F-SQUARED INVESTMENTS

RETHINK INNOVATION

The F-Squared Quantitative Analysis Team

F-SQUARED INVESTMENTS

Our Difference

New ideas start with new questions. Our diverse team of quantitative experts comes from backgrounds ranging from mathematics and physics to computer and rocket science. With extensive professional experience, the Quantitative Analysis team brings innovative ideas and new questions to traditional financial concepts.

Our Quantitative Analysis team is changing how to approach investing — and even changing how to think about investments.

Founded for the Investor

F-Squared Investments was built to improve the investor experience, and that focus is still in place today. The founders refused to replicate an environment where building products for saleability was primary and where managers were paid for 'beating a peer group,' even if their clients lost money. A main issue they wanted to address was: "Help clients avoid large drawdowns."

Their approach was different: first, start with the investor and second, use advanced quantitative research as the source of innovation. From this basis, the founders built Portfolio Replication Technology or PoRT™. PoRT is an advanced dynamic modeling engine that leverages predictive analytics. The capabilities of this mathematically powerful tool are incorporated into F-Squared's risk management tools. The concept of predictive analytics within PoRT also enabled a more recent development — True Volatility™.

VADIM FISHMAN
MANAGING DIRECTOR,
CO-FOUNDER

> "We apply advanced statistical techniques that, to our knowledge, have not been used in financial markets before."

A pioneer in quantitative applications for investment management, Vadim Fishman leads the F-Squared Quantitative Analysis team. Mr. Fishman's path to investment management via mathematics and computer programming resulted in an innovative approach to investment management — one that improves the investor experience by delivering both market participation and downside protection.

DIFFERENT QUESTIONS

What if we look at the risk of loss instead of the opportunity to win?

What if benchmarks were considered obsolete?

What if it's possible to develop preemptive responses to volatility?

The result: innovative, evolving investment solutions.

An Innovative Approach

The Quantitative Analysis team developed the algorithm that drives F-Squared's dynamic volatility indicator called True Volatility.

"Every day our team conducts research and continues to innovate," says Vadim Fishman. "Our products are the result of the collective wisdom of the group. We are all experts in our fields and feel secure in our abilities. And this creates intellectual freedom, which in turn creates innovation."

Leveraging Diversity

True Volatility is an example of the result of the team's collaboration. The goal of True Volatility is to detect changes in volatility more quickly than traditional methods and repeatedly deliver signals to indicate these changes.

At the core of True Volatility is a concept used in image processing for signal compression and de-noising. Mathematicians on the team who were studying price returns over different time periods introduced this concept. They were looking for ways to remove noise from large amounts of data and then use the clean data to predict significant changes in price return volatility. Other team members, familiar with signal processing, recognized the idea's potential. After extensive coding and testing, this technology became foundational to the True Volatility methodology.

"When we developed True Volatility, we wanted a predictive measure of volatility. There are many different ways to look at volatility, but they are not necessarily predictive. And we know that volatility alone isn't comprehensive, so our model captures significant outputs, and filters out the 'noise' or insignificant data," says Mr. Fishman.

Teamwork and a Rigorous Modeling Environment

While the majority of F-Squared employees are located in Wellesley, MA, the Quantitative team is located in Princeton, NJ. The smaller Princeton office provides a more academic environment than the home office.

ALEX PANCHEKHA, PHD, CFA
SENIOR VICE PRESIDENT, QUANTITATIVE ANALYST

> "You must stay open to the idea that your concept may not work."

The F-Squared Quantitative Analysis team works in a unique, creative atmosphere. "Each of us realizes that none of us could do it without the rest," says Alex Panchekha. "Each of us thinks differently, takes a different approach, and conducts our research in a different way. All together it works."

All members of the Quantitative team are fully involved in the investment process, which involves translating vast quantities of data and mathematical concepts using computer programs. Each team member can program software to directly implement ideas.

First, the original 'inventor' of an idea writes a code to express the idea mathematically and the program is then run. Other team members test the code, and its assumptions, in very specific terms. Rather than looking at the results, they re-run the code to see how the results were generated and to test the accuracy and the stability of the code.

The entire team will go through the code, inserting different data, testing intermediary steps, and trying to find flaws in the mathematical expression.

"We are constantly trying to answer the question 'Is the code useful?'" says Mr. Panchekha. "We do not force data to comply with what we want it to prove. At all times we must be open to the data telling us nothing — or something completely different."

True to Our Vision

Almost a decade later, the work that our founders started is at the core of our firm: A clear investment goal, a sophisticated decision-making engine, and straightforward execution. The result of our Quantitative team's approach is innovative investment intelligence that delivers for the client. ■

F-Squared's Quantitative team is unique. They think differently and creatively develop technology to help deliver a better experience for investors.

