Colleagues In Trading Seminar

17 Feb 2007

John Ehlers
805-927-3065
ehlers@mesasoftware.com

mesasoftware.com
eMiniZ.com
IndiceZ.com
ISignals.com

ENGINEERS ARE AS

$$\frac{1}{\sqrt{2\pi\sigma}} e^{\frac{-(x-\mu)^2}{2\sigma^2}}$$

AS ANYONE

Fibanacci Ratios

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	FIBANACCI															RATIO
2	1	1	2	3	5	8	13	21	34	55	89	144	233	377		0.618037
3	2	19	21	40	61	101	162	263	425	688	1113	1801	2914	4715		0.618028
4	B	S														
5																
6																

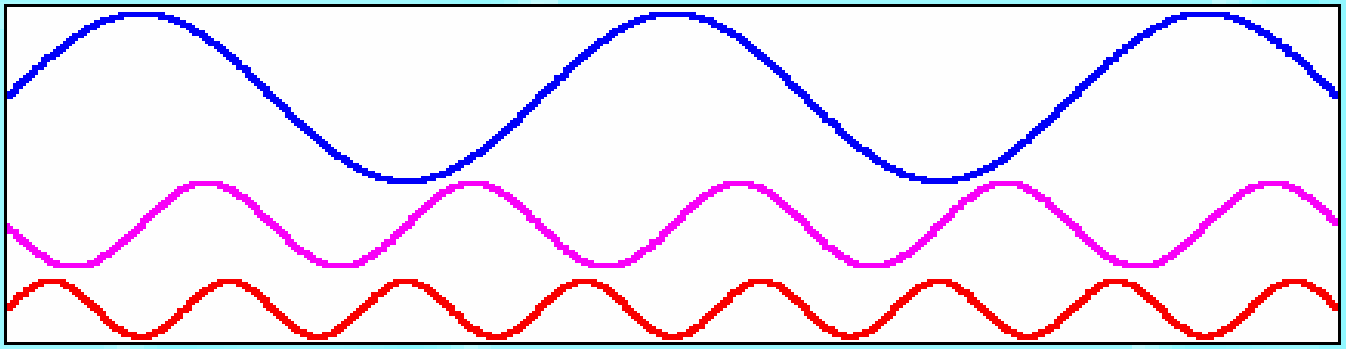
Patterns

- **Thousands of patterns have been catalogued**
  - **Double Bottom, Head & Shoulder, Flags, Pennants, etc.**
  - **All are anecdotal or within the probability of chance**
- **Tune your TV to an unused channel and stare at the screen intently**
  - **I guarantee you will see patterns formed out of pure noise**
- **If seeing is believing, check out www.mesasoftware.com/optical.htm**
  - **Very interesting optical illusions**

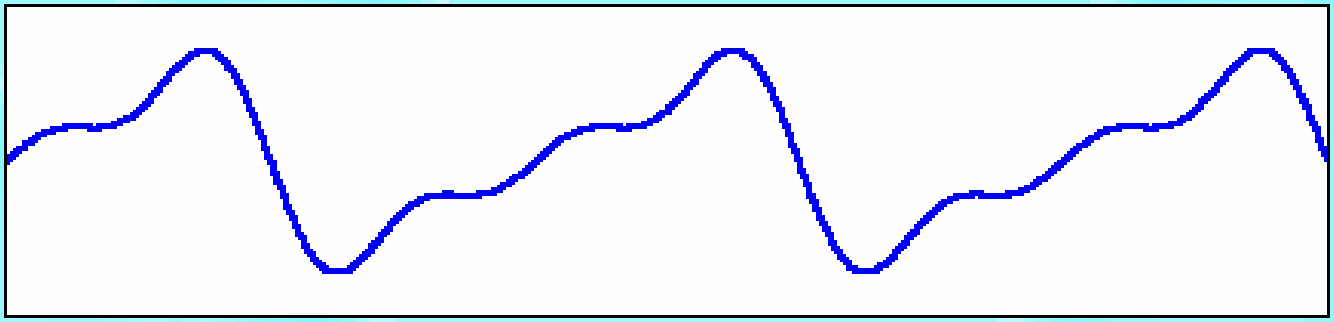
Wave Synthesis

- **Sinewaves are the primitives to synthesize more complex waves**

  wave = SIN(F*T) - SIN(2*F*T)/2 + SIN(3*F*T)/3

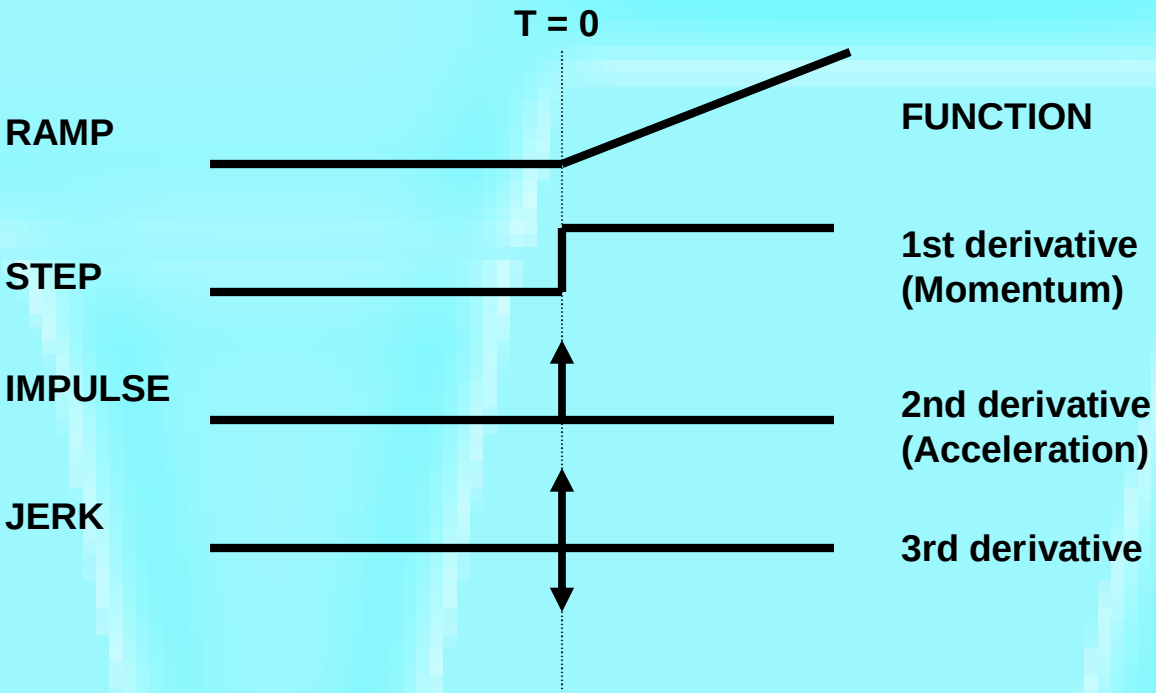


Combined Waveform: Elliott Wave?



- **Why not just deal with measurable primitives?**

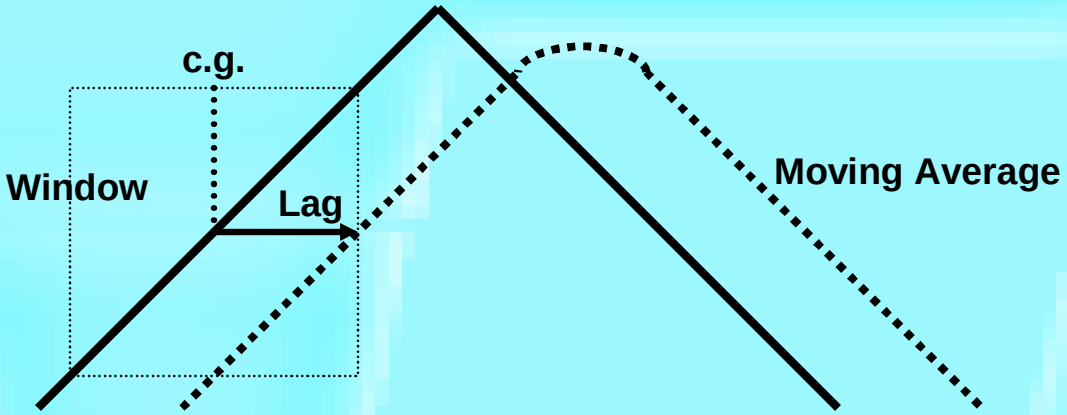
Momentum Functions



CONCLUSIONS:

1. **Momentum can NEVER lead the function**
2. **Momentum is always more disjoint (noisy)**

Moving Averages



CONCLUSIONS:

1. **Moving Averages smooth the function**
2. **Moving Averages Lag by the center of gravity of the observation window**
3. **Using Moving Averages is always a tradeoff between smoothing and lag**

Relating Lag to the EMA Constant

- **An EMA is calculated as:**

  $g(z) = \alpha * f(z) + (1 - \alpha) * g(z - 1)$

  where g() is the output
  f() is the input
  z is the incrementing variable

- **Assume the following for a trend mode**
  - **f() increments by 1 for each step of z**
    - has a value of "i" on the "i th" day
  - **k is the output lag**

$i - k = \alpha * i + (1 - \alpha) * (i - k - 1)$

$= \alpha * i + (i - k) - 1 - \alpha * i + \alpha * (k + 1)$

$0 = \alpha * (k + 1) - 1$

Then $k = 1/\alpha - 1$ OR $\alpha = 1/(k + 1)$

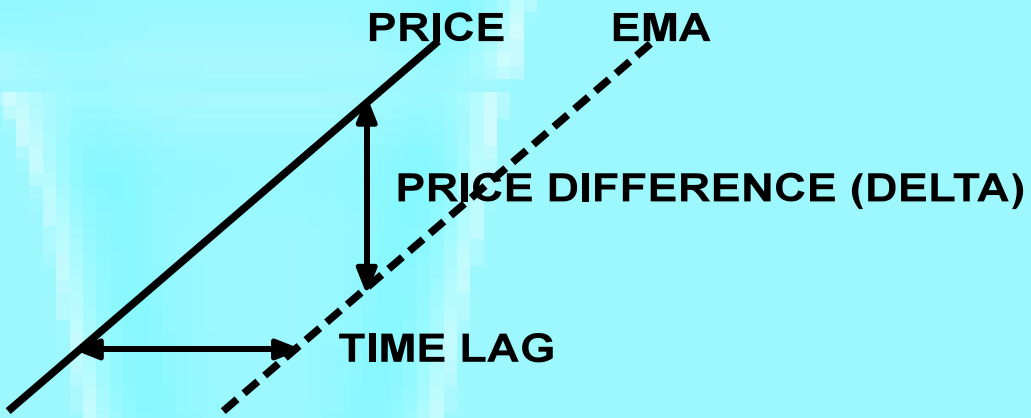
Relationship of Lag and EMA Constant

α	k (Lag)
.5	1
.4	1.5
.3	2.33
.25	3
.2	4
.1	9
.05	19

- Small α cannot be used for short term analysis due to excessive lag

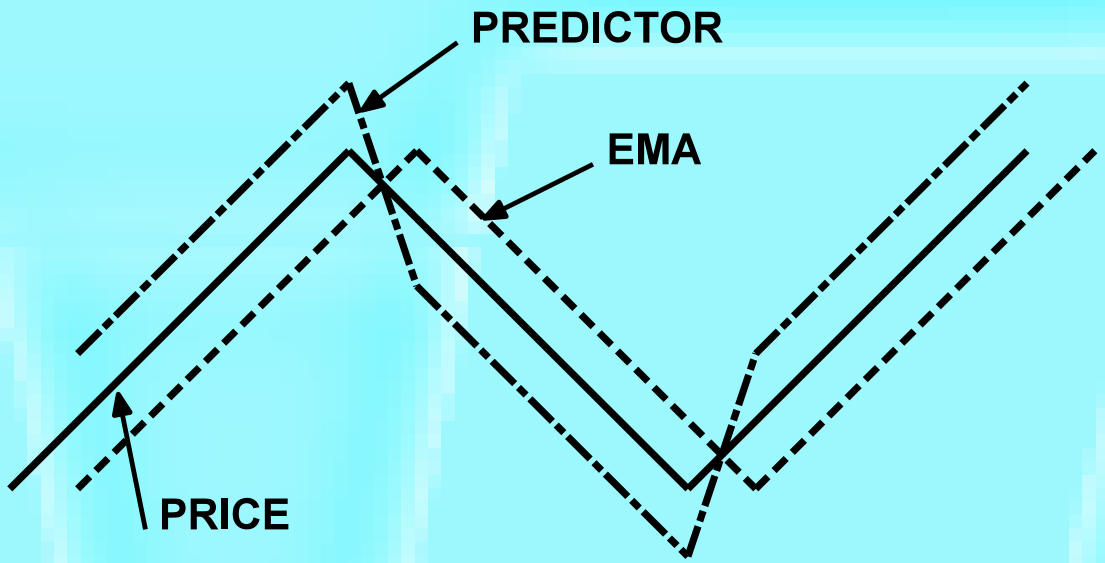
Concept of Predictive Filters

- **In the trend mode price difference is directly related to time lag**



- **Procedure to generate a predictive line:**
  - **Take an EMA of price**
  - **Take the difference (delta) between the price and its EMA**
  - **Form the predictor by adding delta to the price**
    - equivalent to adding 2*delta to EMA

