Finding NIMo
Net Interest Margin Optimization

jss

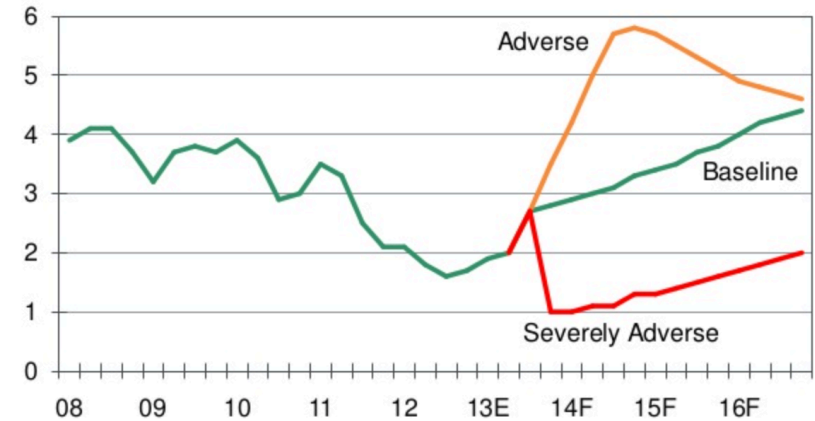Mar-2015

CCAR

Kamakura Corporation
U.S. 3 Month Treasury Bill Rate
Federal Reserve CCAR 2015 Stress Testing

Actual Data — Base Line Forecast
Adverse Forecast — Severely Adverse Forecast

Source: Kamakura Corporation, Federal Reserve
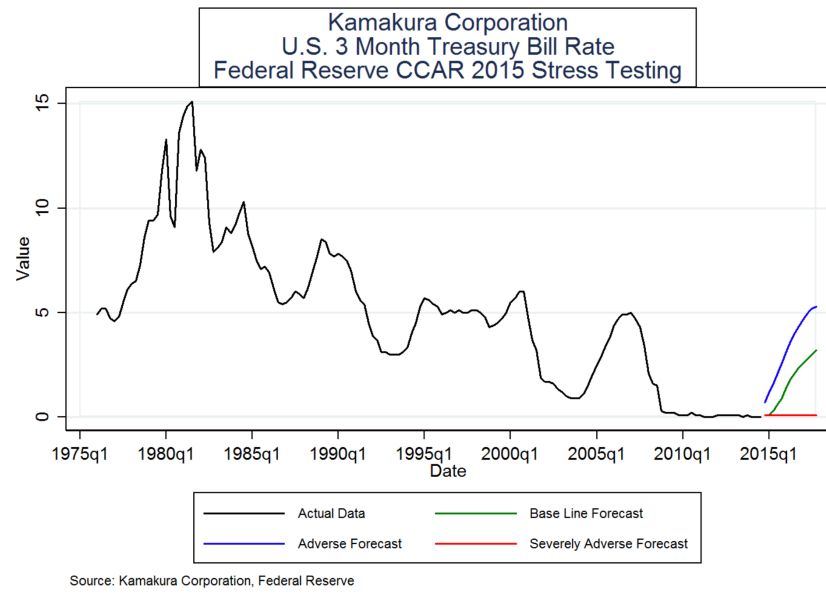
Adverse Driven by a Surge in LT Treasury Rates…

10-yr Treasury bond rate, %

Sources: Federal Reserve, Moody's Analytics

Why is NIM Forecasting important?

- A bp of NIM ~$180mm of annual revenue for large Balance Sheet.
- +0.2% in automated Capital Allocation efficiency at 300 bps NIM is 0.6bps.
- **$100+mm USD annual revenue (in perpetuity), otherwise foregone**.

References:

- Finding Nemo, Disney
- van Deventer, Kamakura Corporation, Dec 2014
- FRB, Comprehensive Capital Analysis and Review.
- Assessing the Fed's CCAR Scenarios, Moody's.

