares of companies with low system performance so that get a return more in line with the market portfolio compared to the new model of network analysis.

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