**Portfolio Optimization System**

**Overview**

This comprehensive portfolio optimization system provides tools for sophisticated investment portfolio analysis, optimization, and management. It combines modern portfolio theory with AI-enhanced market analysis to deliver data-driven investment allocation recommendations.

**Key Components**

**RiskReturnOptimizer**

The core module that integrates multiple data sources to optimize investment portfolios:

* Retrieves stock price data from Yahoo Finance and Alpha Vantage
* Incorporates macroeconomic indicators from FRED
* Performs clustering and portfolio optimization
* Calculates optimal asset weights based on risk and return profiles

**Portfolio Optimization Module**

Implements various portfolio optimization strategies:

* Sharpe ratio maximization
* Volatility minimization
* Risk parity and maximum diversification approaches
* Black-Litterman model and robust optimization
* Target return and target risk optimization

**Visualization Module**

Creates comprehensive portfolio visualizations:

* Efficient frontier plots with optimal portfolios
* Correlation matrices and risk contribution analysis
* Performance metrics including returns, drawdowns, and volatility
* Interactive dashboards for portfolio analysis

**Data Handling Module**

Manages financial data acquisition and processing:

* Multi-source stock data retrieval
* Macroeconomic indicator integration
* Market indices and sector performance tracking
* Data cleaning and preprocessing

**Date Management Module**

Facilitates time period selection for investment analysis:

* Custom date range definition
* Trading day calculations
* Period-based analysis (quarterly, monthly, annually)

**Investment Allocation Module**

Translates portfolio weights into actionable investment plans:

* Calculates investment amounts based on portfolio weights
* Determines rebalancing requirements
* Creates dollar-cost averaging schedules
* Simulates portfolio drift over time

**Risk-Return Analysis Module**

Provides advanced risk and performance metrics:

* Risk measures (VaR, CVaR, maximum drawdown)
* Performance indicators (Sharpe, Sortino, Treynor ratios)
* Portfolio stress testing capabilities
* Monte Carlo simulations

**News Sentiment Analysis Module**

Enhances portfolio decisions with market sentiment analysis:

* Retrieves company, sector, and market news
* Utilizes Anthropic API for news sentiment analysis
* Aggregates sentiment results to generate market forecasts
* Evaluates potential news impact on market prices

**Technical Features**

* Data integration from multiple financial APIs
* Machine learning-enhanced optimization algorithms
* API-based sentiment analysis using Claude AI
* Customizable risk-return preferences
* Interactive visualizations for decision support
* Backtesting and forward simulation capabilities

This system provides investors with sophisticated tools typically available only to institutional investors, enabling data-driven portfolio management with consideration of both quantitative metrics and qualitative market sentiment.