RESEARCH ARTICLE

ANALYSIS OF AN INVESTMENT PORTFOLIO, MINIMIZING RISKS

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ABSTRACT

Investments are becoming increasingly important to people in recent years. With the economic instability scenario and with the great uncertainties, such as those related to social security reform, many people decide to start investing in financial market. But, there is always the doubt in which market assets one the people should invest. In today's dynamic and globalized world, it is necessary to make a decision more quickly more efficiently, bringing positive results and contributing to the growth of an organization. Many investors believe that paying attention to only the return of an asset is beneficial, but they forget that higher returns carry greater risks, so it's important understanding the mechanisms for calculating a risk so that there is less chance of loss. The key word for risk minimization in a portfolio is diversification; because when investing in several assets, there is a decrease in the impact of a loss of a certain asset.

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INTRODUCTION

This paper aims to set up a portfolio of investments, seeking allocation of several assets to achieve the purpose of this report: minimize risk and at the same time maximize return.
According to Markowitz (1952), the risk of a portfolio is less than the sum of the individual risks of each asset. This means if there is a significant loss in a poorly planned investment it will not affect as much as there are other investments in portfolio that can cushion this negative impact. Even if in a given period, the investor has a negative return on a high risk asset, the portfolio will have a lower risk and a positive return because it was correctly defined by the size of the position of riskier and less risky assets, the portfolio has a solid diversification position over time. In the selection of assets for investment, the use of Linear Programming allows choosing the best possible combination of assets under the view of Markowitz Theory, that is, the risk of a portfolio depends on the risk of each component, its share of the total investment and the way in which its components relate to one another. What has greatly influenced investors, beyond expectations of return, is the political factor. This is because the investor is influenced by a number of internal and external issues, which go far beyond numbers. Therefore, with the current complex economic scenario, it is difficult to say with certainty what is

the best investment for the current time, considering the changes in the financial scenario. From the perspective of the holder of capital, in order to avoid losses, it is necessary to follow closely the factors that can have a direct impact on the market. When deciding to invest in the financial market, it has to be considered the value and durability of the application that the investor wishes to make. It is important to consider investor profile and because this can help in shape the portfolio and the risk of investing in a particular asset. In this paper it was used operational research techniques that supports the decision-making process. These tecniques can model real, deterministic or probabilistic systems, related to the need to allocate scarce resources. The decision process can have qualitative approaches (simple problems, based on previous experiences) and quantitative ones (complex problems, scientific perspective). The scientific approach of operational research is based on the observation, formulation of problem and construction of the scientific model (mathematical or simulation). The use of modeling in the decision-making process generates several advantages: the decision-makers have to explicit their objectives, identify their decisions and the relations between different decisions, identification of limitations, determination of variables to be considered and their quantification and allow communication and group work (ASSAF, 2007). In this paper it was used a linear programming model conjoit with statistics. Linear Programming is the branch of applied mathematics that uses mathematical, statistical and algorithmic models to aid in the decision making of a given problem. Its main function is the optimization to

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find the best solutions of the most varied problems, from maximization of returns and minimization of losses to significant reduction of time of certain variables. For example, Linear Programming can be used in the planning of product distribution and production, in decisions related to the economic policies of the countries' governments, in the use as subroutines to support specific tasks in codes of nonlinear programming (GOLDBARG, 2000). How can we increase the return on risk mitigation of a set of investment assets? The goal of the Linear Programming model, used in this project, is to identify three main elements: description of decision alternatives, determination of the purpose of the study and specification of the limitations of the system. The following examples are day-to-day issues that can be optimized using this method: What's the best way to go? (In the stock exchange) In which companies to invest? (In an industry) What and in what order to produce? (In a group work) What people allocate to what tasks? (In distribution company) What network (electric, gas, etc.) to install? (In a distribution company) What network to install? (electrical, gas, etc.).