NIM Optimization
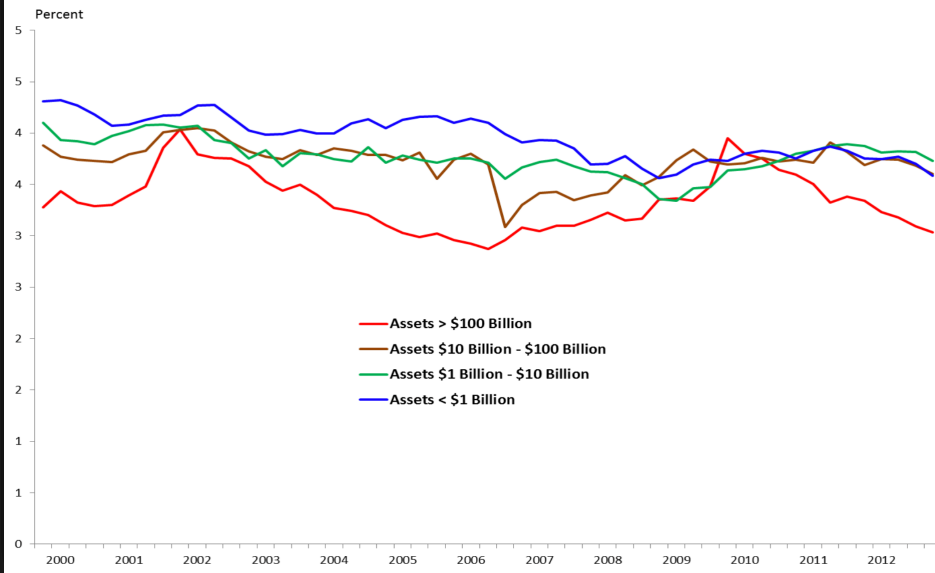
NIM = Avg. Interest Assets - Avg. Interest Liabilities

Classical Nonlinear Optimization Problem:

Find x in R^n, the allocation of capital to
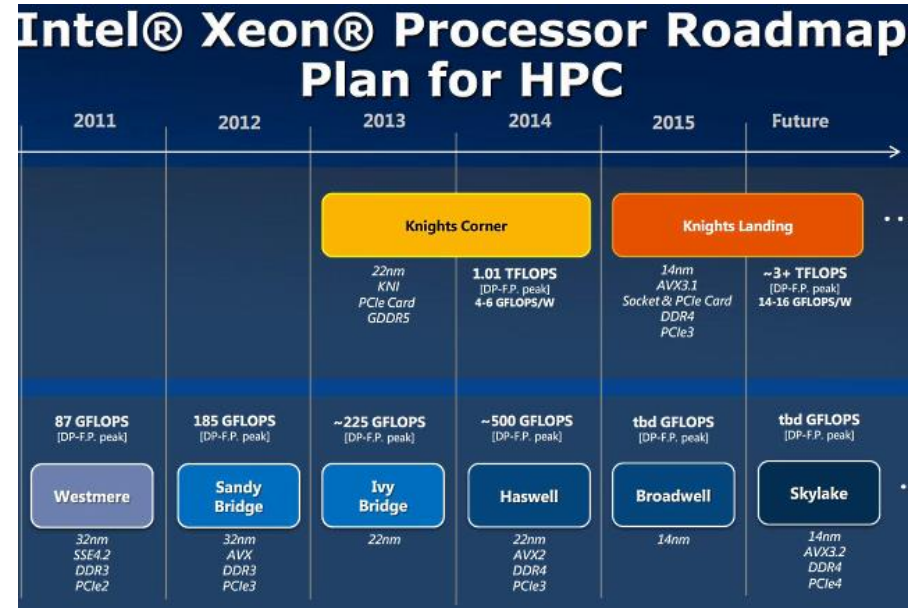
Maximize:

$$f(x) – The\ Firm\ NIM$$

Subject to:
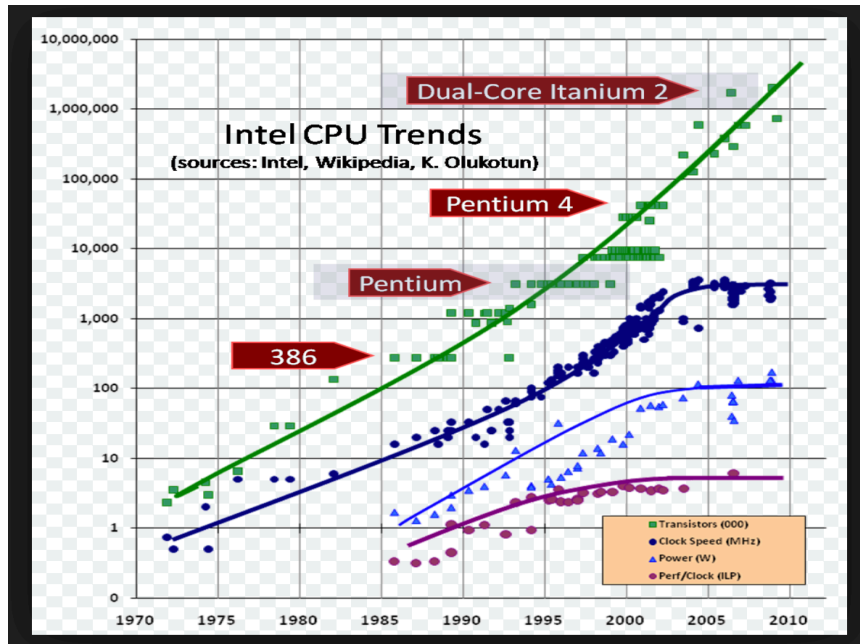
$$g_i(x) <= 0$$

$$h_j(x) = 0$$

References:

- FDIC, Remarks by Gruenberg 1Q2013
- FRED, NIM for US Banks

2015 Inflection Point
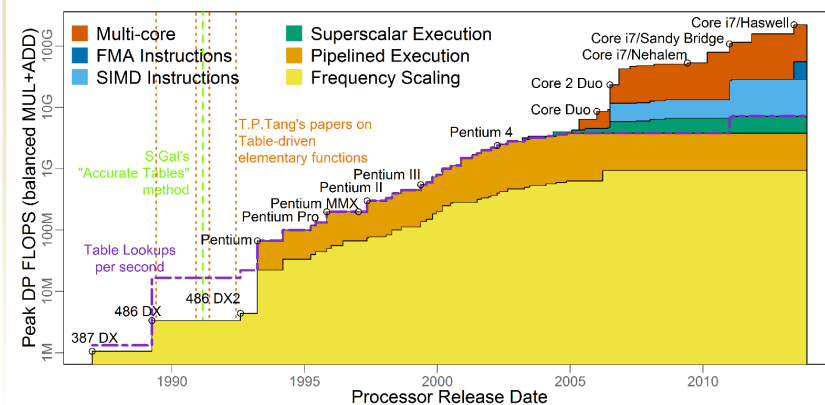
References:

- Sandberg, Trading System Floating Point, Feb-2014 presentation.
- Dukhan, Hot Chips 2013.
- Intel Roadmap
- Colwell, Hot Chips, 2013, The Chip Design Game at the End of Moore's Law.

NIMo = NLP over MC over CCAR
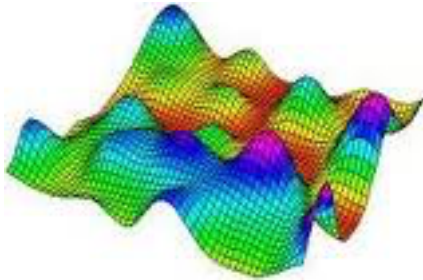
NLP – Nonlinear Programming
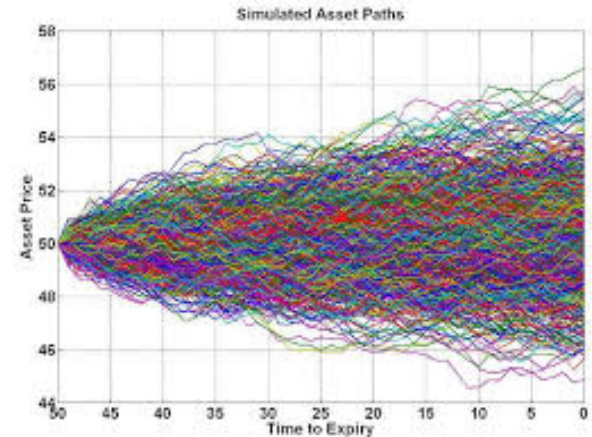
Monte Carlo

