Use of External Data for Operational Risk Management

Joseph Sabatini, Chairman
Simon Wills, Executive Director

Tokyo, 19 March 2008
Agenda

- Overview of ORX
- ORX Data Collection Processes
- The Loss Data
- Data Analytics
- ORX Outlook 2008 and Beyond
Overview of ORX

• Background & History
• ORX Structure
• Membership Profile
• Key Affiliations
Background and History

- ORX is a not-for-profit organization, owned and run by the Members
- ORX was incorporated as a Swiss Association in April 2002
- ORX was founded with the objective of sharing quality operational risk data on a secure and anonymized basis to enable banks to improve risk measurement and management
- ORX also works with its members to:
  - develop operational risk management practice
  - set common standards for the industry
  - develop professional networks
  - conduct leading edge research
Structure

- Board of Directors, Managing Board
  - Sets policy and strategy
  - Provides overall management

- Working Groups
  - Focus on specific topics to advance ORX value
    - Definitions
    - Analytics
    - Quality assurance
    - Operational risk transfer

- General Membership
  - Approves matters affecting ORX Members
  - Elects Board of Directors
### Membership

- ORX currently has 41 Members from 14 different countries.
- Membership has more than tripled since its foundation in 2002 and strong future growth is anticipated.

<table>
<thead>
<tr>
<th>ABN Amro</th>
<th>Cajamar</th>
<th>ING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banco Bilbao Vizcaya Argentaria</td>
<td>Caixa Catalunya</td>
<td>Intesa Sanpaolo</td>
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<td>Banco Pastor</td>
<td>Commerzbank AG</td>
<td>JPMorgan Chase &amp; Co.</td>
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<td>Credit Agricole</td>
<td>Lloyds TSB Bank plc</td>
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<td>Danske Bank A/S</td>
<td>National City</td>
</tr>
<tr>
<td>Banc Sabadell</td>
<td>Deutsche Bank AG</td>
<td>Royal Bank of Canada</td>
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<td>Banco Santander</td>
<td>Dresdner Bank AG</td>
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<td>Bank Austria - Creditanstalt</td>
<td>Erste Bank</td>
<td>Skandinaviska Enskilda Banken AB</td>
</tr>
<tr>
<td>Bank of America</td>
<td>Euroclear Bank</td>
<td>TD Bank Financial Group</td>
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<tr>
<td>Bank of Nova Scotia</td>
<td>Fortis</td>
<td>US Bancorp</td>
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<td>Barclays Bank</td>
<td>Grupo Banesto</td>
<td>Wachovia Corporation</td>
</tr>
<tr>
<td>BMO Financial Group</td>
<td>Hana Bank</td>
<td>Washington Mutual</td>
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<tr>
<td>BNP Paribas</td>
<td>HSBC</td>
<td>WestLB</td>
</tr>
<tr>
<td>Caja Laboral</td>
<td>HBOS plc</td>
<td></td>
</tr>
</tbody>
</table>
Key Affiliations

- ORX leverages its key affiliations to execute its operating model and business objectives
  - RMA: Executive and administrative support
  - PwC Switzerland: Data custodian
  - SAS: Technology and application support
  - IBM Research Lab, Zurich: Data analytics

- ORX is committed to co-operating with other industry bodies in the development of compatible standards and to making ORX standards freely available to all interested parties

- ORX is emerging as an industry utility and standard setter in the field of operational risk
What ORX has Achieved to Date

- Since 2002 ORX has built a significant platform made up of:
  - **Membership**: ORX membership currently stands at 41 institutions; strong pipeline of interest
  - **Data**: ORX Global Loss Database contains 92,000 loss events to a total value of €30 billion and is an unrivalled analytical resource
  - **Knowledge**: ORX has developed 5 years of experience in how and how not to run an operational risk loss data consortium; begun to collaboratively exploit the analytic potential of the ORX data
  - **Brand**: ORX is well known and well respected in the industry and by supervisors
  - **Culture**: highly valued culture of co-operation amongst membership

- The strategy for ORX is based upon the continued development of this platform and then incremental exploitation releasing exponential value
ORX Data Collection Processes

- Data Quality
- Data Requirements
- Data Security
- Data Collection Process
Data Quality

- Ensuring data is of the highest quality is essential to ORX
  - Begins with the process of applicant review and vetting
    - Every new Member is required to participate in an assessment of their ability to supply data of the required quality to ORX
    - Upon application, new Members are asked to formally attest to the quality and completeness of data to be supplied
  - Maintained by requiring that rigorous standards are followed
    - The cornerstone of this effort is the ORX Reporting Standards, developed and maintained by the ORX Definitions Working Group
    - These standards are supplemented by the dialogue within the Working Group and captured in the form of a centralized FAQ resource
  - Assessed via data quality checks built into the ORX Data Cycle process
    - Assures appropriate formatting of data submissions to ORX
    - Tests individual member data submissions against the data patterns regularly observed in the aggregate ORX loss database
    - In cycle tests for form and volatility, out of cycle tests for systemic trends and completeness
Data Requirements

