
Colleagues In Trading Seminar

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ENGINEERS ARE AS

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

AS ANYONE



Fibonacci 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

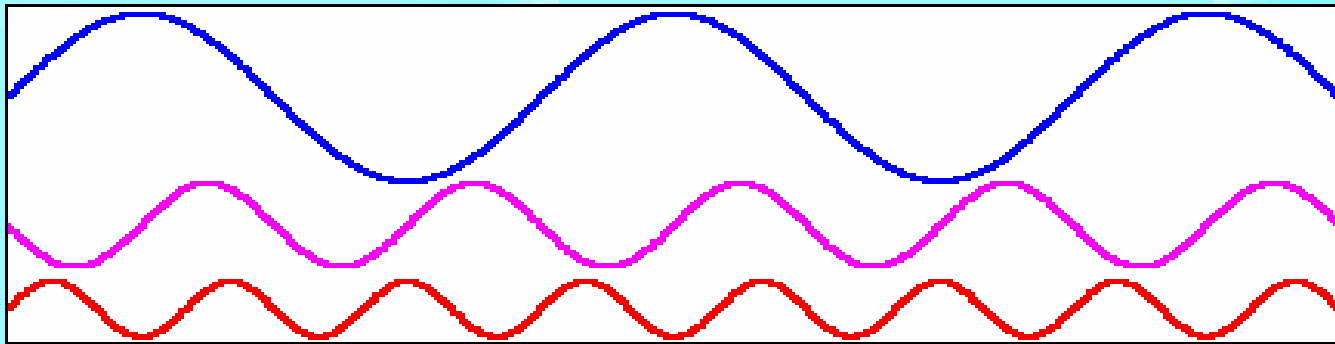
- **Thousands of patterns have been catalogued**
 - Double Bottom, Head & Shoulder, Flags, Pennants, etc.
 - All are anecdotal or within the probability of chance
- **Tune your TV to an unused channel and stare at the screen intently**
 - I guarantee you will see patterns formed out of pure noise
- **If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



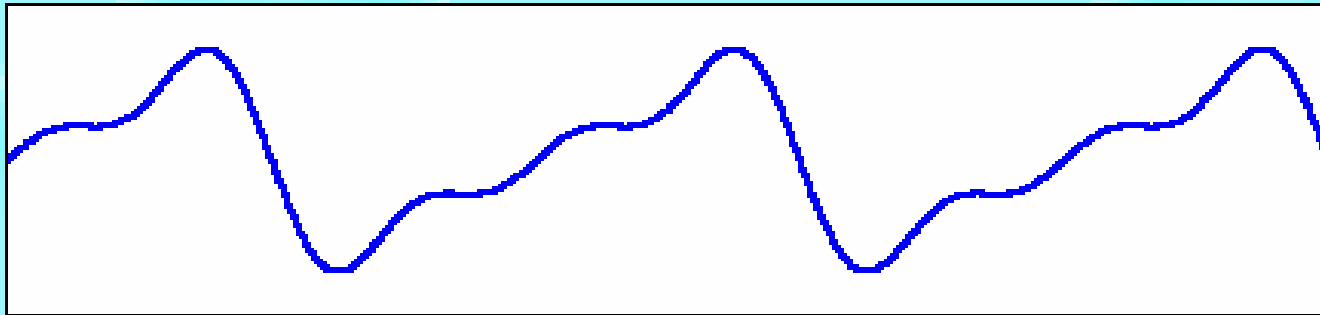
Wave Synthesis

- Sinewaves are the primitives to synthesize more complex waves

$$\text{wave} = \text{SIN}(F*T) - \text{SIN}(2*F*T)/2 + \text{SIN}(3*F*T)/3$$



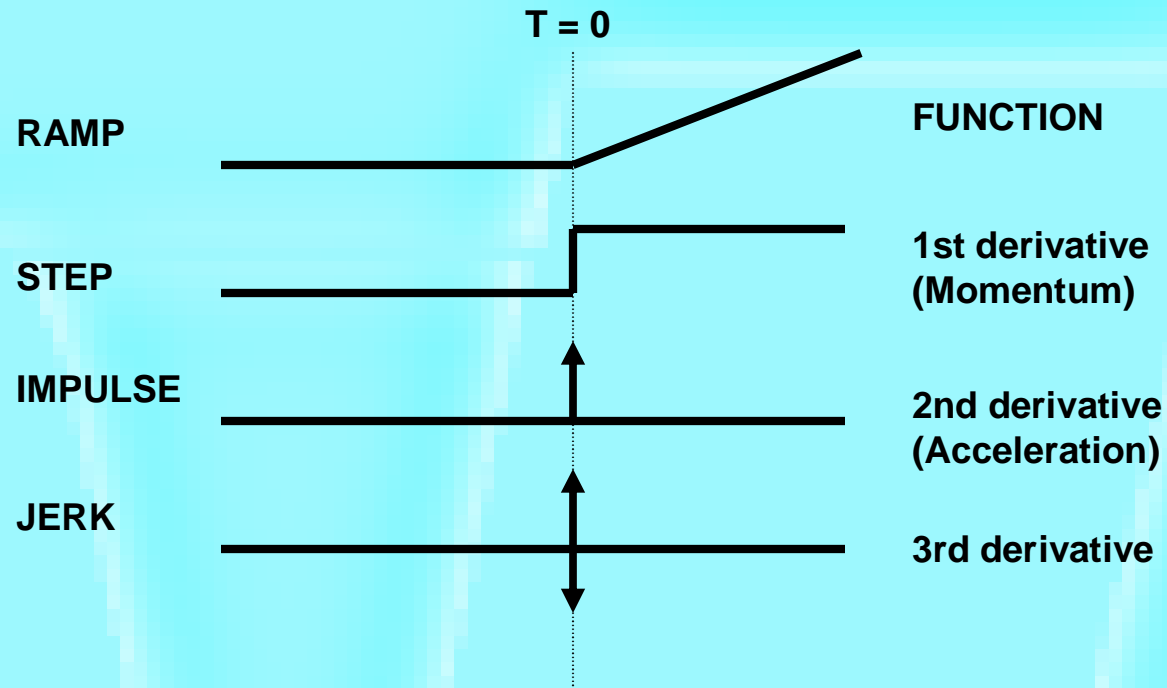
Combined Waveform: Elliott Wave?



- Why not just deal with measurable primitives?



Momentum Functions

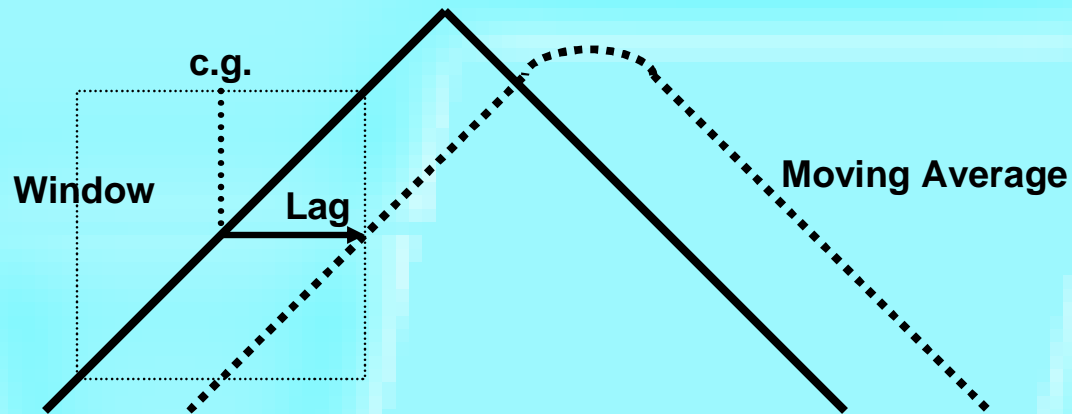


CONCLUSIONS:

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

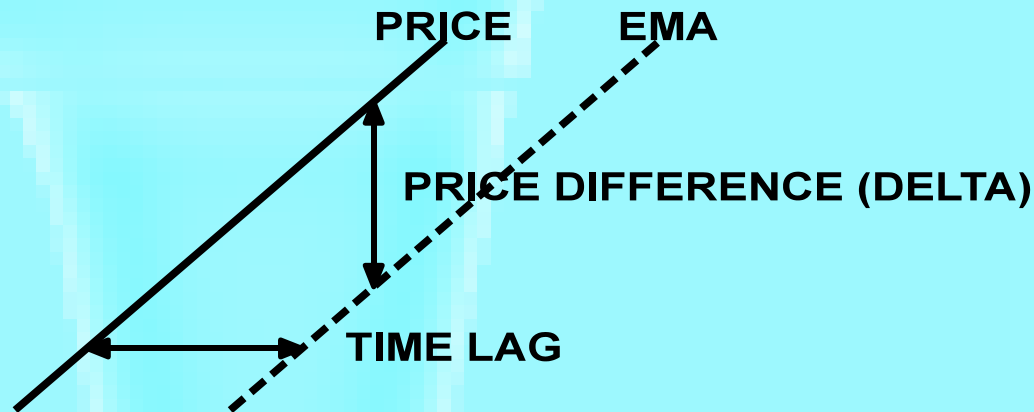
<u>α</u>	<u>k (Lag)</u>
.5	1
.4	1.5
.3	2.33
.25	3
.2	4
.1	9
.05	19

