

Investment Analytics

Volatility Arbitrage Program

Program Description

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Origins



“Using the power of computational econometrics to navigate financial markets.”

Program Objectives

- Non-discretionary, systematic approach
 - Robust under varying market conditions
- Reliable, high-alpha, arbitrage strategies
 - Non-directional
 - Uncorrelated
- Risk controlled
- Scalability and capacity

Arbitrage Program Platform

- Econometric Models
- Data Management System
- Model Management System
- Portfolio Management System
- Trade Sheets
- Risk Management System



Advantages

- Proven track record in \$170M hedge fund
 - Returns from 15% to 1600% in 2003
- Source of sustainable, uncorrelated alpha
- Adaptable to broad range of strategies, markets and asset classes
- Rapid scalability, capacity in \$billions

Experience



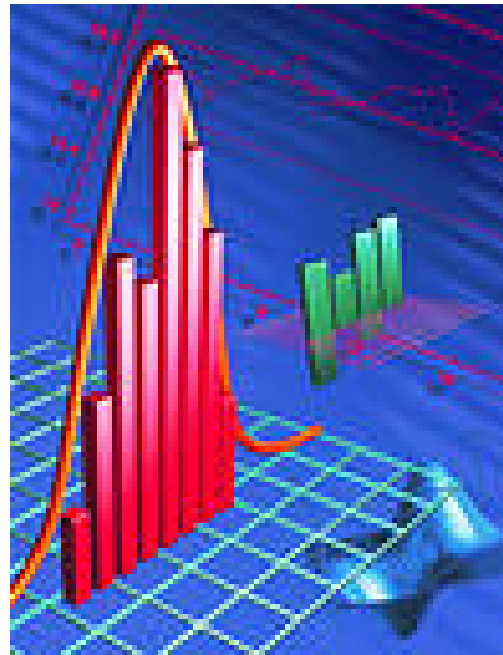
- Jonathan Kinlay, PhD
 - CEO of Proteom Capital Management Ltd.
 - Founder & GP of \$350M Caissa Capital fund
 - Managed \$50M hedge fund for 7 Years
 - Founder, Investment Analytics
 - PhD Graduate Economics
 - Adjunct Professor, New York University



- Chris Rosevear, PhD
 - PhD Graduate Economics
 - 15 years as financial analyst
 - AG Becker, NatWest, Citibank
 - Technical consultant, MCSE qualified

Key Investment Concepts

- Returns are non-Gaussian
- Volatility is stochastic
 - Varies over time
 - Predictably
 - With 'long memory'
- Portfolio Construction
 - Cointegration
- Risk Management
 - Hedging extreme event risk



Volatility Modeling

- What is “volatility”?
 - Second moment of returns distribution
 - Unobservable
 - Not the standard deviation of returns
- Range-based volatility metrics
 - More efficient, less “noisy”
 - Normally distributed
 - Important characteristic for modeling purposes

