Formation Of A Stock Portfolio And Improving Its Performance Using The Genetic Algorithm

Analytical Research In The Iraqi Stock Market

تشكيل محفظة الاسهم و تحسين ادائها باستعمال الخوارزمية الوراثية

بحث تحليلي مقارن في سوق العراق للأوراق المالية

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Abstract

The aim of the study is to build a stock portfolio based on the companies listed in the Iraq Stock Exchange under the traditional financial methods and using the genetic algorithm at other times, as the time period for the sampling was chosen from 2008-2020, depending on the monthly closing prices of the research sample companies, as their number reached 43 companies in the light of meeting the conditions of data completeness and stability of the time series, and through the reference review of previous studies, as it identified the areas of shortcomings in light of working with data that suffers from dispersion, instability and missing data, which will be reflected in the failure to reflect the reality of trading properly and ended The study using the of genetic algorithm, and accordingly, portfolios were presented and the optimal ones were selected, as well as the generation of multiple optimal portfolios in light of abnormal data, and the genetic algorithm was also used to re-weight the assets of the portfolio, which generated many portfolios, which outperformed the traditional portfolios. The study came out with two main portfolios, the first using traditional financial tools and the second using the genetic algorithm. This result indicated the possibility of pairing technical concepts with financial ones.

Keywords: optimal portfolio, genetic algorithm

المستخلص

هدف الدراسة الى بناء محفظة الاسهم العادية بالاعتماد على الشركات المدرجة في سوق العراق للأوراق المالية في ظل الاساليب المالية التقليدية وباستعمال الخوارزمية الوراثية تارة اخرى، اذ تم اختيار الفترة الزمنية للمعاينة من 2008–2020 وذلك بالاعتماد على اسعار الاغلاق الشهرية للشركات عينة البحث اذ بلغ تعدادها 43 شركة في ضوء تلبيتها لشروط اكتمال البيانات واستقراريه السلسلة الزمنية، ومن خلال المراجعة المرجعية للدراسات السابقة اذ حددت مكامن القصور في ظل العمل ببيانات تعاني من التشتت وعدم الاستقرار وفقدان البيانات والامر الذي سينعكس على عدم عكس واقع التداول بشكل سليم وانتهت الدارسة باستعمال ادارة الخوارزمية الوراثية، وعليه تم تقديم محافظ واختيار الامثل منها وكذا توليد محافظ مثلى متعددة في ظل البيانات الشاذة وكذا تم استعمال الخوارزمية الوراثية في اعادة وزن موجودات المحفظة والتي ولدت العديد من المحافظ والتي تفوقت بأدائها على المحافظ التقليدية، خرجت الدراسة بمحفظتين اساسيتين الاولى باستعمال الادوات المالية التقليدية والثانية باستعمال الخوارزمية الوراثية وقد اشرت هذه النتيجة امكانية مزاوجة المفاهيم التقنية مع المالية.

الكلمات المفتاحية : المحفظة المثلى ، الخوارزمية الوراثية

Introduction

Profitable investment portfolios are designed and managed by employing the intellectual premises of the Modern Portfolio Theory, which describes the mechanism of investment in the financial markets, Behavioral Finance theories that focus on the behavior of investors in those markets, and this means that both entries represent different schools of thought and the level of analysis, as portfolio theory is concerned with describing investment in financial markets and a description that may be associated with percentage idealism, starting with the contributions of (Markowitz, 1952) and passing through the contributions of (Fama, 1963), who in turn established the birth of the efficient financial market theory after he assumed the efficiency of the financial market in which the decisions of investors are characterized by rationality and rationality according to the availability and supply of information available to all as a basis according to which prices move close to their real value that is difficult to achieve Unusual returns due to the absence of insiders who can better and more accurately predict stock prices and returns due to the correct confidential information that is not public and is supposed to be in their full possession at the right time and with the required accuracy, Perhaps this assumption is contrary to reality, as not every investor is aware of the same amount of information in terms of quantity, quality, and timing, not to mention that it is not always possible to accept the possibility of absolute rationality for the investor, as it is a relative concept based on the words of (Simon, 1960).

The current research was directed towards addressing multiple and vast issues that require detailed study and in-depth analysis of the reality of investment in all its aspects, The research dealt with the possibility of improving the performance of the optimal portfolio through the use of the multi- genetic algorithm tool through the redistribution of wealth among the assets that make up the portfolio, In accordance with the preferences of the investor based on the best combination of assets within the optimal portfolio in light of the conditions of the Iraqi market for securities, as an attempt to achieve the best correct trade-off between return and risk, which is considered the goal sought by all studies, whether as a motive for the research or as a result that the researchers wanted to reach. The review of the foundations culminated in diagnosing the knowledge gap and identifying shortcomings at the level of experimentation. The current research destination was an embodiment of the unobserved and untreated aspects by other researchers. It was characterized by missing data and was framed by the randomness of data and the failure of stock prices to reflect the reality of trading and investment at the level of companies and the financial market after that concluded by employing the multi- genetic algorithm tool, Thus, it is either limited to building portfolios and selecting the optimal ones, or generating optimal portfolios without paying attention to the issue of processing missing data in the data series, or neglecting the possibility of generating investment portfolios and classifying them as optimal according to the investor's preferences. And others employed the genetic algorithm without linking it to the two goals of the portfolio of return and risk, which helped to give birth to the idea of the current research by employing multi-objective programming in achieving the correct exchange between return and risk. on this basis, the aim of the current research is to build an optimal portfolio in light of the original data at times and at times using the multi- genetic algorithm.

Presenting the means that ensure obtaining the optimal portfolio that achieves the best correct trade-off between return and risk in light of the challenges of the existence of divergent preferences for investors on the one hand, and the lack of clarity of information provided by the Iraq Stock Exchange on the other hand.

The First Topic-Review of The Foundations

First: The Theoretical Background of The Investment Portfolio

1- Investment Portfolio:

Work began towards the scientific organization of the issue of the investment portfolio and directing it towards the scientific frameworks that are informed by the work of (Harry Markowitz) and framed in his article published in (1952) entitled "Choosing a Portfolio", The portfolios formed in the aforementioned contribution were referred to as naive diversification and centered around increasing the number of the investor's holdings in order to avoid the risk that afflicts his assets (Levišauskait, 2010:51). Whereas, the efficient diversification referred to in the modern portfolio theory that enabled investment portfolio managers to refine the huge amount of information flowing from the corridors of financial markets in light of the two dimensions of return and risk and the interrelationship between them (Saltuk & el idrissi, 2012: 8) The efficient curve shown in Figure (1) expresses those portfolios that achieve the best correct exchange between return and risk, which represents the group of portfolios that maximize return for each level of risk or reduce risk for each level of return (Halicki & Uphaus, 2014:102), and More precisely, the efficient limit is defined as the group of portfolios that maximize the return with a certain standard deviation (Jordan & Miller, 2009:368). As the efficient limit provides the answer to the basic question in forming any portfolio, how can the best level of diversification be determined, or in other words, what is the best exchange that can be obtained between return and risk? This means that the efficient limit is a curve that shows the different exchanges between return and risk for a group of portfolios. The first starting point is to place the portfolio on the efficient limit, and this can only be achieved in light of meeting the basic condition expressed by the ability of any portfolio to maximize return for a certain level of risk. Or lower risk to a target level of return (Kierkegaard et al, 2006:13).