In the vast majority, economic problems are ultimately optimization problems; it seeks to maximize a goal (like profits, for example), or minimize it (as costs). It turns out that maximization or minimization can not be absolute: profits from a certain point have to be subject to limitations, such as market acceptance, legal conveniences, etc. Costs can never be equal to zero because of the natural limitations of cost reductions. According to the Modern Portfolio Theory, it is evident that, with the diversification of assets in a portfolio, selecting assets with negative correlation, the tendency is to reduce or eliminate non-systematic risk. The correlation aims to explain the degree of relationship verified in the behavior of two or more variables. There are two types of Risk: the diversifiable risk, the one that can be eliminated through diversification of the portfolio; and the Non-diversifiable risk, the one that is due to systemic issues: macroeconomic problems, natural disasters, financial crisis, high inflation, among others. Diversification reduces the total risk of a portfolio as new assets are added. Portfolio return is determined by the weighted average of individual asset returns.

MATERIALS AND METHODS

Portfolio Study

The selected investments comprised fixed income and variable income assets. The investment portfolio set up has a more conversational profile, that is, the greater weight of the investment was in the fixed income assets that present a good profitability to a low risk. Fixed income: Fixed income investments are those that offer a certain remuneration predicted already before the application. When a person applies for fixed income, implies that in some way it is "lending" the money to the title issuer, be it a financial institution or the government. The return therefore, will be the interest charged on that loan. Fixed income funds are investment options offered by banks or brokerages. They contain a basket of applications for different types of investor, considering various securities, risk profiles, minimum allocation and liquidity. There has been a comprehensive qualitative research of specific research on Risks in search sites for books, articles, college work and companies that are part of the financial sector, which address the topic of risk minimization of investment portfolio. All as sources are

explained without reference Bibliographical references of this project. There are several sources for finding stock returns. As key sources for quote calculation and stock indexes or Economatica software, the site of Yahoo Finance, BMF and BOVESPA. It was used for the others assets, as sample returns, sources that deal directly with the investment, for example, one of the assets chosen to compose the portfolio was the TESOURO DIRETO IPCA; linked to the IPCA (main measure of inflation in Brazil), therefore obtaining data of this asset was taken from the site of the TESOURO NACIONAL. The expected returns on assets comprised the period between 2012 and 2016.

The expected return on the portfolio is the weighted average of the expected returns on the individual assets:

$$\bar{R}_P = E(R_P) = E\left(\sum_{i=1}^{N} X_i R_{ij}\right)$$

Where:

  E (Rp) = Portfolio Return
  N = Quantity of variables
  X = Individual Asset Weight
  R = Return of each Individual Asset
  N = Number of variables (sample period)

The portfolio included in this project included the following fixed income assets:

• **Tesouro direto ipca; Bradesco prime fic ; Cdb pós-fixado**

Variable income: For the more aggressive profiles, variable income applications occupy the top of the preferences due to the high attractiveness, but that is proportional to the risk. This type of investment is less conservative, there is the possibility of bigger gains - even if you have to take more risks. Unlike fixed income, it allows you much more meaningful profit options. But at the same time, it can also cause considerable losses.

In the portfolio set up in this research the following variable income assets were included:

•Itub4;Ouro;Fexc11b;Ibovespa;Ise;Natu3;Aapl34

Table 1 shows the assets chosen to compose the portfolio and their respective responsible institutions used in this paper.

Table 1. Assets of the portfolio and issuing institution

Assets	Issuing Institution	
1	Tesouro direto ipca	Tesouro nacional
2	Itub4	Itaú unibanco
3	Ouro	Bm&f bovespa
4	Fexc11b	Banco pactual
5	Ibovespa	Bovespa
6	Ise	Bovespa / fgv-eaesp
7	Natu3	Natura
8	Aapl34	Apple
9	Bradesco prime fic	Bradesco
10	Cdb pós- fixado	Bmg

Source: Author with survey data

Tesouro Direto IPCA (Direct Treasury IPCA) is a type of public bond issued by the National Treasury to finance the

activities of the central government, contracting public debt. This bond has its profitability tied to the inflation rate IPCA (Broad Consumer Price Index, which measures the "official" inflation of the country), plus interest and is usually more recommended for long-term investors. The Direct Treasury is considered a low-cost and safe investment option, since public bonds are considered the lowest risk assets in an economy.

ITAU UNIBANCO is a Brazilian bank founded on November 4, 2008 through the merger of two of the country's largest financial institutions, Holding Itaú and Unibanco banks. It is currently the largest private bank in the country and its main share in the market is the preferred shares (which do not have voting rights at times of corporate decision but are more preferred than holders of common shares in the distribution of dividends) ITUB4. Big banks should remain bullish and bring interesting returns to their investors.

