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RANKING OF SELECTED NASDAQ100 COMPANIES ACCORDING TO THEIR FINANCIAL PERFORMANCE WITH MCRAT AND RAPS

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ABSTRACT

In this study, two new multi-criteria decision-making methods (MCDMs) for investment decision making in the stock market are introduced. The first method is called multiple criteria ranking by alternative trail (MCRAT); the second method is ranking alternatives by perimeter similarity (RAPS). In this study, 79 stocks in the NASDAQ 100 index are ranked by MCRAT and RAPS methods based on 9 different financial indicators. The ranking results obtained were compared with the widely preferred TOPSIS method using the same alternatives and criteria. As a result of the analysis, it is observed that MCRAT and RAPS methods have high correlation with the ranking results obtained by TOPSIS method. Therefore, it is concluded that MCRAT and RAPS methods can be used with confidence when making investment decisions in the stock market.

Keywords: MCRAT, RAPS, Multi-criteria decision making, NASDAQ 100, Financial performance

MCRAT VE RAPS İLE NASDAQ100 KAPSAMINDAKİ SEÇİLMİŞ ŞİRKETLERİN FİNANSAL PERFORMANSLARINA GÖRE SIRALANMASI

ÖZET

Bu çalışmada, hisse senedi piyasasında yatırım kararı vermek için kullanılan iki yeni çok kriterli karar verme yöntemi (ÇKKV) tanıtılmıştır. İlk yöntem, alternatif izine göre çoklu kriter sıralaması (MCRAT) olarak adlandırılmıştır; ikincisi ise çevre benzerliğine göre alternatifleri sıralama (RAPS) yöntemidir. Çalışmada, NASDAQ 100 endeksinde yer alan 79 hisse senedi, 9 farklı finansal gösterge çerçevesinde MCRAT ve RAPS yöntemleri ile sıralanmıştır. Elde edilen sıralama sonuçları, aynı alternatif ve kriterler kullanılarak yaygın olarak tercih edilen TOPSIS yöntemi ile karşılaştırılmıştır. Analizler sonucunda, MCRAT ve RAPS yöntemlerinin, TOPSIS yöntemi ile elde edilen sıralama sonuçlarıyla yüksek korelasyona sahip olduğu gözlemlenmiştir. Bu nedenle, MCRAT ve RAPS yöntemlerinin hisse senedi piyasasında yatırım kararı verirken güvenle kullanılabileceği sonucuna varılmıştır.

Anahtar Kelimeler: MCRAT, RAPS, Çok kriterli karar verme, NASDAQ 100, Finansal performans

1. Introduction

In our daily personal and professional lives we are constantly evaluating trade-offs between conflicting criteria. Often such decisions are based on one's past experiences and intuition. These decisions include trying to optimize our financial portfolio by choosing various investment instruments (Thakkar, 2021).

Problems involving the evaluation of multiple criteria and alternatives are typically recognized as part of the field of multi-criteria decision making (MCDM). MCDM methods are among the analytical techniques that aim to make the most appropriate decision by considering multiple criteria in complex decision problems. MCDM methods can also be applied in the ranking of financial assets such as stocks. These methods generally try to determine how to rank each stock overall by evaluating various factors that affect the performance of stocks.

In this study, stocks in the NASDAQ 100 index, for which there is no missing data, are ranked using two relatively new methods MCRAT (multiple criteria ranking by alternative trace) and RAPS (ranking alternatives by perimeter similarity) based on their financial performance. In the study, 79 stocks in the NASDAQ 100 were ranked from best to worst using MCRAT and RAPS techniques, taking into account the decision criteria consisting of 9 financial indicators suggested by experts. Rank correlation coefficients were calculated in order to compare the ranking results with each other, and the results obtained were evaluated.

2. Literature Review

MCDM methods are among the methods used when more than one criterion is taken into consideration in the decision-making process. It is seen in the literature that MCDM methods are used in business decision-making processes, determining marketing strategies, new product development processes or investment decisions. In this section of the research, a brief evaluation of some of the important studies conducted in recent years in the field of finance by utilizing MCDM methods is presented.

Basilio, De Freitas, Kämpffe, and Bordeaux Rego (2018) utilized the PROMETHEE II method to rank 111 companies listed on the São Paulo stock exchange in 2015.

Pätäri, Karell, Luukka, and Yeomans (2018) utilized MS, TOPSIS, and AHP methods to rank non-financial companies in NYSE, AMEX, and NASDAQ.

Ertikin (2019) utilized TOPSIS and PROMETHEE methods to compare the financial performance of companies in the construction sector that are traded in Borsa Istanbul.

Palma, Miranda, Alvarez, Bernal, and Castro (2023) utilized the hierarchical version of the ELECTRE III method to compare the financial performance of 30 stocks included in the Dow Jones index traded on the New York Stock Exchange.

