BARCLAYS CAPITAL

The POINT® Portfolio Optimizer

Index, Portfolio, and Risk Solutions

June 2010

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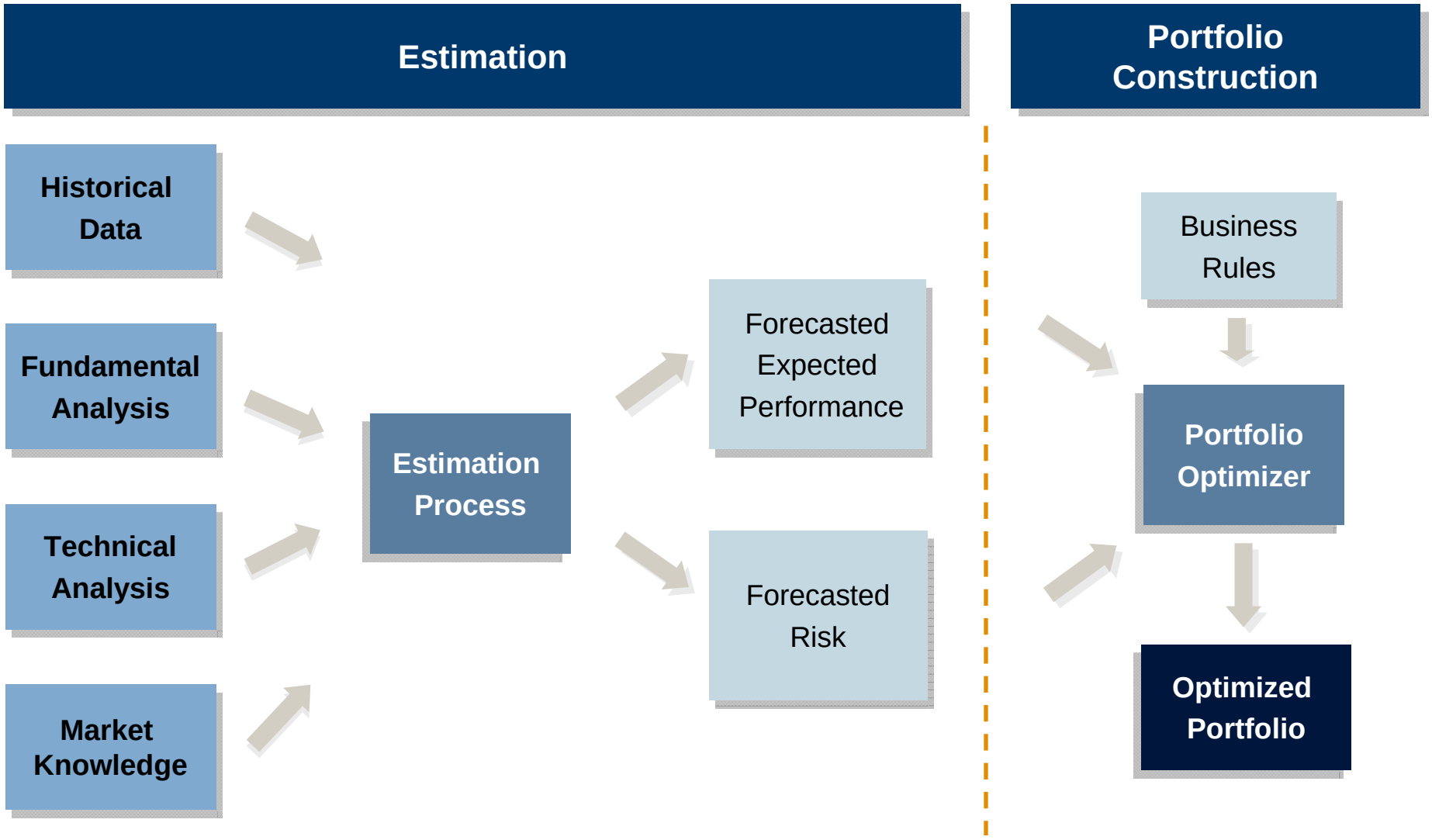
PLEASE SEE ANALYST CERTIFICATIONS AND IMPORTANT DISCLOSURES STARTING AFTER PAGE 47

Roadmap to Portfolio Construction



POINT Portfolio Optimizer

The optimizer takes a unified approach to

Portfolio Construction

- Index replication: construct a model portfolio with few (cash/derivatives) securities tracking a benchmark.
- Total return: construct a portfolio to maximize risk-adjusted returns (overlay alpha strategies, equity long-short optimization (130/30 strategies))
- Semi-active: construct a factor-mimicking portfolio with exposure to certain factors (factor/tilt portfolios, duration/sector overweight portfolios)

Portfolio Re-balancing

- Recommend a few trades with low turnover to re-align the risk profile of a portfolio with a benchmark as new market information comes in.
- Optimally and partially liquidate a portfolio to withdraw cash or support cash injections
- General rebalancing based on budget, turnover, leverage, risk and return preferences.

Portfolio Hedging

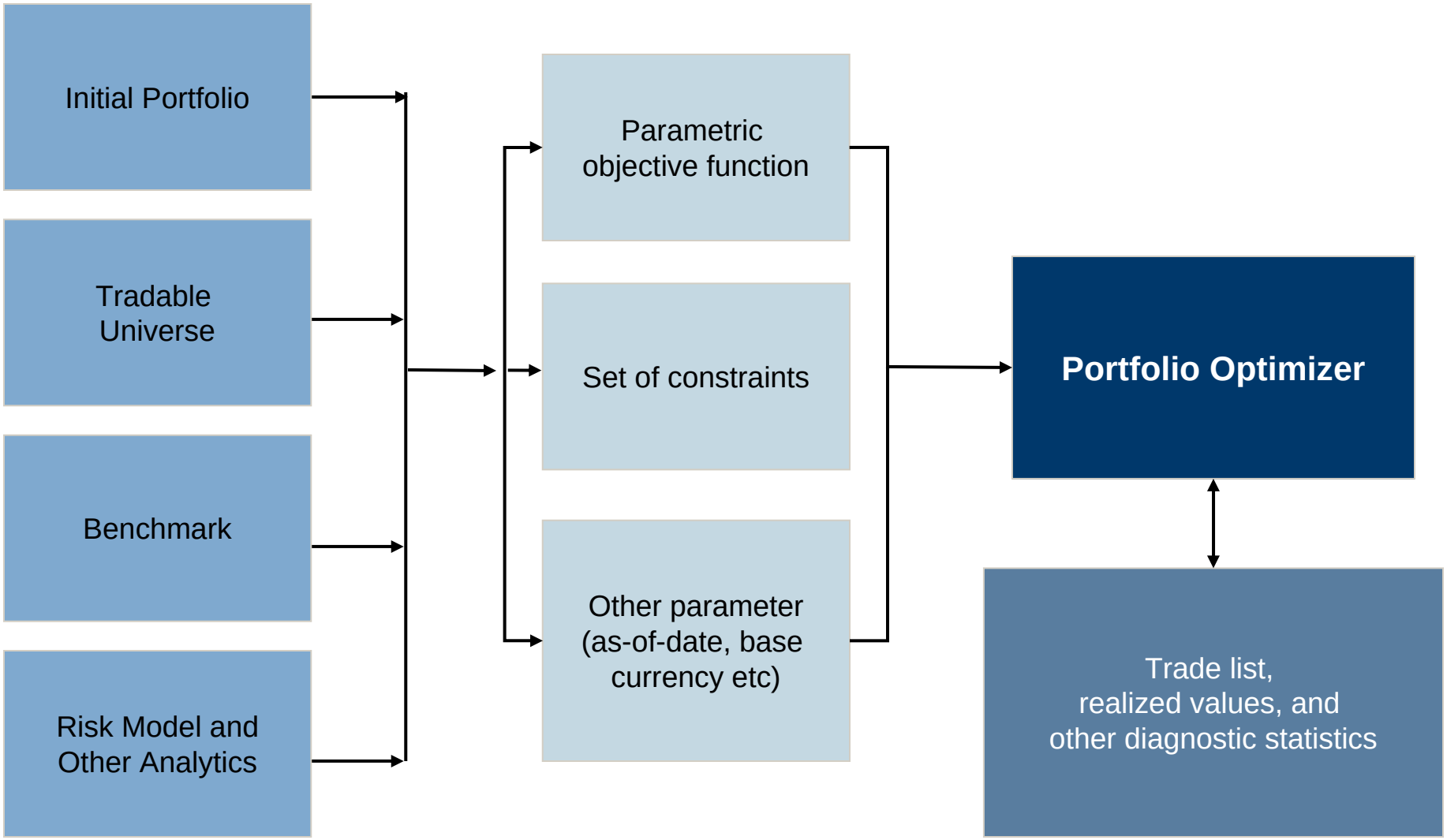
- (Linear and non-linear) Hedging specific components of portfolio risk using derivatives, for example.
  - Currency/curve risk using FX/IR swaps, futures, and forwards
  - Equity/credit risk using equity and credit derivatives
  - Volatility risk using volatility products (e.g., IR caps, floors, etc.)

Incorporating Different PM Preferences

Sample portfolio characteristics that the optimizer allows users to control (i.e., use in the objective function and set constraints on) in the process.

Turnover	*Liquidity*	*Maximize*
Leverage	*Expected Returns*	
Transaction Costs	*Absolute Risk*	*Minimize*
Sector Exposures	*Issuer Concentration*	
Number of Trades	*Tracking Error*	*Constrain*
Number of Names	*No Shorting*	
Smallest Holding	*Sector (Over) Weights*	

Point's Optimization Schematic



The Optimization Models

Maximize objective function

Subject to

- Budget constraints
- Turnover constraints
- Upper bound on **number of securities** in the final portfolio
- Upper bound on **number of trades** recommended by the optimizer
- Lower bound on the size of trades suggested by the optimizer
- Generic linear constraints on the final portfolio analytic computed at
  - Generic security buckets defined using security partitions and
  - With respect to a user specified benchmark
- Upper bond on the total, systematic, or idiosyncratic portfolio risk with respect to cash or a specified benchmark

Where the **objective function** is specified as the weighted sum of the following terms with user specified weights.

- The **systematic, idiosyncratic,** or **total tracking error variance** of the portfolio with respect to a user-specified benchmark
- The user-provided security **expected return/performance** estimates
- A large number of POINT-supported **quantitative analytics** across all asset classes
- Transaction costs

The POINT Portfolio Optimizer

- **Fast, scalable**, and **real-time performance** – support of **large tradable universes** (up to 10,000 issues) and benchmarks with a **predictable and practical** turnaround time in minutes
- Seamlessly integrate with **POINT's Global Risk Model (GRM),** and other **quantitative analytics** base on state-of-the-art pricing engines.
- Covers the entire universe of securities supported in POINT and the Global Risk Model, including multi-currency **cash bonds** and **equities,** as well as **derivatives.**
- In particular, allows
  - **Multi-currency optimization**
  - **Historical optimization (back-testing)**
  - **Mixed fixed income - equities optimization**
  - **Long-short optimization**
  - **The construction of overlay strategies**
  - **Transaction cost optimization**
  - **Optimization using portfolio instruments/custom funds**

The POINT Portfolio Optimizer

- Operates at the **security level,** returning a set of “trades” taking into account both **systematic** and **idiosyncratic risk**
  - Not a simple 10-by-10 strategic asset allocation tool
- Allows **most security attributes** available in POINT to be used in objectives and / or constraints
- Ability to control **leverage, turnover, budget,** and **notional** of the portfolio.
- Fully customizable parametric objective function
  - Terms include **TEV, Sharpe/Information ratio**, generic **penalty** functions, **analytics,** etc.
- Generic constraints on large universe of portfolio analytics measured on
  - **Generic security buckets** defined using **generic Point partitions**
  - Portfolio, or portfolio net of benchmark, or trading portfolio
- **Supports issue/issuer/ticker exposure** constraints
- Supports **soft** constraints
- Supports **non-convex and combinatorial constraints**
  - upper bound on the **number of securities** in final portfolio,
  - upper bound on the **number of trades** recommended,
  - lower bound on **minimum trade size**

Portfolio Optimization Publications

- Screenshot shows the Portfolio optimizer white paper and user guide

BARCLAYS CAPITAL

INDEX, PORTFOLIO, AND RISK SOLUTIONS

Portfolio Modeling | 20 November 2009

PORTFOLIO OPTIMIZATION

Barclays Capital Portfolio Optimizer in POINT

The Barclays Capital Portfolio Optimizer, available through the POINT system, provides advanced portfolio construction, hedging, and re-balancing capabilities. The optimizer creates optimal portfolios by automatically trading off risk, return, transaction costs, and other portfolio analytics using client-specified preferences. Users can enforce a diverse set of constraints on the portfolios, reflecting their investment goals and regulatory requirements.

The optimizer is integrated with the rest of the analytical tools in POINT, including the Global Risk Model (GRM), benchmark indices, and quantitative analytics based on state-of-the-art pricing engines. It supports a diverse universe of tradable securities including cash bonds, equities, options, futures, and other derivatives and allows users to incorporate their market views (e.g., security-level return forecast, analyst ratings, etc.) in the optimization process. Investors can control portfolio leverage, turnover, budget, notional, number of positions, and number of trades. In addition, the optimizer supports generic sector constraints on a number of portfolio analytics.

The optimizer is a large-scale quadratic constrained quadratic programming (QCQP) solver utilizing state-of-the-art optimization technology with support for a number of non-convex and combinatorial constraints. We believe our generic approach is superior to optimization tools based on traditional mean-variance frontiers and gradient descent approaches. It operates at the security level and recommends optimal trades in investable securities. It supports large optimization universes and runs interactively, with a turnaround time of minutes. It can also be programmed through the POINT batch processing engine to deliver trade lists at a given sequence of dates, essentially defining the evolution of optimal portfolios over time and facilitating the back-testing of portfolio construction strategies.

The optimizer allows users to construct optimal multi-currency portfolios, long-short portfolios, and overlay strategies. It incorporates the relationships between diverse asset classes (e.g., fixed-income and equities) to construct optimal portfolios. Users can easily construct optimal index-tracking portfolios (e.g., minimizing tracking error volatility with few positions), portfolios maximizing risk-adjusted expected returns, and portfolios targeting specific risk factors or in specific market sectors. The optimizer can be used to optimally and partially liquidate a benchmarked portfolio to generate cash outflows or invest new cash injections while controlling trading costs and turnover. It can be used to construct optimal hedges using derivatives and tradable portfolio instruments to target a specific component of risk.

