Individual Household Financial Planning

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*i*ALM

individual Asset Liability Management

software for financial advice

_i_ALM helps households to

- objectively estimate financial possibilities over their life span
- plan their finances for years to come
- optimize savings accumulation
- consider individual household specific wishes and features

Theoretical basis is **Dynamic Stochastic Programming**

A Typical Household

A couple 43 and 40 years old

with an 8 year old child

total annual income £ 120,000

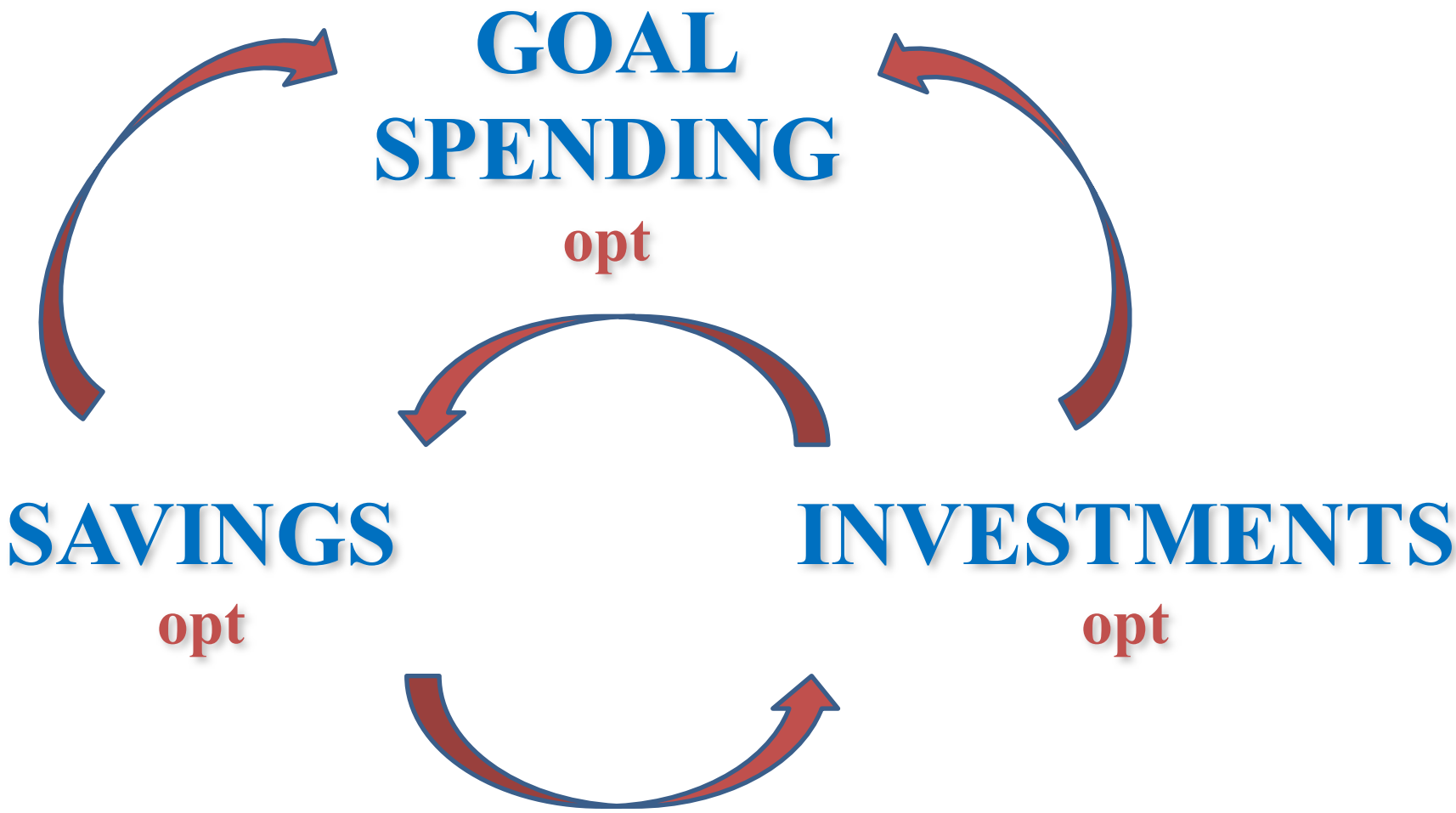
£50,000 of savings

6-year university fees in 10 years

15-year remaining mortgage

each retiring at 65

and purchasing a chalet

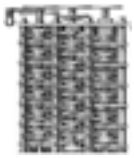


*i*ALM is an *Intelligent* Robo Advisor

1. Goal-oriented investment advice and the ability to assess many different household choices on the its financial wealth
2. Optimal dynamic asset allocation generates an additional return in order of 0.5-1% per annum for a typical middle-class household
3. Retirement saving options and valuation of impact of the existing pension schemes on household's financial wealth

