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AN INTERACTIVE SYSTEM FOR LEARNING HOW TO DETERMINE INVESTMENT EFFICIENCY [12]

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Abstract: *It's inevitable to avoid risk when a company has to undertake significantly larger investment projects. For a business to grow, its financial decision-makers have to be very certain and confident in their judgment, skills, and knowledge. This paper affirms the need for financial analysis software in business and proposes a desktop software solution that can aid the education of financial decision-makers and others. The described software solution uses data analysis tools such as Pandas, NumPy, the Python programming language. It is designed to be used with large data set and provides an interactive financial analysis workplace with visual presentation. Such desktop software can also expose students of finances to the idea of managing and utilizing large investment data sets.*

Keywords: *Efficiency, Investment, Capital Budgeting, Cash Flow, Net Preset Value, Internal Rate Of Return, Discounted Payback Period, Business Analysis, Large Data Set, Desktop Software Solution*

INTRODUCTION

A company during its lifespan eventually has to consider undertaking large investment capital projects so that its business can grow and expand. Significant financial planning is required to make a well-informed decision about which projects to approve and pursue. The company's financial decision-makers have to determine the investment efficiency of capital projects. Therefore, it is important for financial decision-makers, such as investors and business analysts, to understand and apply the investment efficiency measurements that are part of the capital budgeting management process.

What Is Capital Budgeting: Capital budgeting is a financial management tool that can be used to measure a project's potential risks and expected long-term return on investment. Companies must carefully consider the capital investment that a project requires and the amount of value expected to determine whether it is worth pursuing (Capital Budgeting: Definition, Importance and Different Methods, 2021).

Why Is Capital Budgeting Important: It lowers the risk that a company takes after the projects it undertakes are done with the analysis capital budgeting process done and it will be possible to demonstrate that a project can be a worthwhile investment. The completed capital budgeting process provides a financial plan because it requires a significant amount of planning to understand how much money the firm needs for the investment. This helps clarify the investment decisions, which is essential for any successful company to know which projects to pursue now and which should be put on hold (Verbeck, 2020).

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Why Is Understanding Capital Budgeting Important To Business: Capital budgeting creates accountability and measurability of potential projects. Any business that seeks to invest in a project without understanding the risks and returns will be held as irresponsible by its shareholders. Furthermore, with no way of measuring effectiveness of investments, a business would have little chance of surviving in the competitive marketplace (Pinkasovitch, 2021). Therefore, financial decision-makers must learn and understand how to apply the capital budgeting measurement process to be confident in their decisions and demonstrate the effectiveness of investment. Creating an interactive software system to aid and ease their learning process will help them build the required confidence which will be of great benefit to any business.

Relevance to Business Analytics: Business analysts have to use a set of software applications to build statistical models to make educated predictions about business problems. Such organizations collect and manage large sets of data that need to be analyzed. The business analytics process is a seven step process (Hargreaves, 2013). A software application can be created to assist analysts at step three (analyze) and step four (predict). A necessary requirement for such a software application is to operate on a large data set. Satisfying this requirement would allow such a system to be used by a business analyst or expose financial students to the idea of managing a large data set.

Capital Budgeting Methods - Investment Efficiency Measurements: The three most commonly used capital budgeting valuation methods that can be used to determine whether a project is promising and worthwhile are:

- Net present value (NPV)
- Internal rate of return (IRR)
- Discounted payback period (DPP)

Businesses use these valuation methods to either accept or reject investment projects. The most favorable method among business analysts is the net present value (NPV), although the internal rate of return (IRR) and discounted payback period (DPP) are often used under certain circumstances. Financial decision-makers can have the most confidence in their analysis when all three methods indicate a positive value (Pinkasovitch, 2021).

Net Present Value: The net present value (NPV) represents the difference between the present value of cash inflows and outflows. A positive NPV, means that a profit will be generated overtime, while a negative NPV means losing money. NPV can be calculated using the following formula (Net Present Value, 2020):

$$NPV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} - C_o \qquad (1)$$

where C_t - cash flow during the period t; C_o - total initial investment costs; r - discount rate; t - number of time periods.

