TECHNOLOGY SECTION
"A KNOWLEDGE COMMUNITY FOR THE SOCIETY OF ACTUARIES"

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Inside

Actuaries
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Letter from the Editor

by Howard Callif

This edition is packed with useful and important information. Although some articles are reprints that have appeared in other publications, we have decided that this information is important and relevant enough to justify including here. Several of these topics will be covered at upcoming SOA meetings, so reprinting the articles seems appropriate and timely.

For example, the article on grid computing (by David Dorfman and Don Canning) discusses how to use the latest technology to solve actuarial problems. These techniques are more accessible, and result in significant performance increases which will continue to improve as dual and quad core processors become commonplace. This either opens up opportunities for competitive advantage, or means you'll need to work harder to keep up if you ignore this possibility!

The article on data governance (by Tim Pauza) is another good example. According to Paula Hodges, one of the key points of the article is that data shouldn't be allowed to grow on its own. It should be managed closely as a resource. Unfortunately, most companies generate a lot of data prior to getting it under control. They then have data to clean up, processes that need to change, and control to regain. None of these things is easy!

There is another article on this topic by Eric Perry, specifically discussing spreadsheets and how to manage data and processes. Look for further discussion and sessions on these topics at the Spring SOA meeting, and in future editions of this newsletter. Given the topic's importance and relevance, we already have more coverage of this in the next newsletter: A book review by Mary Campbell on the topic of spreadsheet checks and controls.

We also have articles related to project management (by Stewart Shay), a draft for an XML standard for interest scenario's (by Steve Strommen), and a discussion of IRRs (by Tim Rozar) which includes code for you to use.

A special thanks to all of these authors for their hard work!

We are also moving cautiously forward on actuarial software reviews. We are still in the planning stages, but if you are looking for Pricing, Valuation, Cash Flow Testing, or other actuarial software, **please e-mail the editor!** We want to be able to provide a resource to help with the selection process, such as features charts, user reviews and other detailed information. However, that requires feedback and information from you!

The lack of feedback from our last issue is surprising. Life is busy for all of us, but it is important to contribute your expertise and ideas to maximize the value of the Technology section, and this newsletter. Please forward your suggestions, remarks on programs or tools you've found useful and other questions to howard@callif.org, or one of the section council members. Thanks!

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The Actuary's High-Performance Computing Challenge

David Dorfman and Don Canning

The following article is reprinted from "Windows in Financial Services" - *www.windowsfs.com.*

The insurance industry is under increasing short-term pressure. It faces growing competition from non-traditional competitors and must satisfy an investing public, increasingly aware of the ever-expanding number of investment options. In step with these pressures, the industry has evolved to develop products that are more complex and offer more aggressive returns.

This shift is putting new computational demands on existing tools. In fact, computational requirements are expected to increase more than 100-fold, far exceeding the capabilities of desktop computers and many existing enterprise computing resources. To meet this challenge, leading insurers have turned to high-performance computing (HPC). Working with its vast partner channel, Microsoft has responded swiftly to offer a choice of HPC solutions specifically targeted toward the challenges of the industry to help insurers meet these new demands with an eye to cost, profitability and productivity.

Factors Driving the Move to HPC

Traditional life insurance and annuities face competition from new products, such as variable annuities and equity indexed Annuities designed to offer more aggressive financial returns to the policyholder based on the performance of a particular equity index or linked investments. Another recent development is the emergence of the Life Settlement-backed Securities industry, through which the insured public can sell traditional life policies to investors for eventual use as the collateral for

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asset-backed bonds. The fact that third-party investors will outbid life insurance companies for the cash surrender value of mature policies implies the existence of new applications for actuarial computational models. Although the reduction of policy surrender rates could have little or no effect on the bottom line of the industry, does this new type of financial instrument represent the emergence of a new set of applications that attempt to divert profit and cash from the industry through the innovative use of computational modeling?

Investing in the computational power required to run larger models more frequently results in improved productivity and more reliable results.

The industry consolidation has reduced cost, thus improving profitability. At the same time, it has forced a reduced number of larger companies towards a greater dependence on fewer risk-and-return scenarios, requiring greater diligence in the evaluation of each scenario.

An additional challenge is the increased competition for the limited number of attractive investment opportunities required to generate the required returns to fund the expected portion of earnings and growth from invested capital. Competition requires insurers to invest more aggressively, in some cases using improved computational models to guide investment decisions.

As insurance products increase in complexity, so does the rigor of regulatory compliance. Federal and state insurance boards require complete transparency and the ability to interrogate the drivers of profit and loss across actuarial processes. Increased complexity and embedded risk in new insurance products has resulted in regulatory changes to mitigate this risk.

All of the above factors drive the increased investment in computational infrastructure required by the actuarial profession to keep up with these increased demands. Investing in the computational power required to run larger models more frequently results in improved productivity and more reliable results.

HPC's Emergence

It is expected that this combination of competitive, financial and regulatory pressure will increase computational modeling requirements by two or three orders of magnitude. A commensurate increase in computational power will be required, demanding capabilities beyond what is provided by a single desktop or high-end workstation.

Over the next three years the calculation of life insurance reserve requirements must conform to the mandate for a computationally-intensive principle-based approach (PBA). The PBA seeks to factor in a wider range of economic risk, as opposed to a traditional formulaic approach. With this shift, all life insurance providers will require dedicated compute clusters for computational modeling. This transition has already resulted in significant investments by leading providers of variable annuities in computational modeling software and hardware. The graphic (See page 27) explains why the use of nested stochastic modeling in the PBA leads to dramatic expansion in computational requirements.

In anticipation of these upcoming requirements, many companies have already begun incorporating nested stochastic analysis into their product pricing and development process. This usage pattern rewards the decision of leading providers to develop dedicated HPC clusters. HPC is also required to support the annual regulatory requirement for in-depth analysis of solvency scenarios for each company.

As a result of these changes, HPC is poised to move from the category of an advanced tool to a mission-critical capability in the IT strategy of every life insurance provider. HPC will be required in order to meet monthly regulatory obligations, possibly as early as Jan. 1, 2009. Increasing actuarial model size will also require the adoption of 64-bit technology for larger memory address space support required over the full range of modeling techniques.

Microsoft's HPC Solutions

Microsoft has quickly responded to support the industry with tools and solutions tailored to meet these requirements. A new version of Windows Server is available for the computers required to run actuarial models. Microsoft Windows Compute Cluster Edition (CCE) is fully-compatible with existing 64-bit versions of Windows Server and runs all the industry leading actuarial modeling packages, such as Milliman's MG-ALFA, SunGard's iWORKS Prophet and Towers Perrin/Tillinghast's MoSes. CCE is the most cost-effective version of Windows Server for HPC; dramatically reducing the software cost for the implementation of HPC clusters, with processor counts numbering in the hundreds or thousands.

The Windows Compute Cluster Pack (CCP) includes a resource manager, job scheduler and management pack, allowing the low cost creation, management and scheduling of HPC clusters for the execution of actuarial models. CCE and CCP are combined as the components of Windows Compute Cluster Server 2003 (CCS).

For customers interested in building their own actuarial models, Microsoft Visual Studio 2005 offers a wide range of parallel and high-performance development tools that can be integrated with the entire set of Microsoft products allowing the development of fully-integrated modeling systems using high-performance compilers, parallel development tools, high-performance SQL server engines for storage and retrieval of transactional and historical data, reporting tools for post processing analysis, workflow tools for development of regulatory compliant information sharing applications, collaboration tools for sharing of data and analysis worksheets using Office SharePoint Server 2007.