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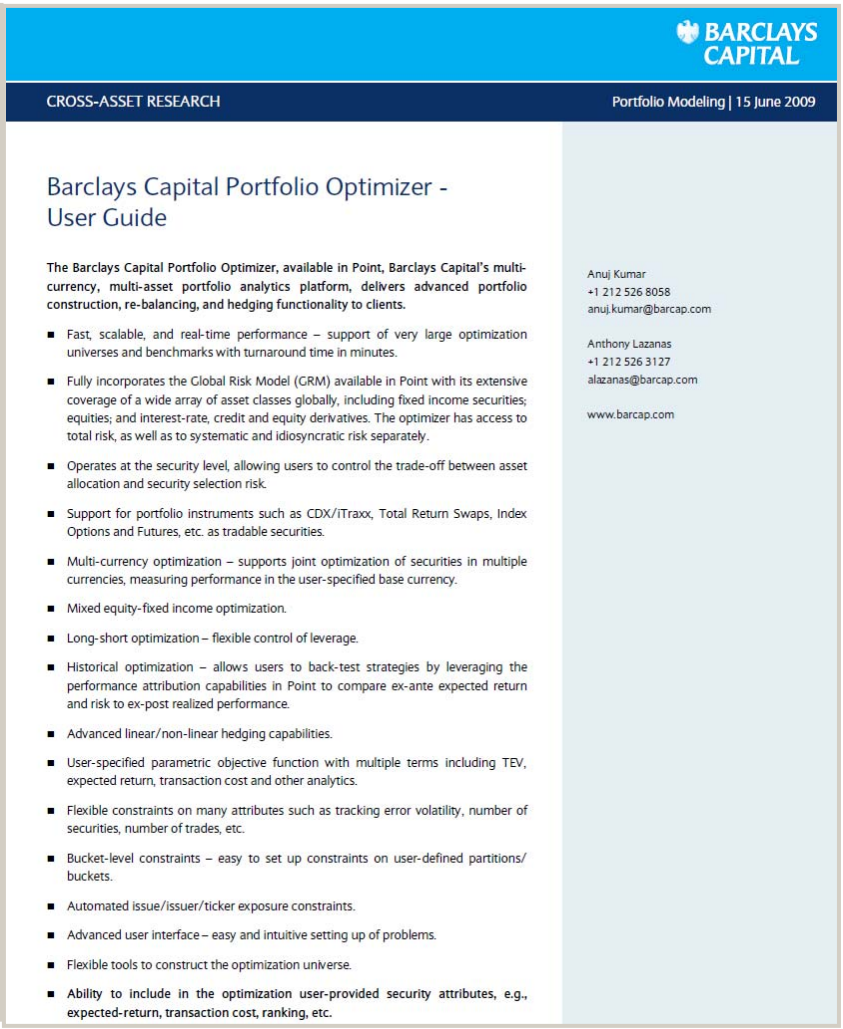

BARCLAYS CAPITAL

CROSS-ASSET RESEARCH

Portfolio Modeling | 15 June 2009

Barclays Capital Portfolio Optimizer - User Guide

The Barclays Capital Portfolio Optimizer, available in Point, Barclays Capital's multi-currency, multi-asset portfolio analytics platform, delivers advanced portfolio construction, re-balancing, and hedging functionality to clients.

- Fast, scalable, and real-time performance – support of very large optimization universes and benchmarks with turnaround time in minutes.
- Fully incorporates the Global Risk Model (GRM) available in Point with its extensive coverage of a wide array of asset classes globally, including fixed income securities; equities; and interest-rate, credit and equity derivatives. The optimizer has access to total risk, as well as to systematic and idiosyncratic risk separately.
- Operates at the security level, allowing users to control the trade-off between asset allocation and security selection risk.
- Support for portfolio instruments such as CDX/iTraxx, Total Return Swaps, Index Options and Futures, etc. as tradable securities.
- Multi-currency optimization – supports joint optimization of securities in multiple currencies, measuring performance in the user-specified base currency.
- Mixed equity-fixed income optimization.
- Long-short optimization – flexible control of leverage.
- Historical optimization – allows users to back-test strategies by leveraging the performance attribution capabilities in Point to compare ex-ante expected return and risk to ex-post realized performance.
- Advanced linear/non-linear hedging capabilities.
- User-specified parametric objective function with multiple terms including TEV, expected return, transaction cost and other analytics.
- Flexible constraints on many attributes such as tracking error volatility, number of securities, number of trades, etc.
- Bucket-level constraints – easy to set up constraints on user-defined partitions/ buckets.
- Automated issue/issuer/ticker exposure constraints.
- Advanced user interface – easy and intuitive setting up of problems.
- Flexible tools to construct the optimization universe.
- **Ability to include in the optimization user-provided security attributes, e.g., expected-return, transaction cost, ranking, etc.**

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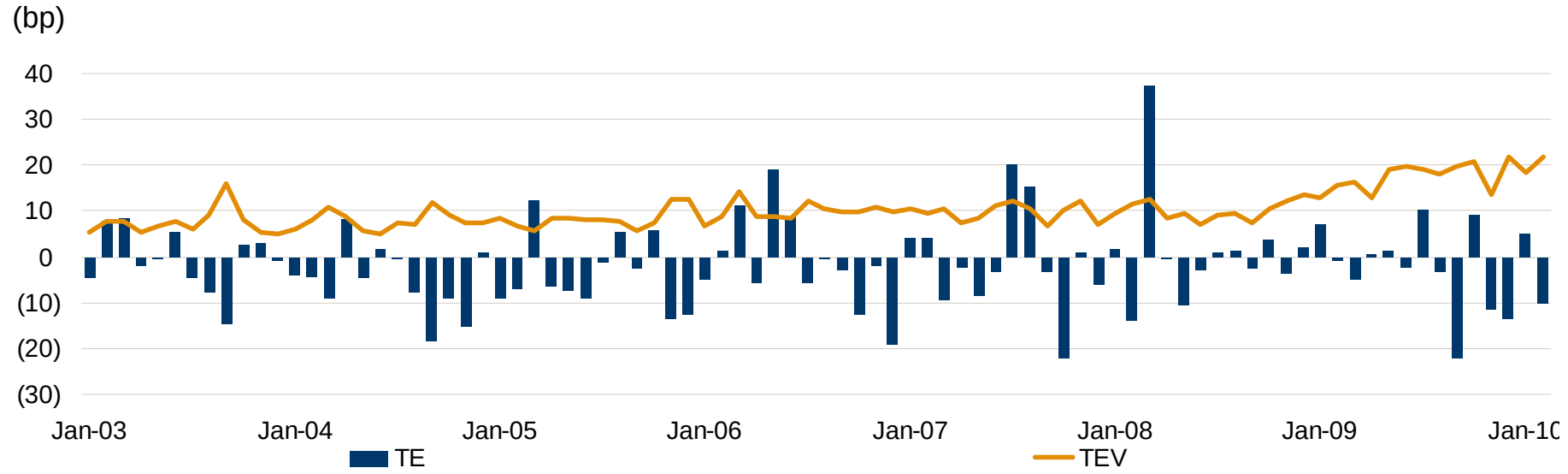
Sample Applications

All sample results are for demonstration purpose only. Please refer to optimizer white paper (Kumar, (2009), Portfolio Optimization – Barclays Capital Portfolio Optimizer in POINT) for details.

Index Replication I – Global Treasury Index Using a 20-bond Minimum TEV Portfolio

Sample period – January 2003–February 2010 (86 months)



Realized Tracking Error Statistics

	Volatility Forecast	Active Return	Standardized TE
Median	9.3		
Stdev		9.4	0.9
Max	21.7	37.3	2.97
Min	4.9	(22.0)	(2.14)

Source: Barclays Capital POINT.

Index Replication I – Sample Optimal Portfolio

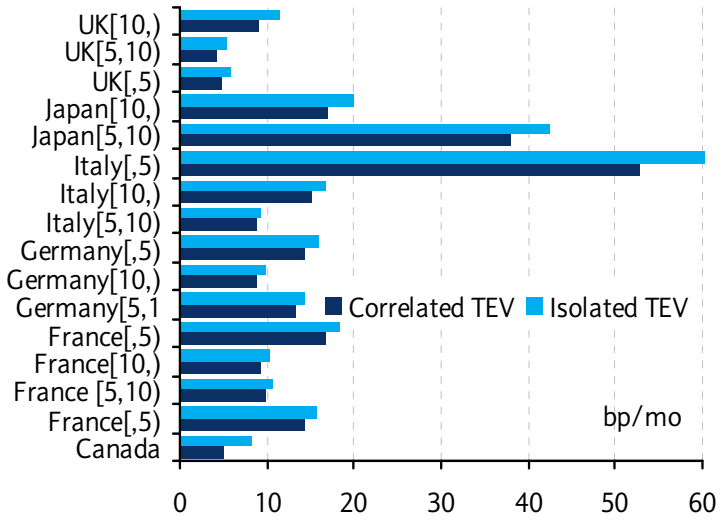
Identifier	Description	Coupon	Currency	Maturity Date	Face Value (1,000's)	Market Weights
912828NC	US TREASURY NOTES	1.38	USD	5/15/2013	9,654	9.70%
JP11030519C2	JAPAN (GOVT OF) 10Y #305	1.30	JPY	12/20/2019	676,151	7.52%
FR0000189151	FRANCE (REPUBLIC OF)	4.25	EUR	4/25/2019	5,399	7.44%
GB00B1VWPC84	UNITED KINGDOM	5.00	GBP	3/7/2018	4,408	7.28%
ES00000120L4	SPAIN (KINGDOM OF)	3.90	EUR	10/31/2012	5,177	6.68%
JP10508719C3	JAPAN (GOVT OF) 5YR #87	0.50	JPY	12/20/2014	503,844	5.57%
JP1050881A37	JAPAN (GOVT OF) 5YR #88	0.50	JPY	3/20/2015	505,026	5.57%
JP1050841970	JAPAN (GOVT OF) 5YR #84	0.70	JPY	6/20/2014	493,605	5.52%
912828MP	US TREASURY NOTES	3.63	USD	2/15/2020	5,287	5.48%
JP1050851995	JAPAN (GOVT OF) 5YR #85	0.70	JPY	9/20/2014	489,533	5.46%
IT0001174611	ITALY (REPUBLIC OF)	6.50	EUR	11/1/2027	3,589	5.30%
912828MX	US TREASURY NOTES	1.75	USD	4/15/2013	4,710	4.79%
NL0009086115	NETHERLANDS (KINGDOM OF)	4.00	EUR	7/15/2019	3,108	4.34%
912810FM	US TREASURY BONDS	6.25	USD	5/15/2030	2,735	3.57%
KR1035017VC6	KOREA (REPUBLIC OF)	4.75	KRW	12/10/2011	4,072,407	3.54%
BE0000303124	BELGIUM (KINGDOM OF)	4.25	EUR	9/28/2014	2,219	3.08%
ES0000011660	SPAIN (KINGDOM OF)	6.15	EUR	1/31/2013	2,174	2.95%
912828MT	US TREASURY NOTES	1.38	USD	3/15/2013	2,087	2.10%
912828JU	US TREASURY NOTES	1.75	USD	11/15/2011	2,035	2.07%
FR0000187361	FRANCE (REPUBLIC OF)	5.00	EUR	10/25/2016	1,388	2.04%

Benchmarked to USD and as of may-end, 2010.

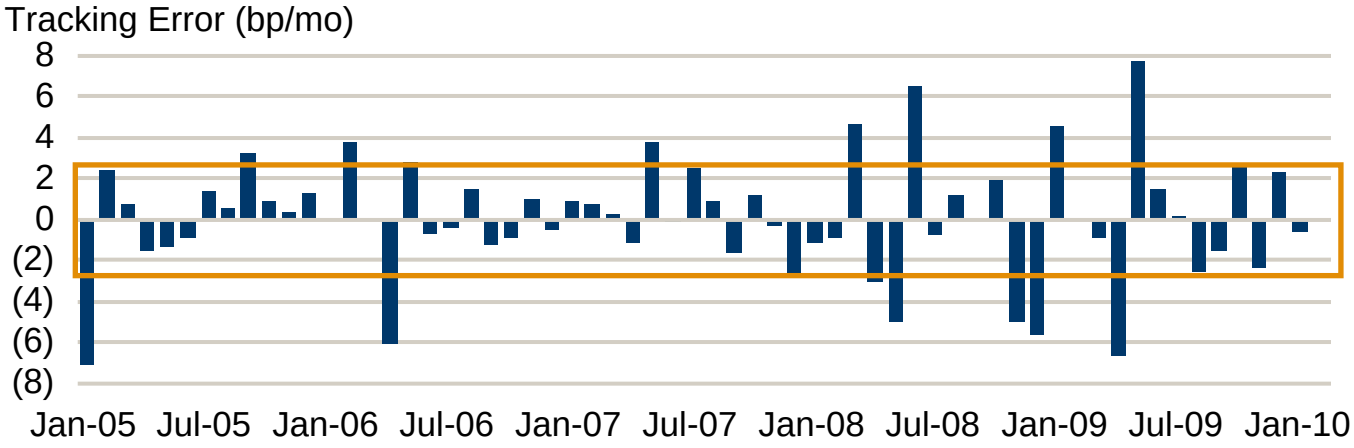
Index Replication II – Global Treasury G7 Ex-USD Index Using Stratified Sampling

- Only trade bonds with OASs between -10 and 10bp in Japan, Germany, UK, and Canada (to avoid specialness due to deep discount or premium)
- Match market weights and OAD exposure in the following cells
  - Three maturity buckets (0 to 5y, 5 to 10y, and 10y and above) in Germany, France, Italy, UK, and Japan (15 cells)
  - Canada (1 cell)
- Minimize turnover and reinvest the cash generated by the portfolio

Risk decompositions*



Realized Tracking Error Statistics

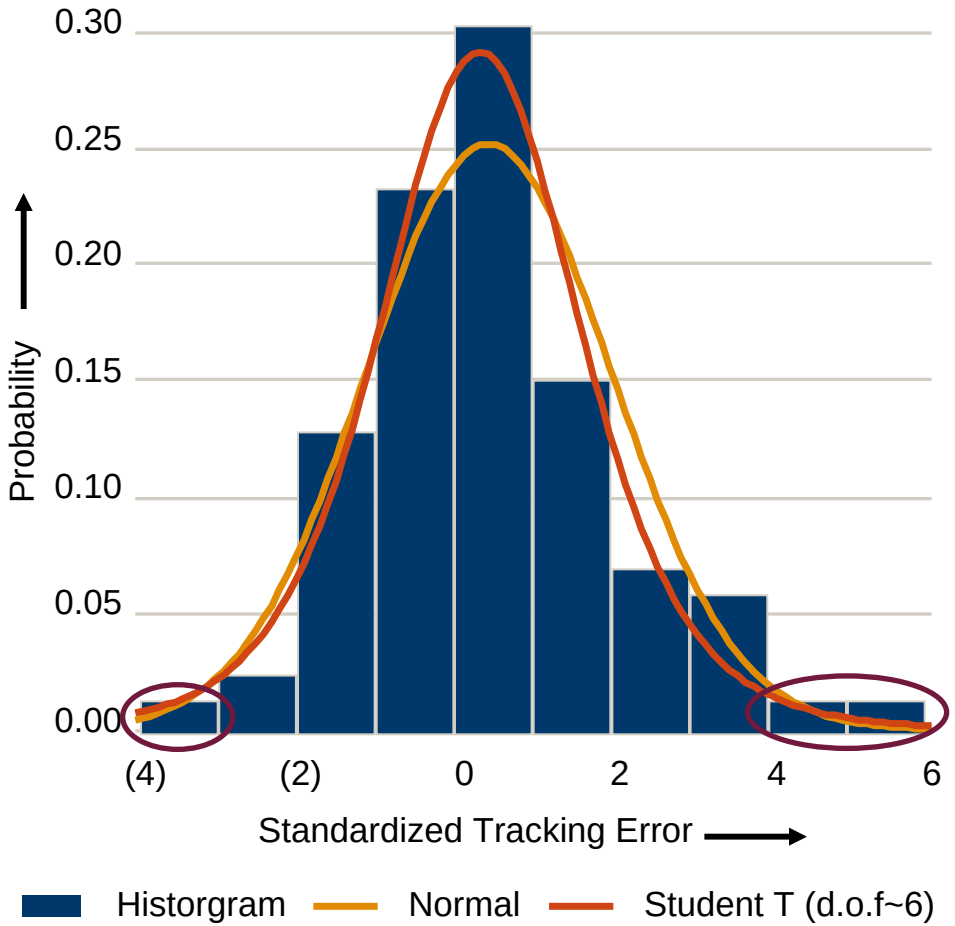


Average	0.0
Median	0.1
Std Dev	2.8
Max	7.8
Min	(7.1)
Avg. Turnover	9%

Source: Barclays Capital POINT. (*) Based on the global risk model (GRM) as-of January 2005.