Veeramani, Venugopal and Muruganandan (2023) utilized Fuzzy Multi-Criteria Decision Making methods to compare the top 25 NASDAQ-listed companies based on their daily stock prices for the period 2015 - 2019.

Özden, Turanlı and Gerçeker (2024) utilized MCRAT, RAPS and TOPSIS methods to compare the financial performances of 24 stocks included in the BIST30 index traded in Borsa Istanbul.

3. Methodology

ELECTRE was developed in 1965, TOPSIS in 1980, and PROMETHEE in 1986, which are the most frequently used methodologies in the field of CRMF. In recent years, there has been a slow progress in the development of new methodologies in the field of CRMF. MCRAT and RAPS are two of the most recently developed CRM methods. The main advantage of MCRAT and RAPS methods is that they can be applied in a simpler way than many other methods. MCRAT and RAPS methods are similar to other methods in the stages of creating the decision matrix, normalizing the decision matrix, determining the criteria weights, creating the weighted normalized decision matrix, determining the best alternative, decomposing the best alternative, and decomposing each alternative. After these steps, the component size for each component of the optimal alternative is calculated as in Equation 1.

$$Q_k = \sqrt{q_1^2 + q_2^2 + \cdots q_k^2}$$
$$Q_h = \sqrt{q_1^2 + q_2^2 + \cdots q_h^2} \quad (1)$$

The same approach is applied for each alternative.

$$U_{ik} = \sqrt{u_{i1}^2 + u_{i2}^2 + \cdots u_{ik}^2}, \forall i \in [1, 2, \cdots, m]$$
$$U_{ih} = \sqrt{u_{i1}^2 + u_{i2}^2 + \cdots u_{ih}^2}, \forall i \in [1, 2, \cdots, m] \quad (2)$$

After the component loads are calculated, the ranking process with the MCRAT method is carried out as follows. As seen in Equation 3, the F matrix consisting of the optimum alternative components is created.

$$F = \begin{bmatrix} Q_k & 0 \\ 0 & Q_h \end{bmatrix} \quad (3)$$

In addition, the G_i matrix of alternative components is constructed using Equation 4.

$$G_i = \begin{bmatrix} U_{ik} & 0 \\ 0 & U_{ih} \end{bmatrix}, \forall i \in [1, 2, \cdots m] \quad (4)$$

The matrix T_i is formed by multiplying the matrices F and G_i as shown in Equation 5.

$$T_i = F \times G_i = \begin{bmatrix} t_{11;i} & 0 \\ 0 & t_{22;i} \end{bmatrix}, \forall i \in [1,2,\cdots,m] \quad (5)$$

The projection of the T_i matrix is obtained as in Equation 6.

$$tr(T_i) = t_{11;i} + t_{22;i}, \forall i \in [1,2,\cdots,m] \quad (6)$$

The alternatives are ranked in descending order according to the $tr(T_i)$ values obtained.

After the component loads are calculated, the ranking process with the RAPS method is carried out as follows. In the RAPS method, the perimeter of the optimal alternative is expressed as the perimeter of a right-angled triangle. The components Q_k and Q_h represent the base and right side of this triangle, respectively.

$$P = Q_k + Q_h + \sqrt{Q_k^2 + Q_h^2} \quad (7)$$

The perimeter of each alternative is calculated in the same way as in Equation 8.

$$P_i = U_{ik} + U_{ih} + \sqrt{U_{ik}^2 + U_{ih}^2} \quad (8)$$

Perimeter similarity represents the ratio between the perimeter of each alternative and the perimeter of the optimal alternative.

$$PS_i = \frac{P_i}{P}, \forall i \in [1,2,\cdots,m] \quad (9)$$

Alternatives are ranked in descending order according to the PS_i values obtained (Urošević, Gligorić, Miljanović, Beljić, & Gligorić, 2021).

4. Ranking of Selected Companies in NASDAQ 100 According to Their Financial Performance with MCRAT and RAPS Methods

This study aims to rank the stocks of non-financial companies traded on NASDAQ and included in the NASDAQ 100 index using MCRAT and RAPS methods. Of the 101 companies in the NASDAQ 100, 79 were used as investment alternatives within the scope of the study. The reason for selecting these stocks is that they must meet certain conditions in order to be included in the NASDAQ 100. These conditions reduce the possibility of speculation on these stocks. This makes it possible to conduct objective analysis of NASDAQ 100 stocks. The criteria values for the alternatives used in the analysis are shown in Table 1.

