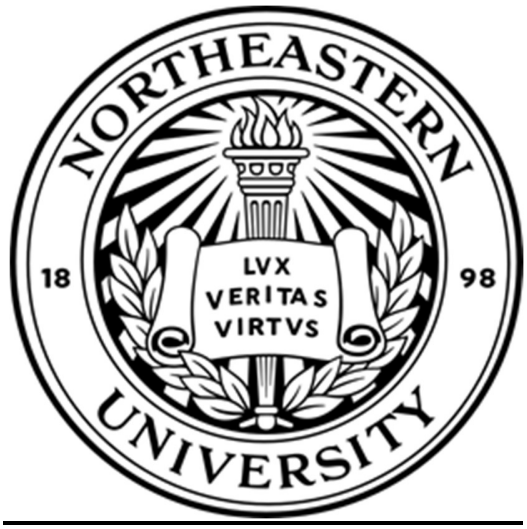
EMGT 6225

Section - 05

Economic Decision-Making Project Report



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Abstract

An investment is a risk and a temporary sacrifice of money, time and effort in hopes of multiplying it. However, with inadequate financial knowledge, an investment can be a move to cause heavy damage to one's hard-earned money. To assist such investors, we have created a Business to Consumer (B2C) wealth management system that will consider user defined inputs across five major asset classes and provide the best investment option. Concepts like Weighted Average Cost of Capital (WACC) method of determining Minimum Acceptable Rate of Return (MARR) and predictive analytics are used to generate projections of possible future investment opportunities and potential profit, and Value at Risk (VaR) and Weighted Average Risk of Capital (WARC) are used to determine their rate of risk.

Introduction

The portfolio management market could be volatile or stable depending upon the investor's risk appetite. However, the implications of these risks are not arbitrary and have some implicit relations with each other across asset classes. These risks have been examined and portrayed such that the rate of return, based on risk, has been weighed and incorporated into each asset class. Five asset classes are considered: equity, fixed income security, cash asset, marketable commodity, and real estate asset class. However, due to the practical limitations on the amount of money that can be invested and the extremely low rate of returns, we boiled down to three asset classes: equity, fixed income, real estate, and commodity.

Objective

The objective of this project is to perform economic analysis on potential asset classes in order to propose an investment strategy to maximize profit for a user-defined value of risk.

User Inputs

MARR
Minimum Acceptable Rate of Return (MARR) is the least expected rate of return on investment that a client has for their investment.

Investment Treasury
The capital in the form of liquefied funds the client holds to invest at any given time is called Investment Treasury. This is rewarding as investment can be made quickly when presented with an opportunity.

Salary
The wages earned by the client are termed as salary and the time period for this is one year. Increment happens at the average rate of inflation every year.

Down Payment
The amount paid at the early stages of a large purchase. This represents a small amount of the total amount due.

System Outputs

WARC
Weighted Average Risk of Capital is the metric used to calculate the minimum overall risk of the investment. It is a dynamic value which changes with respect to MARR and VaR.

Portfolio Distribution
It is the ratio of investment towards individual asset classes. It is dynamic and changes according to the expected MARR.

Profit
It is the After-Tax Cash Flow which tells us the return on the investment and helps us determine whether or not the investment is favorable.

Data Description

A user-based wealth management system is created using MS Excel. Economic analysis is performed on multiple datasets obtained from reliable sources. These datasets are from the years 2000 to 2020. This data is extensively processed before performing an economic analysis. Upon processing, we obtained information and made inferences about finalizing things like geographical area for investment, potential stocks for investment, and - the least risky of these asset classes - the bond market. To keep the portfolio dynamic, values such as income, tax rate, risk appetite, etc. are user input based.

We have obtained detailed datasets on each of the asset classes to determine historical data and processed these datasets extensively to identify predictable patterns and trends.

Bonds
The dataset of Bond asset class is limited to:

- Government Bonds, Moody's Rating: A1, A2, A3, A, AA1, AA2, AA3, AAA, B1, B2, B3, BA1, BA2, BA3, BAA1, BAA2, BAA3, C, CA, CAA1
- Corporate Bonds, Moody's Rating: A1, A
- Structured Notes, Moody's Rating: A
- Index Linked Notes, Moody's Rating: A
- General Obligation Notes, Moody's Rating: A
- Federal Agency Bonds, Moody's Rating: A
- US Treasury Bonds, Moody's Rating: A
- Non-US Currency, Denomination Bonds, Moody's Rating: A
- Foreign Bonds, Moody's Rating: A

The Dataset takes in account the issuer, coupon rate, yield rate, maturity date, currency, Moody's rating, bond type and face value for the above listed bond types.