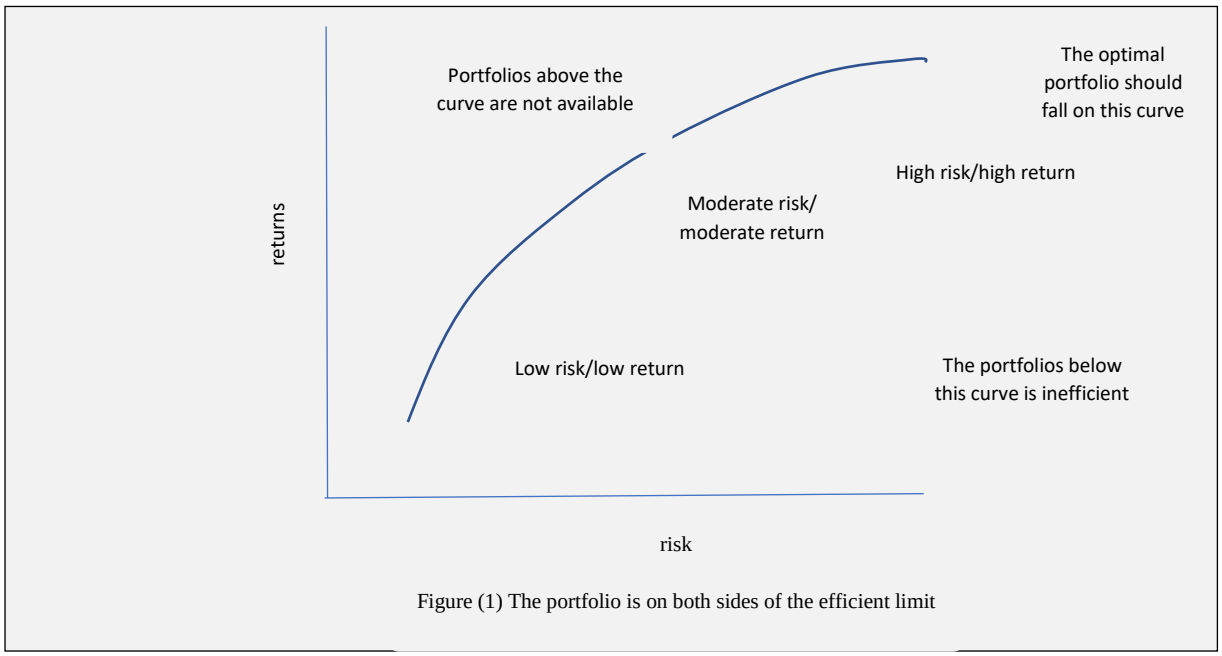

Figure (1) The portfolio is on both sides of the efficient limit

Source: Kierkegaard, Kristian & Lejon , Carl & Persson, Jakob (2006), Practical Application of Modern Portfolio Theory, Bachelor's Thesis within Business Administration, international business school, JÖNKÖPING university, p13 .

2- Portfolio Return: Concept and Measurement:

a- Individual Stock Return:

The daily changes in the values of securities, which depend on the closing prices, indicate capital gains, as they are the profits generated from the sale of capital assets such as stocks and lands (McClelland, 2017:1) (Evans, 2015:8), as it is the percentage of price changes in securities prices Financial to represent price returns, which is the return that is measured across the investment time horizon, which may be a day, a month, or one year. The choice of the time horizon for investment depends on the approved application mechanism (Ang, 2015:52), so the daily rate of return is It is the difference between the closing price for a previous period and a subsequent one, which is calculated through equation No. (1) as follows (Ghodratia & Zahiri, 2014: 468):

$$R_{i,t} = \left(\frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}}\right) \quad \ldots\ldots.(1)$$

Since: P_{it}: i^{th} share price during day t^{th}

P_{it-1} : i^{th} share price during the day $(t-1)^{th}$

$R_{i,t}$: The i^{th} return per share for the day t^{th}

A number of other researchers went to estimate the return of individual stocks more accurately by linking it to the amount of change or risk to the return of the market index through the one-index model known as the (Sharpe) model, and as shown by Equation No. (2) (KAMIL, 2003:2):

$$\overline{R}_i = \alpha_i + \beta_i \overline{R}_m \ldots\ldots\ldots (2)$$

Since: $\bar{R}_i$: expected return per share i

A_i : earnings per share i

B_i: the amount of change in the return of the stock R_i relative to the change in the return of the market index R_m

$\bar{R}_m$: average return of the market index

b- Portfolio Return:

And since the portfolio is a group of assets linked to each other by a linear relationship, its return is expressed as a function of the returns of the assets that make up the portfolio, as shown by equation (3):

$$R_{pt} = \sum_i^n x_{it} R_{it} \ldots\ldots (3)$$

Since: R_{it}: the return of the asset i during the period

X_{it}: the weight of the i item in the portfolio

3- Portfolio Risk: Concept and Measurement:

Portfolio theory introduced the concepts of unsystematic and systemic risk (Aven & Vinnem, 2007:29). The distinguishing feature of the first is that the securities within the portfolio are not linked to a complete direct relationship between them. In other words, this portfolio is built on the basis of diversification, which works to reduce risk to a level lower than the weighted average of the total risk of individual stocks, and this is measured through the standard deviation(Smith & Smith, 2005:88), This risk results from the changes that occur in micro-economic factors such as employment, technological progress, research and development The dominant feature of these factors is that they may affect some industrial sectors and not others, and therefore their impact extends through a limited group of securities or on some individual securities (Mehrara, 2014:30). The quantitative measure of unsystematic risk is the standard deviation, which is extracted according to the equation (4) (lee at al, 2010:58):

$$\sigma = \sqrt{\frac{\sum_{i=}^{N}(X_i-\mu)^2}{N}} \text{.....(4)}$$

Since: X_i: the value of the singular i^{th}

μ: mean

N: community size

Ignoring this risk lies in the possibility of avoiding it and getting rid of it through the principle of diversification that was introduced by (Markowitz, 1952) within the portfolio theory, and accordingly, most of the focus of investors will be on systemic risk (Hotvedt & Tedder, 1978:135) (Chakrabarti & Sen, 2013: 56), It is the risk that continues to affect the investor's portfolio even if he diversifies the assets of the portfolio (Eun & Resnick, 2004: 249). The statistical measurement of systemic risk is (Beta) (Brusa et al, 2014: 1), it is the result of dividing the covariance between investment returns by the variance of the market index portfolio, it is how the investment value moves with changes in the value of the total portfolio for that It can be used to assess the impact of individual investment risks on the risks of the entire portfolio (Whittington & Delaney, 2004: 1083). The value of (beta) ranges between (+0.1 to -0.1) (Maheshwari, 2008:32), and the mathematical formula for calculating (beta) is as shown according to equation (5) (Reilly & Brown, 2012:269):

$$\beta = \frac{COV(R_i,R_m)}{\sigma^2_{Rm}} \text{..... (5)}$$

Since: [Q2]Rm: market return variance

R_i: return on investment

R_m: market return

4- Simple Staging Model:

a- Concept:

The Simple Ranking Model was introduced due to its ease, accuracy, and ability to build the optimal portfolio, which is, in fact, synonymous with the single indicator model, as it is possible to dispense with some mathematical and mathematical operations of the single indicator model (Elton et al, (1978:296) pointed out the two advantages of their model:

- The characteristics of the shares that are used in this model are characterized by their desirability and uniqueness with the weights that each share has individually within the portfolio, and this will be considered easy to understand by portfolio managers.
- The ease of determining the optimal portfolio, which can usually be calculated using pen and paper, or in the worst case, a manual calculator.

