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# Bounded Tradable Processes

# Confidentiality

- Information in this presentation is strictly private & confidential

# Background

- Strategy live at Buttonwood Group Trading (BGT) 07/2011 – 10/2012 (16 months); back-tested from 01/2006 with similar performance results
- Founder of Quanterra Advisors LLC and developer of quantitative trading strategies since 06/2010
- Project Manager / Subject Matter Expert, Global Banking & Markets at RBS and ABN AMRO 2001-2010
- M.Sc. in Financial Mathematics, University of Chicago
- B.Sc. in Physics & IT, Novosibirsk State University
- Research at VEPP-4 electron-positron collider of Novosibirsk Institute of Nuclear Physics (11 GeV energy range)

# Live Track Record

Buttonwood Group Trading, 07/2011 – 10/2012

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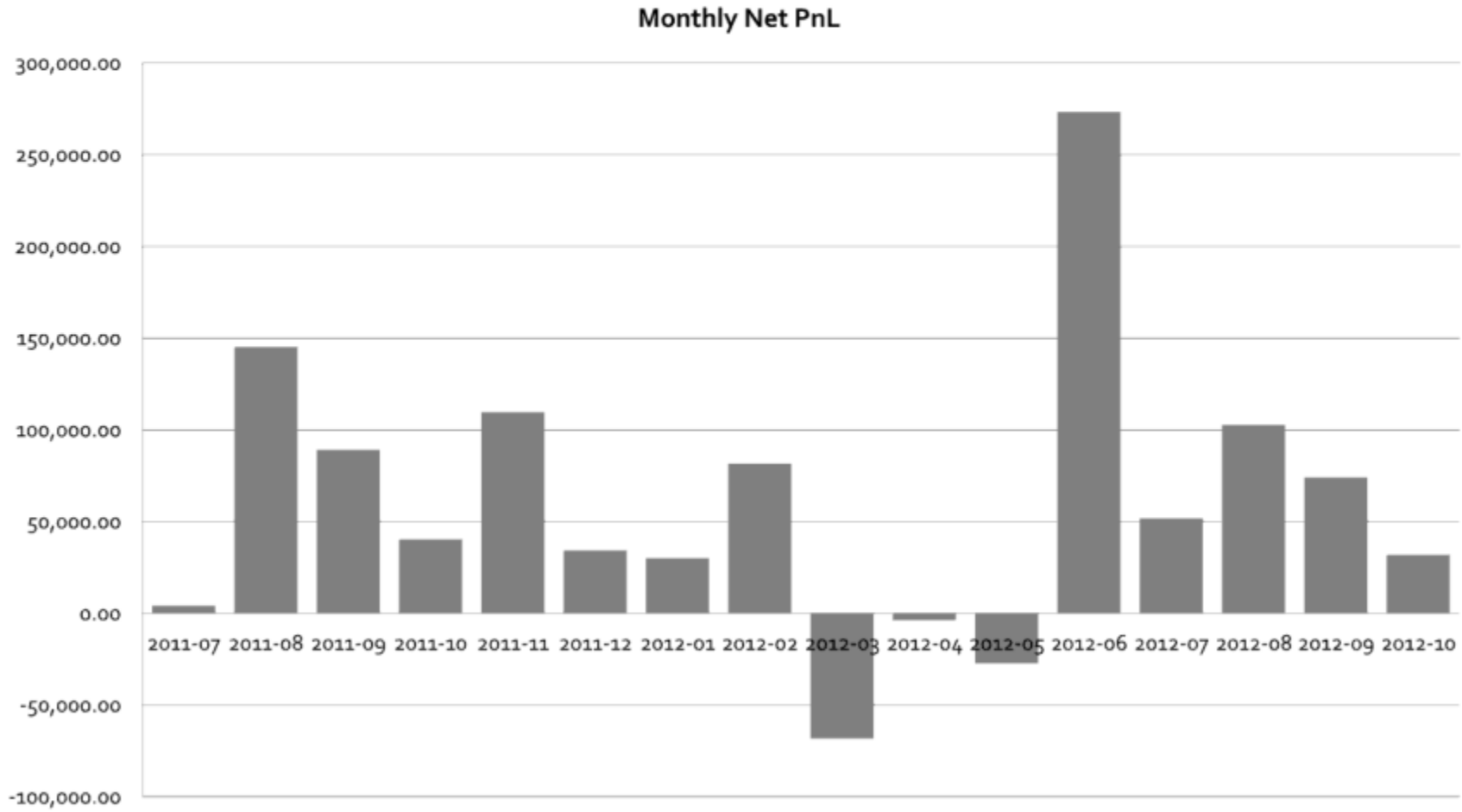
# Live Track Record – BGT