Internal Rate Of Return: Calculation of internal rate of return (IRR) allows for an investment to see if it will be profitable without a discount rate. It is calculated by finding a rate at which NPV equals 0. Mathematically this looks like (Tamplin, 2021):

$$0 = NPV = \sum_{t=1}^{T} \frac{C_t}{(1+IRR)^t} - C_o \qquad (2)$$

where parameters are the same as in formula (1) except the rate r is now IRR. Calculation of such rate manually requires a lot of trial and error guesswork and even experience by the financial decision-maker. This can be avoided, if the software relieves the user from this guesswork. That way it will guarantee that a financial decision-maker knows the IRR measurement of investment.

Discounted Payback Period: The payback period is a measurement that can estimate the length of time it takes for an investment to generate enough cash inflows to recover the initial investment. The ordinary payback period does not factor in the time value of money - preset value. However, similarly to NPV, the discounted period does. Therefore it is more accurate and it can

be calculated using the following formula (Discounted Payback Period | Formula, Example, Analysis, Conclusion, n.d.):

$$DPP = W + \frac{B}{F} \tag{3}$$

where W - last period before the net discounted cash flow goes into investment recovery; B - remaining balance of the initial investment to be recovered; F - Total amount of discounted cash flows after the recovery period.

EXPOSITION

Analysis Of Existing Software Solutions: An online search was concluded to discover existing capital budgeting solutions on the Internet. Only a few of them were able to simultaneously calculate the three common investment efficiency methods. Unfortunately, these systems were incomplete and lacking further explanation. Most other solutions that exist are specific to calculate only one of the efficiency methods at a time. All software solutions found were designed to calculate only a single investment's cash flows. Most of them share very similar characteristics such as:

- They are designed for quick single use in an input form, built using web technologies (HTML, CSS, JavaScript or server-sided logic like PHP)
- Some provide an explanation of the formula below the input form.
- The forms provide fields for initial investment, discount rate, calculate button and buttons to add and remove periods.
- Results display solely the measurement value with no way to compare more than one investment.

These solutions are not advanced web systems that work with big data because they do not use the advanced software technologies to process big data (Stefanova and Draganov, 2019). They are clearly unsuitable for big data processing. The business analysis needs big data processing systems.

Requirements And Goals: Based on the online search, such software application must adhere to the following requirements to be competitive with the existing systems:

- Simple, intuitive and easy-to-use interface.
- Display results in a clean and straightforward manner.
- Ability to add or remove the periods of investment.

In addition to the aforementioned requirements, the interactive system for learning how to determine the investment efficiency described in this paper, will also adhere to the following goals:

- Allow the user to import or export the inputted data using a data interchangeable format.
- Capability to processing large data sets as required by the business analysis field.
- It must provide means to compare more than one investment, preferably a way to display the most promising and favorable investments.
- It must come with an explanation and examples of the capital budgeting methods.
- It has to provide a visual representation of the investment's cash flows over the periods.

Designing An Interactive System: Considering the data driven nature of the business analysis field, the requirement to save or load large data sets and the computational amount hints that developing a desktop software application would be an ideal choice. The user of the application also has to manipulate different investment cash flows, including their lengths and discount rate. A use case diagram of the necessary functionality can be seen in Fig. 1 below. A detailed diagram of the typical workflow using the proposed interactive system can be viewed in Fig. 2.