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



Concept of Predictive Filters

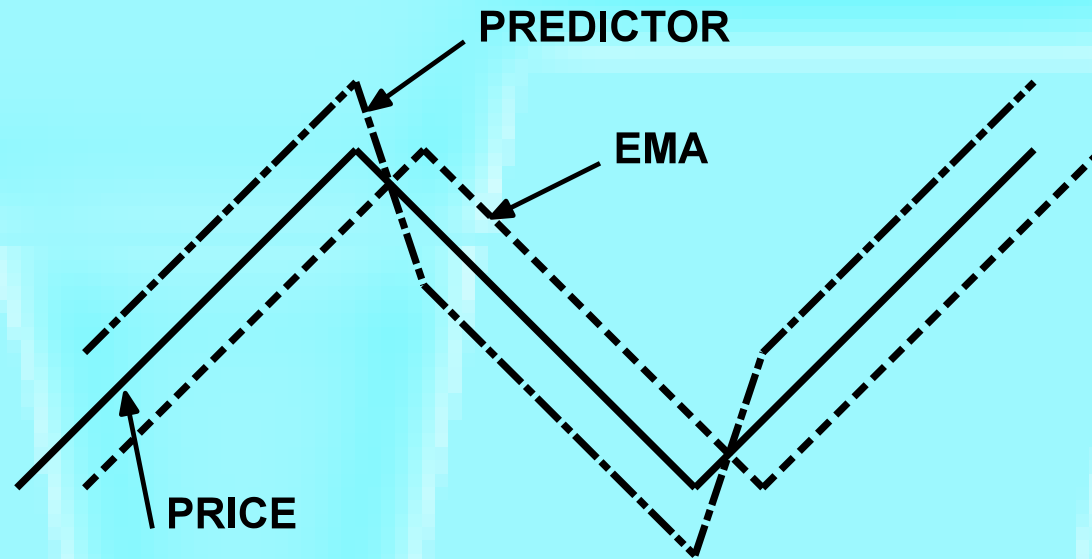
- **In the trend mode price difference is directly related to time lag**



- **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 $2 \cdot \text{delta}$ 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**

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

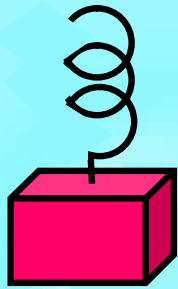


Efficient Market

- **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



$$F = -kx$$

$$F = ma$$

$$\text{Therefore: } ma = -kx$$

$$dx/dt = v$$

$$dv/dt = a$$

$$\text{Therefore: } a = d^2x / dt^2$$

$$\text{And: } m \cdot d^2x / dt^2 = -kx$$

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

$$\text{Then: } dx/dt = \omega \cdot \cos(\omega t)$$

$$d^2x/dt^2 = -\omega^2 \cdot \sin(\omega t)$$

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

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)



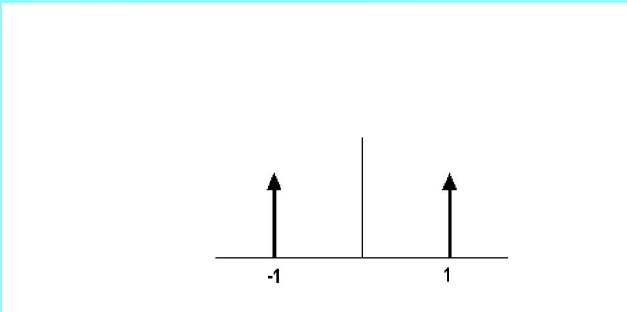
Many Indicators Assume a Normal Probability Distribution

- **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**



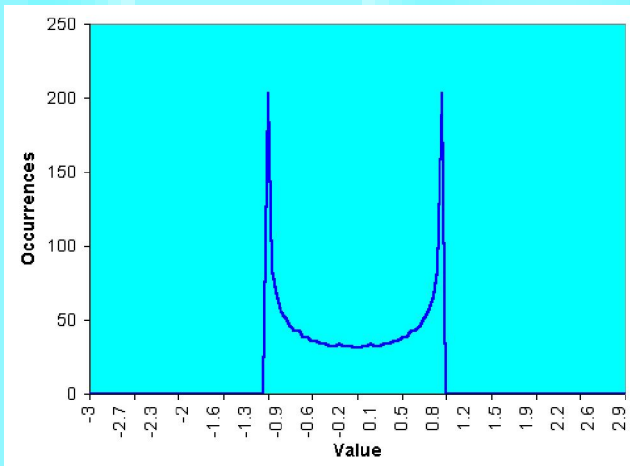
What are Probability Density Functions?

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

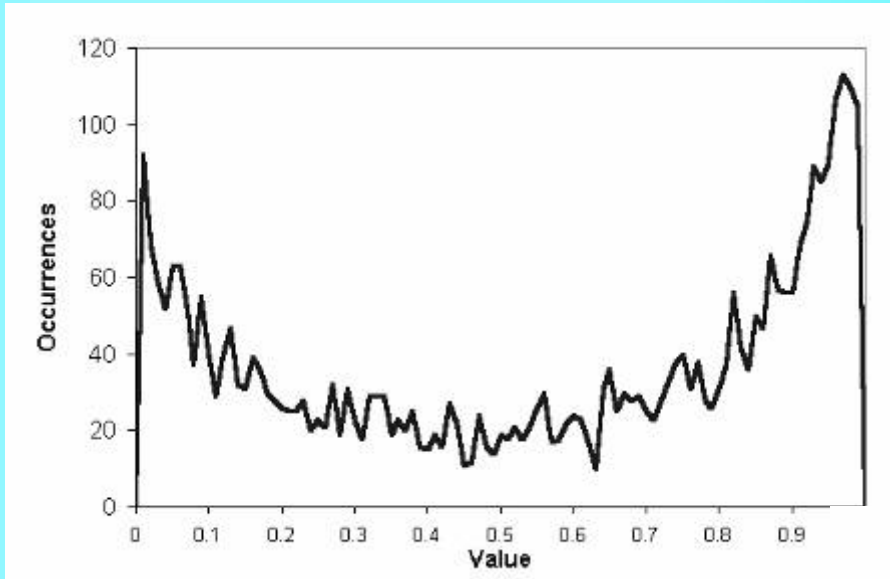
A Square Wave is untradeable with conventional Indicators because the switch to the other value has occurred before action can be taken



