

# VOLATILITY ARBITRAGE PROGRAM

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DESCRIPTION OF MODELING SYSTEM AND  
INVESTMENT PROGRAM

AND

DUE DILIGENCE QUESTIONNAIRE

**PRIVATE AND CONFIDENTIAL**

Prepared for:

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INVESTMENT ANALYTICS (BERMUDA) LTD.  
AUGUST 2004

# Arbitrage Program

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## OVERVIEW

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The Investment Analytics proprietary arbitrage program comprises econometric models that produce forecasts of future volatility of exceptional accuracy. One measure of the ability of the models, direction prediction accuracy, shows that, on average, the models enable the correct timing of the volatility market approximately 75% of the time. This extraordinary level of forecasting performance accounts for the exceptional trading results achieved by the Caissa Capital Fund, which licensed the investment program from Investment Analytics in 2002. The models are based on advanced econometric research into the properties of asset volatility conducted by Mr Kinlay and other leading academic researchers, dating from around 1996, most of which has yet to be released into the public domain.

The system uses a variety of sophisticated analytical tools to identify option arbitrage opportunities and construct long/short volatility portfolios that have the desired risk/return characteristics. Specific trading recommendations are issued in the form of a daily trading sheet, which is emailed automatically to traders and risk managers before the start of the trading session. The system is run concurrently on two independent servers, one based in New York, the other in the UK, to ensure failsafe delivery and backup.

Hedge fund arbitrage strategies using the Investment Analytics program produced returns of between 15% and 1600% in 2003 and have remained very profitable during 2004.

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## DATA MANAGEMENT SYSTEM

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The data management system is an automated system that handles the process of downloading and validating stock and option data for the stocks in the investment universe. Currently around 100,000 data items for an investment universe comprising 150 stocks in the S&P500 are downloaded at the end of each trading day, including market closing prices for each stock and options with varying strikes and maturities. The data are subjected to a number of integrity checks prior to being added to the databases. These are then manipulated by the Model Management System to update the individual forecasting models.

The data management system is highly robust and operates on two independent servers to ensure redundancy.

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## THE MODELING SYSTEM

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The Investment Analytics proprietary arbitrage program comprises econometric models that produce forecasts of future volatility of exceptional accuracy. One measure of the ability of the models, direction prediction accuracy, shows that, on average, the models enable the correct timing of the volatility market approximately 75% of the time. This extraordinary level of forecasting performance accounts for the exceptional trading results achieved by the Caissa Capital Fund, which licensed the investment program from Investment Analytics in 2002.

The modelling system analyses stock and option data at the end of each trading day, updates volatility forecasts, and identifies new arbitrage opportunities. Using complex portfolio construction algorithms, the system produces a trading sheet which contains specific recommendations specifying the quantities of each option to be bought or sold, the theoretical edge of the trade and the hedging requirement. The trading sheet is emailed automatically to traders and risk managers before the start of each trading session.

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### FORECASTING MODELS

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The system operates on a ground-up approach with several different individual models for every asset in the investment universe. Each model emphasises different aspects of volatility behavior and will perform best under different market conditions. The types of model include:

- i. Long memory models that model the important long term serial autocorrelation effects which are pervasive in asset volatility processes. These models perform best when the behaviour of the process is dominated by reinforcing trends, such as applied in the period from 1995–1999 and from 2003–mid 2004 in US equity volatility markets.
- ii. Short term models that capture transient mean-reverting behaviour, another important characteristic of volatility. These models typically give rise to contrarian trading recommendations.
- iii. Models that follow the interaction and feedback between the asset returns and volatility processes, which give rise to skewness and kurtosis in the returns process.
- iv. Asymmetry models that take account of the tendency of volatility to spike more during market sell-off than during periods when the market is strong.
- v. Multifactor models that model the interaction of long memory and transient volatility processes.
- vi. Markov models that identify different volatility regimes and associated state transition probabilities.

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### MODEL MANAGEMENT SYSTEM

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The models are maintained by a Model Management System (“MMS”) that analyses the data processed by the data management system, updates each of the models, produces current forecasts and evaluates the performance of each of the models. The MMS rates each model on approximately 30 different criteria and compares the current performance of each model with its historical performance, with the performance of other models of the same process and with the performance of models for other asset processes. The MMS then selects the best models whose aggregate results lie in the upper quartile of performance. In this way the system automatically biases volatility forecasts to favour models best suited to current market conditions, while filtering out models which are currently performing with lower levels of accuracy.

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### OPTION ANALYSIS

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The next stage of the process is for the system to identify risk arbitrage opportunities amongst the universe of equity options under consideration. The system selects the stocks for which the forecasting models are performing at the highest levels and evaluates the options using the volatility forecasts and proprietary option pricing models. The system then “cherry picks” the best opportunities where the differential between market and theoretical value exceeds a minimum threshold level, which can be set by the model user.

COINTEGRATION ANALYSIS AND PORTFOLIO CONSTRUCTION

During the portfolio construction stage the modelling system decides the amounts of capital to allocate to the available arbitrage opportunities. The system examines the multivariate behaviour of the volatility processes and identifies cointegrated baskets, comprising long and short volatility positions that typically have more stable risk-returns characteristics than the individual underlying processes. The procedure is comparable to the mean-variance optimization procedure due to Markovitz, but is significantly more sophisticated. The resulting baskets, or portfolios, tend to have more stable and robust performance characteristics than portfolios constructed in the traditional way using correlations, as the latter are notoriously unreliable, especially during market crashes. The cointegrated baskets identified by the system are tested by a simulation processes to ensure that their performance characteristics meet the minimum criteria and behave robustly under varying market conditions. A genetic algorithm is employed to select the most appropriate baskets for trading.

