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The Application of Mathematical Analysis in Investment Planning

Ridwan Hasyim Umar[1*], Zidan Amirudin[2]

[1,2]*Mathematics Undergraduate Study Program, Faculty of Mathematics and Natural Science, Padjadjaran University, Sumedang, Indonesia*

Corresponding author email: zidan22001@mail.unpad.ac.id, ridwan22003@mail.unpad.ac.id

Abstract

Investment serves as a means to cultivate assets and secure long-term profits. However, inadequate investment planning poses a substantial risk of significant losses. Consequently, precise analysis becomes imperative for making intelligent investment decisions. One effective analytical approach involves the application of mathematical concepts in investment planning. This article conducts a comprehensive review of existing literature pertaining to the utilization of mathematical analysis in investment planning. Common mathematical concepts employed in investment analysis encompass probability theory, statistics, portfolio theory, and options theory. Probability theory and statistics aid investors in comprehending and forecasting potential gains and losses from specific investments. The primary objective of investment planning is profit maximization through effective risk management, necessitating a mature and structured analysis. Mathematical analysis emerges as a valuable method, and its application in investment planning yields more accurate and efficient results. Techniques such as statistical analysis, portfolio theory, and probability analysis contribute to risk minimization and return maximization by considering factors like asset correlation and risk levels. Thus, the incorporation of mathematical analysis proves crucial for well-structured and successful investment planning. The fifth entry in the bibliography emphasizes the importance of careful and planned analysis in making investment decisions. Economic and financial factors affecting market and investment performance are explored, along with portfolio risk diversification techniques and investment control. The article underscores the significance of understanding investment objectives and investor profiles while discussing various investment instruments such as stocks, bonds, and mutual funds. Overall, the article provides insights into managing investment portfolios effectively for optimal profitability.
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Keywords: Mathematics, mathematic finance, investment, investment planning.

1. Introduction

Investment planning holds paramount importance for various entities, including institutional investors, individuals, and organizations. The goal of investment planning is to maximize profits while managing existing risks, requiring a thorough and structured analysis. This article delves into the application of mathematical analysis in investment planning, appealing to individuals interested in mathematics and investment seeking innovative approaches to optimize their investments.

2. Literature Review

Investment planning is essential for cultivating assets and securing long-term profits, but the risk of significant losses looms with inadequate planning. This literature review explores the role of mathematical analysis in making intelligent investment decisions. Probability theory and statistics are key components in understanding and forecasting potential gains and losses. The primary goal of investment planning is profit maximization through effective risk management, necessitating mature and structured analysis. Mathematical analysis, encompassing portfolio theory and options theory, proves valuable for accurate and efficient results. Techniques like statistical analysis contribute to risk minimization and return maximization by considering factors such as asset correlation and risk levels.

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understanding investment objectives and investor profiles, discussing various instruments like stocks, bonds, and mutual funds. Overall, the incorporation of mathematical analysis is crucial for well-structured and successful investment planning, providing insights into managing portfolios effectively for optimal profitability (Fitri, 2023).

3. Materials and Methods

3.1. Materials

This research employs secondary data, which indirectly provides data to the data collector (Sugiono, 2008: 402). Secondary data includes sources such as books, previous research, and various readings related to the concept of investment planning, supporting the needs of primary data.

3.2. Methods

Mathematical analysis in investment planning encompasses several methods, including:

- Statistical Analysis: Involves the collection of historical data and its analysis to predict market behavior in the future. Techniques such as regression analysis, moving average, and variance analysis are utilized.

- Portfolio Theory: Concerned with risk management and the distribution of investments across multiple assets to maximize profits. Portfolio theory considers asset correlation and risk levels to determine optimal investment allocation.

- Probability Analysis: Measures the likelihood of specific events occurring. In investment, probability analysis is used to estimate the level of profit and investment risk.

4. Results and Discussion

The application of mathematical concepts such as probability theory, statistics, portfolio theory, and probability analysis in investment planning yields more accurate and efficient results. Statistical analysis, utilizing techniques like regression analysis and moving average, aids in predicting market behavior based on historical data. Portfolio theory, considering asset correlation and risk levels, assists investors in managing and optimally allocating investments. Probability analysis enhances understanding of investment profit and risk levels.