A Sinewave PDF is not much different from a Squarewave PDF

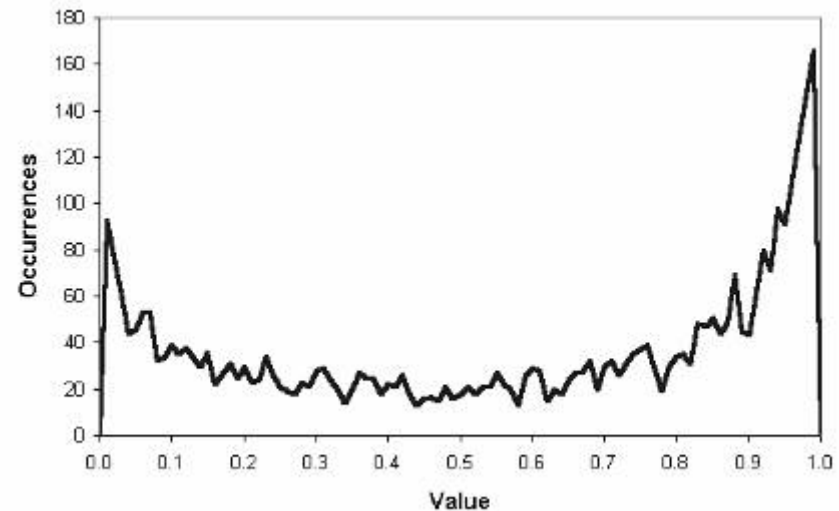


Real Probabilities are NOT Gaussian

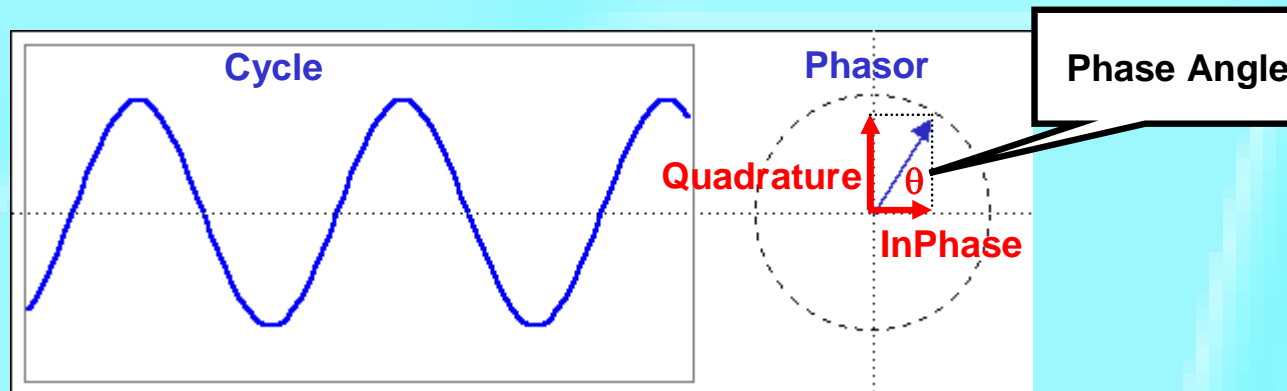


**Probability Distribution of a 10 Bar Channel
Over 15 years of Treasury Bond data**

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



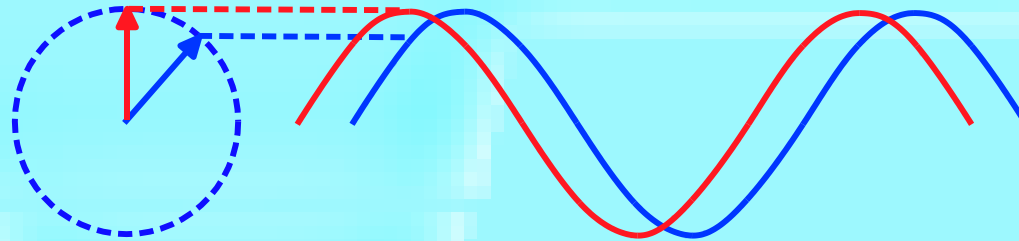
A Phasor Describes a Cycle



- **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°**



Sinewave Indicator Advantages

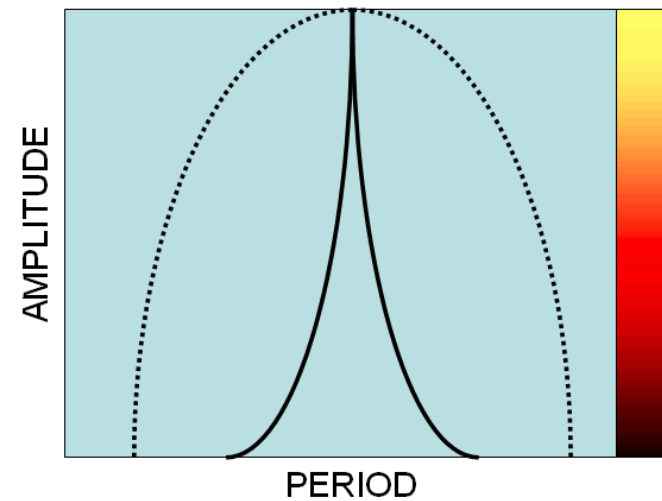
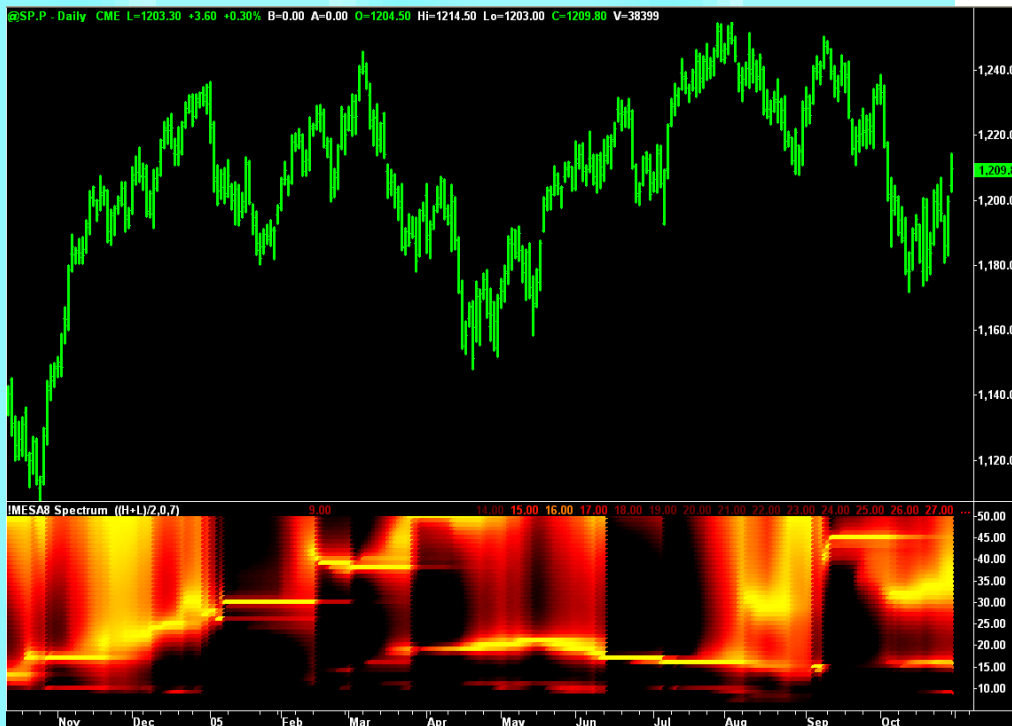


- **Line crossings give advance warning of cyclic turning points**
- **Advancing phase does not increase noise**
- **Indicator can be “tweaked” using theoretical waveforms**
- **No false whipsaws when the market is in a trend mode**



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**



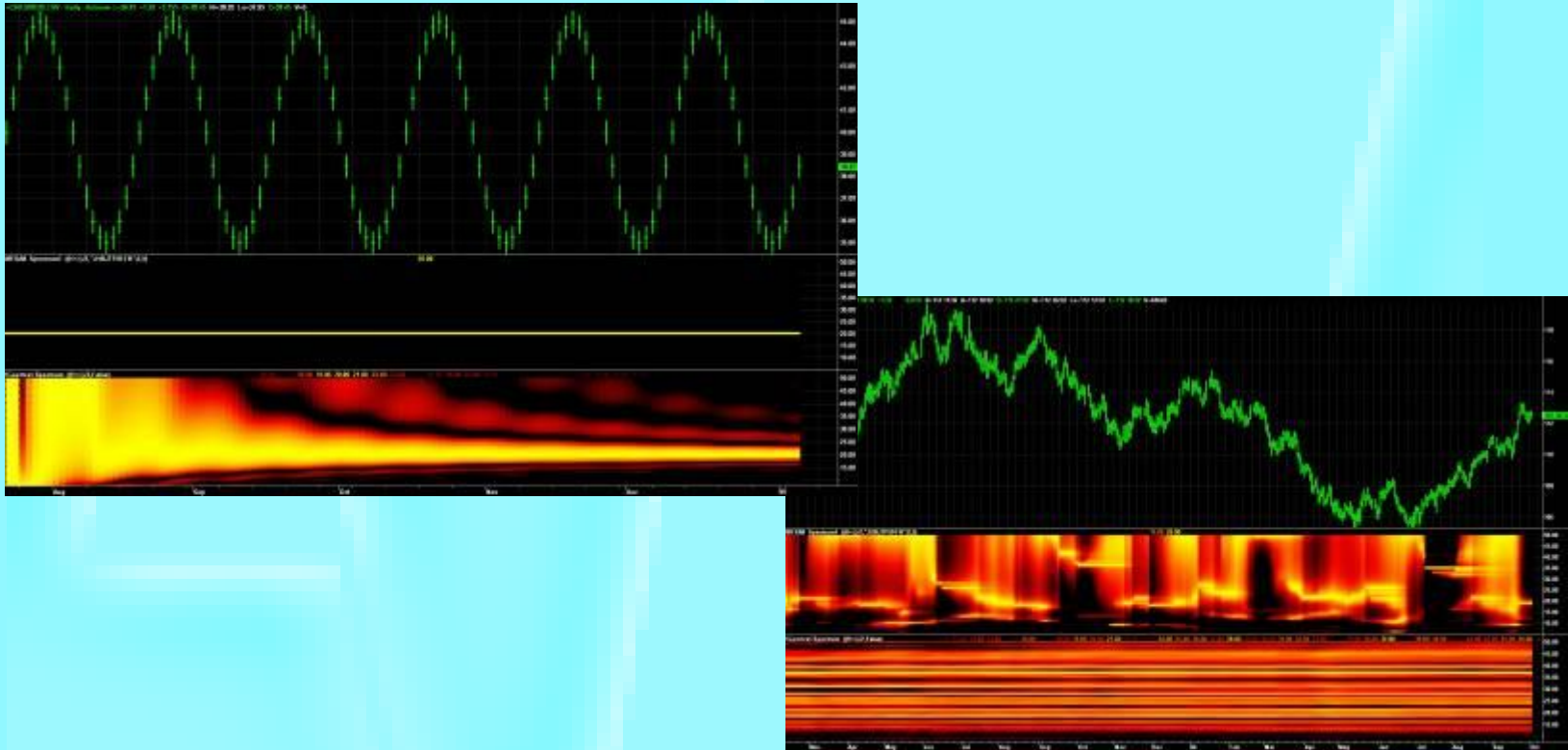
Chirped Z Transform (CZT)