| Date range | 07/2011 – 10/2012 (16 months) |
|---|---|
| Reserved capital | 3.5m |
| Average utilized capital (AUC) | 1.4m |
| Available leverage | 15x |
| Reinvestment of gains into the strategy | No |
| Asset classes | Equities (85%); futures (15%) |

| Total net PnL | 0.97m (67.5% return on AUC) |
|---|---|
| Positive months | 13 (81%) |
| Negative months | 3 (19%) |
| Best month | 0.27m |
| Worst month | -0.07m |
| Sharpe ratio | 2.67 |

# Live Track Record - BGT

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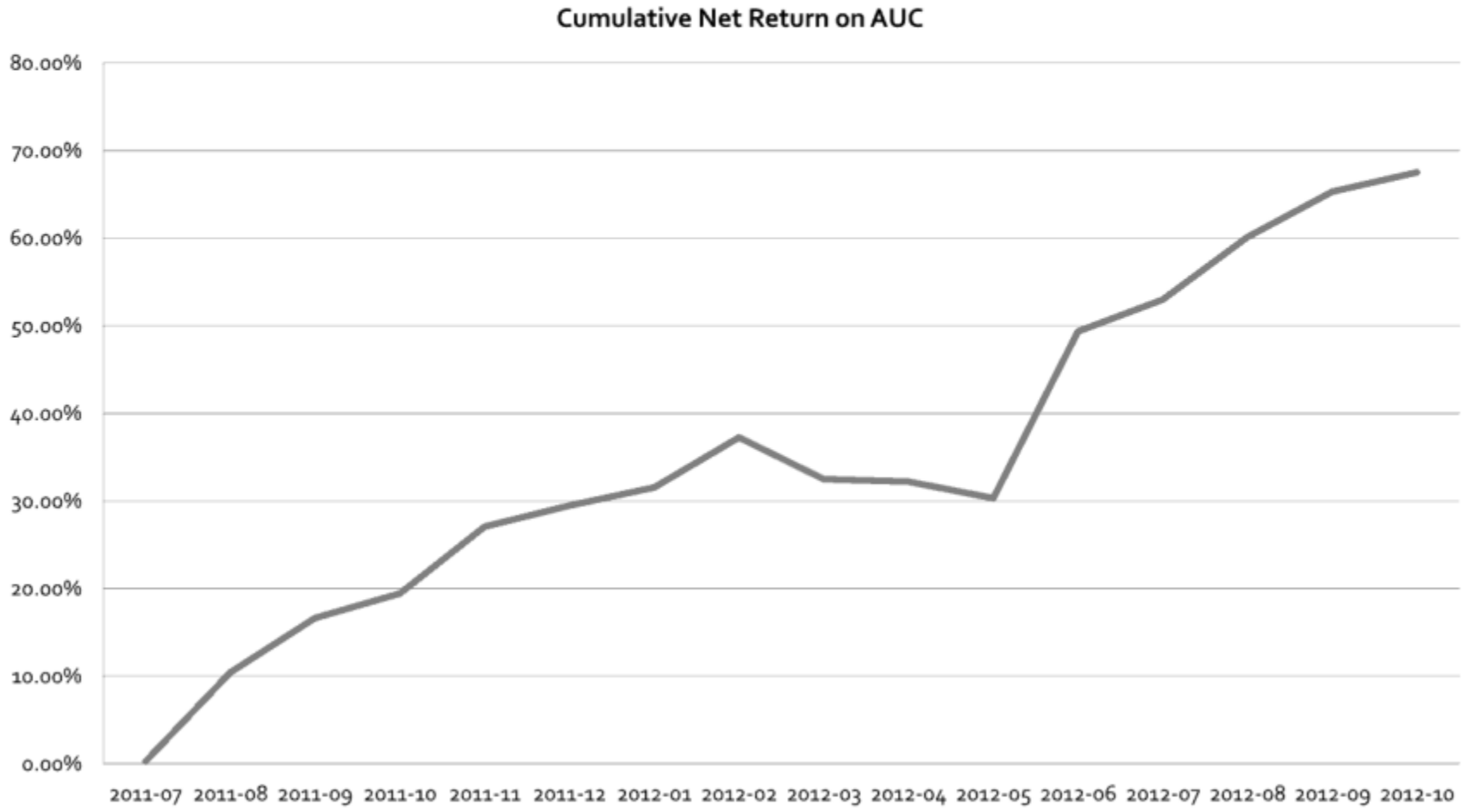
# Live Track Record – BGT