Simple Predictive Trading System



- **Rules:**
  - **Buy when Predictor crosses EMA from bottom to top**
  - **Sell when Predictor crosses EMA from top to bottom**
- **Usually produces too many whipsaws to be practical**
- **Crossover ALWAYS happens after the turning point**

Drunkard's Walk

- **Position as the random variable**
- **Results in Diffusion Equation**

$$\frac{\partial P}{\partial t} = D\frac{\partial^2 P}{\partial x^2}$$

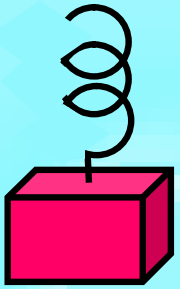
- **Momentum as the random variable**
- **Results in Telegrapher's Equation**

$$\frac{\partial^2 P}{\partial t^2} + \frac{1}{T}\frac{\partial P}{\partial t} = C\frac{\partial^2 P}{\partial x^2}$$

Efficient Market

- **Meandering river is a real-world example of the Drunkard's walk**
  - **Random over a long stretch**
  - **Coherent in a short stretch**
- **Hurst Exponent converges to 0.5 over several different spans**
  - **However I used it to create an adaptive moving average based on fractals over a short span (FRAMA)**

Coherent Behavior Example



$F = -kx$

$F = ma$

Therefore: $ma = -kx$

$dx/dt = v$

$dv/dt = a$

Therefore: $a = d^2x / dt^2$

And: $m*d^2x / dt^2 = -kx$

Assume: $x = \text{Sin}(\omega t)$

Then: $dx/dt = \omega*\text{Cos}(\omega t)$

$d^2x/dt^2 = -\omega^2*\text{Sin}(\omega t)$

Assumption is true if: $\omega^2 = k/m$

CONCLUSION: One can create a leading function by taking a derivative when the market is coherent (in a cycle mode).

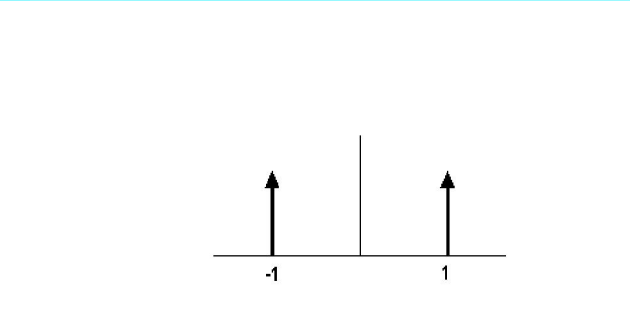
i.e. Cosine(x) leads Sine(x)

Many Indicators Assume a Normal Probability Distribution

- **Example - CCI**
  - **by Donald Lambert in Oct 1980 Futures Magazine**
- **CCI = (Peak Deviation) / (.015* Mean Deviation)**
- **Why .015?**
  - **Because 1 / .015 = 66.7**
  - **66.7% is (approximately) one standard deviation**
    - **IF THE PROBABILITY DENSITY FUNCTION IS NORMAL**

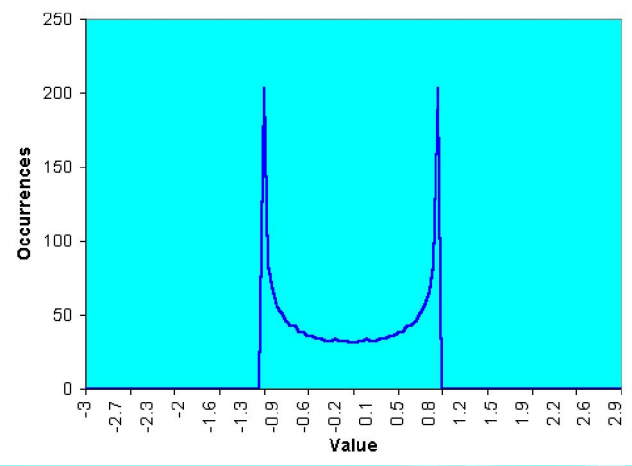
What are Probability Density Functions?

A PDF can be created by making the waveform with beads on parallel horizontal wires. Then, turn the frame sideways to see how the beads stack up.



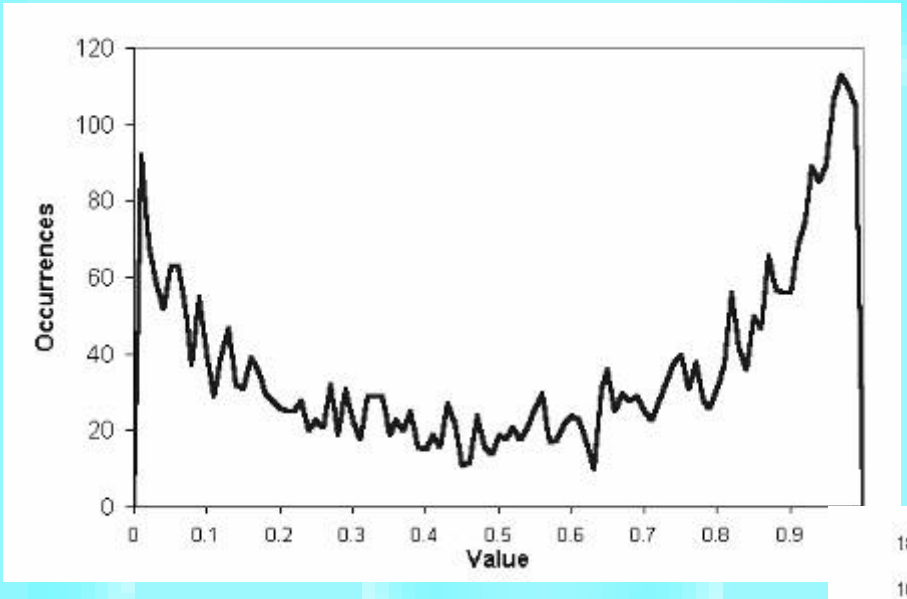
A Square Wave only has two values

A Square Wave is untradeable with conventional Indicators because the switch to the other value has occurred before action can be taken



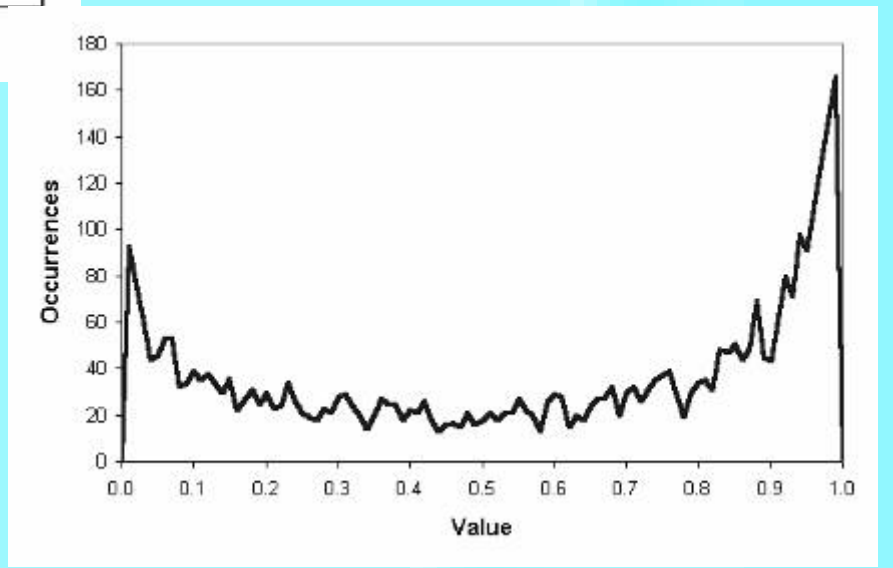
A Sinewave PDF is not much different from a Squarewave PDF

Real Probabilities are NOT Gaussian

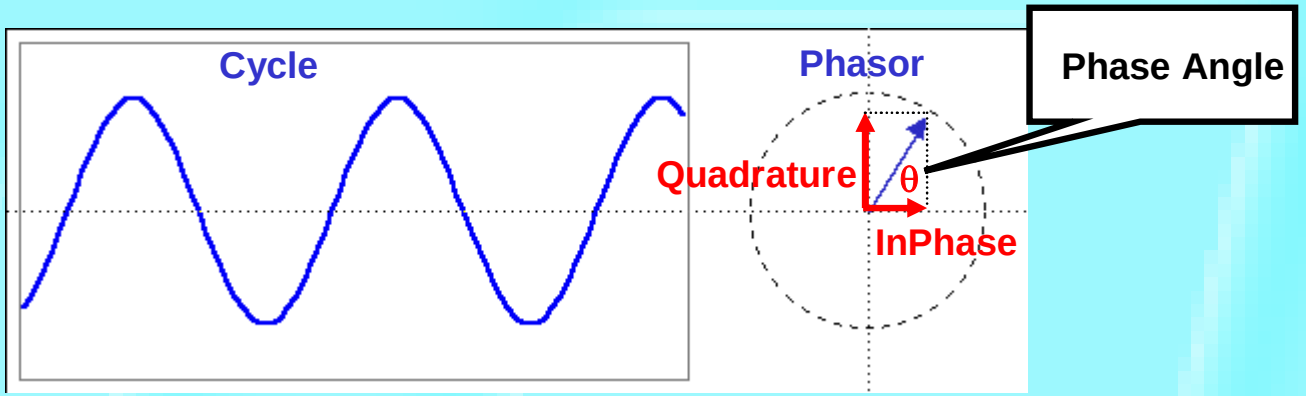


Probability Distribution of a 10 Bar Channel
Over 15 years of Treasury Bond data

Probability Distribution of a 30 Bar Channel
Over 15 years of Treasury Bond data



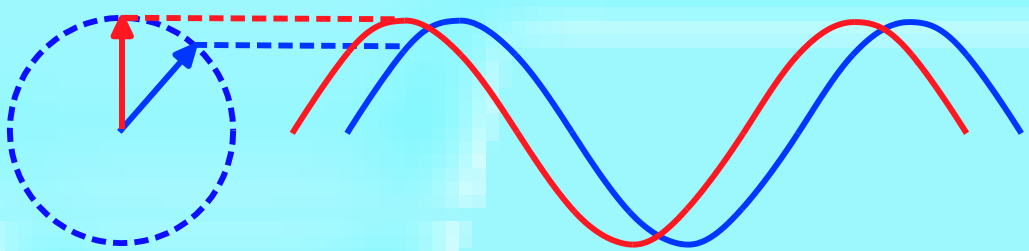
A Phasor Describes a Cycle



- **Cycle Amplitude (Pythagorean Theorem)**

  $\text{Amplitude}^2 = (\text{InPhase})^2 + (\text{Quadrature})^2$
- **Phase Angle = ArcTan(Quadrature / InPhase)**
- **Cycle Period when Σ Phase Angles = 360^0**

