The Kase Dev-Stop SM – Accounting for Volatility, Variance and Skew in Managing Trading Risk

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Introduction

Having started out as a fundamental trader for a major oil company, I never gave much thought to trade management in my early years. Once a trade was taken and a stop level agreed upon, trades were generally allowed to run until either the stop was hit or profit taken at a pre-agreed level. Drawdowns were never a concern as long as the trade was above break-even.

As I learned to trade technically, I focused on trade opportunity identification and trade entry as these areas were emphasized in the literature and other material I studied. However, once I made the transition to trading purely on a technical basis, I found monitoring my trades, dealing with reversals and exiting trades as challenging if not more so than the initial part of the process. Thus my interest in risk management and exit techniques was roused. This interest and dissatisfaction with existing stop techniques led to the development of the Dev-Stop.[1]

Use of Existing Stop Methods

My first step in using stops was simple: to select a fixed value which empirically made sense, and in combination with Fibonnaci retracement levels, employ a trailing stop. Having traded only the contracts of the energy complex, it was fairly easy to get a feel for what the magnitude of the stops should be. For crude oil, for example, a stop in the 15 to 25 cent range on 15 to 20 minute bars was usually sufficient. However, all changed in the summer of 1990. As volatility increased to record levels, it became clear that stops had to be scaled for volatility.

By that time, I had learned from Perry Kaufman's book[2] that volatility could be viewed differently than the way in which options folks define it. I thus began to use three very simple definitions of volatility: high – low volatility, the true-range, and close-to-close volatility. Also, from books by Wells Wilder[3] and Richard Bookstaber[4], I read about volatility systems. Although both volatility systems were presented as stop-and-reverse systems, I threw out the "and reverse" portion and just used the stop.

Wilder/Bookstaber Volatility System:

Buy if the close rises by more than k*TRaverage from the previous close

Sell if the close falls by more than k*TRaverage from the previous close

Both men recommended a factor of about 3 for the multiplier

First Pass at a Trailing Stop, Scaled for Volatility

Stop Long when Price = (Trade High – x*TRaverage)

Thus, my next step beyond fixed-value trailing stops was to set a stop equal to a factor times the True Range[5].

I found three major problems with the stop used in this manner:

1) A "one-factor fits all" stop did not account for market conditions. For example, when first in a trade I might want to take less risk than during an good impulse run.

2) Volatility as used in the volatility-stop method is average volatility. Although it expresses the general or global volatility environment, it does not account for variance in volatility, that is the degree of point-to-point variation in the volatility.

3) The stop is not quantifiable, that is, there is no direct statistical way to measure the odds of being stopped out with a stop of a particular magnitude.

My dissatisfaction ultimately led to the design of the Dev-Stop which scales for volatility and variance, and is displayed at three different levels to account for varying market conditions. The development process, supporting research and findings are discussed in the following sections.

Variance

Before designing a stop which accounts for variance, I wanted to confirm that variance was actually significant. In order to do this, I down-loaded true-range data into Excel and drew up distribution charts of the true-range to measure the degree of variance (expressed as standard deviation mathematically).

Then I compared the variance in consecutive runs of data. For example, I compared the relationship of the 85th percentile reading in one consecutive set of 1000 5 minute bars of WTI[6] data, to the next consecutive set of 1000 bars of WTI data, over 100,000 bars, and again downloaded the results into Excel, and plotted a distribution of the degree of variance.

Charts One A, B and C are typical of the shape of volatility distribution charts. Chart One A shows daily S&P True Range from June 1974 to September 1992. The readings range from a minimum reading of a 50 cents to over a $6.50. Charts B and C show the range volatility as expressed as a percentage of the mean (by definition 100%). For two different time frames, we can see that not only do we still get wide variation from the mean, but that the degree of variation is different on the two different charts.

