A STUDY ON THE IMPORTANCE OF BLACK SWANS AND VAR

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ABSTRACT

There are two general classes of likelihood spaces; each is unmistakable, both subjectively and quantitatively. The principal appropriation is known as thin tail, the second is fat tail. In slight tail disseminations, factual special cases happen yet they don't convey bizarrely enormous results. In fat-tail conveyances, when critical deviations (Black swans) happen, the results are normally disastrous in nature. Black Swan is an occasion or event that strays past what is regularly expected of a circumstance and that would be very hard to anticipate. Standard deviation is a helpful factual estimation of hazard, if the fundamental resource returns are circulated in a typical manner about the mean. Be that as it may, if the benefit returns go amiss altogether from what might be normal in a slim tail standard deviation is regularly a lacking and poor estimation of all out hazard and can frequently bring about the genuine underestimation of potential misfortunes. VaR is genuinely exact in anticipating little day by day misfortunes with high likelihood; it separates totally in determining enormous calamitous misfortunes that exist in the tail of the dispersion – Black swan occasions. A look at the Dow Jones Industrial Average's greatest one-day additions and misfortunes affirms the presence of Black swan occasions: On every one of two distinct days in October 2008, the Dow flooded over 10%. On every one of eight unique days in late 2008, the Dow gave back over 5%. 2008 was an especially unstable year, however enormous moves can happen whenever. Right now, hypothetical ordinariness supposition that is observationally tried (and obviously dismissed) utilizing time arrangement of stock returns for the U.S. securities exchange throughout the previous 30 years. The reason for this examination is to represent the presence of black swan occasions and their authentic recurrence, giving specific consideration to the timeframe 1980-2010.

Keywords: VaR, Black Swans, Thin Tail, kurtosis, fat tails.

INTRODUCTIONS

The expression "Black Swan" originates from the normal misguided judgment that 'All swans are white' and has discovered general application in the money related markets, particularly considering the 1987 securities exchange crash, the 2008/09 credit showcase

emergency and the 2010 blaze crash. A Black Swan is a representation that was begat by Nassim Taleb to portray occasions that are evidently conceivable, however couldn't have been anticipated dependent on past proof. Before Taleb, David Hume (1748), John Mill (1843) and Karl Popper (1968) all portrayed the issue of reaching general determinations from restricted perceptions. Budgetary choice models depend on a model foreseeing conceivable money related results frequently disregards, yet consistently restricts the effect of occasions which are viewed as exceptions to the model. A solitary such locating of a black swan can nullify that 'all swans are white'. Taleb anyway was not the first to find "fat tails" in stock returns. Present day monetary hypothesis has propelled our comprehension of budgetary markets colossally; some of money related hypothesis' central suspicions don't seem, by all accounts, to be borne out by showcase real factors. An ordinary circulation is an incredible logical device, since one can determine the conveyance with just two factors, the mean and the square foundation of the change. In any case, these models are delinquent in catching 'fat tails': rare yet enormous value changes. Fat tails are firmly identified with power laws, a numerical connection between two factors that are described by visit little occasions and rare enormous occasions. (Mauboussin, 2002). This is the aftereffect of the mix of kurtosis hazard and the hazard related with skewness.

Suppositions of typical dispersions of stock returns are the mainstays of finance models, including present day portfolio hypothesis (mean-difference measure), the capital resource estimating, Value-at-Risk (VaR). The 1987 stock exchange crash was so implausible (black Monday was a black swan - 18 sigma occasion) given the standard factual models utilized in account, that it has called the whole premise of neo-traditional money models into question and this drove numerous to reason that there are some repetitive occasions, maybe a couple for each decade, that overpowers the measurable suppositions inserted in the standard fund models utilized for exchanging, venture the board and subsidiary evaluating (Estrada 2008). These factual inconsistencies seemed to influence numerous money related markets immediately, including ones that were regularly not thought to be connected. Additionally, these extreme market occasions rarely had a noticeable monetary reason or cautioning. These uncommon occasions were later named "Black Swans" by Taleb (2007) and the idea has stretched out a long ways past fund. By definition, dark swan occasions come up short on the authentic point of view expected to perform ex-ante numerical hazard investigation.

LITERATURE REVIEW

Various Industry experts, academicians and research scholars have conducted a large number of studies on Black swan and VaR. Here is a brief description of the prominent studies related to the theme of the study:

Starting with Engle (1982) and later with Bollerslev in 1986, examined that "Generalized Autoregressive Conditional Heteroskedasticity models" also referred as GARCH models more accurately describe the random nature of actual stock returns than the thin tail assumption.