THE F-SQUARED QUANTITATIVE ANALYSIS TEAM

Vadim Fishman
MANAGING DIRECTOR,
QUANTITATIVE ANALYSIS

A co-founder of F-Squared Investments, Mr. Fishman serves as Managing Director of the Quantitative Analysis team. He is also an Investment Committee member. Previously, he was Founder and CEO of IntelDM, Inc., a consulting firm providing mathematical and programming services for the financial services and biotech industries. In the past, he held various analytical and development roles customizing solutions for the financial services industry. Mr. Fishman earned an MS in Technology from the Kharkov Polytechnic University, Ukraine.

Alex Panchekha, PhD, CFA
SENIOR VICE PRESIDENT,
SENIOR QUANTITATIVE ANALYST

Mr. Panchekha is an Investment Committee member. Previously, Mr. Panchekha was the Head of Research at Markov Processes International LLC. Earlier, he led Portfolio Analytics Research at Bloomberg, where his team developed the multi-asset class portfolio risk system. In addition to expertise in designing high-performance financial application software, Mr. Panchekha has conducted scientific research on semiconductors, oceans, and complex brain-task activity. He holds an MS in Physics and Engineering and a PhD in Physics and Mathematics from the Kharkov Polytechnic University, Ukraine.

Rodrigo Toso
SENIOR VICE PRESIDENT,
QUANTITATIVE ANALYST

Mr. Toso is an Investment Committee member. Presently, he is a doctoral candidate in the Department of Computer Science, Rutgers University, where his research focuses on the interdisciplinary area of experimental algorithmics, including real-world problems in data analysis, machine learning, and optimization. Mr. Toso received his BSc from the Universidade Federal de Lavras, Brazil, and MSc from the Universidade Federal Fluminense, Brazil, both in Computer Science.

Ilya Muchnik
QUANTITATIVE CONSULTANT

Mr. Muchnik is a world-renowned scientist in the field of machine learning and combinatorial optimization. A lifelong innovator, he played a pivotal role in the introduction of kernel tricks to the field of pattern recognition in 1964. Today, kernel tricks are a fundamental component of pattern theory. Mr. Muchnik also advanced the field of combinatorial optimization. He introduced quasi-convex set function, a technology that has facilitated the creation of efficient, practical methods for clustering analysis. He has actively participated in various real-world application projects in the fields of Biotechnology, Finance, Epidemiological and Text Mining and has published hundreds of articles on these topics. Mr. Muchnik earned his PhD from the Institute of Control Sciences of the Russian Academy of Sciences, Moscow. He has worked as a professor at various universities, including Rutgers University, and has mentored a large cohort of PhD students who are currently successful scientists across the globe.

Leonard Gurevich
SOFTWARE DEVELOPER

Mr. Gurevich has more than 16 years of experience working as a Software Developer and Architect for small startups and large financial companies such as Cendant Mortgage, Bullrun Financial, Dow Jones, Bank of America, and ICAP. He has a BA in Arts from Belgorod College of Arts and a BS in Management from Kharkov State Academy of Culture, Ukraine.

Luiza Miranyan, PhD
SENIOR VICE PRESIDENT, QUANTITATIVE CLIENT PORTFOLIO MANAGER

Ms. Miranyan is an Investment Committee member. Previously, she worked in the Risk Management team at Highbridge Capital Management, modeling multi-asset class portfolios. Prior to that, she worked at Bloomberg, conducting research and implementing risk models for equities and fixed income. She also worked as Equity Derivatives Quantitative Researcher at JP Morgan, supporting equity exotics traders. Ms. Miranyan holds a BA and PhD in Mathematics from UC Berkeley.

Carlos Oliveira, PhD
VICE PRESIDENT, SENIOR SOFTWARE DEVELOPER

Mr. Oliveira specializes in computational optimization. He has worked for Princeton Consultants Inc. and for Bloomberg L.P. in New York City. Mr. Oliveira has authored several papers in areas related to optimization, mathematical programming, and computing, covering algorithms for NP-hard problems in areas such as computer and telecommunications networks, Internet modeling, and biological computing. He is a member of the Editorial Board of the journal *Optimization Letters*. Mr. Oliveira has also published a book on Objective-C programming, *Objective-C Programmers' Reference* (Apress, 2013). Mr. Oliveira obtained a PhD in Operations Research and Systems Engineering from the University of Florida.