Table 1. 79 Values of 79 Stocks for 9 Criteria for 2023

Alternative	P/E	EPS	EM	LR	OPM	CR	ROE	NIG	P/B
MSFT	38,25	11,06	0,52	0,47	0,44	0,73	0,39	0,36	13,19
AAPL	26,22	6,43	0,34	1,46	0,31	0,68	1,54	0,26	35,16
NVDA	70,69	11,94	0,57	0,26	0,54	2,35	0,91	0,49	48,38

GOOG	26,81	5,81	0,33	0,11	0,28	3,71	0,27	0,24	6,84
AMZN	63,83	2,89	0,15	0,77	0,07	0,56	0,17	0,05	9,49
META	34,38	14,90	0,47	0,25	0,39	1,73	0,28	0,29	8,56
AVGO	49,08	26,98	0,52	1,08	0,39	0,16	0,25	0,30	8,72
TSLA	40,68	4,30	0,14	0,15	0,09	3,10	0,28	0,16	8,90
ASML	45,64	21,50	0,35	0,36	0,33	1,46	0,70	0,28	25,98
COST	46,72	15,28	0,04	0,45	0,03	1,09	0,31	0,03	15,26
AMD	323,22	0,52	0,18	0,05	0,03	1,92	0,02	0,04	4,89
NFLX	51,33	12,02	0,64	0,82	0,21	0,42	0,26	0,16	12,97
PEP	25,89	6,56	0,20	2,54	0,15	0,21	0,51	0,10	12,61
LIN	36,17	12,60	0,36	0,51	0,25	0,23	0,16	0,19	5,53
ADBE	46,70	10,47	0,40	0,26	0,35	1,67	0,32	0,24	14,32
AZN	35,67	1,91	0,28	0,73	0,16	0,21	0,16	0,13	5,39
CSCO	15,14	3,29	0,31	0,27	0,28	2,08	0,31	0,23	4,35
QCOM	25,31	6,90	0,30	0,67	0,25	0,78	0,38	0,22	8,47
TMUS	23,14	6,94	0,36	1,75	0,19	0,05	0,12	0,11	2,97
INTU	65,17	9,78	0,28	0,38	0,23	0,23	0,17	0,18	10,56
AMAT	24,57	8,50	0,31	0,34	0,29	1,25	0,46	0,27	9,96
INTC	98,95	0,39	0,18	0,47	0,00	0,50	0,02	0,03	1,53
CMCSA	10,79	3,71	0,31	1,25	0,19	0,06	0,19	0,13	1,92
TXN	24,23	7,07	0,49	0,70	0,42	0,73	0,41	0,37	9,22
AMGN	21,56	12,48	0,44	10,50	0,29	0,17	1,36	0,24	23,13
ISRG	76,85	5,03	0,31	0,01	0,25	58,16	0,15	0,25	10,23
HON	23,30	8,47	0,25	1,36	0,21	0,38	0,35	0,15	8,12
LRCX	37,36	25,86	0,31	0,61	0,28	1,13	0,42	0,24	15,43
ABNB	22,32	7,23	0,16	0,28	0,16	4,38	0,70	0,48	12,62
VRTX	28,93	13,89	0,40	0,05	0,38	13,88	0,23	0,37	5,89
REGN	27,07	34,75	0,36	0,10	0,33	4,01	0,16	0,30	3,96
ADP	28,89	8,59	0,28	0,80	0,25	0,48	0,97	0,19	23,60
ADI	36,17	5,59	0,49	0,20	0,30	0,19	0,08	0,24	2,82
KLAC	35,15	19,69	0,43	2,00	0,38	0,55	0,96	0,28	30,75
MDLZ	18,66	3,62	0,19	0,71	0,15	0,09	0,18	0,14	3,21
PANW	43,36	6,40	0,12	0,50	0,08	1,55	0,90	0,30	20,54
GILD	15,45	4,50	0,44	1,12	0,34	0,33	0,26	0,21	3,80
SNPS	62,56	9,08	0,29	0,10	0,23	1,90	0,23	0,23	12,99
CDNS	80,75	3,82	0,34	0,24	0,31	1,41	0,34	0,25	24,60
MELI	76,20	19,45	0,15	2,09	0,13	1,14	0,40	0,07	24,47
CRWD	854,24	0,36	0,05	0,34	0,00	4,38	0,05	0,03	32,55
PYPL	17,34	3,85	0,20	0,55	0,16	1,22	0,21	0,14	3,40
WDAY	52,56	5,14	0,06	0,41	0,02	2,37	0,20	0,19	8,83
CSX	19,43	1,84	0,49	1,57	0,38	0,08	0,30	0,25	5,79
CTAS	46,57	14,49	0,26	0,63	0,21	0,05	0,38	0,16	16,17
MAR	23,24	10,72	0,36	1,32	0,28	0,37	0,35	0,21	7,41
PCAR	13,53	8,76	0,19	0,90	0,17	0,63	0,32	0,13	3,91
CEG	37,45	5,01	0,15	0,85	0,04	0,05	0,15	0,07	5,44
ROP	42,66	12,70	0,40	0,37	0,28	0,03	0,08	0,22	3,32
MNST	36,14	1,54	0,28	0,01	0,27	49,28	0,21	0,23	7,05
CPRT	40,24	1,40	0,43	0,02	0,39	23,09	0,23	0,33	7,96
DXCM	106,26	1,31	0,22	1,25	0,17	1,05	0,26	0,15	25,95
MCHP	21,19	4,28	0,48	0,81	0,37	0,05	0,35	0,28	6,92
ODFL	38,99	5,63	0,34	0,05	0,28	2,16	0,31	0,21	11,24
ROST	25,11	5,56	0,13	1,18	0,11	0,85	0,41	0,09	9,61
LULU	29,17	12,21	0,27	0,33	0,23	1,60	0,42	0,16	10,62
PAYX	27,49	4,59	0,45	0,23	0,41	2,04	0,46	0,32	12,11
KHC	15,99	2,31	0,24	0,42	0,20	0,07	0,06	0,11	0,91

