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Application of Operations Research in Financial Decision Making

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ABSTRACT

"O.R. is the application of scientific methods, techniques and tools to problems involving the operations of a system so as to provide those in control of the system with optimum solution to the problem. -Churchman, Ackoff and Aronoff." This report includes the application of OR (Operation research) in financial industry. How OR's instruments would avail in solving quandaries such as portfolio management, asset allocation, investment strategies and imperil evaluation etc. Finance management is a very delicate process and needs a very profound understanding in order to realise its functioning. Most of the times avail of experts is required to understand it's working. OR gives a very efficient method to solve things and get the optimal solution thereby minimizing extra costs and jeopardizations. The topics discussed in the report are 1) Monte Carlo Simulation 2) Index Tracking Fund (Includes Quadratic Programming) 3) Data Envelopment Analysis (DEA). It is difficult to utilize operations research when you wish to make decisions but the conditions are not matched, and when differing objectives conflict with each other. The problems which are being solved through this report are 1) Financial Risk Management 2) Passive Portfolio Optimization 3) Banking Operations and Decision Making.

Keywords— *Operation Research, Risk Management, Portfolio Optimization, Money, Financial Problems, Decision Making*

1. INTRODUCTION

News Corner:

> *"Pak Central Bank Reserves Fall By $123 Million To $20 Billion. Stock of this travel support services company has zoomed 75% in 2 weeks".*
>
> *"BPL hits upper circuit for 10th straight trading session, zooms 86%. The stock hit a 52-week high of Rs 60.75, having rallied 86% in the past two weeks from Rs 32.60."*
>
> *"Sensex gains 226 pts, Nifty closes tad below 16500; IT, bank & financial stocks shine"*
>
> *"Vodafone Idea continued to rally in the absence of any negative development. Zen Technologies continued to hit upper circuit, once again, whereas Ujjivan Financial Services, NSE 9.92 % continued its free fall. Investors booked profits in realty players."*

The application of OR described in the report lies in the field of finance (The way OR helps in managing). Management of finance involves various things such as analysis, calculated forecasting, intuition etc. These things make up management of finance and therefore are necessary while making financial decisions. The field of finance is huge and there is a requirement to solve different problems with precision to get a desired result. These problems require instruments which would help people to make decisions.

The report shows some of the methods that are used in the financial industry. Each of them solves some of the problems and are used by people on daily basis

The methods used in the report are namely:

(a) Monte Carlo Simulation: Financial models are assumption based. Not every model but most them are associated uncertainty and risk. In these cases, Monte Carlo Simulation avails us to analyse the effect of arbitrariness introduced by some of the variables in our model. The simulation works by performing perpetual calculations utilizing desultory inputs for these posits and then averages out the most probable output of the model.

(b) Index Tracking Fund: Index Tracking Fund is a type of exchange traded fund (ETF) which helps to keep an eye on market performance when the manager cannot rely on the theoretical portfolio. It's like a testing fund which determines whether the performance a particular company is good enough for buying equities from its index. Mainly done in two ways 1) Full Replication 2) Partial Replication.

(c) Data Envelopment Analysis: Data envelopment analysis is one of the most popular methods applied in the studies on measuring efficiency of companies. It helps them to make the best outputs out of the inputs made. DEA is also commonly used to measure efficiency issues in banking.

These are some of the widely used techniques around the world. They help solving finance related problems and each of the techniques are performed using particular software and can only be done using the required constraints and variables that make up the problem with also requiring training to use the softwares. These might not be the best method that provides the best solution, the desirable result can be obtained using other methods also but since our research focuses only on some of the procedure, so the result is only limited to the ones that can be given by used methods and should not be considered as the only method to have the solution to these problems.

2. LITERATURE REVIEW

2.1 Gaps and Problems

The problems which are being solved through this report are

(a) Financial Risk Management- The risk arising when people choose to allocate their funds in different sources and want it to be safe and risk free. This problem has to be solved as it causes financial losses to people giving a decline a decline their net worth which is very undesirable. At one place they try to allocate funds to get more returns and at second place getting losses from the allocation is a big misery.

(b) Passive Portfolio Optimization – It's a very common problem where people want to get high returns from minimum funds allocation. Since not everyone cannot spend huge amounts, it makes it necessary to solve problem where people can still get returns. To do these optimizations its necessary for fund managers to invest at those places where the return is ensured. To check for those sources is main problem which has to be solved.

(c) Banking Operations and Decision Making- Banks are money keeper in the country and it's required for them to be firm in their operations. There are several inputs made while running a bank and it's desirable to get best outputs from the inputs. To check efficiency of those outputs or whether they are giving the desired results or not is main problem. It makes it important to check those inefficiencies and make decisions accordingly.