Model Type I

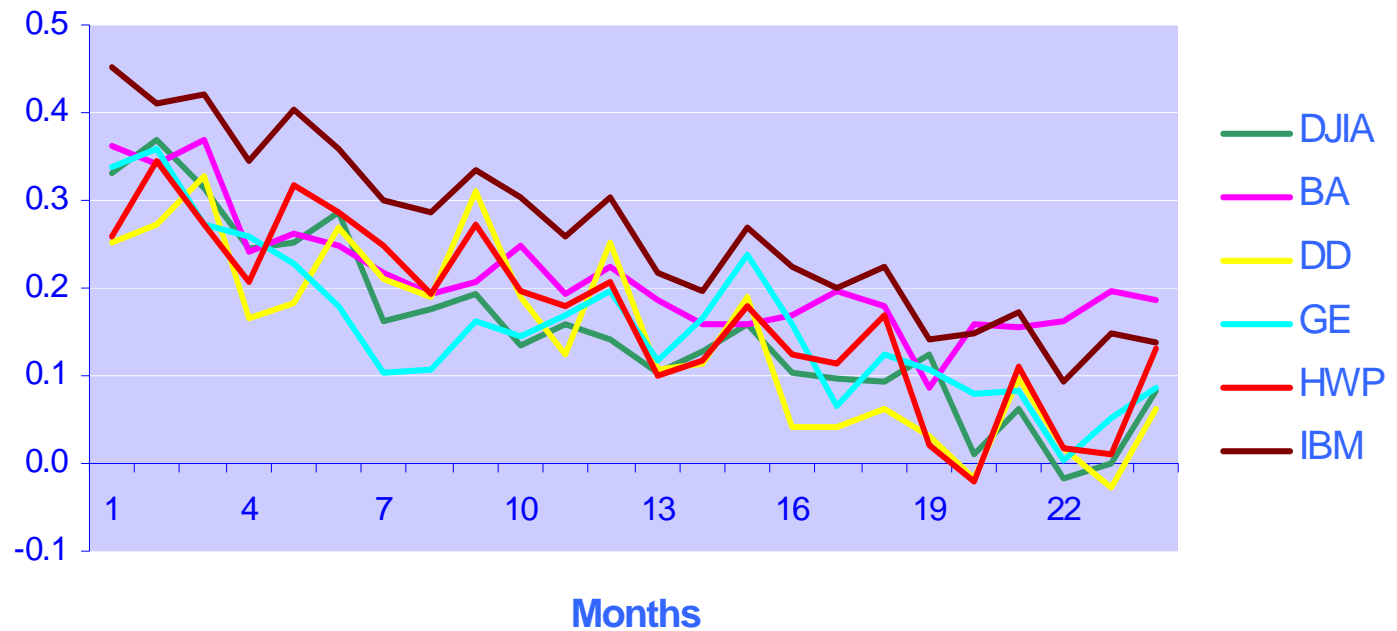
- Long Memory
 - Volatility persistence or trending behavior
- Mean Reversion
 - Short term transient behavior
 - Rapid mean reversion
- Multifactor Models
 - Persistent, long memory component
 - Transient component

Model Type II

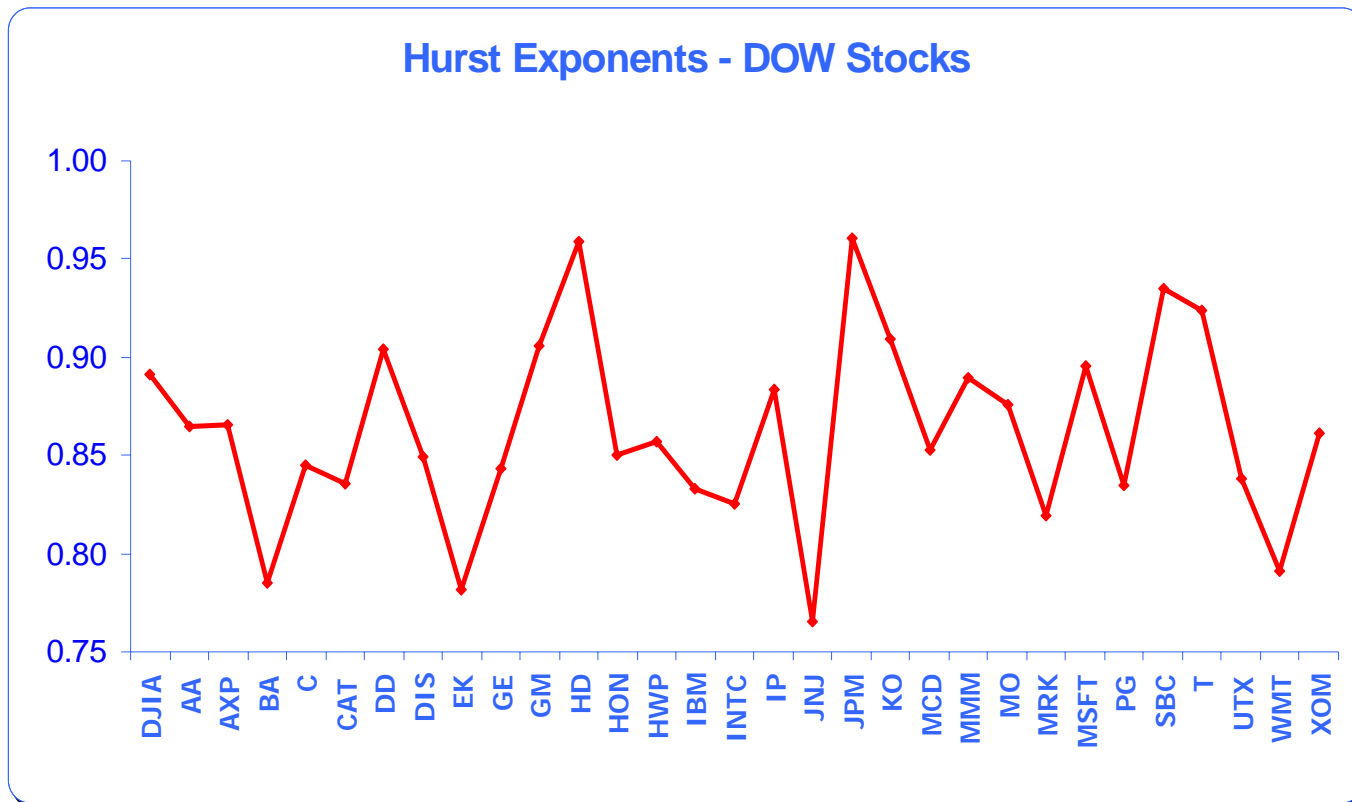
- Skewness and Kurtosis Models
 - Interaction between the volatility and returns process
- Asymmetry Models
 - Captures important asymmetry effects
- Markov State Models
 - Multiple “regimes” of volatility
 - Transition probabilities