Main Features for Comparison

	RoboAdvisor	*i* ALM
Holistic optimization: goals, taxes, transaction costs etc every goal influences decisions on all other goals	✗	✓
Future dynamic portfolio allocation	✗	✓
Advice on how much to save	✗	✓
Takes into account dynamics of portfolio & risk tolerance	✗	✓
Takes into account longevity risk	✗	✓
Takes into account various goals like children's education	✗	✓



HPC Finance Project

- **Initial Capital Gap** is the extra capital required by an inferior strategy to yield the same lifetime utility as the superior strategy
  - This measure was introduced in the paper published as
    M A H Dempster, Dwayne Kloppers, Elena Medova, Igor Osmolovskiy & Philipp Ustinov (2016). Lifecycle goal achievement of portfolio volatility reduction? *Journal of Portfolio Management* **42.2** 99-117
- **New parallel solver was implemented** in collaboration with IBM that increased the solving speed

Why Does High Performance Computing count?

This underlying *i*ALM mathematical model leads to a **large Linear Programme**

$$\pi := \Big\{ \min_{x_1} \; c_1 x_1 + \sum_{\omega^2 \in \Omega^2} p_2(\omega^2) c_2(\omega^2) x_2(\omega^2) + \sum_{\omega^3 \in \Omega^3} p_3(\omega^3) c_3(\omega^3) x_3(\omega^3)] \\ \ldots + \sum_{\omega^T \in \Omega^T} p_T(\omega^T) c_T(\omega^T) x_T(\omega^T) \Big\}$$

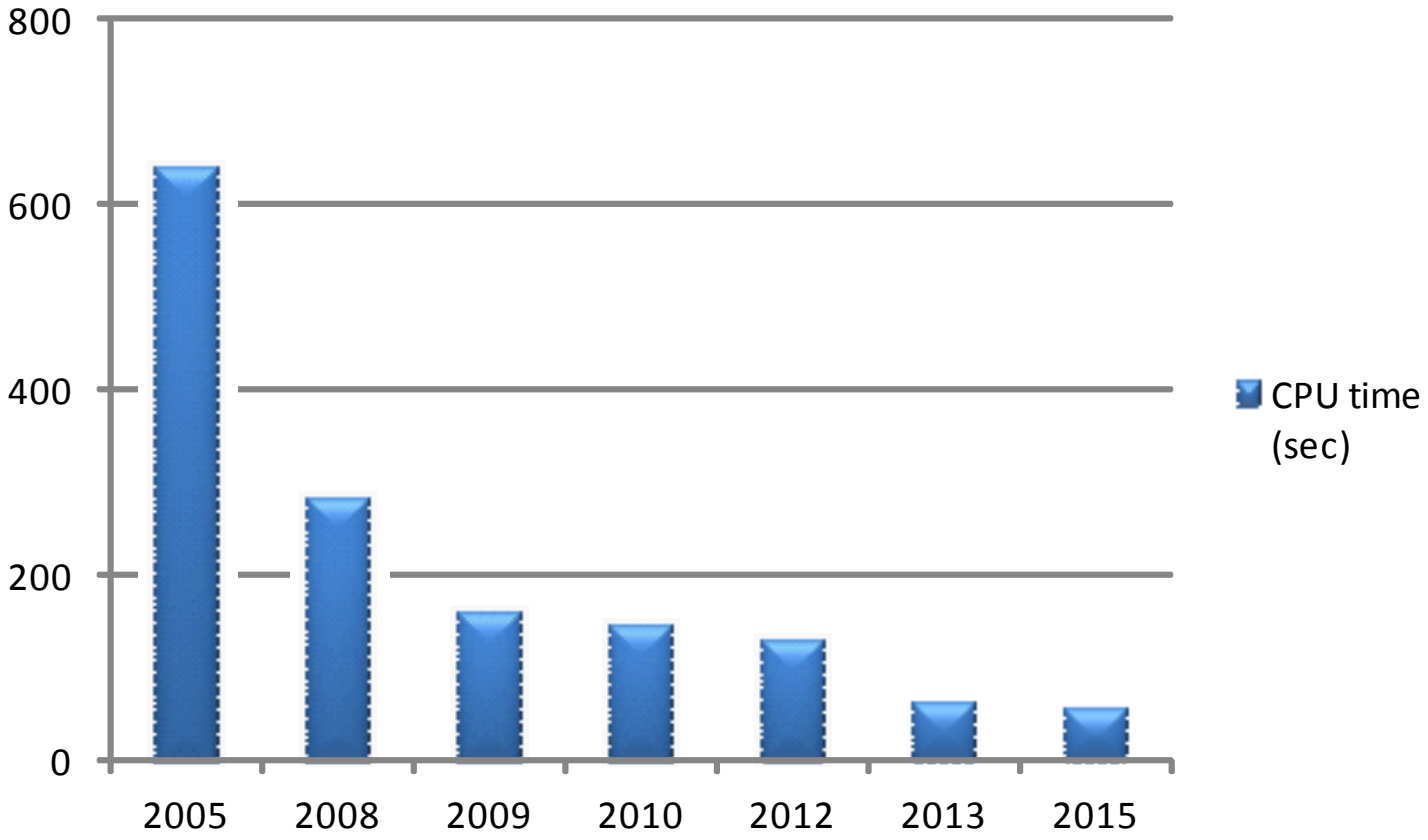
$$\begin{array}{llllllllll} \text{s.t.} & A_{11}x_1 & & & & & & = & b_1 & \\ & A_{21}(\omega^2)x_1 & + & A_{22}(\omega^2)x_2(\omega^2) & & & & = & b_2(\omega^2) & \text{a.s.} \\ & A_{31}(\omega^3)x_1 & + & A_{32}(\omega^3)x_2(\omega^2) & + & A_{33}(\omega^3)x_3(\omega^3) & & = & b_3(\omega^3) & \text{a.s.} \\ & & : & & : & & \ldots & : & & \\ & A_{T1}(\omega^T)x_1 & + & A_{T2}(\omega^T)x_2(\omega^2) & + & \ldots & + A_{TT}(\omega^T)x_T(\omega^T) & = & b_T(\omega^T) & \text{a.s.} \end{array}$$