MODEL OUTPUT

The final stage of the process entails the creation and distribution a trading sheet containing the detailed trading recommendations. The sheet gives the current volatility forecast for every stock in the investment universe, but highlights only those option trades which meet the pricing differential criterion. Options that have been selected for purchase (sale) are highlighted in blue (red), and the sheet gives the market bid and offer prices and the theoretical price based on the latest volatility forecasts. In addition, the output shows the quantity of options to be bought or sold, the % price differential and the option delta, so that trades can readily be executed on a market-neutral basis. Trading sheets are contained in an Excel workbook, which is emailed by an automated email server to a specified list of email recipients, usually members of the trading and risk management teams.

Option Values			03-Dec-03												Expiry: 16-Jan				% Cutoff 30%		\$ Cutoff 0.1						
Stock	Price	Vol	Model	Spreads	Code	Jan-04 OTM PUT				Code	Jan-04 ATM PUT				Code	Jan-04 ATM CALL				Code	Jan-04 OTM CALL						
				Total	B/S	Strike	Bid	Ask	Theory	B/S	Strike	Bid	Ask	Theory	B/S	Strike	Bid	Ask	Theory	B/S	Strike	Bid	Ask	Theory			
HDI	46.50	19%	**	1.65		HDIMV	42.5	0.40	0.50	0.12	HDIMW	47.5	2.05	2.20	1.77	HDIAD	47.5	1.10	1.20	0.89	HDIAD	55	0.10	0.01	0.01		
							S	30%	222%	-0.08	-0.05		27%	16%	-0.60	-896		23%	24%	0.40	-1.179		25%	-100%	0.01	27.986	
HON	29.64	23%	**	1.7		HONMY	27.5	0.20	0.35	0.21	HONMF	30	1.10	1.20	1.11	HONAF	30	0.70	0.80	0.82	HONAZ	32.5	0.10	0.20	0.17		
								27%	-03%	-0.16	39.080		26%		-0.53			20%	-03%	0.47	11.718		22%	20%	0.14	-7.656	
HPQ	22.41	32%	***	1.81		HHYMD	20	0.15	0.20	0.18	HHYMX	22.5	0.85	0.90	1.01	HHYAX	22.5	0.75	0.80	0.98	HPOAE	25	0.10	0.15	0.23		
								33%	-16%	-0.14	9.387		29%	-11%	-0.48	2.416		24%	-18%	0.52	1.513		25%	-36%	0.18	3.155	
IAGI	30.96	37%	**	1.74		QTHMY	27.5	0.45	0.55	0.36	QTHMF	30	1.15	1.25	1.11	QTHAF	30	2.30	2.40	2.14	QTHAZ	32.5	1.00	1.20	1.01		
								43%	27%	-0.16	-2.650		41%	04%	-0.37	-6.069		41%	07%	0.63	-1.589		38%	19%	0.39	-1.308	
IBM	90.30	15%	***	1.91		IBMMO	75	0.05	0.10	0.00	IBMMR	90	2.15	2.20	1.60	IBMAR	90	2.70	2.70	2.13	IBMAA	105	0.05	0.10	0.00		
								28%	36167%	0.00	-5.816		S	21%	34%	-0.45	-510		18%	27%	0.55	-505		22%	1586%	0.00	-6.166
ICOS	44.80	50%	*	1.3		IIGMG	35	0.30	0.40	0.24	IIGMI	45.00	2.75	2.95	3.16	IIGAI	45.00	2.50	2.70	3.07	IIGAK	55.00	0.20	0.35	0.52		
								56%	27%	-0.06	-3.960		47%	-07%	-0.47	1.174		41%	-12%	0.53	669		B	42%	-33%	0.14	1.438
IMCL	41.49	52%	***	1.95		OCIMF	30	0.35	0.50	0.09	OCIMH	40	2.90	3.20	2.24	OCIAH	40	4.40	4.70	3.83	OCIAJ	50	1.25	1.30	0.68		
							S	74%	269%	-0.03	-1.164		69%	30%	-0.38	-457		64%	15%	0.62	-527		S	68%	84%	0.18	-530

Fig. 1 Model Output in Excel File Format

# Due Diligence Questionnaire

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## FIRM BACKGROUND

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**Please attach bio for the principals of the Firm.**

***Jonathan Kinlay***

Jonathan Kinlay is the chief executive of the investment consultancy Investment Analytics, which he founded in 1998, and a general partner of the Proteom Fund, founded in 2004. In 2002 Mr. Kinlay founded Caissa Capital LP, a quantitative derivatives hedge fund that uses the Investment Analytics volatility arbitrage program as the basis for its investment strategies. Mr. Kinlay has consulted with leading investment funds and financial institutions in Europe and North America for over 20 years in the areas of financial engineering, investment strategy, quantitative analysis and risk management, initially with NatWest and Chase Manhattan banks and subsequently as the head of quantitative analytics and proprietary trading in a European hedge fund, where he traded US and European equities, fixed income and OTC & exchange traded derivatives. Mr. Kinlay has lectured at postgraduate level at a number of leading universities including, Carnegie Mellon University in New York, and Oxford, Cambridge and Reading Universities in the UK. His first degree is in Mathematics and Statistics from University of Bristol. He also graduated with an MSc in Statistics from University of Sheffield and an MBA from the London Business School and Stern School of Business, New York University.

**Please provide referees for the principals of the Firm.**

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**Describe the advisory firm's history:**

Investment Analytics (Bermuda) Ltd is an investment strategy consulting firm formed by Mr Jonathan Kinlay in 2003, which succeeded a partnership of the same name that existed since 1998. Investment Analytics provides independent research focusing on applications of sophisticated mathematical and financial modeling techniques to problems of strategy development and repair, performance analysis and risk management for clients in the investment management industry in Europe and North America. Further details of the firm and its services is to be found on the web site: [www.investment-analytics.com](http://www.investment-analytics.com).

