

# **R in the Practice of Risk Management Today**

**UseR! 2011**

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# Landscape

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- Problems within Finance Services (FS) vary greatly
- Their formulations differ wildly from firm to firm
- Regulators suggest how to estimate risk, but not how to decide on a trade
- FS uses many technologies, and has deeply technical practitioners
- Algorithmic and technological innovation has high value for many problems

Where does R fit in?

# Best Problems for R?

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In the field, many use cases benefit greatly from the characteristics of the R language, its development cycle, and its community.

- Nimble means quick time-to-market for models
- Easy to integrable means more ways to add value to existing systems
- Strong, open community means innovation is strong, programmers abound

These things we know well.

What are the right scales of problems? The right business cultures to enter?

# Disclaimers

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The examples that follow are representative anonymized composites derived from direct experience in the field and from publically available reports.

There may be coverage of various topics mentioned here. I didn't do a comprehensive search of CRAN, and do not mean to ignore any of the great contributions there.

# Case Study 1: Public Pension Plan

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- Large pension fund for public employees
- Over 75 BB EUR assets
- Challenges:
  - Lifespans are lengthening
  - Active membership is declining; fewer workers are entering the field
  - Current investment environment is challenging: > 12 BB EUR funding shortfall
  - Mean years on pension = 30, mean years contribution = 26
  - “Generational Equity:” in 70 years, some active plan members will still be drawing benefits

# Case Study 1: Public Pension Plan

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- **Regulatory oversight**

- Regional government requires a full fund valuation at least every 3 years
- Due to the stress of the shortfall, the Fund may proactively accelerate the schedule for the next valuation

- **Timeline**

- For October reporting needs, the Fund solicits software solutions in July
- There is interest in using new technologies
- Solution needs to be quick-to-market and not disruptive

# Case Study 1: Public Pension Plan

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## Industry Quantitative Environment

- Pension Funds are often less technology-enabled than other Financial Institutions, such as investment banks. (same in Insurance)
- Funds have less frequent reporting and valuation requirements, and longer risk horizons.
- Spreadsheets with niche add-in solutions are common. (same in Insurance)
- Corporate IT holds far more programming and technology skills than the business, and often have a strong say in the decision to adopt.

# Case Study 1: Public Pension Plan

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## Analytical needs

- Forecast interest rates
- Forecast investment returns
- Estimate life expectancy and retirement age
- Estimate active membership (affects ability to mitigate adverse changes)



# Case Study 1: Public Pension Plan

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## Some Details

**Case 1: VaR calculation takes 30-40 seconds per query through Excel. This is painfully slow. Excel in-memory engine is moderately fast but not parallelized. Time-to-market of models does not scale with number of models. Further, cell formulas, cell dependencies, and macros are understood by one person and are not documented.**

**Case 2: Larger problem: ALM projections. We look at scenarios of VaR projections in the enterprise ALM context. There are 20,000 holdings and commonly 5,000 scenarios, data points in 100 MMs. Data is in ORCL; current database querying is known to be inefficient. Business logic is all over the place, again. Analyst waits 20-30 minutes for a projection using Excel macros. We need internet-scale response time.**

# Case Study 1: Public Pension Plan

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## Summary

- **Technology: faster performance for ad hoc use**
  - We see solutions in the community here; need to be understandable to business
- **Culture: move from Excel to lightweight scripting, versioning, and packaging**
  - We see specific solutions arising; need to be business-ready and analyst-friendly
- **Oversight: expect more frequent requests, not different models**

# Case Study 2: Global Trading Division P&L

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- **Large division of large Financial Institution**
- **Want to ammunition to challenge the Enterprise Risk Function**
  - This is not the hugest problem, but a big one
- **Challenges**
  - Need a non-disruptive solution; keep under the radar of corporate IT (key theme)
  - 50K holdings, a dozen metrics, 5 years of daily data
  - Need to perform daily VaR based on historical P&L analysis
  - Aggregating “diversified” P&L involves modeling the association among risk factors under the 50K instruments
  - Data is in ORCL and in a proprietary columnar database

# Case Study 2: Global Trading Division P&L

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## Summary

- **Technology: simple implementation**
  - Need to keep inside the business, only involving IT attached to business
  - Daily frequency
- **Culture: support a “build your own” environment**
  - There is continued value in ease of integration with larger systems
- **Oversight: local governance, not industry mandated**

# Case Study 3: Stress Tests in Risk Management

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**Requirements around the estimation of Credit, Market, Operational and Liquidity Risk continue to increase**

**Large Banks have an incentive to use their own models to estimate certain risks**

**Banks will have continued pressure to model quickly**

- *[1] “US Bank holding companies with assets > 100 BB USD had a few months to show to regulators what capital they would need in the event of adverse scenarios drawn up by several supervisory agencies.” (WSJ, 25 Feb 2009)*
- The fire drill determined who must accept capital assistance repayable with interest.
- The analysis was done against a baseline and an adverse scenario.
- The adverse scenario included the assumption that USA would lose its risk-free sovereign rating....not!

# Case Study 3: Stress Tests in Risk Management

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- [2] In January 2011, the European Banking Authority mandated stress tests, *“one of a range of supervisory tools used for assessing the strength of individual institutions as well as the overall resilience of the system.”* (2011 EU-Wide Stress Test: Methodological Note, EBA, 18 March 2011)
- This is in addition to any stress tests dictated by national banking systems, or by the bank itself
- Need easy-to-review methodology
- Timeline: 04 March 2011 - 29 April 2011
- Results were publically disclosed for 90 banks
  - 8 flunked
  - 16 barely passed
  - The worst case scenario included a national debt default...not!

# Case Study 3: Stress Tests in Risk Management

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## Summary

- **Technology: the enterprise case**
  - Need to integrate cleanly with disparate data sources
  - Large scale problems benefit from high-performance architectures
- **Culture: provide clean ad hoc reporting**
  - Many different eyes on the system, stakeholders with varying backgrounds
- **Oversight: standardized across banks**
  - Repeatable case supports packaging...stay for the following presentation!

# Other Cases

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## Large bank forecasting asset quality of commercial portfolio

- 800 K obligors, 15 forecasting periods, 25 LOBs, deterministic model
- 10-15 second response per LOB

## Medium-size hedge fund

- Analyze candidate portfolios based on MVO
  - 25 target returns, 5 in-sample windows, 10 x 10 pairs of individual min/max weight constraints, 8 out-of-sample metrics, 100-500 assets
  - Show information in one page
  - < 1 hour turnaround



# Other Cases (cont.)

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## Large bank managing MBS payouts

- Thousands of mortgages
- Excel system is too slow
- System is needlessly complex
  - One loan at a time is pushed from MS Access to MS Excel
  - Valuation and senior / subordinate contributions are calculated
  - Details are written to MS Access
- Business rules could be packaged here
- Performance of this highly vectorizable task can be greatly improved

# Summary

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**There are many problems in Financial Services where business needs are aligned with the characteristics of R.**

**Regulations in the subfield of Risk Management provide opportunities for repeatable solutions.**

**There is room for bringing value with high performance computing in R, while keeping under the automated trading / HFT ceiling.**

**In many areas of Financial Services, R provides a bridge to better practice from an Excel-based approach. This involves a culture change.**

**Clean reporting will continue to have value in contexts where there are many eyes on the answers.**