- **Hopeless**



Goertzel

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

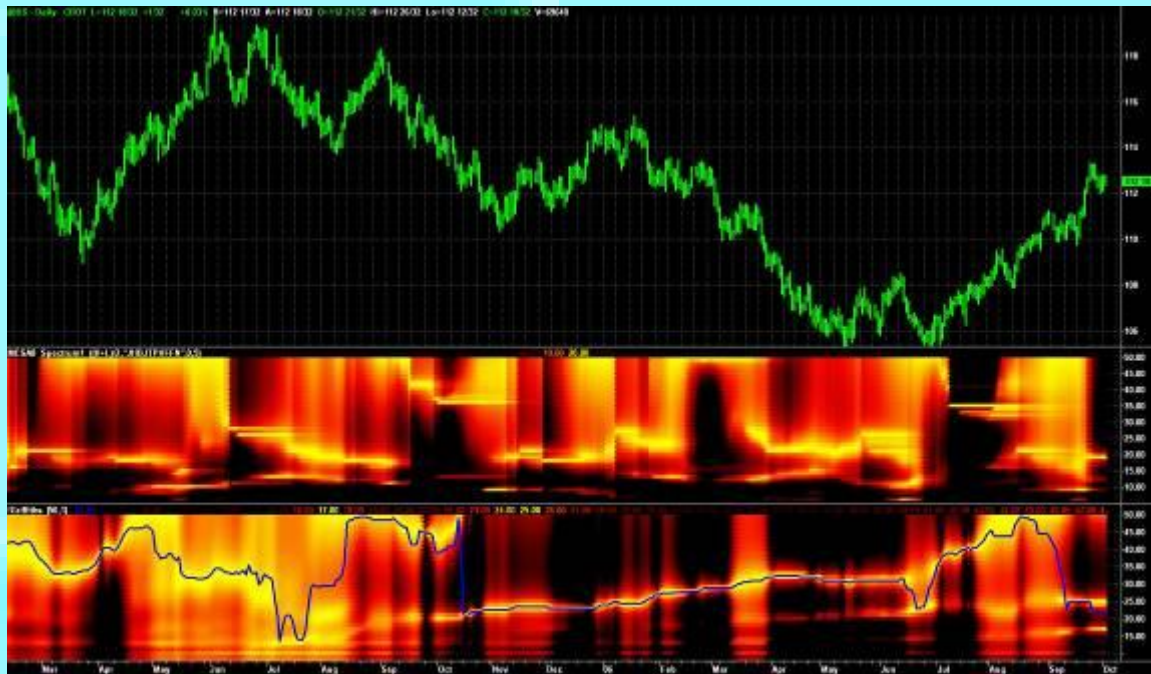


- Goertzel measurements do not converge on market data



Griffiths

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

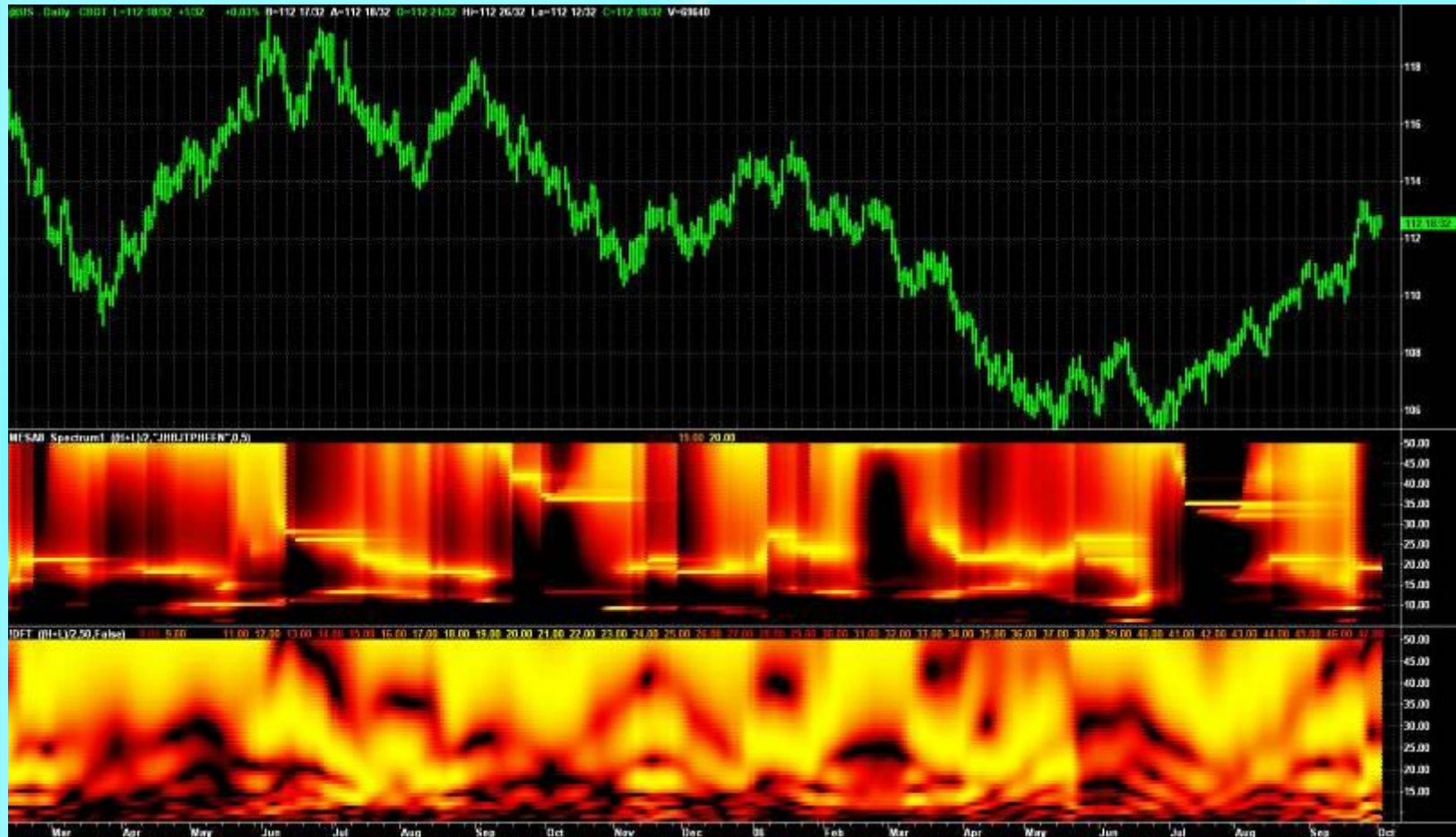


- **No kewpie doll for accuracy**



DFT

- Discrete Fourier Transform (DFT) has poor resolution



MUSIC

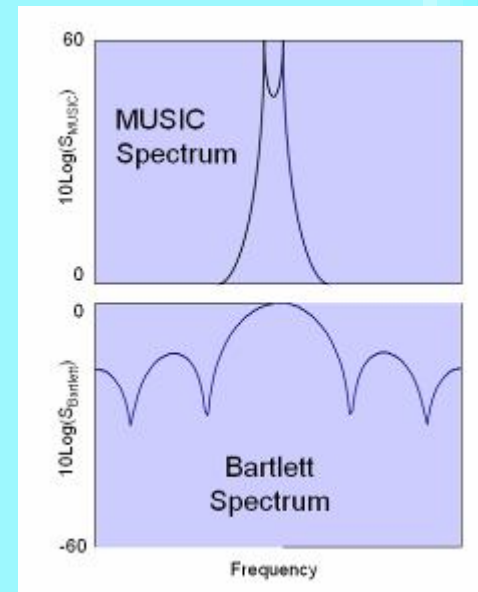
- **MULTiple Signal Identification and Classification (MUSIC)**
- **Kay & Demeure*** showed that the resolution of the Bartlett spectrum (a DFT) and a MUSIC spectrum (a MESA) are related by the transform

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

$$\text{where } 0 \leq S_{Bartlett} \leq 1$$

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

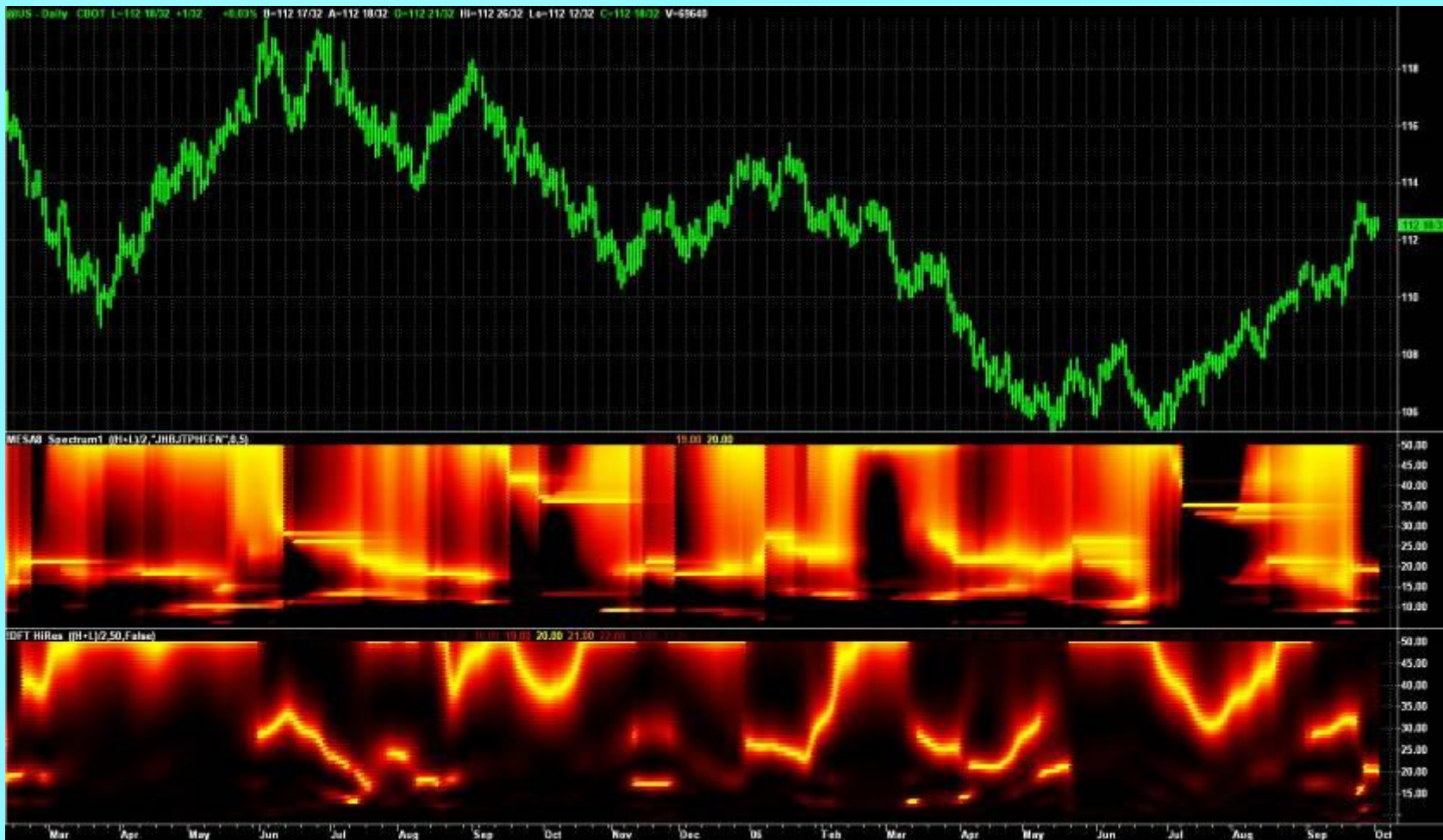
$$S_{MUSIC} = \frac{0.01}{1 - .99 * S_{DFT}}$$