CHART TWO

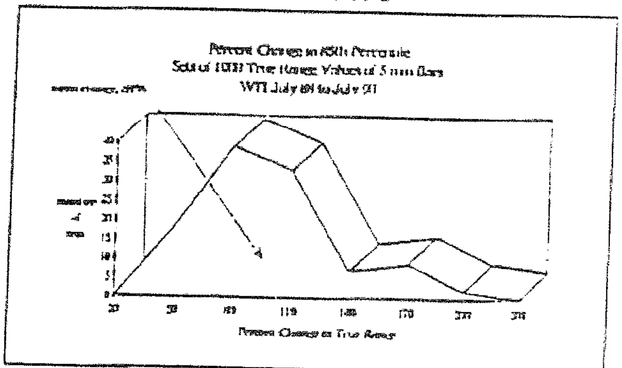


Chart Two evaluates the percent change in the magnitude of the 85th percentile observation in sets of 1000 bars, relative to the mean, versus the same value in the next set of 1000 consecutive bars. The mean difference in this value (which roughly corresponds to the value which would be obtained at one standard deviation above the mean in a

CHART ONE A

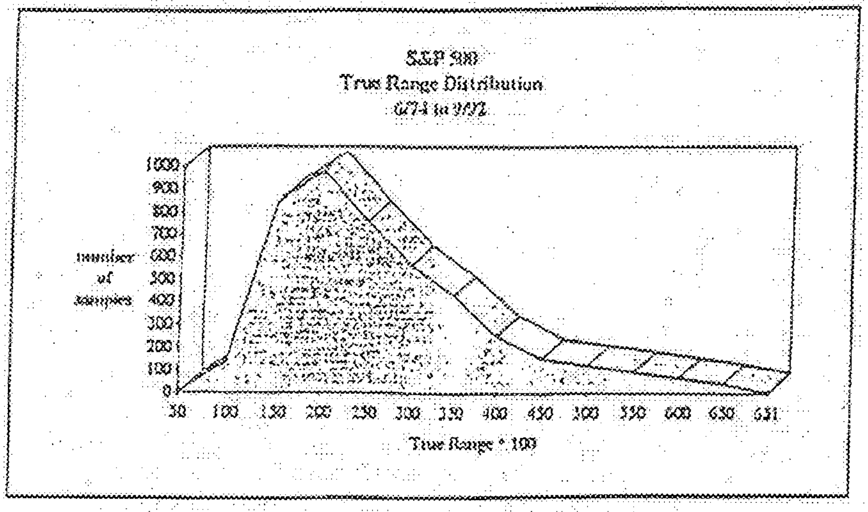


CHART ONE B

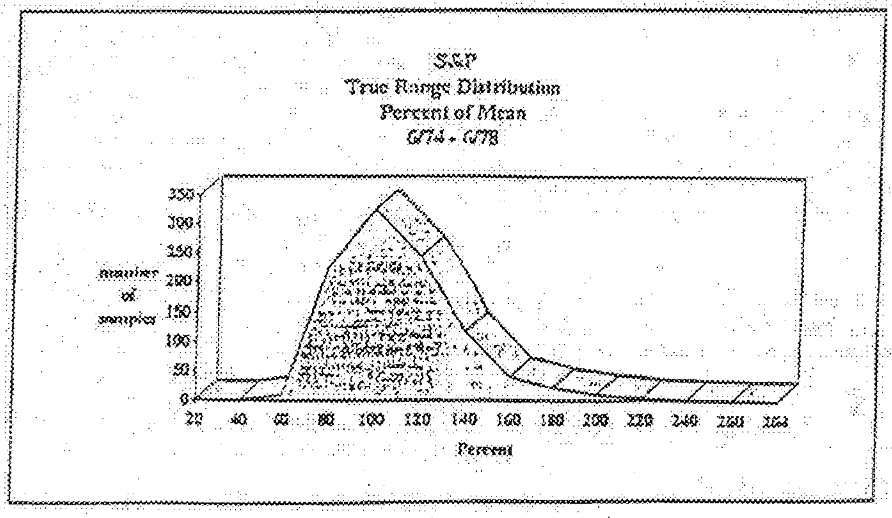
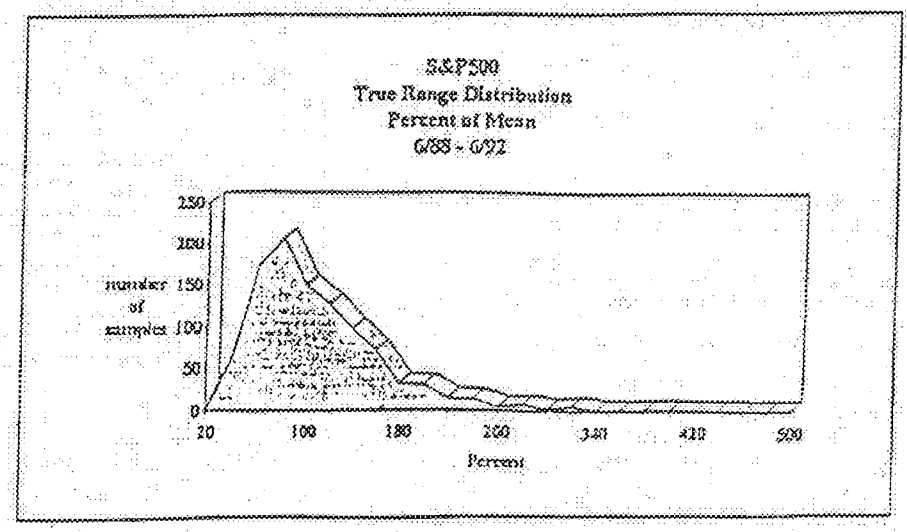