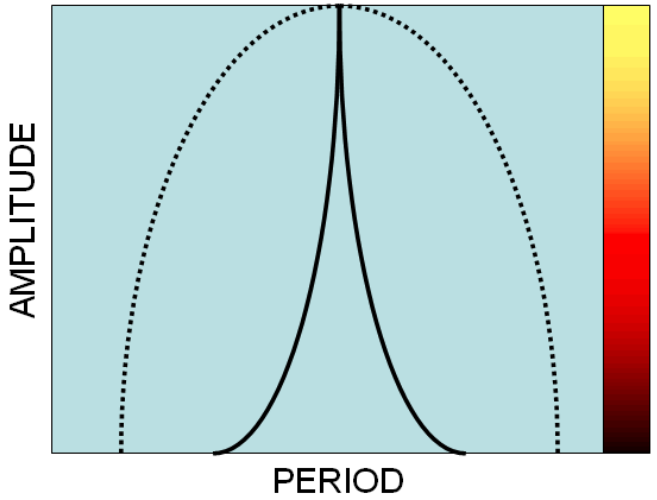
Sinewave Indicator Advantages

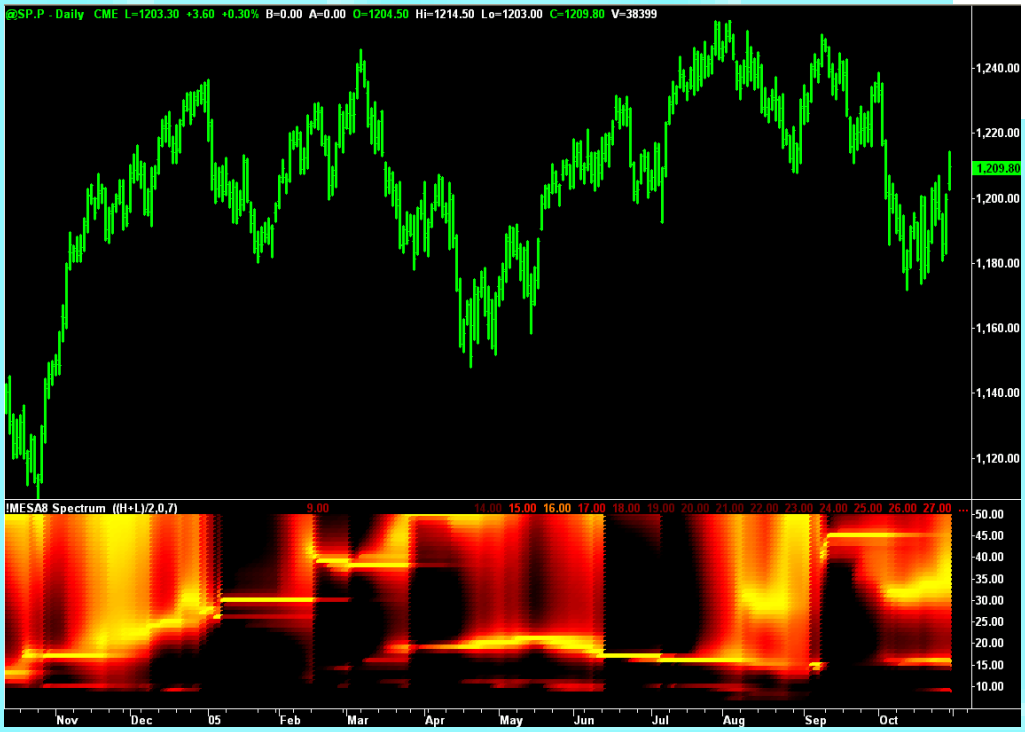


- **Line crossings give advance warning of cyclic turning points**
- **Advancing phase does not increase noise**
- **Indicator can be “tweaked” using theoretical waveforms**
- **No false whipsaws when the market is in a trend mode**

Cycle Measurement Techniques

Convert Amplitude to Color so spectrum can be plotted in sync with prices





MESA8 Spectral Estimate (standard against which other techniques will be measured)

FFT

- **Constraints:**
  - Data is a representative sample of an infinitely long wave
  - Data must be stationary over the sample time span
  - Must have an integer number of cycles in the time span
- **Assume a 64 day time span**
  - Longest cycle period is 64 days
  - Next longest is 64 / 2 = 32 days
  - Next longest is 64 / 3 = 21.3 days
  - Next longest is 64 / 4 = 16 days
- **Result is poor resolution - gaps between measured cycles**

FFT (continued)

Paradox:

- **The only way to increase resolution is to increase the data length**
- **Increased data length makes realization of the stationarity constraint highly unlikely**
  - 256 data points are required to realize a 1 bar resolution for a 16 bar cycle (right where we want to work)

Conclusion:

FFT measurements are not suitable for market analysis

Sliding DFT

- **Requires spacing of spectral lines just like a FFT**
- **Therefore the resolution of a Sliding DFT is too poor to be used for trading**

Frequency Discriminators

- **I described 3 different discriminators in "Rocket Science for Traders"**
- **Measure phase differences between successive samples**
  - **For example $\Delta\theta$ = 36 degrees describes a 10 bar cycle period**
  - **Discriminators respond rapidly to frequency changes**
- **Problem: long cycles have a small change in phase per sample**
  - **For example 40 Bar cycle phase change is only 9 degrees**
  - **Result: Long signal cycles are swamped by noise**
- **I no longer recommend Frequency Discriminators**

Pisarenko Harmonic Decomposition

- **Similar to Phase Discriminators except that autocorrelation is used to reduce noise**

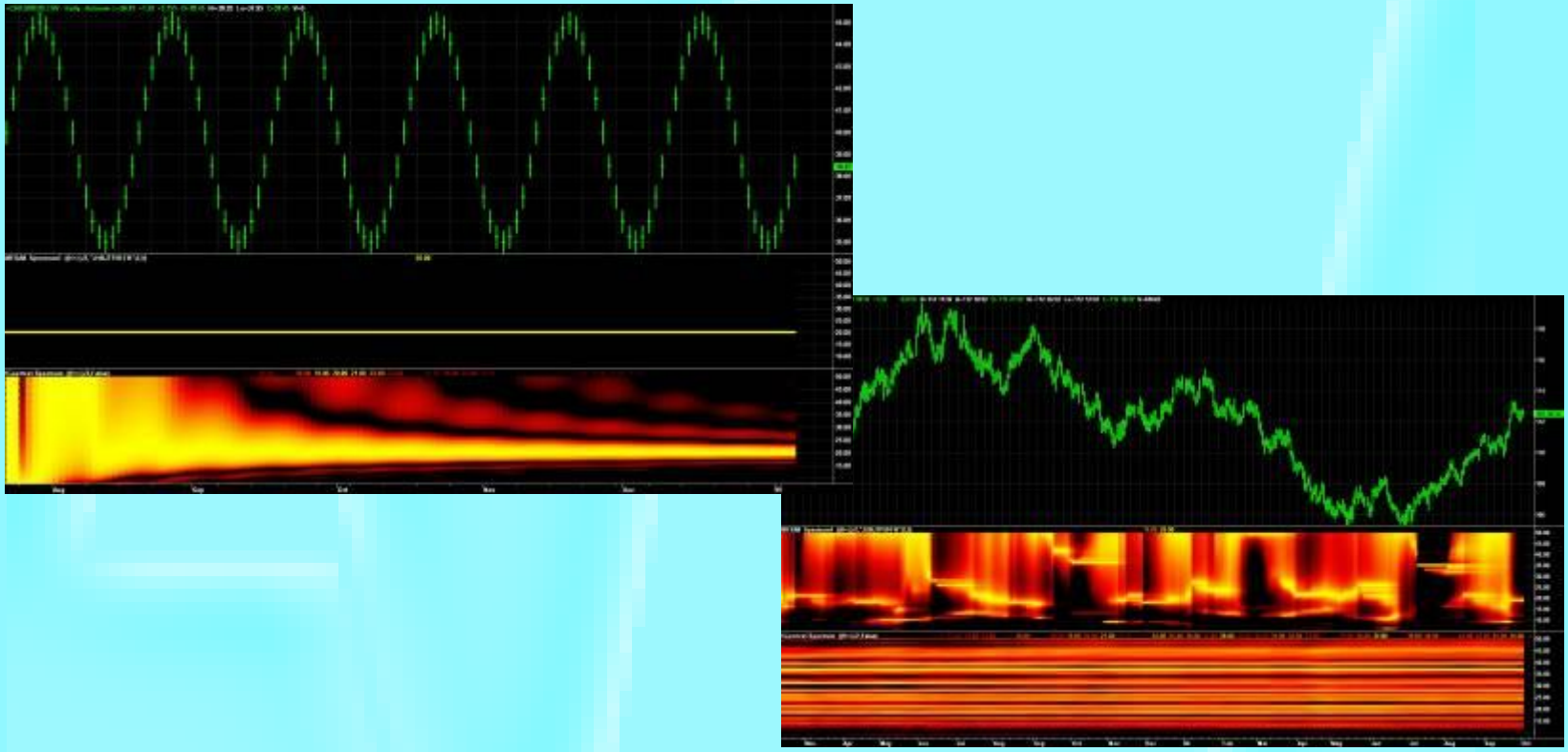
- **Decimation does not improve cycle measurements**

Chirped Z Transform (CZT)

- **Hopeless**

Goertzel

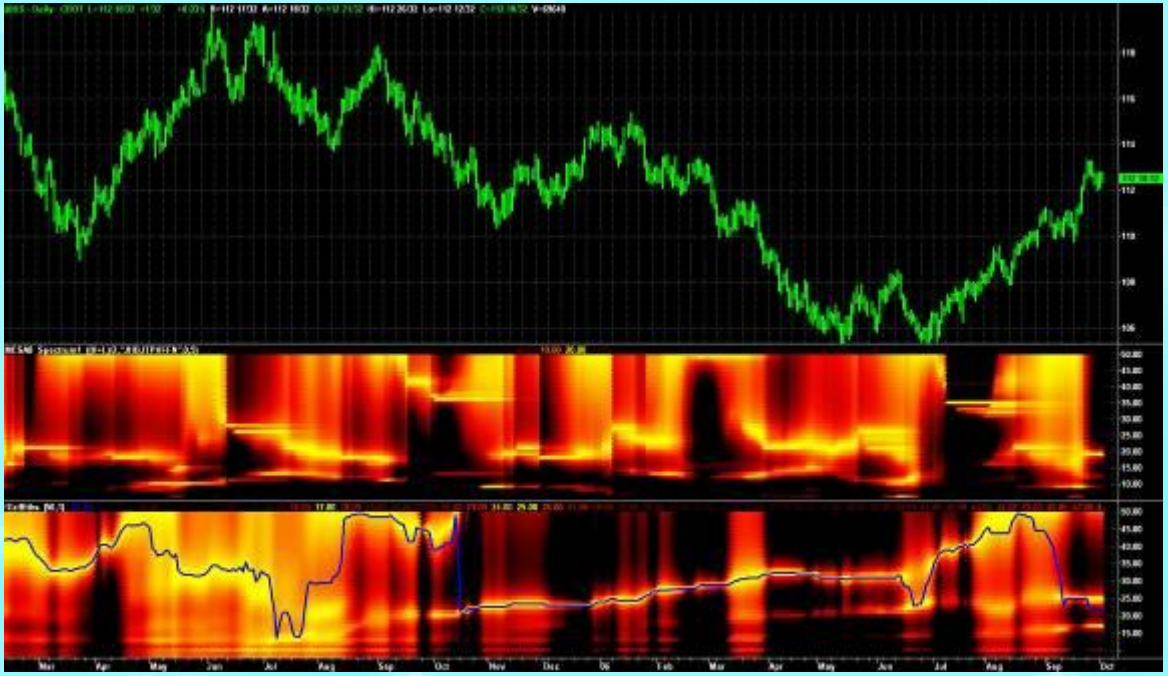
- **Used to detect two-tone phone dial codes**
- **Depends on LMS convergence**