Eugene Pinsky, PhD
VICE PRESIDENT, RESEARCH

Previously, Mr. Pinsky worked in quantitative finance and algorithmic trading for a number of companies including Harvard Management, Trading Cross Connects LLC, and Letra Group LLC. He began his research career at Boston University and was later at the Massachusetts Institute of Technology (MIT) as a visiting scientist. He received a BA in Mathematics from Harvard University and a PhD in Computer Science from Columbia University.

Svitlana Senenko
SENIOR VICE PRESIDENT, QUANTITATIVE OPERATIONS

Ms. Senenko oversees F-Squared's development and enhancement of operations processes, supervises the redesign of current systems and processes, manages databases and programming, and develops server applications. Previously, in her work as an astrophysicist, Ms. Senenko calculated the landing of the Soviet Shuttle, Buran. Ms. Senenko earned a BS and MS in Engineering from Kharkov Polytechnic University, Ukraine.

Jerry Yuan
VICE PRESIDENT, RESEARCH

Mr. Yuan is an Investment Committee member. His work at F-Squared Investments focuses on quantitative analysis of trading strategies. He joined from Saba Capital Management and was previously with Saba Principal Strategies at Deutsche Bank, supporting credit derivatives trading. Prior to that, Mr. Yuan worked in Quantitative Research at JP Morgan and Bear Stearns, focusing on fixed income derivatives and cross-asset modeling. He has authored original research papers in quantitative finance. Mr. Yuan received an ME in Computer Systems from Rensselaer Polytechnic Institute and an MS and BS in Physics from the Institute of Physics and Fudan University, China.

Elena Zarubina
QUANTITATIVE OPERATIONS ANALYST

Ms. Zarubina's responsibilities include application and production support, execution and testing of various models, distributed database application support, configuration management, application deployment, and multi-platform installation. She has more than 10 years of experience as a programmer analyst and previously worked in two third tier application and production support for Broadridge Financial Solutions (formerly ADP). Ms. Zarubina earned a BS in Library and Information Studies from St. Petersburg State University of Culture.

Zachary Zeltsan
VICE PRESIDENT OF TECHNOLOGY AND SENIOR PROGRAMMER ANALYST

Mr. Zeltsan's responsibilities include technology and programming proficiencies. Previously, he was a Developer of Communication Security Standards at Alcatel-Lucent and a Senior Computer Programmer at Dow Jones. Mr. Zeltsan received a BS and MS in Electrical and Mechanical Engineering from Kharkov Polytechnic University, Ukraine, and holds an MS in Computer Science from Brooklyn College.

- **20 Degrees**
- **4 PhDs**
- **5 Languages**
- **5 Mathematicians**
- **Editorial Board Member of *Optimization Letters***
- **Astrophysicist *(former)***
- **Visiting scientist at MIT *(former)***

A Distinguished Body of Work

The F-Squared Quantitative team has the deep knowledge and experience needed to bring innovative ideas to traditional financial concepts. Below are some of the patents and publications produced by our team.

PATENTS

Our team members boast rights to multiple patents, advancing their fields of expertise, including:

"Method and System for Securities Pool Allocation," U.S. Patent No. 5,563,783 (E. Pinsky et al.).

"Systems for Determining and Providing a Portfolio Overlay for Investment Portfolio Adjustment to Mitigate Financial Risk," U.S. Patent Appl. Publ. No. 2014/0164288 (H. Present, V. Fishman) (also International PCT WO2014/059187).

"Method and Apparatus for Reducing E-mail Spam and Virus Distribution in a Communications Network by Authenticating the Origin of E-mail Messages," U.S. Patent No. 7,752,440 (Z. Zeltsan et al.) (also Japan JP2005259141, Europe EP1575228, and China CN1668040).

"Method and Apparatus for Authentication of Session Packets for Resource and Admission Control Functions (RACF)," U.S. Patent No. 8,108,677 (Z. Zeltsan et al.).

PUBLICATIONS

FINANCE. Over 10 articles and research papers in the field of finance, including:

Miranyan, Luiza, "Incorporating Forward-Looking Market Data into Linear Multifactor Fundamental Models," The Journal of Risk, (pp 3–34) Volume 14/Number 4, Summer 2012.

E. Pinsky, R. Sunitsky, "High Frequency Trading and Market Inefficiencies: A Statistical Physics Viewpoint," October 2009, Trading Cross Connects, white paper.

MATHEMATICS. Over 50 articles and research papers in the field of mathematics, including:

The magic of the prolate spheroidal functions in various setups (F. A. Grunbaum, L. Miranyan), 2001 Proc SPIE 4478, pp 151–61.

Quasi Concave Functions on Meet-Semilattices, Discrete Applied Mathematics (Ilya Muchnik, Yulia Kempner), Volume 156, Issue 4, February 15, 2008, pp 492–499.