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# Live Track Record – BGT

Comments:

- Reinvestment of strategy gains back into the strategy would have resulted in significant performance improvement due to compounding (total return on AUC 89.9% vs. 67.5%)
- Strategy performance was negatively impacted on at least 3 occasions by emergency re-allocation of capital to other traders

# Back-Testing Track Record

01/2006 – 12/2012 (84 months)

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# Back-Testing Track Record

| Date range | 01/2006 – 12/2012 (84 months) |
|---|---|
| Reserved capital | 1.0m |
| Average utilized capital (AUC) | 0.62m |
| Available leverage | 15x |
| Reinvestment of gains into the strategy | No |
| Asset classes | Same as live trading |

| Annualized net PnL | 0.57m (57.8%) |
|---|---|
| Positive months | 70 (83%) |
| Negative months | 14 (17%) |
| Best month | 0.42m |
| Worst month | -0.17m |
| Sharpe ratio | 3.12 |

# Back-Testing Track Record

Observations:

- Slightly better performance vs. live performance during 07/2011 – 10/2012 period (no capital re-allocation issues as mentioned above)
- Slightly better overall performance (higher average volatility)
- Market volatility results in better performance; best years for the strategy were 2008 and 2009

# Strategy Description

Bounded Tradable Processes

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# Strategy Description: Bounded Tradable Processes

- "Process" can be
  - single financial instrument (stock, future, option, FX, etc.)
  - two-legged spread $S = X - aY$, where $X$ and $Y$ are financial instruments (stocks, futures, options, FX, etc.)
  - three-legged spread $S = X - aY - bZ$, where X, Y, Z are financial instruments
  - complex combination spreads e.g. $S = aX/Y$, $S=aX - bY/gZ$, *etc.*
- "Tradable" means that all components of S can be traded at any time in required quantities (given liquidity constraints and other technicalities)