Beginning in 1998 Mr Kinlay researched and developed a number of sophisticated econometric models used for measuring and forecasting the volatility of financial processes such as asset returns. In 2002 Mr Kinlay formed a hedge fund, Caissa Capital LP, and invited two associates to join him in that venture as partners. The models were licensed to Caissa Capital to provide the basis for the firm's volatility arbitrage strategies. The strategies proved very profitable and assets under

management quickly grew to over \$160M. Having established the underlying concept within Caissa Capital, Mr Kinlay has decided to focus on his work in Investment Analytics and to start a new hedge fund, the Proteom Fund.

**Describe the advisory firm and its structure:**

Investment Analytics (Bermuda) Ltd. is a Bermudan based limited company. The firm's Directors are Jonathan Kinlay and James Keyes. The firm was established in 2003, although a partnership of the same name existed from 1998.

**Who were the founders?**

Mr. Jonathan Kinlay.

**Are there any new principals or owners since founding? If Yes, who? No.**

**Who owns the firm? Are any owners not active in the firm's management?**

Mr. Jonathan Kinlay is the owner of the firm and he is active in the firm's management.

**Does the Firm have any branch offices/locations/operations? What activities are conducted at them?** The firm is located in Bermuda. It conducts research activities there and in other locations in the USA and Europe.

**Do the principals engage in any business activities outside of the firm?**

Jonathan Kinlay is the General Partner of the Proteom Fund, a quantitative equity hedge fund. based in New York and Bermuda.

**Who is primarily responsible for managing research analysts? How many analysts are there?**

At present, Mr. Jonathan Kinlay is responsible for the ongoing research effort.. Consultants are employed to assist in the development of new technologies.

**Who is primarily responsible for managing operations? How many operations people are there?** Mr. Kinlay is responsible for operations. Dr Christopher Rosevear is also employed in operations.

**What is the total number of firm employees? How many are dedicated full time to the Strategy?**

At present Mr. Jonathan Kinlay is the only employees. All bookkeeping, accounting and administrative work has been outsourced.

**How are employees and principals compensated? What percentage of principals' compensation is salary vs. bonus?**

Investment Analytics earns consulting and licensing fees. There is a direct correlation between compensation and authority.

**Are any legal or disciplinary actions being taken against the Firm, its affiliates, or its principals? Have any been taken? What were the outcomes?**

There are no pending legal or disciplinary actions being taken against the firm or any of its affiliates or principals. There have been no legal or disciplinary actions taken against the firm in the past.

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## MODELING SYSTEM

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**Who developed the models? When were they developed?**

Jonathan Kinlay developed the theory and all of the models in the system in the period from 1998 to 2004.

**Who owns the intellectual property?**

The entire program, including the modeling system, is the property of Investment Analytics (Bermuda) Ltd, which owns all of the copyright. The program is in the process of being patented.

**Describe the underlying theory behind the modeling system.**

The program includes a number of proprietary theoretical concepts developed by Jonathan Kinlay. These include:

- New volatility metric, which is up to three times more efficient than standard estimators.
- Multifactor models of long memory and short term transient volatility processes and their interaction.
- New theoretical framework for modeling skewness and kurtosis in the returns distribution.
- Applications of multivariate fractional cointegration to portfolio construction.
- New methodology for model performance assessment.
- Proprietary methodology for regime shift detection.

In addition, the system applies a wide variety of known econometric theory, some of which is described in the paper “Long Memory and Regime Shifts in Asset Volatility”, published in Wilmott magazine in 2003.

**What programming languages are used in the development of the models?**

The models were developed in a variety of programming languages, including C, C++, Visual Basic and Ox.

**What computer systems are used to run the models?**

The modeling system runs on two independent machines each with very fast math processors and large amounts of RAM. The output is passed to two independent servers, one in the USA and the other in Europe, which mail the trading sheet as an Excel workbook to a specified recipient list.

**Describe the types of forecasting models used in the system.**

The system operates on a ground-up approach with several different individual models for every asset in the investment universe. Each model emphasises different aspects of volatility behavior and will perform best under different market conditions. The types of model include:

- vii. Long memory models that model the important long term serial autocorrelation effects which are pervasive in asset volatility processes. These models perform best when the behaviour of the process is dominated by reinforcing trends, such as applied in the period from 1995–1999 and from 2003–mid 2004 in US equity volatility markets.
- viii. Short term models that capture transient mean-reverting behaviour, another important characteristic of volatility. These models typically give rise to contrarian trading recommendations.
- ix. Models that follow the interaction and feedback between the asset returns and volatility processes, which give rise to skewness and kurtosis in the returns process.
- x. Asymmetry models that take account of the tendency of volatility to spike more during market sell-off than during periods when the market is strong.
- xi. Multifactor models that model the interaction of long memory and transient volatility processes.
- xii. Markov models that identify different volatility regimes and associated state transition probabilities.

**How many models are there in the system?**

There are between 4-6 models for each stock. With 150 stocks in the investment universe, there are in excess of 600 models in total.

**What data does the system use? Does the system use fundamental data?**

Fundamental data is used only to help in defining and selecting the investment universe. The models themselves use historical prices to construct asset returns, volatility and correlation series.

**Describe the data management system.**

The data management system is an automated system that handles the process of downloading and validating stock and option data for the stocks in the investment universe. Currently around 100,000 data items for an investment universe comprising 150 stocks in the S&P500 are downloaded at the end of each trading day, including market closing prices for each stock and options with varying strikes and maturities. The data are subjected to a number of integrity checks prior to being added to the databases. These are then manipulated by the Model Management System to update the individual forecasting models.

The data management system is highly robust and operates on two independent servers to ensure redundancy.

**Which asset classes have the models been tested on?**

The models have been tested on US and European equities, Pacific Rim equity markets, and approximately eleven emerging markets. Limited tests have been performed in currency and commodities markets. The models performed well in all tests.