AEP	19,99	4,25	0,38	1,74	0,21	0,01	0,09	0,11	1,77
CHTR	9,02	30,02	0,39	8,92	0,23	0,01	0,45	0,08	3,55
FAST	37,40	2,02	0,23	0,16	0,21	0,41	0,35	0,16	12,88
IDXX	51,55	10,06	0,33	0,72	0,30	0,43	0,81	0,23	29,02
KDP	19,93	1,55	0,27	0,58	0,22	0,02	0,09	0,15	1,67
TTD	241,84	0,36	0,16	0,11	0,10	5,85	0,08	0,09	19,55
DDOG	961,65	0,13	0,01	0,45	-0,02	2,86	0,03	0,02	20,37
GEHC	28,61	3,02	0,16	1,38	0,13	0,25	0,19	0,08	5,52
CSGP	102,78	0,92	0,16	0,15	0,12	4,76	0,05	0,15	5,26
EXC	16,20	2,34	0,35	1,71	0,19	0,02	0,09	0,11	1,47
FANG	11,85	17,35	0,75	0,41	0,54	0,09	0,20	0,37	2,21
CTSH	16,89	4,21	0,19	0,10	0,15	2,00	0,17	0,11	2,67
EA	32,99	3,96	0,25	0,26	0,20	1,59	0,14	0,14	4,65
BKR	17,79	1,91	0,15	0,44	0,10	0,54	0,13	0,08	2,21
CDW	31,18	8,11	0,09	3,07	0,08	0,09	0,61	0,05	16,59
VRSK	54,25	4,20	0,53	9,99	0,42	0,10	0,75	0,29	105,44
CCEP	17,38	3,93	0,17	1,43	0,13	0,17	0,22	0,09	3,56
ON	14,42	4,89	0,39	0,47	0,32	0,69	0,31	0,26	3,86
XEL	16,90	3,21	0,37	1,57	0,18	0,01	0,10	0,12	1,71
BIIB	25,86	7,98	0,23	0,50	0,17	0,14	0,08	0,12	2,02
ANSS	60,11	5,72	0,35	0,16	0,28	0,98	0,10	0,22	5,55

Five experts were consulted to determine the criteria to be used in the study and the weights of these criteria, and the criteria and weights used were determined. The financial indicators used as criteria in the study, whether these indicators should be maximized (max) or minimized (min) in accordance with the objective, and the weights of the criteria showing the importance levels of the criteria for the objective are presented in the table below.

Table 2. Weights of Financial Indicators Used as Criteria in the Study and Their Effects on Purpose

Financial Indicators	Max or Min	Weight (%)
Price Earnings Ratio	Min	0,20
Earnings per Share	Max	0,15
EBITDA Margin (%)	Max	0,15
Leverage Ratio (%)	Min	0,10
Operating Profit Margin (%)	Max	0,08
Cash Rate	Max	0,08
Return on Equity (%)	Max	0,08
Net Profit Growth (%)	Max	0,08
Market Value / Book Value	Min	0,08

Price Earnings Ratio

The price earnings ratio is the ratio of price per share to earnings per share. Researchers, market analysts, fund managers and investors often use price earnings ratio to analyze the relative attractiveness of equity investments. Price earnings ratio is used to evaluate the performance of individual stocks, sectors and markets (Afza & Tahir, 2012; Molodovsky, 1953). Nicholson (1960) argues that stocks with low price earnings ratios have better investment performance. Stocks with low price earnings ratio are assumed to be cheap (Sezgın, 2010). Therefore, the price earnings ratio should be minimized. In line

with the experts' recommendation, the price earnings ratio criterion weight is taken as 0.20. The calculation of the price earnings ratio is shown in Equation 10.

$$P/E = \frac{MVPS}{EPS} \tag{10}$$

MVPS (Market Value Per Share): Share price per market capitalization. EPS (Earnings Per Share): Earnings per share.