CCAR

References:
http://www.wolfram.com/products/applications/mathoptpro/
http://www.cs.ucsb.edu/~kyleklein/publications/neldermead.pdf
http://www.maths.uq.edu.au/~kroese/montecarlohandbook/
http://www.federalreserve.gov/bankinforeg/ccar.htm
http://www.top500.org/statistics/sublist/

NIMo NLP

- Push nonlinearity valuation into the Monte Carlo expected case full balance sheet simulation. The $g_i(x)$ in the NLP is the Monte Carlo on the balance sheet simulation. The NLP checks the outputs from MC for the various incremental capital allocation plans in X (below).
- X contains O(10K) elements
  - NIM & Firm New Investment levels (O(1))
  - Firm & Regional Risk level constraints (O(100))
    - Libor, Sovereign, FX, Credit, Vol, and Basis
  - Regulatory level constraints (O (10))
    - Liquidity Coverage Ratio
    - Net Stable-Funding Ratio
  - Business Entity Balance level constraints (O(10K))
    - Acquisition, Retention, Runoff goals per GOC
  - Product Model Constraints (O(1000))
- Constraints are sparse
- Parallel Simplex formulations may scale up see: http://www.cs.ucsb.edu/~kyleklein/publications/neldermead.pdf

FLOPS Estimates

New Supercomputer Category like: Weather, Oil, Fluid Flow, Energy, Big Data.

- 64 Giga FLOPS per Balance Sheet NIM valuation

- 10K Paths for MC with Risk sensitivities
  - 640 Tera FLOPS

- 100K NLP vals. to find NIMo, risk weighted
  - 64 Exa FLOPS

P&L Estimates

#	Bank	Assets US$m	NIM bps	NIMo bps	PV(NIMo) US$m
1	Industrial & Commercial Bank of China Limited, China	3,124,474	250	7.895	2467
2	China Construction Bank Corporation, China	2,537,402	250	7.895	2003
3	BNP Paribas SA, France	2,474,078	250	7.895	1953
4	Agricultural Bank of China Limited, China	2,405,091	250	7.895	1899
5	Bank of China Limited, China	2,291,492	250	7.895	1809
6	Deutsche Bank AG, Germany	2,214,678	250	7.895	1748
7	Barclays Bank PLC, UK	2,173,936	250	7.895	1716
8	Crédit Agricole SA, France	2,112,250	250	7.895	1668
9	Japan Post Bank Co Ltd., Japan	1,961,701	250	7.895	1549
10	JPMorgan Chase Bank National Association, USA	1,945,467	242	7.642	1487
11	The Bank of Tokyo-Mitsubishi UFJ Ltd, Japan	1,760,014	220	6.947	1223
12	Société Générale, France	1,697,721	220	6.947	1179
13	The Royal Bank of Scotland plc, UK	1,688,912	220	6.947	1173
14	BPCE, France	1,544,145	220	6.947	1073
15	Banco Santander SA, Spain	1,533,312	220	6.947	1065
16	Sumitomo Mitsui Banking Corporation, Japan	1,518,269	220	6.947	1055
17	Mizuho Bank Ltd , Japan	1,437,609	220	6.947	999
18	Bank of America NA, USA	1,433,716	220	6.947	996
19	Lloyds TSB Bank Plc, UK	1,427,395	220	6.947	992
20	Wells Fargo Bank NA, USA	1,373,600	220	6.947	954
21	China Development Bank Corporation, China	1,352,212	220	6.947	939
22	Citibank NA, USA	1,346,747	220	6.947	936
23	HSBC Bank plc, UK	1,344,088	220	6.947	934
24	UniCredit SpA, Italy	1,162,505	220	6.947	808
25	UBS AG, Switzerland	1,130,736	220	6.947	786
26	ING Bank NV, Netherlands	1,082,523	220	6.947	752
27	Bank of Communications Co Ltd, China	984,514	220	6.947	684
28	Credit Suisse AG, Switzerland	956,681	220	6.947	665
29	Bank of Scotland plc, UK	941,235	220	6.947	654
30	Rabobank Nederland, Netherlands	926,524	220	6.947	644
31	Postal Savings Bank of China Co Ltd, China	920,682	220	6.947	640
32	Nordea Bank AB (publ), Sweden	866,457	220	6.947	602
33	Intesa Sanpaolo SpA, Italy	860,752	220	6.947	598
34	Crédit Agricole Corporate and Investment Bank, France	832,791	220	6.947	579
35	The Hongkong and Shanghai Banking Corporation Limited, Hong Kong	830,456	220	6.947	577
36	The Toronto-Dominion Bank, Canada	826,814	220	6.947	574
37	Royal Bank of Canada, Canada	825,172	220	6.947	573
38	The Norinchukin Bank, Japan	805,396	220	6.947	560
39	Banco Bilbao Vizcaya Argentaria SA, Spain	800,680	220	6.947	556
40	Commerzbank AG, Germany	755,444	220	6.947	525
41	National Australia Bank Ltd, Australia	753,146	220	6.947	523
42	Commonweath Bank of Australia, Australia	746,370	220	6.947	519
43	The Bank of Nova Scotia, Canada	712,987	220	6.947	495
44	Natixis, France	701,115	220	6.947	487
45	Standard Chartered PLC, UK	674,380	220	6.947	469
46	China Merchants Bank Co Ltd, China	663,352	220	6.947	461
47	Australia and New Zealand Banking Group Limited, Australia	654,920	220	6.947	455
48	Westpac Banking Corporation, Australia	648,969	220	6.947	451
49	Kreditanstalt fur Wiederaufbau (KfW), Germany	638,751	220	6.947	444
50	Shanghai Pudong Development bank Co. Ltd., China	607,813	220	6.947	422
	Total				**47,317**

