Design & Innovation Project (DIP)

Project Charter

Application of machine learning in financial market

Project Group: E029

School of Electrical and Electronic Engineering
Academic Year 2023/24
Semester 1

Date Prepared: 01/08/2023

Project Name:	Application of machine learning in financial market
Project Supervisor:	Wong Jia Yiing, Patricia
Project Manager:	Deonatan Dinata
Treasurer:	Bulusu Sai Sridharaswami

Project Purpose or Justification:

● *Describe the reason or justification the project is being undertaken*

1. Create User-Friendly Portfolio App:

- The creation of a user-friendly portfolio app addresses a common challenge faced by individuals who are new to investment and portfolio management. The financial markets can be complex and intimidating, making the process of creating one's first portfolio seem daunting.
- This app aims to lower the barriers to entry and make the process more accessible and user-friendly. By providing an intuitive interface and simplified tools, it guides users step-by-step in creating their first portfolio.
- The justification lies in the belief that democratizing portfolio management can empower a broader range of people to take control of their financial future, fostering financial literacy and inclusivity.

2. Demand to Boost Profitability:

- The existing portfolio management strategies often fall short in delivering optimal results, relying on traditional methods that may not fully leverage available data and insights.
- This project addresses the demand for more profitable investment strategies. By harnessing machine learning, sentiment analysis, quantitative models, and advanced portfolio optimization techniques, it seeks to provide clients with a more data-driven and sophisticated approach to managing their portfolios.
- The justification stems from the recognition that investors are increasingly seeking innovative tools and strategies to enhance their profitability in the dynamic and competitive financial markets. This app aims to meet that demand by offering a cutting-edge solution.

3. Develop Risk-Driven Strategy:

- Fear of financial losses is a significant concern for investors in the financial market. This apprehension often leads to overly conservative investment approaches or hesitation to enter the market at all.
- This project recognizes the importance of addressing this fear by emphasizing risk management and aligning the investment strategy with the user's risk tolerance.
- The justification lies in the understanding that a risk-driven strategy can provide a more balanced and personalized approach to investment. By tailoring the portfolio to the individual's risk tolerance, the app seeks to generate profit while mitigating the fear of substantial losses, making it a more appealing and confidence-building tool for investors.

Project Description:

- *Provide a summary-level description of the project.*
- *This section may include information on high-level product and project deliverables as well as the approach of the project.*

The project's purpose is to develop a web-based application that empowers users to optimize their investment portfolios through data-driven decision-making. It involves quantitative analysis, specifically technical analysis, to identify and quantify technical components correlated with stock prices. Sentiment analysis, based on news and company statements, gauges market sentiment. The app uses historical price data and predictive machine learning models for long-term price forecasts. Users can then create personalized portfolio optimization strategies based on their risk tolerance. The project also integrates risk management, including Value at Risk (VaR) calculations, to provide a comprehensive approach to portfolio management, aiming to empower investors with valuable insights and tools for optimized and well-managed portfolios.

High-level Project and Product Requirements:

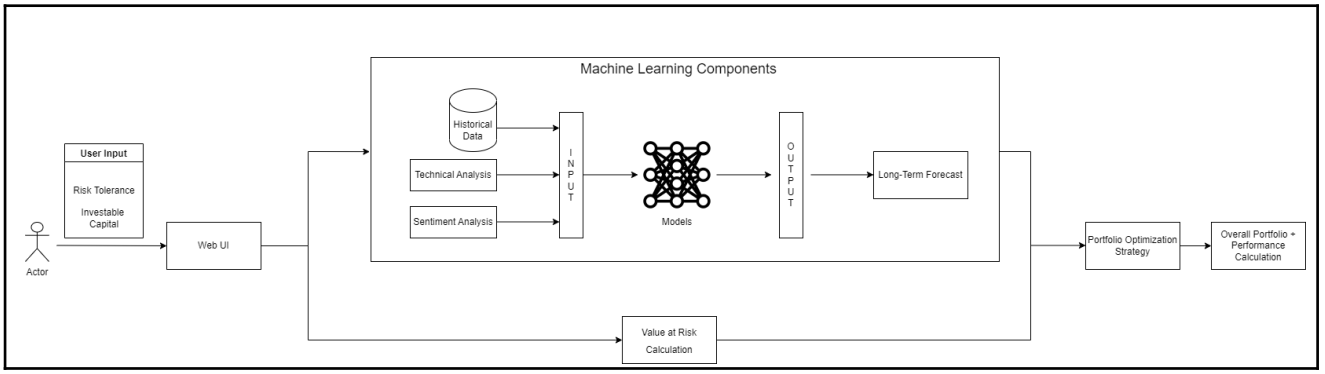
1. Asset Evaluation
    a. Picking different lists of justifiable asset classes.
        i. Equities (picked based on factors below)
            a. Market solvency ratio (Financial health)
            b. Current and projected profitability
            c. Cash flow
            d. Valuation
        ii. Bond (picked based on factors below)
            a. Bond yield
        iii. Commodities (picked based on factors below)
            a. Volatility
            b. Average return
        iv. CryptoCurrency (picked based on factors below)
            a. Market capitalization
            b. Trading volume
            c. Average return and volatility

2. Data Processing
    a. Pulling stable data from the financial market
    b. Retrieving market sentiment data
        i. Getting data from news
        ii. Getting data from tweets
        iii. Quantify string data to numerical values using NLP
    c. Preprocess stock price data with technical analysis
        i. Exponential Moving Average
        ii. Relative Strength Index
        iii. Support Resistant

3. Machine Learning Models
    a. Picking most suited models for price forecast
    b. Training machine learning models
    c. Backtesting models with actual data

4. Portfolio Optimization Strategy
    a. Applying an optimization strategy based on the forecasted data
    b. Managing risk based on VaR

5. App Integration and Deployment
    a. Creating user-friendly UI based on React.js
    b. Creating server endpoints on Flask
    c. Integrating models with web app
    d. Deploying and testing the app



Project Management plan:

This section should be developed based on information provided in the project management course

- *Identify key innovations of the proposed project and the sources of opportunity.*

The proposed project introduces key innovations in the field of portfolio management. It seeks to harness the power of machine learning algorithms, integrating quantitative models for technical analysis, sentiment analysis from scraped news and company statements, and a risk-driven portfolio strategy. These innovations are timely, given the growing demand for data-driven investment strategies and advancements in technology, which now enable the application of complex analysis techniques to portfolio management. Additionally, there is an opportunity to make portfolio management more accessible and user-friendly, addressing the needs of a broader audience. By emphasizing risk mitigation, the project aims to cater to risk-conscious investors and distinguish itself in a competitive landscape while considering regulatory requirements. In summary, the project combines innovation and market demand to create a comprehensive and user-focused portfolio optimization solution for investors in the financial market.

- *Check if the objectives are specific, measurable, achievable, relevant, and time bound.*

Objective: Develop a user-friendly portfolio optimization application to meet the growing demand for boosting profitability while emphasizing a risk-driven strategy.

- **Specific**: The objective is clear; it involves the development of a user-friendly portfolio optimization app.
- **Measurable**: The KPI is defined by the profitability and risk management of the application. The UI will be measured by user satisfaction and feedback.
- **Achievable**: Developing a user-friendly app and improving profitability through data-driven strategies are achievable within the project's scope.
- **Relevant**: The objective aligns with the project's overall goal of providing innovative portfolio management solutions.
- **Time-bound**: The timeline is described in detail in the milestone section. In general, the project will end at week 13.

- *Plan for monitoring and control activities during project execution.*
- Conducting weekly scrum meetings to catch up on blockers, progress, and any updates on each subteam.

