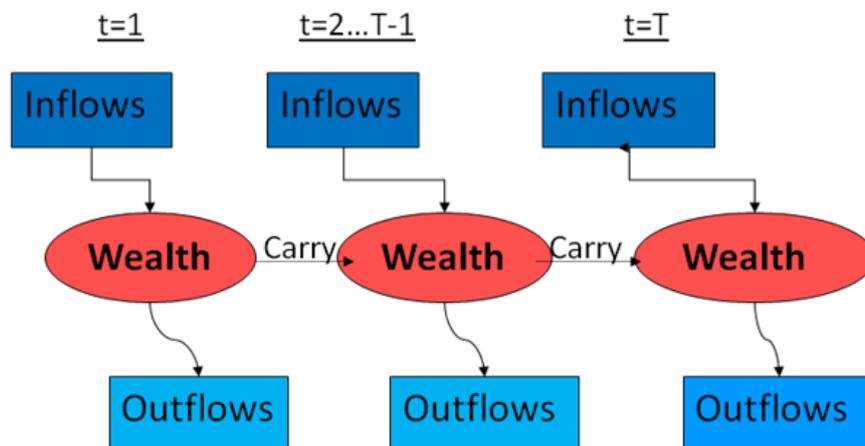


Asset Liability Management / Liability Driven Investment Optimization (LDIOpt)

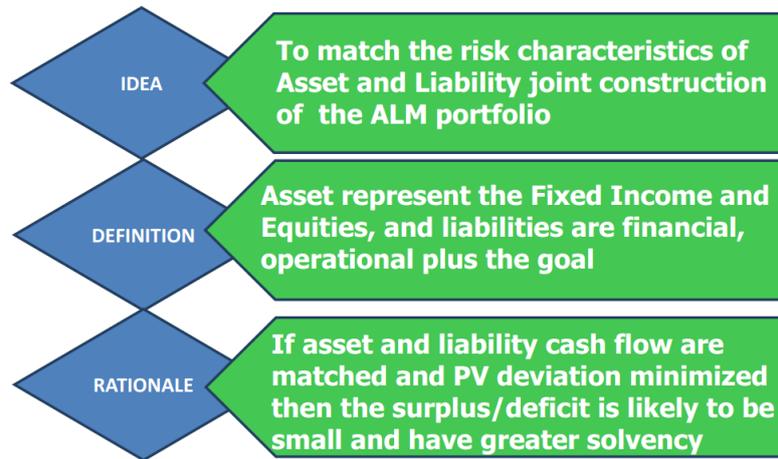
Introduction –



ALM CASH FLOWS

OptiRisk Liability Driven Investment Optimization LDIOpt is an asset and liability management (ALM) optimisation modelling software. It has applications in pension fund, banking, insurance, trust funds, and infrastructure companies – any obligation whose cash flows can be forecasted. It is designed to match and outperform a pension and annuity plan's liabilities.

The tool enables the user to analyse their current investment portfolio, rebalance it to a new portfolio using advanced stochastic optimization models which take into account future uncertainties in asset return, interest rate, inflation, liabilities such as mortality, insurance claims, and early withdrawal of deposits by banks.