Volatility Long Memory

Volatility Autocorrelations



DOW Stock Volatility – Long Memory



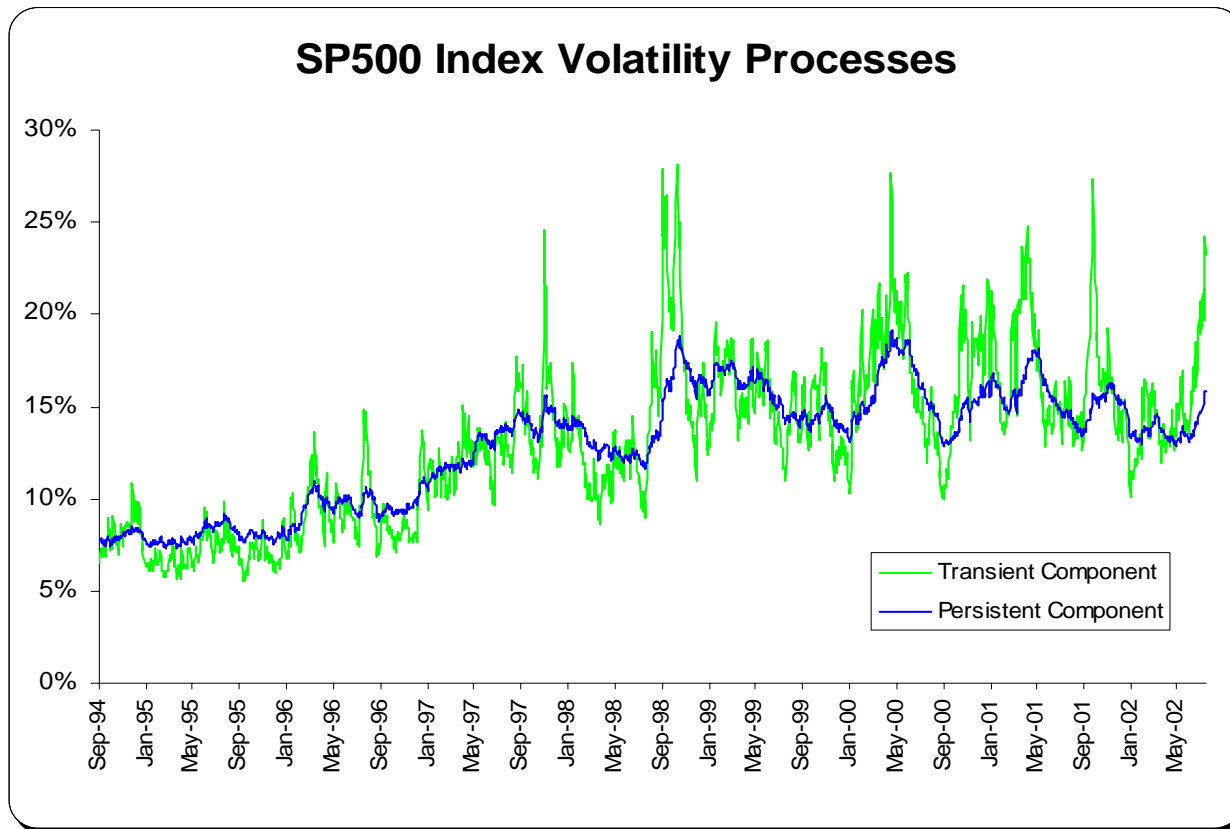
Multifactor Models

- Transient (h_t) & long term (q_t) components
- Volatility asymmetry (δ)

$$\ln h_t - \ln h_{t-1} = k_h (\ln q_{t-1} - \ln h_{t-1}) + \phi_h X_{t-1}^D + \delta_h R_{t-1} / h_{t-1}$$

$$\ln q_t - \ln q_{t-1} = k_q (\mathcal{G} - \ln q_{t-1}) + \phi_q X_{t-1}^D + \delta_q R_{t-1} / h_{t-1}$$