- **Goertzel measurements do not converge on market data**

Griffiths

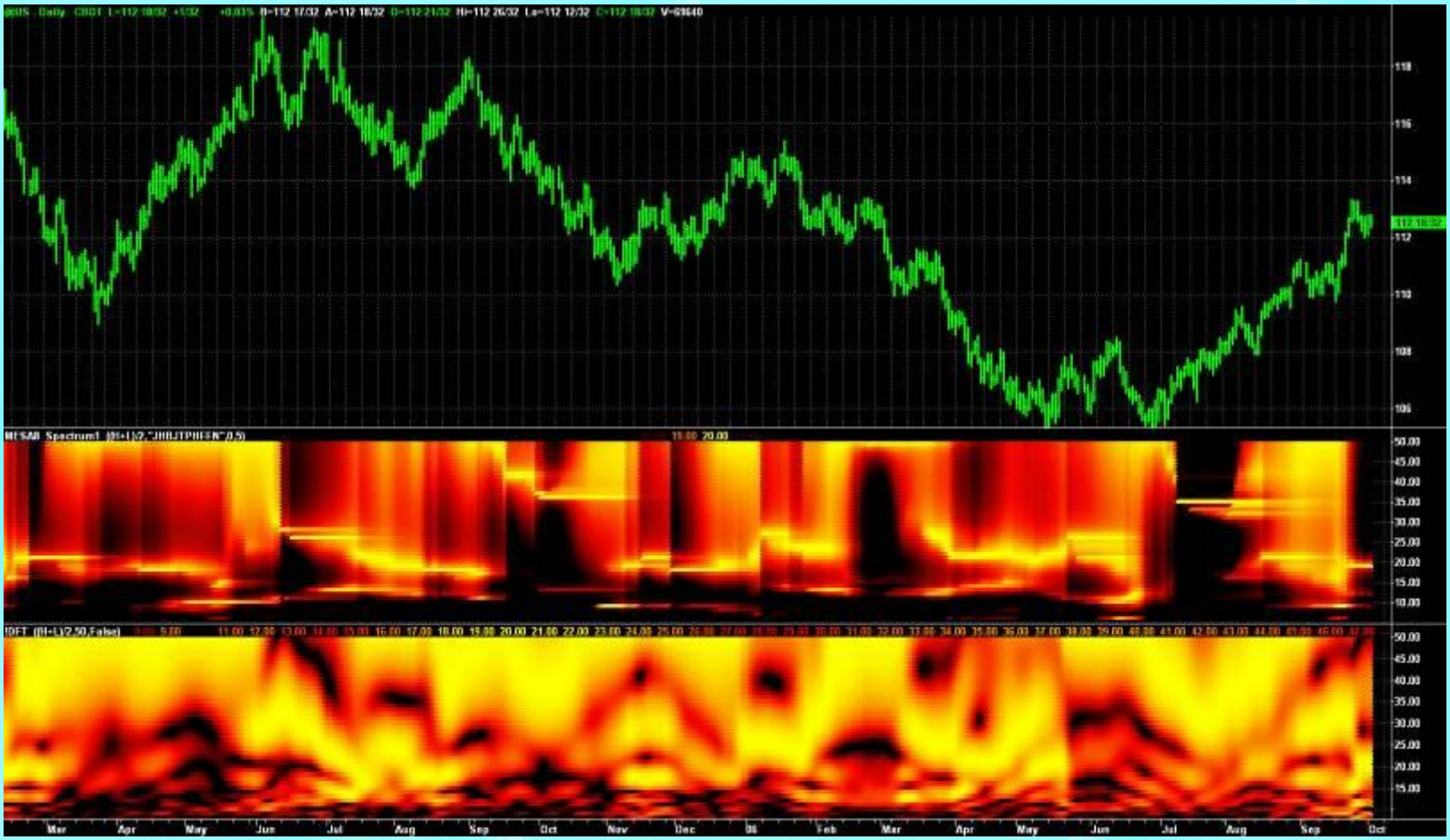
- **Griffiths is a sliding algorithm that also depends on LMS convergence**



- **No kewpie doll for accuracy**

DFT

- **Discrete Fourier Transform (DFT) has poor resolution**



MUSIC

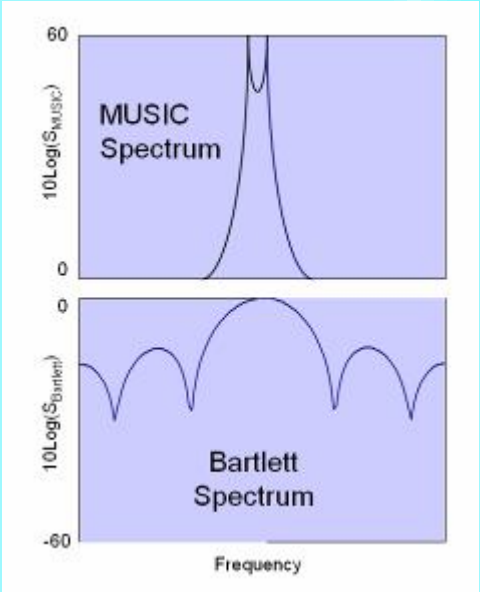
- **MUltiple Signal Identifcation and Classification (MUSIC)**
- **Kay & Demeure* showed that the resolution of the Bartlett spectrum (a DFT) and a MUSIC spectrum (a MESA) are related by the transform**

$$S_{MUSIC} = \frac{1}{1 - S_{Bartlett}}$$

where $0 \le S_{Bartlett} \le 1$

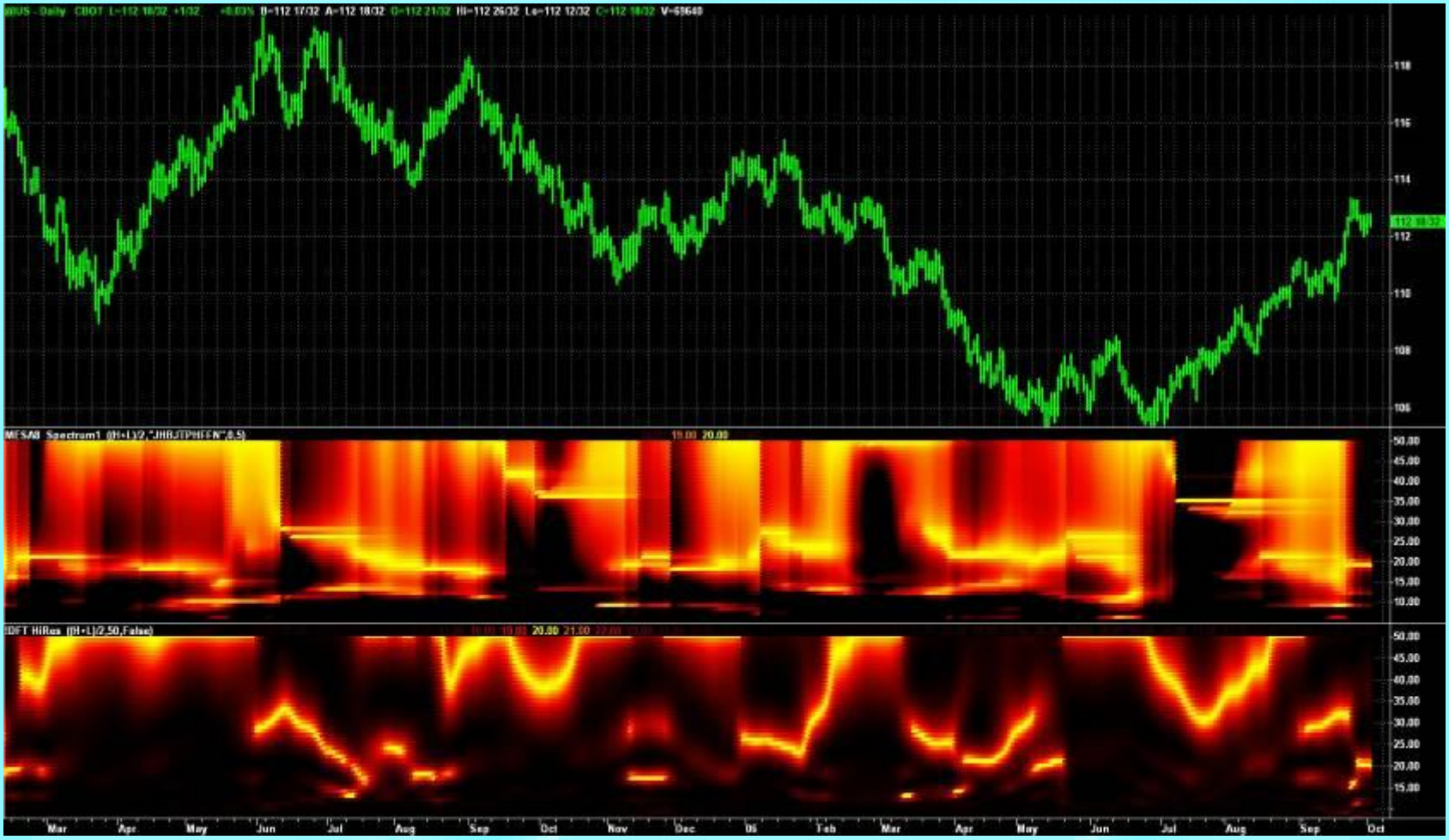
- **I use this transform to enhance the resolution of the DFT**