Stocks

The S&P 500 index was initially considered. It has 500 companies which can be grouped into 10 sectors. We obtained datasets which spanned a total of 8 years. However, despite extensive processing and analysis, we were unable to establish a viable investment strategy. Therefore, the Nifty50 index was considered. Nifty 50 is the index of companies with the highest market capitalization stocks in the Indian stock exchange. The dataset consisted of 50 companies which were then segregated according to sectors. These csv files contained information about stock open, high, low, close, adj close and volume traded values.

Real Estate

Datasets are collected from Fred Economic Data for the past 20 years by extracting average housing prices of the house from all the regions of United States segregated as per census regions and divisions. Along with the historical sales prices we also collected the average rental and average mortgage payments made by a person in every state over a period of time.

Assumptions

General

- No major unprecedented catastrophic event to occur

Housing and loan

- No natural calamity, annual investor income is $90,000
- Investors lock in period is 10 years
- Housing costs are statistical average depending on the area
- Average area of a house is 1000/sqft
- Average cost of construction of $250/sqft
- Loan tenure is 30 years

Bonds

- Coupon rate is semi-annual
- Moody's credit rating scale is used
- All bonds listed in the dataset are issued recently

Analysis

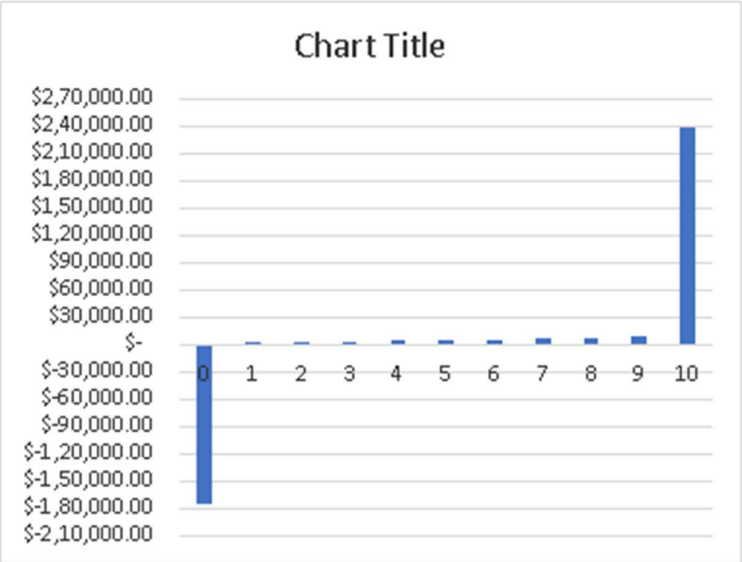
Real Estate:

The initial step of our project was to figure out in what geographical location profits will be maximized. So, we analyzed data pertaining to 4 regions - South, West, Midwest, and Northeast in the United States. Each region has different appreciation percentages which were calculated from a trend pertaining to data of 20 years - in which we observed that there were multiple depreciations and appreciations. We averaged these fluctuations to find a mean value for 20 years. From this, we inferred that the northeastern region has

the highest appreciation. Further, average monthly rent and mortgage were analyzed in a similar pattern. In this case too, the northeastern region has the highest monthly mortgage and rent. The average cost of a house is $527,720. For such a scenario, we are borrowing $377,720 as the loan amount from a bank at an interest rate of 5.544% compounded monthly with a tenure of 30 years with a down payment of $150,000. The monthly mortgage payment is $2245.09. Principal and interest amount change every month but the overall amount for monthly payment is fixed at $2245.09. Now, the initial rent is $2000 per month for the first year and it increases by 5% every year. Therefore, our annual income for the 1st year is $24000. Depreciation analysis is done on the build-up cost per square feet - which is $250 per square feet. The average area for a house is 1000 square feet. Therefore, we depreciate the house on a value of $250,000 with a property class of 27.5 years. The average selling price for the property is calculated as $937,957.18 by taking 5.92% compounding interest over a period of 10 years. Now, the capital gain is found out to be $410,237. The book value at year 10 is $164,400. Therefore, tax is calculated on the difference between capital gain and book value of $245,837. Tax on the annual income is taken to be 27.1% and for the capital gain is 20.2% which includes federal and state tax as 15% and 5.2% respectively. Applying internal rate of return (IRR) on the after-tax cash flow, it is seen that IRR is 5.68% and ERR is found to be 5.64%, which is greater than the user's MARR of 5%. Now, assuming our down payment to be $200,000 and loan amount to be $327,720, it is seen that IRR and ERR are 8.02% and 7.84% respectively, which is lower than the MARR.A down payment of $20,000 is generally not considered as the down payment should be in the range of 20%-25% of the house value. Further if we increase the loan amount to $422,176 and down payment to $105,544 the IRR and ERR change to 12.65% and 12.41%, which is the minimum amount we need to invest as down payment as the rule of the thumb is investing 20% of the house value.