- < need the correct 2014 NIM in adj table>
- Assume Current Bank NIM Process 95% optimal
- Assume automated optimization can make it 98% optimal.
- ~47 Bn USD Annual Revenue at top 50 Banks
- McKinsey est. 10 to 15 bps in optimization Jul-13 puts Annual Rev @ 100+ Bn

References:

- Accuity, Bank Rankings – Top Banks in the World.
- McKinsey, Between deluge and drought: The future of US bank liquidity and funding

Regional Supercomputer Partners

- US Vendors: Intel, Cray, IBM, HP

- France Vendors: Bull, NEC

- China Vendors: TBD

- Germany Vendors: TBD

- UK Vendors: TBD

- Japan Vendors: NEC, Fujitsu

- Asia/Pac Vendors: TBD

Pros and Cons

Pros:

- ~1 Bn USD per Top 50 Bank Annual Revenue (+3%@300bps)

- US Bank NIM at 30 Year lows according to FRED. A bp of US Bank NIM value at premium in 2015.

- NIM_{opt} rides Tech Wave: Moore's Law continues to improve NIM_{opt} performance (capacity to search) through 2020.

- CCAR cleans the Accrual inventory dataflow, pricing, and indicatives for NIM_{opt} to reuse.

- CCAR Balance Sheet gives frame of reference for NIM simulation to Treasury users globally.

- Turns CCAR sunk costs into a Revenue Center.

- Moves from CCAR worst case analysis to expected case analysis.

- Balance Sheet math modeling can be much more aggressive in a purely non-CCAR optimization framework.

Cons:

- Need the 1000x kick in efficiency from 2015 FP code optimization to get NIM_{opt} feasible.

- Floating Point optimization literate programmers on the Street are rare.

- NLP/MC is not a trivial math programming problem.

- Maybe Transfer Pricing Curves take some or all of the NIM_{opt} improvements off the table.

- Some parts of the Balance Sheet AFS/HTM costly to simulate without rewriting code not in our possession.

References:

- Sandberg, Citigroup, Ruby Floating Point 2015.

- http://www.computerworld.com/article/2847865/us-sets-sights-on-300-petaflop-supercomputer.html