**Which asset classes could the program be applied to?**

The capabilities of the system have been clearly demonstrated in equity markets. It is likely that the system would perform equally well in currency and commodity markets, but further research and development is required.

**What is the role of the Model Management System?**

The models are maintained by a Model Management System (“MMS”) that analyses the data processed by the data management system, updates each of the models, produces current forecasts and evaluations the performance of each of the models. The MMS rates each model on the basis of approximately 30 different criteria and compares the current performance of each model with its historical performance, with the performance of other models of the same process and with the performance of models for other asset processes. The MMS then selects the best models, whose aggregate results lie in the upper quartile of performance. In this way the system automatically biases volatility forecasts to favour models best suited to current market conditions, while filtering out models which are currently performing with lower accuracy.

**Describe some of the performance criteria used to assess model performance.**

There are approximately 30 different criteria used to assess the performance of each model. The Model Management System uses an adaptive weighting system to evaluate these criteria and judge their relative importance. An overall performance “score” is produced which is used to compare the performance of each model against its historical performance and against its peers.

The criteria break down into two broad categories: measures of forecasting performance and measures of statistical goodness of fit. Both sets of criteria are important, but greater weight is assigned to forecasting performance in assessing the overall model performance. The single most important model criterion is direction prediction accuracy, as this closely correlates with strategy performance. The direction prediction criterion measures the ability of the model to forecast the direction of the underlying process one period ahead. A random predictor would expect to achieve a DP score of 50%. The Investment Analytics models achieve a DP accuracy level of close to 75%, across all assets and time periods. This means that, on average, the models correctly predict the future direction of volatility three periods out of four.

The forecasting performance measures include the following:

- Mean Square Error
- Mean Absolute Deviation
- Mean Absolute Percentage Error
- Theil’s U
- Direction prediction

Statistical measures include:

- Likelihood
- Adjusted Coefficient of Determination
- Akaike Information Criterion
- Bayes Information Criterion
- Error skewness
- Error Kurtosis
- Jarque-Bera Normality test
- Box-Pierce portmanteau test
- ARCH-LM test
- Sign Bias test
- Durbin-Watson statistic

**What is cointegration?**

The concept of cointegration was due to Nobel prize winning economist Clive Granger in the 1990’s. It is best illustrated by means of an example. Consider the prices series of a spot and futures contract on a commodity such as gold. Both series are non-stationary – the prices of gold can vary anywhere between \$200 and \$800 an ounce (or higher). If fact the series are integrated order 1, meaning that the first difference of each series (i.e. the returns process) is a stationary white noise process. Non-stationary series are, understandably, very difficult to trade profitably.

Now consider a series consisting of the differential between the spot and futures prices, i.e. the Basis. This too is a stochastic process, but unlike the price series it is stationary – it fluctuates inside a range. The reason for this behavior is of course that cash and carry arbitrage obliges the basis to remain within bounds. In this example, we would say that the spot and future price series are cointegrated order 1. There are two important points to note. The first is that cointegrated “baskets” such as the Basis in the above example, are inherently more stable, and hence easier to trade, than the underlying non-stationary price processes. The second point is that cointegration relationships tend to be more reliable than correlation relationships because they relate to some underlying economic factor (cash and carry arbitrage, in the example).



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## INVESTMENT STRATEGY

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**Characterize strategy's investment style:**

Classical economic theory has experienced considerable success over the last fifty years in advancing our understanding of the general behavior of financial markets. The products of that research, which include CAPM and the Black-Scholes model, have played a central role in the progress achieved in investment theory during that time. Empirical research over the last fifteen years, however, has brought more clearly to focus some of the major deficiencies of classical theory. In particular we now know that:

- Asset returns are not normally distributed. Gaussian theory will tend to underestimate the probability of very small, or very large, movements in the market.
- Asset correlations are highly unstable, especially at times of market stress, when they become increasingly correlated. Consequently risk management tools such as Value-at-Risk tend to break down during extreme market conditions.
- Volatility is not constant, as envisaged in the Black-Scholes world, but varies over time. There is clear evidence of strong autocorrelations and long memory effects in asset volatility.

Investment Analytics has developed research tools to enable us to identify opportunities to trade asset volatility at times of favorable market conditions. Our proprietary asset allocation methodology combines elements of portfolio optimization and risk management theory that enable us to create portfolios capable of generating consistent, high returns, with minimal drawdown, even at times of high market stress and regardless of the direction of the overall market.

In summary our investment approach is:

1. Asset Class: Equity Options
2. Strategy: Volatility Arbitrage
3. Methodology: Econometric Modeling
4. Style: Market Neutral

The Strategic Volatility Strategy exploits short-term arbitrage opportunities in equity options to deliver very high rates of return. The strategy employs a statistical arbitrage style of trading and is a classical long and short hedge fund portfolio. The difference is that it is long and short volatility instead of equities.

The investment universe comprises options on around 150 leading equities that are members of the S&P 500 Index. These includes many household names such as BAC, BMY, C, DOW, GE, GM, IBM, JNJ, MMM, MRK, PG and WMT. Investment Analytics has constructed sophisticated, proprietary volatility models for each of these stocks that enable us to identify short-term opportunities to buy or sell options that are trading at uneconomic prices. A trade may be executed using any one of a number of possible option combinations, including verticals, calendars or butterflies, and typically will be initiated with 5 – 50 days to expiration. Some of these trades are designed to exploit a mismatch between the forecast level of volatility and that priced into the options (the implied volatility). In other cases the chief intention is to trade the volatility skew. In the majority of cases the trades will be initiated close to delta-neutral and the strategy seeks to maintain a non-directional, delta-neutral position by selling or buying SPDRs at the close of each trading day.

The strategy also employs sophisticated risk controls to ensure that at all times the account is operating within acceptable Value-at-Risk limits and that its exposure to extreme market or volatility moves is managed within pre-defined limits.

