The Performance Evaluation of Stock using PROMITHEE

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Abstract:
Buying a right stock at the right time is the key to success in investment decision making. It is always challenging to invest the hard earned money in equity due to the volatility in the market. For finding the prominent stocks by observing risk & return trade-off the available options are to be compared, an integrated Multi-Criteria Decision Making model (MCDM) is proposed in this study, which is inclined for selecting the superior stock. Eight risk measurement tools are used for measuring the risk on Nifty-50 data from 2011-19. Through PROMITHEE method, varied alternatives of stocks are ranked based on the risk-return combinations. The study shows the effectiveness of the methodology in the process of deriving value out of the investment.

Keywords: Multi Criteria Decision Making Model, PROMITHEE, Stock Selection, Superior Stock, Value Investing, Risk Measurement.

1. Introduction

The stock selection approach involves buying stocks and position those stocks in a portfolio. This is a distinct decision of investors which is backed with lot many factors of investment decision making. Investors face tough challenges while selecting stocks for creating a profitable portfolio. For evaluation of performance of a stock before decision making, here risk is measured over a period of time through CAPM, Sharpe Ratio, Treynor Ratio, Jensen's Alpha, Information Ratio, Sortino Ratio, Return relative to VAR and M&M. The identified risk of the stock is extensively measured and evaluated by using PROMITHEE.

The preference of stock selection is observed through ranking method which is expressing quantitative aspect for risk measurement tools. This also provides the consistency among ranking of options over the period of time so that the model can provide sustainability to investors for better decision making. As risk measurement tools and available options of stock are in multiple numbers, hence, decision making becomes complex. The problem itself gives notion to understand Multi Criteria Decision Making Model which solves problem and is characterized as a selection among alternatives [14] [1].

Multi Criteria Decision Making (MCDM) clearly evaluates multiple conflicting criteria in decision making. The stock selection is always a crucial task which ultimately uphold the eye towards the best risk-return trade off. The research attempts to find the

superior stocks listed among Nifty-50 based on several risk measurement tools. Further, for investment decision making PROMITHEE (Preference Ranking Organization Method for the Enrichment of Evaluations) method is applied on the selected sample of stocks.

[2] [3] PROMITHEE was developed by Brans et.al (1984, 1986) in varied areas with regards to ranking of alternatives. These multi-criteria situation problem cannot be figured out unless the additional information is provided for decision making purpose [2] [7]. The uses and application of PROMITHEE covers choice, priority, resource allocation, ranking and conflict resolution. *Table I* shows the area of application of PROMITHEE for decision making based on review of selective papers.

Table I Areas Showing Use & Application of PROMITHEE.

Author & Year	Area of Application	Discussion
Albadavi, 2004	Information Technology	The preference ranking explored E-education, E-research, E-office and E-information services as most prominent alternatives amongst the researched economic, social and cultural development aspects of the country. 1% GDP was allocated to these alternatives.
Vinodh & Girubha, 2012	Sustainable Concept	The study evidenced the best sustainable concept from social, economic and natural perspectives. It revealed that the degree of change in material is the best sustainable option.
Abdullah, 2019	Green Supply Chain	The effect of varied alternatives selection was checked for which economic and environmental variables were used. The preference of one supplier is observed i.e. A1 (Food Marketing Sdn Bhd) over other 3 suppliers. The cost, quality, service, delivery time, technology, environmental management system and green packaging were the seven criteria.
Zopounidis, 1999	Financial Management	The research asserts that financial decision making is based on optimal allocation of funds and optimal financial capital structure. The operational research technique is used for optimization of stock, cash, current liability and account receivables.
Abutaleb, 1995, Ozelkan 1996	Water Resources & Management Water Resources & Management	Water crisis is a major issue in the Middle East. PROMITHEE is applied to find out the potential water resources. Technical, Managerial, Pricing and Regulatory options are explored for water resource options of Jordan. THE MCDM is extensively used to find the best solution to the problem.
Ignatius et.al, 2012	Automotive Sector	The performance of Iranian automotive enterprises is evaluated based on seven indices such as Sales Growth, Sales Margin, Return on Assets, Return on Equity, Current Ratio, Asset Turnover and Operating Profit/Financial Cost. Sales growth was observed as the prominent factor for financial behavior of the company.
Kolli, 1992	Manufacturing Sector	For advanced manufacturing technology, this methodology is used on the basis of payback period, net present value, return on investment. The multiple variables in manufacturing sector are throughput time, flexibility, quality, inventory management and competitiveness.
XIdonas, 2009	Stock Exchange	Firms are examined on the basis of profitability, activity, liquidity, solvency and structure ratios. For medium to long term horizon the security is evaluated. Equity is selected on the basis of Financial Analysis (FA) which are taken from commerce, financial service, banking institution, insurance and industry/commerce firms.
Hu & Chen, 2011	Bankruptcy Prediction	The classification methods such as Linear Discriminant Analysis, Logistic Regression, SLP, Multi-Layer Perceptron, Decision Tree Algorithms and CART were used for bankruptcy prediction. In comparison to these methods PROMITHEE was observed more effective for early prediction of bankruptcy.
Vasic, 2018	Energy Saving	The screening of energy problem was at Novi Sad explored that technology solutions are dominating in terms of designing policy for energy saving. The investment and operational cost should be given more priority for renewable energy.