CHART ONE C



normal distribution) is 88%, a significant degree of variation in variance

Chart Three

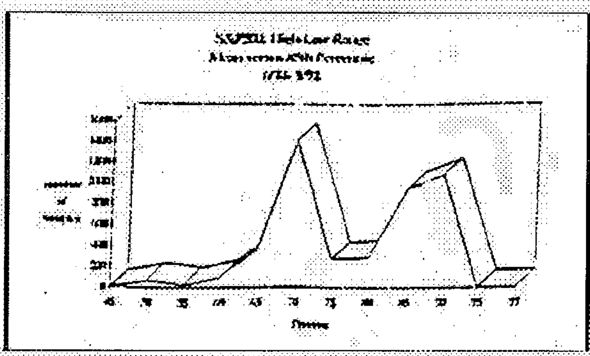


Chart Three shows a similar evaluation on daily S&P data. Again the percentage change between the 85th percentile and the mean. varies greatly, most of the readings on the S&P falling between 65 and 95%.

Thus we conclude that variation in variance is significant and must be accounted for if we wish our stops to "breathe" with changes in market conditions.

The Dev-Stop (first pass)

After confirming that the variance is an important consideration, I designed a new stop based on various numbers of standard deviations above the mean. Using standard deviations automatically accounts for variance and allows the user to quantify the odds of being stopped out based on a normal distribution.

I based the Dev-Stop on a 2-bar reversal, my thinking being that I wanted to allow the market to reverse for 2 bars almost under all circumstances at least on a stop basis.

Calculating the "Dev-Stop"

1. Calculate True Range of Double Bar (use highest of both high's, lowest of both lows) Note that the High-Low range may be substituted for short bars.
2. Calculate Moving Average of True Ranges, ATR
3. Calculate Standard Deviation of True Ranges, SDEV
4. Dev Stop Reversal Value = ATR + (f * (SDEV)), DDEV where f = 1, 2, and 3
5. Dev Stop Long = Trade High – DDEV
   Dev Stop Short = Trade Low + DDEV

The percent chance of being stopped out is the inverse of the cumulative probability. For example, setting the number of standard deviations above the mean to 1.033, means that 85% of all observations fall below that value, and 15% above, or in other words, we have a 15% chance of being stopped out on any 2 bar reversal which might occur. Again, this all assumes a normal bell curve.

Table 1

Cumulative Probabilities of the Standard Normal Distribution

Cumulative Probabilities	No. of Standard Deviations above Mean
80	0.848
85	1.033
90	1.282
95	1.645
97.5	1.960
98	2.054
99	2.326
99.5	2.576
99.9	3.090

As can be seen in the Dev-Stop algorithm, standard deviations at three levels are used. The application of the three level stop will be discussed later in the paper, however the main idea is to use the three levels as follows:

Three Level Stop

Narrow Stop. 1 standard deviation. Use early in the trade (prior to break even) and late in the trade when indications are that a major reversal or end of trend is imminent.

