Portfolio Pro

Analyze and optimize your investment strategy with real-time economic data.

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Introduction

Portfolio Pro is an advanced portfolio analysis and management tool designed for investors, financial analysts, and portfolio managers seeking to optimize their investment strategies. By integrating cutting-edge financial modeling techniques and intuitive visualizations, it provides actionable insights into portfolio performance, risk, and potential future outcomes.

Key Features:

- **Backtesting**: Evaluate how different asset allocations would have performed historically to guide future investment decisions.
- **Monte Carlo Simulation**: Model thousands of potential future scenarios to assess risk and return under various market conditions.
- **Modern Portfolio Theory (MPT)**: Optimize portfolios by balancing risk and return using diversification principles.
- **Factor Regression Analysis**: Analyze portfolio returns based on risk factors like market size, value, and momentum.
- **Asset Correlation Report**: Assess relationships between different assets in a portfolio to identify diversification opportunities.

Tools and Technologies:

- **Data Sources**:
    - **Yahoo Finance (yFinance)**: Retrieves real-time and historical financial data.
    - **FRED API**: Provides economic indicator data from the Federal Reserve.
- **Frontend**:
    - **React**: For building dynamic, user-friendly interfaces.
    - **Tailwind CSS**: For modern, responsive styling.
- **Backend**:
    - **Flask**: Manages APIs related to financial tools and analysis.
    - **Express**: Handles economic indicator data and manages JWT-based authentication.

Who Is It For?

- **Individual Investors**: Looking to make data-driven investment decisions.
- **Financial Analysts**: Seeking in-depth portfolio analysis to recommend optimal strategies.
- **Portfolio Managers**: Managing large portfolios, aiming to balance risk and returns using advanced risk models.

Backtest Asset Allocation

What It Is: Backtest Asset Allocation is a method to evaluate how a specific mix of investments would have performed over time. It helps us understand the potential risks and returns of different asset combinations.

How It Works:

1. **Fetching Data:** We gather historical price data for various asset classes (like stocks, bonds, gold, etc.) over the last ten years. This data shows how the price of each asset has changed over time.

2. **Initial Investment:** We start with a certain amount of money we want to invest.

3. **Allocations:** We decide how much of our total investment to allocate to each asset. For example, if we have $1,000 and allocate 60% to stocks, we invest $600.

4. **Yearly Calculations:** Each year, we calculate how much each asset has grown based on historical returns. We update the total value of our investment by adding the gains from each asset.

5. **Tracking Performance:** We track how our investments perform each year and calculate the following:
    - **CAGR (Compound Annual Growth Rate):** This shows our investment's average annual growth rate over the entire period.
    - **Annual Returns:** The percentage gain or loss for each year.
    - **Standard Deviation:** This measures how much the returns fluctuate; higher values indicate more risk.
    - **Sharpe Ratio:** This compares the returns of our investment to the risk taken, helping us understand if the returns justify the risk.

Why It Matters: By backtesting our asset allocation strategy, we can see how it would have performed in the past, which helps us make informed decisions about future investments.

Monte Carlo Simulation

What is a Monte Carlo Simulation?
A Monte Carlo simulation is a method used to predict the future performance of an investment portfolio. It does this by simulating many possible scenarios (or "what-ifs") based on historical data. Essentially, it helps us estimate the range of potential outcomes and risks.

How It Works:

1. **Collecting Historical Data:**
   We use the past performance of different assets (like stocks, bonds, and real estate) to calculate how much these assets have grown on average each year and how much their returns have fluctuated (the risk).
2. **Calculating Average Return and Risk:**
   - **Average Return:** We look at how much each asset (like stocks, bonds, etc.) has typically gained or lost each year.
   - **Volatility (Risk):** We also measure how unpredictable the returns of each asset are. The more volatile, the bigger the swings between high and low returns.
3. **Simulating the Future:**
   Using the data collected, we run many different simulations. Each simulation represents one possible future scenario for the portfolio. We start with an initial investment amount (e.g., $10,000) and use the average return and volatility data to simulate how the portfolio would perform each year over some time, such as 15 years. In each year of the simulation, we adjust the returns based on the asset's volatility to account for randomness (how real-life markets behave).
4. **Repeating the Simulation:**
   We repeat this process thousands of times to generate multiple possible outcomes. Each simulation may result in a different outcome, with the portfolio either growing or shrinking depending on the random variations in returns.
5. **Analyzing Results:**
   Once all simulations are completed, we analyze the results by organizing them into percentiles (e.g., 10th, 25th, 50th, 75th, and 90th percentiles). This helps us understand the range of potential outcomes:
   - **10th percentile:** Represents a worst-case scenario—10% of the simulations performed worse than this.
   - **50th percentile (Median):** Represents a middle-ground scenario—half the simulations did better and half did worse.
   - **90th percentile:** Represents a best-case scenario—90% of the simulations performed worse than this.
6. **Why It Matters:**
   Monte Carlo simulation gives us insight into the uncertainty of investments. Instead of relying on just one prediction, it shows us a range of possible results, helping investors plan for both good and bad market conditions.