In Brazil, the most common way to invest in gold is through the Commodities and Futures Exchange. To buy gold on the BM & F, the investor should look for a listed broker. Investment in gold is very different from other variable income investments. Gold is a great form of protection during times of financial crises and inflationary pressure. It usually has high demand at this time, since it is not subject to a decrease in its value (inflation). This is because, unlike money, gold is not subject to intervention by governments, that is, it can not be printed, so it has intrinsic value because of its scarcity.

FEXC11B is a real estate fund issued by BTG PACTUAL bank. The fund invests in real estate projects, through the acquisition of real estate receivables certificates (CRI), real estate-backed securities guaranteed by real estate, with a promise of cash payment; mortgage bonds (LH), fixed-income securities issued by financial institutions authorized to grant mortgages; real estate credit bills (LCI), fixed income securities issued by banks to finance real estate; or rights related thereto, seeking an annual profitability of 105% of the CDI (securities issued by banks as ... profitability of investments in investment funds). Therefore, it is classified as a Paper type fund and falls within the segmentation IGP-M (Inflation Measure made by FGV). The high yield is explained by the composition of the fund's papers and bring the shareholder a natural hedge against the most direct inflation.

The Bovespa Index (IBOVESPA) is the most important performance indicator of stock prices traded on the São Paulo Stock Exchange, since it is formed by the companies with the largest volume of shares traded in Brazil and Latin America. Created in 2005 by BM & FBOVESPA in partnership with FGV EAESP, the Corporate Sustainability Index (ISE) reflects the return of a portfolio composed of shares of companies with the best performance in all dimensions that measure business sustainability. It is the main reference for sustainable investment in Latin America.

Natura is currently achieving what few companies can: expand physical sales, profits and revenues to more than 20% per year in real terms. The ordinary share NATU3 is also considered a sustainable action, since the company is one of the institutions of the country that invest more in sustainability.

AAPL34 is a BDR (Brazilian Depositary Receipt), or certificate of deposit of securities, is a security issued in Brazil that represents another security issued by publicly-held companies, or similar, with headquarters abroad. The institution that issues the BDR in Brazil is called a depository institution. Some of the BDRs are not available to common investors. Apple is one such case. These can only be acquired by investment funds, financial institutions and portfolio managers.

BRADESCO PRIME FIC is a fixed-income investment issued by Bradesco, the second largest private bank. This asset was chosen because it has a very high return and because it is low risk.

CDB is a fund raising certificate issued by banks, with the purpose of financing their activities. There are two types of CBD: post-fixed: the remuneration accompanies the variation of the CDI, an index published daily by CETIP; pre-fixed: the remuneration rate is defined for the period traded at the time of application and is valid until maturity, regardless of any change in the economic scenario.

The amount that will be redeemed on the due date is already known at the time of application. (BMG, 2016). The asset selected was the post-fixed CBD of BMG. If there is a prospect of interest reduction, it makes sense to seek the security of the prefixed. But if the scenario ahead indicates interest increases, then it may be more interesting to resort to post-fixed.

The data used in this research were BMF & BOVESPA, Económatica software and the site of Yahoo finances in the period 2012 to 2016.

Portfolio Risk

The Portfolio Risk calculation followed the Markowitz Theory, it could be observed that, although the expected return is the weighted average of the individual yields of each asset, the variance of the portfolio depends on the covariance between the asset pairs, which depends on the correlation between assets. Thus, when the assets are related, they are not able to have a lower risk than the weighted average of the individual risks, occasionally obtaining a lower risk than the lower risk asset that has a higher return than this investment.

In this project, the following methods were used to evaluate financial risk:

- The return of the portfolio that is determined by the weighted average of the returns of the individual assets;
- The variance, a measure of dispersion that shows how far the values are from the mean;
- The population standard deviation that measures the volatility of the assets (how much any asset, such as a stock, moves during a certain period of time), calculated by the square root of the corresponding population or sample variance;
- The covariance between two real random variables, defined as the measure of how two variables vary together;
- The correlation that aims to explain the degree of relationship verified in the behavior of two or more variables;
- The risk-free asset is the asset whose rate at which it is invested is certain that at the time the investor received interest and the principal back.