Index Replication III – Replicating the US Credit Index

- Minimum TEV portfolios to replicate US Credit Index
- Limit number of positions to 75
- Jan 2003–Feb 2010 (86 months)



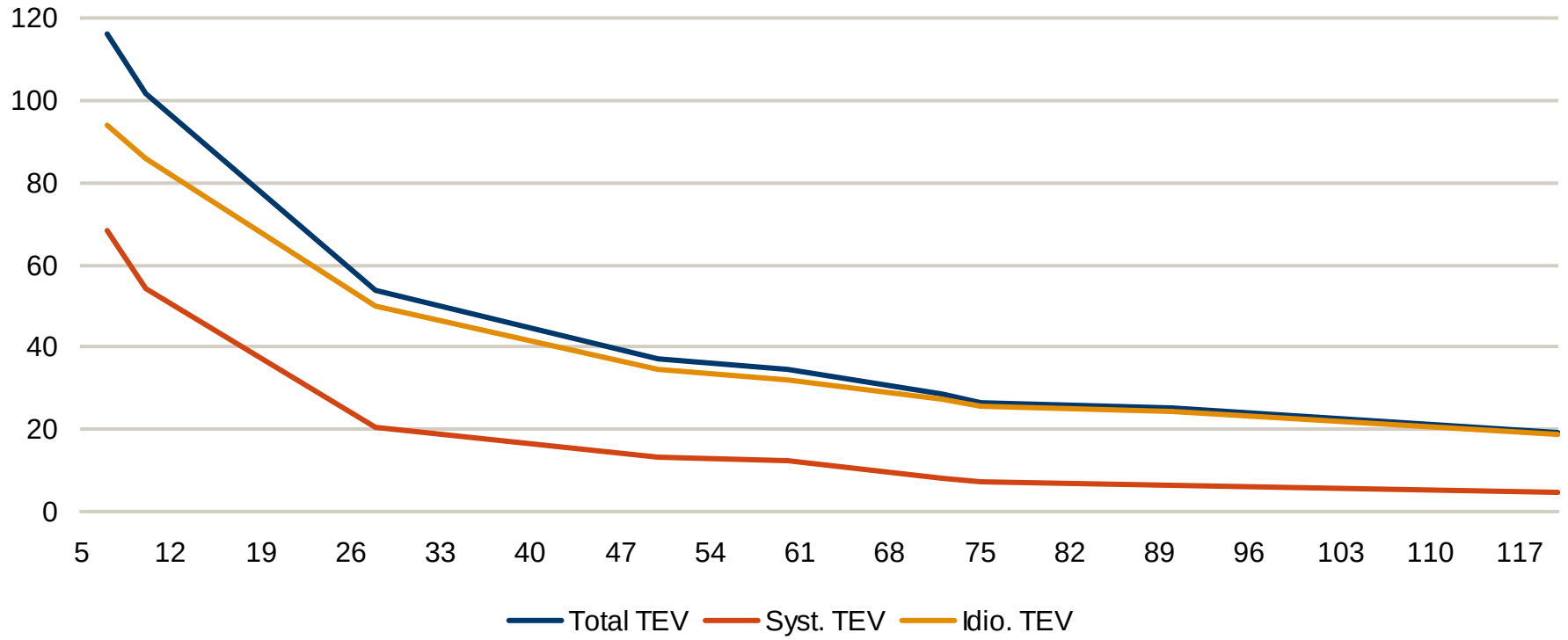
	Tracking Error	Standardized Tracking Error
Std Dev	24bps	1.58
Max	1.19%	5.36
Min	0.41%	(3.02)

- Tradeoff between number of positions and default/tail risk
- Tail risk: six sigma events on the positive side and four sigma events on the negative side
- MLE student-t fitting results in six degrees of freedom
- Outperformance in the credit crisis due to positive liquidity bias

Source: Barclays Capital POINT.

Index Replication IV – Number of Bonds vs. Tracking Error Volatility

- What is the trade-off between number of positions in the portfolio and the expected tracking error volatility for US credit replication?
- As we increase the number of bonds, systematic risk decreases first, followed by idiosyncratic risk
- Choose an optimal number of bonds to achieve an acceptable level of TEV and trading/management costs (e.g., to minimize TEV plus the trading costs as a function of number of bonds)



Source: Barclays Capital POINT.

Portfolio Rebalancing – Alternative Rebalancing Strategies for a US Credit Portfolio

- Rebalance a US credit portfolio using ten self-financing trades
- Preferences over tracking error volatility, transaction costs, sector weights, and yield-to-worst
- Four different formulations
  - RB1: minimize TEV
  - RB2: minimize TEV and constrain active sector* weights (+/-4%)
  - RB3: minimize TEV, transaction costs and constrain sector weights
  - RB4: minimize TEV, maximize yield to worst and constrain sector weights

Portfolio analytics: before and after using 4 different formulations

	Initial Value	RB-1	RB-2	RB-3	RB-4
Total TEV (bp/mo)	40.9	30.5	31.8	33.6	35.2
Systematic TEV	23.9	8.7	12.3	19.1	13.9
Idiosyncratic TEV	33.2	29.3	29.3	27.6	32.3
Yield to Worst (%/yr)	6.29	6.00	5.95	5.70	6.54
Transaction Cost - ($)	N.A.	1362	1217	913	1764

*w.r.t. class 2 classification with 10 buckets

Portfolio Hedging – Evaluating Alternative Curve Hedging Schemes

- Multiple formulations for hedging curve risk of a credit portfolio
  - Eliminate KRD exposures (linear hedging)
  - Minimize isolated curve risk based on a risk model (non-linear hedging)
- Use the four front treasury futures as the hedge instruments
- Two different hedging methods
  - V1: Minimizes isolated curve risk based on the risk model
  - V2: Match 5y and 10y KRDs and the 6m+2y and 20y+30y KRDs (four constraints)

Hedging – Curve Risk Before and After*

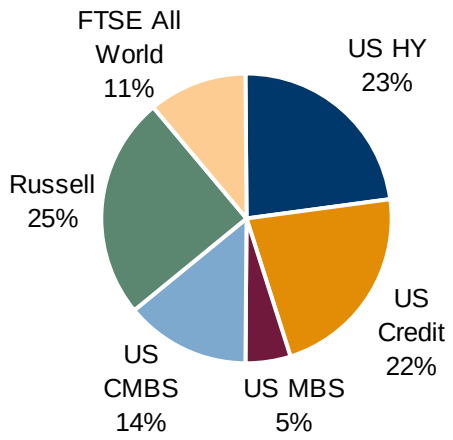
	Initial Value	V1: RM Hedge	V2: Partial Linear Hedge
Curve Risk (bp/mo)	210.2	9.0	12.1
Notional of Hedges (000s)**		187,290	81,352

* As of March-end 2009. See optimizer white paper for more details.

** USD100mn credit portfolio

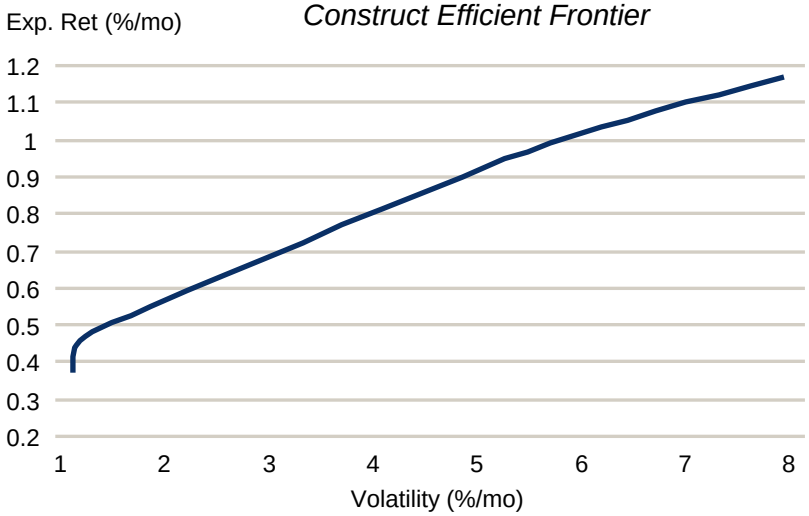
Strategic Asset Allocation – Using Indices as Asset Classes

- Use (Barclays or third party) indices to define the asset classes
- Use custom funds linked to the returns of indices to represent the asset classes in the optimizer
- Optimizer automatically implies the asset class covariance matrix based on index constituents and Global Risk Model
- Import expected returns for each asset class



Index	Exp. Ret. (%/yr)	Vol (%/mo benchmarked to USD)	Correlations (%)									
Euro Credit	5.00	4.54	100	41	55	25	95	62	32	28	45	63
US HY	9.00	4.92	41	100	52	22	23	64	26	-18	46	47
US Credit	6.00	2.89	55	52	100	45	53	69	8	58	25	32
US MBS	4.19	0.74	25	22	45	100	28	42	12	53	10	11
Euro Treasury	2.90	4.31	95	23	53	28	100	53	27	44	36	54
US EM	7.72	5.05	62	64	69	42	53	100	19	29	43	47
US CMBS	8.83	6.26	32	26	8	12	27	19	100	-11	37	41
US Government	2.35	1.55	28	-18	58	53	44	29	-11	100	-10	-3
Russell 3000	14.00	8.00	45	46	25	10	36	43	37	-10	100	86
FTSE All World	13.00	7.37	63	47	32	11	54	47	41	-3	86	100

Allocation Frontier



Other Sample Applications

- Rebalancing SMAs (separately managed accounts)
  - Minimize TEV (or match analytics) relative to the model portfolio for the investment strategy to reduce dispersion in performance for portfolios belonging to the same composite
- Equitizing cash
  - Minimizing TEV relative to the benchmark index using positions in liquid index futures
- Derivatives-based index replication
  - Use derivative to match key risk factors to replicate beta exposure
- Optimizing transition portfolios
  - Liquidate a portfolio by optimally allocating its positions to existing portfolios
- Constructing overlay strategies
  - Optimize exposure to custom trade ideas subject total risk budget
- Risk-consistent portfolio construction to implement the sector/security selection views
  - Factor mimicking/tilt portfolios

Functionality Details and the User Interface

See "Kumar and Lazanas, (2009), Barclays Capital Portfolio Optimizer – User Guide", Barclays Capital research publications" for details on the functionality and the user interface.

Optimizer Reports

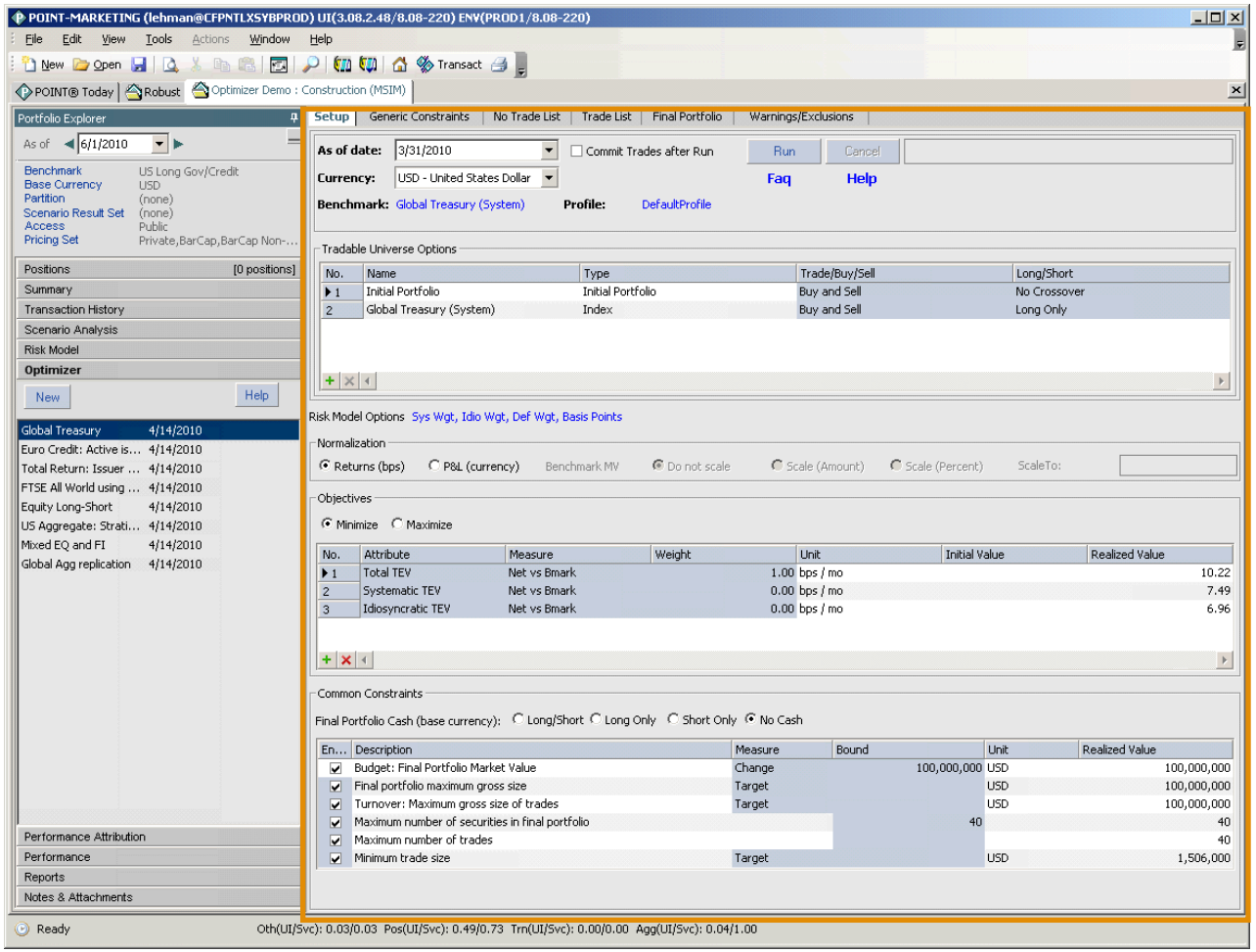
The *Optimizer reports* represent portfolio optimization problems in POINT.