In general, investors typically buy investments for a minimum long-term period, ranging from several months to years. During this time, investors refrain from selling and repurchasing (buying back) their shares. Investors are usually large corporations, investment banks, pension funds, hedge funds, insurance companies, wealthy individual investors, or other institutions (Mardhiah, 2015). In the millennial era, the capital market is targeting young people as investors in financing matters, given the potential for increased capital sources from the young population (millennial generation). Particularly for Islamic instruments in the capital market, there is a possibility that they will continue to be widely sought after.

There are several things that prospective investors, especially millennials, need to know about planning and managing investments in Sharia-compliant stocks (Mardhiah, 2015). This requires investors to be aware of the limitations and rules of Islamic investments, including the process, objectives, objects, and concepts of investment planning in Sharia-compliant stocks in the millennial era.

Some aspects that investors need to consider from an Islamic perspective include (Chair, 2015):
a. Material or financial aspect: Investments should generate competitive financial benefits compared to other forms of investment.
b. Social and environmental aspect: Investments should contribute positively to the wider community and the surrounding environment, benefiting both the current and future generations.

Unlike companies in conducting stock analysis, the investor's perspective is simpler in evaluating the condition of a stock. In the investment world, there are two types of securities analysis that investors can use to make investment decisions (Rustagi, 2021): Fundamental Analysis (economic and capital market analysis, industry analysis, company analysis) and technical analysis (the Dow theory, moving average, and relative strength).

Fundamental analysis is a method based on a company's performance. It aims to assist in assessing which stocks are the best investments. Technical analysis, on the other hand, predicts price movements and market trends by examining past charts. This method assumes that the price of a stock is determined by the supply and demand for that stock.

An investor's evaluation of a stock includes (Fahmi, 2015: 77):

a. Promising business prospects.

b. Good financial and non-financial performance.
c. Clear and open financial statements.
d. Evident and increasing profitability.

When choosing promising business prospects, prospective investors must consider various companies or industries in which they plan to invest. There are four categories of industries that brokers should understand when deciding to purchase stocks, as mentioned by Haryajid, Hendy, and Anjar in Fakhuddin (2008: 236):

a. Growing industries occur in young companies where the company is still active in expansion.
b. Mature industries are stable and tend to maintain existing positions.
c. Declining industries are well-established, requiring good innovation to attract new markets.

Understanding industry issues in various conditions is closely related to the Product Life Cycle (PLC) concept or the product life cycle concept. For more clarity, refer to the diagram below.
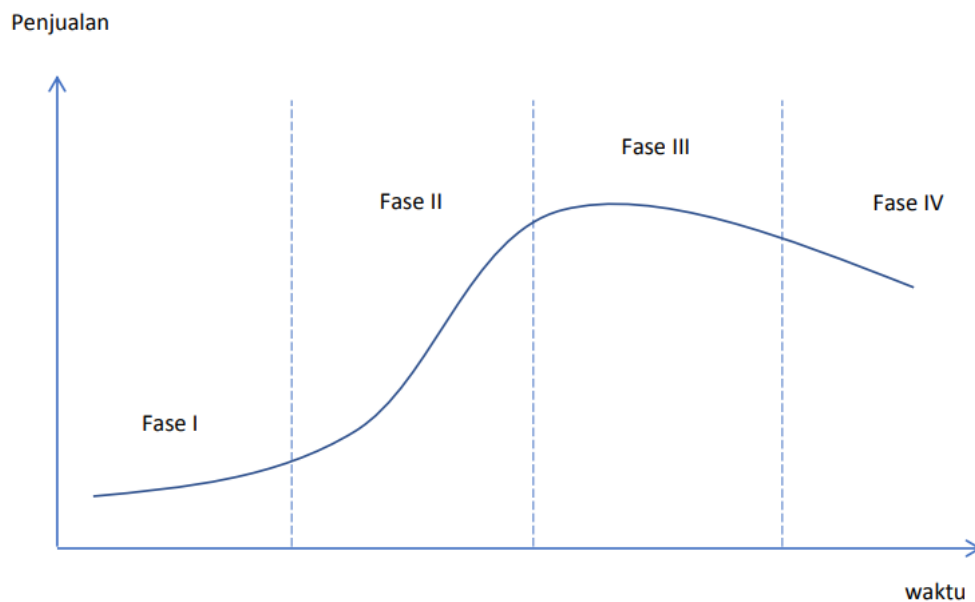
Sumber: Fahmi, 2015: 78.