Two-Factor Model for SP500 Index

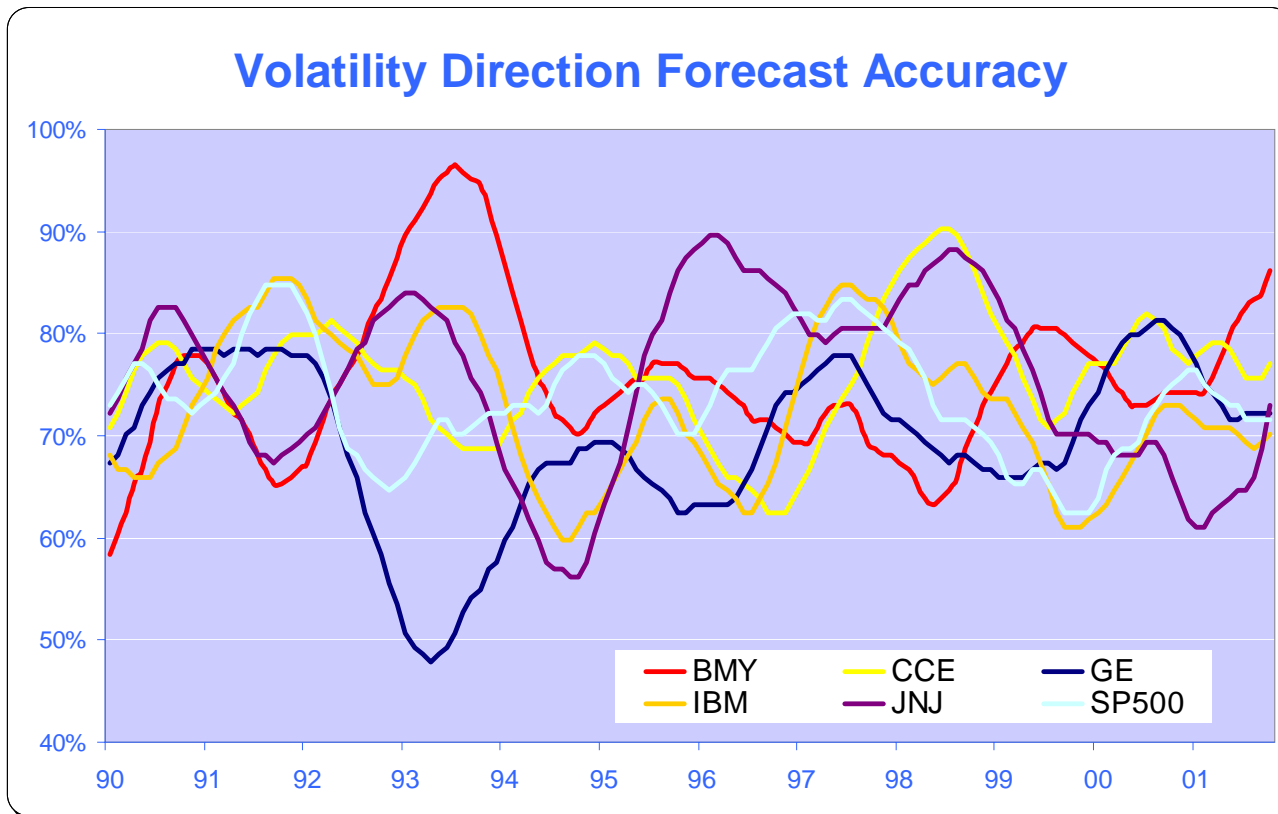


Model Management System

- MMS updates each model daily
 - 800+ models in total!
- Rates model performance
 - Around 30 statistical criteria
 - Current vs. historical performance for each model
 - Relative performance of each model
 - Regime shift detection
- Produces forecasts
 - Automatically biases in favor of best performing models
 - Makes system very robust to changing market conditions



Volatility Forecasting



Portfolio Construction

- Proprietary, multi-factor option pricing models
