SIMPLE INVESTMENT PORTFOLIO ANALYTICS W/ R SHINY

Robert Lando

Chart taken from TradingView.com

MOTIVATION

- Investing in the stock market has historically been profitable, but it naturally carries downside risk.

- S&P 500 has arguably been in a ~90-year bull market. However, it has not been completely immune to aggressive downswings along the way.

- Modern investing practices seek to minimize downside risk as much as possible, while maximizing potential profits.

- With an unprecedented amount of participation in the market from new retail investors, having access to a web app to help evaluate portfolio performance & risk can help make investment decisions.

"Risk"

- Broadly speaking, we consider two types of risk. Non-diversifiable (aka "systematic") and diversifiable risk.

- Diversifiable risk can be lowered through deliberate portfolio construction, such that it minimizes the variance of your portfolio returns.

- The standard deviation σ of an asset or portfolio's periodic returns is how diversifiable risk is commonly quantified.

The Capital Asset Pricing Model

- Simple and widely used.

- Estimates the expected return of an asset or portfolio as a function of non-diversifiable risk (commonly referred to as β).

- $E[R_i] = R_f + \beta_i(E[R_m] - R_f)$

- Where:

  - $E[R_i]$ = expected return on asset i

  - R_f = risk free return

  - $E[R_m]$ = expected return of the overall market (S&P500 return is commonly used as an estimate)

  - $\beta_i = \dfrac{Cov(R_i, R_m)}{Var(R_m)}$, is a measure of how volatile an asset is relative to the whole market.

Sharpe Ratio & Alpha

■ $SR = \frac{R_p - R_f}{\sigma_p}$ (excess return per unit risk)

■ $\alpha = R_P - (R_f + \beta(R_m - R_f)) = R_p - E[R_p]$

■ We seek $\alpha > 0$ & maximal SR.

■ Where:

   – R_p = *portfolio return.*

   – R_f = *"risk-free" return rate.*

   – R_m = *overall market return.*

   – σ_p = *standard deviation of portfolio returns. (unit of risk)*

   – β = *portfolio's beta.*

Basic Shiny App Goals

- Visualize aggregate and monthly returns of a user defined weighted portfolio.

- Visualize equities over a defined time interval.

- Visualize boxplots of each asset within a weighted portfolio.

- Calculate Alpha, Beta and Sharpe ratios for a given portfolio to give an idea of risk adjusted performance.

Daily Charts:

- By Default, the app shows daily candlestick charts of the S&P500 (top), and the Dow Jones Industrial Average (bottom).

- Users can input any ticker of choice in the side bar along with a date to start the chart at.
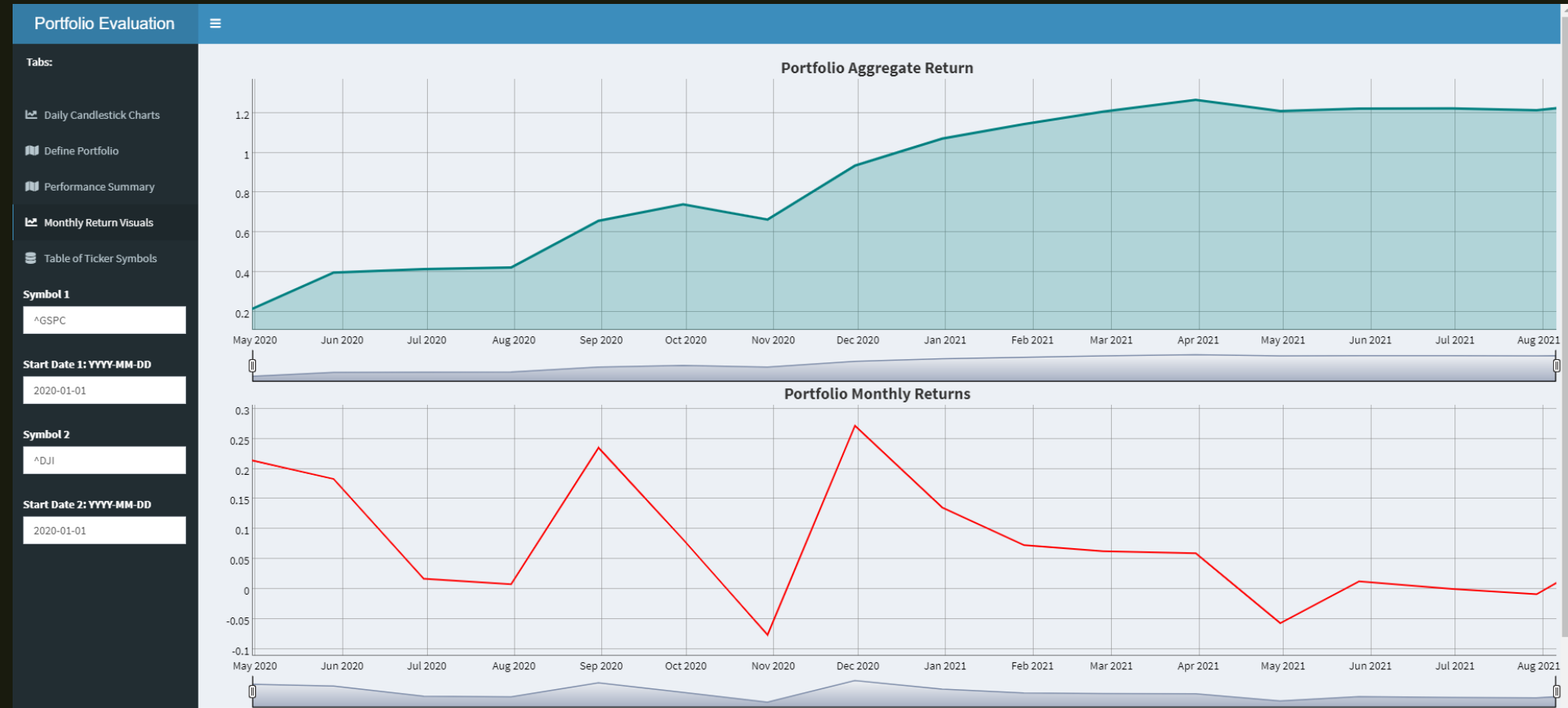
Input a User Portfolio:

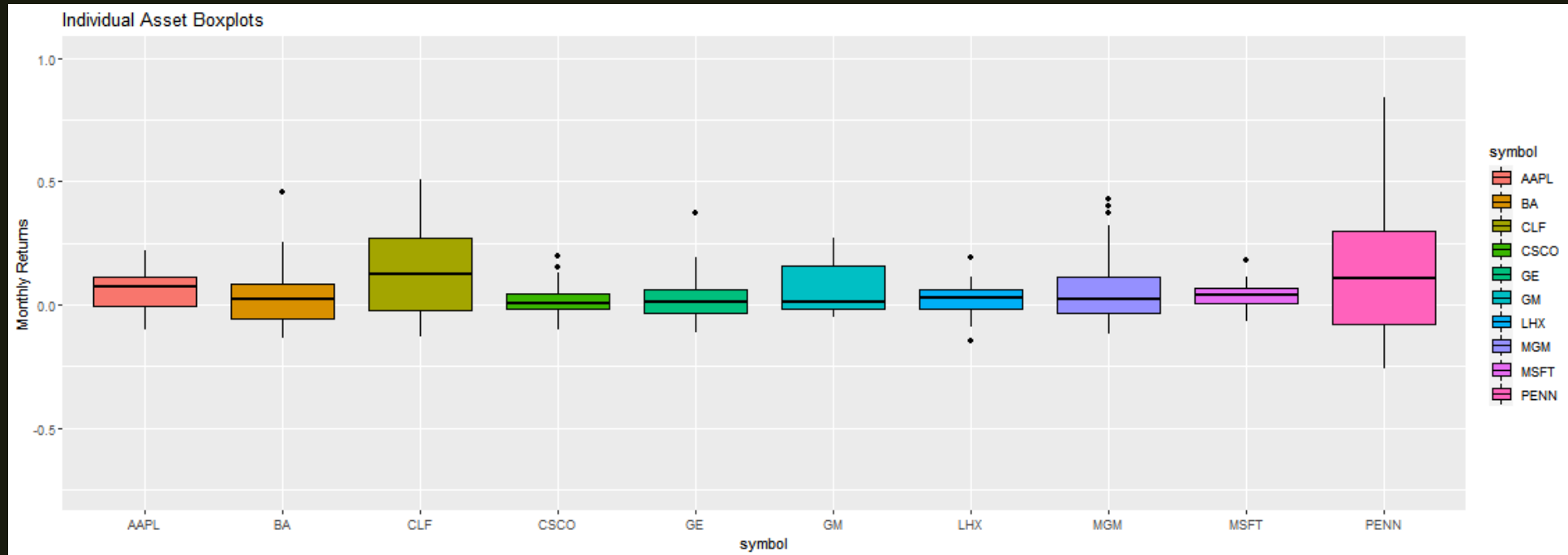- On the "Define Portfolio" tab, users can enter up to 10 asset tickers and corresponding decimal weights to represent their portfolio.

- A time period for evaluation is also set by the user.