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

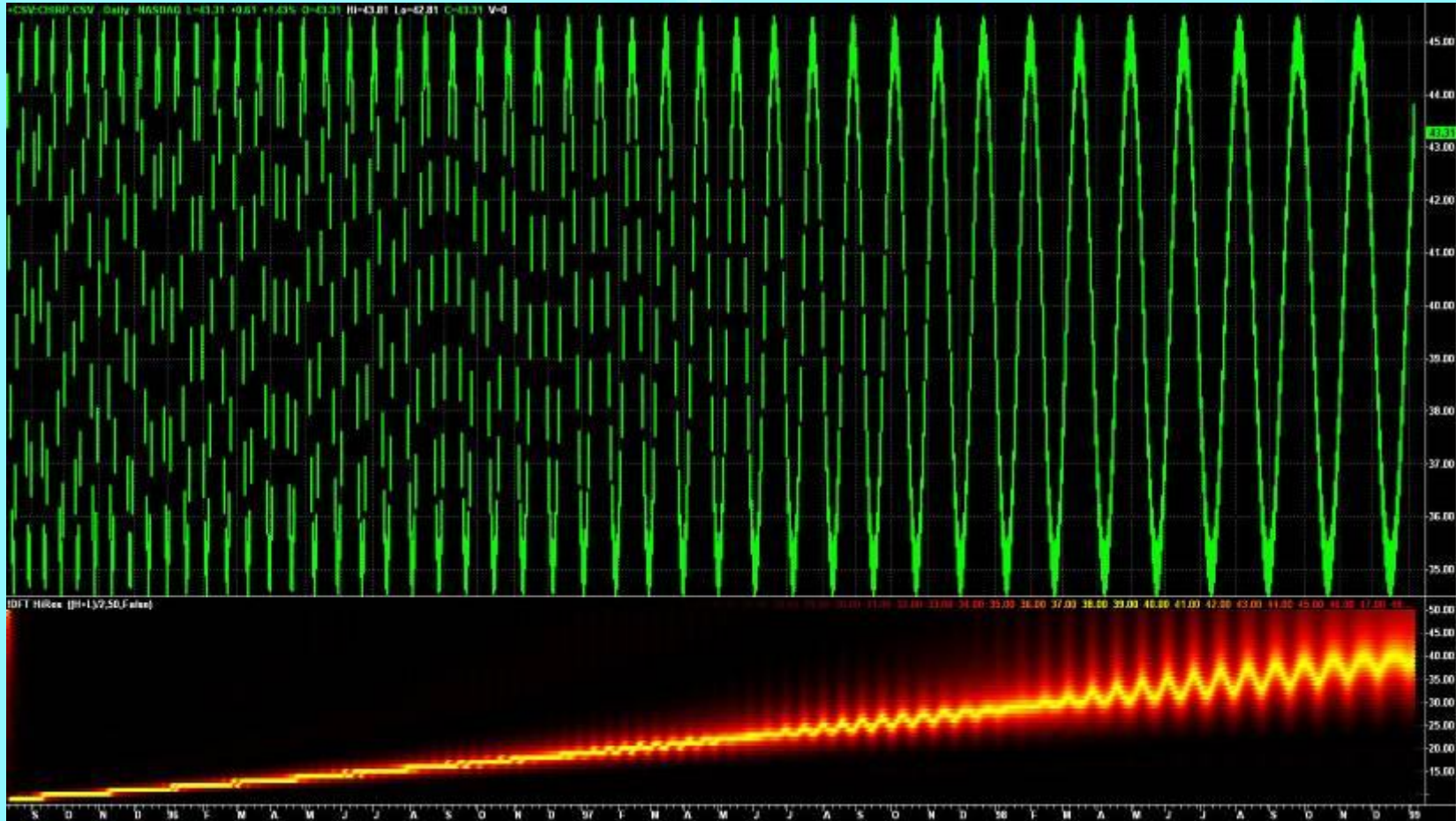


MUSIC



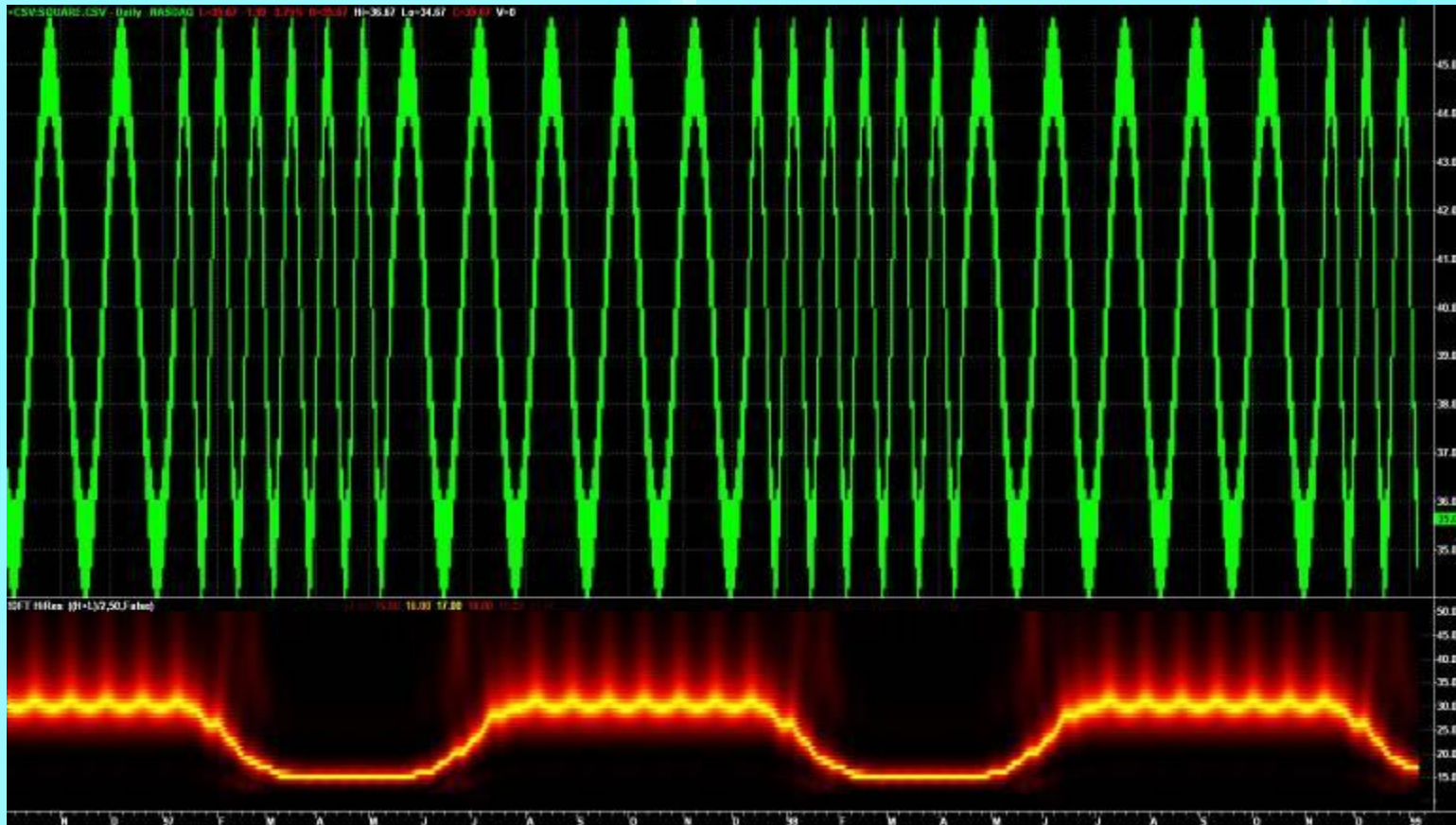
DFT Chirp Response

- High Resolution DFT Accurately Measures Cycle Periods



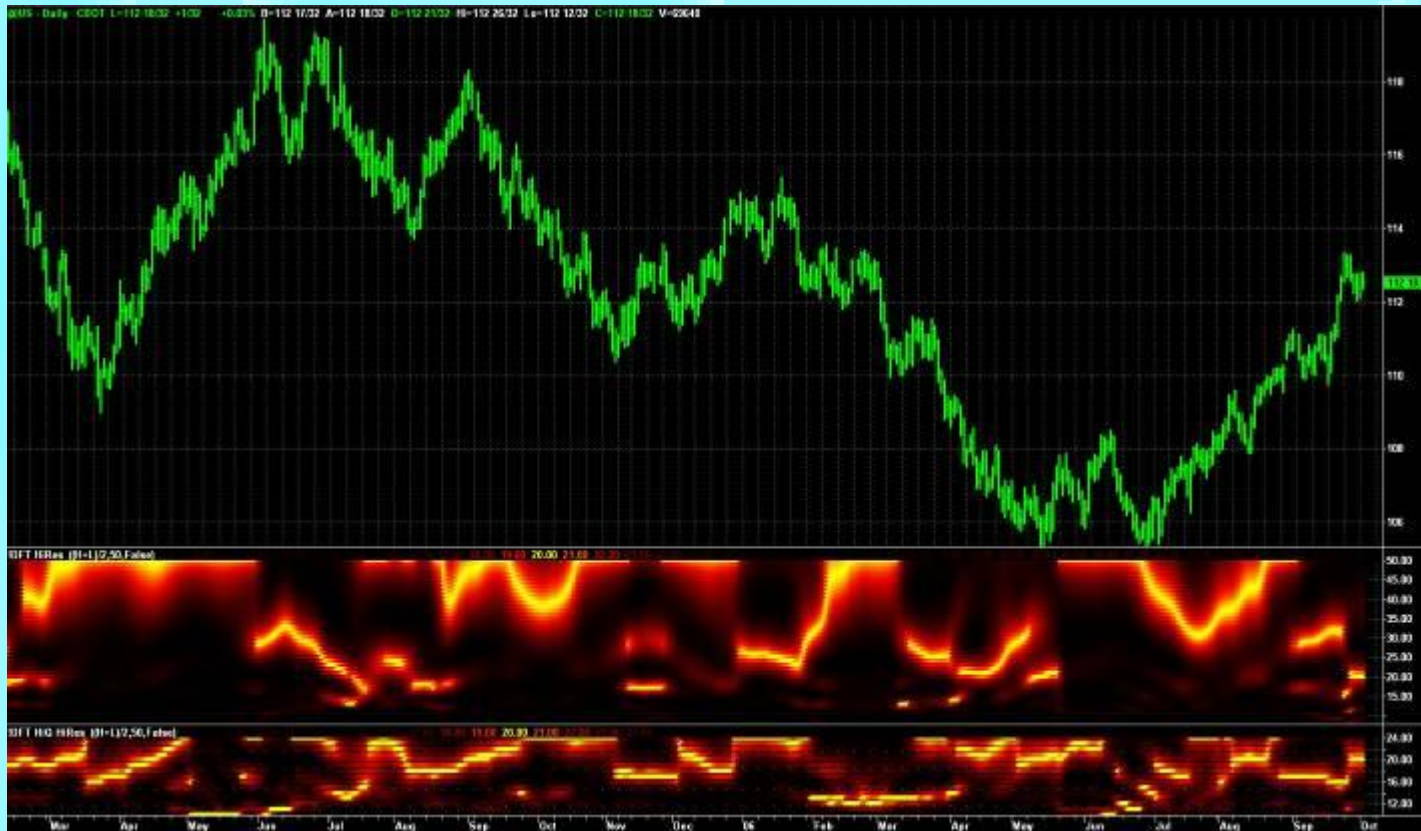
DFT Square Wave Response

- 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: $d(\text{Sin}(\omega t) / dt = \omega * \text{Cos}(\omega t)$
 - Therefore: $\text{Lead} = (\text{Period} / 6.28318) * (\text{BP} - \text{BP}[1])$
- **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]);
```

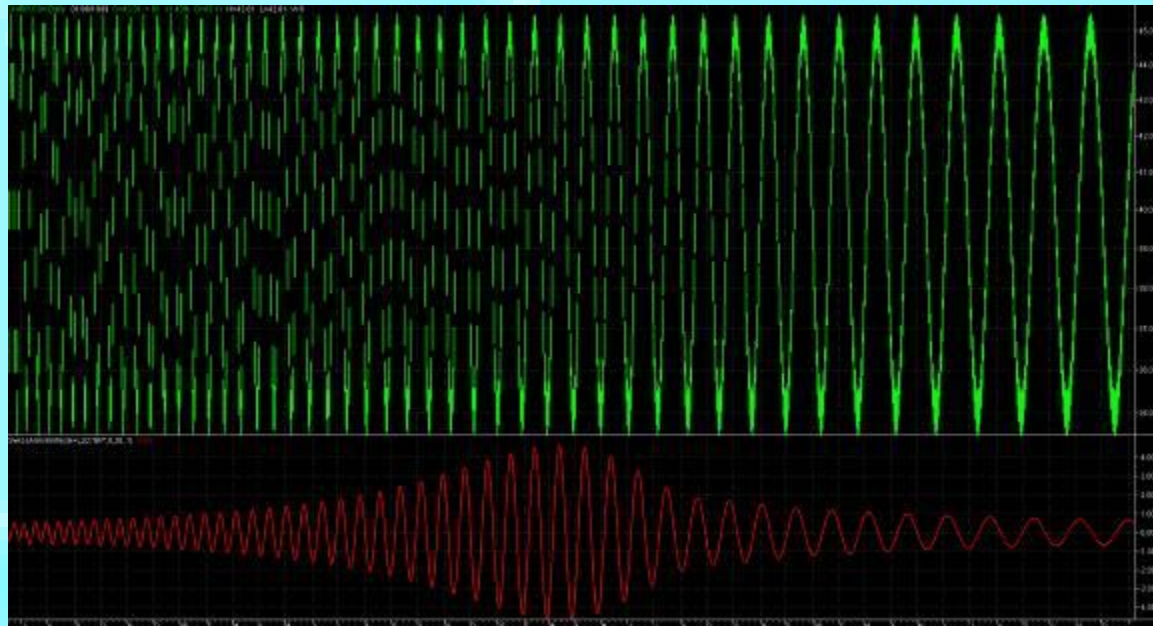
```
Plot1(BP,"bp");
```