Improvement of the investment portfolio

To optimize the portfolio and achieve the objective of the work, which is to reduce risk and maximize returns, the Excel Solver tool was used with the use of Linear Programming and Sensitivity Analysis. The linear programming model to achieve the objective of the article can be visualized in the following Table 2:

Table 2. Linnear Lrogramming Model

X1,…, X10. (The ten assets that make up the portfolio)

Z= Portfolio Risk

Objective function: MIN Z : 3,3252% (risk)

Restriction 1 : X1, …, X10 <= 0.3 (no asset must have a weight greater than 30% of the portfolio)

Restriction 2 : X1, …, X10 >= 0,01% (each asset must be at least 1% in the portfolio)

Restiction O 3 : X1+X2, + …+ X10 = 1 the sum of the weights must be equal to 100%)

X1,...X10 ≥0

Source: the author with research data

As explained in the article, there is a systematic risk, that is, the risk that organizations and investors can not control and that can not be eliminated by diversifying an investment portfolio.

RESULTS AND DISCUSSION

Table 3 below shows the average return of all assets, their standard deviations, variances and weights. The weights of each investment were selected in a random manner, according to the risk and return that each presented. Fixed income investments accounted for 55% of the portfolio, stocks 15%, stock indices 15%, real estate funds 10% and currency exchange, 5%. From the data collected can be reached the Return of the Portfolio, resulting in a value of 5.377%. Portfolio Risk, without Solver's optimization resulted in a value of approximately 3.33%. The obtained results are presented in Table 4, shows that the weights of each investment have changed with this optimization of the portfolio. Fixed-income investments now account for 72% of the portfolio, 6% stocks, 4% stock indices, 9% real estate funds and 10% currency exchanges. Showing what the profile of the portfolio became even more conservative.

Table 3. Average return, standard deviation, variance and weights of the assets

Assets	Average return	Standard deviations	Variances	Weights
Tesouro direto ipca	9,160%	5,93%	35,17%	20%
Itub4	1,620%	9,51%	90,44%	5%
Ouro	-0,200%	3,81%	14,51%	5%
Fexc11b	0,520%	4,56%	20,79%	10%
Ibovespa	3,790%	20,10%	407,00%	10%
Ise	4,610%	11,91%	142,00%	5%
Natu3	1,170%	8,98%	80,64%	5%
Aapl34	2,050%	10,97%	120,35%	5%
bradesco prime fic	9,170%	4,52%	20,41%	15%
cdb pós fixado	6,480%	10,60%	112,46%	20%
			SUM	100%

Source: the author with research data

Table 4. Change in the weights of the assets after the solver analysis

Assets	Average return	Standard deviations	variances	weights
TESOURO DIRETO IPCA	9,160%	5,93%	35,17%	27%
ITUB4	1,620%	9,51%	90,44%	4%
OURO	-0,200%	3,81%	14,51%	10%
FEXC11B	0,520%	4,56%	20,79%	9%
IBOVESPA	3,790%	20,10%	407,00%	3%
ISE	4,610%	11,91%	142,00%	1%
NATU3	1,170%	8,98%	80,64%	1%
AAPL34	2,050%	10,97%	120,35%	1%
Bradesco Prime Fic	9,170%	4,52%	20,41%	30%
CDB	6,480%	10,60%	112,46%	15%
			SUM	100%

Source: the author with research data

Limitations of the Methodology Used

This project is academic and should not be used as a benchmark for investment for equity holders. By understanding a random period, the use of historical data that covered returns from January 2012 to December 2016 may have caused a distortion of results. At certain periods of time, an asset may have had better results because of the country's economic situation at some point in time that may have benefited from some investment. Another important point is that the quantitative analysis comprises past data, that is, there is no way to predict if an asset will obtain better revenues.

In table 5 it is shown the weight change of each portfolio in relation to its risk. With the use of linear programming it can be seen the change in the results of the average weights. The ITUB4 share which had a 9.51% risk lowered its risk from 0.48% to 0.39%, down 0.09%. TESOURO DIRETO linked to the IPCA, which had a risk of 5.93%, increased by 0.4% in relation to its average individual risk. From the Solver analysis, it can be seen that the return increased from 5.397% to 6.448%, an increase of 1,051 percentage points. The risk reduced more than doubled, from 3.3252% to 1.1657%, down 2.1595%. This has proven how linear programming is efficient to improve everyday problems.