Three ways to create and run optimization reports

- Using the **optimizer node** in the **portfolio explorer**.
- Using **standalone reports**.
- Using **batch scheduler** to run multiple standalone reports in sequence or parallel

An optimizer report contains

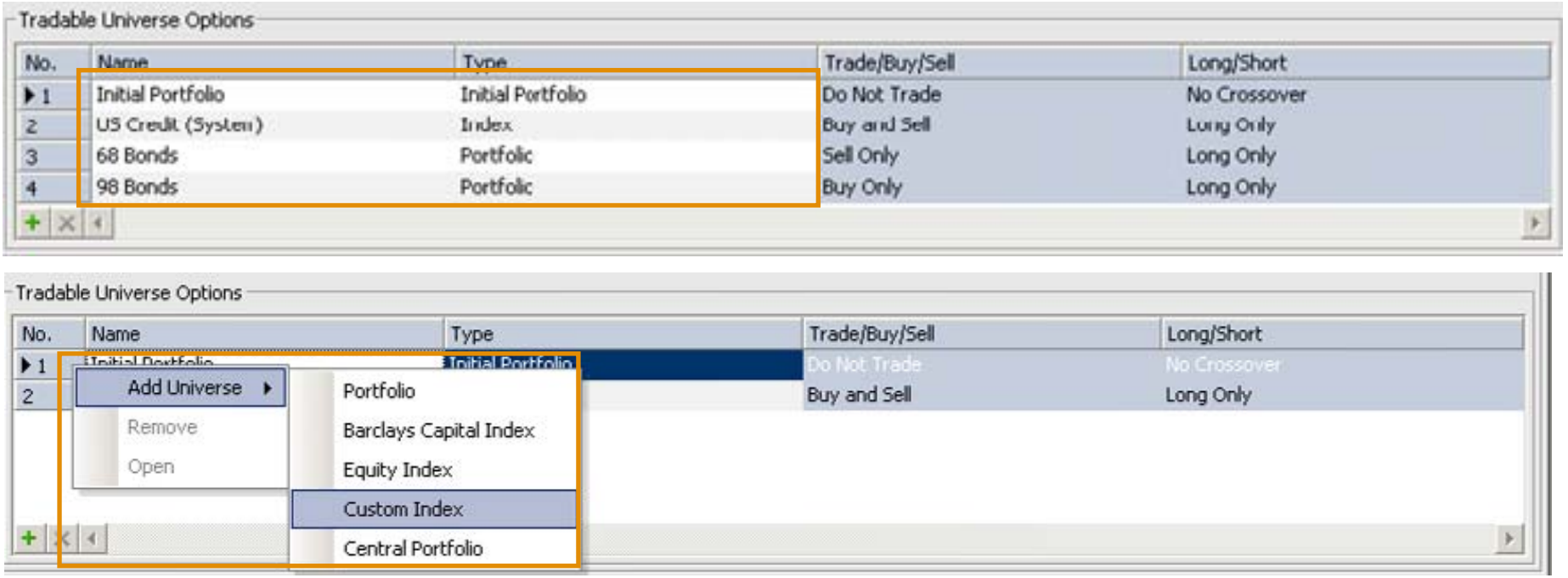
- An optimization **profile (i.e. problem definition including constraints and objective function)**
- Universes, as-of-date, etc.
- (Saved) results



Optimizer Reports

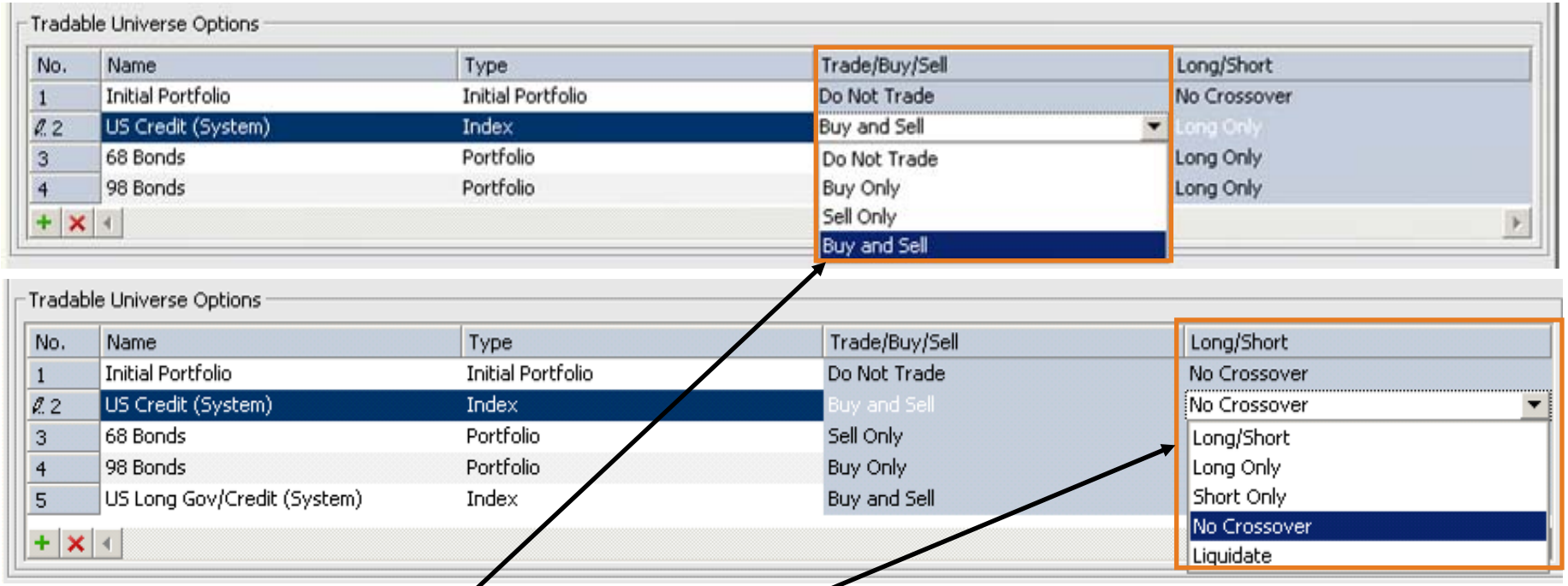
- Report contains six tabs
  - **Setup, Generic Constraints, No Trade List** define the problem, and
  - **Trade List, Final Portfolio, Warning/Exclusions** present the results/output
- Setup tab consists of
  - Users specify an **as-of-date, benchmark** universe, and **base currency**
  - **Tradable** universes
  - **Objective function**
  - **Common constraints**
  - Normalization options (P&L vs. returns space)

Tradable Universes



- Multiple **portfolios, indices (including Barclays and third party indices),** and **custom indices** be added as tradable universes.
- **Central portfolios** containing “rolling” hedge instruments (FX forwards, IR swaps, etc.)
- Supports **private prices** based on universe-specific pricing hierarchy

Tradable Universes – Continued…



- Custom constraints on **trading** and **holding behavior** of each tradable universe
- Facilitates use of
  - Recommended **buy** and **sell** list and **long** and **sell** list
  - Confirmed liquidate list, etc.

Objective Function

The *objective panel* defines the objective function of the problem.

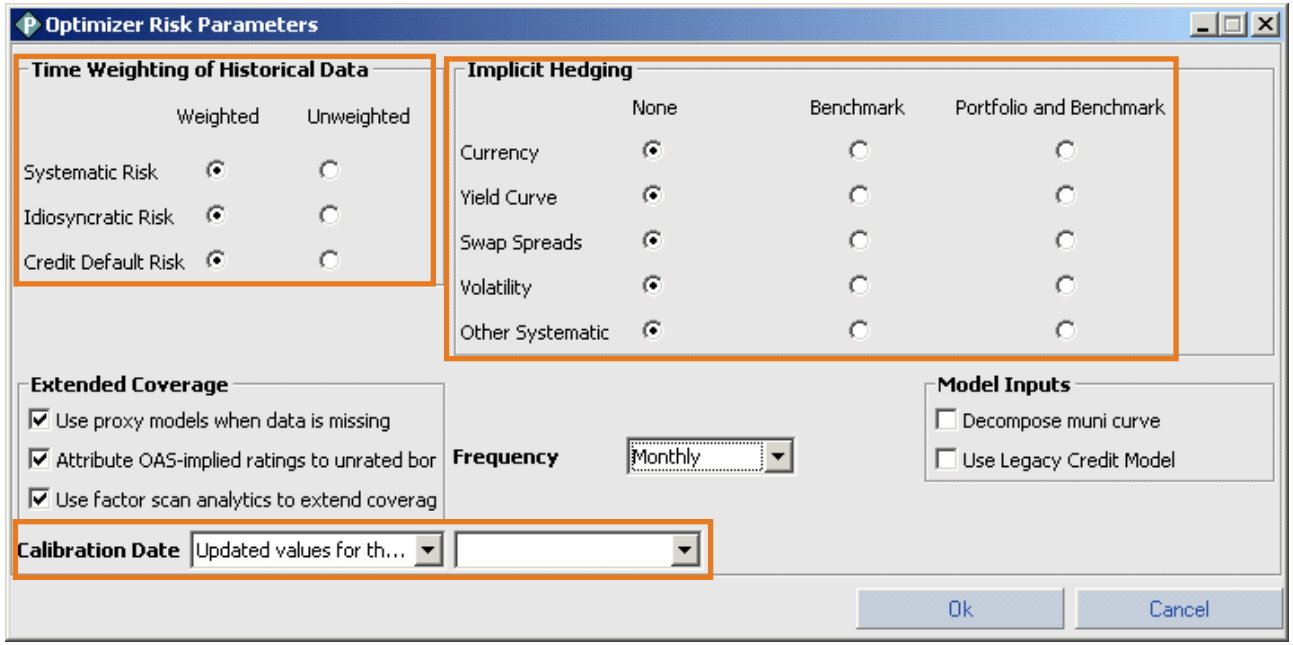
Objectives

Minimize Maximize

No.	Attribute	Measure	Weight	Unit	Initial Value	Realized Value
1	Yield to Worst		100.000	% / yr	0.000	9.330
▶ 2	Total TEV	Net vs Bmark	-3.46	bps / mo		135.20
3	Systematic TEV	Net vs Bmark	0.00	bps / mo		103.29
4	Idiosyncratic TEV	Net vs Bmark	0.00	bps / mo		87.23

- Objective function is the weighted sum of optimization terms including
  - **Tracking error volatility (TEV)** with respect the user-specified **benchmark** or **cash** for **total return portfolios.**
  - User-provided **expected returns**
  - **Transaction costs**
  - **Spreads, yields,** and hundreds of other analytics available in POINT.
- User specifies the weights and POINT reports the values of these terms before and after optimization in the **Initial Value** and **Realized Value** columns.

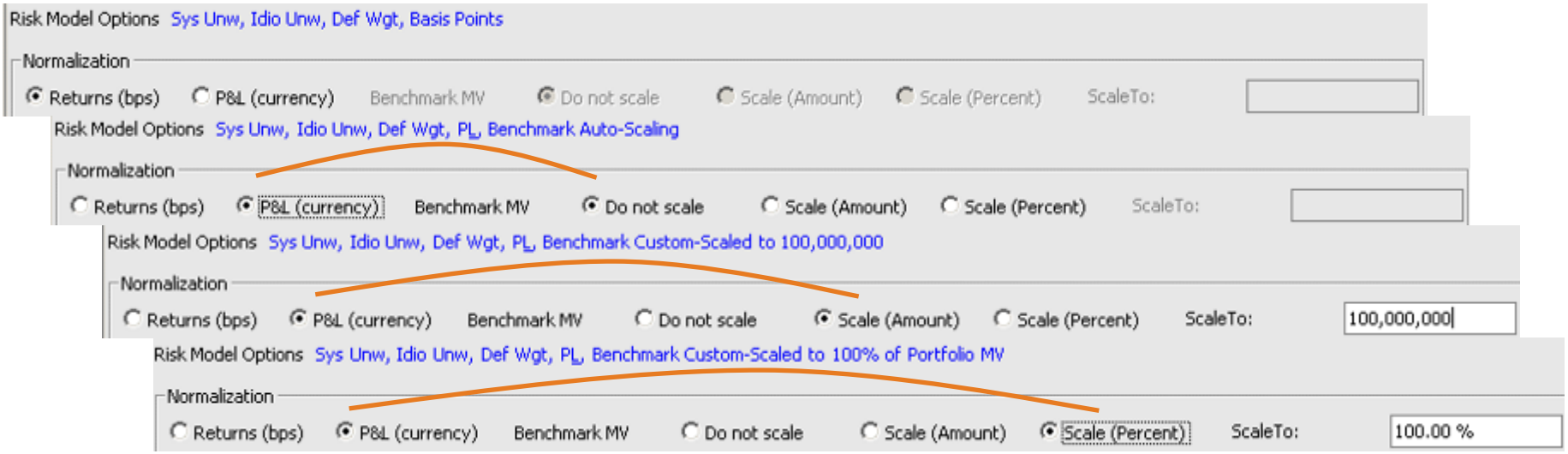
Risk Model Options – Customize the Risk Model Underlying the Optimization Problem



- Choose a risk horizon (monthly vs. daily) using the frequency drop-down
- Change time-weighting of historical data to choose a conditional (weighted) vs unconditional (un-weighted) forecast
- Implicit hedging – ask the optimizer to ignore certain component of risk (e.g., FX) because it is managed separately
- As-of-date of the covariance matrix, etc.

Normalization Options – Choosing between P&L Space and Returns Space

Normalization options specifies whether the optimization is to occur in P&L space or return space.



- Budget constraint is mandatory in the return space
- Benchmark scaling is mandatory in the P&L space
- Risk (TEV) terms are measured in bp/mo in return space and in monetary units (<base currency>/mo) in P&L space

Common Constraints

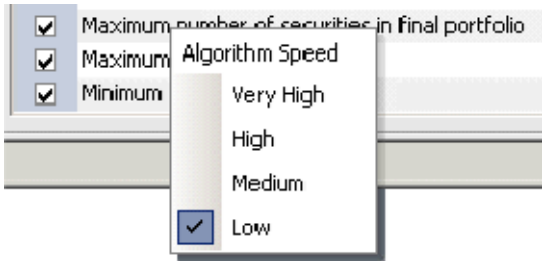
The common constraints panel gives quick access to standard constraints.