```
Plot2(Lead, "lead");
```



BandPass Filter

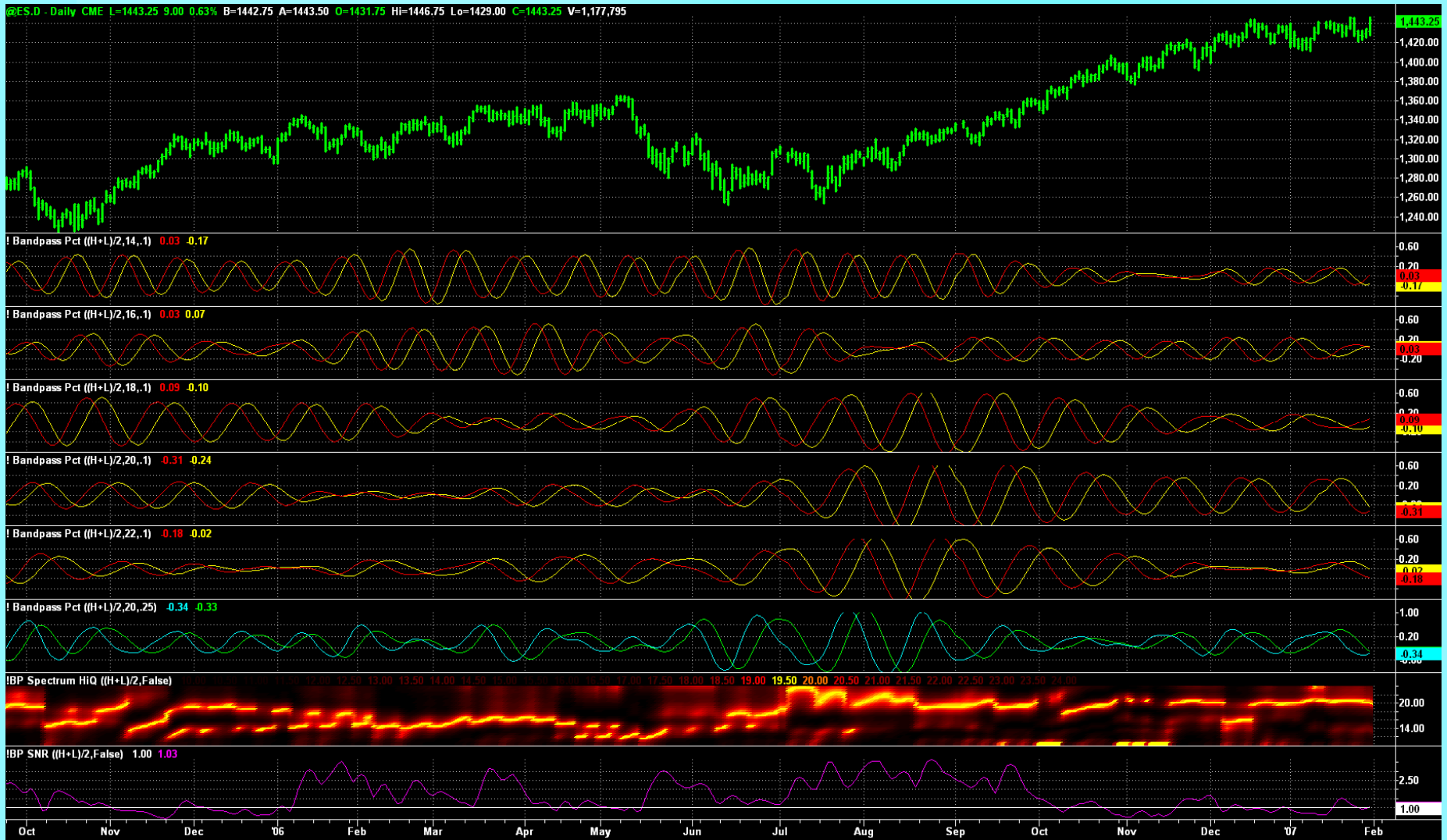
- **Eliminates both high frequency and low frequency noise**



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

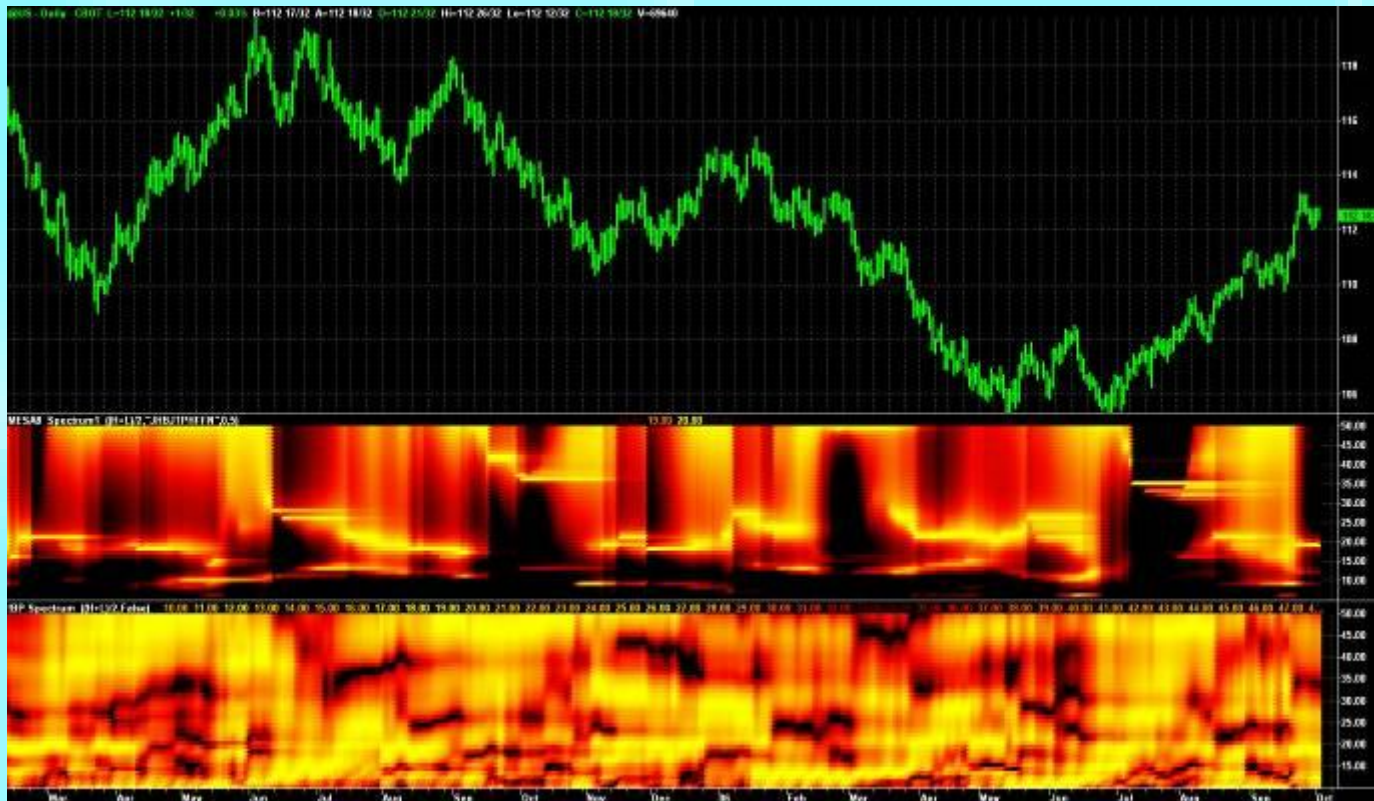


BandPass Response Study



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

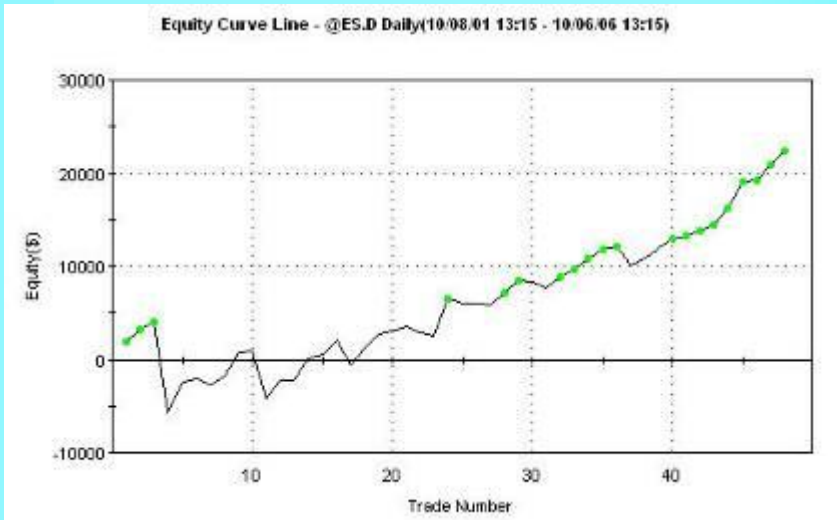


How to Use Measured Cycles

- **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

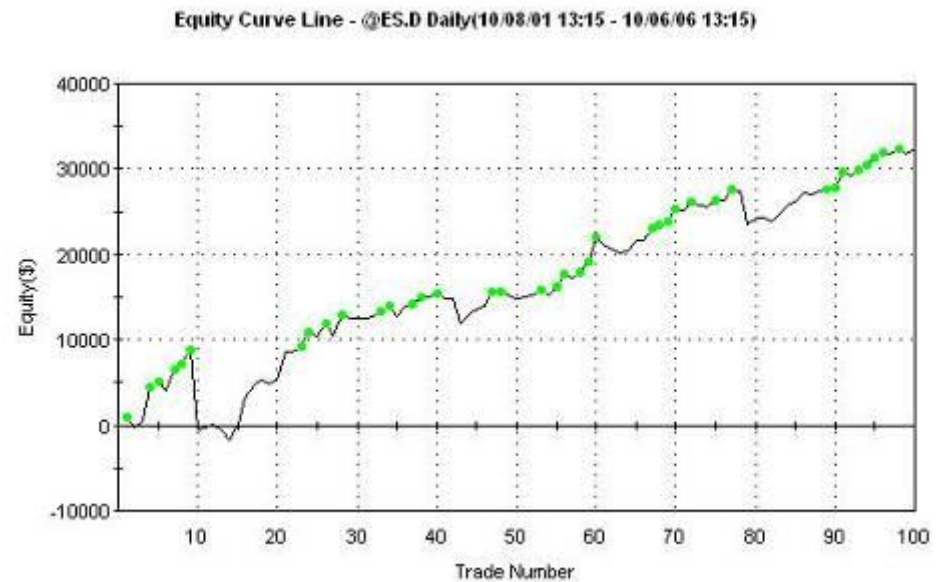


Adaptive Strategy Improvement



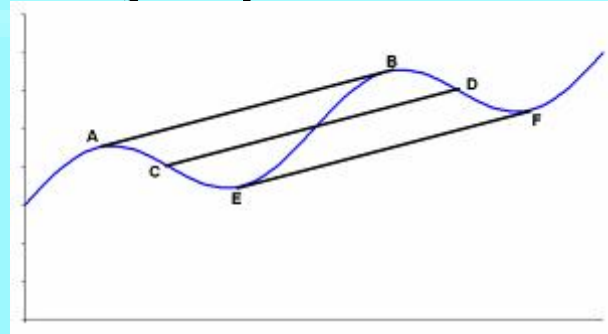
**Fixed-Length RSI
(and length optimized)**

DFT-Tuned RSI

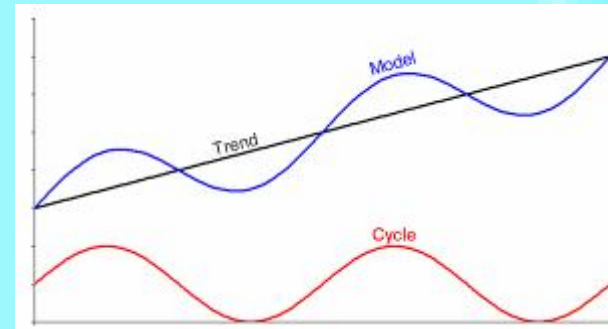


Trends

- **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 $(\text{ProfitFactor}) * (\% \text{ Profitable})$



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



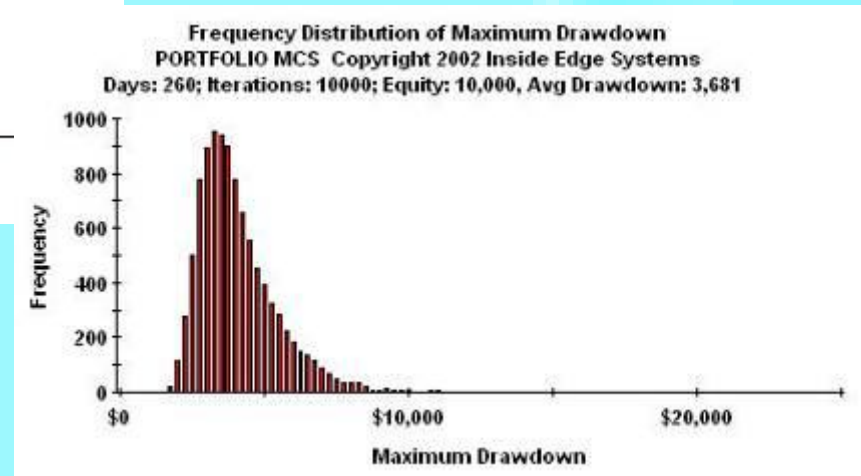
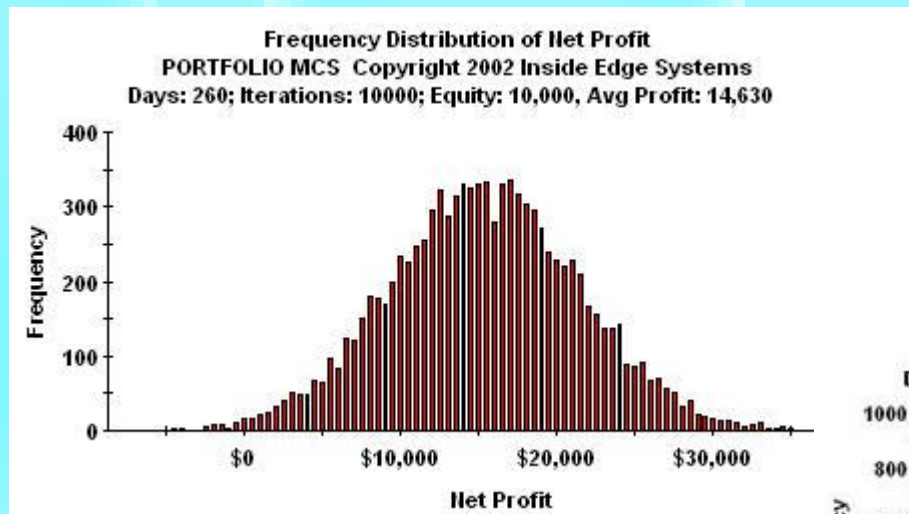
Portfolio Diversification

- **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 losing trades
 - PF = Profit Factor = $\$W / \L
 - % = Percent Winning Trades $\{(1-\%) = \text{Percent Losing Trades}\}$ as fractions



Some Interesting Relationships