And (Elton) and his colleagues sought to clarify the method of simple scaling in their book modern portfolio theory and investment analysis in the year (1995) in the ninth chapter, where they put forward the idea of using the (Treynor) ratio to build the optimal portfolio by arranging these shares from highest to lowest. The higher percentage that exceeds the cut-off limit is included in the portfolio, which will be considered optimal (Elton et al, 2010:181). (Al-Amiri, 2010: 104-106;Eales, 1995: 160-161;Hashem & Ismail, 2013: 69; Hadi, 2012: 105) indicate the feasibility of adopting the simple gradient model as an alternative to the model. The single indicator or as it is known as the market model in building the optimal portfolio. The simple scaling model relies on the same assumptions made by (Sharpe, 1963) and the measurement mechanism and equations, but the latter differed in that it is in the construction phase based on the simplest mathematical methods without the need to perform operations complex math.

b- Mathematical Construction of The Simple Staging Model:

This model is based on two basic steps in the process of building an optimal portfolio:

- Determine the excess return to beta ratio for each share, and then rearrange these shares from the highest relative to the lowest according to equation (6):

$$\frac{\bar{R}_i - R_F}{\beta_i} \ldots\ldots\ldots (6)$$

Since: $\bar{R}_i$: the expected return of R_f for stock i

R_f: return on riskless assets

B_i: expected changes in the rate of return for stock i associated with changes in the market return

- The optimal portfolio will be formed by investing in stocks that obtained the ratio($\frac{R_i - R_F}{\beta_i} > c_i$). The cut-off limit is calculated according to equation (7):

$$ci = \frac{\sigma_m^2 \sum_{i=1}^{N} \frac{(R_i - R_f)\beta i}{\sigma_{ei}^2}}{1 + \sigma_m^2 \sum_{i=1}^{N} \frac{\beta_i^2}{\sigma_{ei}^2}} \ldots\ldots\ldots (7)$$

Since: σ_m^2: Variation in the market index

σ_{ej}^2: the variance of stock movements that are not correlated with the movements of the market index.

and this is usually referred to as the irregular risk of the stock (Elton et al, 2010: 183-186), in addition to the two mentioned steps, and to complete the process of building the optimal portfolio, the steps must be followed the following in detail:

- Calculating the value of (Zi), which is used to calculate the weight of each share in the portfolio, and is calculated according to equation (8):

$$Z_i = \frac{\beta_i}{\sigma_{ei}^2}\left[\left(\frac{\bar{R}_i - R_f}{\beta_i}\right) - C_i^*\right] \ldots\ldots\ldots\ldots (8)$$

- Calculating the value of (xi), which represents the percentage of capital allocated to each share invested in the portfolio, and is calculated according to equation (9) (KAMIL, 2003:6):

$$xi = \frac{z_i}{\sum_{i=1}^{N} z_i} \ldots\ldots\ldots (9)$$

Second: Optimization Using The Multi-Objective Genetic Algorithm

Despite the widespread use of traditional mathematical programming models, they require a set of conditions in the process of formulating the model to find the optimal solution for it, including the single objective function, as it takes either the form of maximization or minimization, as well as the primacy of finding solutions for some variables at the expense of other variables. It requires an improvement process on the approved programming models with single goals and a shift to building models that are able to address many goals at the same time with the same amount of resources (Al-Allaf, 2009: 197), And even this tool and with its aforementioned ability, but the most important thing is to use another tool that has the ability to improve these generated results and to maximize the value of these two goals (Sadaf & Ghodrati, 2015: 365), as it was represented by the genetic algorithm that It works to improve the weights that represent the percentage of the contribution of each component component of the optimal portfolio, as it will be reflected in maximizing the return and minimizing the risk, and this is achieved through the mating or intersection process referred to above. The two main objectives of any investor (Sefiane &

Benbouziane, 2012:147), and the objective functions and constraints of the objective programming model are formulated as follows (Qu et al, 2017:2) (Chiam et al, 2008:68):

$$\text{MIN } \beta_i = \sum_{i=1}^{N} w_i \beta_i \text{.....(10)}$$

$$\text{MAX } r_i = \sum_{i=1}^{N} w_i r_i \text{.....(11)}$$

$$\text{Subject to } \sum_{i=1}^{N} w_i = 1 \qquad w_i \geq 0;$$

Since: MIN β_i: The function of minimizing the value of the portfolio's systemic risk component

MAX r_i: portfolio return maximization function

w_i: The weight of the assets of the optimal portfolio, whose value ranges between (0-1).

The Second Topic-Research Methodology

First: The Research Problem

Is it possible to build an optimal portfolio for investing in stocks that achieves the best correct trade-off between return and risk that suits the preferences of investors in the Iraqi stock market, according to their degree of willingness to accept risk and bear its expected burdens, and improve the performance of the portfolio formed using the multi-objective genetic algorithm? Perhaps the answer to the following questions expressing the basic features of the research problem in its intellectual and experimental aspects within its procedural context leads to an answer to the main question of the research:

A-What are the levels of return and risk as characteristics of investment in a portfolio of shares listed in the Iraq Stock Exchange?

B-Is it possible to achieve the right trade-off between return and risk by building an optimal portfolio for investment in the Iraq Stock Exchange?

C-Does the multi-objective genetic algorithm, as a complex quantitative tool that combines the fields of statistics and operations research, contribute to raising the level of performance of the optimal portfolio in the Iraqi stock market?

Second: Research Aims

1- Presenting an integrated algorithm for the process of building an optimal portfolio in light of a financial market that suffers from several problems, including randomness, lack of clarity, and limited actual trading companies, as well as inappropriate conditions in the financial market environment, which reflects a state of instability in the activity of joint-stock companies, which may cause In undermining the role of the financial market in enhancing the possibilities of achieving sustainable economic development.

2- Provide an integrated picture of the mechanisms for addressing the lack of clarity of data and improving the performance of the investment portfolio in stocks by using the multi-objective genetic algorithm, which helps the investor to carry out the process of forming a portfolio based on a limited amount of data away from the complexity associated with building the portfolio and the high costs associated with it.

3- Determining the optimal portfolio from among the efficient portfolios based on its construction using the simple scaling model in light of its approach to the optimum in a greater way after achieving the best correct exchange between return and risk on the basis of reallocating the weights given to the nominated shares within the efficient portfolio for investment by employing the algorithm Multiple genetic targets in it.

Third: Data Selecting

1- The research community and its sample: The study population was determined in the Iraq Stock Exchange, including the companies traded in it, for the period (2008-2020), as the sample consisted of companies that continued trading and within the period referred to, which resulted in the adoption of a long time series for observations of (150) to obtain accurate results that reflect Market conditions are consistent with the nature of statistical tools and the approved quantity.