Earnings per Share

Earnings per share represents the revenue generated from each common share. Earnings per share is widely used by shareholders and potential investors to assess the profitability of a company (Kieso, Weygandt, & Warfield, 2020). Earnings per share is calculated to monitor the progress of a company's operations, determine the share price, and determine the amount of dividends to be distributed (Almeida, 2019; Arsal, 2021). Since earnings per share is a value that shows the profitability of a company, this criterion should be maximized. In line with the experts' recommendation, the weight of the earnings per share criterion is taken as 0.15 in the analysis. The calculation of earnings per share is shown in Equation 11.

$$EPS = \frac{NI - PD}{AOCS} \tag{11}$$

NI (Net Income): Net income generated by the company. PD (Preferred Dividends): The sum of dividends paid on preferred shares. AOCS (Average Outstanding Common Shares): Average number of outstanding common shares.

EBITDA Margin (%)

EBITDA (Earnings Before Interest, Taxes, Depreciation and Amortization) is a performance measure used for various purposes such as corporate valuation, management performance and solvency measurement (Bouwens, De Kok, & Verriest, 2019). EBITDA Margin is EBITDA divided by total revenues (Trejo Pech, Noguera, & White, 2015). The calculation of EBITDA is shown in Equation 12 and the calculation of EBITDA margin is shown in Equation 13.

$$EBITDA = NI + T + IE + D\,\&\,A \tag{12}$$

NI (Net Income): Net income generated by the company. T (Taxes): Total taxes paid by the company. IE (Interest Expense): Interest expense. Represents the amount of interest paid by the company. D (Depreciation): Depreciation. A cost that reflects the depreciation of the company's assets. A (Amortization): A cost that reflects the decline in the value of assets over time.

$$EM = \frac{EBITDA}{R} \tag{13}$$

EBITDA (Earnings Before Interest, Taxes, Depreciation, and Amortization): Earnings before interest, taxes, depreciation, and amortization. R (Revenue): Revenues. The EBITDA margin shows how much profit the business makes for every 1 unit of

revenue. A high EBITDA margin may indicate that the profitability of the business is strong, while a low EBITDA margin may indicate that the business is having difficulty controlling costs or increasing revenues. Therefore, the EBITDA margin should be maximized. In line with the experts' recommendation, the criterion weight for EBITDA margin was set to 0.15.

Leverage Ratio (%)

The leverage ratio measures a company's ability to fulfill its obligations in the long term (Ross, Westerfield, Jaffe, & Jordan, 2022). Leverage ratio is used to measure the degree of financial leverage of a company. Financial leverage refers to the company's ability to obtain financing using debt. The leverage ratio usually shows the relationship between debt and equity. The calculation of the leverage ratio is shown in Equation 14.

$$LR = \frac{TD}{E} \tag{14}$$

T (Total Debt): Represents the amount of the company's total debts. E (Equity): Represents the equity of the company. The leverage ratio shows the soundness of a company's financial structure. A high leverage ratio indicates that the company's debt is greater than its equity and that its debt is increasingly risky. A low leverage ratio indicates that the company has less debt and is financially stronger. Therefore, the leverage ratio should be minimized. In line with the experts' recommendation, the criterion weight for the leverage ratio was taken as 0.10.

Operating Profit Margin (%)

Operating profit margin shows the company's ability to generate profits to cover fixed costs and other operating costs. Operating profit margin is used to compare a company's operating costs for production or sales with other companies in the same industry (Mahdi & Khaddafi, 2020). A high operating profit margin may indicate that the company is generating profits from its operating activities more efficiently, while a low operating profit margin may indicate that the company is having difficulty in generating profits from its operating activities or is unable to control its costs. Therefore, the operating profit margin should be maximized. In line with the experts' recommendation, the criterion weight for the operating profit margin was taken as 0.08. The calculation of the operating profit margin is shown in Equation 15.

$$OPM = \frac{OP}{R} \tag{15}$$

OP (Operating Profit): Represents the company's profit from operating activities. R (Revenue): Revenues.

Cash Rate

Cash rate is used to measure the adequacy of available cash (Libby, Libby, & Short, 2009). The cash rate is obtained by dividing cash by short-term debt (Affandi, Sunarko, & Yunanto, 2019). The cash rate shows the short-term liquidity of a company. A high cash rate indicates that the company has sufficient liquidity to meet its short-term

debts, while a low cash rate indicates that the company may be under short-term liquidity risk. Therefore, the cash rate should be maximized. In line with the experts' recommendation, the criterion weight for the cash rate was taken as 0.08. The calculation of the cash rate is shown in Equation 16.

$$CR = \frac{CCE}{CL} \tag{16}$$

CCE (Cash and Cash Equivalents): Represents cash on hand, cash in bank accounts and short-term investments. CL (Current Liabilities): Represents the company's short-term debts that must be paid within one year.