**Briefly describe the strategy conceptually:**

The Strategic Volatility Strategy is a volatility statistical arbitrage strategy designed to produce annual returns of 15% - 20% with a volatility of 6%-9%.

The pricing of most exchange-traded options is based on variants of the vanilla Black-Scholes model and its extensions. Among the model's main shortcomings are the assumptions of Gaussian distributed returns and constant volatility in the underlying. Empirical studies have demonstrated consistently that returns follow a distribution that is skewed and leptokurtic: markets are more likely to remain where they are or make a large move than a Normal distribution would suggest. It is evident, too, that volatility is not constant, but stochastic, and may fluctuate in a wide range depending on general market conditions and firm-specific events. There are several extensions to Black-Scholes which enable non-Normal returns, stochastic volatility and long memory effects to be incorporated into the model. Although option prices are typically adjusted to account for the effects of stochastic volatility and non-Gaussian returns, this is not always the case. According to our analysis, at certain times both put and call options are under- or over-priced by as much as 30%. Part of what we are seeking to do in our investment strategies is to capture these mis-pricing opportunities.

An important element in the investment strategy is the prediction of future volatility. We know from empirical research that, in addition to being stochastic, volatility is typically both very volatile and highly persistent. We use these additional characteristics of volatility to improve investment performance and enhance the risk-reward profile of the basic strategy.

Investment Analytics has developed a proprietary volatility index that measures underlying volatility more accurately and efficiently than traditional methods. Using proprietary econometric models we are able to correctly anticipate the future direction of volatility an average of 72%-75% of the time in the universe of stocks and equity indices we analyze, and identify regimes of unsustainably high or low levels of volatility with a high degree of accuracy. These additional techniques enable us to select investment opportunities that offer the greatest risk-reward trade-off.

The Strategy seeks to achieve its target returns by trading volatility portfolios comprising long and short positions in options on major listed equities and indices, primarily the DOW 30 and the 150 largest cap SP500 index stocks. The strategy resembles a traditional

long/short equity hedge fund strategy, with the attendant benefits of risk reduction through diversification. We supplement this with hedging mechanisms that are specifically designed to protect the portfolio in the event of a market crash. The result is a portfolio producing high risk-adjusted rate of return with very stable performance characteristics.

The Strategic Volatility Strategy is based on certain statistical properties of volatility processes that render them more amenable to econometric modeling than asset returns processes. Specifically, volatility processes exhibit 'long memory' behavior in which events affecting the series today continue to affect it for many months into the future. In principle, this makes volatility more easily forecastable. Our quantitative methodology identifies volatility processes that are co-integrated (i.e. that tend to vary together in a stable pattern) and applies sophisticated econometric models to produce volatility forecasts that are then fed into our option pricing models. Sophisticated genetic algorithms are then used to construct volatility portfolios that have appropriate risk-return characteristics. The final step in portfolio construction is to overlay an optimal hedge that protects the portfolio against extreme market moves. The hedge is constructed using CrashMetrics®, a proprietary risk management technology.

The investment universe comprises options on around 150 leading equities that are members of the S&P 500 Index. These include many household names such as BAC, BMY, C, DOW, GE, GM, IBM, JNJ, MMM, MRK, PG and WMT. Investment Analytics has constructed sophisticated, proprietary volatility models for each of these stocks that enable us to identify short-term opportunities to buy or sell options that are trading at uneconomic prices. A trade may be executed using any one of a number of possible option combinations, including verticals, calendars or butterflies, and typically will be initiated with 5 – 50 days to expiration. Some of these trades are designed to exploit a mismatch between the forecast level of volatility and that priced into the options (the implied volatility). In other cases the chief intention is to trade the volatility skew. In the majority of cases the trades will be initiated close to delta -neutral and the strategy seeks to maintain a non-directional, delta-neutral position by selling or buying SPYDRs at the close of each trading day.

The strategy also employs sophisticated risk controls to ensure that at all times the account is operating within acceptable Value-at-Risk limits and that its exposure to extreme market or volatility moves is managed within pre-defined limits.

#### **Discuss the investment process/strategy.**

The trading universe consists of options in the nearest two months in approximately 150 stocks of the S&P500 index, together with the S&P500 and QQQ indices.

Data comprising closing market prices and risk parameters are downloaded overnight and analyzed by the modeling systems. A number of forecasting models are applied to each stock or index in the investment universe, which vary both in terms of forecast frequency and in the emphasis given to individual aspects of volatility behavior such as long-term memory or short-term memory, volatility correlation, volatility asymmetry and the volatility of volatility (kurtosis). A model management system continuously evaluates each model on approximately 20-30 performance criteria and weights the forecasts according to current performance.

Using these volatility forecasts, the modeling systems then seek to identify risk arbitrage opportunities comprising options which are substantially under-priced or over-priced, on the basis of proprietary option pricing models. These arbitrage opportunities are identified in an electronic trading sheet which is routed to the trading system for review by the trading team prior to execution. Typically 50-60 arbitrage opportunities are identified in each daily trading sheet. These arbitrage opportunities are used to construct the volatility portfolios incrementally each day. Volatility portfolios are consequently widely diversified, not only with regard to the number of stock in which positions are held, but also with regard to option expiration, strike and entry point. This serves to mitigate the stock-specific volatility risk in the portfolio of each of the Funds. As a consequence, the number of positions in a given portfolio, as well as its average tenor, will vary over the course of time as existing positions expire and new positions are added.