2- Research Methodology: Comparative Descriptive: This approach was adopted as a guide in which the process of reviewing the results of the current study was carried out and its results were compared with those of previous studies in terms of agreement on the aim of the study and the tools for achieving this goal, and the most prominent results it reached, so the comparison process flowed according to this. The methodology consists of analysis, diagnosis, reasoning, and discussion.

3- Sampling Method: The non-random (non-chance) sampling method was adopted in the light of the hypothetical sampling or the intentional sampling (intentional) for reasons determined by the same criteria and as follows:

a- The regularity of trading the shares of companies throughout the period of time covered by the research and the non-stop trading of their shares during that period of time.

b- Availability of all the required data for the purposes of measurement and analysis, including the monthly closing prices of the shares that were selected as a sample for the research.

c- Inclusion of the sectors of the Iraqi financial market was after selecting the shares of companies belonging to those sectors, in order to ensure the possibility of generalizing the results of the research on the Iraqi market for securities and not on the companies on which the optimal portfolio was built.

Fourthly: The Approved Quantitative Methods in Measurement, Analysis and Construction

1- Exponential Smoothing**:** As a result of the conditions of the Iraqi market for securities, which created time series that suffer from the loss of some values, which constituted an obstacle to continuing to work with such series, as it required a process of processing to compensate for these lost values when the time series of data belonging to the traded companies were formed, and from here the smoothing method was employed Exponential for the purpose of estimating these values. The treatment process took place through a number of steps, as follows (Mohamed, et al, 2014: 8-11):

A- Estimate the value (α) for each missing part of the data within the series using (statistical 18) program.

B- Use the following formula for forecasting:

$$F_{t+1} = \alpha A_t + (1-\alpha)F_t \ldots\ldots\ldots (12)$$

Since: F_{t+1} : the predicted value for the period (t+1)

F_t : predicted value of variable (A)

A_t: the actual value

α : exponential constant and range value ($0 \leq \alpha \leq 1$)

2- Formation of optimal portfolios based on the Simple Ranking Model, which can be summarized according to the following steps:

A- Analysis Stage:

- Calculate earnings per share using equation (1):

$$Ri = \frac{(P_t - P_{t-1})}{P_{t-1}} \ldots\ldots\ldots (1)$$

- Estimating the return using the Single Index Model according to equation (2):

$$\overline{R}_i = \alpha_i + \beta_i \overline{R}_m \ldots\ldots\ldots (2)$$

- Estimating beta according to equation (5)

$$\beta = \frac{\sum(R_m - \bar{R}_m)(R_i - \bar{R}_i)}{\sum(R_m - \bar{R}_m)^2} \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

For the purpose of estimating the (β_i) parameter, the data must follow the normal distribution, and since the nature of the financial data is not normally distributed, the distribution of this data was converted to the normal using a two-stage method through the program (spss) as follows (Templeton, 2011:48:50):

1- Arranging the data using the Fractional Rank method
2- Generating new values based on the data arranged according to the previous step, the mean, and the standard deviation of the original data using the (inverse DF) and (IDF normal) method.

- Find the additional return (beta) for each share according to the Treynor index, according to Equation (6):

$$T = \frac{(R_i - R_f)}{\beta_i} \ldots\ldots (6)$$

- Calculation of the cut-off ratio, through which, and by comparison with the Treynor ratio, the shares are nominated within the optimal portfolio components and are calculated according to equation (7):

$$ci = \frac{\sigma_m^2 \sum_{i=1}^{N} \frac{(R_i - R_f)\beta i}{\sigma_i^2}}{1 + \sigma_m^2 \sum_{i=1}^{N} \frac{\beta_i^2}{\sigma_i^2}} \ldots\ldots (7)$$

- Calculating the value of (Zi), which is used to calculate the weight of each share in the portfolio, and is calculated according to equation (8):

$$Z_i = \frac{\beta_i}{\sigma_{ei}^2}\left[\left(\frac{R_i - R_f}{\beta_i}\right) - C^*\right] \ldots\ldots\ldots\ldots (8)$$

- Calculate the value of (wi), which represents the percentage (weight) of the contribution of each share of the total investment amount in the portfolio according to equation (9):

$$Wi = \frac{Z_i}{\sum_{i=1}^{N} Z_i} \ldots\ldots\ldots (9)$$

B- Construction Phase

Efficient portfolios are adopted after fulfilling the condition [(Ri-Rf)/ βi > Ci]for each stock being nominated within the components of efficient investment portfolios.

Multi-objective genetic algorithm

3- For the purpose of improving the performance of the optimal portfolio, the multi-objective genetic algorithm was employed towards improving the contribution weights of the components of the optimal portfolio, ensuring the achievement of the two goals of maximizing return and minimizing risk within certain levels, as the model is defined as follows:

$$\text{MIN } \beta_i = \sum_{i=1}^{N} w_i \beta_i \ldots. (10)$$

$$\text{MAX } r_i = \sum_{i=1}^{N} w_i r_i \ldots. (11)$$

$$\text{Subject to } \sum_{i=1}^{N} w_i = 1 \quad w_i \geq 0;$$

$$0 \leq w_i \leq 1, i = 1, \ldots, N$$

Since: MIN β_i: The function of minimizing the value of the systemic risk component of the portfolio

MAX r_i: portfolio return maximization function

w_i: The weight of the assets of the optimal portfolio, whose value ranges between [0-1]

The Third Topic-The Practical Side

First: Building the Optimal Portfolio Under the Simple Scaling Model

1. **Reviewing the Results of Analyzing the Data of The Shares of Companies Listed on The Iraq Stock Exchange:**

Table (1) shows the requirements for the first starting point to build the optimal portfolio, represented by extracting the monthly rate of return for the selected shares based on Equation No. (1) as a preliminary step in preparation for estimating the return based on the single index model of (Sharpe) Equation No. (2), The table below presents the initial data that form the basis for the process of building the optimal portfolio according to the simple gradient model, as it is noted that the highest rate of return was achieved for the benefit of the Bank of Baghdad with a sequence (12) with a value of (0.196), and in contrast, the lowest rate of return was achieved for the benefit of the Babylon Hotel Sequence (15) with a value of (-0.012), and these discrepancies in returns may be due relatively to the case of supply and demand for the shares of certain companies and not others, and this situation becomes entrenched, especially in the case of dealing with the monthly returns, which do not reflect the amount of the distributed profits.