Table 5. Average weight of the risks of the assets with the minimization of the total risk of the portfolio

Ativos	Peso Médio
Tesouro direto ipca	1,59%
Itub4	0,39%
Ouro	0,36%
Fexc11b	0,40%
Ibovespa	0,62%
Ise	0,12%
Natu3	0,09%
Aapl34	0,11%
Bradesco prime fic	1,36%
Cdb pós- fixado	1,55%

Source: the author with research data

Table 6. Return and Risk with the the solver analysis

Portfolio Return	6,448%
Portfolio Risk	1,1657%

Source: the author with research data

Table 7. Sensitivity Report with Solver Analysis

	Final	Reduced
Name	Value	Gradient
WEIGHT TESOURO DIRETO IPCA	0,268585787	0
WEIGHTPESO ITUB4	0,040930665	0
WEIGHTPESO OURO	0,095697315	0
WEIGHTPESO FEXC11B	0,087501765	0
WEIGHTPESO IBOVESPA	0,030776688	0
WEIGHTPESO ISE	0,01	0,004220797
WEIGHTPESO NATU3	0,01	0,017330106
WEIGHTPESO AAPL34	0,01	0,000324961
WEIGHTPESO Bradesco Prime Fic	0,3	-0,010959943
WEIGHTPESO CDB	0,146507785	0
	Final	Lagrange
Nome	Value	Multiplier
WEIGHTPESO	1,000000005	0,014725797

Source: the author with research data

As it is shown in table 7, the weight of Natura's asset, the NATU3 share at the top of the chart, has a Reduced Gradient of approximately 0.017, that is, if the portfolio holder invested another 1% in this share, he will incur a risk 0.017% higher if he did not increase its investment in NATU3. The asset Bradesco Prime Fic, in this perspective, would reduce the individual risk by 0.01 percentage points. The Corporate Sustainability Index and the non-sponsored BDR AAPL34, issued by the multinational company APPLE, would increase its risks by approximately 0.4% and 0.03%, respectively. The other assets have a reduced gradient of zero, that is, if there is any adjustment in the investments, there will be no reduction in price volatility. The purpose of this report is to explain a bit of the process of risk minimization and maximization of returns through the Excel Solver tool, one should not follow the same as a source of guidance to make some investment. Factors such as inflation, real gain, interest rate, investor equity, the profile of the holder of capital, knowledge in the financial market, risk propensities and planning are variables that are part of decision making to obtain high profits, avoiding losses, which is the main goal of an individual who wants to get extra income beyond what he gets from formal work. The management of a portfolio is important because it can be observed in its growth rate, estimate the risk and return of investments, make adjustments in asset allocations and monitor the growth of equity. The diversification of a portfolio is essential for the stability of the portfolio since each type of application accompanies indexers and sectors of the economy different from each other.

Conclusion

This article, even though it is merely academic, describes how and why it is important to set aside certain capital to invest in the market. For this, one must consider the risks of losses, the return, the time and the financial limits of each individual. In this project, the meaning of risk in the financial market is understood, the formation of a portfolio of investments to avoid total investment of equity in a single asset and this will perform poorly (or suffer a great fall), leaving everything the committed equity. Amidst the ten assets concentrated in the production of the investment portfolio, what types of portfolio and portfolio analysis should be done? The major problem that causes financial losses is the inexperience of a large number of individuals in how to minimize the risk of loss and how to compensate for these potential threats of injury. For this reason, most people in Brazil still apply part of their income to savings, which, even if they obtain income below inflation, which causes an annual loss of income, is still seen as an easier, practical and safe investment alternative. Others choose to save some of the income for emergency or retirement reserves. Another limitation for early investors is to decide on what stocks and bonds to invest in, the credibility of the market interferes a lot in that decision. It is important to analyze whether the company has growth potential, whether the type of income is appropriate to the time the equity holder wants to redeem its money and to the profile to buy or sell certain assets depending on the current historical situation and the future prospects of the Marketplace.