Since the profitability of the strategies is dependent upon the differential between the strategies' view of volatility and that held by the market (as expressed by option implied volatility), it is important that the majority of the positions in the portfolio are held until option expiration. Consequently, we are attentive to the issue of hedging the portfolio risk over the expiration cycle, and in particular to maintaining market neutrality. At the end of each day, the inventory of current positions is loaded automatically into the risk management system for analysis. A daily risk analysis is produced several hours before the start of each trading day which seeks to identify the Value-at-Risk (VaR) in the existing volatility portfolio of each Series Fund and each of its constituent elements. Positions which may be contributing significantly to the total VaR, or which have low or negative expected return, are marked for individual hedging using underlying stocks, or may be liquidated prior to expiration. The risk management system also seeks to identify an excess or deficit in the overall portfolio deltas, which are then hedged at the start of the trading session using a combination of underlying stocks and SPYDRs (as a market proxy). The risk system also evaluates the Gamma, Theta and Vega risk of the portfolio, and performs stress tests to assess the exposure to crashes either in the overall market or in market volatility, or both.

**What opportunities are being exploited?** The Strategy takes arbitrage positions in options on our universes of 150 SP500 stocks which, based on our valuation models, are mis-priced by minimum of 30% (average 55%). These opportunities typically arise from the hedging and speculation activities of market participants for whom derivatives are of secondary concern, including equity portfolio managers, market timing strategists, and those pursuing yield enhancement strategies such as covered call writing.

**Which market environment does this strategy perform well/poorly?** For the Strategy to perform it requires either (a) a wide divergence of views as to the level of future volatility in universe of stocks we trade or (b) a consistent, but incorrect, view of future volatility. The first of these situations is the normal state of volatility markets. The second arises from time to time and can be highly profitable for our strategy (for example in Feb 02).

The strategy would perform poorly in a situation where the market held a consistent, correct view about future volatility in a large proportion of stocks in our investment universe. Such a situation has arisen in the past in currency markets during Euro convergence, but is highly unlikely to arise in equity markets.

**Describe the idea generation process:** The process of identifying arbitrage opportunities is entirely automated and model-driven. The models identify 50-60 potential investment opportunities each day in options which are under- or over-priced by 30% or more. Co-integration analysis is used to identify how these potential trades should be combined to create volatility baskets with stable risk-return characteristics which meet our investment objectives. Our overall portfolio is constructed using these volatility baskets.

**Discuss the main drivers of performance and risk of the strategy:**

The main drivers of performance are:

- Divergences of views on future volatility
- The volatility of volatility (kurtosis)
- Price insensitivity of market participants who use options for hedging and speculation.
- Note that neither the level of the market nor the level of market volatility is a driver of performance.

The main drivers of risk are:

- Gamma
- Liquidity
- Event risk

**Describe why the strategy should be expected to generate excess returns over time:**

In recent years many important discoveries have been made in the study of volatility. Only in the past year has “Volatility” become a media buzzword. As a niche area of the marketplace, it has been slow to attract the attention and resources of the powerhouse firms on Wall Street. This represents both uncharted territory and opportunity for those with the tools to exploit them.

The research team at Investment Analytics believes this creates the opportunity for generating alpha for a number of years to come. However, it will be important to keep a vigilant eye on theoretical discoveries in the area of volatility. In order to maintain the Investment Analytics advantage, it will be incumbent upon the research team to incorporate worthwhile discoveries into existing models and strategies. Practical considerations are keeping pace with constantly improving execution platforms and technologies as well as the structural changes in the US options markets. As with any financial strategy, success will encourage others to devote talent and resources. Over time, the existing marketplace will either:

- a. have to expand to accommodate the new entrants
- b. have narrowing spreads (edge)
- c. squeeze out less talented entrants

Investment Analytics management foresees this process as taking a minimum of three to five years. The most likely scenario by that time is a recovering stock market, leading to expanding marketplace [there are already signs of increased public participation (retail) returning to the options market. In addition, a rising market tends to lead people away from statistical based strategies and back to the realm of directional and momentum strategies. Therefore it is quite possible the Investment Analytics volatility arbitrage program will be very viable over the medium to long term.

**Describe the investment objectives of the strategy (return, risk, correlation, other):**

**The Strategic Volatility Strategy** is a volatility statistical arbitrage strategy designed to produce annual returns of 15% - 20% with a volatility of 6%-9%. The strategy seeks to achieve its target returns by trading volatility portfolios comprising long and short positions in options on major listed equities and indices, primarily the DOW 30 and the 150 largest cap SP500 index stocks. The strategy resembles a traditional long/short equity hedge fund strategy, with the attendant benefits of risk reduction through diversification. We supplement this with hedging mechanisms that are specifically designed to protect the portfolio in the event of a market crash. The result is a portfolio producing high risk-adjusted rate of return with very stable performance characteristics.

**The Strategic Volatility Strategy** is based on certain statistical properties of volatility processes that render them more amenable to econometric modeling than asset returns processes. Specifically, volatility processes exhibit 'long memory' behavior in which events affecting the series today continue to affect it for many months into the future. In principle, this makes volatility more easily forecastable. Our quantitative methodology identifies volatility processes that are co-integrated (i.e. that tend to vary together in a stable pattern) and applies sophisticated econometric models to produce volatility forecasts that are then fed into our option pricing models. Sophisticated genetic algorithms are then used to construct volatility portfolios that have appropriate risk-return characteristics.

**What are the strengths and weaknesses of your investment strategy?**

Much of the theory that Investment Analytics employs has only been developed since 1996. Many earlier important works were either ignored, or not fully appreciated. Investment Analytics has developed proprietary models that embrace and combine these technologies with their own ideas, to develop a unique approach in a niche market.

Investment Analytics also enjoys the advantage of being able to correctly predict the direction of volatility in the underlying assets, 72%-75% of the time. This is combined with portfolio optimization, stringent risk management and low cost execution.

**What is the universe of securities considered for trading?**

The portfolio comprises exchange-traded options on major indices and on large-cap stocks with liquid options markets, defined as assets on which there is sufficient liquidity to trade at least 1,000 options. The majority of stocks whose options traded are DOW and

S&P500 index constituents. Our investment universe includes the leading companies from virtually every industrial sector, from capital goods to pharmaceuticals. Some assets we trade only from the short or long side, but the majority we take either long or short positions depending on market conditions and our model projections, which may vary from month to month. In general the fund will have short positions in around 400-600 stock or index options and an equal number of longs. All investments are executed as long or short positions in at-the-money straddles or butterflies, typically with 30 – 60 days to expiration.