Table (1) $\bar{R}_i$ variance of return per share σ_i^2, and parameter β_i for the shares of traded companies

No	Company	$\bar{R}_i$	β_i	σ_{ei}^2	ت	Company	R_i	β_i	σ_{ei}^2
1	Badia for public transport	0.080487	0.017545	0.07088	23	Karkh Tourist Games City	0.013403	0.000611	0.029463
2	Al-Ameen Insurance	0.002282	0.002748	0.026935	24	Iraqi seed production	0.065152	0.002303	0.096596
3	Iraqi Engineering Works	0.034659	-0.00213	0.024847	25	The National Bank of Iraq	0.16513	0.006192	0.365303
4	Al-Khazir for the production of construction materials	0.019367	0.001818	0.014104	26	Metal and bicycle industries	0.019486	0.007174	0.087724
5	Al Ahlia Insurance	0.013883	0.000638	0.044572	27	Al Mamoura Real Estate Investments	0.045094	0.005524	0.051133
6	Iraqi Land Transport	0.00325	0.000811	0.017871	28	Iraqi agricultural products	0.00763	0.000078	0.00516
7	Iraqi carpets and furnishings	0.001134	0.001193	0.010864	29	Elite General Contracting	0.010003	0.004985	0.030277
8	Iraqi Commercial Bank	0.139453	0.024644	0.322021	30	Iraqi for the production and marketing of meat	0.006572	0.000156	0.024644
9	Baghdad Hotel	0.042486	0.004473	0.075604	31	Baghdad to transport passengers and goods	0.046847	0.000215	0.038787
10	Ishtar hotels	-0.01035	0.001762	0.013076	32	Chemical and plastic	0.129198	0.002749	0.276816
11	Mansour Hotel	0.00931	0.000329	0.018618	33	Canadian for the production of veterinary vaccines	0.048197	-0.00348	0.113587
12	Baghdad Bank	0.195549	0.00201	0.477748	34	Modern tailoring	0.017947	0.002377	0.071946
13	Bank of Babylon	0.097351	0.00175	0.136993	35	Electronic industries	0.040066	-0.0019	0.063961
14	North Bank	0.006748	0.003392	0.116133	36	light industries	0.058476	-0.01425	0.068752
15	Babylon Hotel	-0.01207	0.00881	0.01759	37	Fallujah for the production of construction materials	0.014303	0.000006	0.026364
16	Baghdad for the manufacture of packaging materials	0.139416	0.00742	0.260592	38	National Tourism Investments	0.035711	0.003377	0.053573
17	Baghdad Soft Drinks Co	0.039995	0.007879	0.095774	39	Alweam for financial investment	0.038963	0.000223	0.070489
18	Sumer Commercial Bank	0.018575	0.003267	0.02852	40	Modern dye industries	0.071681	-0.00095	0.119633
19	Iraqi Investment Bank	0.030025	0.000084	0.054497	41	Karbala hotels	0.007071	0.007909	0.023048
20	Gulf Commercial Bank	0.097974	-0.00402	0.169511	42	Iraqi Union Bank	0.009389	0.000443	0.010574
21	Mosul to the city of games	0.056546	0.004381	0.088408	43	Kurdistan International Bank	0.086509	0.005403	0.085674
22	الشرق الاوسط لانتاج الاسماك	0.037191	-0.01355	0.021764					

Source: Iraq Stock Exchange

2. Arranging Stocks in Descending Order According to The Treynor Index:

For the purpose of building the optimal portfolio, the Treynor ratio should be adopted as part of the requirements for using the simple scaling model, through which it indicates the desirability of any stock to form part of the components of the optimal portfolio based on the descending order process achieved by this ratio and based on the elements of return, risk and interest rate on Treasury transfers, and accordingly, the basic rule on which this ratio is based is the amount that the rate of return exceeds the interest rate for treasury transfers, divided by the value of coefficient (β), It is noted that the highest percentage was from the share of the Bank of Baghdad, which amounted to

(82.363), and the lowest percentage belongs to the Fallujah Company for the production of construction materials, which amounted to (2616.194-), and in fact, the value of this percentage is an expression of the amount of the contribution of each return of a specific share in diversifying risk Accordingly, this ratio provides the answer to the question about the preference of the shares of some companies over others, not to include them in the portfolio, and table (2) presents the results of calculating the mentioned ratio

Table (2) Rearrangement of the traded companies according to the (Treynor) index

No	Company	Treynor	No	Company	Treynor
12	Baghdad Bank	82.3626598	18	Sumer Commercial Bank	-3.4971283
31	Baghdad passengers and goods transport	78.3599404	29	Alnukhba General Contracting	-4.0113607
39	Alweam for financial investment	40.1929358	15	Babylon Hotel	-4.7747390
13	Bank of Babylon	38.4863908	34	Modern tailoring	-5.0707313
32	Chemical and plastic industries	36.0849918	33	Alkendi for veterinary vaccines production	-5.2290236
25	The National Bank of Iraq	21.8232630	35	Electronic industries	-5.2866846
24	Iraqi seed production	15.2633757	4	Al-Khazir for construction materials production	-5.8487281
16	Baghdad for packaging materials manufacture	14.7461324	14	North Bank	-6.8549276
43	Kurdistan International Bank	10.4588965	2	Al-Ameen Insurance	-10.0864602
21	Mosul for amusement park	6.0592543	20	Gulf Commercial Bank	-16.9005639
8	Iraqi Commercial Bank	4.4413795	10	Ishtar hotels	-22.9012960
1	Badia for public transport	2.8775576	7	Iraqi carpets and furnishings	-24.1960008
9	Baghdad Hotel	2.7913346	5	Al Ahlia Insurance	-25.2623619
27	Al Mamoura Real Estate Investments	2.7324252	23	Karkh Tourist Games City	-27.1638694
38	National Tourism Investments	1.6910441	6	Iraqi Land Transport	-32.9845705
17	Baghdad Soft Drinks	1.2685509	40	Modern dye industries	-43.8281543
19	Iraqi Investment Bank	0.3013072	42	Iraqi Union Bank	-46.5269200
22	Middle East for fish production	-0.5308343	11	Mansour Hotel	-62.8884540
26	Metal and bicycle industries	-1.4655786	30	Iraqi for the production and marketing of meat	-150.1773199
36	light industries	-1.9985789	28	Iraqi agricultural products	-286.7923127
3	Iraqi Engineering Works	-2.1854174	37	Fallujah for construction materials production	-2616.1938129
41	Karbala hotels	-2.8991288	The rate of interest on Treasury drafts (0.03)		

cut- off rate: Based on the previous premises, the construction of the optimal portfolio was initiated. Through the optimal cut-off limit, the number of shares constituting the optimal portfolio is determined. It answers the most important question of the descending order of shares, which was achieved through the use of the (Treynor) ratio. Where is the stop? Through the aforementioned ratio, the descending arrangement provides a certain weightage for all stocks to form the optimal portfolio, as many stocks will achieve a loss for the portfolio based on the negative returns they achieve, which are associated with the negative value of coefficient (β), so the stock becomes a candidate among the components of the optimal portfolio, and this indicates the opposite movements For the return of this stock with the return of the market portfolio, Here, the role of the cut-off rate appears, which will determine which share will be

included in the portfolio and which one will be excluded through a comparison between (ci) and (T), as any share is accepted based on the rule $[(\frac{R_i - R_i}{\beta_i}) > C_i]$ and as shown in the following table:

From Table (3) it is noted that the highest cut-off value amounted to (0.019) and belonged to the Iraqi Investment Bank, and the lowest value was for the Fallujah Company for Construction Materials Production as it amounted to (-0.014), which is not included in the calculations of weighting any share within the optimal portfolio. Because it will take the weakest position when compared with the (Treynor) ratio, while the reliable limit is what is known as the optimal cut-off rate that determines the optimal portfolio composition and amounts to (0.019) and the return of the Investment Bank of Iraq, which, based on its value, determined the number of shares that the optimal portfolio is formed by (17), starting with the share of the Bank of Baghdad and ending with the share of the Investment Bank of Iraq.