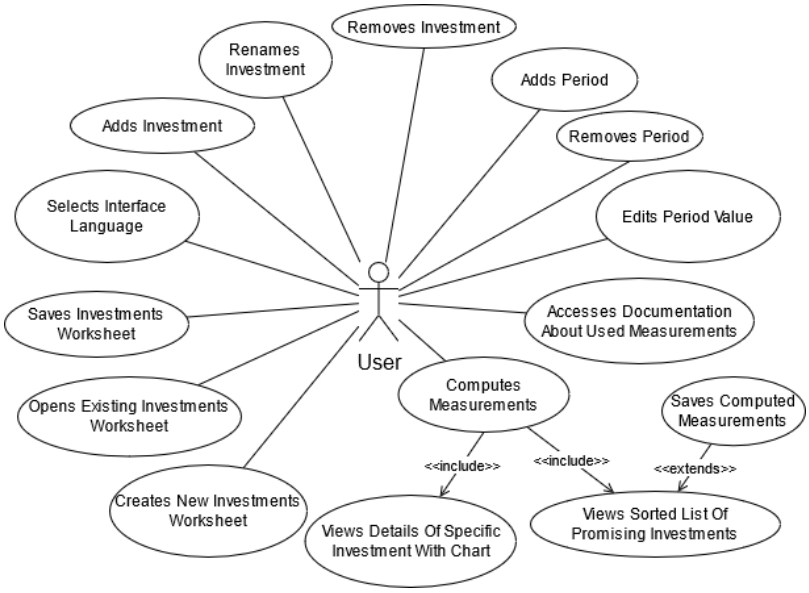

Fig. 1. Use case diagram of the necessary functionality from user perspective.

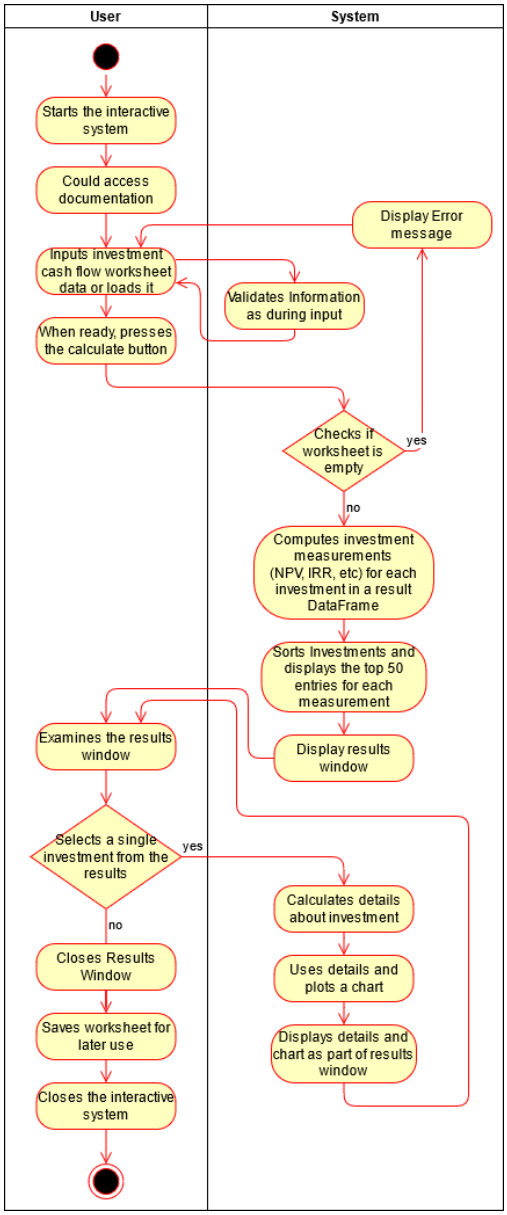

Fig. 2. Activity diagram of the typical workflow using the application

Implementing An Interactive System: Implementing the software system into an actual product requires the use of appropriate developing tools. The *Python 3* programming language was chosen because it is widely used both for developing desktop applications and within the field of data science and data analysis. To achieve faster speeds than raw python and being able to work with data sets known to business analysts the two *SciPy* (Scientific Python) libraries *NumPy* and *Pandas* were used. The graphical user interface is backed up by the official python Qt6 bindings called *PySide6*. The graphing functionality extended is provided by the scientific graphing library *pyqtgraph*. These stable and mature libraries and the familiarity of python 3 in the business analysis field make the python programming language an excellent choice.

Internally, the interface has to directly edit a *Pandas DataFrame* using the Model/View concept by developing an appropriate model. This creates an important interface to directly manipulate *Pandas DataFrame* almost natively using Qt6. Externally, the interface (see Fig. 3) provides a tidy, straightforward, and attractive working experience.