Microsoft has invested in recruiting, developing, training and integrating a wide range of solutions integrators and software partners to support risk modeling for the insurance industry. For example, many existing resource schedulers such as Digipede Networks, DataSynapse GridServer and Platform LSF/Symphony support the distribution of compute tasks to CCE-based compute nodes. Newly developed applications can leverage the integrated support for computational grids using the .NET Framework supported within tools such as the Digipede Grid Networks. Microsoft's HPC initiative also includes integrated support of mathematical modeling tools such as Matlab, Mathamatica, and Microsoft Office Excel 2007 on a CCS cluster. Most importantly, Microsoft has encouraged support for CCS as a production platform for the industry leading actuarial modeling packages such as MG-ALFA, MoSes and Prophet.

The competitive and regulatory pressures of the insurance industry are driving increased complexity, requiring more sophisticated actuarial tools. Computational clusters represent a key technology to meet this increasing pressure. Microsoft has invested in the products required to implement computational clusters in a cost-effective manner using existing staff and operational monitoring software. Microsoft HPC technologies ensure the implementation of these capabilities will occur in the shortest possible time.

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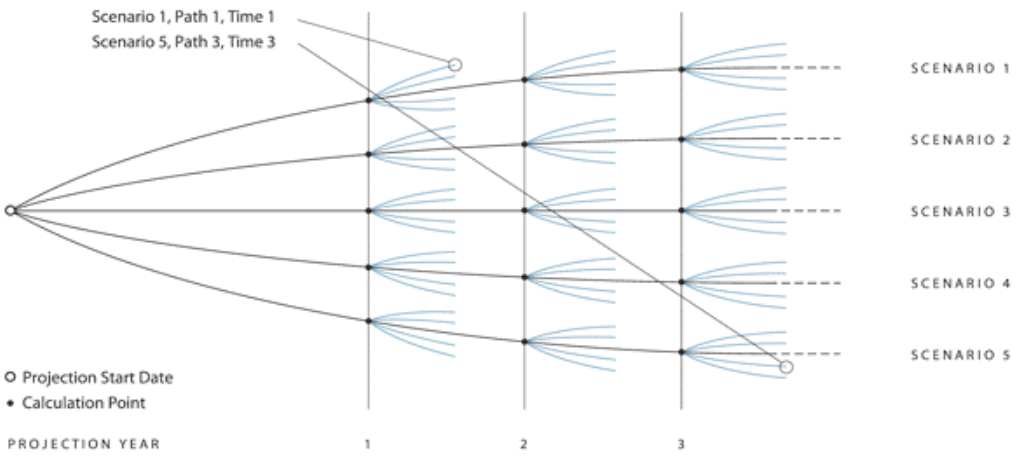
Nested Stochastic Modeling

"Nested" stochastic models, as the name implies, are stochastic models inside of other stochastic models. They are not explicitly part of the principle-based reserve method, but since the setting of reserves and capital will be based on stochastic valuation, earnings projections will require stochastic projections at each future projection data, across all scenarios. This means that nested stochastic models are needed to appropriately manage the business, price new products, project earnings, or measure risk. These models are not for the technologically challenged—a 1,000 scenario model with reserves and capital based on 1,000 paths at each valuation point for a 30-year monthly projection requires the cash flows for each policy to be projected 360 million times. Layer on top of this the desire to look at the implications of stochastic mortality or credit and we have introduced additional nested loops into the projections.

The ability to run these types of projections and analyze the resulting information will require significant changes in the hardware and software infrastructure at most companies. Ultimately, a solution for many of these challenges will involve grid computing (linking many PCs together under common control). Some companies are already running stochastic and nested stochastic projections on grids with as many as 1,500 PCs.

Nested Stochastic Modeling



Effective Data Governance Strategies for Actuaries

Tim Pauza

Editor's note: The following is an excerpt from a report by Ernst & Young LLP, and is reprinted with their permission. An Ernst & Young Actuarial TransformationTM Roundtable discussion, held in New York in August of 2007, was attended by close to 20 actuarial and IT executives from major insurance companies in the United States. Joining several Ernst & Young facilitators were two insurance company executives: Paula Hodges (past technology section chair and current friend to the council) from Allstate Financial, and Eric Lin from Prudential Financial. For a complete reprint of this article or information about the Ernst & Young Actuarial Transformation Roundtable series, please contact Steve Goren (steve.goren@ey.com), or visit the Ernst & Young Insurance and Actuarial Advisory Services Web site (www.ey.com/us/actuarial).

At most insurance companies today—and actuarial departments are no exception—high-quality, timely financial reporting is a top-level problem. Discussions about how to report and analyze financial results, as well as how to forecast, lead to conversations about company processes that underlie difficulties in valuation systems and data management. Data quality and data management are common concerns throughout these discussions and are often the Achilles heel of high-quality financial and management reporting.

Behind such practices as data assessment, validation and certification, reporting and management of metadata, there are day-to-day horror stories about poor data quality and insufficient and slow data integration in actuarial and financial reporting processes. At many companies, there is still debate about who should be in charge of the financial and actuarial data, how to avoid duplicate versions of them, where they should be kept, how they should be accessed and so forth.

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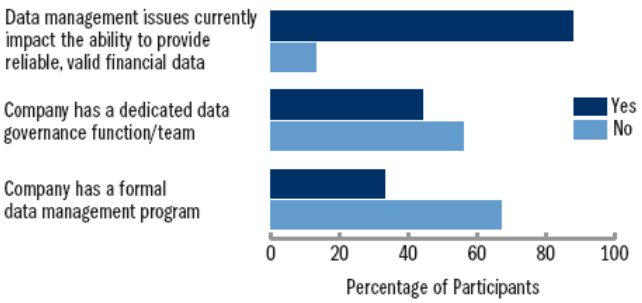
Figure 1. Roundtable Participant Views – Basic Data Management Issues Today



At the Roundtable, it was clear that data governance was on everyone's mind. In fact, 88 percent of attendees felt data management issues negatively impacted their ability to provide reliable financial data. But yet over half—56 percent—said they did not have a dedicated data governance functional team in place. And 67 percent said they had no data management program in place at all. These results point to why data governance and data management remain significant insurance industry and actuarial department issues.

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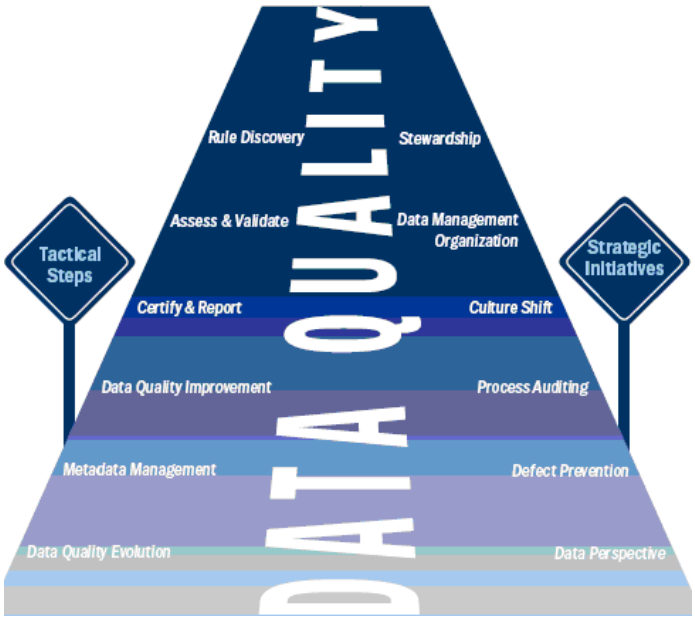
Data Governance: Tactical and Strategic Views

A fair question asked by insurance industry leaders is why data governance is still such a big and nagging issue. The simplest answer is that over decades of growth—through consolidations and constant product innovations, new demands on financial analysis and reporting, and diversification into new distribution channels—policy administration and actuarial technologies have become quite complex. This creates challenges related to the integration of disparate data, how to prepare them for input into the various valuation and modeling engines and how to report and analyze results.

