Black Litterman Model

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Aim: To **fine-tune the modeling of key parameters** in the Black-Litterman framework, **focusing on these two parameters**:

- **Subjective views on expected returns**
- **Degree of confidence in subjective views**

For Subjective View on Expected returns:

I have used Factor Modelling (Fama French Method) and I have called the betas on my own using the different parameters like SMB, HML, Momentum_factor and RMW.

Factor modeling, specifically using the **Fama-French Method**, is a technique in finance used to explain stock returns based on multiple risk factors rather than just the traditional market risk (as in the CAPM model). In this approach, stock returns are broken down into different components influenced by various factors.

I have applied a multi-factor regression model to estimate how different factors impact stock returns. The **Fama-French model** initially had three factors:

1. **Market Risk Premium** (MKT_RF) – The excess return of the market over the risk-free rate.

2. **Size Factor (SMB - Small Minus Big)** – Captures the excess return of small-cap stocks over large-cap stocks.(Considering the top 3 and bottom 3 by MCap and getting there pct)

3. **Value Factor (HML - High Minus Low)** – Measures the excess return of high book-to-market stocks (value stocks) over low book-to-market stocks (growth stocks).(Using Book to Market Ratio)

4. **Momentum Factor** – Stocks that have performed well in the past tend to keep performing well, while poor performers continue underperforming.
5. **RMW (Profitability Factor - Robust Minus Weak)** – This captures the difference in returns between firms with high profitability and those with low profitability.(Using ROE)

I have calculated the **factor sensitivities (betas) manually** by performing a **multiple regression analysis**, where each factor (SMB, HML, Momentum, RMW) serves as an independent variable, and the stock's excess return is the dependent variable. The estimated **betas** (coefficients from the regression) indicate how much each factor influences the stock's return.

In simpler terms, I've essentially **analyzed how different risk factors impact stock returns by building a statistical model and estimating their effects (betas) on your own, instead of using pre-calculated ones.**

Note: I was also considering using Sentiment analysis on the News Websites but I wasn't able to complete in the given time frame

For Subjective View on Degree of Confidence:

I calculated this by first finding the **margin of error**, which depends on three things: how much the data varies (**standard error**), how many data points we have (**sample size**), and the **confidence level** we choose (which gives us the **t-statistic**). The more data we have, the smaller the margin of error, meaning we can be more confident about our estimate. Once we have the margin of error, we subtract it from the expected return to get the **lower bound** and add it to get the **upper bound**. This final range (confidence interval) tells us that, based on the data, the actual expected return should fall within this range most of the time (e.g., 95% of the time if using a 95% confidence level). So, in simple terms, the confidence interval helps us measure **how much we can trust** our expected return estimate.

How changing market conditions influence model adjustments?

Changing market conditions directly impact factor models like the **Fama-French model**, requiring adjustments to keep predictions accurate. As market dynamics shift, the influence of factors such as **size (SMB), value (HML), momentum, and profitability (RMW)** changes as well. For instance, during a bull market, investors may favor growth stocks, reducing the importance of value-based factors, while in bear markets, profitability factors may play a stronger role. Additionally, factors like momentum can weaken in high-volatility environments where sudden reversals are common. Changes in **interest rates and market risk premiums** also influence expected returns, requiring recalibration of the model's assumptions. To adjust for these shifts, investors often **re-estimate betas using recent data, incorporate new economic factors, and apply dynamic weighting techniques** to ensure the model remains relevant. Without these adjustments, the model may fail to capture the actual drivers of stock returns, leading to inaccurate investment decisions.

The Stats are as follows:

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Expected annual return: 24.7%

Annual volatility: 16.2%

Sharpe Ratio: 1.52
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