**Markets**

Quantitative Section

Data – 1yr Daily Returns for 100 stocks and a Market Index in StockReturns.csv and IndexReturns.csv. A Price, MarketCap ($MM), SharesOutstanding(MM), EPS and Factor Z-Score for each stock is provided in StockData.csv.

Calculation to be performed in Python, present all results formatted in a PDF or Excel. Please provide your python script.

I checked AAPL. Looks like we are using arithmetic returns on adjusted close, including the effect of corporate actions and dividends. Assumes no stdev of risk-free rate. Equally weighted portfolio rebalanced each day.

• What is the annualized return, volatility, Sharpe Ratio, P/E Ratio, and the Factor loading Z-Score of an Equal, MarketCap and Volatility weighted portfolio of the 100 stocks? (*Assume that MarketCap and Volatility are held constant as of the beginning of the stock return period for portfolio weight calculations.)*

• What is the beta, correlation and annualized tracking error of each of the 3 portfolios constructed in (1) to the provided market index?

• Consider the following formula: Expected Return (Er) = Stock Beta(b) \* (Market Index Return(Mr) – Risk Free Rate(Rf)). Given an Rf = 2%, using the data provided calculate each stock’s beta and plot the security market line vs each stock’s realized return in one chart.

• Using the results from (3) what are the top 5 best/worst performing stocks relative to their Expected Returns.

• Using your results from 3), calculate the residual volatility of each stock, where residual volatility is the volatility of each stock’s returns residualized for beta.

• Plot the distribution of the 100 stock’s annualized return. What does the charted distribution tell you relative to your own expectations?

• Chart the Factor Z-Score (x-axis) vs. each stocks realized annual return (y-axis). Considering this chart what does the Factor Z-Score represent?

Essay Questions

• Using data from your answers in the quantitative section, choose a stock you believe performed best and explain why.

• Explain how you would measure TSLA’s contribution to the volatility of the equal weighted portfolio and how could you use this information?

https://breakingdownfinance.com/finance-topics/modern-portfolio-theory/marginal-contribution-to-risk-mctr/

You could also just manually test adding and removing it

Depends on covariance with respect to the portfolio and also volatility of Tesla.

I don’t think this formula makes much sense.

**How would you estimate a portfolio’s exposure to the Overall Market, Business Sectors, and the portfolio’s valuation relative to the market?**

• I would use a sophisticated multi-factor risk model like BARRA or Axioma, inputting my portfolio holdings to generate factor exposures. These models quantify the portfolio’s betas to factors like market, industry, and country. By regressing portfolio returns against factor returns over a historical period, I can assess market sensitivity and sectoral exposures.

• Additionally, I would analyze valuation ratios like P/E, P/B, P/S for the portfolio versus a benchmark. Comparing these to the market betas of broad indexes like the S&P 500, I can evaluate if my portfolio carries more or less market risk and assess its stance on growth vs. value stocks.

**What is an equity risk model and how and why would you use one?**

• Equity risk models, such as the BARRA model, relate stock returns to systematic risk factors using tools such as linear regression, encompassing fundamental and statistical factors like country, industry, market cap, and momentum. It helps in quantifying a portfolio's exposures to systematic sources of risk like the market, industries, and investment styles.

• I would use an equity risk model to understand the key drivers of my portfolio's returns and risks, and to separate alpha (idiosyncratic return) from beta (systematic return). I would use such models for risk decomposition, performance attribution, and hedging. By quantifying my portfolio’s sensitivity to each factor, I can isolate, hedge, and optimize these risks, enabling me to manage multifactor risk in complex portfolios.

**How would you calculate an orthogonal factor and why might it be useful in equity portfolio risk management?**

To calculate an orthogonal factor, I would regress the raw factor (e.g., short interest) against the loadings of the existing factors in the model and use the residuals as the orthogonal factor. These residual loadings represent the portion of the raw factor uncorrelated with existing factors. Orthogonal factors are valuable in equity portfolio risk management as they reduce multicollinearity and help isolate incremental explanatory power, enabling more targeted hedging and attribution strategies.

Orthogonal factors are crucial for isolating unique risk components. They enable targeted hedging and precise performance attribution, essential for managing complex equity portfolios.

**What do you think are the most important factors in assessing the risk of an equity portfolio?**

The most important factors in assessing equity portfolio risk include market sensitivity, exposures to different business sectors, investment style factors like momentum, size, value vs. growth, and idiosyncratic risk. Understanding these systematic and idiosyncratic factors is crucial for measuring risk, attributing performance, and avoiding unintended bets.

It’s important to pay attention to what others see as prominent market themes that may come and go. These may cause correlation amongst otherwise uncorrelated assets. Examples include exposures to COVID, elections, Middle East conflicts, etc.

**How would you recommend reducing a portfolio’s exposure to an undesirable risk?**

• I would analyze my portfolio's factor exposures using the risk model, then adjust sector positions, short correlated stocks or ETFs, diversify across trading styles, and reduce sizes of volatile positions for fine-grained hedging.

• In cases of excessive risk, raising cash by selling assets is a prudent strategy. This approach allows for protecting capital while maintaining strategic exposure to desired risks.

**What firms would you consider to be the best asset managers? Why?**

In my view, the best asset managers are those who combine fundamentally-driven stock picking with robust risk management practices. Top firms like Bridgewater and Citadel stand out due to their use of cutting-edge quantitative techniques, strong long-term performance, and disciplined, systematic approaches. They invest heavily in technology and research to continuously improve their models and strategies, balancing quantitative insights with qualitative judgment.

**Position Sizing**

A portfolio manager claims he is excellent at sizing his positions. Using the sample data “Sizing Data”, determine if his claim is true. (Returns are for the evaluation period, position capital is as of beginning of this period).