Extrapolation of the components of the cut-off rate equation mentioned in the first chapter determines the role of the market portfolio return element, which plays a decisive role in the admissibility of the traded shares for inclusion within the optimal portfolio components, whose value amounted to (0.521). Which reflects negatively on the value of the cut-off limit, and this provides a weighting for the shares to be included in the portfolio based on the comparison with the (Treynor) ratio.

Table (3) Cut-off rate

code	Company	$\frac{(R_i - R_f) * \beta_i}{\sigma_{ei}^2}$	$\frac{(R_i - R_f) * \beta_i}{\sum_{i=1}^{n} \frac{(R_i - R_f) * \beta_i}{\sigma_{ei}^2}}$	$\frac{(R_i - R_f) * \beta_i}{\sigma_{ei}^2}$	β_i^2	$\frac{\beta_i^2}{\sigma_{ei}^2}$	$\sum_{i=1}^{n} \frac{\beta_i^2}{\sigma_{ei}^2}$	$\left[\sum_{i=1}^{n} \frac{\beta_i^2}{\sigma_{ei}^2}\right]$ / $1 + \left[\frac{\sigma_m^2}{\sigma_m^2}\right]$	ci
12	Baghdad Bank	0.0006965	0.0006965	0.0003629	0.000004040100	0.0000085	0.0000085	1.0000044	0.000362870
31	Baghdad passengers and goods transport	0.0000934	0.0007899	0.0004115	0.000000046225	0.0000012	0.0000096	1.0000050	0.000411523
39	Alweam for financial investment	0.0000284	0.0008182	0.0004263	0.000000049729	0.0000007	0.0000104	1.0000054	0.000426296
13	Bank of Babylon	0.0008604	0.0016786	0.0008745	0.000003062500	0.0000224	0.0000327	1.0000170	0.000874528
32	Chemical and plastic	0.0009851	0.0026637	0.0013878	0.000007557001	0.0000273	0.0000600	1.0000313	0.001387731
25	The National Bank of Iraq	0.0022905	0.0049542	0.0025811	0.000038340864	0.0001050	0.0001650	1.0000859	0.002580875
24	Iraqi seed production	0.0008381	0.0057923	0.0030177	0.000005303809	0.0000549	0.0002199	1.0001146	0.003017374
16	Baghdad for packaging materials manufacture	0.0031155	0.0089078	0.0046409	0.000055056400	0.0002113	0.0004311	1.0002246	0.004639812
43	Kurdistan International Bank	0.0035637	0.0124715	0.0064975	0.000029192409	0.0003407	0.0007719	1.0004021	0.006494917
21	Mosul for amusement park	0.0013155	0.0137870	0.0071829	0.000019193161	0.0002171	0.0009890	1.0005152	0.007179167
8	Iraqi Commercial Bank	0.0083764	0.0221633	0.0115469	0.000607326736	0.0018860	0.0028750	1.0014978	0.011529600
1	Badia for public transport	0.0124971	0.0346604	0.0180577	0.000307827025	0.0043429	0.0072179	1.0037605	0.017990069
9	Baghdad Hotel	0.0007387	0.0353991	0.0184426	0.000020007729	0.0002646	0.0074826	1.0038983	0.018370957
27	Al Mamoura Real Estate Investments	0.0016306	0.0370297	0.0192921	0.000030514576	0.0005968	0.0080793	1.0042092	0.019211252
38	National Tourism Investments	0.0003600	0.0373897	0.0194797	0.000011404129	0.0002129	0.0082922	1.0043201	0.019395866
17	Baghdad Soft Drinks	0.0008222	0.0382120	0.0199080	0.000062078641	0.0006482	0.0089404	1.0046578	0.019815744
19	Iraqi Investment Bank	0.0000000	0.0382120	0.0199081	0.000000007056	0.0000001	0.0089405	1.0046579	0.019815762
22	Middle East for fish production	-0.0044762	0.0337358	0.0175760	0.000183521209	0.0084324	0.0173729	1.0090511	0.017418362
26	Metal and bicycle industries	-0.0008598	0.0328760	0.0171281	0.000051466276	0.0005867	0.0179595	1.0093567	0.016969275
36	light industries	-0.0059012	0.0269747	0.0140536	0.000203005504	0.0029527	0.0209123	1.0108951	0.013902100
3	Iraqi Engineering Works	-0.0003998	0.0265750	0.0138453	0.000004545424	0.0001829	0.0210952	1.0109904	0.013694769
41	Karbala hotels	-0.0078684	0.0187066	0.0097459	0.000062552281	0.0027141	0.0238093	1.0124044	0.009626517
18	Sumer Commercial Bank	-0.0013088	0.0173978	0.0090641	0.000010673289	0.0003742	0.0241835	1.0125994	0.008951294
29	Elite General Contracting	-0.0032924	0.0141054	0.0073488	0.000024850225	0.0008208	0.0250043	1.0130270	0.007254282
15	Babylon Hotel	-0.0210682	-0.0069628	-0.0036275	0.000077616100	0.0044124	0.0294167	1.0153258	-0.003572790
34	Modern tailoring	-0.0003982	-0.0073610	-0.0038350	0.000005650129	0.0000785	0.0294952	1.0153667	-0.003776973
33	Al-kindi for veterinary vaccines production	-0.0005575	-0.0079185	-0.0041255	0.000012110400	0.0001066	0.0296018	1.0154223	-0.004062811
35	Electronic industries	-0.0002996	-0.0082182	-0.0042816	0.000003625216	0.0000567	0.0296585	1.0154518	-0.004216427

4	Al-Khazir for construction materials production	-0.0013705	-0.0095887	-0.0049956	0.000003305124	0.0002343	0.0298928	1.0155739	-0.004919012
14	North Bank	-0.0006791	-0.0102678	-0.0053494	0.000011505664	0.0000991	0.0299919	1.0156255	-0.005267143
2	Al-Ameen Insurance	-0.0028278	-0.0130957	-0.0068227	0.000007551504	0.0002804	0.0302723	1.0157715	-0.006716776
20	Gulf Commercial Bank	-0.0016128	-0.0147085	-0.0076630	0.000016176484	0.0000954	0.0303677	1.0158213	-0.007543626
10	Ishtar hotels	-0.0054375	-0.0201460	-0.0104958	0.000003104644	0.0002374	0.0306051	1.0159450	-0.010331109
7	Iraqi for carpets and furnishings	-0.0031699	-0.0233159	-0.0121473	0.000001423249	0.0001310	0.0307362	1.0160132	-0.011955897
5	Al Ahlia Insurance	-0.0002307	-0.0235466	-0.0122675	0.000000407044	0.0000091	0.0307453	1.0160180	-0.012074139
23	Karkh Tourist Games City	-0.0003442	-0.0238908	-0.0124469	0.000000373321	0.0000127	0.0307580	1.0160246	-0.012250551
6	Iraqi Land Transport	-0.0012140	-0.0251048	-0.0130793	0.000000657721	0.0000368	0.0307948	1.0160438	-0.012872797
40	Modern paint industries	-0.0003313	-0.0254361	-0.0132519	0.000000904401	0.0000076	0.0308023	1.0160477	-0.013042642
42	Iraqi Union Bank	-0.0008635	-0.0262996	-0.0137018	0.000000196249	0.0000186	0.0308209	1.0160574	-0.013485288
11	Mansour Hotel	-0.0003656	-0.0266652	-0.0138923	0.000000108241	0.0000058	0.0308267	1.0160604	-0.013672718
30	Iraqi for meat marketing production	-0.0001483	-0.0268135	-0.0139696	0.000000024336	0.0000010	0.0308277	1.0160609	-0.013748753
28	Iraqi agricultural products	-0.0003382	-0.0271517	-0.0141458	0.000000006084	0.0000012	0.0308289	1.0160615	-0.013922142
37	Fallujah for construction materials production	-0.0000036	-0.0271553	-0.0141476	0.000000000036	0.0000000	0.0308289	1.0160615	-0.013923974