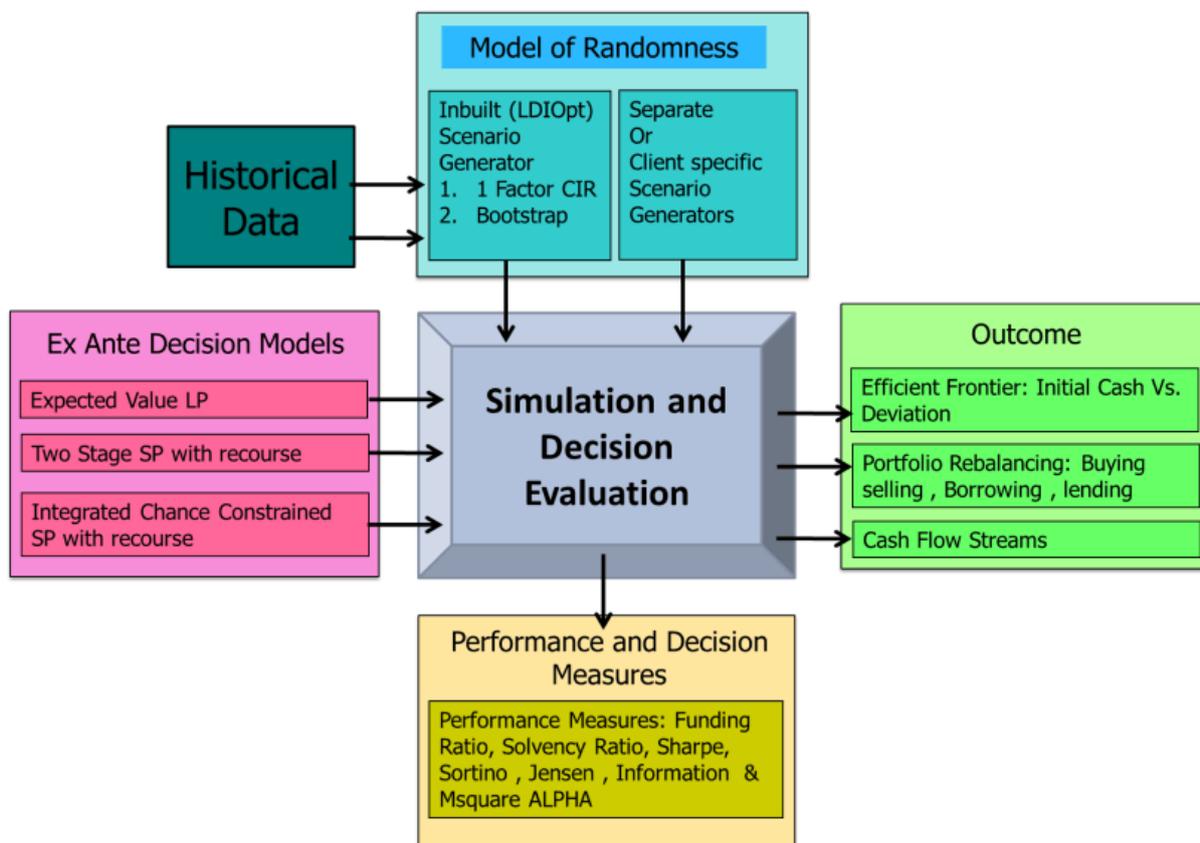
LDI - Liability Driven Investing Typical cash flow cycle of an ALM problem

Challenges

Economic and business environments change, most of the pension funds and insurance companies experience deviation between assets and liabilities over time. Recent financial convulsions has placed greater emphasis on liquidity management with tighter regulations and reporting requirements. The central decision problem in ALM is to construct a portfolio for pension funds or an insurance company that takes into account the future outflows (liabilities) of the pension or insurance scheme and a set of other constraints and determines the optimum trade-off between initial injected cash from policy holder and sponsoring company and deviations between assets and liabilities.

Solutions -

Quantitative models have gained acceptance in recent years due to their theoretical basis and proven outperformance of other methods of investment management. The goal of the LDIOpt optimisation models is to minimise initial injected cash while at the same time minimising total present value deviations between assets and liabilities. Traditionally optimal portfolio is made of fixed income assets and cash; With LDIOpt and stochastic optimization techniques, performance of the fund can be increased by considering investments in indices such as a bond index, stock index, real estate index, commodity index or hedge fund index can be also introduced. Further, LDIOpt allows overlay strategies with interest rate swaps.



LDIOpt :From Historical data to Optimum ALM decisions : - Operational Summary

Benefits

The tool enables the user to analyse their current investment portfolio, rebalance it to a new portfolio using advanced stochastic optimization models which take into account future uncertainties of the assets and liabilities. The goal of the optimisation models underlying LDIOpt is to minimise initial injected cash while at the same time minimising total deviations between assets and liabilities.

	TRADITIONAL ALM	LDIOpt
FOCUS	Short Term Earning	Long Planning Horizon, Earning and portfolio Value after long term
Portfolio Allocation	Fixed Mix strategy	Dynamic Asset Allocation , ALM portfolio
Scenarios	Only Subjective, used in Testing	Objective is scenarios based asset Allocation