Figure 2. Data Governance Path for Improved Data Quality



Data management becomes complicated fast, and the case for an overall, integrated approach to data governance becomes stronger as companies come to recognize that quick fixes and end-user computing solutions that have worked in the past are no longer sustainable.

There are problems with data governance with which company management must contend because they impact a company's decision-making, valuation calculations and financial reporting:

- Companies have vast quantities and types of data.
- Each system that provides data can have different rule sets and different data definitions.
- There are questions about which organizational or administrative structures within the company actually "own" the data—stewardship of the data is important.
- How are the data best maintained? How should the data be brought together and integrated to make them most useful? How should data be stored and at what level of granularity? How should the data be made available to the people who need it?

Raw data are used in many different applications; therefore, the data are put into many formats. This leads to situations in which the same raw data are reformatted and presented to different users for different purposes. So it is critical to have clearly defined data standards and rule sets that can streamline and keep the multiple versions of the data better organized.

One of the keys to an effective data governance strategy is a strong metadata component. Metadata are the data about the data—the complete set of data definitions as well as the technical information about the data, how they are formatted where and when they were obtained. Metadata repre-

sent an entire, additional layer of data that need to be stored and managed. Actuarial input to metadata management is critical. How the required data that are input to the actuarial process are created, what they mean, and how they will be used, how the calculations and assumptions are defined—all add to improved data quality. This business perspective on data usage is an area of best practice in data governance that offers help to companies in their struggle to obtain control of their data.

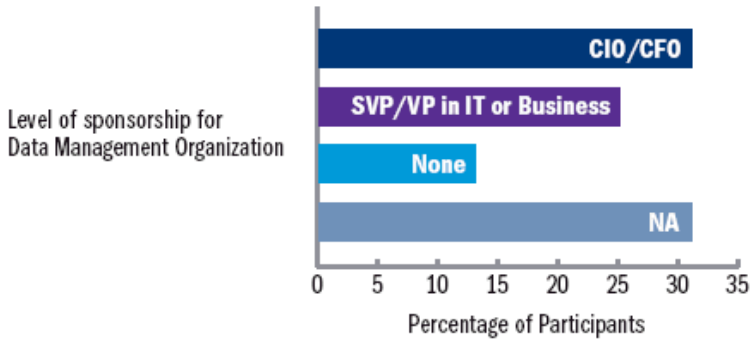
Companies are also paying closer attention to the assumptions they need to make when performing valuation and modeling processes. Almost 90 percent of the people at the Roundtable thought the assumptions they used in their actuarial models constituted data that should be managed in the same manner as the raw data from their policy administration systems.

A company's data archival process and data storage are also critical because they are integrally related to version control. Company users must be able to go back into historical time periods and review what data and assumptions were used for financial and product performance in the past.

Data Governance Organization Structure

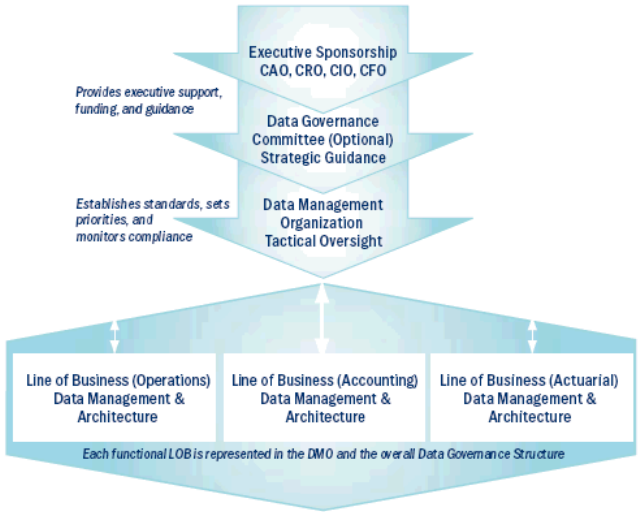
To address the issues and increasing needs of users of data, many companies are working to evolve organizational structures and approaches for effective governance of mission critical data. It was clear from Roundtable participants that "sponsorship" or ownership of data varies broadly—from the chief investment officer, to the chief financial officer, to IT executives in the business units, to no specific ownership at all.

Figure 3. Roundtable Participant Views — Data Governance Organizational Issues



Between the corporate C-Suite and business-line operations, some companies are establishing a dedicated Data Management Organization (DMO). The DMO is guided by the C-Suite and, in some cases, an executive-level data governance committee.

Figure 4. Data Governance Organization Structure



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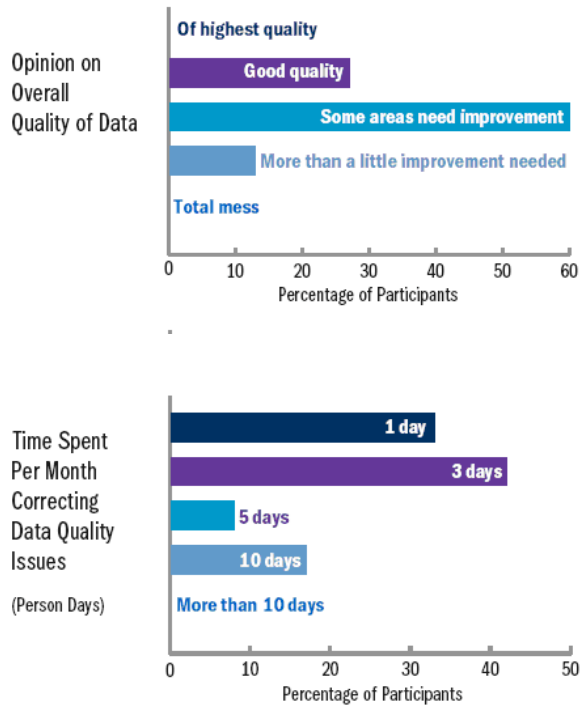
The DMO serves as the center of collaboration with the lines of business—specifically, the operations, accounting, IT and actuarial people in those lines of business as well as with corporate functional areas. The responsibility of the DMO is to establish the standards and rules for managing data, maintaining legacy data and handling incoming data from new products or systems. Ideally, the DMO becomes the conduit across all organizations that use the data and that are involved in developing the rules and strategies for managing the data.

Figure 5. Roundtable Participant Views—Data Quality



A requisite for any effective organizational approach is executive sponsorship and governance that support having a single, trusted source for financial and actuarial data. In addition, companies must also engineer a culture shift. They need everyone to believe data governance and data quality are key corporate priorities and will pay back dividends in terms of lower cycle times, lower total cost of ownership, and higher-quality actuarial analysis and financial reporting.