Summary Budget:

- *List the initial range of budget for the project.*
- *ChatGPTPlus Subscription ($27 x 7)*
- *TradingView Subscription (USD$14.95 x 7 for 5 indicators / USD$ 29.95 X 7 for 10 indicators)*
- *Google Colab Pro ($14.20 x 7)*
- *Twitter API Access (USD$100/month for Basic plan - Need at least 2-3 months)*

Initial High-Level Risks:

- *List the general risks that might be expected to occur during the project and assess the probability and potential impacts.*
- *Provide alternative solutions and mitigation plans.*

1. **Data Availability and Quality:**
    a. **Risk:** Insufficient access to high-quality financial data, news sources, and historical pricing information can hinder the accuracy and effectiveness of machine learning models, sentiment analysis, and technical analysis.
    b. **Mitigation:** Conduct thorough research to identify reliable data sources and establish data acquisition pipelines. Implement data quality checks and validation processes to ensure the integrity of data used in the project.
2. **Model Accuracy and Validation:**
    a. **Risk:** The performance of machine learning models, especially those forecasting long-term stock prices, may not meet expectations, leading to inaccurate predictions.
    b. **Mitigation:** Implement rigorous model validation and testing procedures, including backtesting on historical data. Continuously refine models and seek expert advice in data science and financial modeling to improve accuracy.
3. **Regulatory and Compliance Risks:**
    a. **Risk:** The project may face regulatory challenges related to financial data usage, privacy, or financial industry compliance standards, potentially resulting in legal issues or delays.
    b. **Mitigation:** Conduct a thorough review of relevant regulations and compliance requirements. Ensure that data usage, privacy, and reporting adhere to legal and industry standards. Consult legal experts if necessary.
4. **Technology Challenges:**
    a. **Risk:** The integration of complex technologies such as machine learning algorithms, sentiment analysis, and web development may encounter technical challenges, leading to project delays.
    b. **Mitigation:** Assemble a skilled and multidisciplinary project team with expertise in the relevant technologies. Conduct thorough feasibility assessments and prototype testing to identify potential technical issues early.
5. **User Adoption and Education:**
    a. **Risk:** Users may face difficulties in adopting and utilizing the advanced features of the application, leading to lower user adoption rates and dissatisfaction.
    b. **Mitigation:** Develop comprehensive user training materials, tutorials, and support resources to facilitate user onboarding. Incorporate user feedback to improve the app's usability and user experience.
6. **Market Volatility:**
    a. **Risk:** Financial markets can be volatile, affecting the performance and stability of investment portfolios. Sudden market fluctuations can impact the accuracy of long-term price forecasts.
    b. **Mitigation:** Implement risk management features within the application, such as Value at Risk (VaR) calculations, to help users assess and mitigate the effects of market volatility. Educate users about the inherent risks of investing in dynamic markets.

Summary Milestones	Target Date
• Set investment strategy and algorithm pipeline • Role delegation (Data processing, Models, and Strategy)	Week 3
• Complete Project Charter • Asset selection for portfolio	Week 4
• Create quantitative analysis code on asset price • Create a scraping algorithm to scrape related news • Create a data streaming pipeline for historical price data • Create the most suitable machine-learning model	Week 6
• Implement technical analysis model to real asset • Implement new data into numerical sentiment value using NLP • Implement VaR calculation	Week 8
• Complete model training and testing • Implement a Portfolio Optimization Strategy	Week 9
• Deploy user-friendly UI • Deploy backend server • Integrate frontend and backend	Week 11
• Integrate backend with machine learning models • Integrate the backend with a portfolio optimization strategy • Complete bug fixes and testing	Week 12
• Final report	Week 13

RACI Chart

RACI Chart	Person						
Activity	Deon	Albert	Jose	Siqi	Francis	Joash	Sai
Asset Class Selection	R	I	A	I	C	I	I
Technical Analysis Framework	A	I	R	R	R	I	A
Web Scraping	I	R	I	I	I	R	I
Risk Quantification Model	C	I	R	I	I	I	A
Sentiment Analysis Framework	A	R	I	I	C	R	I
Data Ingestor for Historical Asset Price	A	I	A	R	R	I	R
Machine Learning Models	R	R	R	R	R	R	R
Portfolio Optimization Algorithm	R	I	A	I	I	I	I

Webapp Development	R	I	I	I	I	I	I
Application Integration	R	R	R	R	R	R	R