SCIENCE. Over 50 articles and research papers in the field of science, including:

A.Ya. Mogilevsky, L.P. Derzhiruk, A.P. Panchekha, E.A. Dershiruk, "Adaptive regulation of nonlinear dynamics of brain electrical activity," Zhurnal Vysshey Nervnoy Deyatelnosti, v.47, N1, pp 147–158 (1997) (Neuroscience and Behavioral Physiology (1998), Volume 28, Issue 4, pp 366–375).

Prediction of protein folding class using global description of amino acid sequence, Inna Dubchak, Ilya Muchnik, Stephen R Holbrook, Sung-Hou Kim, 1995/9/12, Journal of Proceedings of the National Academy of Sciences, Volume 92, Issue 19, pp 8700–8704, published by National Academy of Sciences.

COMPUTER SCIENCE. Over 50 articles and research papers in the field of computer science, including:

Oliveira, Carlos, *Objective-C Programmers' Reference*, Apress, 2013. Print.

E. Pinsky, Y. Yemini, "The Canonical Approximation in Performance Analysis," Computer Networking and Performance Evaluation, Hasegawa (ed), North-Holland, 1986, pp 3.3.1–3.3.13.

ENGINEERING. Over 25 articles and research papers in the field of engineering, including:

"An implementation of logical analysis of data," Endre Boros, Peter L Hammer, Toshihide Ibaraki, Alexander Kogan, Eddy Mayoraz, Ilya Muchnik 2000/3, Journal of Knowledge and Data Engineering, Volume 12, Issue 2, pp 292–306, Published by IEEE (Institute of Electronics and Electronics Engineers).

E. Pinsky, A. Conway, W. Liu, "Blocking Formulae for the Engset Model," IEEE Transactions on Communications, vol 42, no.6, 1994, pp 2213–2214.

IMPORTANT INFORMATION

Risk Disclosure

No investment strategy or risk management technique can guarantee returns or eliminate risk in any market environment.

All investments include a risk of loss that clients should be prepared to bear. The principal risks of the AlphaSector Indexes and Strategies are disclosed in the publicly available Form ADV Part 2A.

True Volatility is a proprietary statistical measure of volatility developed by F-Squared Investments. The True Volatility metric may be applied to traded securities, including ETFs, using market pricing information as a primary input. True Volatility is designed to provide an improved measure of volatility through advanced quantitative techniques, with the goal of identifying patterns of volatility with enhanced speed and clarity.

"PoRT" is a product offering of F-Squared Investment Management, LLC ("F-Squared"). Investment products that may be based on PoRT Indexes are not sponsored by F-Squared, and F-Squared does not make any representation regarding the advisability of investing in them. There is no guarantee that an investor's account will achieve its objectives or avoid losses. Inclusion of a security in an index does not in any way reflect an opinion of F-Squared regarding the investment merits of such a fund, nor should it be interpreted as an offer of such a fund's securities. None of the securities included in an index has given any real or implied endorsement or support to F-Squared or to this index. One cannot invest directly in an index. All PoRT Indexes represented in this material do not reflect the actual trading of any client account. No representation is being made that any client will or is likely to achieve results similar to those presented herein. Most PoRT Indexes are evaluated for rebalancing on a bi-weekly basis.

FSquared defines "derisking" as reducing exposure to a given asset class by reallocating to a cash alternative (generally, a Shortterm Treasury ETF). AlphaSector Indexes may derisk or rerisk in response to market conditions as determined by our disciplined quantitative models. Although the goal of "derisking" is to avoid losses, it is subject to its own risks, including loss of principal. The allocation to the cash alternative may underperform the returns of the asset class. Cash alternatives offer little opportunity for capital appreciation.

The views expressed in the referenced materials are subject to change based on market and other conditions. These documents may contain certain statements that may be deemed forward-looking statements. Please note that any such statements are not guarantees of any future performance and actual results or developments may differ materially from those projected. Any projections, market outlooks or estimates are based upon certain assumptions and should not be construed as indicative of actual events that will occur.

The information provided does not constitute investment advice and it should not be relied on as such. It should not be considered a solicitation to buy or an offer to sell a security. It does not take into account any investor's particular investment objectives, strategies, tax status or investment horizon. You should consult your tax and financial advisor.

For more information, visit our website at www.f-squaredinvestments.com.

F-SQUARED INVESTMENTS

F-Squared Investments is an asset manager that provides investment indexes and strategies based on its AlphaSector® and Portfolio Replication Technology capabilities. The firm delivers investment solutions to help meet investors' expectations and serves clients in the advisor, institutional, retail, and retirement markets. As of September 30, 2014, F-Squared affiliated entities had over $25 billion in fee-generating assets.

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