Medium Stop: Use as an intermediate stop to lighten up on trade-size during possible reversals.

Wide Stop: Use most of the time.

The Dev-Stop at this point in its development solved all three major objections I had to the earlier stop designs in that it:

1. accounts for variance
2. comes in three different levels to account for different trading conditions, and
3. is quantifiable in terms of the % chance of being stopped out.

However, a new problem arose during the development stage. This is the problem, of right hand skew.

The Dev-Stop Corrected for Right-hand Skew

Looking at the volatility distribution charts above, it can easily seen that all the charts have a long extended right-arm. This is called right-hand skew. The reason that this exists is that volatility is bounded by zero (price can not change less than not at all) on the left, and theoretically be infinity (or limit) on the upside. As has been observed by many, breakouts and reversals are often accompanied by increases in volatility, which cause abnormally long bars. (I call these bars "stray bullets" because although the odds of being hit by them are low, they are deadly to the unprotected).

It does not make sense to make stops so wide as to accommodate the one in 1000 high volatility bar. However, it appears from observing the distribution chart that an account for right hand skew is called for. In addition, in my own trading, I found that the third standard deviation stop

CHART FOUR

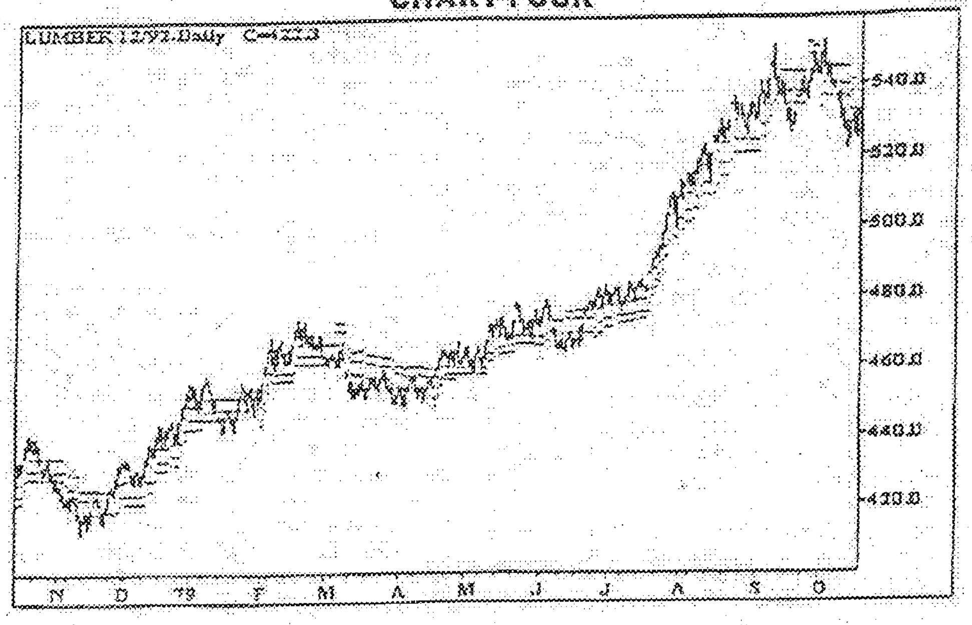


CHART FIVE

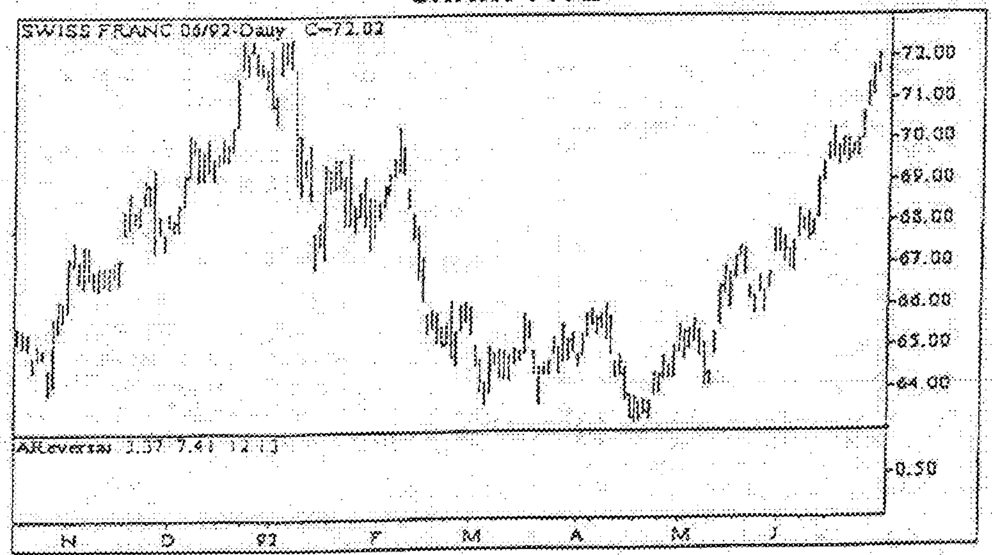
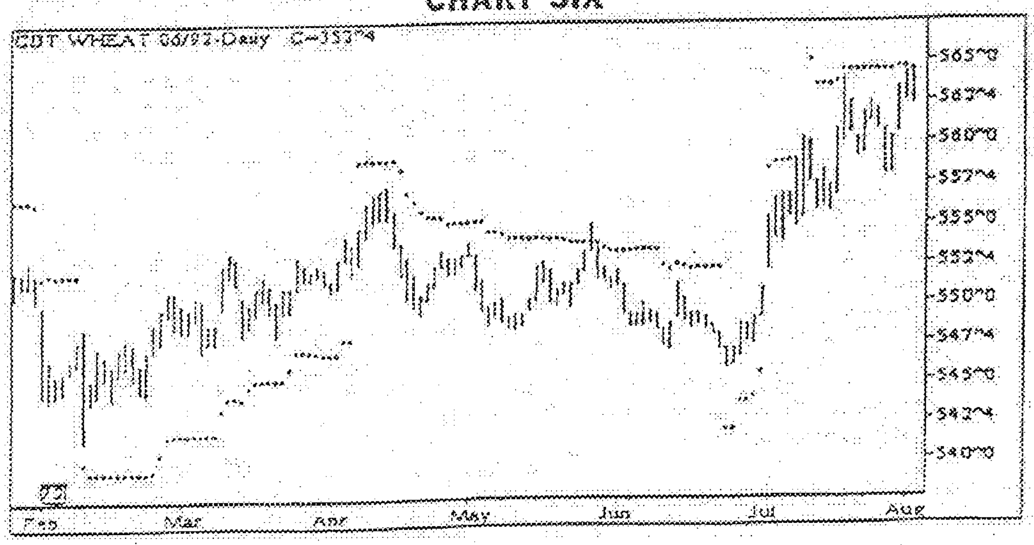


CHART SIX



would also be breached a predictable, consistant amount.

The method I used to measure volatility skew was to compare the value predicted with the normal distribution to the actual percentile value. This mean was compared to the median, the 1.033 standard deviation level compared to the 85th percentile, 1.282 standard deviations to the 90th percentile, and so forth up to the comparison of 3 standard deviations to the sample maximum. Thus in the table below, Ratio 85 is the ratio of the 85th percentile value and the calculated value at or below which 85 percent of these observations would be expected to fall. The program used to accomplish this evaluation was written in a system-design shell called Composer.

The research was carried out on thousands of consecutive 100 5-minute bar sets. The following results, calculated from a sample of 3,000 one-hundred bar sets of consecutive five-minute WTI bars, are typical.

The first column shows the mean observed value for a given measure, and the second shows the value one standard deviation above the mean observed.