Benoit Mandlebrot inferred that based on his investigation of stock returns, that the over dependence on the supposition of ordinary dispersion of return has brought about genuine defects in most present day budgetary model

and he widely explored this issue. He reasoned that the broad dependence on the ordinary appropriation for a significant part of the group of present day money and venture hypothesis is a genuine blemish of account demonstrating (counting the Black-Scholes choice model, and the Capital Asset Pricing Model). He clarified his perspectives and elective money hypothesis in a book: The Misbehavior of Markets.

Mandelbrot (1997) proposed to replace the normality assumption with a "fractal view of risk, ruin, and reward.". According to the fractal view, large stock return swings are far more clustered than what would be predicted if the market followed a random walk normal distribution; the prevailing paradigm in investments.

Eugene Fama demonstrated that extreme returns occurred with much greater frequency than if returns were normally distributed by testing stock price changes. According to Fama (1965): "Mandelbrot is right. The distribution is fat-tailed relative to the normal distribution. In other words, extreme returns occur much more often than would be expected if returns were normal. As the result, the normality of stock returns has been replaced by the assumption of fat-tailed distributions in a wide variety of markets, assets, and time periods."

Kon (1984), Berglund and Liljeblom (1990), Campbell and Hentschel (1992), Chan and later, Frennberg (1993), has examined subsequent to looking at foreign markets covering distinctive timeframes, all reasoned that stock returns will in general be fat followed and not thin tail in nature.

Roll (1988) conducted the study that the stock market returns tends to increase the degree of kurtosis of the returns and often results in increased outliers or fat tails when compared to the ubiquitous normal distribution. This doesn't address the subject of why black swan occasions seem to bunch together.

RESEARCH METHODOLOGY

A standard typical circulation is an ordinary chime molded dispersion with a unit change ( ) and a zero mean ( ). A Fat tail is a likelihood circulation wherein there is an enormous likelihood of encountering a little addition, combined with a little likelihood of encountering an extremely huge misfortune; which more than exceeds the increases. The mean of this hypothetical dispersion is under 0 and the difference is boundless. The experimental dissemination has fat tails (leptokurtic) and a high level of kurtosis when contrasted with the typical appropriation. An arrival circulation that is topped or firmly conveyed shows a high level of kurtosis and normally will be described by fat tails in the dissemination. This is particularly evident when contrasted and the flimsy followed typical appropriation. These fat tail imply that there exists a more noteworthy likelihood for outrageous occasions happening and are alluded to in the writing as leptokurtosis. To decide the recurrence of black swan occasions happening, a multiyear timeframe was chosen using day by day, week by week and month to month returns. The s&p500 fills in as the intermediary for the market. To observationally distinguish the nearness of extraordinary dark swans in the U.S. securities exchanges, two distinct philosophies were utilized right now an endeavor to experimentally distinguish the nearness of outrageous dark swan occasions on the NYSE. The main strategy was to ascertain the measurable properties of stock profits

for a month to month, week after week and regular routine. Furthermore, the scopes of dissemination frequencies were processed for every day, week by week and month to month returns over the timeframe of March 31, 1979 and March 31, 2009.

VALUE AT RISK

Value at Risk (VaR) has been broadly utilized to determine the potential hazard for misfortunes on a monetary resource portfolio and is normally characterized as the most extreme worth that the "mark-to advertise" misfortune likelihood on the portfolio will surpass this limit esteem This is regularly alluded to as the potential misfortune to resource esteems estimated in the association's every day accounts. VaR accept a lognormal dispersion return process dependent on a hidden typical dissemination of profits. A misfortune which surpasses the VaR limit is commonly named a "VaR break," with a likelihood level of one short the likelihood of a VaR break happening. VaR essentially denotes the factual limit between typical days and extraordinary occasion (Black Swan) days.