 - Stochastic volatility
 - Long memory, mean-reversion and asymmetry
 - Skewness, kurtosis
 - Interaction between returns and volatility
- Cointegration Analysis
 - How volatility processes “correlate”
 - Long/short volatility “baskets”
 - Stable risk/return characteristics
 - Cointegrating vectors determine allocations
 - Genetic algorithms used to select baskets

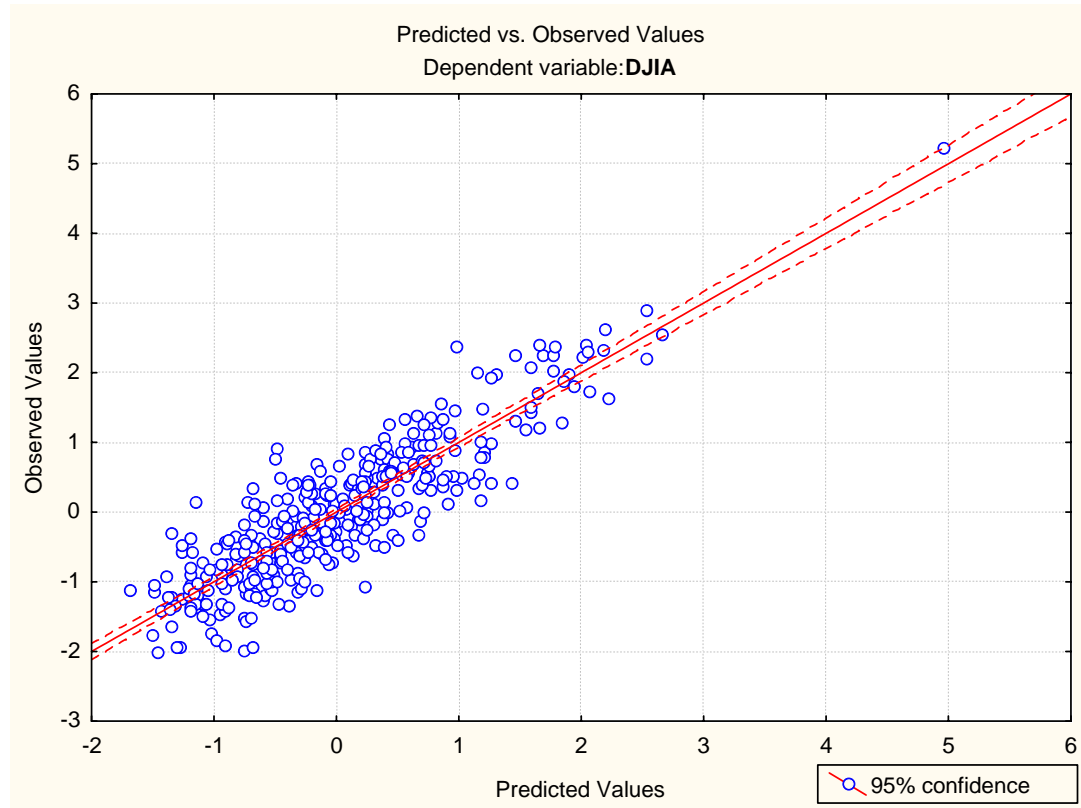


Volatility Cointegration

- Baskets of volatility move together
- Stable, long term relationships
 - Much more important than correlation
- Example:
 - Volatility in NYMEX vs IPE