The central idea of PROMITHEE is pairwise comparison of alternatives by comparing each other based on certain criteria. Brans et.al 1986, propounded PROMITHEE I which is applied for partial ranking. PROMITHEE II is a revision over PROMITHEE I

which is based on complete ranking of available options.

PROMITHEE Methodology

[4] PROMETHEE method (Preference Ranking Organization Method for Enrichment Evaluation) is used to evaluate and rank the different alternatives. For evaluating the alternatives, the information required such as; Information regarding the importance of criteria used in the study, basically study required weights for providing relative importance to each criterion.

There are various steps involved in implementing PROMETHEE II method:

1. Calculate the maximum and minimum value of each criterion.
2. Apply the formula if:
   a. The criterion preferred the maximum value i.e. Beneficial Criteria:

$$S_{ij} = \frac{[x_{ij} - min(x_{ij})]}{[max(x_{ij}) - min(x_{ij})]}$$

(1)

   b. The Criterion preferred the minimum value i.e. Non- Beneficial Criteria:

$$S_{ij} = \frac{[max(x_{ij}) - x_{ij}]}{[max(x_{ij}) - min(x_{ij})]}$$

(2)

3. Calculate the evaluative difference of ith alternative with respect to other alternatives.

4. Calculate the preference function, $PF_j (a,b)$

$PF_j (a,b) = 0$ if $S_{aj} \leq S_{bj}$ i.e. $D (S_a - S_b) \leq 0$ (3)

$PF_j (a,b) = (S_{aj} - S_{bj})$ if $S_{aj} > S_{bj}$ i.e $D(S_a - S_b) > 0$

5. Then, evaluate Aggregated Preference Function, $\Pi (a,b)$

$$= \frac{\left[\sum_{j=1}^{n} w_j\, p_j (a,b)\right]}{\sum_{j=1}^{n} w_j}$$

(4)

6. Determine the leaving and entering outranking flows

Leaving (positive) flow for a_{th} alternative, φ^+

$$= \frac{1}{(m-1)}\sum_{b=1}^{m} \pi (a,b) \qquad (a \neq b)$$

(5)

Entering (negative) flow for a_{th} alternative, φ^-

$$= \frac{1}{(m-1)}\sum_{b=1}^{m} \pi (b,a) \qquad (a \neq b)$$

(6)

7. Calculate the net outranking flow for each alternative:

$$\varphi(a) = \varphi^+ (a) - \varphi^-(a)$$

(7)

8. Determine the ranking of all the alternatives depending on the values of $\phi (a)$.

Research Methodology:

For finding out the "best eggs in the basket" PROMETHEE II has been used which is applied on NSE- NIFTY-50. The sample excludes three stocks viz, India Bulls, Bajaj Auto and Infratel due to unavailability of data. The time series data for the study is observed from 2011-19 and data is extracted from the official website of NSE. The study used purposive sampling technique.