$$S_{MUSIC} = \frac{0.01}{1 - .99 * S_{DFT}}$$



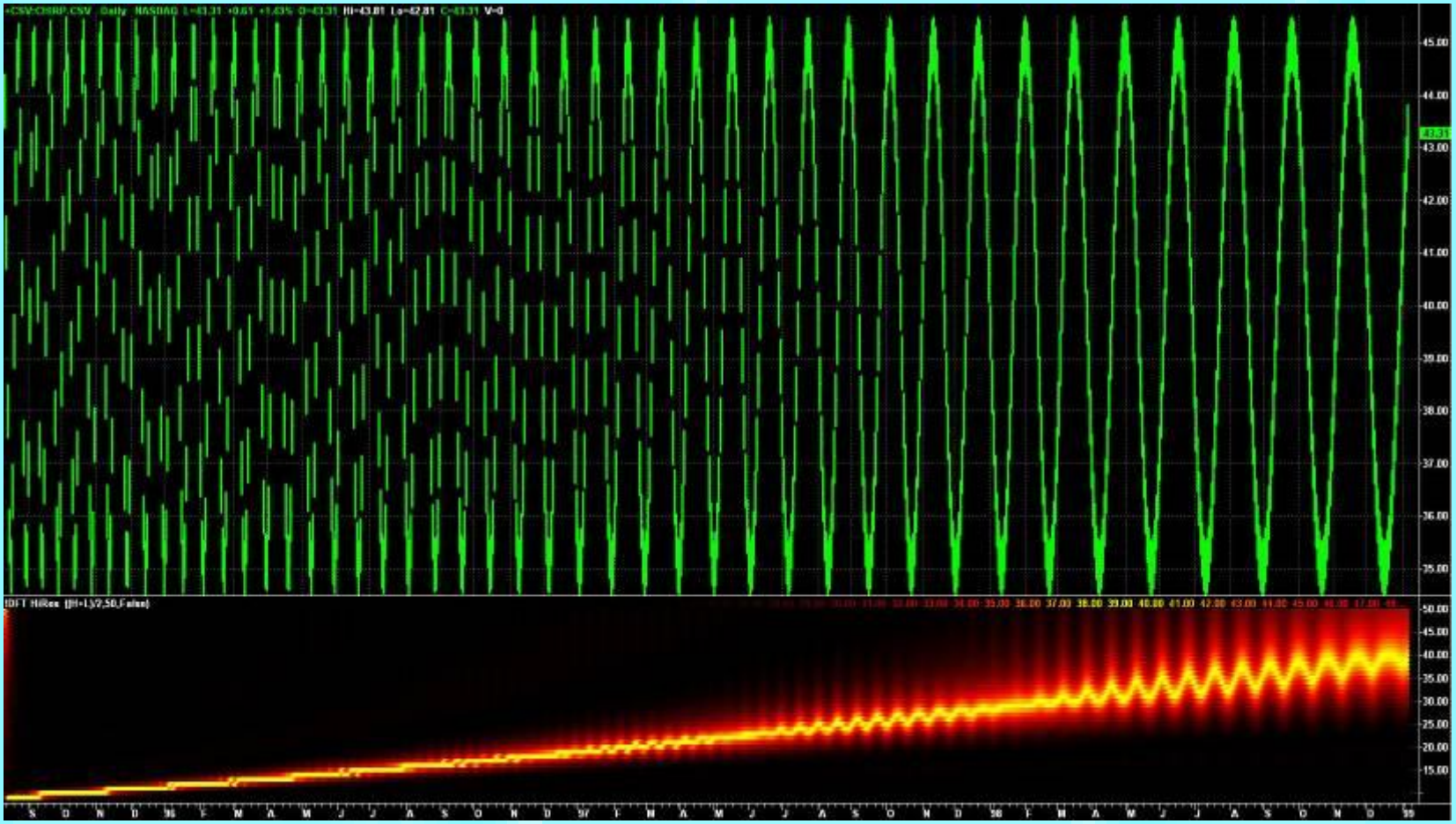
*** Steven Kay and Cedric Demeure, "The High-Resolution Spectrum Estimator – a Subjective Entity", Proceedings IEEE, Vol 72, Dec 1984, pp1815-1816**

MUSIC


Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
05
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct

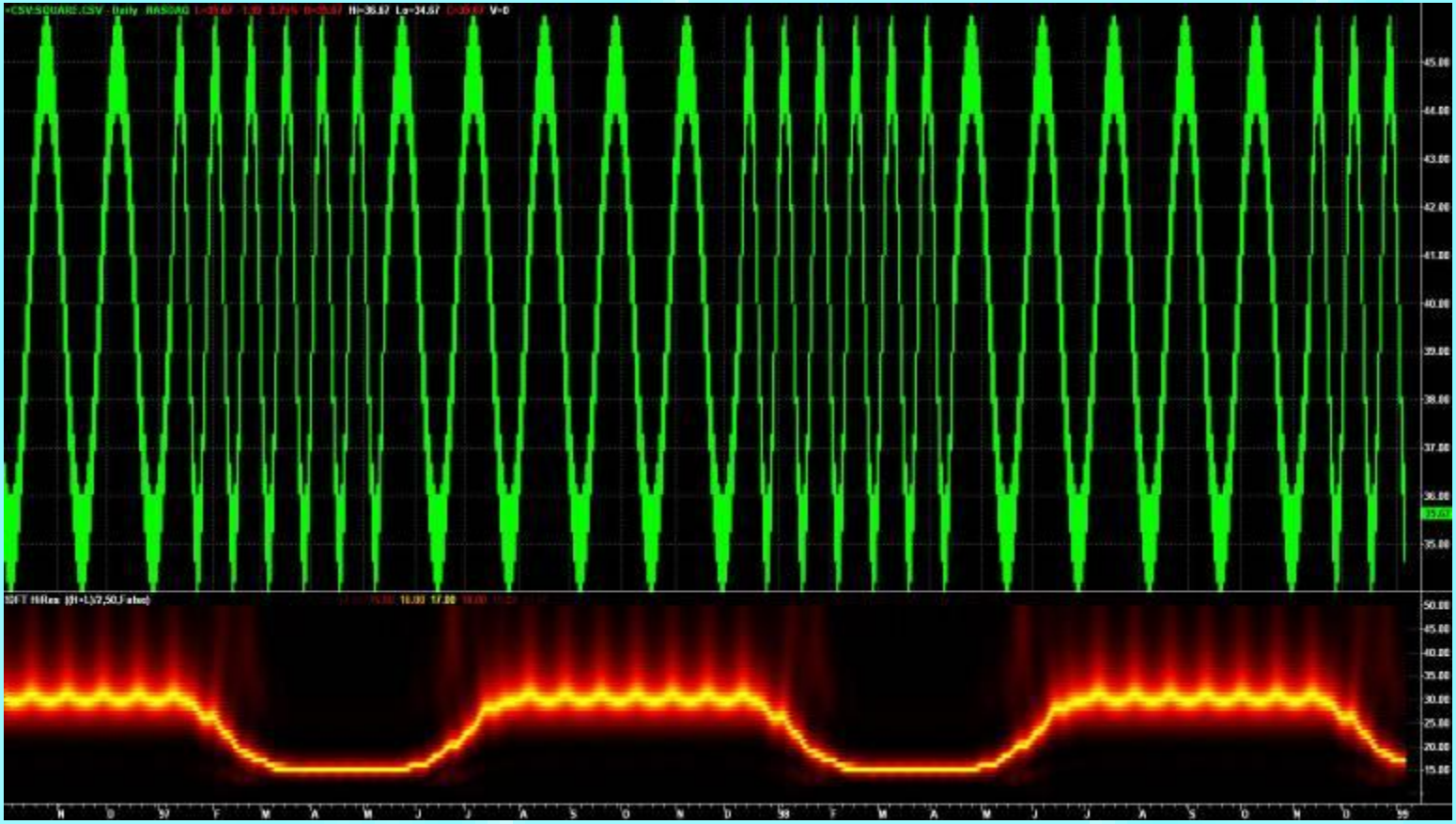
DFT Chirp Response

- **High Resolution DFT Accurately Measures Cycle Periods**



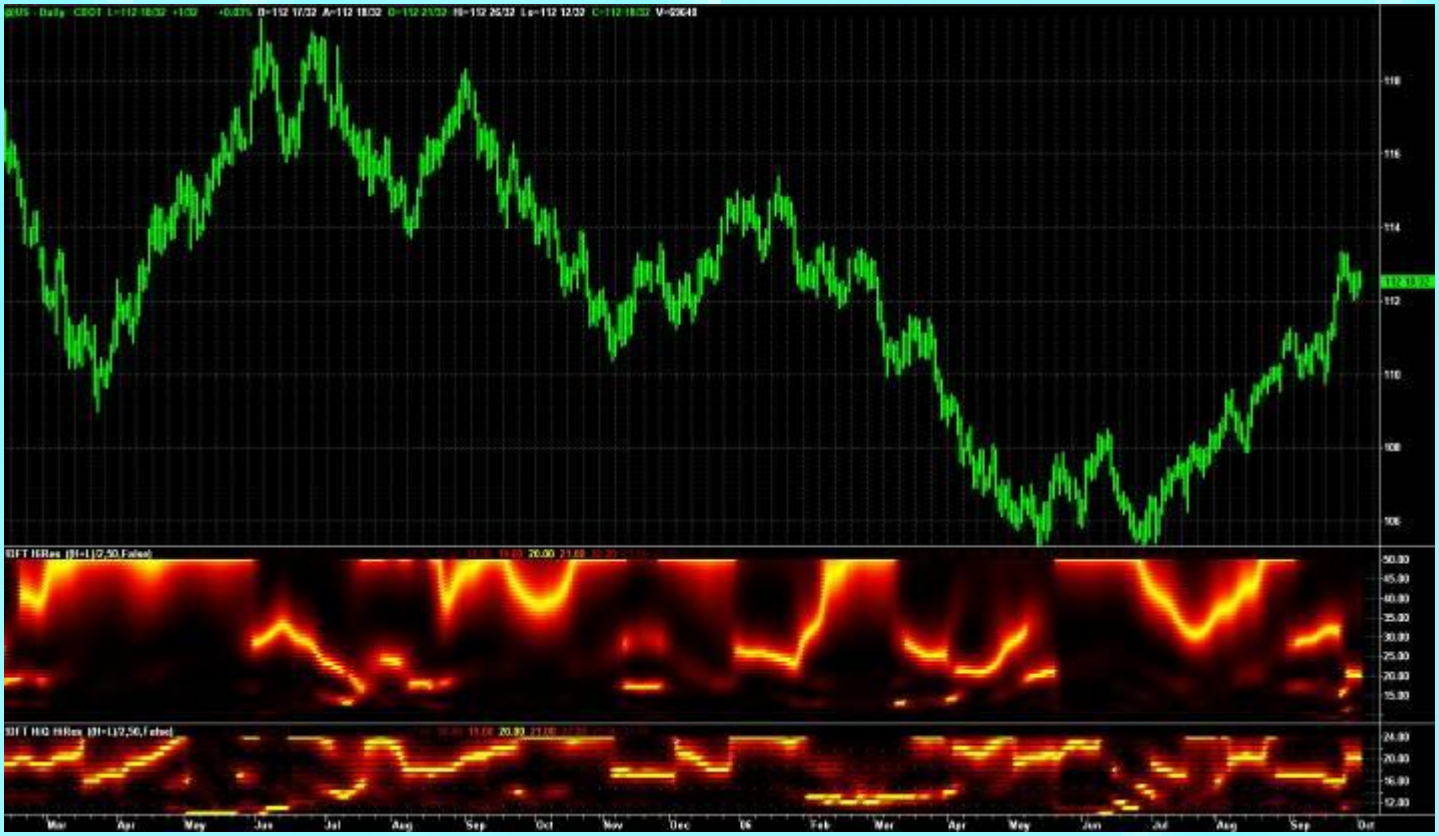
DFT Square Wave Response

- **High Resolution DFT has a quick transient response**
- **Chart switches between a 15 and 30 bar cycle**



The Market is Fractal

- **Longer cycles will always dominate**
- **Limit the cycle measurement to the cycle periods of interest**