Variation in the rate of return of the stock market portfolio (0.5209898)

3. Determine the Weights of The Stocks That Make Up The Optimal Portfolio:

The optimal cut-off rate provided the upper limits for the group of companies that make up the optimal portfolio. However, the most important of all for the investor is the weight of each present within the portfolio. The amount of wealth that he owns cannot be simply divided among all the optimal shares equally. It is more important than the subsequent share, and this is due to the three components on the basis of which the mentioned percentage was formed, the estimated return according to the (Sharpe) model, the (beta) coefficient, and the interest rate on treasury transfers.

Table (4) The weights of the components of the optimal portfolio, Zi, and the percentage of each share's contribution to the total wealth wi

No	Company	$\frac{\beta_i}{\sigma_{ei}^2}$	$\frac{R_i - R_i}{\beta_i}$	ci	Zi	wi
1	Baghdad Bank	0.004207	82.36265984	0.019815762	0.346436	0.06210
2	Baghdad passengers and goods transport	0.005543	78.35994036		0.434246	0.07784
3	Alweam for financial investment	0.003164	40.19293583		0.127092	0.02278
4	Bank of Babylon	0.012774	38.48639084		0.491388	0.08809
5	Chemical and plastic industries	0.009931	36.08499176		0.358155	0.06420
6	The National Bank of Iraq	0.01695	21.82326302		0.369575	0.06625
7	Iraqi seed production	0.023841	15.26337571		0.363429	0.06515
8	Baghdad for packaging materials manufacture	0.028474	14.74613238		0.419312	0.07517
9	Kurdistan International Bank	0.063065	10.45889655		0.658336	0.11801
10	Mosul for amusement park	0.049554	6.05925427		0.299281	0.05365
11	Iraqi Commercial Bank	0.076529	4.441379454		0.338378	0.06066
12	Badia for general transport	0.247532	2.877557595		0.707382	0.12680
13	Baghdad Hotel	0.059164	2.791334624		0.163973	0.02939
14	Al Mamoura Real Estate Investments	0.108033	2.732425192		0.29305	0.05253
15	National Tourism Investments	0.063035	1.691044131		0.105346	0.01888
16	Baghdad Soft Drinks	0.082267	1.2685509		0.102729	0.01842
17	Iraqi Investment Bank	0.001541	0.301307176		0.000434	0.00008

4. Determine the return and risk of the optimal portfolio

The last important step in the process of building the portfolio is embodied in determining the amount of return and expected risk for the portfolio, for the purpose of giving a clear picture to the decision-maker, so clear results must be presented about the ends of the process of building the optimal portfolio, and accordingly, this requires determining the total return of the portfolio and the amount of systemic risk Associated with this amount of return, and through table (5) it is clear that the return of the portfolio amounted to (0.096), while the risk recorded (0.007), and this indicates the optimal exchange between the two components of the portfolio.

Table (5) Optimal Portfolio Return and Risk

No	corporate shares	Optimum portfolio return			Optimum portfolio stock risk	
		wi	R_i	$wi * R_i$	β_i	$w_i * \beta_i$
1	Baghdad Bank	0.06210	0.1955489	0.0121439	0.0020100	0.00012482
2	Baghdad for passengers and goods transport	0.07784	0.0468474	0.0036467	0.0002150	0.00001674
3	ALweam for financial investment	0.02278	0.0389630	0.0008877	0.0002230	0.00000508
4	Bank of Babylon	0.08809	0.0973512	0.0085752	0.0017500	0.00015415
5	Chemical and plastic industries	0.06420	0.1291976	0.0082948	0.0027490	0.00017649
6	The National Bank of Iraq	0.06625	0.1651296	0.0109397	0.0061920	0.00041022
7	Iraqi seed production	0.06515	0.0651516	0.0042445	0.0023030	0.00015003
8	Baghdad for manufacture of packaging materials	0.07517	0.1394163	0.0104792	0.0074200	0.00055773
9	Kurdistan International Bank	0.11801	0.0865094	0.0102092	0.0054030	0.00063762
10	Mosul for amusement park	0.05365	0.0565456	0.0030336	0.0043810	0.00023503
11	Iraqi Commercial Bank	0.06066	0.1394534	0.0084588	0.0246440	0.00149483
12	Badia for general transport	0.12680	0.0804867	0.0102060	0.0175450	0.00222478
13	Baghdad Hotel	0.02939	0.0424856	0.0012488	0.0044730	0.00013148
14	Al Mamoura Real Estate Investments	0.05253	0.0450939	0.0023689	0.0055240	0.00029018
15	National Tourism Investments	0.01888	0.0357107	0.0006744	0.0033770	0.00006377
16	Baghdad Soft Drinks	0.01842	0.0399949	0.0007365	0.0078790	0.00014509
17	Iraqi Investment Bank	0.00008	0.0300253	0.0000023	0.0000840	0.00000001
final sum		portfolio return	0.096150227		portfolio risk	0.006818058

5. Review Results

It is noticed by displaying the results of the (matlab) program emerging from the application (toolbox), presenting different combinations of weights to express the optimal mixing ratio between return and risk. It is the weight of each existing within the optimal portfolio, and the question remains of choosing any combination according to the highest return and the least risk that these weights will achieve. 6) Displays the weights of that portfolio that achieved the best correct exchange between the return of the portfolio and its risk.

Table (6) The combination of return and risk according to the new weights

No	w_i	**No**	w_i	**No**	w_i
1	0.000187	7	0.045466	13	0.040556
2	0.037908	8	0.040488	14	0.036045
3	0.039591	9	0.094119	15	0.051066
4	0.149312	10	0.020742	16	0.040192
5	0.184104	11	0.116845	17	0.02399
6	0.045051	12	0.034337		

It is noted from the weights listed in Table (6), which express the weights of the optimal portfolio components that achieve the best correct exchange between return and risk among the multiple weights, as it is clear from the process of calculating the weights for return and risk according to these different formations that they offer the investor many combinations, In general, all combinations of weights emanating from the multi-objective genetic algorithm are all better than the original combination of weights, and therefore the issue of the acceptability of any combination of weights that will be the best will be determined according to the rule of the best combination between return and risk.