ALM Strategies: Traditional Vs LDIOpt

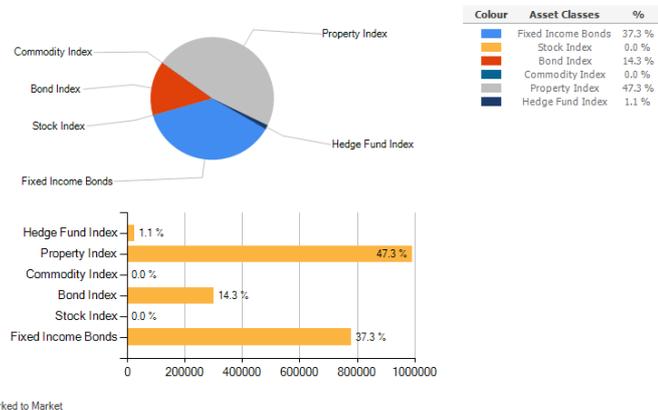
- Support multiple Optimization models
- Determines the optimal trade-off between initial injected cash from policyholders and sponsoring company and deviations between assets and liabilities.
- Allows setting upper and lower limit for selecting bonds with certain rating and from sectors.
- Supports Investment options in bonds, indices and swaps.
- Calculates Traditional ALM risk measures such as macaluy duration , modified duration & convexity
- Calculates number of performance measures such as solvency , sharpe , sortino ,jesen etc
- Supports sensitivity , stress and back testing

Features -

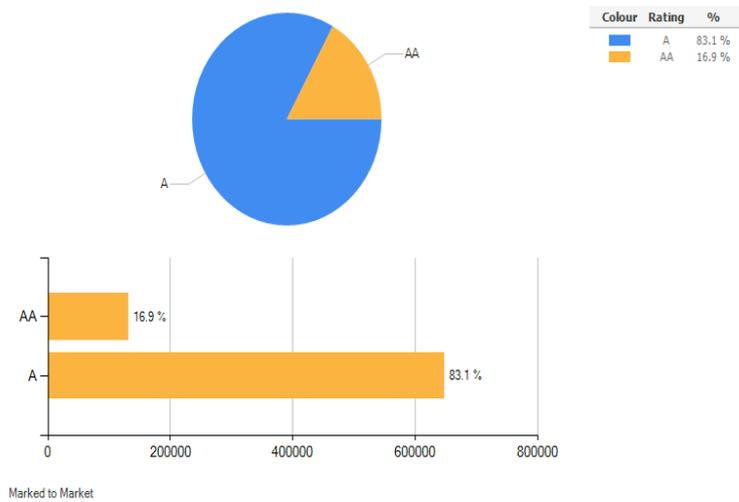
Optimization Models:-

LDIOpt gives the option to choose from three mathematical programming models which are

1. Deterministic linear programming
2. Stochastic programming with recourse
3. Integrated chance constrained programming.



