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**Time Series Transformations -
 Converting Raw Data into Profit Opportunities**

Bob Pelletier continues his sabbatical from writing new articles for the CSI Technical Journal as he works on adding stocks to Unfair Advantage.® This slightly updated article first appeared in the March, 1993 issue.

The naval operations officer reading images on his sonar display is actually viewing mathematically transformed data. Each blip on the sonar

screen has been filtered and screened to capture the valuable information and ignore the superfluous. Like the naval officer, the modern investor can use mathematical filters and screening methods to identify obstacles and formations in market data. It can be shown that certain mathematical manipulations, when applied to raw market data, can reveal hidden directional market forces.

In sonar signal processing, a field in which I was involved for many years, we were able to transform raw detected signals from a target into useful information. The transformation took what appeared to be garbled random noise and produced viable targets with finite characteristics. These included the target's size or classification, range or distance,

velocity, acceleration and direction or heading.

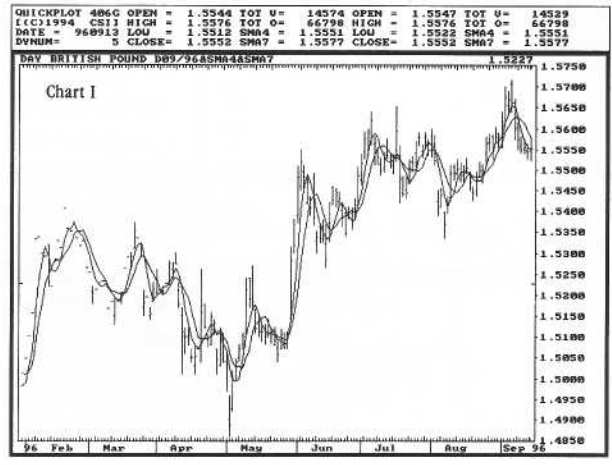
Using properly selected frequencies, filtering and noise cancellation and/or suppression techniques (all of which

have corollaries with simple moving averages), a high degree of sophistication in target detection and classification had been achieved.

With today's sonar systems, the Navy most likely

can not only classify a target submarine, but identify its type and country of origin.

The methods used in military applications are not unlike the ideas I would like to introduce to you. Raw market data is often used without transformation to identify significant directional market movement. A pair of simple moving averages on raw futures data can measure momentum and temporary price direction. This is done by examining the direction of crossover of the shorter moving average from above or from below the longer period average. (Please see Chart I, which displays raw data for the September '96 British Pound with a four- and seven-day moving average.) This admittedly crude form of



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technical analysis is used by many traders as their exclusive source of determining future market direction. The analyst who first transforms raw data into stationary data and then

applies differential smoothing techniques has a much greater chance of deriving profitable trading signals.

Transforming Raw Data into Stationary Data

Readers of this Journal are not so easily fooled.

They know, because we insist that they know, that Perpetual Contract® data is stationary.

Stationarity is required of any stochastic series where there is a need for consistency and repeatability in predictions. If trading methods yield consistent profitability

with Perpetual Contract data that is stationary, then there is no reason to expect otherwise in the future. Back-adjusted continuous data and nearest futures data cannot and should not be used because of the apparent absence of stationarity. We do not recommend using non-stationary data because it is not likely to perform for you.

Perpetual Contract data focuses on a constant-forward period of perhaps 91 days. It represents a time-weighted average of the two contracts that lie before and after the 91-day-forward

target date. This time-weighted interpolation of price produces a slight smoothing that tends to reduce volatility and stabilize price behavior. Chart II shows a #46 Perpetual Contract series of the British Pound with a five-day exponential moving average superimposed. The significance of the exponential average is explained below.

This first level of necessary data transformation occurs when converting raw futures data into a stationary Perpetual Contract series. Once this is done, the pair of moving average calculations should then be applied to the smoothed series. A careful examination should reveal fewer crossovers in time and less false alarms of long-to-short and short-to-long directional market changes.

Transforming and Enhancing Stationary Data Through Differential Smoothing

A second level of data transformation would be obtained by smoothing the Perpetual Contract data. In doing so, one can adopt an exponential smoothing approach giving the heaviest weight to data for the most current readings. Please note the relationship of the exponentially smoothed curve superimposed over the Perpetual Contract data in Chart II. For the sophisticated analyst, the exponential smoothing should be replaced by a differential smoothing approach. In either event the object is to transform the stationary data such that the number of crossovers of a momentum-measuring device are minimized.

The approach used for the final transformation must also minimize the lag time consumed to implement trades. This is a critical fine-tuning process. Acting too soon may produce a disappointing reversal and acting too late could trim most or all of the profit opportunity from the trade.



Unfair Advantage® Update:

Transforming Differential Data into Trading Signals

The final step in the stationary/differential smoothing process is to apply your favorite indicator. It must be done such that the number of trade positions is minimized and the level of realized return is maximized. You will find this task much easier on the newly transformed data than on your original raw market data.

Chart III shows four and seven-day moving averages applied to the exponential series of chart II. We could have selected any other indicator for this purpose. Please notice the incidence of crossover versus the heavier incidence in Chart I. Through this demonstration, it is easy to see that by applying some simple transformations, one can avoid overtrading, reduce costs and improve profits.

The example in Chart III uses only closing prices. Greater profits may be realized by smoothing stationary highs and lows or factoring in a small delta price on the averages that will reduce false signals. Space limitations in our Journal restrict the detail we can present, so further refinements will be left to the reader. This may sound self serving, but we believe the key factor in deriving profits from time series transformations is achieving stationarity. You want repeatability of the simulated past to unfold in the real future. We believe this first step is critical.

And so, like the naval officer, the astute financial analyst can discern the unseen through mathematics. The simple steps of transforming raw data into stationary data, applying differential smoothing techniques and deriving trading signals should result in improved trading results. The naval officer's raw data may uncover no more than what may appear to be a school of fish, whereas the mathematically transformed series might trap the image of a truly coveted target. ♦

Bob Pelletier

We are releasing our new software on a staggered basis to assure that the largest percentage of Unfair Advantage users will receive a flawless product. If you have ordered Unfair Advantage, but haven't received your copy, please bear with us a little longer.

We are moving past the introductory stage with the official release of Unfair Advantage as this Journal goes to press. The daily update price will go to \$26/mo. for North America market traders (plus a \$150 license fee) or \$39/mo. for world market traders (plus a \$199 license fee). If you wish to reserve the lower introductory price for a full year, please call us immediately to order. ♦



Customizing Computed Contracts with Unfair Advantage (UA)

A unique capability of Unfair Advantage, which is being officially released this month following intensive Beta testing, is its computed contract construction tools. With UA's resident world data base, users can produce computed contracts for Gann, nearest future, open interest weighted, back adjusted and Perpetual Contract data that are fashioned from the raw price data of any commodity. You can customize the result you wish to achieve by forcing the input data to include only selected contracts and by controlling the date when volatile expiring contracts will no longer represent trading opportunities.

The user can also control the roll forward methodology of back adjusted controls by focusing on close to open, close to close or open to open differentials. Menus and selection options are simple and concise making data base construction a breeze for the serious professional trader. ♦