Return on Equity (%)

Return on equity shows the extent to which companies use their capital effectively (Heikal, Khaddafi, & Ummah, 2014). A high return on equity may indicate that the company provides a high return to its owners, while a low return on equity may indicate that the company's profitability is poor or that capital is not being used effectively. Therefore, return on equity should be maximized. In line with the experts' recommendation, the criterion weight for return on equity was taken as 0.08. The calculation of return on equity is shown in Equation 17.

$$ROE = \frac{NI}{SE} \tag{17}$$

NI (Net Income): Net income generated by the company. SE (Shareholders' Equity): Represents the equity owned by the company's shareholders.

Net Profit Growth (%)

Net profit growth shows the percentage increase in a company's net profit in a given period compared to the previous period. Net profit growth is an important indicator of whether a company's profitability is increasing or decreasing. A positive net profit growth can indicate that the company's profitability is increasing and is on a growth trend, while a negative net profit growth indicates that profitability is decreasing and there may be problems. Therefore, net profit growth should be maximized. In line with the experts' recommendation, the criterion weight for net profit growth was taken as 0.08. The calculation of net profit growth is shown in Equation 18.

$$NIG = \frac{(CPNI - PPNI)}{PPNI} \tag{18}$$

CPNI (Current Period Net Income): Net income for the period being calculated. PPNI (Previous Period Net Income): Net income for the previous period to be compared.

Market Value / Book Value

The Market Value to Book Value ratio is calculated by dividing a company's market capitalization by its book value (equity based on the cost of the company's assets and asset values). The Market Capitalization to Book Value ratio is used in market and company analysis by combining external and internal factors of price (Block, 1995). If the Market Capitalization to Book Value ratio is below 1, the company's stock price is

lower than its book value and the stock is interpreted as affordable. If it is above 1, the stock price is higher than the book value and the stock is interpreted as expensive. Therefore, the Market Value / Book Value ratio should be minimized. In line with the experts' recommendation, the criterion weight for the Market Value / Book Value ratio was taken as 0.08. The calculation of the Market Value / Book Value ratio is shown in Equation 19.

$$P/B = \frac{MV}{BV} \tag{19}$$

MV (Market Value): Represents the market value of the company, i.e. the share price multiplied by the total number of shares. BV (Book Value): Represents the book value of the company, i.e. its equity based on the cost of its assets.

5. Results

Calculations regarding the ranking of 79 stocks within the scope of NASDAQ 100 according to their financial performance with MCRAT, RAPS and TOPSIS methods were carried out with the Excel program in Microsoft 365. The findings obtained as a result of the calculations are shown in Table 3.

Table 3. MCRAT, RAPS and TOPSIS Analysis Results and Rankings

Alternative	MCRAT		RAPS		TOPSIS	
	$tr(T_i)$	Rank	PS_i	Rank	Score	Rank
MSFT	0,0499	18	0,4020	20	0,5054	11
AAPL	0,0495	19	0,3911	24	0,4849	14
NVDA	0,0524	14	0,4378	9	0,5745	8
GOOG	0,0405	40	0,3188	42	0,3875	39
AMZN	0,0165	75	0,1302	75	0,2980	73
META	0,0489	24	0,3909	25	0,5167	10
AVGO	0,0552	9	0,4537	6	0,6473	2
TSLA	0,0232	69	0,1833	69	0,3211	66
ASML	0,0465	29	0,3770	29	0,5928	6
COST	0,0275	67	0,2174	67	0,3894	38
AMD	0,0160	76	0,1261	76	0,2562	77
NFLX	0,0467	28	0,3809	28	0,4960	12
PEP	0,0331	55	0,2621	55	0,3558	50
LIN	0,0395	44	0,3130	45	0,4412	22
ADBE	0,0393	45	0,3161	43	0,4493	19
AZN	0,0298	62	0,2343	63	0,3294	62
CSCO	0,0515	16	0,4127	16	0,3696	47
QCOM	0,0399	42	0,3142	44	0,3913	36
TMUS	0,0419	36	0,3302	37	0,3769	45
INTU	0,0291	64	0,2342	64	0,3925	35
AMAT	0,0433	35	0,3409	35	0,4211	28
INTC	0,0216	71	0,1736	71	0,2816	75
CMCSA	0,0602	4	0,5018	4	0,3508	53
TXN	0,0538	12	0,4248	13	0,4632	15
AMGN	0,0564	7	0,4448	8	0,5368	9
ISRG	0,0555	8	0,4372	10	0,3549	51
HON	0,0386	46	0,3051	48	0,3828	42
LRCX	0,0490	22	0,3945	22	0,5914	7
ABNB	0,0460	32	0,3619	32	0,4118	30