$$\begin{aligned} \frac{\text{AveWin}}{\text{AveLoss}} &= \frac{\$W/\#W}{\$L/\#L} \\ &= \frac{\$W \#L}{\$L \#W} \\ &= PF \frac{\#L (\#W + \#L)}{\#W (\#W + \#L)} \\ &= PF \frac{(1 - \%)}{\%} \end{aligned}$$

$$\text{AveTrade} = T$$

$$\begin{aligned} &= \frac{\$W - \$L}{\#W + \#L} \\ &= \frac{\$W}{\#W + \#L} - \frac{\$L}{\#W + \#L} \\ &= \frac{PF}{1 + \#L/\#W} - \frac{\$L}{\#L(\#W/\#L + 1)} \end{aligned}$$

and, since $\$L/\#L = 1$

$$\begin{aligned} &= \frac{PF}{1/\%} - \frac{1}{1/(1 - \%)} \\ &= PF\% - (1 - \%) \\ &= \%(PF + 1) - 1 \end{aligned}$$

Breakeven occurs when $T = 0$. In this case:

$$1 = \%(PF + 1)$$

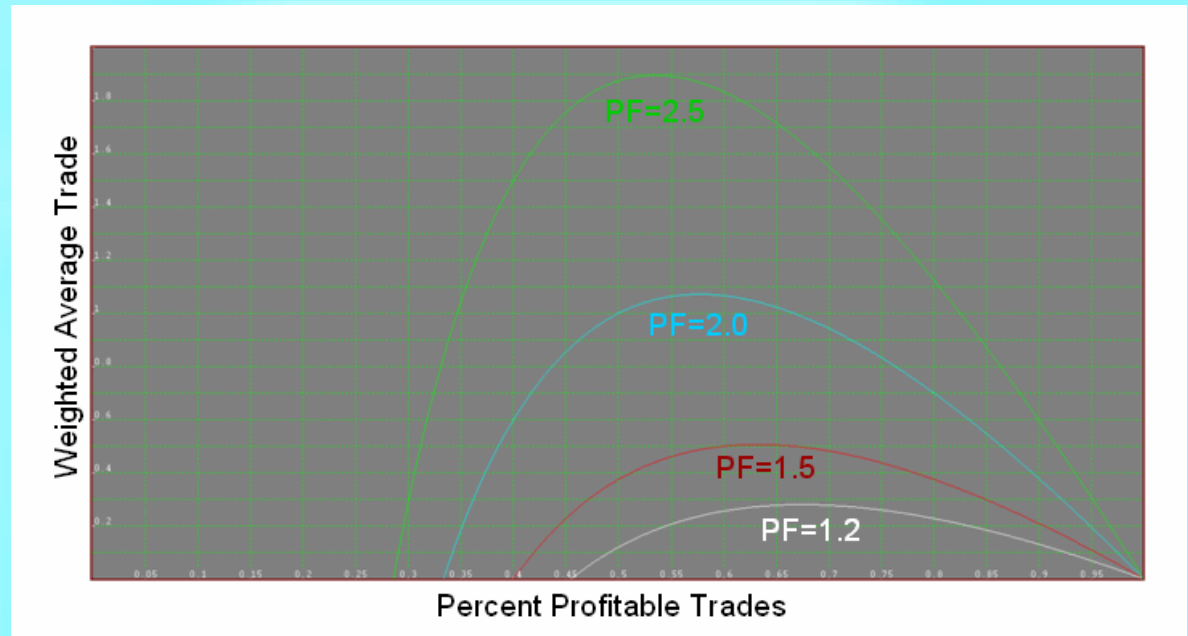
$$PF = \frac{1}{\%} - 1$$

$$PF_{\text{BREAKEVEN}} = \frac{1 - \%}{\%}$$



Weighted Average Trade

$$\begin{aligned} T \frac{\text{AveWin}}{\text{AveLoss}} &= TW \\ &= (\% (PF - 1)) \left(\frac{PF(1 - \%)}{\%} \right) \\ &= PF \left((PF + 1) - \frac{1}{\%} \right) (1 - \%) \\ &= PF (PF(1 - \%) - (\% + \frac{1}{\%}) + 2) \end{aligned}$$



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

$$0 = -PF - 1 + \frac{1}{\%}^2$$

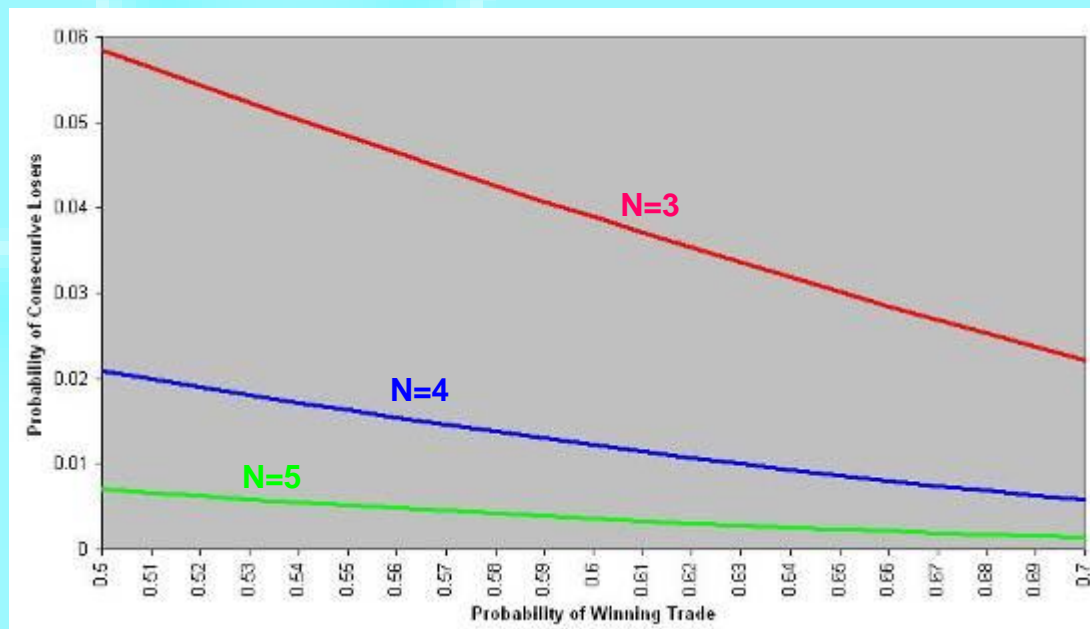
so that

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