Modern Portfolio Theory (MPT)

What is Modern Portfolio Theory (MPT)?
Modern Portfolio Theory is a way of building an investment portfolio that aims to balance risk and reward. The idea is to create a mix of assets that maximizes the expected return for a given level of risk or minimizes risk for a desired level of return. This is also known as finding the “Efficient Frontier.”

How It Works:

1. **Collecting Historical Data:**
   We start by gathering historical price data for different assets (such as stocks, bonds, or real estate) to understand how their values have changed over time.
2. **Calculating Returns and Risk:**
   - **Returns:** We calculate how much each asset has earned on average each year.
   - **Risk (Volatility):** We measure how unpredictable the returns of each asset are. Volatility tells us how much an asset’s price moves up and down over time.
3. **Understanding Asset Correlation:**
   MPT also looks at how different assets move concerning one another. For example, if two assets tend to go up and down together, they are positively correlated. If one asset goes up when another goes down, they are negatively correlated. Diversifying with negatively correlated assets can reduce overall risk.
4. **Running Simulations to Find Optimal Portfolios:**
   - We run simulations by randomly assigning different weights (percentages) to each asset. These weights represent how much of the portfolio is invested in each asset.
   - For each portfolio, we calculate:
     - **Expected Return:** How much we expect the portfolio to grow based on the average returns of its assets.
     - **Risk (Volatility):** The overall risk of the portfolio, calculated by considering both individual asset risks and how the assets move together.
     - **Sharpe Ratio:** This measures how much return we’re getting for each unit of risk. A higher Sharpe Ratio means better performance for the risk taken.
5. **Efficient Frontier:**
   After simulating many portfolios, we plot them to create what is called the “Efficient Frontier.” This is a curve that shows the best possible portfolios that give the highest expected return for each level of risk. Portfolios on the Efficient Frontier are the most optimal, while portfolios below the frontier are suboptimal (you could be getting better returns for the same risk).

Why MPT is Important:
Modern Portfolio Theory helps investors choose a diversified portfolio that balances risk and reward. By understanding how different assets work together and running simulations to find

the best combinations, MPT allows investors to maximize returns while keeping risk under control. It’s all about finding the most efficient mix of assets for your financial goals

Factor Regression Analysis

What is Factor Regression Analysis?

Factor regression analysis is a method used to understand what drives the returns of an investment portfolio. In simple terms, it helps you determine how much of your portfolio's performance is due to various market factors like size (SMB), value (HML), momentum (MOM), and the general market (Rm-Rf), while also considering the risk-free rate of return.

The idea is to break down a portfolio's returns into contributions from each of these factors to understand which factor plays the biggest role in explaining the portfolio's behavior.

Steps to Calculate:

1. **Gathering Factor Data:**
    - We collected data on four key factors:
        - **Market (Rm-Rf):** Represents the overall stock market (S&P 500).
        - **Size (SMB):** Measures the performance difference between small and large companies.
        - **Value (HML):** Compares the returns of value stocks (stocks with lower price relative to their fundamentals) versus growth stocks.
        - **Momentum (MOM):** Reflects the tendency of stocks that have performed well recently to continue performing well.

2. This data was resampled monthly to match the frequency of the analysis. We also included the **Risk-Free Rate (RF)**, which is typically represented by short-term U.S. Treasury bills.

3. **Portfolio Returns:**
    - We calculated the historical returns for the portfolio by gathering price data of the selected assets and then determining the weighted average return based on the given asset allocations.

4. **Running the Regression:**
    - The regression model compares the portfolio's returns (after adjusting for the risk-free rate) against the returns of each factor. The model estimates how much of the portfolio’s return is explained by each factor (called **loadings**).

5. **Results Interpretation:**
    - The regression provides insights into how sensitive the portfolio is to each factor. For example, a high loading on the "Market" factor suggests that the portfolio’s returns are closely tied to the overall stock market. The results also

include confidence intervals and p-values, which indicate the statistical significance of each factor’s influence on the portfolio.

Factor Statistics

What are Factor Statistics?

Factor statistics help us understand the performance and behavior of different investment factors over time. In simple terms, it's a way to assess how well various factors (such as growth, value, quality, size, momentum) perform, how risky they are, and how they relate to one another in terms of correlation.