To apply PROMETHEE II, firstly we require weights for each Criterion i.e. is defined in *Table II*. For assigning weights, experts' advice was taken for giving weights to each of the risk measurement tools [17]. After putting weights on each criterion, adjusted daily closing price of NIFTY-50 has been taken to calculate all eight risk measurement tools (Table II). Further, the steps of PROMITHEE-II is followed to give ranks to different alternatives of stocks.

Results and Analysis:

PROMETHEE-II was applied to compare the performance of one stock with another and to provide a suitable rank to choose the stock for the

investment purpose. For execution of this method, each ratio is given weight i.e defined in *Table II*.

Table II: Risk Measurement Tools and Assigned Weights to Each Method

Name of Method	Formula	Description	Polarity	Weights
CAPM	$R_f + \beta(R_m - R_f)$	It is used as benchmark to earn the return.	Max	.08
Sharpe Ratio	$\dfrac{(R_p - R_f)}{\sigma_p}$	It helps the investor in understanding return of an investment compared to its risk.	Max	.06
Jensen's Alpha	$R_p - (R_f + \beta(R_m - R_f))$	Ratio is Risk adjusted Risk measure.	Max	.51
Treynor Ratio	$\dfrac{(R_p - R_f)}{\beta_p}$	The ratio denotes the excess return over one unit of risk level.	Max	.05
Sortino Ratio	$\dfrac{(R_p - R_f)}{\sqrt{SV_p}}$	It measures an investment's return for a given level of risk.	Max	.04
Information Ratio	$\dfrac{\alpha_p}{\sigma_{\varepsilon p}}$	Ratio measures the Asset Manager's skill level to generate relative excess return.	Max	.08
Modigliani-Modigliani-M^2	$\dfrac{(R_p - R_f)}{\sigma_p}(\sigma_m - R_f)$	Ratio denotes the reward which is earned by investor in comparison to the level risk.	Max	.09
Return relative to VaR	$\dfrac{(R_p - R_f)}{VaR}$	How much return is earned over benchmark return which is divided by the potential loss of occurrence	Max	.09

* Rf is Risk Free Return (RBI Treasury Bills Rate), Rm Market Rate of Return, Rp Expected Return of a Security, β_pdenotes the Beta of security, $\sqrt{(\llbracket SV \rrbracket\_p)}$ denotes the downside deviation, α_p denotes the difference between the portfolio return and benchmark return,

σ _εp denotes the tracking errror (difference between the standard deviation of portfolio and benchmark), σ_m denotes the standard deviation of market, VaR denotes Value at Risk that is measured at 95%.

After obtaining the weights of criterion, different rankings are given to the stocks *(Table III)*. The calculated table defines the Leaving Flow and Entering Flow and the difference is calculated in between the two. Leaving flow is calculated by taking the row-wise average of stock preference value and entering flow is calculated by taking the column-wise average of stock preference value. [18] Preference value is calculated to know the importance of one stock over another *(Appendix-I)*. After calculation of leaving and entering flow and taking the difference between the two i.e ϕ(a) is calculated, then highest rank provided to the largest value. In *Table III* the positive ϕ(a) may be taken to construct the portfolio i.e. from Rank 1 to Rank 17.

Table III: Outranking with Eight Risk Measurement Tools

Security Number	Name of Company	Leaving Flow	Entering Flow	ϕ(a)	Rank
S4	Bajaj Finance Ltd.	87.135	0.145	86.989	1
S8	Britannia Industries Ltd.	44.281	1.078	43.203	2
S12	Eicher Motors Ltd.	39.281	1.123	38.159	3
S5	Bajaj Finserv Ltd.	39.208	1.254	37.954	4
S6	Bharat Petroleum Corporation Ltd.	27.494	1.850	25.644	5
S2	Asian Paints Ltd.	23.498	0.132	23.366	6
S3	Axis Bank Ltd.	11.992	0.464	11.528	7
S26	JSW Steel Ltd.	13.027	3.382	9.646	8
S1	Adani Ports and Special Economic Zone Ltd.	9.622	0.124	9.498	9
S19	Hindustan Unilever Ltd.	12.223	4.091	8.132	10
S24	IndusInd Bank Ltd.	10.859	4.074	6.785	11
S16	HDFC Bank Ltd.	11.054	4.805	6.250	12
S15	HCL Technologies Ltd.	11.037	4.794	6.243	13
S25	Infosys Ltd.	10.855	6.375	4.480	14