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
 - $q = 0.4$
- $q = r + 2r^2 + 3r^3 + 4r^4 + 5r^5 + \dots$
- 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

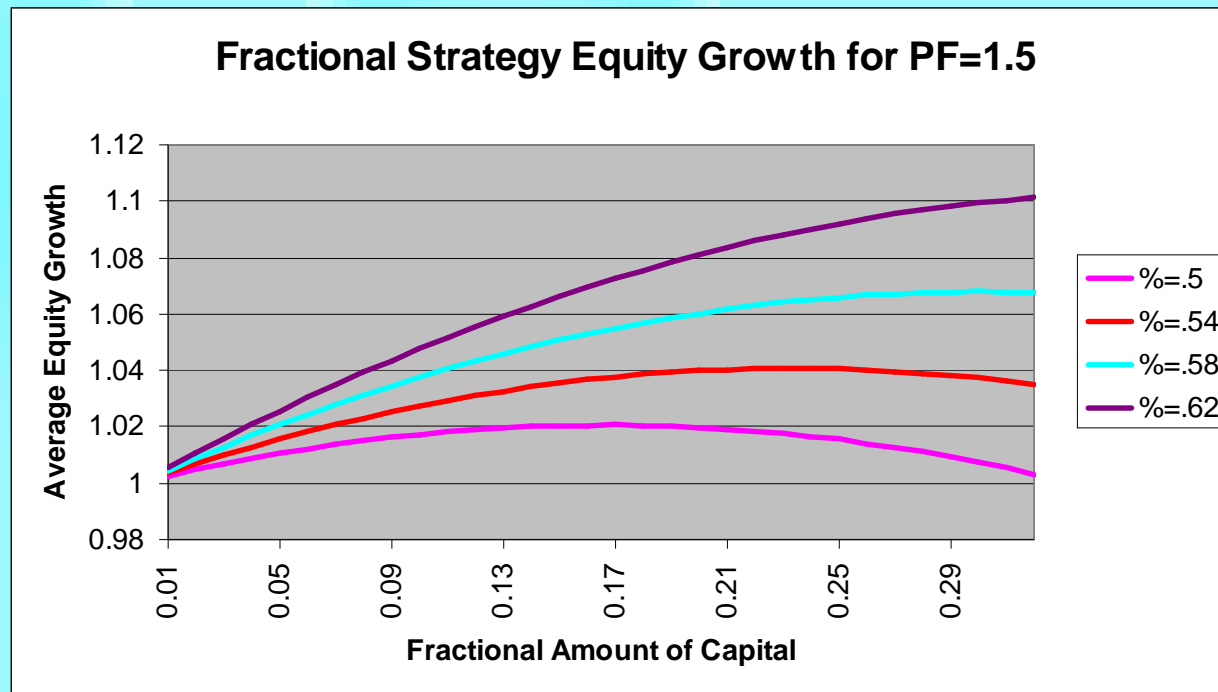
- **Idea is to commit a fractional part of current capital to each trade rather than a fixed trade amount**

In a random process the trades are:

$$E = (1 + fPF)(1 + fPF)(1 - f) \dots$$

So the Expectation of equity growth becomes:

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



Optimal f

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

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

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

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

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

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

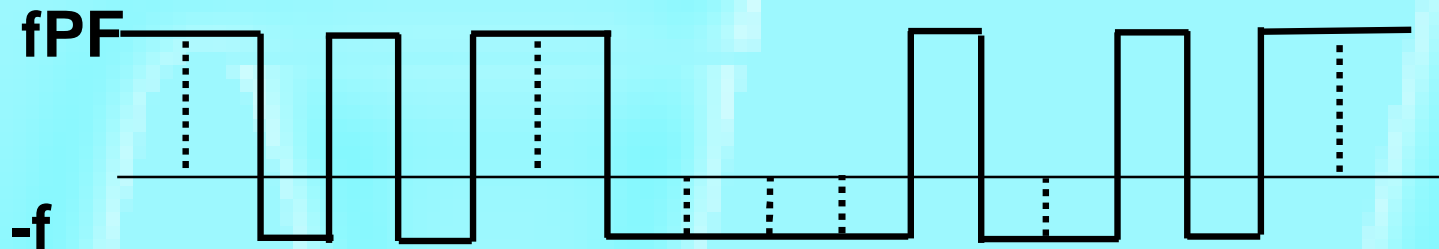
$$f_{opt} = \frac{\%(PF + 1) - 1}{PF}$$

- **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) / $\sigma \approx 1 / RMS$**
- **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



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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**