2.2 Research Objectives

- To understand how Financial Markets works.
- To understand how techniques of OR can be used to solve problems in Financial Industry
- To know which type of technique may be used to solve the particular problem
- To explain how using OR can lessen the chance of horrific investments and improve the economic system.
- To recognize the relationship between OR and economic Markets.
- To understand whether OR is the only solution to the problems related to finance

3. CITATIONS

Monte Carlo Simulation: Applying Operation Research Technique to Financial Market, John Board, University of Reading; William Ziemba, University of British Columbia-Vancouver; Charles Sutcliffe University of Reading,

In 1977, Boyle proposed utilizing Monte Carlo simulation as an opportunity to the binomial version for pricing options for which a closed shape answer is not yarely to be had. Monte Carlo simulation has the gain over the binomial model that its convergence fee is independent of the quantity of nation variables (e.g., the quantity of underlying asset fees and interest charges), at the same time as that of the binomial model is exponential within the wide variety of state variables. Monte Carlo simulation is used to generate paths for the price of the underlying asset till maturity. The cash flows from the choice for each route, weighted via their hazard neutral probabilities, can then be discounted lower back to the prevailing using the chance-free price, sanctioning the average present fee throughout all of the pattern paths to be computed to present the current charge of the option.

Index Tracking Fund: Optimization Methods for Financial Index Tracking: From Theory to Practice: Konstantinos Benidis; Yiyong Feng Dept. of Electronic and Computer Engineering, Daniel P. Palomar –The Hong Kong University of Science and Technology

The price of an index can be tracked explicitly via constructing a portfolio of assets or derivatives whose price follows the fee of the given index. the construction of this type of monitoring portfolio is crucial for numerous motives. First, it's miles the constructing block of an ETF, i.e., that allows you to difficulty an ETF, we want first to assemble the corresponding portfolio that this ETF will constitute. similarly, not all indices or market sectors have an ETF related to them. consequently, a tracking portfolio may be used to explicitly music an index where an ETF does now not exist. subsequently, having the equipment to create such portfolios gives us the power to encompass any partial facts that we may additionally possess or maybe create portfolios that try to

beat the fee of an index, in preference to the usage of a few predetermined financial units that we don't have any freedom on adjusting.

Data Envelopment Analysis: Measuring bank efficiency: DEA application; Jelena TITKO, Jelena STANKEVIČIENĖ, Nataļja LĀCE, Department of Corporate Finance and Economics, Faculty of Engineering Economics and Management, Riga Technical University, Kalnciema 6, LV-1048 Riga, Latvia b Department of Finance Engineering, Faculty of Business Management, Vilnius Gediminas Technical University, Saulėtekio al. 11, LT-10223 Vilnius, Lithuania
Quantifying and comparing the working performance of financial institution branches requires analytic strategies that offer insights beyond those to be had from accounting ratio evaluation. Data Envelopment evaluation (DEA), a mathematical programming method, affords beneficial insights in locating inefficient branches by means of explicitly considering the combination of services provided and the assets used to provide these financial institution services. financial institution control finds the DEA outcomes offer significant insights not available from different techniques that concentrate on methods to improve productiveness. The consequences indicates that DEA is a beneficial supplement to different techniques for enhancing financial institution branch efficiency.

3. ANALYSIS AND FINDINGS

3.1 Finance and Risk Management- Monte Carlo Simulation

Managing finance is a very important thing because the better the finance is managed the better is the risk managed. One always wishes that a person should spend their money on different sources which may provide them better returns and the losses should be minimum, the different sources people can spend their money, can be buying shares, real estates, buying a franchise etc. For that several instruments are used to provide people with best possible options for better returns. The instrument being talked about here is “Monte Carlo Simulation” which predicts using several variables and makes a hit and trial approach until the best possible outcome is achieved. It’s mainly done using different computer software which allows them to predict results of several areas and different companies. The number of predictions can vary, may range from hundreds to thousands and only depends how soon a person gets the desired result. It shows the results in form of graphs. For e.g., In the bell curve aka the only decision then lies with the person is to choose to source where they wish to invest. It’s not necessary that a person may necessarily get a result where they may get the best profits from specific source but a person may get the optimal result from that particular source.

Monte Carlo simulation was developed a long time ago. In daily practice it’s less commonly used because of its cumbersome nature, in modern era Excel and Google sheets perform well and even support day-to-day typical finance tool but Monte Carlo is of best use when valuing derivatives, analyzing portfolios and more, their tools are typically developed in-house, proprietary or prohibitively expensive—rendering them inaccessible to the individual finance professional.