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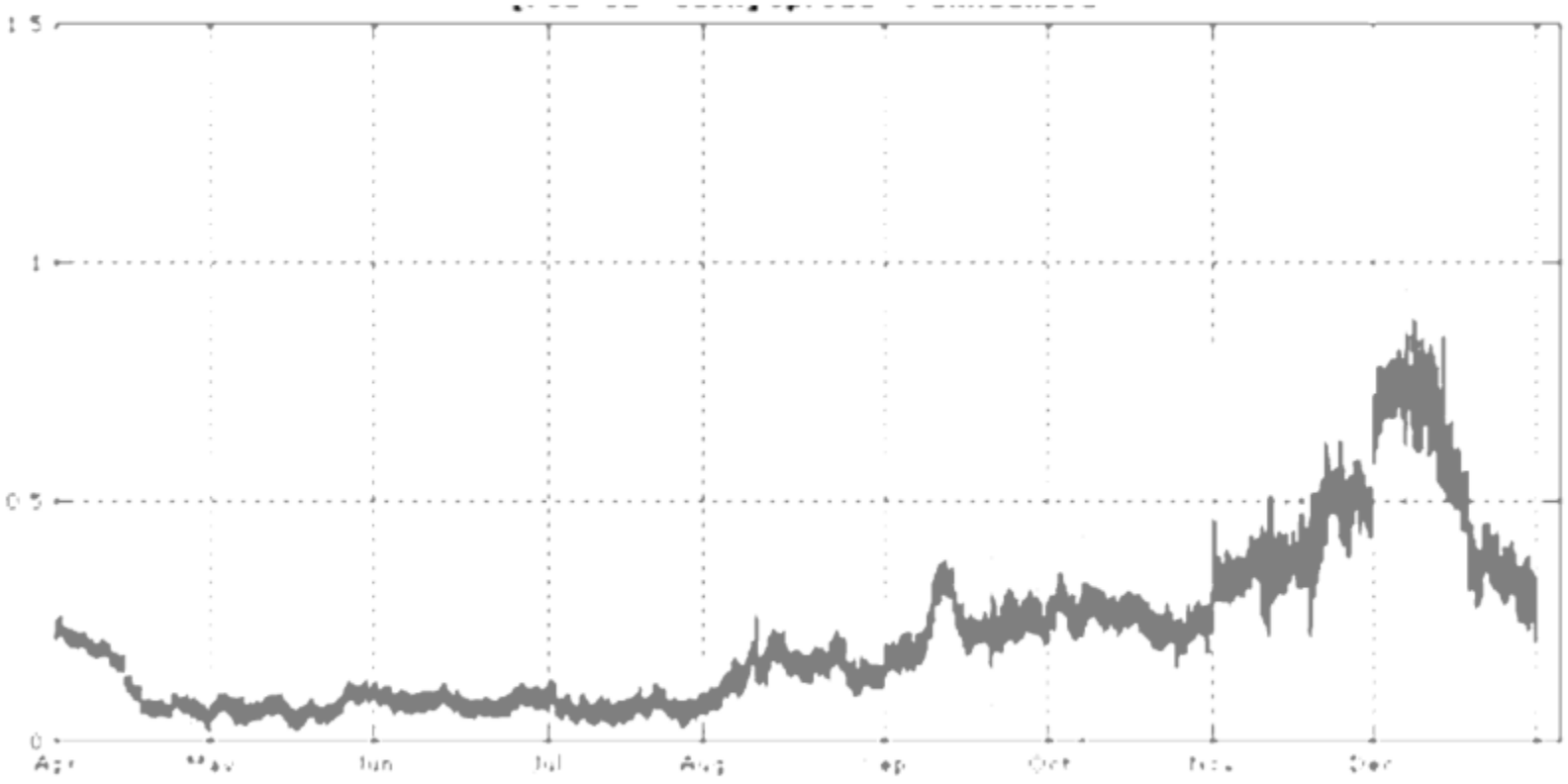
# Arbitrage Bounds

- Tradable Process that has lower, upper, or both lower and upper arbitrage bounds can be unwound at a pre-determined price
- Various "mechanics" enforcing bounds
  - Asset swap ("fungibility"): *X* may be swapped for *Y* at holder's discretion – ensures that $X > Y$; if $X < Y$, buy bunch of *X*, swap for *Y* and sell *Y* for higher price and riskless profit ("pure" arbitrage)
  - Multi-step asset swap: similar to above, but involving multiple steps to unwind complex spread at pre-determined price
- "Hard" bounds – guaranteed to be able to unwind the process at a known price