TABLE 2

Results of Skew Test
5-Minute Bars, WTI
1st Nearby 6/87 to 6/90

	Mean Observed	Value 1 Std Dev Over Mean
Ratio median to mean	0.77	0.88
Ratio 85	0.84	0.95
Ratio 90	0.88	0.99
Ratio 95	0.96	1.08
Ratio 98	1.06	1.22
Ratio 100 (3 std to max)	1.22	1.50

What we find is that the skew is significant enough to be accounted for. Medians generally run about 75% of the mean, the curves cross right around the 2 standard deviation area, and the maximum values tend to be about 20% or so higher than expected. Interestingly, but not surprisingly, distribution curves have their own distributions (and so forth). Thus in choppy (highly dimensional) markets, the skew is greater, and in quiet even markets the skew is lower. A financial engineer obsessed with accuracy might want to imbed a distribution of the distribution in the formula, however, for normal trading applications this would be overkill. So as a reasonable compromise, the second standard deviation value is corrected by a factor of 1.1 and the 3rd by 1.2.

Graphical Representation

The difficulty with graphically representing a stop, is that a stop trails from a trade-high or trade-low. In order to have a trade-high or low, one must have a trade-entry technique. It has not been my purpose to design a trading system in this context, thus I opted to default to a simple, double moving average system with a "switch". If the fast moving average is above the slow, the switch is set to +1, if below the slow, it is set to -1. In this way, any entry technique can be substituted in the code by the user who sets the switch to +-1 for long or short as necessary.

Chart Four shows a three level Dev-Stop on a daily umber chart, using a 10 and 21 day simple moving average of the close to position the stop.

One added, unexpected bonus to using the moving average entries is this: if one uses an entry signal which leads moving averages, than the stops for the opposing position still show up on the screen. The Dev-Stop levels can then be used as a confirmation and scale-in point. As the first level stop is breached, the first tranche of the position is entered and so forth.

Trending versus Non-Trending Markets

The stop itself is independent of whether the market is trending or trading in a range. However, using a moving-average system which is not suitable for trading range markets is inappropriate. Also because trading range markets rarely trade in a perfect sideways manner, using a mechanical entry system to set the stop above or below the bars is less satisfactory. Calculating the reversal values of the stop and placing the stop at the trade-high less or trade-low plus the stop manually is recommended. Chart Five shows the reversal values calculated by computer and displayed at the bottom of the screen. These are the three stop reversal values which would be used to calculate the three stops.

Alternatively, if a mechanical entry system is desired, then a system such as breaching of a 2 standard deviation, Bollinger band can be used. With Bollinger bands, the stop is placed as the price breaches the band, placing it above or below the peak or trough of the oscillation. Charts Six and Seven show this application.

In trading range markets a more simplistic, subjective approach appears to be appropriate. Thus only the third level stop is shown.

Support and Resistance

As with any technique, new uses not originally intended become evident once the technique is in use. Using the Dev-Stop with Bollinger bands, appears to help automatically define support in sideways formations, and can be used to confirm the resumption of a trend once broken. This phenomenon is shown in Charts Eight and Nine.

Summary

Risk is related to volatility; thus any valid universally applied stop system must also account for volatility. Older methods, such as the volatility system introduced by Wilder in the 70's, scaled for volatility by using the average True Range multiplied by a factor (such as 3).

The computing technology at the time (HP calculator) was insufficient to allow a much more complex approach. However, the older method has a number of flaws which can be easily overcome using a modern PC.

These flaws include:

1. lack of accounting for variance in volatility (how widely individual bars vary from the average).
2. failure to adjust stop for market conditions.
3. inability to directly relate the stop level to odds of hitting a stop.
4. failure to account for volatility skew