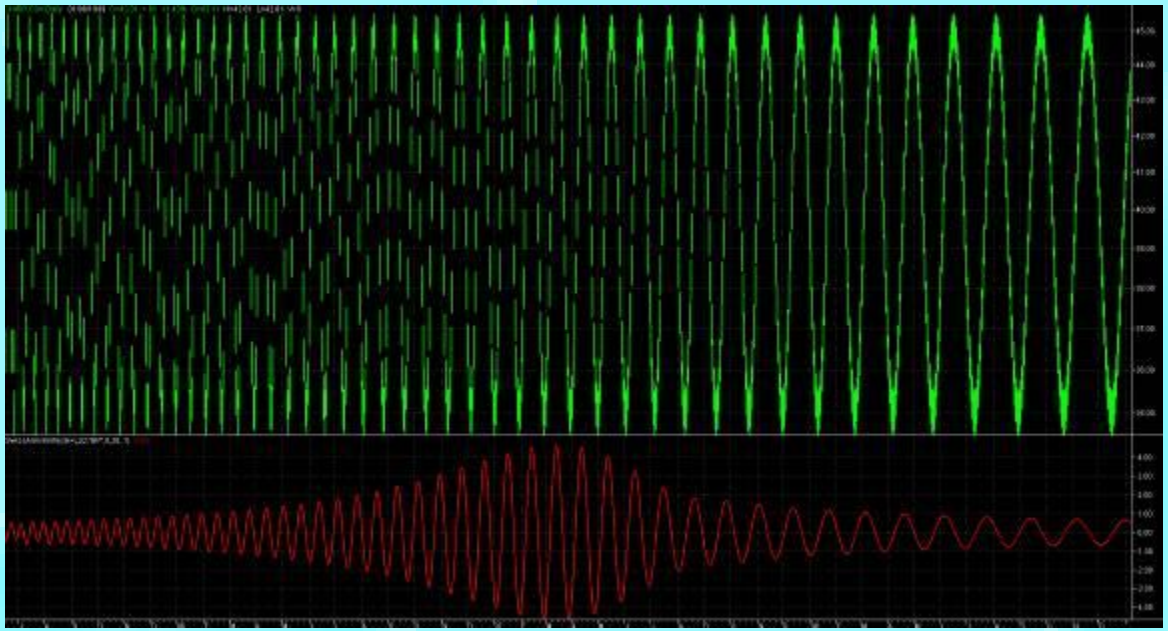
BandPass Filter

- **Since frequency is known, a leading signal can be created from the derivative of a Bandpass filtered signal**
  - **From calculus: d(Sin(ωt) / dt = ω*Cos(ωt)**
  - **Therefore: Lead = (Period / 6.28318)*(BP – BP[1])**
- **Single channel code is simple**

```
Inputs:Price((H+L)/2), Period(20), Delta(.25);

Vars: gamma(0), alpha(0), beta(0), BP(0), Lead(0);

beta = Cosine(360 / Period);
gamma = 1 / Cosine(720*delta / Period);
alpha = gamma - SquareRoot(gamma*gamma - 1);
BP = .5*(1 - alpha)*(Price - Price[2]) + beta*(1 +
alpha)*BP[1] - alpha*BP[2];
Lead = (Period / 6.28318)*(BP - BP [1]);

Plot1(BP,"bp");
Plot2(Lead, "lead");
```

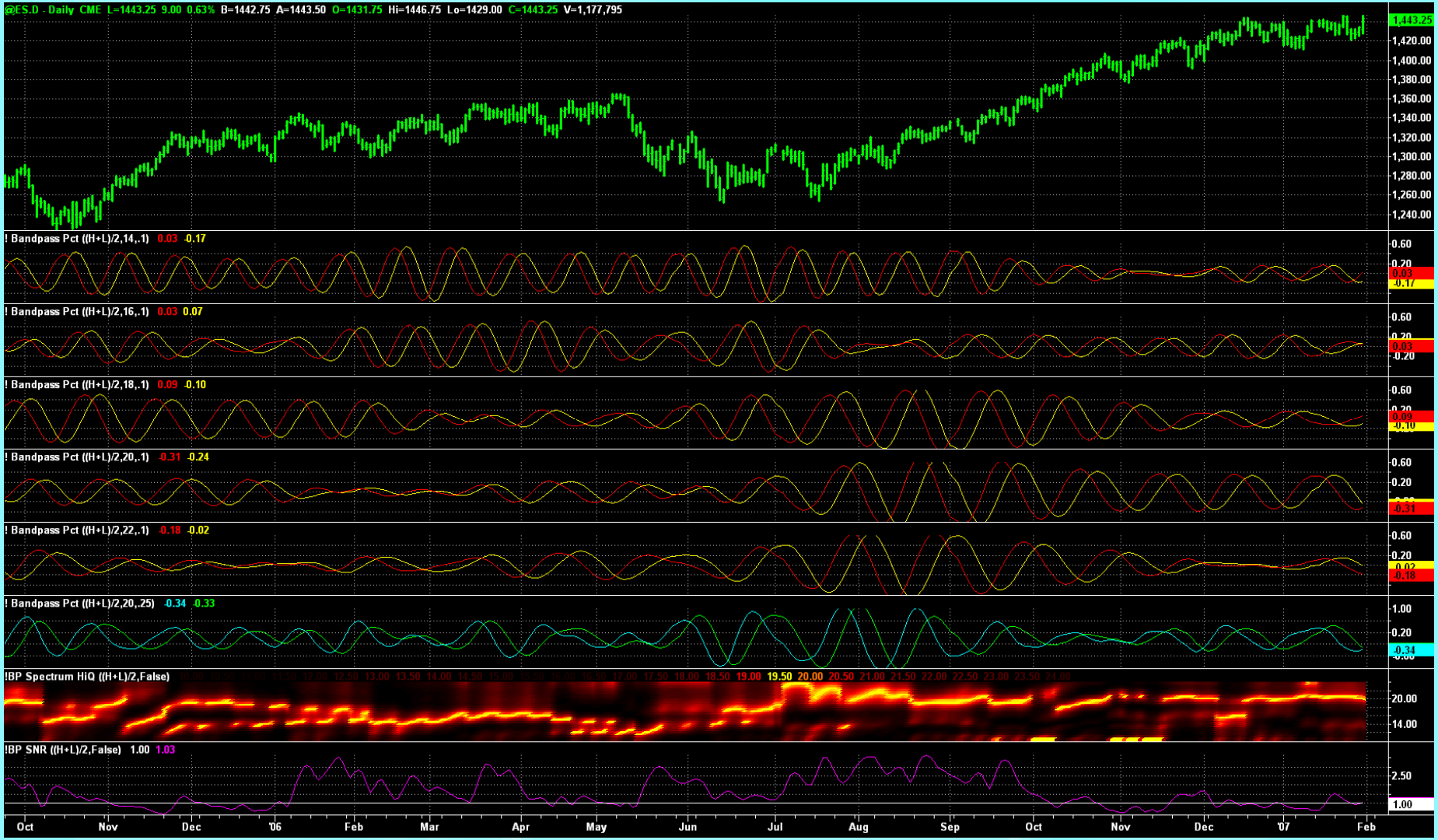
BandPass Filter

- **Eliminates both high frequency and low frequency noise**



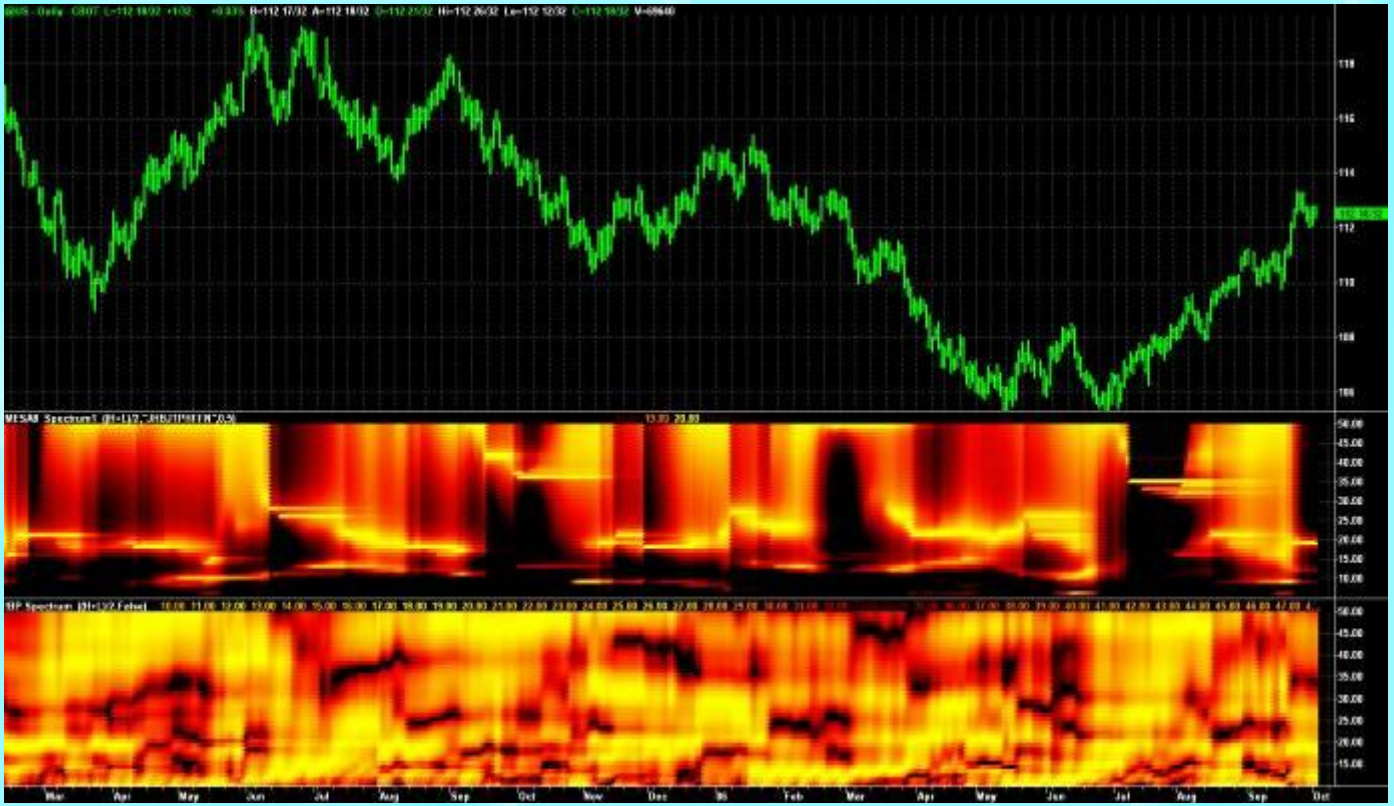
- **Design is a tradeoff between selectivity and transient response**

BandPass Response Study



Channelized Receiver

- **Uses a bank of contiguous bandpass filters**
- **Spacing and bandwidth are controllable**
- **Detect the amplitude at the output of each filter**



- **Can use resolution enhancement transform also**

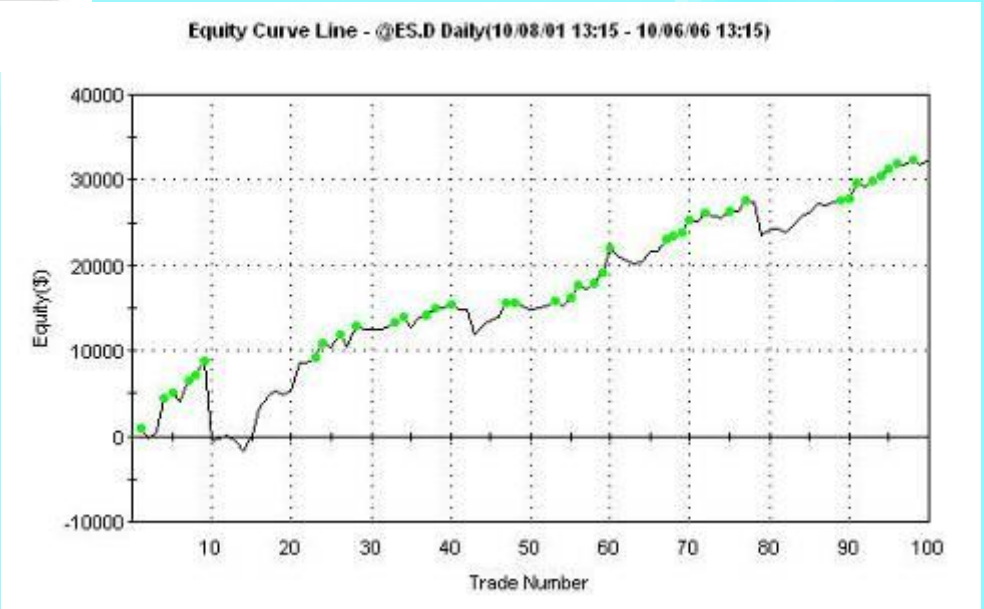
How to Use Measured Cycles

- **Replace fixed-length parameters with dominant cycle fraction**
  - **Makes these indicators adaptive to current market conditions**
- **Examples**
  - **RSI: 0.5*dominant cycle**
  - **Stochastic: 0.5*dominant cycle**
  - **CCI: dominant cycle**
  - **MACD: 0.5*dominant cycle & dominant cycle**
- **By definition, trends have low cycle content**
  - **Cycle peaks or valleys can be used to pick the best entry in the direction of the trend**