Data Quality

Not surprisingly, quality of data was a topic of spirited dialogue at the Roundtable, with 60 percent of attendees saying their company data need at least some improvement and all attendees saying their actuarial team spends at least some time each month correcting data quality issues.

There is a strong argument that the biggest issue of poor data quality has everything to do with increased risk. Wrong data or bad data translate into:

- Inaccurate numbers on financial statements.
- Bad business decisions.
- Missed deadlines and budget overruns.
- Time spent fixing data.

Fundamentally, management cannot depend on bad data when operating the business.

Figure 6. Common Data Quality Problems

Definitions and Standards
- Ambiguous Business Rules
- Multiple Formats for Same Data Elements
- Different Meanings for the Same Code Value
- Multiple Code Values with the Same Meaning
- Field Used for Unintended Data

Data Content
- Missing Data
- Invalid Data
- Data outside Legal Domain
- Illogical Combinations of Data
- Rogue Data

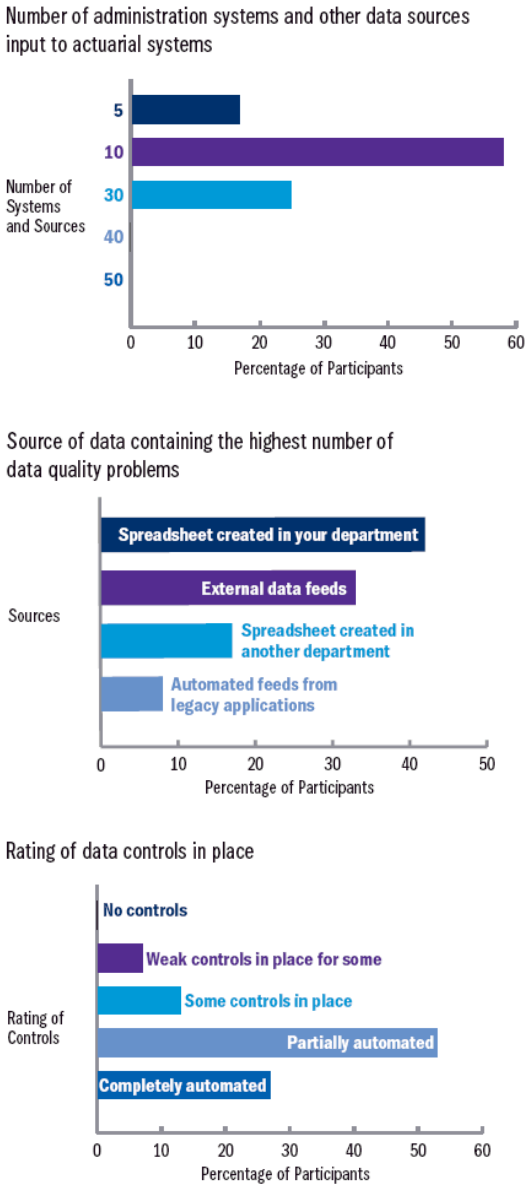
Migration/ Integration
- Rationalization Anomalies
- Duplicate or Lost Data

Roundtable participants shared the most common data quality problems and provided personal horror stories about many of them. They also recognized many of the same root causes of the problems, including:

- Multiple policy administration systems and other data sources that are entered into multiple valuation, modeling, hedging and other actuarial systems.
- Excessive use of spreadsheets and other end-user computing tools.
- Only partially automated or weak controls over the data.

As many companies are learning, effective data governance is not a project—it is a permanent process and way of doing business. It requires strategic thinking, consistent and disciplined practices, well-thought-through training, continuous testing and continuous assessment and scoring of data accuracy to ensure a single version of the truth.

Figure 7. Roundtable Participant Views—Causes of Data Quality Problems



Sustaining and improving this process over time are possible only through mutual cooperation and support among the producers, managers and consumers of the data. Over time, this broad collaboration becomes ingrained in the company culture and is

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reflected at all levels—from the C-Suite to the business units.

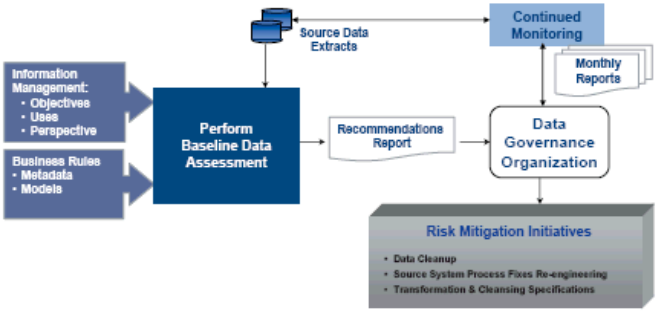
Of limited value are efforts that come and go, become short-term fire drills, and then disappear until the next "data crisis." Instead, companies need to work on building the appropriate financial and actuarial data repositories, adopting clear metadata rules and using industry-standard business intelligence tools. This commitment and discipline will help ensure high quality actuarial valuation, analysis, risk management and modeling processes and results.

Spreadsheets: Use and Management in Actuarial Environments

Sarbanes-Oxley (SOX) Section 404 work has shown that spreadsheet and Access database use is out of control in actuarial departments.

Many companies say they use hundreds of spreadsheets within a single business unit to complete the quarterly close. Controlling and updating hundreds of spreadsheets can lead to situations in which valuation actuaries spend most of their time manipulating data and calculating reserves rather than analyzing and explaining results.

Figure 8. Data Quality Improvement Program – Assess, Improve, Monitor



Spreadsheets are and will most likely continue to be used by financial reporting actuaries for some purposes, such as:

- Direct calculation of selected financial statement amounts.
- Validation of system calculations.
- Limited top-side adjustments to values that are typically calculated in production or automated processes.
- Ad hoc analysis.

However, the industry has developed a "culture" of spreadsheets in actuarial departments that is not responsive to business needs, nor will it accommodate the introduction of future reporting requirements associated with fair value, principle-based reserves and capital, Solvency II and International Financial Reporting Standards. Spreadsheets offer the benefits of flexibility and transparency, and they are easy to create and customize to specific needs. On the downside, spreadsheets are arguably too flexible and difficult to control in a sustainable and efficient manner in a SOX 404 or Model Audit Rule environment. Most significant is that spreadsheets are not conducive to moving into full production mode.

With those downsides, companies are setting informal goals to significantly reduce their use of spreadsheets in actuarial valuation and modeling areas. Many Roundtable participants indicated a desire to reduce spreadsheet use by 90 percent. And even though Access databases allow actuarial end-users to manipulate data easily, they too have downsides.

Conclusion: Improving Data Governance for Stronger Financial Reporting and Business Decisions

Two emphatic conclusions resulted from this Ernst & Young Actuarial Transformation Roundtable. First, companies will not succeed over time without effective actuarial valuation, decision support, modeling and risk management capabilities, especially if the demands on actuarial processes continue to increase. Improved data management is the lynchpin to transformational improvements to these actuarial processes.

Second, effective data management and governance require a collaborative and executive-sponsored organizational commitment and appropriate use of finance and actuarial data repositories and data management tools.

The cultural implications and impending global reporting considerations demand a sense of urgency—one that, in the end, will serve to raise credibility and transparency for actuaries and lead to better decisions and stronger reporting for insurers in the changing environment.

Summary of Key Points

Effective data governance is not a project—it is a permanent process and way of doing business, requiring consistent and disciplined practices, well-thought-through training, continuous testing and continuous assessment and scoring of data accuracy.