- Members are required to submit data in a common format
- Members are required to report all losses over €20,000. Each loss is then characterized according to the following primary attributes:
  - Reference ID number (Member generated)
  - Business Line (Level 2) Code
  - Event Category (Level 2) Code
  - Country (ISO Code)
  - Date of Occurrence
  - Date of Discovery
  - Date of Recognition
  - Credit-related
  - Gross Loss Amount
  - Direct Recovery
  - Indirect Recovery
  - Related event Ref ID
- Members required to report Gross Income per Business Line (Level 2)
- The Definitions Working Group is currently developing categorizations for Product type and Process type. It is also considering plans to produce a categorization for Cause and expand the scaling data collected to include expenses and assets
- ORX is very sensitive to the implications of any changes to data specifications or new data requirements. Processes are in place to provide adequate review of and lead time for such changes
Data Security

Data security is critical to the operation of ORX

- Starts with the decision to establish ORX as an association
  - The Articles of Association are the contract between the Members, and between the Members and ORX. The Articles establish that all Members are equal owners of ORX and bound by the same rules and with the same rights; the purpose of the Association and the Associations rights in respect of contributed data, restrictions on the use of member data and member ownership of their own data

- Supported by the design of the ORX operating model
  - ORX has from the outset appointed a trusted Custodian, PwC Switzerland, to process and anonymize member data
  - Only the data Custodian has access to raw member loss data and the primary contractual duty of the Custodian is to protect the confidentiality of the data

- Operated to the highest standards of information security
  - All communications between Members and the Custodian are encrypted via PKI technology, anonymization is based on a separated transition key system and data is stored on a secure, dedicated and non-networked server

- Reviewed annually, where the whole system is subject to both an internal audit and an independent external review
Data Collection Process

- The data collection process is divided into 5 steps to ensure data quality and security.
## ORX System Upgrade in Process

### Available in the Current System
- Periodic loss data submission/collection
- Confidentiality and security of data
- Robust data validation
- Support/segmentation of national databases
- Loss data analysis and reporting (Loss Frequencies, Loss Severities, Benchmark Reports, etc.)
- System management and audit facilities

### Changes and Additions
- Replacement of CD-ROM interchange with online, secure transmission
- Enhanced access to, and analysis of, data on both predetermined and *ad-hoc* bases by various constituencies
- Additional support for database segmentation (e.g., by industry, country, region, etc.)
- Support for product-based offerings (e.g., Sector or National Groups)
- Self-service capabilities (to reduce the time and cost to respond to routine requests)
- Automated interfaces to and from other external sources (e.g., business environment metrics, third-party operational risk software packages)
- Storage and distribution of software tools, including analytics and validation routines
- More efficient processes (for existing members as well as for on-boarding new members)
- Reduction in the Total Cost of Ownership (TCO)
Data Outputs

- Data output varies by member and by service
- Global loss database:
  - Anonymised loss database
  - Global benchmarks and reports
  - Regional and Business Line Benchmarks and Reports e.g. European Retail External Fraud Benchmark
- National and sector database
  - Anonymised loss database
  - National loss benchmarks and reports
  - Intended to vary by data input e.g. loss versus capacity

<table>
<thead>
<tr>
<th>BL Commercial Banking</th>
<th>Total 2002-2005</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005 Q1</th>
<th>2005 Q2</th>
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<td>12.0</td>
<td>14.0</td>
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<td>ORX average</td>
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<td>9.1</td>
<td>7.4</td>
<td>7.6</td>
<td>9.4</td>
<td>8.6</td>
</tr>
</tbody>
</table>

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The Loss Data

- Primary Data Characteristics
- Loss Data Profile
Primary Data Characteristics

The following data fields are collected for each loss event:

➢ Classification
  • Business Line (Level 2) - ORX definition
  • Event Category (Level 2) - ORX definition

➢ Reference data
  • Reference ID number and Related event Reference ID, if relevant
  • Country of occurrence
  • Credit-related event

➢ Dates
  • Date of Occurrence
  • Date of Discovery
  • Date of Recognition

➢ Amounts
  • Gross Loss Amount
  • Direct Recovery
  • Indirect Recovery

Gross Income is captured per Business Line (Level 2) per quarter
Loss Data Profile: Time Trends in Data Capture

Overall ORX Data and Statistics

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Loss Events</td>
<td>92,157</td>
<td>7,838</td>
<td>10,718</td>
<td>14,905</td>
<td>18,150</td>
<td>21,135</td>
<td>19,411</td>
</tr>
<tr>
<td>Total Gross Loss Amount (Millions)</td>
<td>€30,722</td>
<td>€5,272</td>
<td>€7,068</td>
<td>€4,640</td>
<td>€4,760</td>
<td>€4,218</td>
<td>€4,764</td>
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</tbody>
</table>