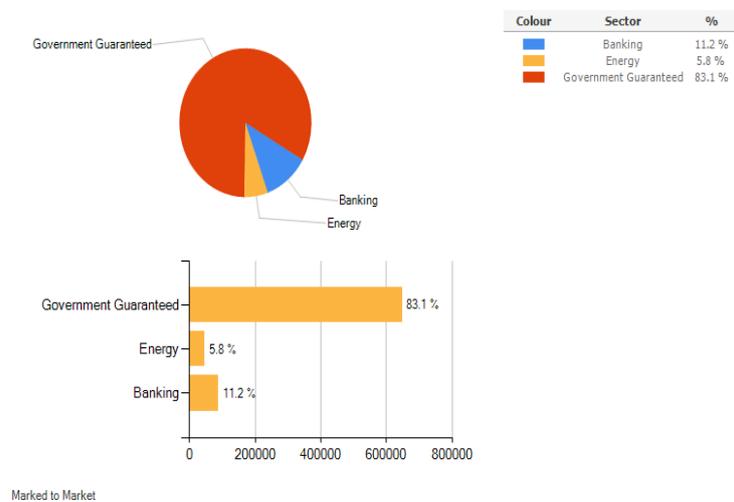
Portfolio Asset Mix Overview



Bond Portfolio Overview – Rating

Optimization Constraints

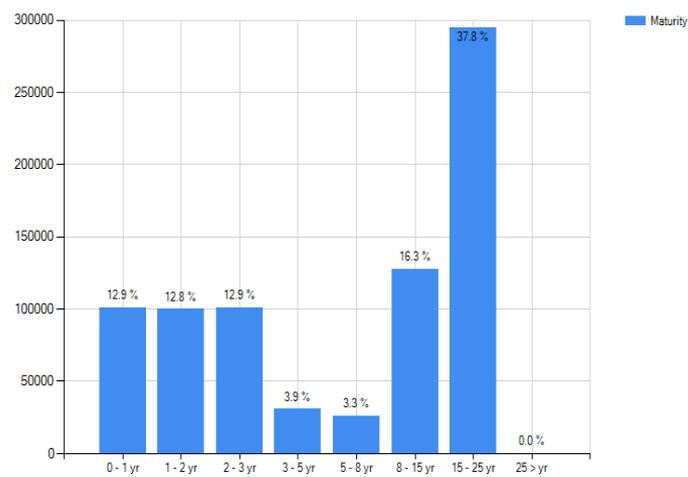
1. Choose Asset Classes
2. Bonds - Min and Max. number can be bought or sold
3. Bonds - Min and Max. in portfolio mix as per Rating and Sector
4. Market Index's – weather you want to include or not , Min and Max. unit of different type of index
5. Swaps – Max and Min. number to be bought
6. Cash – Max borrowing
7. Transaction Cost



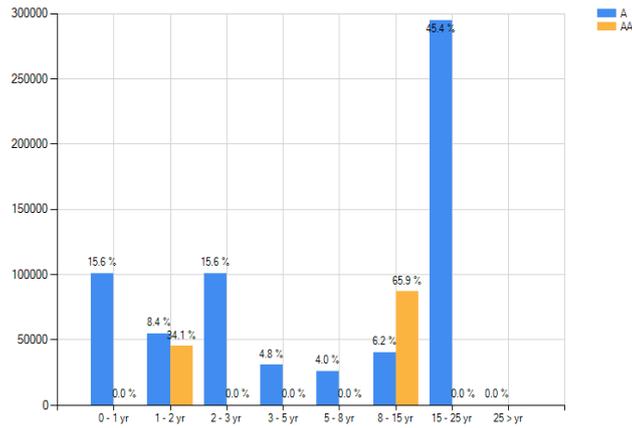
Bond Portfolio Overview – Sector

Asset Classes:

1. Cash
2. Commodities Index
3. Corporate bonds
4. Equity Index
5. Government bonds
6. Hedge funds Index
7. Private equity Index
8. Real estate Index
9. Swaps (vanilla)
10. Bond Index



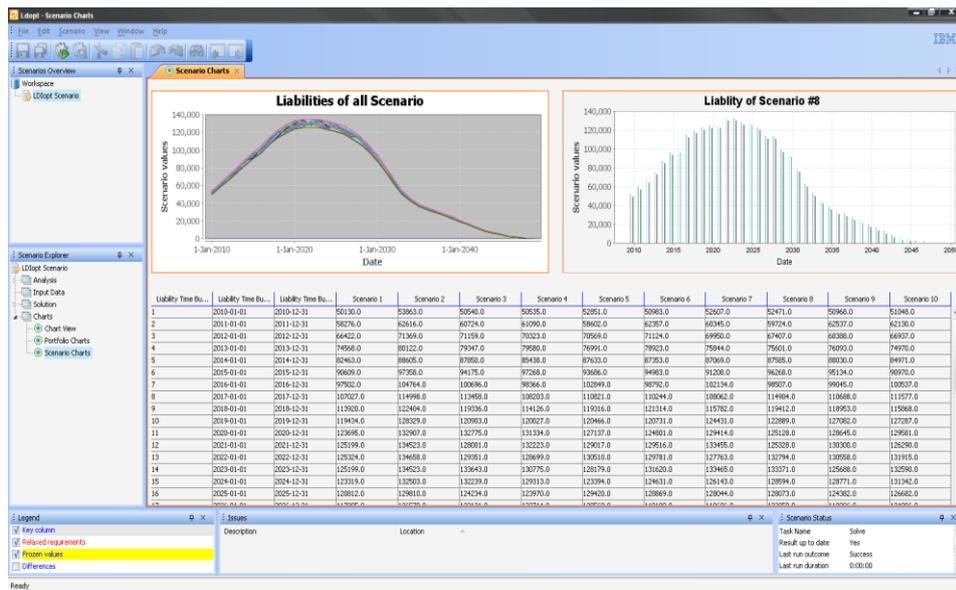
Bond Portfolio Overview - Residual Maturity



Bond Portfolio Overview - Residual Maturity by Rating

Scenario generation Time Models

- CIR single factor Interest Rate scenario Generation Model
- Bootstrapping sampling with replacement