Many companies are evolving organizational structures and approaches for effective data governance, including dedicated Data Management Organizations (DMOs) that actively collaborate with the actuarial department.

More than half of the Roundtable participants (56 percent) do not have a dedicated data governance functional team in place; 67 percent have no data management program in place.

The biggest issue of poor data quality is increased risk.

Metadata (data about the data) management is an emerging area of best practice in data governance, offering promise to companies in their struggle to gain control of their data.

Actuarial departments are seeking to automate processes and improve their analysis and controls; they are making better use of data repositories and setting informal goals to reduce significantly their use of spreadsheets in actuarial valuation and modeling areas.

Effectively Mitigating Spreadsheet Risk in Insurance

by Eric Perry

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The power and flexibility of Microsoft Office Excel have made it the ubiquitous analysis tool of choice for insurance companies in determining premiums and the risk value of clients. Complex spreadsheet models are often developed by actuaries and then run thousands of times to determine risk under thousands of scenarios for each insurance policy. According to a 2006 study led by Louise Pryor, a well known actuarial consultant, 732 respondents across the global insurance market concluded that: "Excel appears to be almost universally used, with 98 percent of all respondents saying they use it."

However, despite their ubiquity, stand alone spreadsheets have proven difficult to control. They are often stored on employee desktops and corporate file shares; an uncontrolled environment that is absent many of the IT controls expected from enterprise class software. In addition, the complexity of actuarial spreadsheets makes them error prone. Even one small mistake in an actuarial spreadsheet model—incorrect input data, a formula error, a bug in a macro, or a false assumption—can produce the wrong results and eventually affect an entire business.

Compliance Mandates and Auditor Guidance

In addition, actuarial spreadsheet models have to comply with ever-changing regulatory mandates such as FAIS, ERISA, PBGC, FAS 87, FAS 106/158, and IAS 19. Leading tax and audit firms have begun to scrutinize the use and dependency on actuarial spreadsheets, and are recommending the application of spreadsheet controls to help insurance firms effectively mitigate risk and improve compliance.

Establishing Effective Spreadsheet Controls

Applying a lifecycle approach to establishing spreadsheet controls has proven to be effective while satisfying the latest guidance from leading tax and audit firms.

First, organizations should discover and inventory all critical actuarial (and financial) spreadsheets across all corporate data sources, including corporate file shares, employee desktops, and document repositories.

Second, assess each spreadsheet for risk, complexity and impact on key financial account balances.

Next, remediate all critical spreadsheets to correct errors, apply best practices, and improve performance.

Then, establish a controlled environment to manage critical spreadsheets that incorporate key IT controls recommended by auditors, including: version control, access control, change control, documentation, input control, security and data integrity, documenta-

tion, backup and archival, software development lifecycle, logic inspection, segregation of duties/roles/procedures, and overall analytics. In most cases, a controlled environment should be established with appropriate spreadsheet management software.

Finally, automate the controlled environment and monitor the process from end-to-end. For example, review and approval of critical spreadsheets can be automated via workflow, proactive alerts can be sent to users about key spreadsheet changes to formulas and macros, and management reports can be sent via e-mail to highlight potential risk and compliance gaps. Management reports can include a review of user access levels to critical spreadsheets, approval status, or cell level change reports.

Driving Business Value

By managing critical actuarial spreadsheets like enterprise software applications, insurance firms can improve visibility and control, improve compliance with regulatory mandates, mitigate the risk of errors, and improve productivity for actuaries. Leveraging the new emerging breed of enterprise spreadsheet management software tools and applications can be a catalyst to helping firms accomplish these goals by automating the spreadsheet risk and compliance management lifecycle.

Prodiance provides spreadsheet governance software and is the winner of the Microsoft 2007 Innovator of the Year award. Further information can be found at *www.prodiance.com.*

The Actuary in an Information Technology World—Planning for Project Success

Stewart Shay

Stewart Shay is senior business analyst with Coss Development Corp. He can be contacted at stewarts@coss.com

As companies move away old desktop and mainframe-based systems, the traditional role of actuary is expanding to supply the insurance knowledge and numerical quality assurance required on these complex projects. The actuary is often a critical stakeholder in any insurance sales or operations support project.

Of the many critical success factors in project management, the capture of precise and correct business rules and requirements is considered the most crucial. Regardless of the Systems Development Lifecycle (SDLC) used, true requirements will emerge and will be far less expensive if found sooner rather than later. Successful projects involving IT will have requirements identified and documented by a Business Analyst (BA) in a formal Business Requirements Document (BRD).

Problems found early in the project life cycle are much less costly to fix. A common rule of thumb is that the project's analysis phase should take 25 percent of the total project's elapsed time to complete but only cost approximately 5 percent of the total project expense. Some studies show that a defect found or avoided early (due to good specifications) can cost 20 times less to fix than one found later in User Acceptance Testing.

For life insurance applications, the gathering of user requirements will normally be communicated to the BA from three sources: sales, operations and the actuary. By contributing to the BRD, providing thorough product specifications, and supporting the QA effort with sound test cases, the actuary can significantly and positively affect the success of any project involving the issue and administration of life insurance products.

Often, when planning a project, the actuary's time is glossed over and possibly not even included at all. However, the actuary often becomes a key consultant to the project manager. The actual time spent by the actuary in support of the project may ultimately equal the project manager's (or business analyst's) effort, which typically amounts to 5- to 10-percent of the overall project.

Depending on the corporate culture and the SDLC used, project managers should consider and include time for actuarial resources for the following activities:

Initiation Phase:

- The actuary may be asked to provide input for a cost/benefit analysis to evaluate whether or not it is worthwhile to take on the project from a financial standpoint.

Analysis Phase:

- The actuary is the owner and producer of the insurance product specifications.
- The actuary is a consultant to business analysts who develop the Business Requirements Document.
- The actuary is a provider of test case scenarios and expected results to be used in the QA process for checking illustrations (new business and reproposals), gross premium and month-i-versary calcula-

tions on non-traditional products, policy cost disclosures, policy annual reports, and 7702/7702a tax calculations.
- The actuary is a consultant and quality assurer on specifications for policy conversions.

Design and Coding Phases:
- The actuary is a consultant for specifications on change requests found after the initial Business Requirements Document is completed.
- The actuary is involved in any negotiations to alter product specifications to fit into an existing system's infrastructure. This involves a tradeoff between saving money by reusing existing technology versus adding new functionality that requires new technology.

Quality Assurance Phase (User Acceptance Testing):
- The actuary is a primary stakeholder in assuring that the new business illustration and administration systems match. This usually involves the reconciliation of the new system's calculations (e.g., policy values, tax premiums, etc.) against an existing legacy system or a trusted spreadsheet.

Implementation Phase:
- Exception handling—while we'd like to think that any new system handles everything thrown its way, oftentimes there is some functionality that does not make it to the first phase of introduction. In such cases, going live means being able to handle some functions outside of the system manually. Actuaries may be involved in planning who, what, when, where and how such processes are to be handled until sufficient automation arrives.

Post-Implementation:
- As a stakeholder of the project, the actuary will be asked to contribute to lessons learned sessions designed to improve future project implementations.
- A systems project that has multiple phases will require a repeat of some of the tasks mentioned above.

Whether a company is large or small, all of these activities should be considered in the project planning phase to ensure actuarial resources are allocated appropriately and are available when needed. For many life insurance IT projects, the actuary is just as key a stakeholder as any other member of the project team and his/her participation should not be overlooked.