Dow Cointegration Model

- DJIA
 - DD
 - GE
 - IP
 - MMM
 - MRK
 - UTX
 - XOM
- $R^2 = 78\%$



Trading Sheet

- Daily Trading Sheet
 - Excel format
- Identifies options mispriced by 50% or more
- 30-40 opportunities daily
- Distribution system
 - Dual servers (EU and NY)
 - Email trade sheet to designated traders

Trading Sheet - Example

Option Values				15-Sep-04								Expiry: 15-Oct						
				Oct-04				Oct-04				Oct-04						
FDC	43.76	18%	***	FDCVH	40	0.15	0.25	0.03	FDCVI	45	1.75	1.85	1.62	FDCJI	45	0.50	0.60	0.45
			2.65	S	28%	341%	-0.12	-2,263		24%	0%	-0.63	-1,946		19%	11%	0.33	-5,406
FNM	76.26	17%	***	FNMVM	65	0.05	0.15	0.00	FNMVO	75	1.25	1.35	0.88	FNMJO	75	2.60	2.70	2.27
			2.66		32%	11826%	-0.04	-5,345		23%	42%	-0.38	-715		20%	15%	0.63	-795
FRE	67.84	13%	***	FREVL	60	0.10	0.15	0.00	FREVN	70	2.90	3.10	2.37	FREJN	70	0.50	0.65	0.33
			2.71		28%	26862%	-0.06	-2,785		24%	22%	-0.65	-526	S	16%	51%	0.27	-1,645
GE	33.53	15%	**															
			2.56															

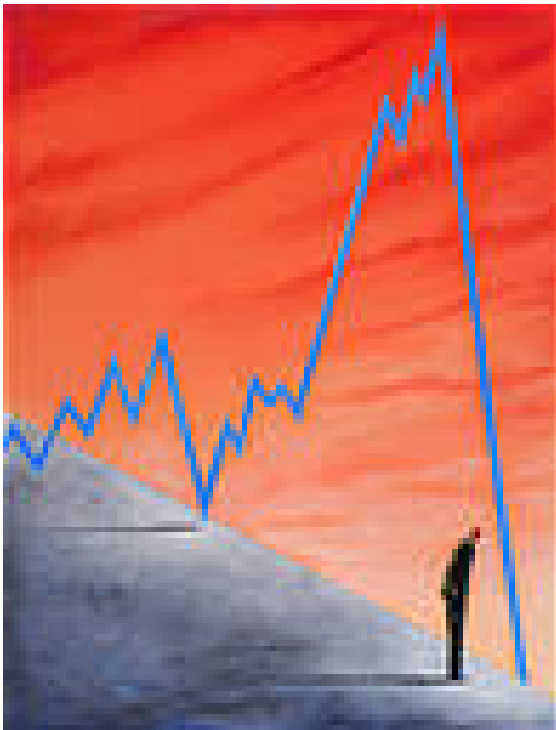
Model Output I

Option Values			
FDC	43.74	18%	***
			2.65
FHM	76.24	17%	***
			2.68
FRE	67.34	13%	****
			2.71
GE	33.53	15%	**
			2.58