NORMAL VS. FAT-TAIL VAR

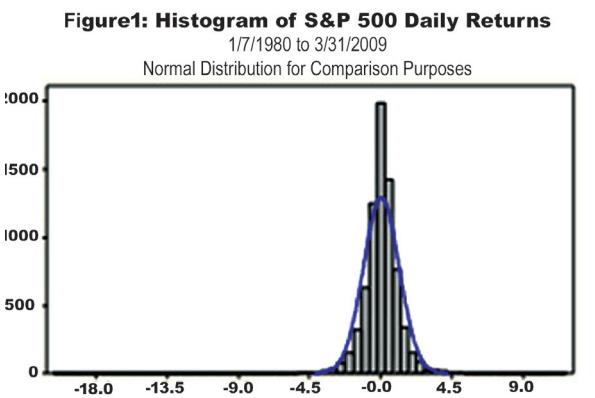
For a likelihood conveyance to be viewed as steady, all the free irregular factors should likewise have a similar circulation as the constants alpha and beta. In addition, the typical circulation is the main stable dispersion whose standard deviation is characterized; all other appropriations have standard deviations that are either boundless or unclear. Given some certainty level t the VaR of the portfolio at the certainty level a is given by the most modest number l to such an extent that the likelihood that the misfortune L surpasses l isn't bigger than (1 – a)". A typical dispersion is characterized as an appropriation whose normal worth = 0 and whose sigma = 1. Fat tail appropriations are instances of fat tail conveyances that have "endless sigma" (all the more actually: "the change doesn't exist"). The reason for receiving the ordinariness conveyance supposition that was to not diminish the hypothetical model to a unimportant observational dissemination fitting, Mandelbrot thought it was silly to need to expect various circulations for every day, month to month and yearly stock returns. Rather, he looked for a model that could be applied to all classes of advantage returns, paying little heed to the time interim being estimated. He found that he could achieve this by expecting a typical circulation of profits (Mandelbrot, 1999). In this manner when return information normally emerge from a fat tail dispersion, in the event that the typical circulation model of hazard is accepted, at that point a gauge of the comparing sigma dependent on a limited example size, seriously downplays the genuine hazard. Numerous academicians have noticed this weakness of the ordinary appropriation demonstrate and have recommended that fat tail conveyances, for example, the steady dissemination administer resource comes back to supplant the typicality supposition in money related models (Mandelbrot 2008; Taleb 2009). Most circulations that are considered "stable" for the most part contain "fat tails". The genuine S&P 500 return circulation showed a lot more noteworthy unpredictability than what might be normal in view of from the earlier likelihood. Graph 1 shows what the normal ordinary recurrence dissemination of profits one would anticipate from 1979-2009 (ran line) on the 'ordinary' dispersion.

The actual realized returns on the market index (SPX) is (1) highly right skewed, (2) much larger frequency of returns (leptokurtosis) occurring around the mean. The frequency of returns that occurred between 1 and 2 standard deviations was much smaller than expected and (3) finally very large negative returns occurred much more frequently than predicted. In this context, 'fat tails' simply refers to the larger -than-expected large positive or negative returns.

ANALYSIS

Now the question comes in: Did the samples come from normally distributed populations?
Null Hypothesis: There is no statistically significant difference between the expected and observed frequencies. If there are no differences

Chart 1: Histogram



then the null hypothesis is rejected and it can be concluded that the sample in question was drawn from a normally distributed population.
Alternative Hypothesis: There is a difference between the observed and expected frequencies. The sample was not drawn from a normally distributed hypothesis. A normal distribution is expected to have a 0 kurtosis, with a stable distribution expected to have a 1 kurtosis. Negative skewness indicates that the curve has a noticeable longer left (or negative) tail. The distribution does not appear to log normal either, but appears to be more representative of a fat tail distribution.

OBSERVATIONS

Under the statistical normal distribution assumption of performance returns, deviations from the mean return should occur with a certain frequency; the greater the deviance, the lower the frequency associated with occurring Table 1 shows the daily performance of the S&P 500 relative to what would be predicted based upon the analysis. Clearly the probability for significant negative returns, which is commonly referred as three standard deviations from the mean (99.9%), exceeds the probability based on the model output. Employing a Chi-Square goodness-of-fit test, the p-Value of 0.000 indicates that there is no chance that the observations come from a normal distribution. See table 2. In Table 2, the p-value corresponding to the computed value of the chi-square test statistic is 0.000. The null hypothesis is strongly rejected. The statistical evidence suggests that there is virtually no chance that these test samples were selected from a normally distributed population. The distributions are "pinched" around the mean. In other words, the actual distributions are not thin tailed like the normal, they are leptokurtic / fat tailed. The appropriate theoretical probability distribution to use in a model (like VaR) would have to be leptokurtic and skewed left. The expected values

were determined by multiplying the number of observations in the sample by the following values which were derived from the normal distribution: It is interesting to note the volatility in returns for 2008 and 2009 with 26/53 3+/- standard deviation day movements occurred in this time period. The clustering effect is clearly evident.

Table 1: Number Of Daily S&P 500 Percent Return More Than 3 Standard Devisions Below The Mean

Year	Numbers Of The Days	Percent
1982	1	1.89
1983	0	0.00
1984	0	0.00
1985	0	0.00
1986	1	1.89
1987	6	11.32
1988	2	3.77
1989	1	1.89
1990	0	0.00
1991	1	1.89
1992	0	0.00
1993	0	0.00
1994	0	0.00
1995	0	0.00
1996	0	0.00
1997	1	1.89
1998	3	5.66
1999	0	0.00
2000	2	3.77
2001	3	5.66
2002	4	7.55
2003	1	1.89
2004	0	0.00
2005	0	0.00
2006	0	0.00
2007	1	1.89
2008	19**	35.85
2009	7*	13.21
TOTAL	53	100