Figure 1: life cycle of a product

From the above diagram, we can understand that the life cycle of a product is fluctuating over time as a company progresses. The phases undergone by a product are (Fahmi, 2015: 78-79):

a. Phase I: The introduction phase, where a company launches its product into the market. During this phase, consumers begin to notice the product through various media advertisements or by directly visiting the product's sales location.
b. Phase II: The growth phase, where the product has entered the market and begins to gain public attention. The public starts to like the product, and consumer loyalty towards the product begins to form.
c. Phase III: The maturity phase, where the company's product has reached maturity or adulthood. Consumers recognize the product as having quality and value in the market, such as products from brands like Philips, Sony, Honda, and so on. The products produced by the company have a high market value, and the company's management is always in a controlled state.
d. Phase IV: The decline phase in product sales. In this phase, a company needs to anticipate the impacts that may arise, both directly on the company's financial condition and indirectly on the public perception of the product.

Both experienced and prospective investors assess the condition of stocks through ratio analysis. According to Kasmir (2013: 115), ratio analysis provides a measure of management's ability to create market value that exceeds investment costs. Therefore, some suggested ratios for analyzing the condition of good stocks for investment planning include the following:

a. The expected profit ratio from stocks is calculated as follows (Fahmi, 2015: 81):

$$r = \frac{D_1}{P_0} + \frac{P_1 - P_0}{P_0}$$

Where:
r = Expected profit from stocks
D_1 = Dividend in year 1
P_0 = Purchase price
P_1 = Selling price

b. The ratio to calculate the book value per share is given by (Fahmi, 2015: 81):

$$Nbp = \frac{Te}{Jsb}$$

Where:
Nbp = Book value per share
Te = Total equity
Jsb = Number of outstanding shares

c. The zero growth model and signaling theory, or more commonly referred to as the no-growth model, are conditions that investors need to carefully understand. For investors, the rise, fall, and constancy of stocks in the market provide both positive and negative signals.

Any information arising from the stock conditions of a company always affects the decisions of investors as signal recipients. The concept of signaling theory plays a crucial role here. Signaling theory is a theory that discusses the fluctuations in market prices, influencing investor decisions.

Investors' responses to positive and negative signals significantly influence market conditions. They react in various ways, such as rushing to buy or taking no immediate action, adopting a "wait and see" approach. Understanding the decision to wait and see is not considered bad or wrong; instead, it is seen as an investor's reaction to avoid greater risks due to market factors that have not yet favored them.

The ratios for the zero growth model and signaling theory are as follows (Fahmi, 2015: 87):
$$P_0 = \frac{D}{K}$$

Where:
P_0 = Intrinsic value of the stock per share
D = Constant dividend
K = Discount rate per year

d. In the calculation of common stock, Myron J. Gordon developed a formula, commonly known as the constant model (Fahmi, 2015: 87). The Gordon growth model ratio is as follows:
$$P_0 = \frac{D_1}{r - g}$$

Where:
P_0 = value of common stock
D_1 = Dividend revenue in one year
r = Desiredrate of return
g = Estimated on stant growth

From the various evaluation ratios for good stocks that investors can choose from, investors will be able to determine which stocks are the best for long-term investment within the provisions of the capital market.

The application of mathematical analysis in investment planning opens opportunities for informed and well-planned investment decisions. For instance, the use of portfolio theory enables effective diversification of investments, reducing risk and enhancing profit potential. Mathematical analysis also guides the determination of suitable investment strategies, considering various risk factors and the probability of specific events. Therefore, the results of mathematical analysis provide a robust foundation for developing successful and well-structured investment plans

5. Conclussion

The integration of mathematical analysis in investment planning empowers investors to make intelligent decisions and mitigate the risk of significant losses. This literature review establishes that mathematical concepts such as probability theory, statistics, portfolio theory, and options theory are applicable in investment analysis. Consequently,

a sound understanding of these concepts is crucial for successful investment planning. Further studies can be conducted to test and expand the application of mathematical analysis in investment planning.

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