6. Recalculation of The Return and Risk of The Optimal Portfolio Components According to The New Weights

By observing the results of the genetic algorithm, we notice the amount of improvement in the combination of return and risk, as shown in Table (7), as the return changed from (0.096150227) to (0.093595714), and on the other hand, the risk decreased from (0.006818058) to (0.00642188), and this indicates the ability of the genetic algorithm Multi-objectives on bringing about improvements in the weights of the optimal portfolio components, which was reflected in the amount of the optimal combination of risk and return.

Table (7) recalculation of return and risk in light of the new weights

No	Companies shares	Optimum portfolio return			Optimum portfolio stock risk	
		wi	R_i	$wi * R_i$	β_i	$w_i * \beta_i$
1	Baghdad Bank	0.00019	0.1955489	0.00004	0.0020100	0.00000038
2	Baghdad for passengers and goods transport	0.03791	0.0468474	0.00178	0.0002150	0.00000815
3	AlWeam for financial investment	0.03959	0.0389630	0.00154	0.0002230	0.00000883
4	Bank of Babylon	0.14931	0.0973512	0.01454	0.0017500	0.00026130
5	Chemical and plastic industries	0.18410	0.1291976	0.02379	0.0027490	0.00050610
6	The National Bank of Iraq	0.04505	0.1651296	0.00744	0.0061920	0.00027896
7	Iraqi seed production	0.04547	0.0651516	0.00296	0.0023030	0.00010471
8	Baghdad for packaging materials	0.04049	0.1394163	0.00564	0.0074200	0.00030042
9	Kurdistan International Bank	0.09412	0.0865094	0.00814	0.0054030	0.00050853
10	Mosul for amusement park	0.02074	0.0565456	0.00117	0.0043810	0.00009087
11	Iraqi Commercial Bank	0.11685	0.1394534	0.01629	0.0246440	0.00287953
12	Badia for general transport	0.03434	0.0804867	0.00276	0.0175450	0.00060245
13	Baghdad Hotel	0.04056	0.0424856	0.00172	0.0044730	0.00018141
14	Al Mamoura Real Estate Investments	0.03605	0.0450939	0.00163	0.0055240	0.00019911
15	National Tourism Investments	0.05107	0.0357107	0.00182	0.0033770	0.00017245
16	Baghdad Soft Drinks	0.04019	0.0399949	0.00161	0.0078790	0.00031668
17	Iraqi Investment Bank	0.02399	0.0300253	0.00072	0.0000840	0.00000202
final sum		portfolio return	0.093595714		portfolio risk	0.00642188

Second: Evaluate The Performance of The Optimal Portfolio

For the purpose of determining the feasibility of the quantitative tools used in building the optimal portfolio, and in a way that reflects to the investor the preference of these tools and at the same time the potential problems with the process of building the optimal portfolio in light of the complete reliance on financial instruments without any statistical and quantitative processing on that data. The evaluation process will focus on the optimal portfolios formed before entering the results for potential improvements by the multi-objective genetic algorithm tool, as shown in Table (8).

Table (8) Measuring the performance of optimal portfolios

Performance measurement tools	market portfolio		The optimal portfolio with raw data		The optimal portfolio with raw data using the genetic algorithm	
	Return	Risk	return	Risk	Return	risk
	0.069245815	1	0.09615	0.006818	0.093596	0.006422
Treynor	0.039246		9.702209485		9.902982229	

Through the results of evaluating the original and improved data portfolios using the multi-objective genetic algorithm according to the (Treynor) indicator, the optimal portfolio preference was presented with the primary data with the use of the genetic algorithm over the primary data portfolio, with a value of (9.902) and (9.702) respectively.

The Fourth Topic-Conclusion

The availability of missing values of data or closing prices of the shares of many companies prevented them from being nominated within the optimal portfolio components within the framework of the construction process, which indicates a state of instability and as a result of the interruption of trading operations on the shares of those companies for certain periods of time, to be another reason behind the randomness of the financial market and the loss of the condition of the normal distribution of its data as a binding basis in estimating many parameters of the quantitative analysis of the data of the Iraqi financial market during the research period. As long as the fluctuation and volatility of stock prices is a characteristic that accompanies investment in the financial market, including the Iraq Stock Exchange, uncertainty and complexity have become a reality that the investor is aware of and requires him to align his preferences towards return and the risk associated with it and his goals aimed at achieving benefit. The highest after investing his wealth in the financial market and by building investment portfolios in which the efficient selection of the constituent shares alone may not guarantee a higher level of performance. Unless the ambiguity, uncertainty and ambiguity of the market data is removed, and then generating efficient investment portfolios that guarantee the achievement of the correct exchange between return and risk, elevating it to an optimal investment portfolio from among a group of efficient portfolios possible after employing the multi-objective genetic algorithm to achieve this goal.

This means that maximizing the investor's wealth in the stock market is a goal that is difficult to realize unless he improves the correct exchange between the two goals of return and risk, and in order to achieve this goal in its experimental framework, the thinking began to employ the multi-objective genetic algorithm as a successful tool that contributed to the generation of investment portfolios An alternative that ensured the achievement of a higher level of performance after pairing the genetic genes and the consequent reallocation of weights between the components of the portfolio from the ordinary shares of the research sample and listed for trading in the Iraq Stock Exchange. And it is inferred from the results of the quantitative analysis at the level of the four portfolios that were concluded by the mechanisms of building each one of them, starting with an efficient portfolio on the basis of primary data, and passing through its counterpart after using the multi-objective genetic algorithm in its construction. All of this indicates the validity of this tool in building investment portfolios. Optimum in the Iraqi market for securities even in the case of instability and volatility as well as the prevalence of a state of uncertainty in market information and data studied. Perhaps this clearly indicates the feasibility of the process of building an investment portfolio in ordinary shares in the Iraq Stock Exchange after using quantitative analysis tools at the level of objective programming, and the genetic algorithm, by combining these two tools and employing them in managing investment operations in the financial market, specifically in building The optimal investment portfolios, as they are quantitative analysis tools that are important due to the nature of the complexity inherent in dealing in the financial markets in terms of the magnitude of the shares included in them, the diversity of trading sectors and the globalization of financial markets coinciding with the state of instability and continuous volatility in those markets, including the Iraq Stock Exchange .The results of measuring the performance of the portfolios that were formed according to the gradation of building mechanisms for each of them revealed the superior performance of the portfolio built after employing the multi-objective genetic algorithm in that compared to the original data portfolio. Perhaps the main reason for the superior performance of this portfolio is due to the fact that it was built on the basis of reallocating the investment weights between those stocks in an optimal allocation that elevated them with efficient diversification into an optimal portfolio.

The multi-objective genetic algorithm contributed to the generation of a number of alternative investment portfolios, which numbered (41) portfolios, after redistributing the ratios or weights of the investment amounts of them, and improving the correct exchange process between the return and the risk of the portfolio and not on the basis of the individual shares constituting it,

and in a way that eliminates the need to change the components of the portfolio from the ordinary shares that were nominated in its construction by adopting specific diversification strategies on the one hand and achieving the investor's desire and preferences regarding levels of return and risk towards achieving his goal of maximizing his limited resources in The framework of the process of continuous improvement of the performance of the portfolio after the employment of the multi-objective genetic algorithm in this on the other hand.

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