Calculation of Generalized IRR in Excel

by Tim Rozar

Decisions about whether to proceed with a project or new product often come down to analyzing the rate of return on the project. Normally, this is a straightforward exercise involving an initial investment which is repaid over time with a stream of future positive cashflows. The discount rate that leads to a zero present value is the rate of return from the project. The calculation of this Internal Rate of Return (IRR) actually involves some tricky mathematics or the implementation of iterative numerical methods. Luckily, technology has provided tools on our desktop to easily perform this analysis. Microsoft Excel provides the IRR function, which will solve for the rate of return for a series of periodic cashflows. The basic function takes two arguments: a range of cash flows, and an initial guess. For example, assume the following investment opportunity:

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Table 1
Life Insurance Products and Finance, Atkinson & Dallas, 2000 Example 11.6.1

	C	D	E
	t	Profit(t)	NPV(t-1) at 5%
5	1	-1000	0
6	2	50	1050
7	3	50	1050
8	4	1050	1050
IRR = 5%			
In Excel: IRR(D5:D8,0.1) = 5.00%			

Unfortunately, the analysis is not always so simple. Sometimes an investment opportunity involves cumulative negative cashflows in the future. In the case where there are multiple sign changes in the projected cumulative cash flow stream, there will also exist a multiple number of real roots (IRR's) that will force the present value of the investment to zero. In such a situation, accumulated negative future cashflows may be viewed as amounts which will require additional financing beyond the returns supplied by the project.

Atkinson & Dallas suggest the Generalized ROI approach for this analysis. This approach was initially outlined by David Becker in "A Generalized Profits Released Model for the Measurement of Return on Investment for Life Insurance," (TSA 1988 Volume 40 part1 *http://www.soa.org/library/research/transactions-of-society-of-actuaries/1988/january/tsa88v40pt15.pdf)* and is therefore often referred to as the Becker IRR. Starting with the final cash flow and working backwards, a present value is calculated using the IRR as the discount rate when the present value at that duration is positive and a rate of borrowing as the discount rate when the present value is negative.

The following examples illustrate this situation:

Table 2
Life Insurance Products and Finance, Atkinson & Dallas, 2000
Example 11.6.4

	C	D	E	F	G
	T	Profit(t)	PV(t-1) if PV(t) <0 (at 7%)	PV(t-1) if PV(t) >0 (at 6.8324%)	PV(t-1)
16	1	-45		0.000	0.000
17	2	140	48.075		48.075
18	3	-55	-98.360		-98.360
19	4	-140		-46.395	-46.395
20	5	100			100.000
Traditional IRR = 11.11% or 100% (or 0%)					
In Excel: IRR(D16:D20,0.1) = 11.11% IRR(D16:D20,0.5) = 100.00%					
Generalized (Becker) IRR at 7% financing rate = 6.8324%					

Table 3
TSA 1988 Vol. 40 part1, Becker, 1988 Table 14

	C	D	E	F	G
	t	Profit(t)	PV(t-1) if PV(t) <0 (at 7%)	PV(t-1) if PV(t) >0 (at 26.271%)	PV(t-1)
30	1	50	0.000		0.000
31	2	-200		-53.500	-53.500
32	3	20		184.987	184.987
33	4	40		208.331	208.331
34	5	200		212.553	212.553
35	6	100	15.850		15.850
36	7	-70	-90.040		-90.040
37	8	-100		-21.443	-21.443
38	9	20		99.195	99.195
39	10	100			100.000
Traditional IRR = 32.61% or 275.34%					
In Excel: IRR(D30:D39,0.1) = 32.61% IRR(D30:D39,2) = 275.34%					
Generalized (Becker) IRR at 7% financing rate = 26.271%					

(continued on page 20)

The generalized or Becker IRR can be incorporated into Excel by setting up the generalized present values with IF() statements and goal-seeking for an IRR to set the present value to zero. To my knowledge, there is not an elegant way to directly calculate this metric from the cashflow stream as there is with the simple IRR(). To that end, I have developed a custom Excel VB function that will allow you to incorporate Becker IRR calculations into your spreadsheets. An important caveat should be observed, however: I'm an actuary—not a programmer. As such, the following code is undoubtedly inelegant. I encourage anyone who has developed more elegant methods for dealing with the multiple root situation in Excel to forward their suggestions to build upon this article.

The formula is set up in two steps. The BeckerOBT function calculates the Outstanding Balance (using Mr. Becker's terminology) accumulated based on either IRR borrowing rate. The BeckerIRR function then performs an iterative binary search to calculate the Generalized IRR.

The parameters needed for implementation of the BeckerIRR function are as follows:

1) EarningsRange: This is the Excel range that contains the cashflows being analyzed.
2) IntDisc: This is the discount rate to be used for financing negative cumulative cash flows.
3) BeckerIRRGuess: This is the starting point guess for the iterative search.
4) ToDecimals: This is the number of decimal places of precision for the Becker IRR result.

The code for these two functions is shown at the end of this article. A sample workbook with this function and the examples above can be e-mailed to you if you contact the editor (*Howard@Callif.org*).

This code can be inserted into each workbook that it is to be used in or it can be referenced from a personal macro workbook. To insert the code into your existing spreadsheet, choose Tools|Macro|Visual Basic Editor. From there, you may insert a new visual basic module by choosing Insert|Module. The following text can be copied and pasted into this new module.

Returning to the examples in Tables 2 and 3 above, we can now use the BeckerIRR function to directly calculate the generalized IRRs:

- Table 2: BeckerIRR(D16:D20,0.07,0.1,6) = 6.8324 percent

- Table 3: BeckerIRR(D30:D39,0.07,0.1,6) = 26.271 percent

A few notes should be observed before utilizing this function:

- Your Excel workbook will need to have macros enabled in order to use this function. This means that macro security (Tools|Macro|Security) must be set no higher than "Medium" and that macros must be enabled when prompted upon opening a worksheet using this function.
- As with all custom functions, use of this function will undoubtedly slow down calculation speed in your spreadsheet. You may wish to "comment out" the function when you don't need to refer to it.
- You may wish to reference the function from a personal macro workbook as personal.xls!BeckerIRR(). This will avoid the need to add the function to each workbook, but will make the file less portable to other users.

```
Function BeckerIRR(EarningsRange As Range, IntDisc As Double, BeckerIRRGuess
As Double, ToDecimals As Integer)
    Application.Volatile

    Dim myRange As Range
    Dim IRRa#, IRRb#, Precision#, BeckerIRRTemp#, OBt#, InitIncrement#
    Dim MaxIter%: MaxIter = 50
    Dim i%: i = 0
    InitIncrement = 0.05
    Dim ErrMsg$: ErrMsg = "Max Iter"

    BeckerIRRTemp = BeckerIRRGuess
    Precision = 10 ^ (-ToDecimals)

    OBt = BeckerOBt(EarningsRange, IntDisc, BeckerIRRGuess)

      If OBt < 0 Then
          IRRa = BeckerIRRGuess
          IRRb = IRRa
          i = 0
          Do While OBt < 0 And i < MaxIter
              IRRb = IRRb - InitIncrement
              OBt = BeckerOBt(EarningsRange, IntDisc, IRRb)
              i = i + 1
          Loop
          If i = MaxIter Then
              BeckerIRR = ErrMsg
              Exit Function
          End If
       ElseIf OBt > 0 Then
          IRRb = BeckerIRRGuess
          IRRa = IRRb
          i = 0
          Do While OBt > 0 And i < MaxIter
              IRRa = IRRa + InitIncrement
              OBt = BeckerOBt(EarningsRange, IntDisc, IRRa)
              i = i + 1
          Loop
          If i = MaxIter Then
              BeckerIRR = ErrMsg
              Exit Function
          End If
       End If
```