Common Constraints

Final Portfolio Cash (base currency): ○ Long/Short ○ Long Only ○ Short Only ◉ No Cash

En...	Description	Measure	Bound	Unit	Realized Value
☑	Budget: Final Portfolio Market Value	Change	100,000,000	USD	100,000,000
☑	Final portfolio maximum gross size	Target		USD	100,000,000
☑	Turnover: Maximum gross size of trades	Target		USD	100,000,000
☑	Maximum number of securities in final portfolio		40		40
☑	Maximum number of trades				40
☑	Minimum trade size	Target		USD	1,506,000

- A static collection of common constraints (some mandatory), including
- **Budget** constraints and base currency cash funding options
- Final portfolio and tradelist **leverage** measured as **gross exposure**
- Non-convex and combinatorial constraints
  - Maximum **number of securities** in the final portfolio
  - Maximum **number trade** recommendations
  - Minimum **trade size**
- Option to choose **heuristic algorithm** speed for combinatorial constraints



Generic Constraints Tab

Setup | **Generic Constraints** | No Trade List | Trade List | Final Portfolio | Warnings/Exclusions

Constraints on values aggregated by Buckets

No.	Soft	Penalty	Attribute	Universe	Measure	Lower Bound	Upper Bound	Unit	Initial Value	Realized Value
1	☐		KRD 6mo	Final Portfolio	Net vs Bmark	0.00	0.00	yrs	-0.03	0.00
2	☐		KRD 2yr	Final Portfolio	Net vs Bmark	0.00	0.00	yrs	-0.85	0.00
3	☐		KRD 5yr	Final Portfolio	Net vs Bmark	0.00	0.00	yrs	-1.91	0.00
4	☐		KRD 10yr	Final Portfolio	Net vs Bmark	0.00	0.00	yrs	-1.23	0.00
5	☐		KRD 20yr	Final Portfolio	Net vs Bmark	0.00	0.00	yrs	-0.23	0.00
6	☐		KRD 30yr	Final Portfolio	Net vs Bmark	0.00	0.00	yrs	-0.03	0.00
7	☐		Market Value	Government-Relat...	Net vs Bmark	0	0	EUR	-3,769,807	0
8	☐		Market Value	Government-Relat...	Net vs Bmark	0	0	EUR	-1,085,075	0
9	☐		Market Value	Government-Relat...	Net vs Bmark	0	0	EUR	1,362,131	0
10	☐		Market Value	Government-Relat...	Net vs Bmark	0	0	EUR	-7,875,603	0
11	☐		Market Value	Corporate-Banking...	Net vs Bmark	0	0	EUR	-2,005,709	0
12	☐		Market Value	Corporate-Banking...	Net vs Bmark	0	0	EUR	-13,222,315	0
13	☐		Market Value	Corporate-Banking...	Net vs Bmark	0	0	EUR	-16,798,134	0
14	☐		Market Value	Corporate-Banking...	Net vs Bmark	0	0	EUR	-2,793,465	0
15	☐		Market Value	Corporate-Finance...	Net vs Bmark	0	0	EUR	-7,559,784	0
16	☐		Market Value	Corporate-Basic:E...	Net vs Bmark	0	0	EUR	-7,736,030	0

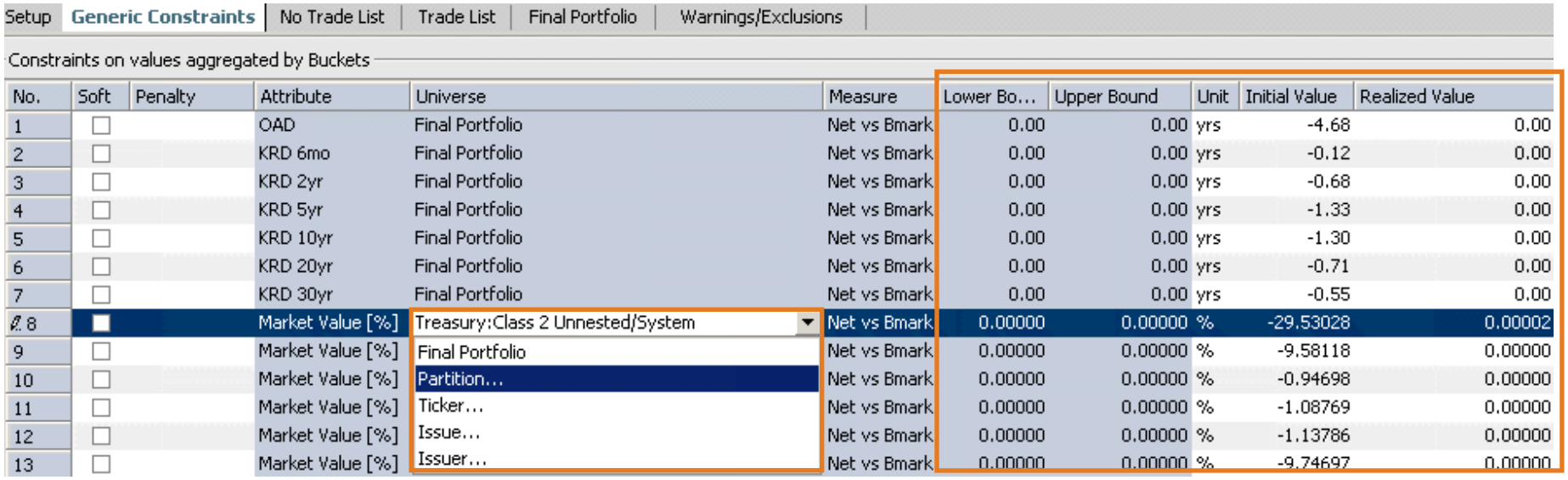
Constraints on each Issue/Issuer/Ticker

Universe Final Portfolio

No.	Soft	Penalty	Attribute	Universe	For Each	Measure	Lower Bound	Upper Bound	Unit	Initial Value	Realized Val
▶ 1	☐		Market Value [%]	Final Portfolio	Issuer	Net vs Bmark	-2.00000	2.00000	%	100.00000	2.000

Generic Constraints – Bucket Constraints

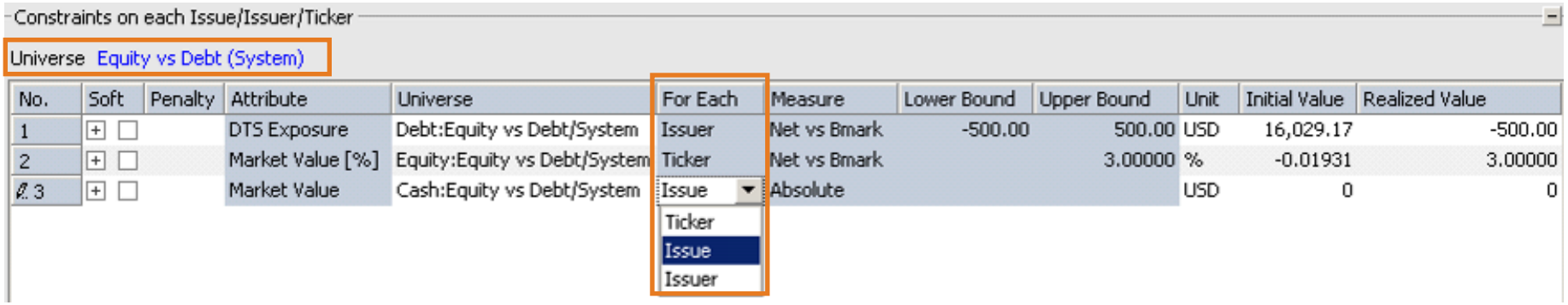
The Bucket Constraints panel allows users to express a variety of custom constraints on attributes of static partition buckets.



No.	Soft	Penalty	Attribute	Universe	Measure	Lower Bo...	Upper Bound	Unit	Initial Value	Realized Value
1	☐		OAD	Final Portfolio	Net vs Bmark	0.00	0.00	yrs	-4.68	0.00
2	☐		KRD 6mo	Final Portfolio	Net vs Bmark	0.00	0.00	yrs	-0.12	0.00
3	☐		KRD 2yr	Final Portfolio	Net vs Bmark	0.00	0.00	yrs	-0.68	0.00
4	☐		KRD 5yr	Final Portfolio	Net vs Bmark	0.00	0.00	yrs	-1.33	0.00
5	☐		KRD 10yr	Final Portfolio	Net vs Bmark	0.00	0.00	yrs	-1.30	0.00
6	☐		KRD 20yr	Final Portfolio	Net vs Bmark	0.00	0.00	yrs	-0.71	0.00
7	☐		KRD 30yr	Final Portfolio	Net vs Bmark	0.00	0.00	yrs	-0.55	0.00
8	☐		Market Value [%]	Treasury:Class 2 Unnested/System	Net vs Bmark	0.00000	0.00000	%	-29.53028	0.00002
9	☐		Market Value [%]		Net vs Bmark	0.00000	0.00000	%	-9.58118	0.00000
10	☐		Market Value [%]		Net vs Bmark	0.00000	0.00000	%	-0.94698	0.00000
11	☐		Market Value [%]		Net vs Bmark	0.00000	0.00000	%	-1.08769	0.00000
12	☐		Market Value [%]		Net vs Bmark	0.00000	0.00000	%	-1.13786	0.00000
13	☐		Market Value [%]		Net vs Bmark	0.00000	0.00000	%	-9.74697	0.00000

- User can specify **upper** and **lower** bounds on
  - A given **attribute** of any generic security **bucket, issue, issuer,** or **ticker**
  - On portfolio, portfolio net of benchmark, or the trading portfolio
- System reports the constrained analytics for the initial portfolio and the final portfolio in the **initial value** and the **realized value** columns, respectively.

Generic Constraints – For-Each Issue/Issuer/Ticker Constraints



- Allows constraints on attributes of each security, or ticker, or issuer belonging to a particular bucket (or the whole portfolio) as defined by the chosen partition
- The static buckets are further partitioned using the **For Each** choice to create the underlying constraints
- The realized values reported correspond to the tightest **child** constraint
- Empty bounds indicates redundant constraints
- Examples of practical formulations,
  - Asset class-specific issue/issuer/ticker exposure constraints
  - Concentration limits on longs and shorts

For-Each Issue/Issuer/Ticker Constraints – Child Constraints

Constraints on each Issue/Issuer/Ticker

Universe Equity vs Debt (System)

No.	Attribute	Universe	For Each	Measure	Lower Bound	Upper Bound	Unit	Initial Value	Realized Value
1	DTS Exposure	Debt:Equity vs Debt/System	Issuer	Net vs Bmark	-500.00	500.00	USD	-10,949.41	-500.00

Debt:Equity vs Debt/System(Issuer)

Name	Initial Value	Realized Value
GTE CORP	171.96	-500.00
SALLIE MAE INC	11.33	-500.00
CONTINENTAL AIRLINES INC	181.34	-500.00
NEWS AMERICA HOLDINGS INC	277.10	-500.00
PACIFIC BELL TELEPHONE CO	183.83	-500.00
JPMORGAN CHASE & CO	396.50	-500.00
VERIZON FLORIDA LLC	45.35	-500.00
MICHIGAN TOBACCO SETTLEMENT FI	56.56	-500.00
FEDERAL HOME LOAN MORTGAGE COR	826.88	-500.00
GOLDMAN SACHS GROUP INC/THE	798.80	-500.00
TENNESSEE VALLEY AUTHORITY	892.68	-500.00
FEDERAL NATIONAL MORTGAGE ASSO	1,914.35	-500.00
PETROLEOS MEXICANOS	262.37	-494.29
XEROX CAPITAL TRUST I	124.99	-476.47
CONOCOPHILLIPS CANADA FUNDING	73.98	-471.04
ABBEY NATIONAL CAPITAL TRUST I	200.80	-449.87
TOBACCO SETTLEMENT FINANCING C	104.37	-411.17
BRAZILIAN GOVERNMENT INTERNATI	2,829.66	-395.87
TOBACCO SETTLEMENT FINANCE AUT	143.03	-388.84
NATIONWIDE FINANCIAL SERVICES	54.89	-387.81
CSX TRANSPORTATION INC	40.42	-386.07
CAROLINA POWER & LIGHT CO	45.10	-373.87
ALCOA INC	360.15	-363.91
BELLSOUTH TELECOMMUNICATIONS I	292.57	-348.00
ALBERTA ENERGY CO LTD	142.62	-341.45

2	Market Value [%]	Equity:Equity vs Debt/System	Ticker	Net vs Bmark	%	-3,400,14...	-159,004.56811
3	Market Value [%]	Cash:Equity vs Debt/System	Issue	Absolute	%	0.00000	0.00000

- Drill down to child constraints to see realized exposure to individual issuers
- Sort by realized exposures
- Observe the number of issuers hitting the concentration limit

Understanding For-Each Constraints

Constraints on each Issue/Issuer/Ticker

Universe Class 1 (System)

No.	Attribute	Universe	For Each	Measure	Lower Bound	Upper Bound	Unit	Initial Value	Realized Value
1	Market Value [%]	Treasury:Class 1/System	Issue	Absolute			%	0.00000	3.60883
2	Market Value [%]	Government-Related:Class 1/System	Issue	Absolute			%	0.00000	3.02880
▶ 3	Market Value [%]	Corporate:Class 1/System	Issuer	Absolute			%	0.00000	3.42212

Objectives

Minimize Maximize

No.	Attribute	Measure	Weight	Unit	Initial Value	Realized Value
1	Total TEV	Net vs Bmark	1.00	bps / mo		42.87
▶ 2	Systematic TEV	Net vs Bmark	0.00	bps / mo		18.05
3	Idiosyncratic TEV	Net vs Bmark	0.00	bps / mo		38.88
4	Yield to Worst		0.00	% / yr	0.00	5.40

Constraints on each Issue/Issuer/Ticker

Universe Class 1 (System)

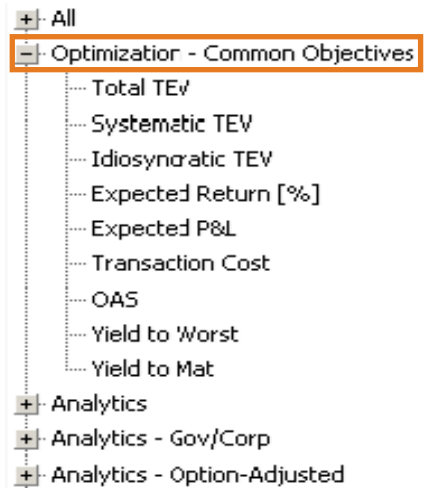
No.	Attribute	Universe	For Each	Measure	Lower Bound	Upper Bound	Unit	Initial V...	Realized Va...
1	Market Value [%]	Treasury:Class 1/System	Issue	Absolute		3.00000	%	0.00000	2.99994
▶ 2	Market Value [%]	Government-Related:Class 1/System	Issue	Absolute		3.00000	%	0.00000	2.77942
3	Market Value [%]	Corporate:Class 1/System	Issuer	Absolute		3.00000	%	0.00000	3.00000