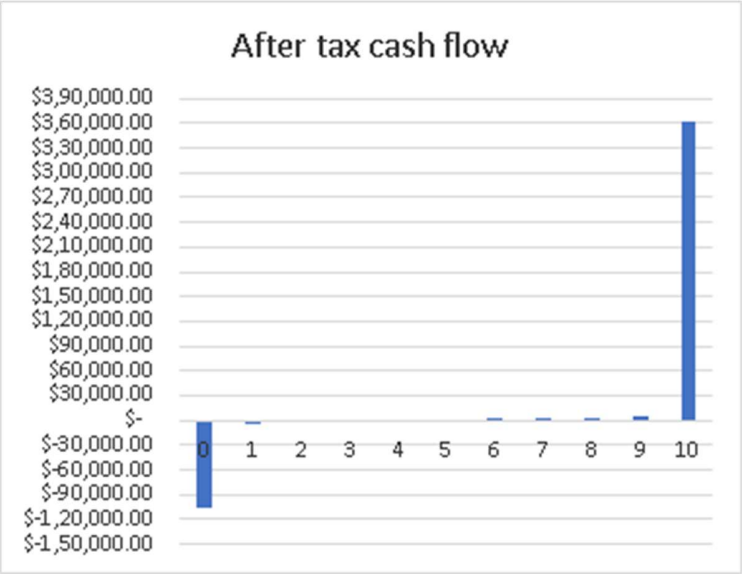
Down payment - $200,000

IRR - 8.02%



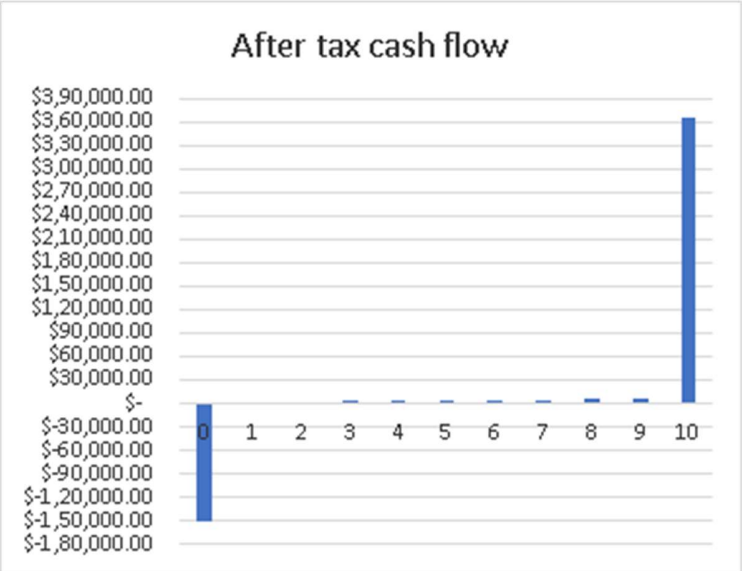
Down payment - $105,544

IRR - 12.65%



Down payment-$150,000

IRR - 10.08%



Sensitivity Analysis on Real Estate:

Considering the initial down payment as 150,000 and applying the sensitivity analysis from -50% to 50%. We have an inference that with lesser the amount of down payment, the IRR is increasing at a constant rate. However, we have kept the minimum down payment of 105,544 to make sure the user has the eligibility to get the loan from a bank.

Considering the Rental Income as 2000 per month as per the input data, we applied the sensitivity analysis from -50% to 50% to rental income. We inferred that higher the rental income higher the IRR and user benefits more.