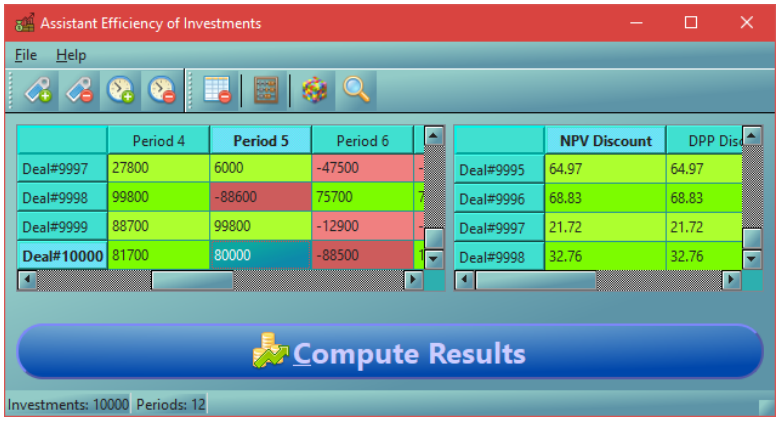

Fig. 3. Re-sized main window showing the investment worksheet.

The user can save or load into following file formats: *.csv; *.json or *.xlsx file. When calculations start a progress bar is shown, giving information back to the user about the computational process. Afterward, the user is presented with the sliced view of the data set showing the top investments of all measurements. The user is able to sort the view according to the measurement to compare all investments against. An interactive chart and details are provided for the selected investment where the user is able to analyze it in depth, see Fig. 4.

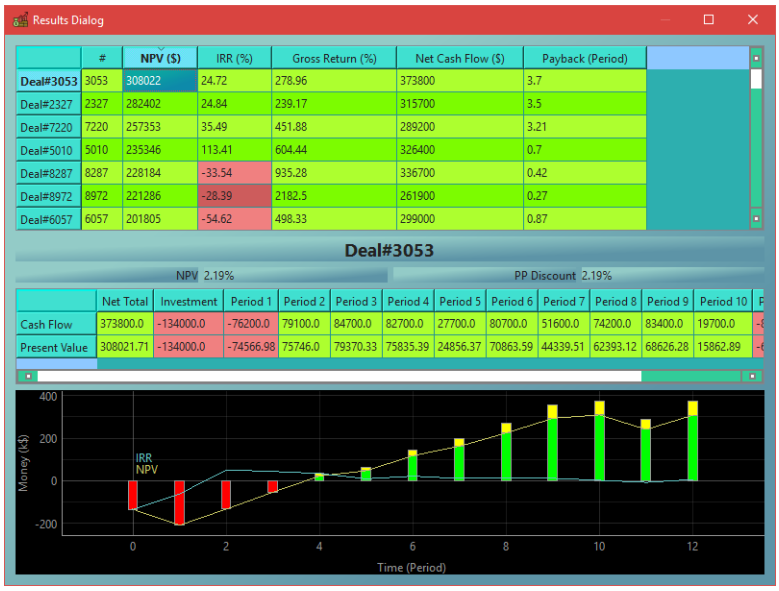

Fig. 4. The results display depicting the top investments, details and visual interactive chart.

Tests And Results: The implemented software application was tested with hypothetical investments using randomly generated numbers within an appropriate probable range. Samples of these numbers can be seen in Fig. 3 and Fig 4. This was used to test the reliability of the software and to measure the computation time. The calculation speeds of these hypothetical investments are: 3 seconds for 1000 investments with 12 periods; 36 seconds for 10,000 investments with 12 periods; 6 minutes and 32 seconds for 100,000 investments with 12 periods.

CONCLUSION

The presented software solution is an interactive system for learning how to determine the investment efficiency that combines the strong points of the existing solutions, solves their shortcomings and provides an attractive and tidy learning workplace. Such interactive solutions can aid the education of young financial decision-makers helping them gain the required understanding and confidence in their skill set. Combining the language and tools business data analysis use, a product foundation is created that can be adapted and extended as needed by business analysts.

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