**How many investments are used on the portfolio's long side and short side?**

A typical portfolio at present contains 400-600 positions. The Strategy does not have a long volatility or short volatility mandate. In any given period of time, the portfolio can lean as high as 70% to 30% in either direction. Historically the portfolio has shown an approximate 60% short volatility bias.

**What is the range of market capitalization of positions and the liquidity of investment positions?**

The underlying equities are household names (i.e. IBM,GE,GM, MRK etc) that are either in the S&P top 200, or are number 1, 2, or 3 in their industry sector. The universe of securities that is traded is very liquid.

**What is the maximum allowed single position size by percent of NAV?** Typically no more than 4% of available capital is allocated to a single entity.

**What is your target long/short/cash position as a percentage of NAV?**

Investment Analytics does not have a long volatility or short volatility mandate. In any given period of time, the portfolio can lean as high as 70% to 30% in either direction. Historically the portfolio has shown an approximate 60% short volatility bias.

**What is your average holding period for longs and shorts? Does it differ for winning or losing positions?**

The average holding period for both longs and shorts is 32 days.

**What are your criteria for entering new trades?**

All new trades are generated by proprietary mathematical quantitative models on a daily basis. The models generate volatility forecasts and produce optimized portfolios. Capital is allocated by using a portfolio optimization model that studies correlations between the different volatilities. Monte Carlo simulations with risk parameters and capital allocation guidelines are run to determine which portfolio offers the highest risk adjusted rate of return. No more than 4% of any portfolio is allowed to one individual position. Each portfolio is reviewed by the investment committee prior to implementation. These portfolios are then executed efficiently and at the lowest possible cost in the US listed options market.

**What are your criteria for exiting trades?**

The criteria are:

1. The positions have become a negative contributor to Value-at-Risk.
2. The expected value of the position has been fully extracted.
3. News event in the horizon related to the position provides an undue reason to believe there will be a problem.

**What is your edge versus other advisors using similar strategies?**

Investment Analytics enjoys the advantage of being able to correctly predict the direction of volatility in the underlying assets, 72%-75% of the time. This is combined with portfolio optimization, stringent risk management and low cost execution. Investment Analytics also enjoys the combination of superior proprietary mathematical option pricing models, and risk management systems, developed by leading researchers in the field and successful money management and trading professionals with proven track records.

**How does the fund differentiate itself from others in its strategy?**

Much of the theory that Investment Analytics employs has only been developed since 1996. Many earlier important works were either ignored, or not fully appreciated. The partners have developed proprietary models that embrace and combine state-of-the-art technologies with their own ideas, to develop a unique approach in a niche market. These proprietary models combined with over 20 years of money management experience afford Investment Analytics the advantage over its peers.

**What benchmark do you feel is most appropriate against which to measure performance? Why?**

There is no benchmark that is appropriate for this strategy. The strategy has high turnover, high leverage and is aggressive.

**In which type of markets or situations does your strategy perform best/worst?**

The best market environment for Investment Analytics is market in which participants expressed a wide divergence of views on future volatility. These conditions, which typically apply, give rise to a continuous flow of opportunities where implied volatilities are mis-priced relative to the actual volatility in the marketplace.

The most challenging market in an absolute sense would be a completely static market where the world was in total agreement across the board on how much range the underlying stocks should have (actual volatility) and accurately priced the options (implied volatility) accordingly. Such a market would be efficient and therefore lack the pricing discrepancies that create our opportunities and consequently our returns.

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**STRATEGY PERFORMANCE**


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**Strategic Volatility Strategy - Summary Performance**

*As of most recent calendar month end: (Figures reported below are as of 1<sup>st</sup> July, 2004)*

<b>Year-to-Date Return (gross):</b> 12.52%	<b>Since Inception Return (gross):</b> 19.47%
<b>Total Months Since Inception:</b> 21	<b>ITD Annualized Daily Std Deviation:</b> 6.98%
<b>% Positive Months Since Inception:</b> 66%	<b>ITD Sharpe Ratio:</b> 1.32
<b>Annualized alpha vs. S&amp;P:</b> 10.43%	<b>Correlation to S&amp;P:</b> -0.04
<b>AUM (this strategy):</b> \$126.2MM	<b>Firm-Wide AUM:</b> \$159.5MM

**Volatility Opportunity Strategy- Summary Performance**

*As of most recent calendar month end: (Figures reported below are as of 1<sup>st</sup> July, 2004)*

<b>Year-to-Date Return (gross):</b> 8.99%	<b>Since Inception Return (gross):</b> 1,853.39%
<b>Total Months Since Inception:</b> 21	<b>ITD Annualized Daily Std Deviation:</b> 70.94%
<b>% Positive Months Since Inception:</b> 81%	<b>ITD Sharpe Ratio:</b> 6.27
<b>Annualized alpha vs. S&amp;P:</b> 166.429%	<b>Correlation to S&amp;P:</b> 0.04
<b>AUM (this strategy):</b> \$13.3M	<b>Firm-Wide AUM:</b> \$159.5M

**Do you expect the strategy's performance going forward to differ from prior performance? Why? "**

In recent years many important discoveries have been made in the study of volatility. Only in the past year has "Volatility" become a media buzzword. As a niche area of the marketplace, it has been slow to attract the attention and resources of the powerhouse firms on Wall Street. This represents both uncharted territory and opportunity for those with the tools to exploit them. The management team at Investment Analytics believes this creates the opportunity for generating alpha for a number of years to come. However, it will be important to keep a vigilant eye on theoretical discoveries in the area of volatility. In order to maintain the Investment Analytics advantage, it will be incumbent upon the management team to incorporate worthwhile discoveries into existing models and strategies. Practical considerations are keeping pace with constantly improving execution platforms and technologies as well as the structural changes in the US options markets. As with any financial strategy, success will encourage others to devote talent and resources. Over time, the existing marketplace will either a) have to expand to accommodate the new entrants, b) Spreads (edge) in the marketplace will narrow, or c) The less talented entrants will be squeezed out and move on to other areas. Investment Analytics management foresees this process as taking a minimum of three to five years. The most likely scenario by that time is a recovering stock market, leading to expanding marketplace [there are already signs of increased public participation (retail) returning to the options market]. In addition, a rising market tends to lead people away from statistical based strategies and back to the realm of directional and momentum strategies. Therefore it is quite possible the Investment Analytics volatility arbitrage strategy will be quite viable for the foreseeable future.

