Basics of Risk Management

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Outline

- Types of market risks
- Risk Exposures
- Hedging
- Portfolio Construction
- Volatility Scaling
- Bet Sizing
- Stop Losses

Two types of market risks

Two important risks that investors must be concerned about within their investment portfolio are - *Idiosyncratic* (or specific) and *Systematic* (or market) risk.

Idiosyncratic risk

This risk is associated with holding a particular asset like a single company stock, which is also known as company-specific risk or a group of an asset belonging to a similar category like stocks from the same sector, which is also known as sector-specific risk. It can be mitigated with diversification i.e. by reducing exposures to a particular asset or sector and transferring that to some uncorrelated assets or sectors.

Systematic risk

This is a risk associated with the market itself and it cannot be mitigated with diversification. The most popular solution is to hedge against such situations using derivatives like options. Though hedging provides good downside protection, at the same time it also limits the overall portfolio's upsides, because it's complex and expensive to implement.

Market Risk Exposure

- Risk exposure to market also known as beta exposure is how sensitive an asset or portfolio is to the market movement i.e. how dependent it is on the market movement.

- If an asset or portfolio have high beta exposure than it will perform very well market is rising but will do very poorly when market is falling.

$$Y = \beta X + \alpha$$

$$Y_{portfolio} = \beta_1 X_{AAPL} + \beta_2 X_{SPY} + \alpha$$

- To avoid market risk or systemic risk we want to have a portfolio with negligible beta exposure to the market that means the return of the portfolio will totally really on alpha and other independent factors (which can understood by using factor models).

Hedging

- Hedging is a way to mitigate the market risks by taking a position such that it offsets the market exposure.

$$\alpha + \beta X - \beta X = \alpha$$

- Hedging leads to return which is purely alpha and independent of market movements i.e. it become market neutral. But it will result reduction of potential profits when the market is performing.

- The caveat is that beta will not remain same over time and it becomes difficult to stay perfectly hedged at any given point in time.

- Strategies like pairs-trading are automatically hedged on its own as we take two opposite offsetting positions.

Portfolio Construction

- Portfolio construction is a way to mitigate Idiosyncratic risk by diversifying the specific risk among uncorrelated investment.

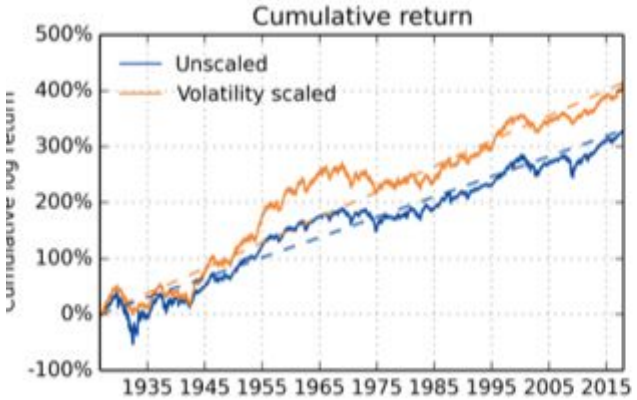
- After we deciding the instruments to make a portfolio, next we need to decide how much money to allocation each of the instrument such that the risk is minimized or profit is maximized or both. This is now an optimization problem which is know as portfolio optimization.

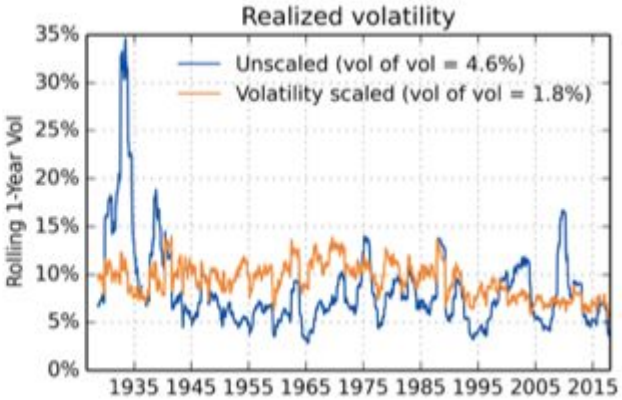
- A classic portfolio optimization method is called mean-variance optimization where the problem is to *minimise risk* subject to a *return constraint* (i.e the portfolio must return more than a certain amount).

- Another very famous method is the Efficient frontier method which was published by Harry Markowitz [1952]. It finds the portfolio with maximum expected return at a specific risk level, which is represented by the efficient frontier curve.

Volatility Scaling

- Realized volatility of a asset is calculated as the standard deviation of the returns. It is basically measure the fluctuation of the returns, higher fluctuation will result in higher volatility and uncertainty.
- The idea of volatility scaling or targeting is maintain a constant volatility exposure by increasing or decreasing the amount of leverage on that asset. If the volatility goes up, he/she has to scale down the portfolio. On the other hand, if the volatility goes down, he/she should take more leverage.
- Volatility scaling depends on the future expectation of realized volatility which is some form of a prediction of the future volatility.





Bet Sizing

- No matter how profitable alpha you design, if you don't have a bet sizing strategy it will surely lose money.
- Bet sizing can be independent of the strategy i.e. it places fix bets regardless of the confidence in the signals generated by the strategy or it can be based on the probability of a trade i.e. higher probability trades gets bigger bets compared low probability trades.
- Dynamic bet sizing updates the bet size based on the market condition and volatility. Again this type of bet sizing depends on some from of predictions. The intuition is somewhat similar to volatility scaling.
- Kelly criterion is a very well know bet sizing technique developed by John Kelly at AT&T's Bell Laboratories.

$$K = W - \frac{1 - W}{R}$$

where

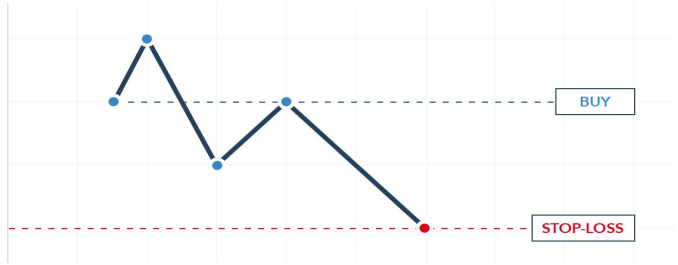
$$K = \text{Kelly Percentage}$$
$$W = \text{probability of winning}$$
$$R = \frac{\text{Total Wins}}{\text{Total Loss}}$$

Stop-loss

- Stop-loss is an order that is placed to avoid further loss when the price reaches a specific level. It is used as an risk management measure that make sure that entire account does get empty on a single bet.

- If stop-loss level is not defined properly it might lose its purpose or reduce your strategies expected return (opportunity cost). This can happen when trading a momentum strategy narrow stop-loss level will often get trigger during higher volatility and trades might get exited sooner than expected.

- Instead of a fixed stop-loss another strategy is dynamically adjust the stop-loss level depending on the strategy performance. This is also known as trailing stop-loss, as the strategies accumulate positive return the stop-loss level increase in some defined proportion.



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