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```
        i = 0
        Do While Abs(IRRa - IRRb) > Precision And i < MaxIter
            BeckerIRRTemp = (IRRa + IRRb) / 2
            OBt = BeckerOBt(EarningsRange, IntDisc, BeckerIRRTemp)
            If OBt < 0 Then
                IRRa = BeckerIRRTemp
            Else
                IRRb = BeckerIRRTemp
            End If
            i = i + 1
        Loop
            If i = MaxIter Then
                BeckerIRR = ErrMsg
                Exit Function
            End If

    BeckerIRR = BeckerIRRTemp

End Function
```

Function BeckerOBt(ParamEarningsRange As Range, ParamDiscRate As Double, ParamBeckerIRR As Double)

```
    Dim myRange As Range
    Dim OBt#: OBt = 0
    Dim i%

    For Each myRange In ParamEarningsRange
        If OBt < 0 Then
            OBt = OBt * (1 + ParamBeckerIRR) + myRange.Value
        Else
            OBt = OBt * (1 + ParamDiscRate) + myRange.Value
        End If
    Next myRange

    BeckerOBt = OBt
End Function
```

Standard File Format for Economic Scenarios to be Exposed for Comment

by Steve Strommen

The times they are a'changing. Years ago no one would have dreamed of offering all the guaranteed living benefits on variable life and annuity products that are available in today's marketplace. And who could have guessed that a mark-to-market model for public accounting might soon replace GAAP? These and other revolutionary changes in the insurance marketplace are placing greater emphasis on the use of stochastically generated economic scenarios for use in product pricing, financial reporting and risk management.

Financial models, implemented in software, are essential tools for the actuary in dealing with the new world, but as yet there are few standards regarding those tools. In terms of standards development, we are still in the days before the U.S. revolutionary war, when all rifle parts were made by hand.

Your Technology Section has recognized the potential benefits of standardization in this area and has assembled a team of volunteers working towards a standard approach to encoding economic scenario data. The hope is that collections of stochastically generated economic scenarios will someday be exchanged as easily as the MP3 files that are already the ubiquitous medium for digital music. Actuaries should not need to deal with the details of formatting scenario information for consumption by their computer models, and widespread adoption of a standard file format can free them from such drudgery.

After over a year's work, the project team has developed a prototype file specification, a definition for a software interface, and an implementation of that interface for exposure to the membership. This article discusses the goals that were set for that work and provides an overview of the results so far.

Specific goals for the standard scenario file format project are:

1) **Platform neutrality**—reflecting a need to work with any operating system, including Windows, Mac, Linux, or various mainframes or minicomputers.
2) **Comprehensiveness**—reflecting a need to contain most of the commonly occurring components of economic scenarios used in actuaries' practice areas, including insurance, investments, employee benefits, as well as maintaining a global perspective and allowing for currency exchange rates and economic conditions that vary by country.
3) **Extendibility**—as forecasting techniques incorporate additional types of models, the standard should not need to be completely reworked; further, software that uses the data in standard-adherent instances should be minimally affected by changes to the standard.
4) **Readability**—facilitating testing as well as examination by actuaries, data which maximizes understanding through visual inspection is desired.
5) **Simplicity of processing**—the standard will be more easily and happily accepted if software modules required to access data are readily available and have an intuitive interface.

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The choices considered for the file format include a new XML dialect, a proprietary binary format, and alternative textual formats. The team has chosen to use XML because it satisfies the list of goals better than the alternatives. XML has other properties useful and relevant to the representation of multiple economic scenarios. It is inherently hierarchical; it facilitates creation of self-documenting products, it allows vector-like structures for data that repeat by calendar month and year, and when necessary, it can be designed to be insensitive to ordering of data. As a text-based format, XML is also inherently readable.

The team has chosen to give the newly-invented dialect of XML a name: ESML, for Economic Scenario Markup Language.

The team has chosen to give the newly-invented dialect of XML a name: ESML, for Economic Scenario Markup Language. A full definition of ESML is beyond the scope of this article. A special addition to the Technology section Web site is being prepared to introduce ESML and provide complete documentation and a set of tools for working with ESML. The tools will include a library of routines callable from Excel VBA, and a sample application (scenario generator) built in Excel VBA. During 2008, all of this material will be in the nature of an exposure draft, and your comments and suggestions will be sought. By the annual SOA meeting a final version might be ready.

The remainder of this article describes three of the most interesting aspects of ESML. These are: 1) the kinds of information that can be included in the file, 2) dealing with potentially huge files, and 3) an approach for storage of yield curves.

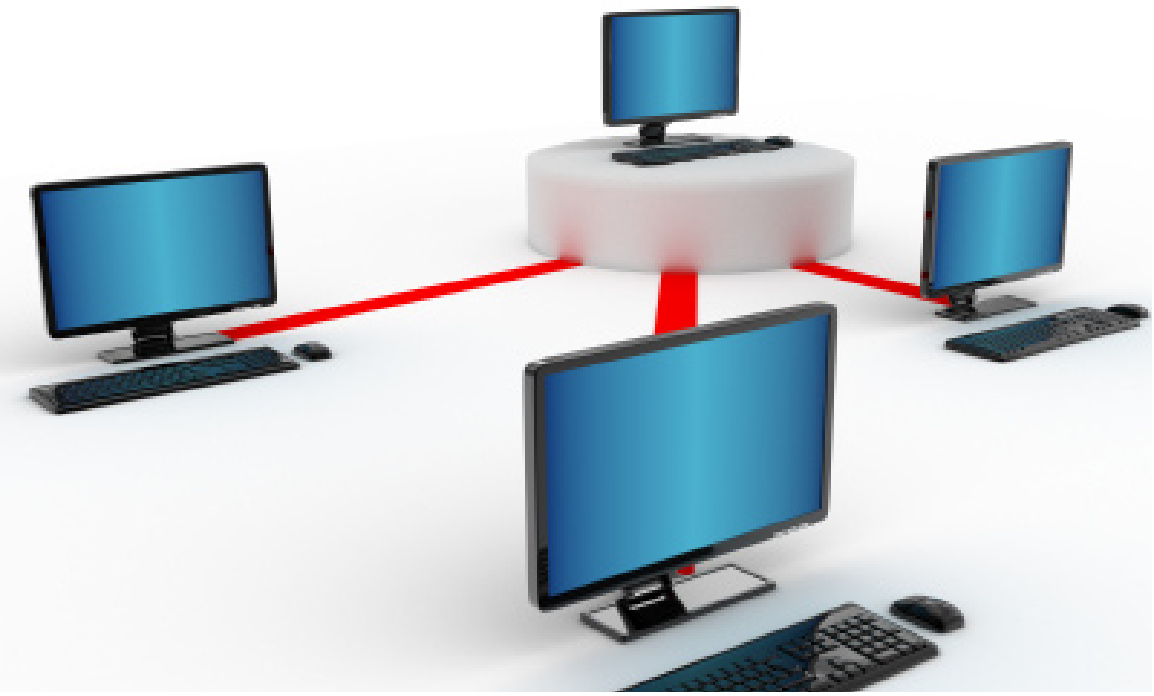
The kinds of information included in ESML

ESML documents contain two main sections: 1) information about the list of scenarios, and 2) the list of scenarios.

The first section of the file (containing information about the list of scenarios) contains items such as the name of the person creating the file, the generator used, any seed value for a random number generator, and a date and time of creation. Also, free-form text comments can be included to describe the intended purpose of the file or document anything special about its creation, such as parameter values used in the generator.

The second section of the file (containing the list of scenarios) contains as much as the generator puts in it. This can include, for any country on any date, any or all of the following:

- Several yield curves varying by credit quality.
- Investment returns for various kinds of equity investments or managed portfolios.
- Currency exchange rates.
- Other economic indexes or rates such as those for inflation, unemployment, GDP growth, and so on. One can include any index or rate by specifying a name for it and giving it a value.