VRTX	0,0508	17	0,4022	19	0,4932	13
REGN	0,0645	3	0,5156	3	0,6496	1
ADP	0,0407	39	0,3206	41	0,4424	21
ADI	0,0445	34	0,3531	34	0,4145	29
KLAC	0,0518	15	0,4164	14	0,6155	3
MDLZ	0,0376	48	0,3075	47	0,3253	64
PANW	0,0307	60	0,2423	61	0,3860	41
GILD	0,0571	6	0,4517	7	0,4037	31
SNPS	0,0304	61	0,2444	59	0,3954	34
CDNS	0,0308	58	0,2518	57	0,3769	44
MELI	0,0307	59	0,2507	58	0,4572	17
CRWD	0,0043	78	0,0349	78	0,1720	78
PYPL	0,0400	41	0,3280	39	0,3310	60
WDAY	0,0195	72	0,1531	73	0,3095	69
CSX	0,0542	11	0,4260	12	0,4034	32
CTAS	0,0339	54	0,2702	54	0,4446	20
MAR	0,0460	31	0,3619	33	0,4394	23
PCAR	0,0493	21	0,4068	17	0,3710	46
CEG	0,0227	70	0,1804	70	0,3141	68
ROP	0,0411	38	0,3277	40	0,4525	18
MNST	0,0545	10	0,4315	11	0,3382	57
CPRT	0,0485	26	0,3833	27	0,3907	37
DXCM	0,0193	73	0,1559	72	0,3063	71
MCHP	0,0527	13	0,4142	15	0,4235	27
ODFL	0,0362	51	0,2858	53	0,3867	40
ROST	0,0297	63	0,2397	62	0,3320	59
LULU	0,0385	47	0,3030	49	0,4303	26
PAYX	0,0485	27	0,3834	26	0,4318	25
KHC	0,0487	25	0,4056	18	0,3250	65
AEP	0,0464	30	0,3682	30	0,3634	48
CHTR	0,0895	1	0,7133	1	0,6149	4
FAST	0,0288	65	0,2262	65	0,3351	58
IDXX	0,0366	50	0,2951	51	0,4583	16
KDP	0,0416	37	0,3348	36	0,3296	61
TTD	0,0136	77	0,1096	77	0,2644	76
DDOG	0,0027	79	0,0215	79	0,1697	79
GEHC	0,0266	68	0,2145	68	0,3091	70
CSGP	0,0176	74	0,1391	74	0,2917	74
EXC	0,0495	20	0,3996	21	0,3436	55
FANG	0,0890	2	0,6999	2	0,6029	5
CTSH	0,0399	43	0,3300	38	0,3273	63
EA	0,0310	57	0,2441	60	0,3398	56
BKR	0,0351	53	0,2980	50	0,3023	72
CDW	0,0277	66	0,2196	66	0,3478	54
VRSK	0,0446	33	0,3643	31	0,4377	24
CCEP	0,0374	49	0,3111	46	0,3191	67
ON	0,0577	5	0,4588	5	0,4034	33
XEL	0,0490	23	0,3928	23	0,3541	52
BIIB	0,0361	52	0,2865	52	0,3584	49
ANSS	0,0323	56	0,2593	56	0,3785	43

According to the findings, the top 5 stocks in the ranking obtained by MCRAT and RAPS methods are the same stocks: CHTR in 1st place, FANG in 2nd place, REGN in 3rd place, CMCSA in 4th place and ON in 5th place. In the ranking obtained by TOPSIS method, REGN ranked 3rd in both MCRAT and RAPS, AVGO ranked 9th in MCRAT and 6th in RAPS, KLAC ranked 15th in MCRAT and 14th in RAPS, CHTR

ranked 1st in both MCRAT and RAPS, and FANG ranked 2nd in both MCRAT and RAPS.

According to the MCRAT and RAPS methods, the last five stocks are the same: AMZN in 75th place, AMD in 76th place, TTD in 77th place, CRWD in 78th place and DDOG in 79th place. According to the TOPSIS method, INTC ranks 75th in the 71st place according to the MCRAT and RAPS methods, TTD ranks 76th in the 77th place according to the MCRAT and RAPS methods, AMD ranks 77th in the 76th place according to the MCRAT and RAPS methods, CRWD and DDOG rank 78th and 79th with the same rankings as the MCRAT and RAPS methods.

In order to understand whether the rankings obtained with the MCRAT and RAPS methods are acceptable or not, the TOPSIS method was also used. The rankings obtained with TOPSIS are in fact similar with very small differences. To show this, Spearman rank correlation coefficients were calculated to indicate the correlation between the rankings obtained with each method. The results are shown in Table 4.