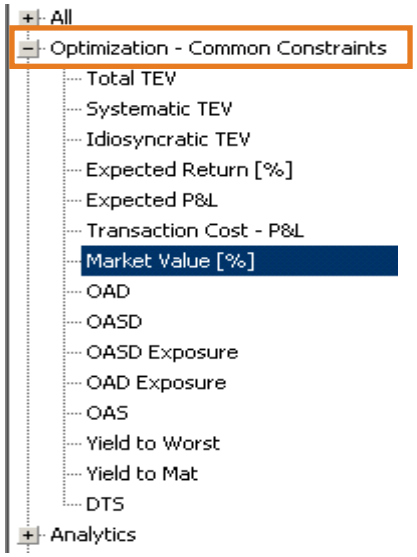
Objectives

Minimize Maximize

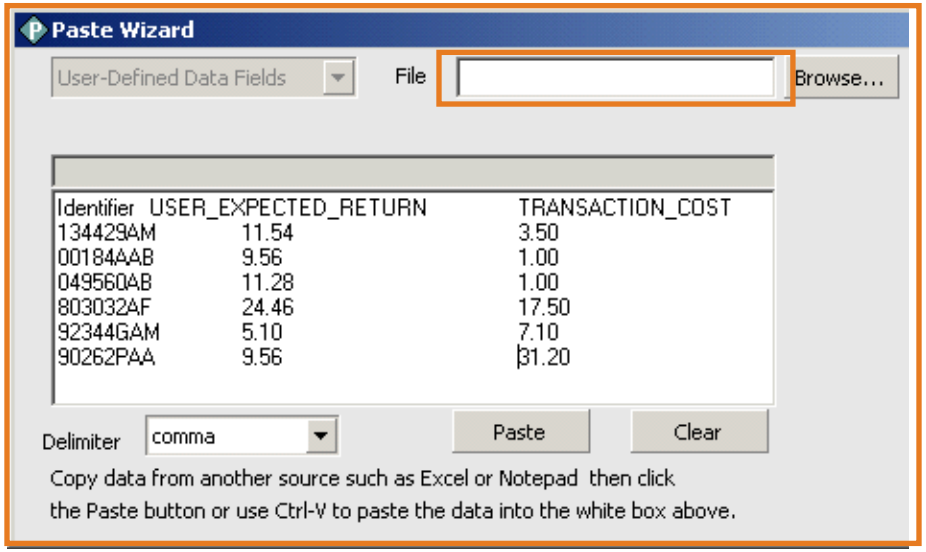
No.	Attribute	Measure	Weight	Unit	Initial Value	Realized Value
1	Total TEV	Net vs Bmark	1.00	bps / mo		43.32
2	Systematic TEV	Net vs Bmark	0.00	bps / mo		17.89
3	Idiosyncratic TEV	Net vs Bmark	0.00	bps / mo		39.46
▶ 4	Yield to Worst		0.00	% / yr	0.00	5.39

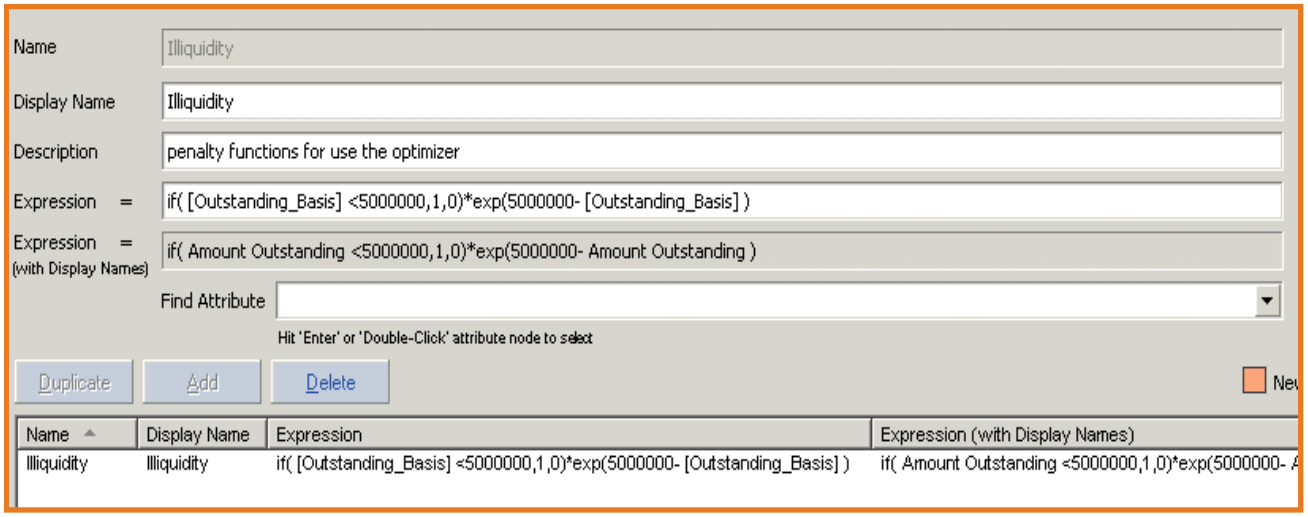
Attributes Available in the Objective Function and Generic Constraints





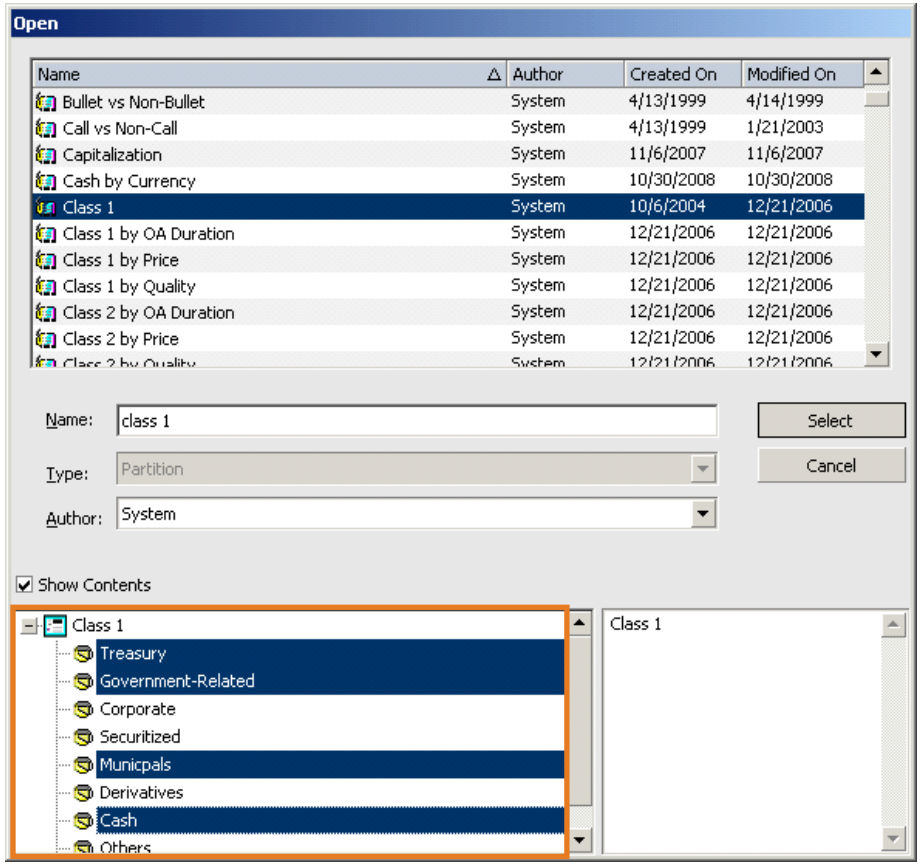
Functionality Details and the User Interface

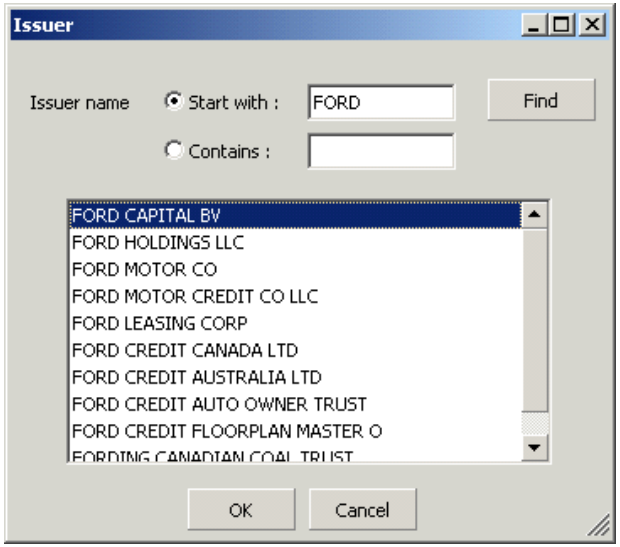




- Hundreds of performance and sensitivity analytics available in POINT including,
  - **User uploaded fields (UDDFs)**
  - **User defined formula fields (UDFFs)**

Creating Constraints Buckets/Specific Issuer

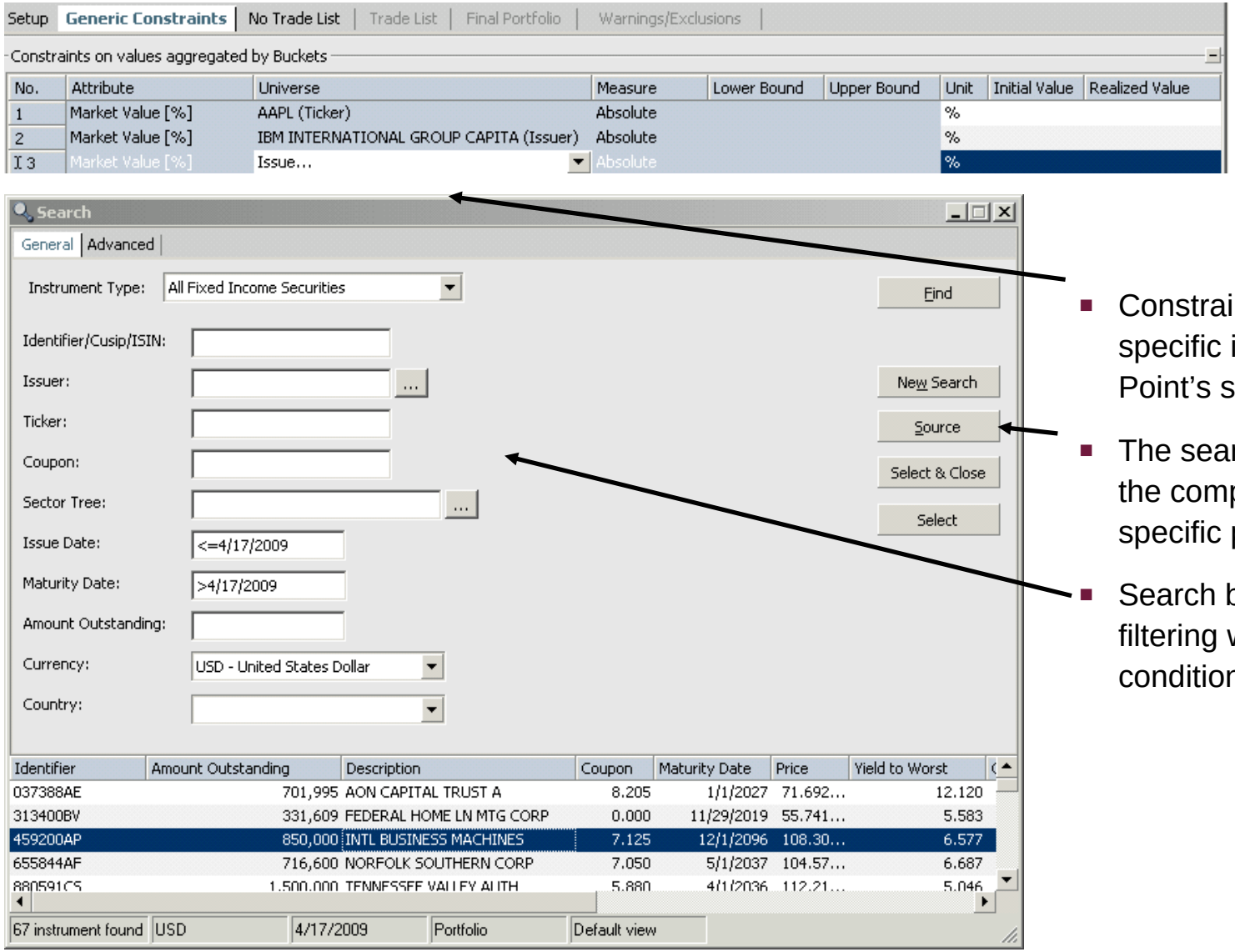




- Search for specific issuer to specify as the constraint universe

- Constrain all (or a chosen subset of) buckets defined by a custom security partition

Generic Constraint on a Particular Issue Using the Security Search Tool



- Constrain the exposure to a specific issue/security using Point's search functionality
- The search universe can be the complete database or a specific portfolio/index
- Search based on generic filtering with custom attribute conditions

Soft Bucket Constraints

Any generic constraint can be specified as soft with a user-provided per-unit penalty.