The Kase Dev-Stop accounts for all these problems. It not

Chart 7

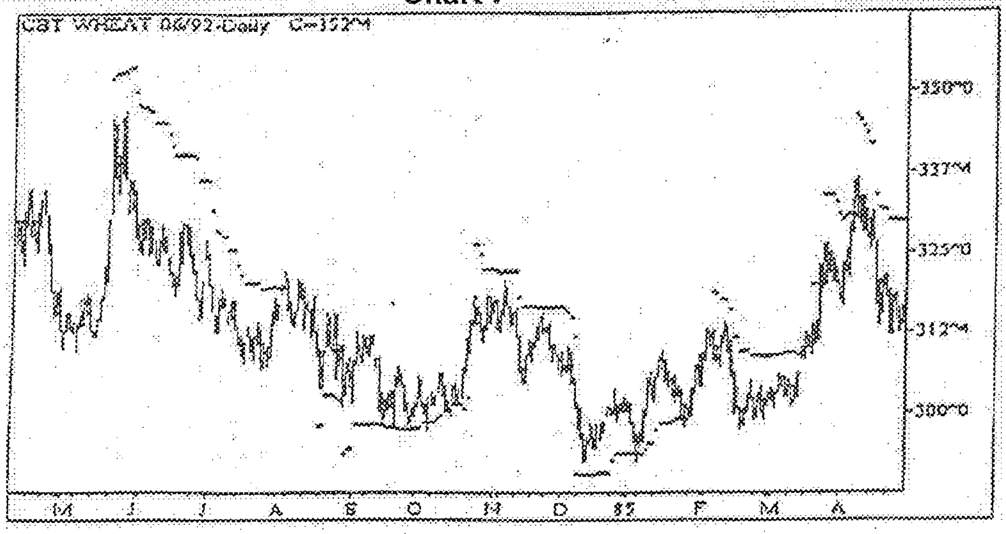


CHART EIGHT

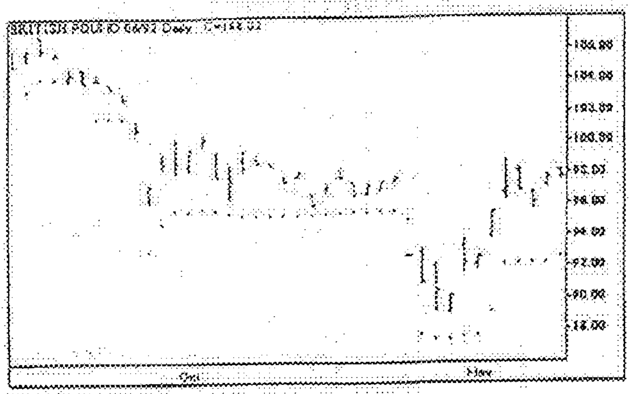
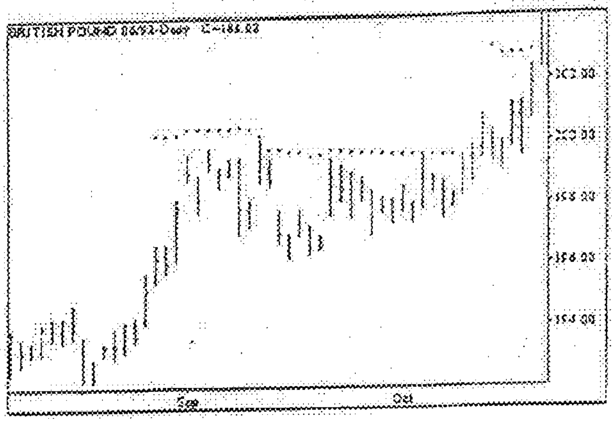


CHART NINE



only scales for volatility, but accounts for variance and volatility skew, is displayed on three levels which allows the trader to choose a stop which suits the quality of his or her trade, and allows the trader to know his or her odds of being stopped out in precise mathematical terms. It can be used in trending and non-trending markets and can be used in time frames down to the tick level. Back testing on the stop itself is unnecessary, as the odds of being stopped out using the Dev-Stop is inherently calculable by statistical means .

REFERENCES

1. Contact the author for computer code suitable for running with Teletrac/Computrac or TradeStation/ SuperCharts charting systems. The Dev-Stop is a service mark of Cynthia Ann Kase, CTA.

2. The New Commodity Trading Systems and Methods, Perry J. Kaufman, Wiley 1987.

3. New Concepts in Technical Trading Systems, Welles Wilder, Trend Research, 1978.

4. The Complete Investment Book, Richard Bookstaber, Scott, Foresman and Company, 1985.

5. True Range equals the maximum of the high minus low or the absolute of the high minus the previous close or low minus the previous close.

6. West Texas Intermediate Crude Oil, as traded on the New York Mercantile Exchange.

7. The Dev-Stop levels as normally displayed relate to a 15%, 2% and nil chance of being stopped out on a two bar reversal.