BLACK SWAN EVENTS 1916-2010

DAILY CHANGE+01-	EXPECTED	ACTUAL	ACTUAL VS EXPECTED
>3.4%	81	425	5X
>4.5%	2	194	97X
>7.0%	1 IN 75,600,000	44	

Table 2 : Result of Chi-Square Analysis of S&P Results

Range of Z Scores	Observed Frequencies Daily	Expected-Frequencies Daily	Observed Frequencies Weekly	Expected-Frequencies Weekly	Observed Frequencies Monthly	Expected-Frequencies Monthly
$Z \leq -3$	53	9.96	15	2.11	3	0
$-3 < Z \leq -2$	118	157.87	23	33.47	10	7.68
$-2 < Z \leq 1$	596	1002.61	153	212.56	32	48.79
$-1 < Z \leq 0$	2856	2518.07	543	533.86	114	122.54
$0 \leq Z < 1$	3001	2518.07	651	533.86	153	122.54
$0 \leq Z < 2$	595	1002.61	143	212.56	40	48.79
$0 \leq Z < 3$	101	157.87	26	33.47	7	7.68
$Z \geq 3$	57	9.96	10	2.11	0	0.48
Total	7377	7377	1564	1564	359	359
x^2=907.35		**P-Value = 0.000**	**x^2=173.41**	**PValue= 0.000**	**x^2=29.53**	**PValue= 0.000**

CONCLUSIONS

A VaR model commonly expect a log-ordinary value dispersion process, and that the log return process follows an ordinary dissemination. In any case, genuine money related markets display a few deviations from this perfect, helpful model. The market circulation for stocks has a few reasonable properties not found in the common log-typical models. Today, most money related models measure VaR dependent on the slim followed and symmetric typical, "Bell-Shaped" distribution curve. As exhibited by the stock market meltdown of 2008, these typical conveyance suppositions brought about excessively idealistic VaR gauges; deficiently representing outrageous occasions. The purpose of this paper was to empirically examine the underlying stock return distribution for the past thirty year period. In 2008, most financial strategies/models were predicated on the flawed assumption of normally distributed returns demonstrated how fat-tail risk can wipe out an investor. For example, Bear Sterns, Fanny, Freddy, Merrill Lynch and AIG all succumbed to the black swan market credit market event of 2008/09 and subsequently failed because of their exposure to certain fat tail risks. It appears that professional investors have become much better at understanding and managing predictable portfolio risks based on assumed probabilities of recent financial hedging tool that have been recently developed. Unfortunately, the recent financial history has also witnessed financial events that could not be predicted based on prior events and have often been quite severe and have resulted in large losses being posted.

Lamentably, the ongoing financial history has seen various extraordinary, and frequently serious, occasions that couldn't be anticipated dependent on earlier occasions. No doubt

present day account procedures and apparatuses may actually, be making the tails of the dissemination a lot fatter. By supporting quirky hazard, for example, outside trade rates, financing costs, ware costs, etc, one can cause their portfolio to give off an impression of being moderately protected. Be that as it may, swapping ordinary hazard for the excellent hazard results in these 'black swan' occasions happening significantly more much of the time than regular hypothesis would propose.

SUMMARY

On the off chance that the perceptions don't give off an impression of being evenly spread around the normal worth, the dissemination is said to be slanted. On the off chance that the conveyance is slanted, the normal and the middle return will be very extraordinary. In the event that one accept that the factors are balanced about the mean, along these lines overlooking skewness chance, the aftereffects of the budgetary model will significantly downplay the hazard/return qualities.

In the event that skewness chance and kurtosis chance is disregarded, the resultant ends dependent on the VaR model will be exposed to genuine estimation mistake. The VaR measure ought to be considered as a deficient hazard execution measure, since it disregards both the skewness and kurtosis of the arrival. It additionally overlooks all the partial minutes coming about because of the long haul interdependencies of financial exchange value changes/returns.As a result, the VaR methodology gives far too little importance to extreme outliers that when they occur are not only catastrophic in nature but also appear to cluster. This is not limited to VaR however; the Black-Scholes model of option pricing is also predicated on a normal distribution. If the stock return distribution is actually a fat-tailed one, then the model will underprice options that are far out of the money, since a 5 or 7 sigma event is more likely than what could be expected under a Gaussian distribution or bell shaped curve.

In summary, small price changes appear more frequently and large negative changes appear far greater than what a normal distribution would predict. Greater than-expected large price changes occurred with greater frequency of these events increased significantly in 2008 and 2009. As a result, there exists much fatter tails with higher probabilities and far less medium sized changes than the normal distribution model would suggest under the standard risk models being employed thus. Extremely large stock price changes appear to have now become the new norm post 2008. As a result, VaR fails to adequately measure the tail beyond the 99% confidence interval leaving out some reasonably uncommon, but extremely large potential for financial losses due to the existence of black swan events; exactly the kind of losses that portfolio risk managers should be most concerned about. Black swans appear to be alive and well, both in nature and in the capital markets.

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