Steps to Calculate:

1. **Data Collection:**
    - We gathered historical price data for different market factors, including the overall stock market (**S&P 500**), small-cap stocks (**IWM**), momentum stocks (**MTUM**), quality stocks (**QUAL**), value stocks (**VLUE**), and other factor ETFs like **SIZE** and **EFV**.
2. **Calculate Returns:**
    - After getting the adjusted close price for each factor, we calculated **daily returns** by finding the percentage change in prices from one day to the next.
3. **Annualized Return and Risk:**
    - To understand how these factors performed on an annual basis, we computed the **annualized return** by multiplying the average daily return by the number of trading days in a year (252 days).
    - We also calculated the **annualized standard deviation** (risk) by scaling up the daily standard deviation using the square root of 252. This tells us how much returns tend to fluctuate over the year.
4. **Correlation Matrix:**
    - The correlation matrix shows how closely related the factors are to each other. A value close to 1 means two factors tend to move together, while a value close to -1 means they move in opposite directions. This helps us understand how diversified the portfolio is.
5. **Compounded Growth:**
    - To visualize how much these factors have grown over time, we calculated **compounded growth** by assuming that every return is reinvested. This gives a clearer picture of how wealth would grow if invested in these factors over the long run.

Key Outputs:

- **Annualized Return:** This is the expected yearly return for each factor, based on historical data.
- **Annualized Standard Deviation:** This tells us how volatile or risky each factor is.
- **Correlation:** The correlation matrix helps understand how different factors interact with each other—whether they tend to move together or cancel each other out.

Risk Factor Allocation

What is Risk Factor Allocation? Risk factor allocation refers to optimizing a portfolio's exposure to certain risk factors, such as market risk, size, value, or momentum. The aim is to fine-tune the portfolio to achieve a specific balance or exposure to these risk factors, based on the investor's goals.

How It Works: This process involves several steps, from collecting data to using optimization techniques to adjust portfolio allocations. Here's a step-by-step breakdown:

1. **Data Collection:**
    - We first gather historical price data for selected stocks or asset classes (represented by **tickers**) using Yahoo Finance's `yfinance` API.
    - The data spans from 2010 to 2023, providing a long-term view of how each asset performed.
    - We also fetch data for a broad market index, like the **S&P 500** (`^GSPC`), to serve as a benchmark for the overall market performance.
2. **Calculate Returns:**
    - The next step is to compute **daily returns** for both the selected tickers and the market index. Daily returns help us understand how much each asset fluctuates in value on a day-to-day basis.
3. **Generate Factors:**
    - Besides the market factor, additional **risk factors** are generated using random data for simplicity (such as **SMB** for small vs. large stocks, **HML** for value vs. growth stocks, **TRM** for term risk, and **CDT** for credit risk).
    - These factors help us understand how different types of stocks or risk profiles contribute to overall returns.
4. **Portfolio Returns:**
    - The portfolio's overall return is calculated by multiplying the individual stock returns by their respective weights (allocations). This gives a weighted average return for the entire portfolio.
5. **Factor Model:**
    - To analyze how the portfolio is exposed to different factors, we fit a **linear regression model** (Ordinary Least Squares – OLS) that relates the portfolio returns to the various risk factors.
    - This helps us understand the sensitivity or "exposure" of the portfolio to different risks, such as market risk or value/growth characteristics. The regression coefficients (`model.params`) show the degree of exposure.
6. **Desired Exposure:**
    - The user specifies a **desired exposure** to each factor (e.g., they may want 50% exposure to market risk, 20% to size, etc.).
    - These desired exposures are converted into an array for use in the optimization process.
7. **Optimization Process:**
    - The goal is to find a new set of **portfolio allocations** (i.e., weights for each asset) that align with the desired exposures to risk factors.
    - We define an **objective function** that calculates the difference between the current factor exposure and the desired exposure, and we aim to minimize this difference.

    - A **regularization penalty** is added to prevent extreme weights, ensuring the portfolio remains diversified. This penalty discourages too much concentration in any single stock or asset.
8. **Constraints and Bounds:**
    - To make sure the portfolio is practical, we enforce two main constraints:
        - The sum of all portfolio weights must equal 1 (i.e., 100% of the capital is allocated).
        - Each weight has a bound between 0.01 (1%) and 0.5 (50%) to avoid extreme positions in any one asset.
9. **Optimization Result:**
    - The optimization process uses a method called **minimization**, which tries to find the portfolio allocations that best match the desired risk exposures.
    - Once the process finishes, the adjusted allocations are returned, reflecting how much of the portfolio should be invested in each asset to achieve the desired risk profile.