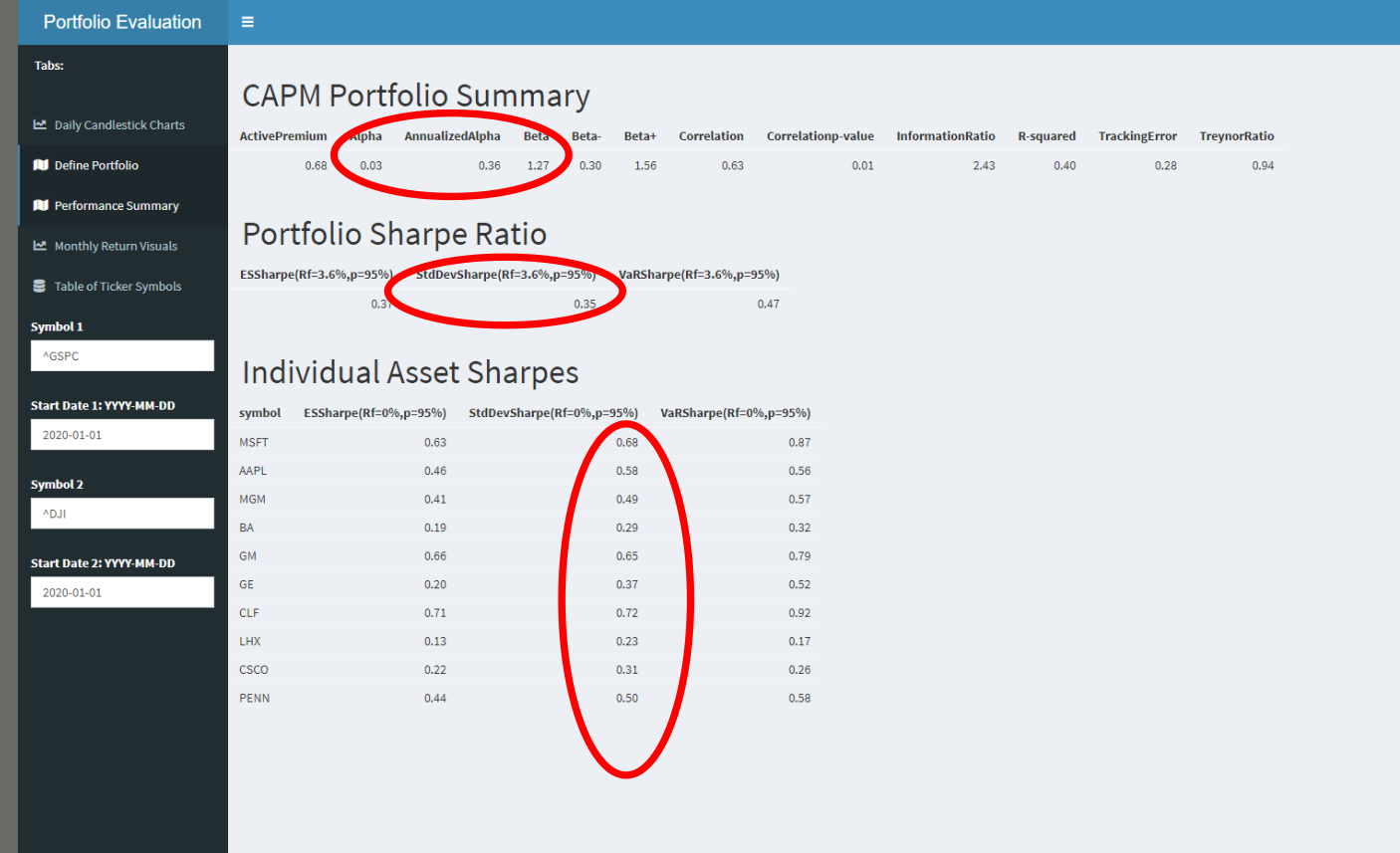- The portfolio shown is entered by default as an example.

Monthly and aggregate returns of the user-defined portfolio can be viewed in the visuals tab:

Individual asset boxplots can also be inspected:

Performance Evaluation Tab:

CAPM Portfolio Summary

ActivePremium	Alpha	AnnualizedAlpha	Beta	Beta-	Beta+	Correlation	Correlationp-value	InformationRatio	R-squared	TrackingError	TreynorRatio
0.68	0.03	0.36	1.27	0.30	1.56	0.63	0.01	2.43	0.40	0.28	0.94

Portfolio Sharpe Ratio

ESSharpe(Rf=3.6%,p=95%)	StdDevSharpe(Rf=3.6%,p=95%)	VaRSharpe(Rf=3.6%,p=95%)
0.31	0.35	0.47

Individual Asset Sharpes

symbol	ESSharpe(Rf=0%,p=95%)	StdDevSharpe(Rf=0%,p=95%)	VaRSharpe(Rf=0%,p=95%)
MSFT	0.63	0.68	0.87
AAPL	0.46	0.58	0.56
MGM	0.41	0.49	0.57
BA	0.19	0.29	0.32
GM	0.66	0.65	0.79
GE	0.20	0.37	0.52
CLF	0.71	0.72	0.92
LHX	0.13	0.23	0.17
CSCO	0.22	0.31	0.26
PENN	0.44	0.50	0.58

- We can see that our example portfolio yielded a positive Alpha, and solid Sharpe Ratio dating from 2020-04-01 -> 2021-08-08.
-    The Sharpe ratio indicates we are being substantially compensated per unit risk (sd of monthly returns).
- The positive alpha indicates we are outperforming the expected returns of our portfolio, given our β.
-    However, this was naively achieved by weighting each asset at 10% of our portfolio.
- Ideally, we can find an optimal weighting that maximizes the Sharpe Ratio.

Further steps:

- Plot Sharpe Ratio vs, standard deviation for 10,000+ randomly generated portfolios.

- Add functionality to optimize asset weightings s.t. the Sharpe Ratio is maximized.

- Implement additionally methods for optimizing portfolio weightings, for example Kelly Fraction weighting.

- Implement simple clustering and back-test portfolios generated by sampling from each modeled group.

QUESTIONS?