A list of the kinds of information included for each country and date (as well as the list of countries) is included in the first section of the file as part of its descriptive information about the scenarios. Note that ESML uses ISO standards when appropriate for things like the exact spelling of codes for countries and currencies.

Dealing with large files

Collections of economic scenarios can be very large files. This can pose problems due to limitations on the amount of memory available. If the entire collection is not stored in memory, there is still a need to enable fast access to any individual scenario.

The ESML standard deals with this by associating a second index file with the XML file containing the scenario data. The index file contains the offset in bytes from the beginning of the scenario file where each scenario's data begins. The information in the index file can be used to allow software to keep as little as one scenario in memory at a time while still maintaining fast access to any scenario in the collection.

Efficient storage of yield curves

Yield curves have complex shapes, and a large amount of data can be required to fully describe a yield curve. Note that there are three fundamental representations of each yield curve: as forward rates, as spot rates, or as bond coupon rates. Any of those three curves can be converted to any other using software. However, one curve alone can involve 360 values if monthly maturities from one month to 30 years are used to define the curve.

Storing every point on the curve is just one way to store a yield curve. For some applica-

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tions, that degree of accuracy is not needed, and fewer points might be stored, with some sort of interpolation being used between points. And for some applications, a formulaic or parametric description of the yield curve might be best.

ESML allows yield curves to be stored in any of these ways. This is accomplished by requiring each yield curve to be associated with a factory name and a set of stored values, each with its own name and value. The factory name is really the name of the algorithm used to reconstruct the full yield curve from the set of named values that are stored. For example, an algorithm that does simple linear interpolation between a few stored points might name each point with its maturity in months and might use a factory name of LinearInterp.

ESML allows any factory name and any names for the stored values representing a yield curve. However, only a handful of factory names will be recognized by any software implementation, and each factory will recognize only specific names for stored values. So as part of the ESML standard, the following factories are defined and should be implemented in any software that claims to implement the standard. (Additional factories might be added during the exposure period).

The BondData yield curve factory

In this factory the stored values are par coupon yields for semi-annual coupon bonds of 0- to 360-months to maturity. A total of 361 values are stored—a complete representation of the bond yield curve.

The string associated with each stored value is dxxx where the xxx represents the number of months to maturity (from 000 to 360).

The string ID for this kind of yield curve factory is BondData.

The Nelson-Siegel yield curve factory

In this factory the stored values are the parameters for a Nelson-Siegel curve that represents the spot rate curve by time to maturity. Each stored value represents a parameter of the curve. The parameters are:

b0 = the ultimate long term rate.
b1 = the excess of the instantaneous short rate over the long term rate (normally negative).
b2 = a parameter governing the size of hump in the yield curve.
k = a parameter governing the location of hump in the yield curve.

The spot rate for t years to maturity is calculated as follows. Of course t can be fractional when calculating yields for a number of months that is not a whole number of years.

spotRate(t) = b0 + (b1+b2/k)*((1-Exp(-k*t))/(k*t)) – (b2/k)*Exp(-k*t)

The string associated with each stored value is the name of the parameter as given above.

The string ID for this kind of yield curve factory is Nelson-Siegel.

The LinearInterp yield curve factory

In this factory the stored values are a small number of points on the bond curve. Each point represents a different number of months to maturity. The remaining points on the bond curve are interpolated or extrapolated linearly. This can lead to a somewhat saw-toothed pattern of spot rates and forward rates, but often that is not viewed as a material problem.

The string associated with each stored value is dxxx where the xxx represents the number of months to maturity (a few values from 000 to 360).

The string ID for this kind of yield curve factory is LinearInterp.

The NSInterp yield curve factory

In this class the stored values are two or three points on the spot curve. Each point represents the spot rate for a different number of months to maturity. The remaining points on the spot curve are interpolated by fitting a Nelson-Siegel curve to the points that are provided.

If the number of stored values is two, then the yield curve has a typical curved shape. The values of parameters b0 and b1 are solved for with the assumption that b2 = 0 and k = 0.5.

If the number of stored values is three, then the values of parameters b1, b2, and b3 are solved for with the assumption that k = 0.5.

The string associated with each stored value is dxxx where the xxx represents the number of months to maturity (a few values from 000 to 360).

The string ID for this kind of yield curve is NSInterp.

Web site exposure on the way

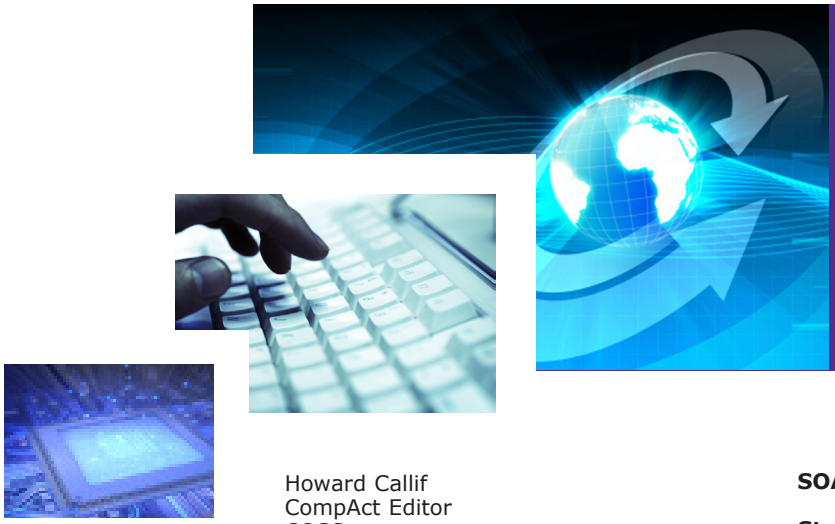
As was mentioned earlier, a new page is being added to the Technology Section Web site to expose ESML work to the membership. Materials to be exposed will include:

1. A document outlining the file format.
2. A sample ESML file.
3. A software implementation of routines to read and write data in ESML, including all of the following:
    a. A Users Guide document.
    b. An online help file that serves as a detailed reference to the API.
    c. A compiled library usable in Windows, NET.
    d. Source code for the library in C#.
    e. A sample Excel VBA application that uses the library to read and write collections of scenarios.

An installation program will be available to facilitate installation of all this material on your PC under Windows. Two additional implementations of the software interface using standard C++ and Java are planned, but will not be initially available.

As was mentioned earlier, a new page is being added to the Technology Section Web site to expose ESML work to the membership.

If you work with stochastic economic scenarios, please take some time to review the ESML proposal and send comments. The Web page will indicate the e-mail address to which comments should be sent.



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