# Non-Arbitrage Bounds

- Process *should not* go beyond certain values due to fundamentals; however there is no way to unwind if it does
- Example: "asset quality"
  - Equity with voting rights vs. equity without voting rights
  - Higher-grade commodity vs. lower-grade commodity
  - Senior vs. subordinated debt
- Once the process moves beyond the bound and information spreads through the market, the relationship would typically get restored as participants buy superior asset for less, or holders of inferior asset replace it with superior asset while booking a profit
- More dangerous than arbitrage bounds – reflect in position sizing (e.g. 10% of arbitrage-bounded trade)

# Example: Arbitrage Bounded Process ("hard" bound at zero)

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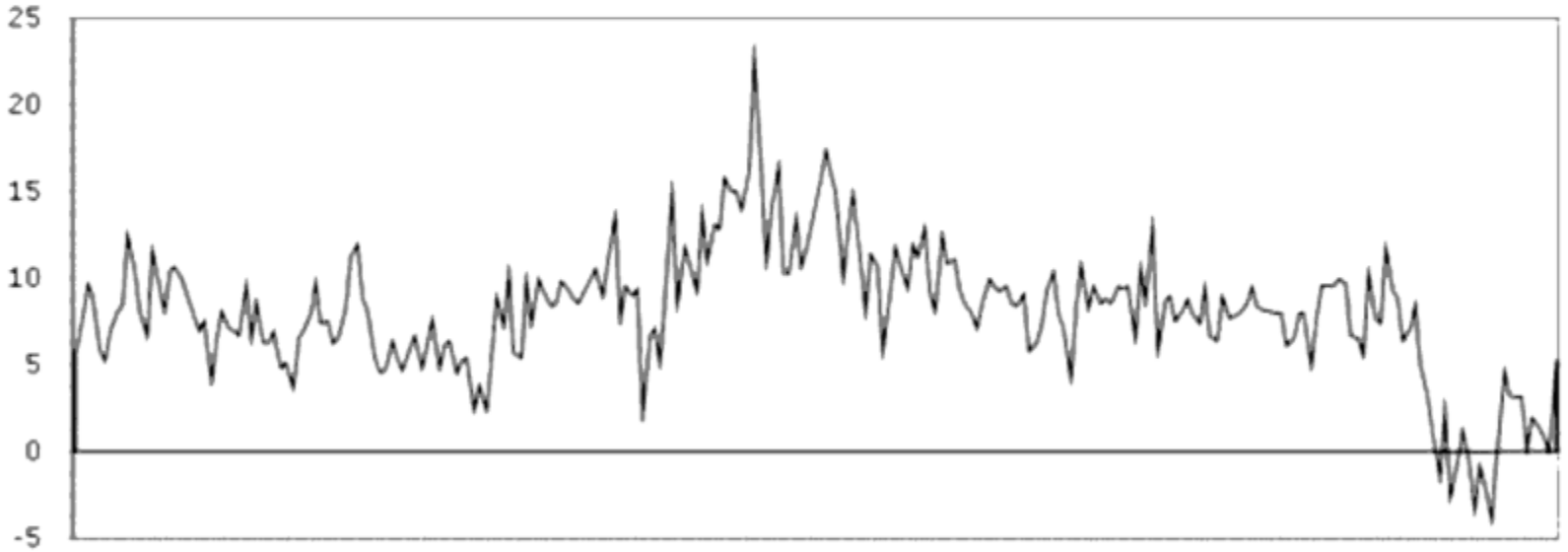
# Example: Non-Arbitrage Bounded Process ("soft" bound at zero)