$$l_1 \le x_1 \le u_1$$
$$l_t \le x_t(\omega^t) \le u_t$$
$$\omega^t \in \Omega^t \qquad t = 1, \ldots, T$$

Matrix size increases **exponentially** with the number of **time stages** and **linearly** with the number of **scenarios.**

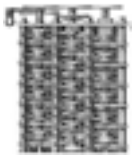
Currently in *i*ALM Simultaneous linear equation constraints in **2 million variables**.

New Parallel Solver Implementation



Some Speed Test Results

UK 2013				
Intel Core i5-3470 CPU (4 cores) @ 3.20 GHz 3.20 GHz, RAM 8GB				
profile	**CPLEX version**	**Average secs**	**12.6.XX/9.1**	**12.6.2/12.6.0**
Profile 1	9.1, 32bit	**69.80**		
	12.6.0, 64bit	**45.40**	0.65	
	12.6.2, 64bit	**43.60**	0.62	0.96
Profile 2	9.1, 32bit	**105.20**		
	12.6.0, 64bit	**66.20**	0.63	
	12.6.2, 64bit	**61.80**	0.59	0.93
Profile 3	9.1, 32bit	**128.80**		
	12.6.0, 64bit	**77.00**	0.60	
	12.6.2, 64bit	**75.20**	0.58	0.98
Profile 4	9.1, 32bit	**119.00**		
	12.6.0, 64bit	**71.60**	0.60	
	12.6.2, 64bit	**76.80**	0.65	1.07



*i*ALM for Retirement Planning

- April 2016 – new pension reforms come into an effect in UK
- New possibilities are introduced, e.g. the right to access your DC pot after 55
- As a consequence new optimal strategies can be developed

*i*ALM Client's Input-Output

Client-server application (integratable with mobile and online platforms)

Input data

- household structure (parents, children, dependents...)
- income structure (salary, securities income, rent...)
- spending structure (tenancy, education, food...)
- loans (mortgages, personal loans...)
- etc. (any important client information)

Aggregated result

- spending optimization
- savings maximization
- retirement planning
- optimal investment recommendations

Demonstration