**What drives the volatility of your strategy?**

The volatility of the strategy is a direct derivative of the difference between the model generated volatility and the actual volatility.

**What steps do you take to reduce volatility? N/A**

**What is the correlation of your strategy with managers implementing a similar strategy?** We believe this to be a unique strategy.

**How many days per month on average do you generate a positive return?** On average the portfolio generates positive return about 65% of the month.

**What is the highest number of days in a month you would expect to show negative returns?** We expect the highest number of negative return days in a month to be 6 out of 20.

**How long did it take you to recover from the largest peaks to valley drawdowns?**

Draw down \_\_\_\_\_ Start \_\_\_\_\_ Bottom \_\_\_\_\_ Full Recovery \_\_\_\_\_ Reason

-5.09%                  Dec-03                  Feb-04                  3 months                  See details below

**How volatile is the strategy relative to its peers?**

The volatility of the fund will be commensurate with its return.

**Do you expect to turn a profit in all positions?**

While the investment advisor expects to turn a profit in all positions, it has been less than perfect. The Strategy definitely does not turn a profit on every issue. Several issues in any given portfolio may act as nothing more than a hedge for other higher profit potential aspects of the given portfolio. The losses and gains in the Investment Analytics portfolio are spread over a broad range of issues.

**How often do a few positions account for most of the returns of the strategy on any given day?** Some issues seem to have ongoing success, while other issues may perform without distinction for a period and then produce favorable results.

**What is the average number of investments in the portfolio? What is the breakdown in terms of long and short?**

The average number of positions in a portfolio is 400-600, spread over 100-150 symbols. Investment Analytics does not have a long volatility or short volatility mandate. In any given period of time, the portfolio can lean as high as 70% to 30% in either direction. Historically the portfolio has shown an approximate 60% short volatility bias.

**Is the fund's investment process easily repeatable or did an isolated incident cause the fund to report good performance?**

We have no difficulty producing consistently high returns in every month since Feb 2003. We expect returns to remain consistent under most market conditions

Provide monthly returns for the strategies which use the Investment Analytics Investment Program.

*Caissa Capital Strategic Volatility Fund*

*Inception: October 2002*

Month	Gross Year	Gross Monthly Returns	Cumulative Since Oct-02
Oct-02		-1.14%	-1.14%
Nov-02		-0.08%	-1.21%
Dec-02	1.14%	2.39%	1.14%
Jan-03		2.55%	3.72%
Feb-03		10.53%	14.64%
Mar-03		0.49%	15.21%
Apr-03		-0.71%	14.40%
May-03		-1.44%	12.75%
Jun-03		-0.60%	12.08%
Jul-03		0.37%	12.50%
Aug-03		2.19%	14.96%
Sep-03		-0.18%	14.75%
Oct-03		1.37%	16.33%
Nov-03		2.03%	18.68%
Dec-03	15.22%	-1.81%	16.54%
Jan-04		-1.80%	14.44%
Feb-04		1.62%	16.29%
Mar-04		1.82%	18.41%
Apr-04		-0.37%	17.97%
May-04		0.90%	18.87%
Jun-04	2.52%	0.37%	19.47%

*Caissa Capital Volatility Opportunity Fund**Inception: October 2002*

Month	Gross Year	Gross Monthly Returns	Cumulative Since Oct-02
Oct-02		-0.93%	-0.93%
Nov-02		0.29%	-0.64%
Dec-02	8.52%	9.22%	8.52%
Jan-03		-6.93%	1.00%
Feb-03		151.74%	154.26%
Mar-03		28.28%	226.17%
Apr-03		17.26%	282.48%
May-03		16.23%	344.56%
Jun-03		47.75%	556.82%
Jul-03		19.89%	687.48%
Aug-03		52.04%	1097.28%
Sep-03		11.23%	1231.71%
Oct-03		26.31%	1582.07%
Nov-03		17.55%	1877.28%
Dec-03	1551.58%	-9.35%	1692.35%
Jan-04		-3.84%	1623.61%
Feb-04		8.43%	1768.93%
Mar-04		3.51%	1834.52%
Apr-04		0.30%	1838.33%
May-04		0.61%	1838.94%
Jun-04	8.99%	0.06%	1839.00%

Strategies undertaken by the fund are not intended to track any index. The fund may employ leverage. Past performance is not necessarily an indicator of future results. Nothing here should be construed as a solicitation of clients, or as an offer to sell or a solicitation of an offer to invest in the fund. Such activities may be made only pursuant to a private placement memorandum. As a matter of practice, Investment Analytics (Bermuda) Ltd does not solicit investments on behalf of any fund. **NO REPRESENTATION IS MADE THAT ANY INVESTOR IN THE PARTNERSHIP WILL OR IS LIKELY TO ACHIEVE RESULTS COMPRABLE TO THOSE SHOWN OR WILL MAKE ANY PROFIT AT ALL OR WILL BE ABLE TO AVOID INCURING SUBSTANTIAL LOSSES.** While every effort has been made to provide data from sources considered to be reliable, no guarantee of accuracy is given.