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RISK MEASUREMENT: AN OVERVIEW

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ABSTRACT

- *Portfolio design should be an outcome of logic and mathematics and not of judgement.*
- *We tried to apply mathematics to figure out a logical answer to construct a portfolio.*

Note:

- *The asset classes used for comparison include equity and debt.*
  - *The investment vehicles included in equity are equity mutual funds and equity structured products.*
  - *For debt, the investment vehicles included are debt mutual funds, debt structured products and hedged equity.*
- *The returns and the risk (Standard Deviation) is calculated for 3 years rolling returns with monthly shift starting from the period of Jan. 2001 to Jul. 2018.*
- *For equity mutual funds we have added an alpha of 2% to Nifty's annualized rolling return.*

***KEYWORDS**: Portfolio Design, Standard Deviation, Debt Mutual Funds, Rolling Return.*

Introduction

- We can measure risk by finding out the magnitude of deviation from the expected outcome.
- We can find that magnitude by calculating Standard Deviation.

What is Standard Deviation?

- Standard deviation is used to quantify the amount of variation of a set of data values from its average.
- A low standard deviation tells us that most of the data is very close to average which makes it less risky, while a high standard deviation means that a lot of data far from the average value making it more risky.

Measurement of Risk - Standard Deviation

Let us understand standard deviation with the help of an example:

Consider the below table which plots the time taken for a person in minutes to reach the office over the period of 10 days.

Day	1	2	3	4	5	6	7	8	9	10
Time to reach office (Mins)	35	30	35	20	30	30	20	30	35	35
	Average: 30 mins									

- On an average it takes 30 mins. to reach office. Hence 30 mins. becomes the desired time to reach based on the average value.
- Any variation from this expected value is the risk to our time estimate.

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Let us look at the variation of time as against the expected time to reach office:

Day	1	2	3	4	5	6	7	8	9	10
Time to reach office (Mins)	35	30	35	20	30	30	20	30	35	35
	Average: 30 mins									
Variation from the average	5	0	5	-10	0	0	-10	0	5	5

The average variation from the expected time is 5.77 mins

This is what standard deviation represents

It means that majority of values fall within **+/- 5.77 mins.** From the average time of 30 mins.

***Note:** The squared sum of the difference from the mean is divided by no. of observations and its square root is taken to arrive at the standard deviation. The squared sum is taken to eliminate negative values and to avoid the sum of zero . Square root is performed later to nullify the effect of squaring.

We saw that majority of values fall within +/- 5.77 mins from the average time of 30 mins.

What is this Majority?

- This majority includes around 68.27% of the values.

What if We Want to Cover More than 68.27% of Values?

- To find that we use 2 standard deviation which includes 95.45% of the values.
- To include even more number of data values we use 3 standard deviation which includes 99.73% of the values.

Hence to Summarize

- Standard deviation: It means that there is a 68.27% probability of the outcome to appear
- Standard deviation: It means that there is a 95.45% probability of the outcome to appear
- Standard deviation: It means that there is a 99.73% probability of the outcome to appear

This is the empirical rule of statistics that can be observed in a normal distribution.

A normal distribution is one where the data is symmetrical and most of the values are clustered close to the average. Half the data will fall to the left of the mean and half the data will fall to the right of the mean.

Measurement of Risk - Understanding volatility of Nifty 50

So what is the standard deviation for Nifty 50?

For 10 year rolling returns (Average: 13.6%):

	1 Standard Deviation (68.27% probability)	2 Standard Deviation (95.45% probability)	3 Standard Deviation (99.73% probability)
Standard deviation	4.19%	8.38%	12.57%

For 3 year rolling returns (Average: 15.9%):

	1 Standard Deviation (68.27% probability)	2 Standard Deviation (95.45% probability)	3 Standard Deviation (99.73% probability)
Standard deviation	12.93%	25.87%	38.80%

The standard deviation of Nifty for 10 years is 4.19% and for 3 years it is 12.93%.

- Therefore we can say that for short periods of investments the volatility is high.
- For longer time periods the data tends towards normal distribution and brings our returns more closer to the average and reduces volatility.
- For short investment periods the returns do not follow normal distribution. Let's understand that with the help of an illustration.

Note: The time period taken for rolling returns is from Jan. 2001 to Jul. 2018.

Measurement of Risk -Understanding volatility of Nifty 50

Let us look at the distribution of past returns:

3 years rolling data (Average: 15.9%):

Returns	Distribution of returns	
<-5%	0.60%	
-5% to 0%	3.40%	
0% to 5%	12.90%	**61.20%**
5% to 10%	25.30%	
10% to 15.9%	19.10%	
15.9% to 20%	8.40%	**38.80%**
>20%	30.30%	
Total	100%	

10 years rolling data (Average:13.6%):

Returns	Distribution of returns	
<-5%	0%	
-5% to 0%	0%	
0% to 5%	0%	
5% to 10%	29.35%	**42.40%**
10% to 13.6%	13.04%	
13.6% to 20%	56.52%	**57.60%**
>20%	1.09%	
Total	100%	

Measurement of Risk -Understanding volatility of Nifty 50

- We can see in the previously that 61.2% of the times the returns fall below the average in case of 3 years rolling returns data. Most of the observations are skewed towards the left of the average. This is known as a chi squared distribution.
- Therefore there will be larger periods of pain in nifty that gives lower returns and shorter periods of pleasure that give higher returns.
- Investing in equities you should be prepared for longer pain periods of low returns before you can reach the pleasurable periods of high returns.

But Is that the only option? Is there any other way to reduce the pain of short term volatility?

Management of Risk

- To counter the short term pain we have a solution which we call Structured Products. Structured products give you higher returns even with marginal movements in Nifty. If we infuse some proportion of Structured Products in our portfolio it negates the short term pain of low returns.
- Taking example of a shorter period of 3 years, an Equity Structured Product will give ~17% annual return with just 5% movement in Nifty.

Let us look at the impact an Equity Structured Product makes in a portfolio

(3 year rolling returns are considered from Jan. 2001 to Jul. 2018)

The 3 years rolling return average of Nifty is 15.9%

If we had allocated our investments in Equity Structured Product

Total observations	178
No. of observations with >15.9% return	148 (83.15%)

Conclusion

- We can see that investing in Equity Structured Product replaces the pain of short term low returns with pleasurable periods of high returns by giving above average returns 83.15% of the time.
- Therefore from a risk management perspective it is important to include Structure Products in our portfolio. It is more of a risk management tool than a return oriented tool and acts as an antidote to short term volatility and will help you traverse the periods of pain (low returns) in a better way.

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