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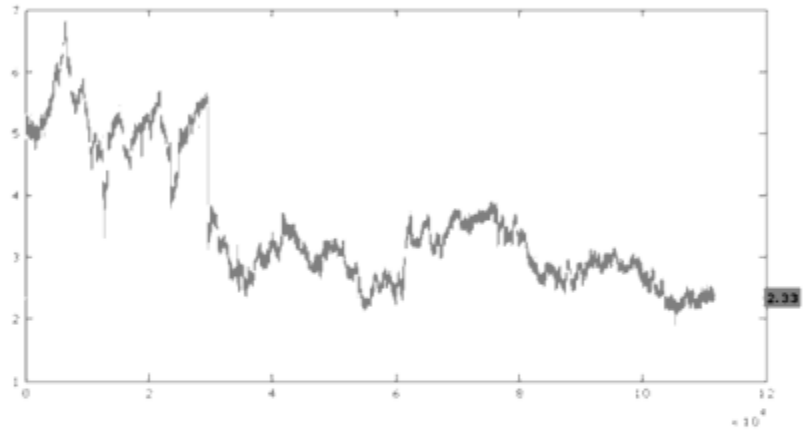
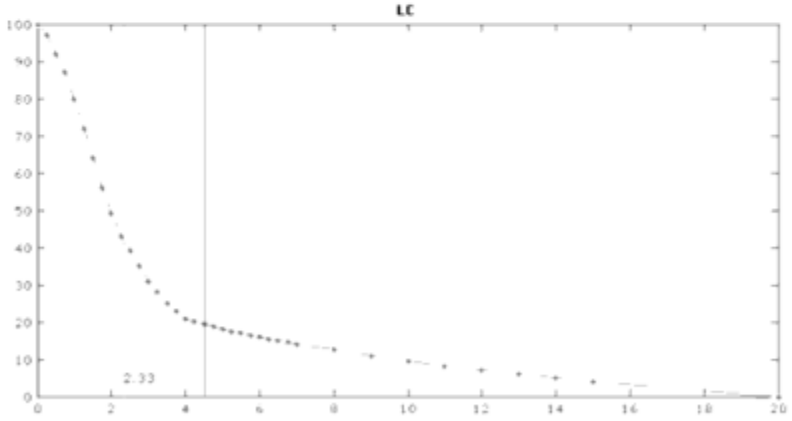
# Approach to Trading

- The closer the process gets to its bound, the bigger the position with 100% of target position size right at the bound
- As the process moves away from the bound, reduce position size
- As the process oscillates we generate PnL buy buying lower and selling higher
- The schedule of process values and corresponding position sizes is known as *loading curve*

# Loading Curve Example

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# Profitability Analysis

- Volatility is good!
- Great opportunities when position can be entered or increased close to the bound and unwound as the process moves away
- Worst-case scenario: process approaching its bound with very low volatility and staying at the bound for prolonged period of time

# Other PnL Contributors

- Market making
- Intraday fluctuations
- Capturing market impact
- Mean-reversion

# Loading Curve Optimization

- Goal: create a loading curve shape that would
  - maximize PnL
  - minimize drawdowns
  - minimize PnL volatility
  - maximize Sharpe ratio
  - other considerations
- Highly computationally-intensive optimization techniques based on historical data

# Competitive Advantage

- Space not nearly as crowded as pure arbitrage trades
- Requires significant R&D efforts that further reduce competition
- Unique and highly computationally intensive process of model calibration and optimization

# Capacity and Scalability

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# Existing Product Groups

- 14 product groups (tradable processes) are fully set up and are available for trading
- Estimated capacity without adverse impact on performance: up to 10 – 15m
- Further scalability with some performance impact: up to 20-25m

# Adding New Product Groups

- New product groups (tradable processes) may be added
- Approximately 2 months of R&D per product group
- Many interesting opportunities in international markets

# Expanding Across Asset Classes

- Same quantitative research methods may be applied to other asset classes and across asset classes
- Virtually unlimited scalability
- Some ideas:
  - Commodity calendar spreads or spread options + physical storage
  - Inter-commodity spreads + physical asset (refinery, power plant)
  - Convertible debt
  - Debt + CDS

# Summary

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# Summary

- Time-tested strategy with excellent performance characteristics
- Market-neutral with no correlation with the S&P 500
- Highly scalable
- Diversified portfolio of trades already live
- Robust quant research framework
- Large search universe for adding new product groups
- Further scalability by expanding across asset classes