Setup | Generic Constraints | No Trade List | Trade List | Final Portfolio | Warnings/Exclusions

Constraints on values aggregated by Buckets

No.	Soft	Penalty	Attribute	Universe	Measure	Lower ...	Upper ...	Unit	Initial V...	Realize...
1	☑	100.00	KRD 6mo	Final Portfolio	Net vs ...	0.00	0.00	yrs	-0.08	0.00
2	☑	100.00	KRD 2yr	Final Portfolio	Net vs ...	0.00	0.00	yrs	-0.85	0.08
3	☑	100.00	KRD 5yr	Final Portfolio	Net vs ...	0.00	0.00	yrs	-1.91	0.00
4	☑	100.00	KRD 10yr	Final Portfolio	Net vs ...	0.00	0.00	yrs	-1.20	0.00
5	☑	100.00	KRD 20yr	Final Portfolio	Net vs ...	0.00	0.00	yrs	-0.23	0.00
6	☑	100.00	KRD 30yr	Final Portfolio	Net vs ...	0.00	0.00	yrs	-0.08	-0.08
7	☑	1,000.00000	Market Value [%]	Government-Related-Gov-Related Agencies:Euro Cr...	Net vs ...	0.00000	0.00000	%	-3.76981	0.00000
8	☑	1,000.00000	Market Value [%]	Government-Related-Gov-Related Local Auth:Euro ...	Net vs ...	0.00000	0.00000	%	-1.08508	0.00000
9	☑	1,000.00000	Market Value [%]	Government-Related-Gov-Related Sovereign:Euro C...	Net vs ...	0.00000	0.00000	%	-4.36243	0.00000
10	☑	1,000.00000	Market Value [%]	Government-Related-Gov-Related Supranational:Eu...	Net vs ...	0.00000	0.00000	%	-7.87561	0.00000
11	☑	1,000.00000	Market Value [%]	Corporate-Banking-AAA:Euro Credit Sectors/System	Net vs ...	0.00000	0.00000	%	-2.00571	0.00000
12	☑	1,000.00000	Market Value [%]	Corporate-Banking-AA:Euro Credit Sectors/System	Net vs ...	0.00000	0.00000	%	-13.22232	-0.00002
13	☑	1,000.00000	Market Value [%]	Corporate-Banking-A:Euro Credit Sectors/System	Net vs ...	0.00000	0.00000	%	-16.79813	-0.00003
14	☑	1,000.00000	Market Value [%]	Corporate-Banking-BBB:Euro Credit Sectors/System	Net vs ...	0.00000	0.00000	%	-2.79346	0.00000
15	☑	1,000.00000	Market Value [%]	Corporate-Finance:Euro Credit Sectors/System	Net vs ...	0.00000	0.00000	%	-7.55978	0.00000
16	☑	1,000.00000	Market Value [%]	Corporate-Basic:Euro Credit Sectors/System	Net vs ...	0.00000	0.00000	%	-7.73603	0.00000

- Circumvent the **infeasibility** observed with **hard** constraints
- Generic **norm-1 distances between portfolio** and **benchmark** (or given constant) analytics
  - E.g., user can minimize sum total of absolute active (i.e., net-vs-benchmark) key rate durations

Soft For-Each Issue/Issuer/Ticker Constraints

Constraints on each Issue/Issuer/Ticker

Universe Euro Credit Sectors (System)

No.	Soft	Penalty	Attribute	Universe	For Each	Measure	Lower Bound	Upper Bound	Unit	Initial Value	Realized Value
1	☑	0.01000	Market Value [%]	Government-Rela...	Issuer	Net vs Bmark	0.00000	0.00000	%	-0.33763	3.43217
2	☑	0.01000	Market Value [%]	Government-Rela...	Issuer	Net vs Bmark	0.00000	0.00000	%	-0.55893	0.13449
3	☑	0.01000	Market Value [%]	Government-Rela...	Issuer	Net vs Bmark	0.00000	0.00000	%	-1.00180	1.68030
▶ 4	☑	0.01000	Market Value [%]	Government-Rela...	Issuer	Net vs Bmark	0.00000	0.00000	%	-6.65530	4.14805

Government-Related-Gov-Related Supranational:Euro Credit Sectors/System(Issuer)

Name	Initial Value		Realized Value △
EUROPEAN INVESTMENT BANK		-6.65530	-3.53347
INTERNATIONAL BANK FOR RECONST		-0.39309	-0.39309
EUROFIMA		-0.08669	-0.08669
NORDIC INVESTMENT BANK		-0.06568	-0.06568
COUNCIL OF EUROPE DEVELOPMENT		-0.02684	-0.02684
INTER-AMERICAN DEVELOPMENT BAN		-0.02422	-0.02422
EUROPEAN BANK FOR RECONSTRUCTI		-0.01806	-0.01806
EUROPEAN COMMUNITY		-0.60572	4.14805

5	☑	0.01000	Market Value [%]	Corporate-Bankin...	Issuer	Net vs Bmark	0.00000	0.00000	%	-1.93459	0.07112
6	☑	0.01500	Market Value [%]	Corporate-Bankin...	Issuer	Net vs Bmark	0.00000	0.00000	%	-1.13952	5.82613
7	☑	0.02000	Market Value [%]	Corporate-Bankin...	Issuer	Net vs Bmark	0.00000	0.00000	%	-1.16236	7.26569
8	☑	0.03000	Market Value [%]	Corporate-Bankin...	Issuer	Net vs Bmark	0.00000	0.00000	%	-0.26483	1.62425
9	☑	0.01500	Market Value [%]	Corporate-Financ...	Issuer	Net vs Bmark	0.00000	0.00000	%	-1.70734	4.09983
10	☑	0.01500	Market Value [%]	Corporate-Basic:...	Issuer	Net vs Bmark	0.00000	0.00000	%	-0.76952	3.96282
11	☑	0.01500	Market Value [%]	Corporate-Consu...	Issuer	Net vs Bmark	0.00000	0.00000	%	-0.67281	1.34900
12	☑	0.01500	Market Value [%]	Corporate-Consu...	Issuer	Net vs Bmark	0.00000	0.00000	%	-0.70518	2.03197
13	☑	0.01500	Market Value [%]	Corporate-Energ...	Issuer	Net vs Bmark	0.00000	0.00000	%	-0.64350	1.43466
14	☑	0.01500	Market Value [%]	Corporate-Techn...	Issuer	Net vs Bmark	0.00000	0.00000	%	-1.17959	2.91664
15	☑	0.01500	Market Value [%]	Corporate-Utility:...	Issuer	Net vs Bmark	0.00000	0.00000	%	-1.12802	2.29207

The No Trade List

No Trade list specifies a collection of securities that cannot be traded

Setup | Generic Constraints | **No Trade List** | Trade List | Final Portfolio | Warnings/Exclusions

Add Instrument Delete Selected

Identifier	Description
GB0009997999	UNITED KINGDOM
IT0003242747	ITALY (REPUBLIC OF)
IT0003618383	ITALY (REPUBLIC OF)

Setup | Generic Constraints | No Trade List | **Trade List** | Final Portfolio | Warnings/Exclusions

Commit All Trades To Initial Portfo... Apply All Trades as Position Adjustments To Initial Portf... Create Final Portfolio Send to Sales Rep

Identifier	Description	Ticker	Coupon	Currency	Maturity Date	Trade Position Amount	Initial Position Amount
912810EL	US TREASURY BONDS	US/T	8.000	USD	11/15/2021	4,305,809	
BE0000291972	BELGIUM (KINGDOM OF)	BGB	5.500	EUR	3/28/2028	1,606,478	
GB0009997999	UNITED KINGDOM	UKT	8.000	GBP	6/7/2021	977,867	
AU0000XCLWH5	AUSTRALIA (GOVERNMENT OF)	ACGB	6.500	AUD	5/15/2013		
GR0124018525	GREECE (REPUBLIC OF)	GGB	5.250	EUR	5/18/2012		
IT0003242747	ITALY (REPUBLIC OF)	BTPS	5.250	EUR	8/1/2017		
GB0031829509	UNITED KINGDOM	UKT	5.000	GBP	9/7/2014		
FR0000189151	FRANCE (REPUBLIC OF)	FRTR	4.250	EUR	4/25/2019		
JP11025613C0	JAPAN (GOVT OF) 10Y #256	JGB	1.400	JPY	12/20/2013		

Add to No Trade list
Commit to Initial Portfolio
Apply as Position Adjustments
Add Constraint ▸
Export ▸

- Search securities to add securities to the **No Trade List**
  - From a given portfolio, index or the complete security database
  - Filter on security attributes including security type, amount outstanding, etc.
- Add a subset of trades to the **No Trade List** after the run and re-run the problem

Results – The Tradelist Tab

Setup | Generic Constraints | No Trade List | **Trade List** | Final Portfolio | Warnings/Exclusions

Commit All Trades To Initial Portfo... | Apply All Trades as Position Adjustments To Initial Portfo... | Create Final Portfolio | Send to Sales Rep

Identifier	Description	Ticker	Coupon	Currency	Maturity Date	Initial Position	Trade Position ▽	Final Position
03979GAL	ARDEN REALTY INC	GE	5.250	USD	3/1/2015		365,590	365,590
6832348D	ONTARIO PROV CANADA-GLOBAL	ONT	4.000	USD	10/7/2019		303,610	303,610
929903CH	WACHOVIA CORP-GLOBAL	WFC	5.625	USD	10/15/2016		293,003	293,003
500769DP	KREDIT FUER WIEDERAUFBAU-GLOBA	KFW	4.000	USD	1/27/2020		266,256	266,256
54474CCY	LOS ANGELES CNTY CALIF PENSION	LOSFAC	0.000	USD	6/30/2011		176,921	176,921
571748AN	MARSH & MCLENNAN COS INC	MMC	5.150	USD	9/15/2010	187,237	-187,237	
895953AD	TRICON GLOBAL RESTAURANTS INC	YUM	8.875	USD	4/15/2011	243,520	-243,520	
803032AF	SANWA BANK LTD	MTFG	7.400	USD	6/15/2011	270,887	-270,887	
416515AQ	HARTFORD FINANCIAL SERV	HIG	5.250	USD	10/15/2011	305,221	-305,221	
59156RAC	METLIFE INC	MET	6.125	USD	12/1/2011	327,702	-327,702	
88732JAK	TIME WARNER CABLE INC-GLOBAL	TWC	6.200	USD	7/1/2013	250,294		250,294
25746UBE	DOMINION RESOURCES INC	D	6.400	USD	6/15/2018	187,877		187,877
845437BK	SOUTHWESTERN ELEC POWER	AEP	6.450	USD	1/15/2019	158,460		158,460
629491AA	NYSE EURONEXT	NYX	4.800	USD	6/28/2013	216,572		216,572
46625HHF	JP MORGAN CHASE & CO	JPM	6.400	USD	5/15/2038	187,896		187,896
2254C0TC	CREDIT SUISSE NEW YORK	CS	5.000	USD	5/15/2013	253,709		253,709
06051GDX	BANK OF AMERICA CORP	BAC	5.650	USD	5/1/2018	256,744		256,744
68389XAC	ORACLE CORP	ORCL	5.750	USD	4/15/2018	184,302		184,302
38141GFM	GOLDMAN SACHS GROUP	GS	6.150	USD	4/1/2018	313,110		313,110
438516AX	HONEYWELL INTERNATIONAL	HON	5.300	USD	3/1/2018	136,327		136,327
87612EAU	TARGET CORP - GLOBAL	TGT	7.000	USD	1/15/2038	130,825		130,825
50075NAU	KRAFT FOODS INC-GLOBAL	KFT	6.125	USD	2/1/2018	152,633		152,633
52517P5Y	LEHMAN BROTHERS HOLDINGS INC	LEH	7.000	USD	9/27/2027	144,724		144,724
20030NAV	COMCAST CORPORATION-GLOBAL	CMCSA	6.950	USD	8/15/2037	158,100		158,100
98385XAL	XTO ENERGY INC	XTO	6.250	USD	8/1/2017	158,726		158,726

Quantity	Market Value	Market Value [%]	Price	Maturity Date	Yield to Worst	OAS	OAD
9,850,483	9,686,897	100.00	105.756	9/18/2018	4.163	161.4	

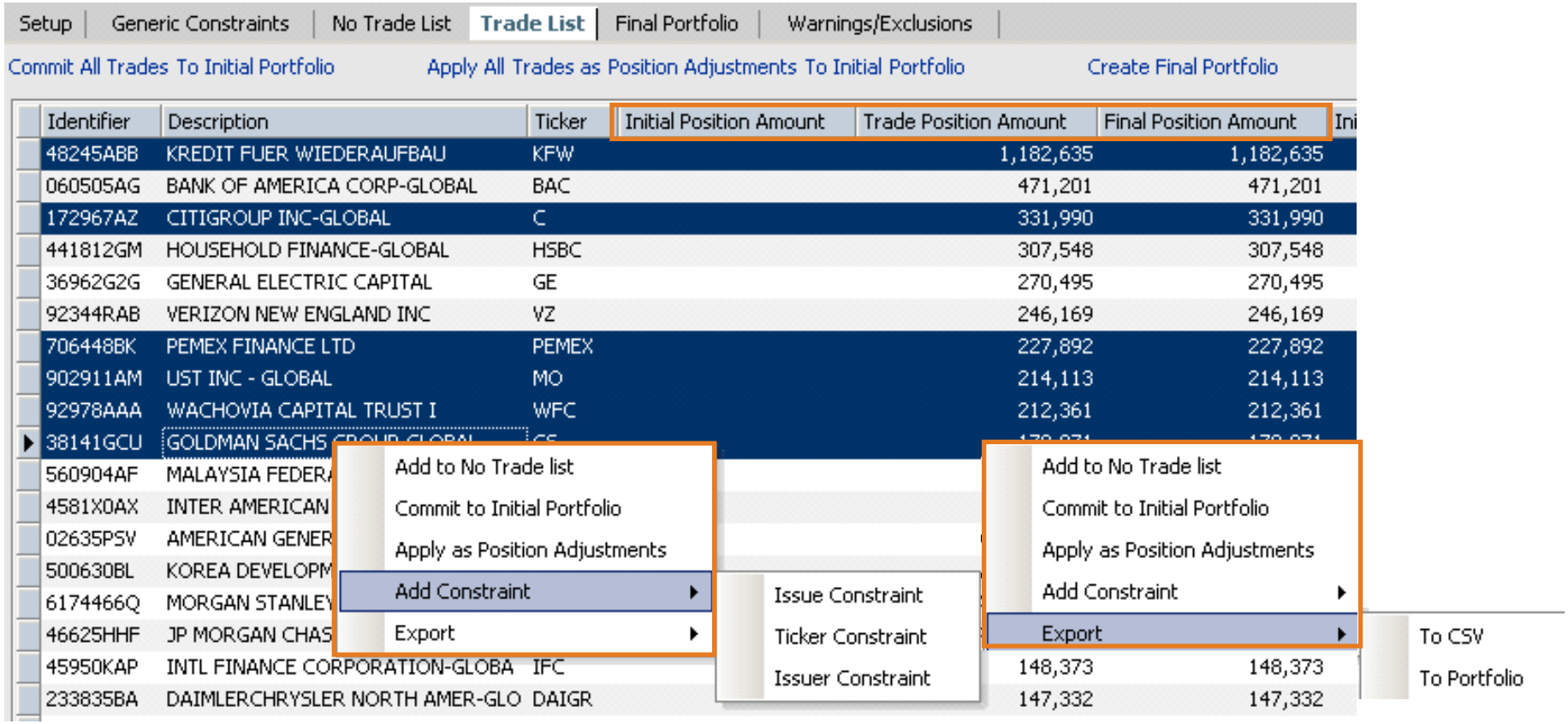
Static view of

- Initial, trading, and final portfolios
- Four position size attributes
- 12 numeric columns

Group by, sort, blank only, etc. tools

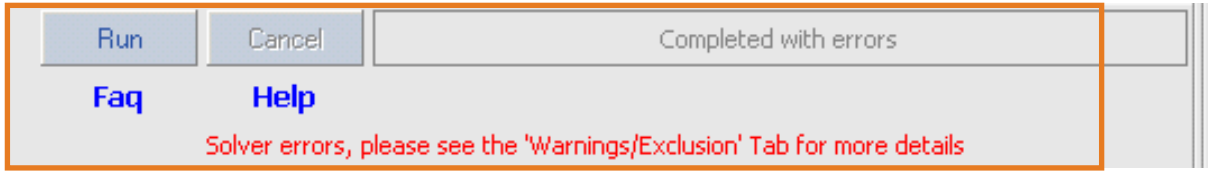
- Commit trades, apply as position adjustment. and create “final portfolio”

The Functionality Available on Tradelist



- Add issue/issuer/ticker constraints from the tradelist
- Export to portfolio, CSV, etc.