Key Outputs:

- **Adjusted Allocations:** The new, optimized weights for each asset in the portfolio.
- These allocations are designed to provide the desired level of exposure to different risk factors, aligning with the investor's goals while maintaining diversification.

Asset Correlation Report

This tool analyzes how different assets (stocks) in a portfolio relate to each other and their performance over time. It gathers historical data and calculates:

Correlation: How closely the prices of the assets move together.

Annualized Return: The yearly percentage return each asset has made on average.

Risk (Standard Deviation): How much the asset's returns fluctuate, both monthly and yearly.

The result is a table that shows both the relationships between assets and key performance indicators to help investors understand the risk and return of their portfolio.

Economic Indicators

Portfolio Pro integrates key economic indicators into its analysis, helping investors understand the macroeconomic factors that can influence market performance. Using data from the Federal Reserve Economic Data (FRED) API, the tool visualizes these indicators with graphs, offering insights into their trends and potential impact on investment portfolios.

Key Economic Indicators:

1. **Consumer Price Index (CPI)**:
    - **What it is**: CPI measures the average change in prices paid by consumers for goods and services over time. It is a key indicator of inflation.
    - **Why it matters**: Rising CPI reflects increasing inflation, which can erode purchasing power and affect interest rates, thus influencing stock and bond prices.
    - **Graph**: Visualizes monthly CPI changes to help understand inflation trends and their effects on investment portfolios.

2. **Oil Prices**:
    - **What it is**: Oil prices represent the cost of crude oil in global markets, a critical factor for energy prices and broader economic costs.
    - **Why it matters**: Fluctuations in oil prices can significantly impact inflation, consumer spending, and the performance of energy-related sectors.
    - **Graph**: Tracks historical oil prices, offering insights into how changes affect sectors like transportation, manufacturing, and energy stocks.

3. **Unemployment Rate**:
    - **What it is**: The unemployment rate measures the percentage of the workforce that is actively seeking employment but unable to find work.
    - **Why it matters**: High unemployment can signal economic distress, while low unemployment is typically associated with economic expansion. Changes in this rate can influence interest rates and market confidence.
    - **Graph**: Displays historical unemployment data, helping investors understand the labor market's health and its implications for economic growth and stock market performance.

4. **Federal Interest Rates**:
    - **What it is**: The federal funds rate is the interest rate at which banks lend to each other overnight, set by the Federal Reserve.
    - **Why it matters**: Changes in interest rates affect borrowing costs for consumers and businesses, influencing stock prices, bond yields, and economic growth.

- **Graph**: Shows the historical trajectory of federal interest rates, allowing users to assess the impact of rate changes on various asset classes like bonds and equities.

5. **Inflation Rate**:
    - **What it is**: The inflation rate reflects the rate at which the general level of prices for goods and services is rising.
    - **Why it matters**: High inflation typically leads to higher interest rates, which can negatively affect stocks and bonds, while low inflation can encourage investment and growth.
    - **Graph**: Visualizes inflation trends, helping users evaluate its impact on portfolio performance and asset allocation strategies.

Why Economic Indicators Matter:

Each of these indicators plays a critical role in shaping the overall market environment. By understanding these factors, investors can make more informed decisions regarding portfolio adjustments, risk management, and potential growth opportunities.

In Portfolio Pro, these indicators are displayed as interactive graphs using data from FRED. The visual representations provide a clear view of trends over time, helping users to anticipate how changes in the economy might influence their investments.

JWT-Based Authentication for Login and Signup

Portfolio Pro uses **JWT (JSON Web Token)** based authentication to securely handle user login and signup processes. This ensures that users' data is protected while allowing them to access their personal portfolios.

How It Works:

1. **User Signup**:
    - New users create an account by providing their credentials (e.g., email, password).
    - The system securely stores the credentials after hashing the password for added security.
    - Upon successful signup, the user receives a JWT token, which is used to authenticate future requests.
2. **User Login**:
    - Existing users log in by providing their credentials.
    - After verifying the credentials, the system generates a **JWT token** for the user.
    - This token contains encoded user information and is sent back to the user, who then uses it to access protected routes.
3. **Token-Based Access**:
    - For each authenticated request (like viewing or managing portfolios), the JWT token is included in the request header.
    - The server verifies the token's validity before granting access to the requested resources.

Why JWT?

- **Stateless**: No need to store session data on the server, making it more scalable.
- **Secure**: The token is signed and encoded, ensuring data integrity and authenticity.
- **Efficient**: It allows secure user authentication without frequent database lookups, improving performance.

This authentication system ensures that only authorized users can access their portfolio data while providing a seamless login/signup experience.