REFERENCES

Albuquerque, Marcelo. Minimização do risco em carteira: Aplicação da moderna teoria do portfólio. (Monografia). Florianópolis: UFSC,2015.

Andrade, E. L. Introdução à pesquisa operacional: Métodos e modelos para análise de decisão. Editora LTC, 2004.

Arenales, M.; Armentano, V.; Morabito, R.; Yanasse, H. Pesquisa operacional para cursos de engenharia. Editora Campus, 2007.

Assaf, N. A. 2007. Mercado financeiro. São Paulo: Editora Atlas.

Bacen (Banco Central do Brasil). Sistema de Metas para a Inflação. Available at : < http://www.bcb.gov.br>. Accessed on: 20/03/2017

Banco BMG. As melhores opções de investimento em renda fixa. Available at : < https://bmginvest.bancobmg.com.br/ >. Accessed on: 20/02/2017

BM&Fbovespa. Available at: < http://www.bmfbovespa. com.br >

Costa, J. J. S. Tópicos de pesquisa operacional. Editora LTC, 1973.

Empiricus. Available at: < https://www.empiricus.com.br/ >

Goldbarg, M. C.; Luna, H. P. L. Otimização combinatória e programação linear. Editora Campus, 2000.

HC Investimentos. Available at: < http://hcinvestimentos.com/ >

junior, Neorbeck; Oliveira, Ualison; Gutierrez, Ruben. Minimização de Riscos de investimentos em carteira DE ações através da pesquisa operacional. (Iniciação Científica). Vitória: Associação Educacional Dom Bosco – AEDB, 2007.

Markowitz, h. Portfolio selection. The journal of finance, v. 7, mar. 1952.

Mirshawka, V. Aplicações de pesquisa operacional. Editora Nobel, 1981.

Moreira, Daniel Augusto. Pesquisa operacional: Curso Introdutório. São Paulo: Thomson Learning, 2007.

Santos, José, Coelho, Paulo. Análise da relação risco e retorno em carteiras compostas por índices de bolsa de valores de países desenvolvidos e de países emergentes integrantes do bloco econômico BRIC. Available at: <http://www.scielo.br/ scielo.php?script=sci_arttext&pid =S1519- 70772010000300003>. Accessed on:24/09/2016

São Paulo: Thomson Learning, 2007.PRATERS, Wlademir. Teoria de Markowitz (teoria da carteira) e a fronteira eficiente. Available at: < http://www.wrprates.com/teoria-de-markowitz-teoria-da-carteira-e-a-fronteira-eficiente/>. Accessed on: 28/07/2017

Schiroky, Marco. Seleção de Carteiras Através do Modelo de Markowitz. (Monografia). Porto Alegre: UFRS,2007.

Shefrin, H., & Statman, M. (2000). Behavioral portfolio theory. Journal of Financial and Quantitative Analysis, 35(2), 127–151.

Silva, E. M. Pesquisa operacional. 1988. Moreira, Daniel Augusto. Pesquisa operacional: Curso Introdutório.

Tesouro Nacional Tesouro Direto. Available at: < http://www.tesouro.gov.br/pt/home >. Accessed on: 20/04/2017

Tostes, F. P. Gestão de risco de mercado - metodologias financeira e contábil. São Paulo: FGV, 2007.

Vérios Investimentos. Risco e retorno em investimentos: uma fábula de três moedas. Available at: < https://verios.com.br/blog/risco-e-retorno-em-investimentos-uma-fabula-de-tres-moedas/>. Accessed on: 20/06/2017

Viver De Investimento. Como Investir em Ouro. Available at: < http://viverdeinvestimento.com/cambio/ouro>. Accessed on: 20/01/2017

Voce Mais Rico. O segredo de como criar uma carteira de investimentos à prova de crises. Available at: < http://vocemaisrico.com/2014/10/07/investimentos/ > Accessed on: 02/07/2017

Yahoo Finanças. Available at: < https://br.financas.yahoo.com >

Zuma Valéria, Caldeira, André M., Pacheco, Giovanna L., Machado, Maria Augusta S. e Gassenferth, Walter, Métodos Quantitativos com EXCEL, Thomson Learnig,2008.

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