3.2 Passive Portfolio Optimisation- Index Tracking Fund (includes Quadratic Programming)

A portfolio is an amassment of financial investments like bonds, stocks, money, money and cash equipollents, including closed-end funds and exchange traded funds (ETFs). It is believed that stocks, cash and bond are the backbone of a portfolio. A passive portfolio mainly focuses on maximizing return with a little fund input. A passive portfolio fund gives the reflection a market index. It’s everybody’s desire that may receive best output with little investment. For this, the most commonly used method is’ Index Tracking Fund.’ It’s basically using a small fragment of fund to invest for testing purpose in order to track the performance of the investment source.

This method is generally used by fund managers when they wish to match the performance of a theoretical portfolio but cannot because of their uncertainty about the market performance. For doing so the use two ways, namely:

(a) Full Replication: In this method, investment is made in every constituent of the index, proportional to its market share, for e.g., issue of new shares by the company and buying each and every type of it.
(b) Partial Replication: In partial replication investment is made in small proportion of the shares, while matching the performance of the entire index. The transaction cost in this method is relatively low compared to full replication. But has a **tracking error** while calculating the deviation (rebalancing) with the chosen index.

3.2.1 What is Tracking Error? A tracking error is commonly believed as the performance of an index fund. But if talking in reality tracking error shows the variability in the performance of index fund

3.2.2 How to minimise the tracking error? (Quadratic Programming): Quadratic Programming is just one of the methods which helps solve complicated equations with the given constraints and variables. For solving the errors in the partial replication. Quadratic Programming is one of the best methods to track those errors. It’s done using computers software where the values a are put and it shows the deviation and there by those errors can be corrected.

3.3 Measurement Bank’s Efficiency and Decision Making- Data Envelopment Analysis (DEA)

Banks are the safehouses of our fund, they run the whole country and without them there is no way the country can even survive and manage its funds. There are thousands of daily operations done in the bank. It’s very necessary for operations to be very smooth without any hassle and be very efficient. These things although are already decided before running the bank but it’s the obvious human nature to make mistakes. To keep an eye on these mistakes, the bank has to check the performance on regular decided intervals and take actions accordingly. One of the methods to check the efficiency of bank is ‘Data Envelopment Analysis’ (DEA)

DEA is basically used to measure DMU's (aka Decision Making Units) efficiency. DEA is all about making best outputs out of all of the inputs. For example, in a Bank there is staff, electronic appliances, stationery etc. DEA merely checks if the way inputs are made by the DMU's are efficient enough or not. If not then it can be corrected using the respected softwares. It gives out the best output so as to maintain the efficiency. The most commonly used software is MS Excel, it's affordable and at times given for free with the purchased operating appliances. DEA is used in bank to promote the high efficiency to ensure that functioning is uniform and the banks are able to give their best performance in providing the respective services to the public.

4. CONCLUSION

We could find ways of finding the solutions to our problem and turns out at every point these are widely used and acceptable. They help people in making difficult decisions with precision. Monte Carlo Simulation predicts the best results. Index Tracking helps to check performance of an index so that it can be used for allocation further on. At last DEA could help in checking banks efficiency and make the desirable decisions. The techniques of OR ensure the smooth functioning in corporate world making people give out their best performances. These techniques require learning and training which helps in development of an individual. Since in the modern tech world there are programmes which makes finance related problem very easy to solve without any flaws. These programmes in designed in this way that it would people to resolve issues related to finance. Moreover, one is not supposed to rely only on these methods described as there are several other like Modern Portfolio Theory and Linear programming etc. which can also help in doing getting the results.

5. RECOMMENDATIONS

It's highly recommended that the decisions should solely not be made in accordance to the results given by these methods and the decision maker should be well experienced and should have that intellect to make decisions which are applicable in the real world. As important it is to take the help of these technique so important would be for an individual to use their own sense which is an experienced based trait and cannot be done without spending time in the industry. For e.g., if a newly started firm shows a huge growth but makes out as a temporary trend then it might not be a good decision for a person to invest there. One should able to picture the future of how the world may seem in next few years and then act.

6. LIMITATIONS

Even though these techniques help in solving these problems but field of finance is just not about calculations and predictions. Today's world is full of unpredictable results and it's the most difficult thing to even predict human behaviour even though these instruments are best to calculate using numbers and can provide you best results but these cannot help of what is going to happen in future. The decisions that are made are a result of the present scenarios and do not tell of what is the probable outcome of the uncertainties. For e.g., if a company's stock price is currently $100 and on another fine day a highly celebrated personality demotivates to consume that product then the stock price is expected to go very down because people would stop buying those products just because they are highly obligated to these famous personalities. The people who had invested in these companies just because they could see the potential growth would suffer losses because the decisions they had made were highly on the basis of present predication and calculation. Now just because of an uncertainty, the techniques used seemed useless because they lack an insight of the unpredictable human nature

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