Table 4. Spearman's Rank Correlation

		MCRAT	RAPS	TOPSIS
MCRAT	Correlation Coefficient	1,000	,997*	,655*
	Sig. (2-tailed)	.	<,001	<,001
	N	79	79	79
RAPS	Correlation Coefficient	,997*	1,000	,640*
	Sig. (2-tailed)	<,001	.	<,001
	N	79	79	79
TOPSIS	Correlation Coefficient	,655*	,640*	1,000
	Sig. (2-tailed)	<,001	<,001	.
	N	79	79	79

* Significant at 0.01 confidence level.

When the Spearman rank correlation coefficients are analyzed, it is seen that there is a high level of similarity between the rankings obtained from the 3 methods at 99% confidence level. There is a 99.7% correlation between the rankings obtained with MCRAT and RAPS methods, a 65.5% correlation between the rankings obtained with MCRAT and TOPSIS methods, and a 64% correlation between the rankings obtained with RAPS and TOPSIS methods. According to the results obtained, it shows that MCRAT and RAPS methods can be used successfully like other MCDM methods for stock selection.

6. Conclusion

Financial experts generally consider that stock market investments offer one of the best opportunities for both low-income and high-income individuals to increase their wealth. However, such investments require careful analysis and sophisticated decision-making to create a preferred investment portfolio. Multi-criteria decision-making (MCDM) techniques provide valuable tools for ranking the best investment methods and, in particular, for classifying and ranking listed companies. These techniques have been widely used in finance in recent years due to their ability to reach an optimal solution despite conflicting criteria.

In this study, two newly developed MCDM methods, MCRAT and RAPS, are introduced and it is shown how these methods can be successfully applied to financial investment problems. In the study, 79 stocks in the NASDAQ 100 are analyzed and ranked according to their performance using MCRAT and RAPS methods within the framework of financial indicators for 2023. In this analysis, 9 financial indicators commonly used in the literature were determined as criteria. The weights of these criteria were determined in line with the recommendations of five experts. The Price Earnings Ratio criterion is given the highest weight (0.20). The remaining weights are distributed among the other criteria with a total weight of 1.

In the rankings obtained by MCRAT and RAPS methods, it was determined that the stocks in the top 5 and bottom 5 rankings were the same. According to these two methods (MCRAT and RAPS), the top five stocks are CHTR, FANG, REGN, CMCSA and ON, respectively. According to MCRAT and RAPS methods, the stocks in the last five ranks are AMZN, AMD, TTD, CRWD and DDOG, respectively.

There are many methods in the field of multi-criteria decision making (MCDM) and each of them has advantages and disadvantages. There may be differences in the rankings obtained as a result of using these different methods. In this study, the results obtained with the MCRAT and RAPS method are compared with the results obtained with the TOPSIS method, which is one of the other frequently preferred and accepted by the researchers within the existing methodology. In the ranking obtained by TOPSIS method, REGN ranked 3rd in MCRAT and RAPS method, AVGO ranked 9th in MCRAT and 6th in RAPS method, KLAC ranked 15th in MCRAT and 14th in RAPS method, CHTR ranked 4th in MCRAT and 1st in RAPS method, In 5th place is FANG which ranks 2nd in MCRAT and RAPS methods, in 75th place is INTC which ranks 71st in MCRAT and RAPS methods, in 76th place is TTD which ranks 77th in MCRAT and RAPS methods, in 77th place is AMD which ranks 76th in MCRAT and RAPS methods, in 78th and 79th place are CRWD and DDOG which have the same ranking as MCRAT and RAPS methods.

As can be seen from the results obtained, there are very small differences between the rankings made by the TOPSIS method (see Table 3). In addition, rank correlation coefficients were calculated to determine the similarities between the ranking results obtained from MCRAT and RAPS methods and the TOPSIS method. A rank correlation of 65.5% was found between TOPSIS and MCRAT and 64.0% between TOPSIS and RAPS. On the other hand, the rank correlation between MCRAT and RAPS was 99.7%. These correlation values are quite high and indicate that MCRAT and RAPS methods can be used reliably in stock rankings.

The results of these three methods were obtained as a single ranking value by averaging the rank numbers obtained according to the research results of the study. According to these results, the best stock is CHTR, 2nd is REGN, 3rd is FANG, 4th is AVGO, 5th is AMGN. On the other hand, the last 5 stocks are AMZN in 75th place, AMD in 76th place, TTD in 77th place, CRWD in 78th place and DDOG in 79th place.

Multi-criteria decision-making methods are also used to make comparisons in decision-making processes and/or to make inferences about the validity of newly developed methods. Therefore, it would be useful for future studies to examine in detail the usability, advantages, and disadvantages of the methods in different fields.

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