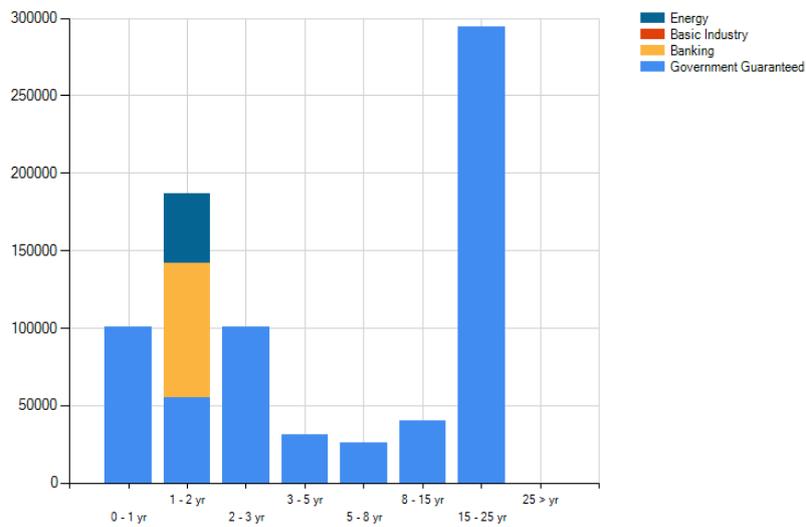
Liability Scenarios

Outcome:

1. Efficient Frontier :-
 - a. Cash Required V/s Total PV deviation
 - b. PV matching Graphs
2. Interest Rate Immunization:-
 - a. Macaulay

b. Modified Duration's

c. Convexity



Bond Portfolio Overview - Residual Maturity by Sector

Risk Factors:-

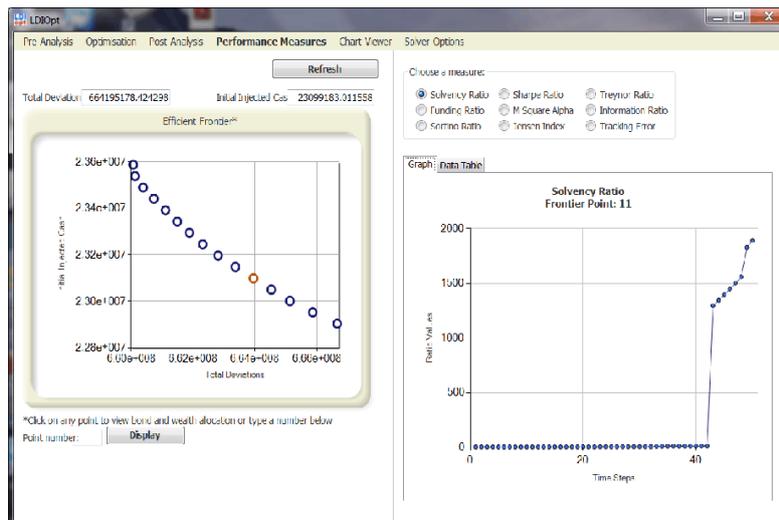
The performance of any portfolio can be evaluated using different **Risk Factors**. We use the most common ones:

From *academia*:

- (1) Solvency ratio (2) Funding ratio (3) Standard Deviation or tracking error (4) Sharpe ratio (5) Jensen Index

From *industry practice*:

- (6) Sortino ratio (7) Treynor ratio (8) Information ratio (9) M-Square Alpha



Screen Shot LDI : Showing Efficient Frontier (left Hand Side) and Risk Factor Solvency Ratio (Right Hand side)

Decision Evaluation :-

1. What-If analysis (Sensitivity Analysis) - Three kinds of *shocks* can be selected, either separately or jointly.
2. Stress testing - The stresses can be chosen one by one, or in combination.
 - a. Interest Rate Shock
 - b. Equities (Market Index) Shock
 - c. Liabilities (Mortality rate) Shock
 - d. Inflation Shock
 - e. Credit risk (Bond Default) Shock
3. Back Testing

Reporting:-

1. Views: Analyse Asset Universe
2. Analyse current portfolio Asset Allocation
3. Analyse Optimized portfolio Asset Allocation
4. Fixed Income Portfolio Rebalancing
5. Investment in different Asset Classes
6. Cash Flows