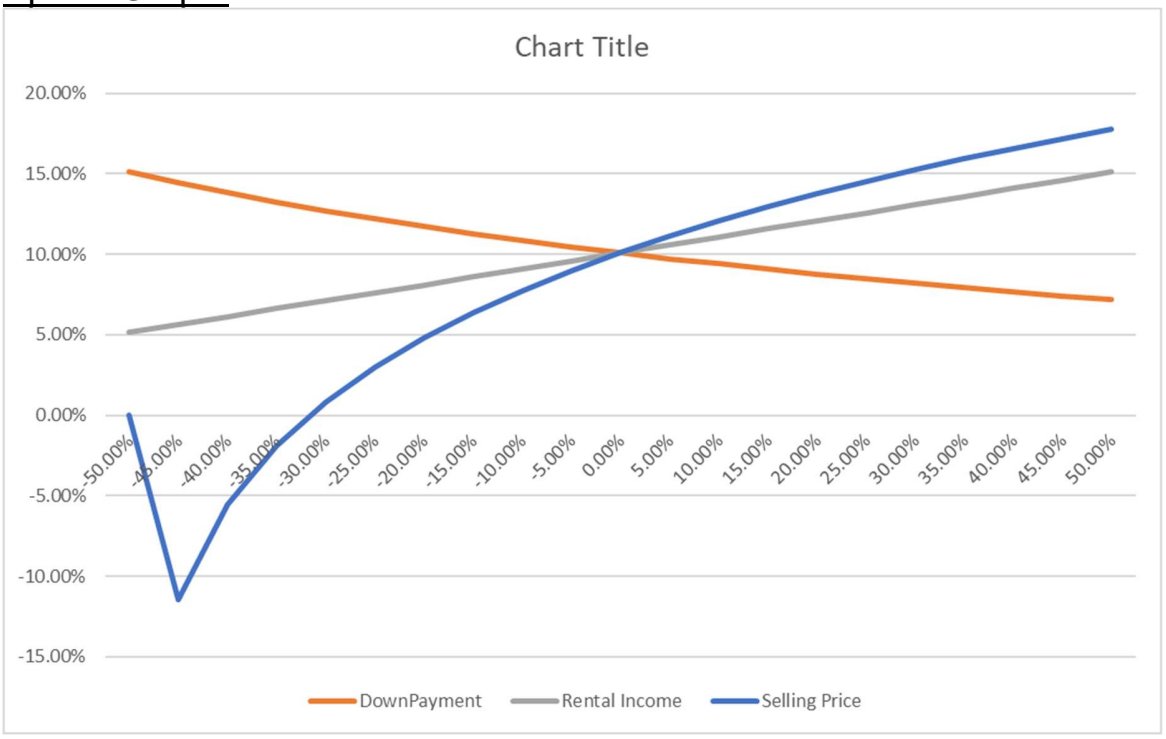
Considering the Selling Price, by applying the sensitivity analysis of -50% to 50%, we can infer that higher the selling price higher the IRR, however user cannot sell the property beneath the -30% of the selling price as it will give loses to the user. In fact, the user can wait longer to increment the selling price over a period of time.

	10.09%	IRR
P1 (Change in Downpayment)	-50.00%	15.15%
	-45.00%	14.46%
	-40.00%	13.82%
	-35.00%	13.24%
	-30.00%	12.70%
	-25.00%	12.19%
	-20.00%	11.72%
	-15.00%	11.27%
	-10.00%	10.85%
	-5.00%	10.46%
	0.00%	10.09%
	5.00%	9.73%
	10.00%	9.40%
	15.00%	9.08%
	20.00%	8.77%
	25.00%	8.48%
	30.00%	8.20%
	35.00%	7.93%
	40.00%	7.68%
	45.00%	7.43%
	50.00%	7.19%

	10.09%	IRR
P2 (Change in Rental Income)	-50.00%	5.15%
	-45.00%	5.64%
	-40.00%	6.13%
	-35.00%	6.63%
	-30.00%	7.12%
	-25.00%	7.61%
	-20.00%	8.10%
	-15.00%	8.60%
	-10.00%	9.09%
	-5.00%	9.59%
	0.00%	10.09%
	5.00%	10.58%
	10.00%	11.08%
	15.00%	11.58%
	20.00%	12.08%
	25.00%	12.58%
	30.00%	13.08%
	35.00%	13.59%
	40.00%	14.09%
	45.00%	14.59%
	50.00%	15.10%