User Message – Infeasible and Unbounded Problems



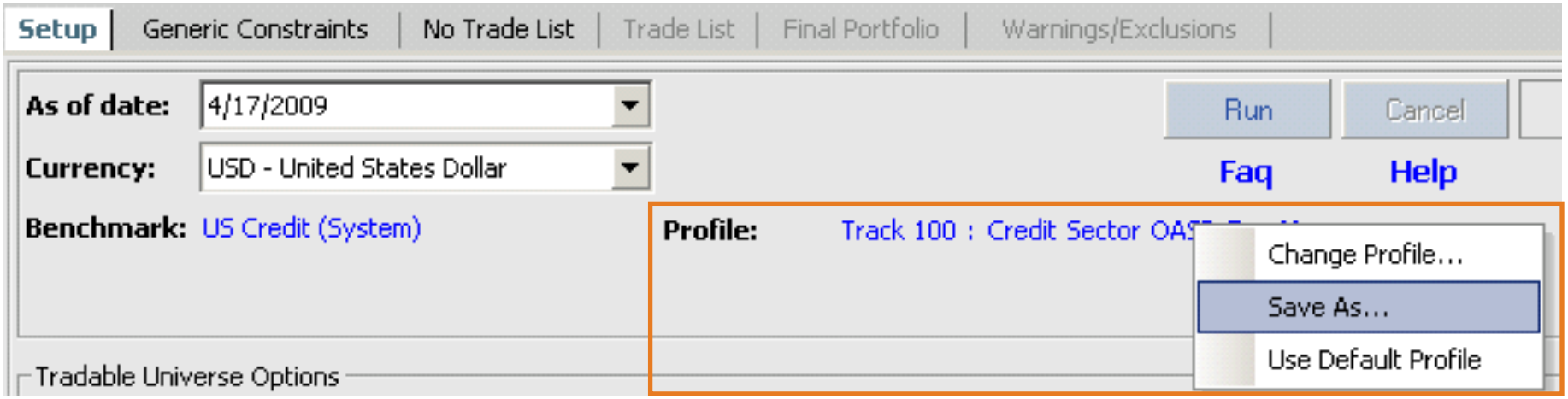
Type	Level	Message
Logic	Minor	MAX_SECURITY constraint is missing upper bound, ignoring constraint...
Logic	Minor	MAX_SECURITY constraint is missing upper bound, ignoring constraint...
Logic	Minor	MIN_VALUE_THRESHOLD constraint is missing lower bound, ignoring constraint...
Error	Severe	Infeasible Problem: Conflicting constraints. Please relax some constraints and try again.
Error	Severe	Infeasible Problem: Conflicting constraints. Please relax some constraints and try again.

Setup | Generic Constraints | No Trade List | Trade List | Final Portfolio | **Warnings/Exclusions**

Type	Level	Message
Logic	Minor	MAX_SECURITY constraint is missing upper bound, ignoring constraint...
Logic	Minor	MAX_SECURITY constraint is missing upper bound, ignoring constraint...
Logic	Minor	MIN_VALUE_THRESHOLD constraint is missing lower bound, ignoring constraint...
Error	Severe	Unbounded Problem: The optimizer is allowed unlimited leverage. Please add more constraints and try again.
Error	Severe	Solve Error

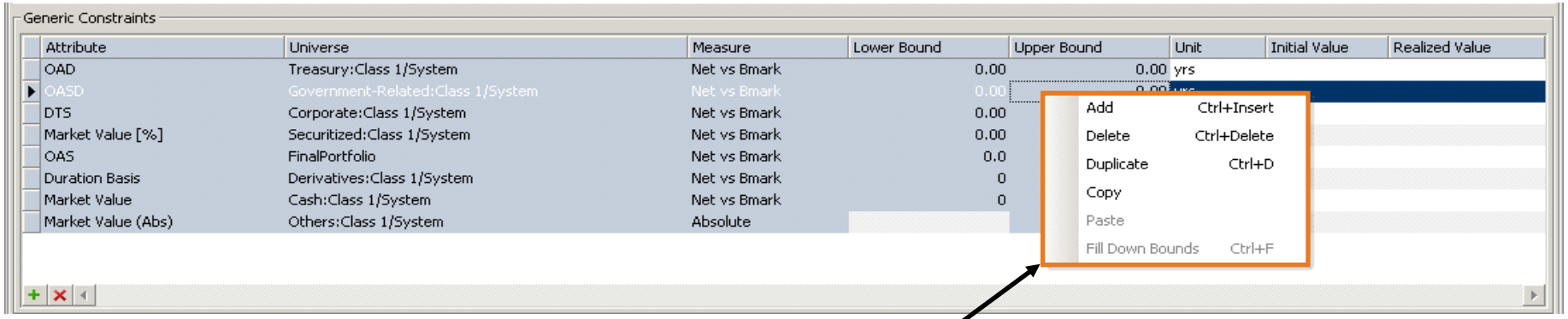
- User message in red indicating the unavailability of the results
- More detailed user message on the Warning/Exclusion tab

Working with Optimization Profiles

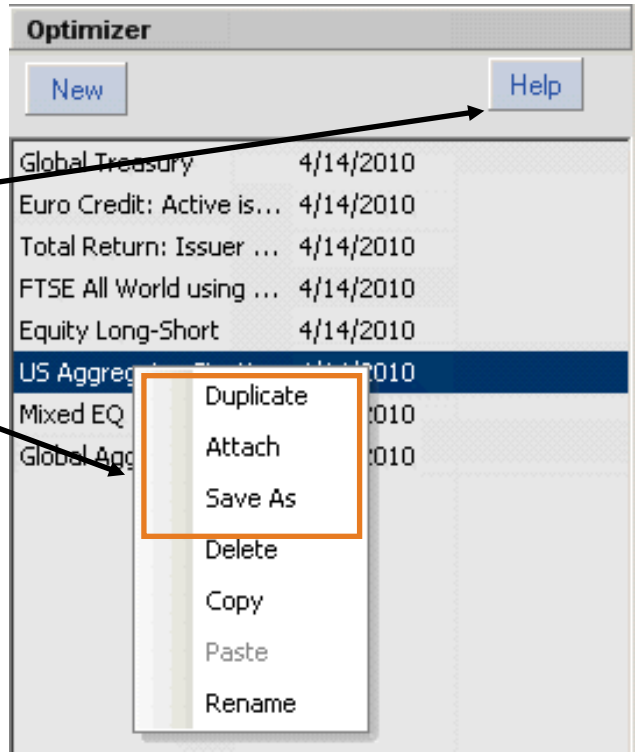


- Profiles makes the optimizer formulation (i.e., objective function, constraints etc) portable across reports and users
- Save-as and attach to reproduce the profile across reports
- Access selected formulations available as system profile

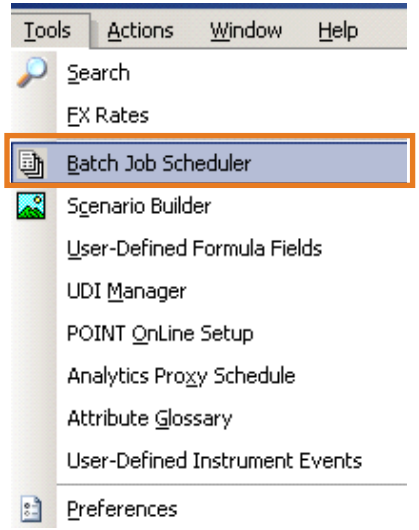
Other User Interface (UI) Features

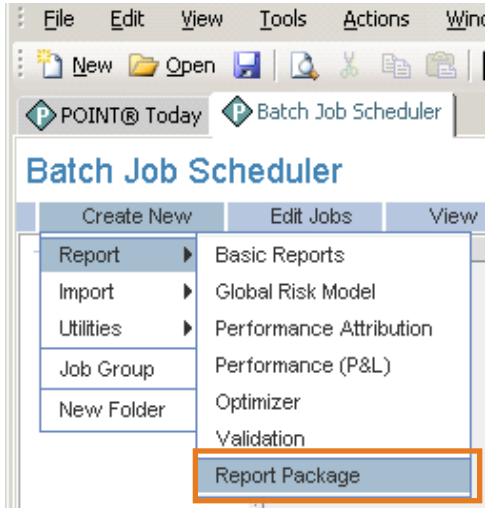


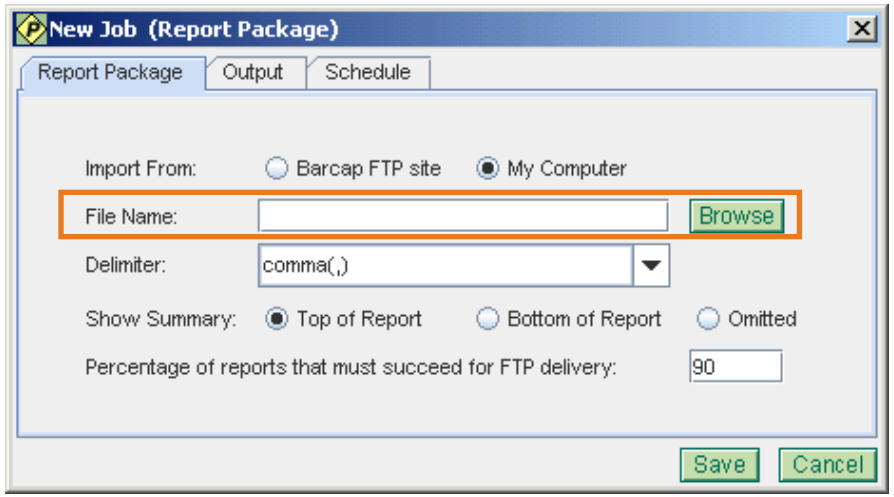
- Copy-paste, add, delete, fill down bounds in generic constraints across different profiles and reports
- Link to optimizer user guide
- Duplicate, save-as, copy-paste, delete, rename, and attach (saved) reports

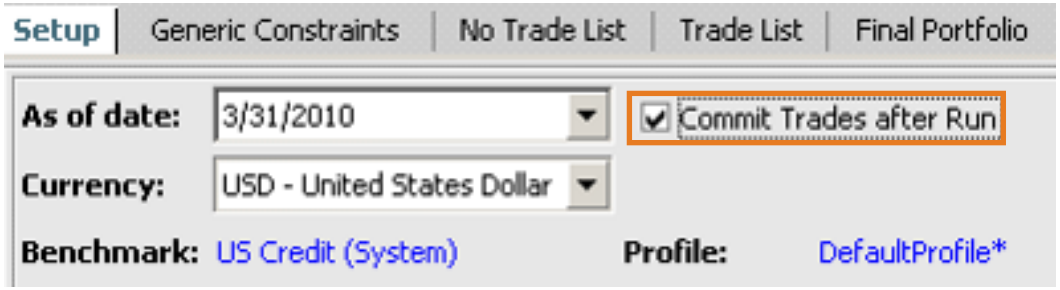


Back-testing Using Batch Scheduler



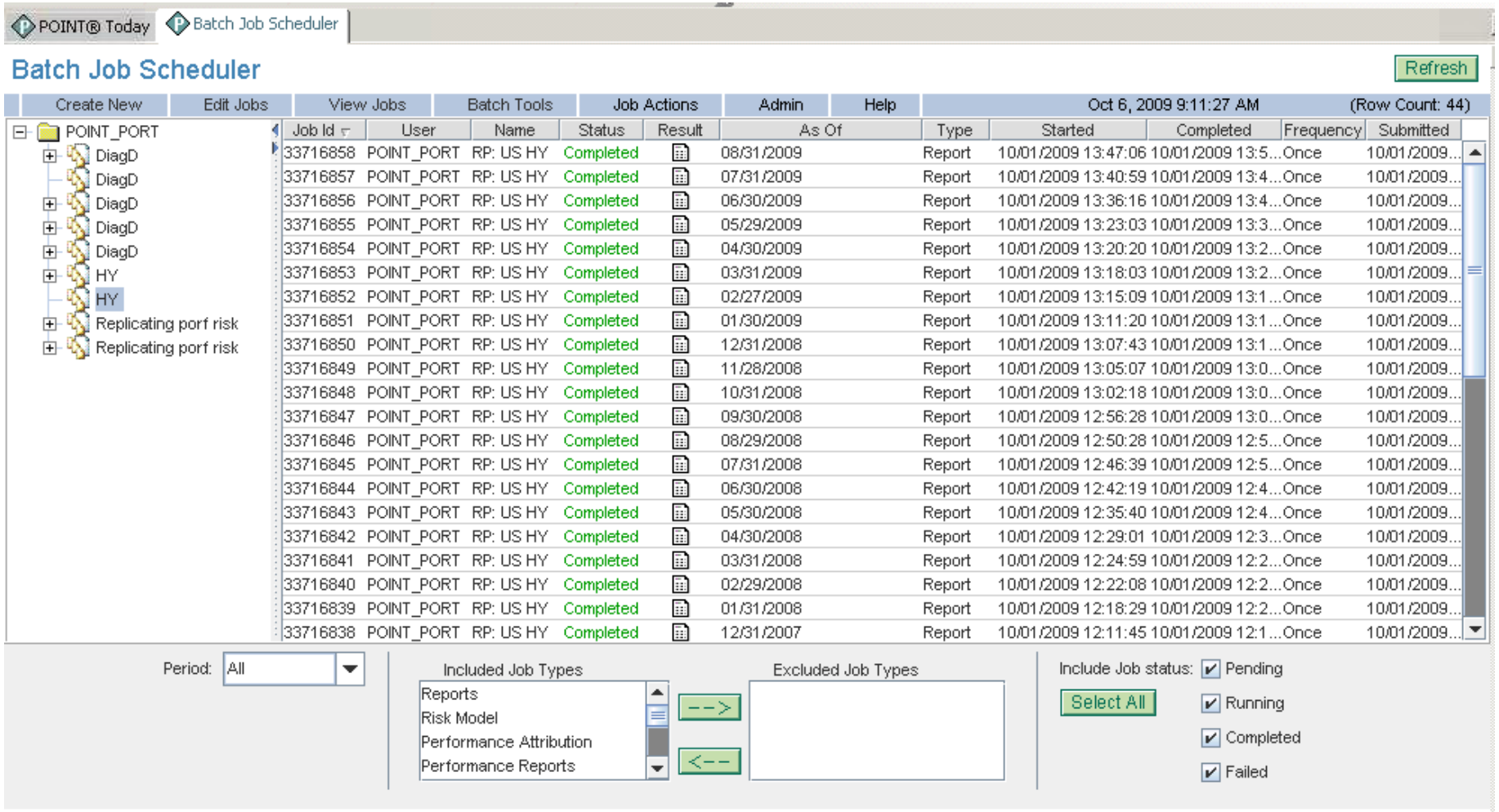






- Ask the optimizer to “commit” trades after run
- Program the back scheduler to run the optimization reports on a given sequence of dates
- Optimizer generates a portfolio history with rebalancing based on a particular optimization strategy
- Run performance tools to study the ex-post performance on the portfolio

Back-testing Using Batch Scheduler – Cont'd



- A sample back-testing screen

Project Pipeline

- Improvements in back-testing capabilities
- Robust portfolio optimization
- Portfolio construction for the ALM framework
- Optimal allocation of trades/hedges to multiple portfolios

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