S23	Indian Oil Corporation Ltd.	8.665	4.972	3.693	15
S27	Kotak Mahindra Bank Ltd.	9.054	5.698	3.356	16
S30	Maruti Suzuki India Ltd.	9.249	7.145	2.104	17
S42	UPL Ltd.	3.454	3.645	-0.191	18
S21	ICICI Bank Ltd.	5.609	7.131	-1.523	19
S41	Titan Company Ltd.	2.530	4.149	-1.618	20
S14	Grasim Industries Ltd.	4.616	7.273	-2.657	21
S46	Yes Bank Ltd.	0.508	3.312	-2.804	22
S40	Tech Mahindra Ltd.	2.073	5.322	-3.248	23
S20	Housing Development Finance Corporation Ltd.	3.901	8.420	-4.519	24
S22	ITC Ltd.	3.905	8.546	-4.641	25
S13	GAIL (India) Ltd.	3.175	8.211	-5.036	26
S9	Cipla Ltd.	1.569	8.566	-6.997	27
S37	Tata Consultancy Services Ltd.	3.143	10.365	-7.223	28
S11	Dr. Reddy's Laboratories Ltd.	1.325	8.548	-7.223	29
S7	Bharti Airtel Ltd.	0.201	8.425	-8.225	30
S47	Zee Entertainment Enterprises Ltd.	0.079	8.533	-8.454	31
S17	Hero MotoCorp Ltd.	2.136	10.686	-8.550	32
S34	Reliance Industries Ltd.	2.238	11.065	-8.827	33
S35	State Bank of India	2.381	11.391	-9.010	34
S29	Mahindra & Mahindra Ltd.	2.746	11.982	-9.236	35
S10	Coal India Ltd.	0.205	10.438	-10.233	36
S28	Larsen & Toubro Ltd.	2.733	12.972	-10.239	37
S36	Sun Pharmaceutical Industries Ltd.	1.663	12.755	-11.092	38
S43	UltraTech Cement Ltd.	1.281	13.195	-11.914	39
S18	Hindalco Industries Ltd.	0.679	13.972	-13.294	40
S33	Power Grid Corporation of India Ltd.	1.199	15.480	-14.281	41
S45	Wipro Ltd.	0.191	21.373	-21.182	42
S39	Tata Steel Ltd.	0.345	21.805	-21.460	43
S32	Oil & Natural Gas Corporation Ltd.	0.241	24.097	-23.856	44
S31	NTPC Ltd.	0.227	25.820	-25.592	45
S38	Tata Motors Ltd.	0.250	28.077	-27.827	46
S44	Vedanta Ltd.	0.270	31.608	-31.338	47

Conclusion:

In this research paper, a Multi Criterion Decision Model (MCDM) has been applied for selecting stocks for investment purpose. Performance evaluation and ranking of the company stock is done through PROMETHEE-II. For the implementation of the method, weights have been given on the basis of expert's advice further on which [19], [20], [21] Fuzzy AHP was applied. The result of the method is based on expert's perception and relevant literature. Weights were assigned on the basis of the same. The calculated net flow was used for determining the rank of a stock (Nifty-50) in which seventeen out of forty seven stocks are showing positive results.

The study can be further extended in designing the optimal portfolio and some other fundamental criterion may be used in place of these ratios (defined in *Table I*). The stock market is affected by lot many other factors which are qualitative and quantitative in nature that may also be considered in achieving better results. The limitations of the paper are that the result of the study is not validated with the present performance of different stocks of Nifty-50. Secondly, confounding does exist which can be controlled to some extent in future research piece of work.