	10.09%	IRR
P3 (Change in Selling Price)	-50.00%	#NUM!
	-45.00%	-11.43%
	-40.00%	-5.56%
	-35.00%	-1.89%
	-30.00%	0.82%
	-25.00%	2.98%
	-20.00%	4.80%
	-15.00%	6.36%
	-10.00%	7.74%
	-5.00%	8.97%
	0.00%	10.09%
	5.00%	11.11%
	10.00%	12.05%
	15.00%	12.93%
	20.00%	13.74%
	25.00%	14.51%
	30.00%	15.23%
	35.00%	15.92%
	40.00%	16.57%
	45.00%	17.19%
	50.00%	17.78%

Spider Graph:



Bonds:

A pivot table is made using the bond dataset. Today's date is automatically input based on the system date. This is subtracted from the maturity date of the bond and gives us the number of days to yield. Since these bond payments are semi-annual, the number of coupons is calculated by dividing the number of days to yield by 180. The coupon value of a bond is calculated by multiplying the coupon rate of a bond to its face value. PV is calculated using yield rate, number of coupons, coupon value and face value. A 'FILTER' function is used to pull up the values from the dataset, the calculated values and the criteria we define. However, the function only works in Office 365. When the two input factors 'risk factor' and 'bond type' are selected by the user, relevant bonds are pulled up. From these, the top 5 bonds with the highest payment are printed in descending order with the help of 'LARGE' function and 'X-Lookup'. This has been done as we needed the top 5 bonds to be printed in a ranked list. For better UI, the data pulled through the previous steps is referenced to a clean sheet. An amortization chart if then printed under the list.

Stocks:

Nifty 50 is the index of companies with the highest weighted stocks in the Indian stock exchange. These 50 companies were grouped into 15 sectors and performed conditional probability to determine the chances of one sector being profitable on the trading day following another sector's profitability by considering data during the financial year 2020. Once 225 such combinations were created, 4 combinations were found to be profitable with a 95% confidence interval.

Money market:

The money market has the highest market cap of all the five asset classes discussed above and works round the clock. It has a daily volume of almost three hundred times of all the stock markets included. After extensive sensitivity analysis we understood that the volume is too large for a normal investor to capture and make a significant income. The regression charts showed a very dispersed distribution as the values could not be predicted due to geopolitical problems sometimes. The change in a currency hedged by another returned a maximum return of 2% per annum which is less than half of the normal YOY inflation. Due to all these reasons and limited funds, entering this market to get significant results was not possible. Ultimately, we skipped this asset class owing to the mass user base generally having these constraints.

VaR and VaR X

VaR stands for 'Value at Risk'. While VaR is the most commonly used risk managers, it is considered a close approximation of potential and was used to calculate risk for Real Estate and Bonds asset classes. We then developed VaRX as a method of dynamic VaR by fixing the value and leaving the rate of risk dynamic to calculate risk for the equity asset class.

Portfolio Management

The project is based on the above explained assets, that are incorporated to analyze historical data, and are individually analyzed and compiled together to attain and recommend maximum profit that can be expected in the future.

A user defined value is taken for the user's MARR and the initial treasury on which the system works combined with the profitable asset classes - real estate, stocks and bonds.

The real estate asset class gives the user freedom to invest in five regions of the United States while recommending to invest in the most profitable region, the northeast. Profits from real estate are incorporated into the treasury at the end of the year.

The amount to be invested in stock asset class is calculated based of the output to input ratio given by:

$$MARR = \frac{(I_{RE} \times IRR_{RE}) + (I_B \times IRR_B) + (I_E \times IRR_E)}{I_{RE} + I_B + I_E}$$

And the overall risk of investment is given by:

$$WARC = \frac{(I_{RE} \times R_{RE}) + (I_B \times R_B) + (I_E \times R_E)}{I_{RE} + I_B + I_E}$$

Here,
I → Investment
IRR → Internal Rate of Return
R → Risk
RE → Real Estate
B → Bonds
E → Equity
MARR → Minimum Acceptable Rate of Return

Based on historical analysis the amount invested in stocks shows an expected growth in subsequent years.

Bond asset class uses the dataset available and allows the user to filter data based on the user picked bond type and risk appetite given by Moody's Credit Rating and recommends the five best bonds that can be invested in based on the annual worth ranking approach.