Adaptive Strategy Improvement

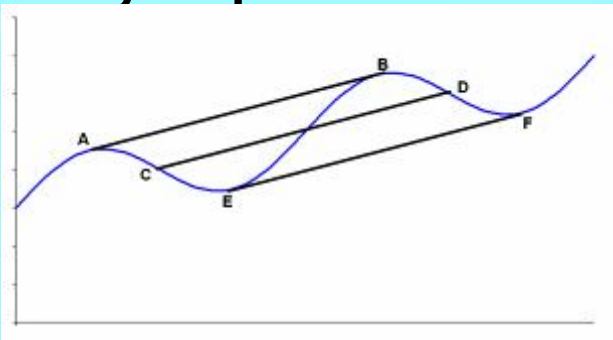
Fixed-Length RSI
(and length optimized)

DFT-Tuned RSI

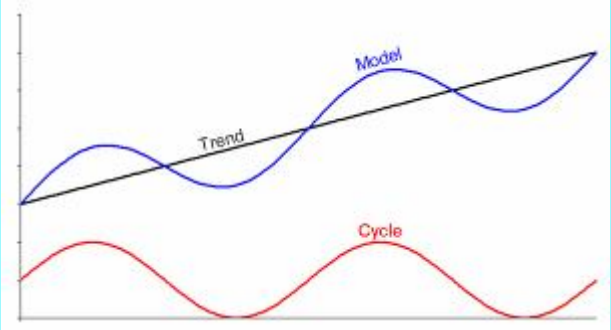


Trends

- **Slope is constant across one full cycle period**
  - **This defines a trend for me**



- **I model the market as an "instantaneous trendline" plus the dominant cycle**



- **Best to trade the trend if the slope is greater than the cycle peak-to-peak amplitude**
- **Trends can also be defined on the basis of cycle length for mode-switching strategies**

Strategy Design

- **KISS**
- **Base strategy on some sound principle**
- **Establish orthogonal parameters**
- **Use at least 30 trades per parameter in testing**
  - **Minimizes curve-fitting**
- **ALWAYS evaluate using out-of-sample tests**
- **Optimize on percent profitable trades**
  - **(in TradeStation)**
  - **Better to optimize on (ProfitFactor) * (% Profitable)**

Voting Systems

- **Systems that have voting components can be effective**
  - **Example: Elder's Triple Screen System**
- **System components should be uncorrelated to avoid weighted votes**
  - **RSI and Stochastic are highly correlated, for example**
  - **A moving average and oscillator tend to be uncorrelated**
  - **5:1 time spread is adequate to use the same indicator in two timeframes to produce a valid vote**

Trading Your IRA

- **Cannot sell short or trade Futures in most IRAs**
- **Create "synthetic" shorts and longs using options**
  - **In the money options have a delta = 1 (theoretically, 0.8 practically)**
  - **In the money option is better than having a built-in stop loss**
    - You cannot lose more than you paid for the option
    - A worthless option can possibly be revived before expiration
  - **Options produce leverage**
    - A $4 option on a $130 index gives 0.8*(130/4) = 26:1 leverage
- **Trade ProShares for 2X leverage both long and short**
  - **www.ISignals.com will soon be available to do this**

QLD	**Ultra QQQ**
SSO	**Ultra S&P500**
DDM	**Ultra DOW30**
MVV	**Ultra MidCap 400**
UWM	**Ultra Russell**
QID	**UltraShort QQQ**
SDS	**UltraShort S&P500**
DXD	**UltraShort Dow30**
MZZ	**UltraShort MidCap 400**
TWM	**UltraShort Russell**

How to Optimize Strategies

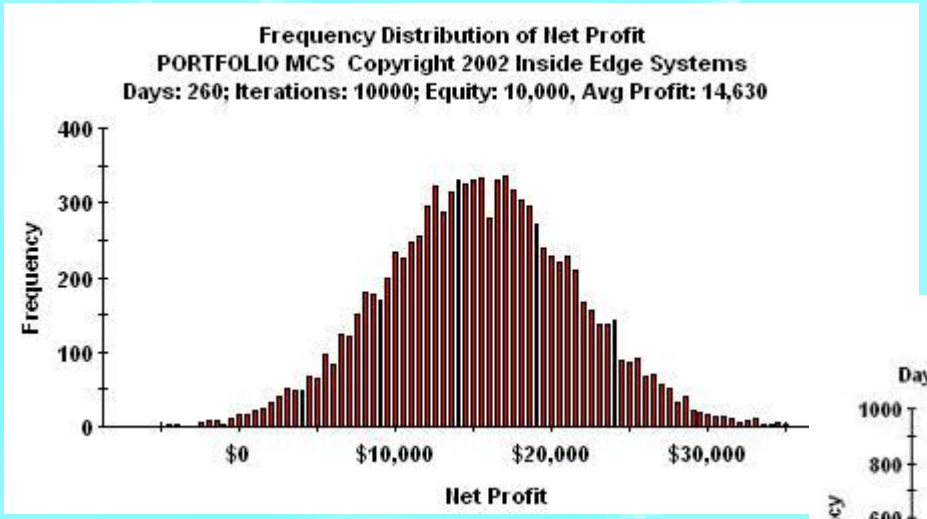
- **Start with orthogonal parameters**
- **Optimize one parameter at a time**
- **View Strategy Optimization Report**
  - **Display should be a gentle “mound” around the optimal parameter value**
  - **An “erratic” display shows the parameter is not optimizing anything – just different performance for different parameter values**
- **Iterate optimization through the parameter set to reduce optimization time**
  - **This is called a “hillclimb” optimization**
  - **If the parameter values change much your parameters are not orthogonal**

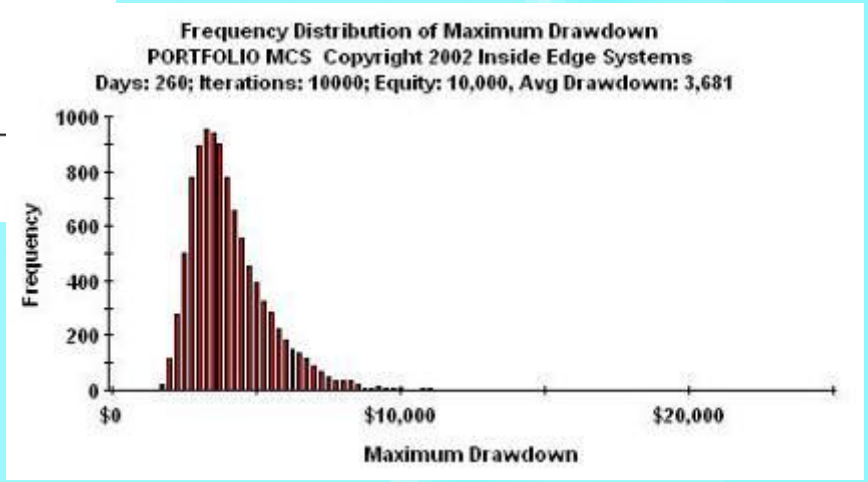
Portfolio Diversification

- **All issues within the portfolio should be uncorrelated to reduce risk**
- **If so, each doubling of issues reduces variation from mean equity growth by .707**
- **Portfolio reaches a point of diminishing returns**
  - **4 issues cuts variance in half**
  - **16 issues cuts variance in half again**
  - **64 issues required to reduce variance by half again**
- **Better strategy is to trade indices to get the benefit of their averaging**

Monte Carlo Analysis

- **Shows statistics of a large number of trades**
  - **Enables the use of recent, more relevant trades**
- **Enables statistical evaluation of risk and reward/risk ratio**





Trading System Evaluation

- **Profit Factor and % Profitable Trades are all you need to know to evaluate trading systems**
- **These are analogous to Payout and Probability of Winning in gaming**
- **Glossary:**

$W = gross winnings
#W = number of winning trades
$L = gross losses (usually normalized to 1)
#L = number of winning trades
PF = Profit Factor = $W / $L
% = Percent Winning Trades {(1-%) = Percent Losing Trades} ….as fractions

Some Interesting Relationships

$$\frac{AveWin}{AveLoss} = \frac{\$W/\#W}{\$L/\#W}$$
$$= \frac{\$W}{\$L}\frac{\#L}{\#W}$$
$$= PF\frac{\#L}{\#W}\frac{(\#W+\#L)}{(\#W+\#L)}$$
$$= PF\frac{(1-\%)}{\%}$$

$$AveTrade = T$$
$$= \frac{\$W-\$L}{\#W+\#L}$$
$$= \frac{\$W}{\#W+\#L} - \frac{\$L}{\#W+\#L}$$
$$= \frac{PF}{1+\#L/\#W} - \frac{\$L}{\#L(\#W/\#L+1)}$$
$$and, since \ \$L/\#L = 1$$
$$= \frac{PF}{1/\%} - \frac{1}{1/(1-\%)}$$
$$= PF\% - (1-\%)$$
$$= \%(PF+1) - 1$$

Breakeven occurs when T = 0. In this case:

$$1 = \%(PF+1)$$
$$PF = 1/\% - 1$$
$$PF_{BREAKEVEN} = \frac{1-\%}{\%}$$

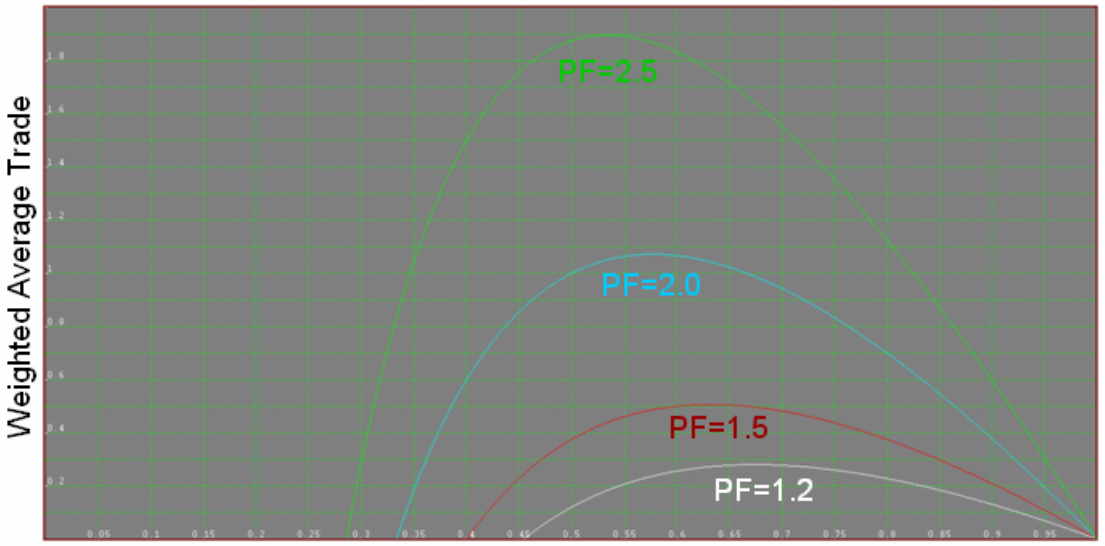
Weighted Average Trade

$$T\frac{AveWin}{AveLoss} = TW$$

$$= (\%(PF-1)\left(\frac{PF(1-\%)}{\%}\right)$$

$$= PF((PF+1)-\frac{1}{\%})(1-\%)$$

$$= PF(PF(1-\%)-(\%+{}^{1}\!/_{\%})+2)$$



Optimize by setting that derivative to zero (zero slope at the inflection point). Doing this, we get:

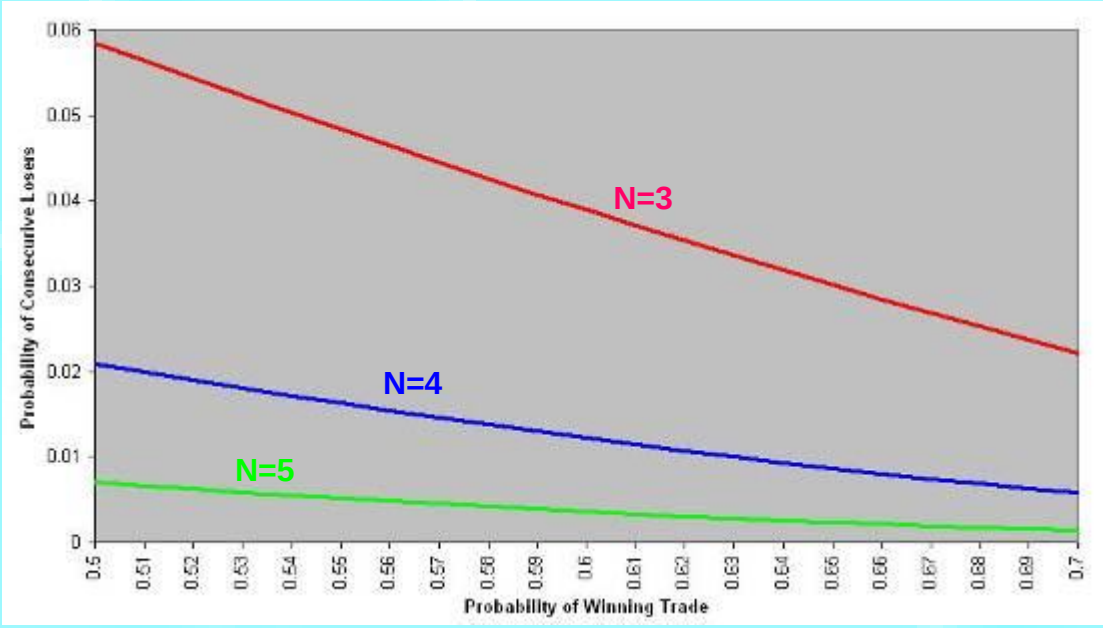
$$0 = -PF - 1 + {}^{1}\!/_{\%^2}$$

so that

$$\%_{OPTIMUM} = \frac{1}{\sqrt{1+PF}}$$

Consecutive Losing Trades

- Probability of a losing trade is (1-%)
- Probability of a second losing trade is $(1-\%)^2$
- Probability of N consecutive losing trades is $(1-\%)^N$
- A good trading system has, say, 60% winners
  - Therefore it has 40% losing trades
  - q = 0.4
- $q = r + 2r^2 + 3r^3 + 4r^4 + 5r^5 + \ldots\ldots$
- If q = 0.4 then r = 0.2349
- Probability of getting 4 losers in a row is $4r^4=0.0122$
- If you trade 50 times per year, the probability of getting 4 losers in a row is 60.9%
  - **That's almost a promise it will happen**



Fractional Strategy Equity Growth

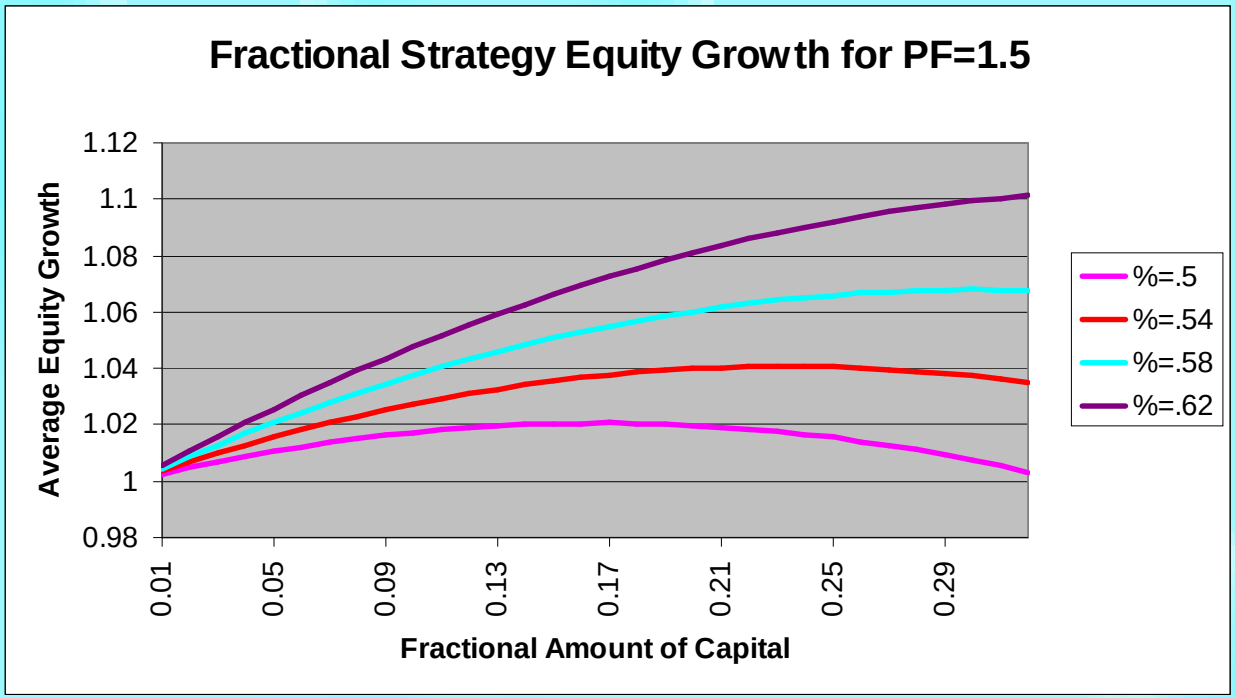
- **Idea is to commit a fractional part of current capital to each trade rather than a fixed trade amount**

In a random process the trades are:

$$E = (1 + fPF)(1 + fPF)(1 - f).....$$

So the Expectation of equity growth becomes:

$$E = (1 + fPF)^{\%}(1 - f)^{(1-\%)}$$



Optimal f

- **Optimize f by setting the derivative of Expectation to zero (zero slope)**

$$\frac{dE}{df} = \%PF(1+fPF)^{(\%-1)}(1-f)^{(1-\%)} - (1+fPF)^{\%}(1-\%)(1-f)^{-\%} = 0$$

$$\%PF\left(\frac{1-f}{1+fPF}\right)^{(1-\%)} = (1-\%)\left(\frac{1+fPF}{1-f}\right)\left(\frac{1-f}{1+fPF}\right)^{(1-\%)}$$

$$\%PF = (1-\%)\left(\frac{1+fPF}{1-f}\right)$$

$$\%PF - \%fPF = 1+fPF - \% - \%fPF$$

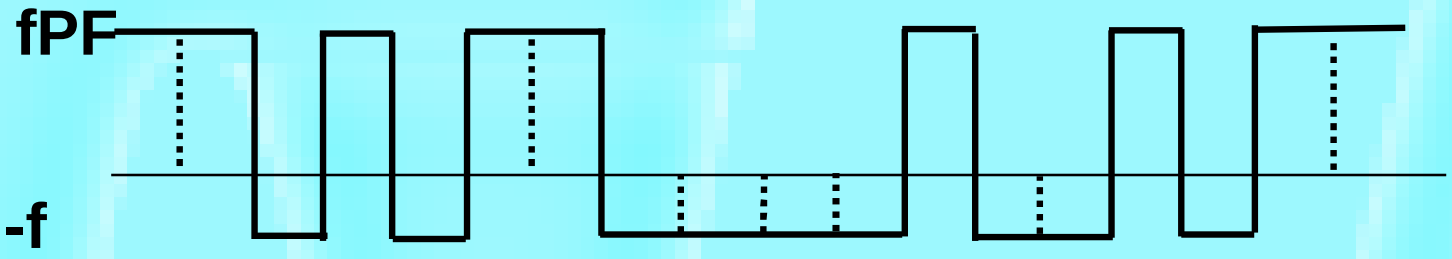
$$\%PF + \% - 1 = fPF$$

$$f_{opt} = \frac{\%(PF+1)-1}{PF}$$

- **This is exactly Ralph Vince's Optimal f**
  - **Kaufman formulation should use (Gross Wins) / (Gross Losses) = PF**

Sharpe Ratio, etc

- **RMS is synonymous with 1 Sigma variation (for a Normal probability distribution)**



- **Since Expectation is only slightly greater than unity:**

$$RMS \approx \sqrt{\%*(fPF)^2 + (1-\%)* f^2}$$

For a sufficiently large Profit Factor:

$$RMS \approx f * PF\sqrt{\%}$$

But downside variance is only $f\sqrt{1-\%}$

- **Sharpe Ratio = (E-I) / σ ≈ 1 / RMS**
- **Trading System Simulation**

Bertrand's Ballot Theorem

- **If candidate A ultimately gets "a" votes and candidate B ultimately gets "b" votes (a>b), then the probability of Candidate A leading throughout the ballot counting process is (a-b) / (a+b)**
- **In our case, let a = %*PF and b = (1-%)**

$$\frac{\%*PF-(1-\%)}{\%*PF+(1-\%)}=\frac{\%*(PF-1)-1}{\%*(PF-1)+1}$$

$$For\ \ positive\ Expectation$$

$$\%*(PF-1)-1>0$$

$$OR$$

$$\%>\frac{1}{PF-1}$$

- **PF must be greater than 2 (even then % must be certainty)**
- **Conclusion: It is almost a promise your account will go underwater some time after you start trading!**

SVD

- Single Value Decomposition (SVD)
- Must be done in C or BASIC
  - Generate a callable DLL in EasyLanguage
- Code is available in Numeric Recipes
- Use only the first EigenValue
  - Orthogonalizes Signal and Noise
- Sensitive to length of data used
- Still is a causal filter
  - System signals are always late
  - I have not yet been able to create a gangbusters system

Recommended Resources

- **"New Trading Systems and Methods", 4th Edition**
  - **Perry J. Kaufman**
  - **John Wiley & Sons**
- **MCSPro (Monte Carlo Simulator)**
  - **Inside Edge Systems – Bill Brower**
  - **1000mileman@mindspring.com**
  - **(203) 454-2754**
- **My Websites:**
  - **www.mesasoftware.com**
  - **www.eMiniZ.com**
  - **www.IndiceZ.com**
  - **www.ISignals.com**

Discount Opportunities

- **20 Percent discounts**
- **www.eMiniZ.com**
  - **Sign up for 30 day free trial using code XQP4135**
- **www.IndiceZ.com**
  - **Sign up for 30 day free trial using code XQH3065**

And In Conclusion . . .

I know you believe you understood

what you think I said,

but I am not sure you realize

that what you heard is not what I meant