Model Output II

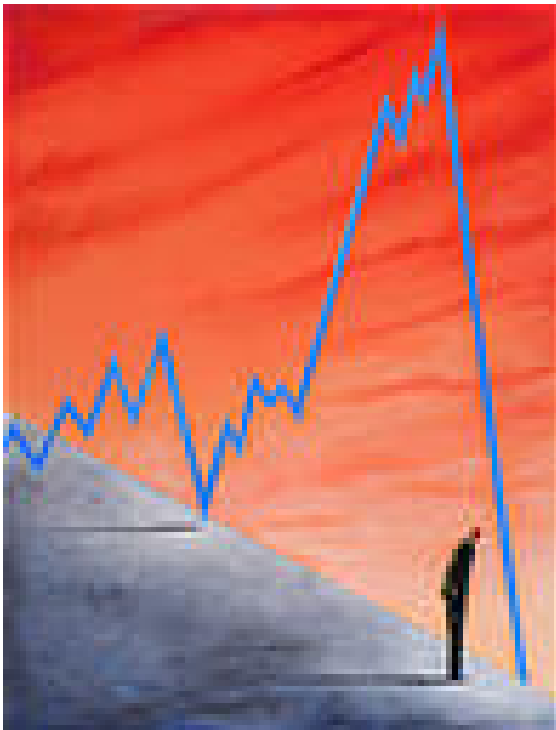
option symbol	option strike	bid	offer	model price	Qty to buy/sell
FDCVH	40	0.15	0.25	0.03	F
S	28%	341%	-0.12	-2,263	
FNMVM	65	0.05	0.15	0.00	FI
	32%	106%	-0.04	-5,345	
FREVL	60		0.15	0.00	F
	28%	26862%	-0.06	-2,785	

Risk Management



- Extreme Markets / Event Risk
 - Operate portfolio within Value-at-Risk limit
 - Stress test for 20% down move
 - CrashMetrics methodology to hedge tail risk
 - Diversification (across stocks, option maturities, multiple entry points)
- Volatility Risk
 - Stress test for 50% increase in volatility
 - Attempt to remain Gamma positive or limit negative Gamma
 - Buy cheap wing protection

Risk Management



- Liquidity Risk
 - Screen stocks for liquidity
 - Invest in only most highly liquid SP500 names (plus SPX and QQQ)
 - Maximum allocation to any single stock is 4% of capital
- Execution Risk
 - Monitor earnings
 - Screen trades in stocks with M&A activity, FDA approvals, etc

Risk Management System

POSITION AND RISK SUM

Fund (Start of Month)	16,500,000
Cash	25,757,924
Options + Stock	-9,257,924
Portfolio Value	16,500,000
Profit to date	2,621,699
Intrinsic Value (Options + Stock)	-51,952,957
Profit (from now) if no moves/'Time value'	-42,695,033
Max winner	2,550,384
Max loser	-31,056
Winners	36
Losers	15
VaR Runs	200
VaR Limit	-4.3%
VaR limit	-709,500
VaR from now to closure	-292,634
One-day VaR	-69,256
Equivalent VaR to closure	-207,767
Permitted Portfolio Level	15,790,500
Theoretical profit left	-42,978,829
Saving if exit theoretical losers	43,522,483

Theta	20,210
Beta Delta (Actual)	14,599
Beta Delta (Implied)	76,023
Beta Gamma (Actual)	-18,033
Beta Gamma (Implied)	-17,678

SPX last	96.42
One-day profit zone max	105
One-day profit zone min	96

When SPX =	992.00
then Beta Delta (Actual) =	-16,135,060
then Beta Delta (Implied) =	-15,756,028
and Portfolio change by tomorrow (implied) =	-7,021,329,392
Hedging bandwidth	60,911

Crash Coeff. (up)	2.883%
Crash Coeff. (down)	-6.219%
Crash Vega	-49,931
Crash Delta	78,268
Crash Gamma	-15,974

Average actual volatility	
Average implied volatility	32.8%

CrashMetrics®

- Correlations unstable during market crashes
- Dataset & methodology for measuring exposure to extremes
- Finds worst outcome for portfolio
 - $\Delta P_{\text{worst}} = -\Delta_C^2 / 2\Gamma_C$
- Platinum Hedging
 - Optimal hedge under extreme scenario
 - Hedging is static
 - Minimize cost
 - Avoid illiquidity during crashes
 - Reduces model error
 - Unstable parameters such as volatility and correlation not used

Summary

- Unique quantitative approach
 - Advanced proprietary econometric models
 - Sophisticated model management
 - Portfolio constructed using latest econometric theory
 - Built-in crash protection
- Proven track record
- Experienced, capable team

Further Information

- Web Site: www.investment-analytics.com
- Go to the web site for:
 - Technical Presentation
 - Two Page Strategy Summaries
 - Zephyr Style Advisor Reports
 - Detailed Strategy Analysis
 - Due Diligence Information
 - Offering Documents

Contact

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Notes

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