References:

1. Brans, J. P., & Mareschal, B. (1994). The PROMCALC & GAIA decision support system for multicriteria decision aid. *Decision support systems*, *12*(4-5), 297-310.
2. Brans, J. P., Vincke, P., & Mareschal, B. (1986). How to select and how to rank projects: The PROMETHEE method. *European journal of operational research*, *24*(2), 228-238.
3. Mareschal, B., Brans, J. P., & Vincke, P. (1984). *PROMETHEE: A new family of outranking methods in multicriteria analysis* (No. 2013/9305). ULB--Universite Libre de Bruxelles.
4. Albadvi, A. (2004). Formulating national information technology strategies: A preference ranking model using PROMETHEE

method. *European Journal of Operational Research*, *153*(2), 290-296.

5. Vinodh, S., & Girubha, R. J. (2012). PROMETHEE based sustainable concept selection. *Applied Mathematical Modelling*, *36*(11), 5301-5308.

6. Zopounidis, C. (1999). Multicriteria decision aid in financial management. *European Journal of Operational Research*, *119*(2), 404-415.

7. Brans, J. P., & De Smet, Y. (2016). PROMETHEE methods. In *Multiple criteria decision analysis* (pp. 187-219). Springer, New York, NY.

8. Abu-Taleb, M. F., & Mareschal, B. (1995). Water resources planning in the Middle East: application of the PROMETHEE V multicriteria method. *European journal of operational research*, *81*(3), 500-511.

9. Özelkan, E. C., & Duckstein, L. (1996). Analysing water resources alternatives and handling criteria by multi criterion decision techniques. *Journal of environmental management*, *48*(1), 69-96.

10. Kolli, S., & Parsaei, H. R. (1992). Multi-criteria analysis in the evaluation of advanced manufacturing technology using PROMETHEE. *Computers & industrial engineering*, *23*(1-4), 455-458.

11. Abdullah, L., Chan, W., & Afshari, A. (2019). Application of PROMETHEE method for green supplier selection: a comparative result based on preference functions. *Journal of Industrial Engineering International*, *15*(2), 271-285.

12. Hu, Y. C., & Chen, C. J. (2011). A PROMETHEE-based classification method using concordance and discordance relations and its application to bankruptcy prediction. *Information Sciences*, *181*(22), 4959-4968.

13. Vasić, G. (2018). Application of multi criteria analysis in the design of energy policy: Space and water heating in households–City Novi Sad, Serbia. *Energy Policy*, *113*, 410-419.

14. Multi Criteria Decision Analysis (MCDA), Natural Resources Leadership Institute (2011), Retrieved from https://projects.ncsu.edu/nrli/decision-making/MCDA.php.

15. Xidonas, P., Mavrotas, G., & Psarras, J. (2009). A multicriteria methodology for equity selection using financial analysis. *Computers & operations research*, *36*(12), 3187-3203.

16. Ignatius, J., Behzadian, M., Malekan, H. S., & Lalitha, D. (2012, June). Financial performance of Iran's Automotive sector based on PROMETHEE II. In *2012 IEEE International Conference on Management of Innovation & Technology (ICMIT)* (pp. 35-38). IEEE.

17. Lee, S. C., & Eid Junior, W. (2018). Portfolio construction and risk management: theory versus practice. *RAUSP Management Journal*, 53(3), 345-365.

18. Basilio, M. P., de Freitas, J. G., Kämpffe, M. G. F., & Rego, R. B. (2018). Investment portfolio formation via multicriteria decision aid: a brazilian stock market study. *Journal of Modelling in Management*.

19. Kwong, C. K., & Bai, H. (2003). Determining the importance weights for the customer requirements in QFD using a fuzzy AHP with an extent analysis approach. *iie Transactions*, *35*(7), 619-626.

20. Tiryaki, F., & Ahlatcioglu, B. (2009). Fuzzy portfolio selection using fuzzy analytic hierarchy process. *Information Sciences*, *179*(1-2), 53-69.

21. Patni, I., & Gupta, N., (2018), Construction of Optimal Portfolio and Stock Selection using Fuzzy Approach. *International Journal of Engineering & Technology (UAE)*, 7(3.30), 118-121