Loss Frequency 2002-2007

Loss Severity 2002-2007
Ratio of Total Losses to Total Gross Income by Year

Ratio of Total Losses to Total Gross Income by Year

2002 2003 2004 2005 2006 2007
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000

Losses to Gross Income

Ratio of Total Losses and Gross Income by Business Line by Year (Log10)

- Corporate Finance
- Trading & Sales
- Retail Banking
- Commercial Banking
- Clearing
- Agency Services
- Asset Management
- Retail Brokerage
- Private Banking

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Loss Frequency by Event Type and Each Business Line

- Frequency profiles of the loss data have become increasingly stable
- Upcoming additions of product and process hierarchies will make the analysis even more worthwhile

Table 3: Distribution of Number of Losses Across Event Type for Each Business Line

<table>
<thead>
<tr>
<th>KEY</th>
<th>Internal Fraud</th>
<th>External Fraud</th>
<th>Employment Practices and Workplace Safety</th>
<th>Clients, Products and Business Practices</th>
<th>Disasters and Public Safety</th>
<th>Technology and Infrastructure Failures</th>
<th>Execution, Delivery, and Process Management</th>
<th>Malicious Damage</th>
<th>% of Total Number of Losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>0% - 1%</td>
<td>0.02%</td>
<td>0.09%</td>
<td>0.11%</td>
<td>0.24%</td>
<td>0.00%</td>
<td>0.01%</td>
<td>0.22%</td>
<td>0.00%</td>
<td>0.70%</td>
</tr>
<tr>
<td>1% - 5%</td>
<td>0.09%</td>
<td>0.07%</td>
<td>0.33%</td>
<td>0.57%</td>
<td>0.01%</td>
<td>0.51%</td>
<td>8.13%</td>
<td>0.00%</td>
<td>9.72%</td>
</tr>
<tr>
<td>5% - 10%</td>
<td>3.71%</td>
<td>32.55%</td>
<td>7.78%</td>
<td>5.49%</td>
<td>0.66%</td>
<td>1.02%</td>
<td>12.94%</td>
<td>0.09%</td>
<td>64.25%</td>
</tr>
<tr>
<td>&gt; 10%</td>
<td>0.16%</td>
<td>3.07%</td>
<td>0.38%</td>
<td>1.19%</td>
<td>0.03%</td>
<td>0.23%</td>
<td>3.78%</td>
<td>0.00%</td>
<td>8.84%</td>
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</tr>
<tr>
<td>Corporate Finance</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trading and Sales</td>
<td>0.09%</td>
<td>0.07%</td>
<td>0.33%</td>
<td>0.57%</td>
<td>0.01%</td>
<td>0.51%</td>
<td>8.13%</td>
<td>0.00%</td>
<td>9.72%</td>
</tr>
<tr>
<td>Retail Banking</td>
<td>3.71%</td>
<td>32.55%</td>
<td>7.78%</td>
<td>5.49%</td>
<td>0.66%</td>
<td>1.02%</td>
<td>12.94%</td>
<td>0.09%</td>
<td>64.25%</td>
</tr>
<tr>
<td>Commercial Banking</td>
<td>0.16%</td>
<td>3.07%</td>
<td>0.38%</td>
<td>1.19%</td>
<td>0.03%</td>
<td>0.23%</td>
<td>3.78%</td>
<td>0.00%</td>
<td>8.84%</td>
</tr>
<tr>
<td>Clearing</td>
<td>0.04%</td>
<td>0.43%</td>
<td>0.12%</td>
<td>0.07%</td>
<td>0.01%</td>
<td>0.11%</td>
<td>1.44%</td>
<td>0.00%</td>
<td>2.21%</td>
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<tr>
<td>Agency Services</td>
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<td>0.01%</td>
<td>0.06%</td>
<td>0.13%</td>
<td>0.00%</td>
<td>0.04%</td>
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<td>0.01%</td>
<td>0.06%</td>
<td>1.81%</td>
<td>0.00%</td>
<td>2.72%</td>
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<tr>
<td>Retail Brokerage</td>
<td>0.10%</td>
<td>0.12%</td>
<td>0.50%</td>
<td>1.77%</td>
<td>0.01%</td>
<td>0.03%</td>
<td>0.92%</td>
<td>0.00%</td>
<td>3.45%</td>
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<tr>
<td>Private Banking</td>
<td>0.22%</td>
<td>0.36%</td>
<td>0.15%</td>
<td>1.45%</td>
<td>0.02%</td>
<td>0.05%</td>
<td>2.06%</td>
<td>0.00%</td>
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<td>0.05%</td>
<td>0.79%</td>
<td>0.01%</td>
<td>2.14%</td>
</tr>
<tr>
<td>% of Total Number of Losses</td>
<td>4.44%</td>
<td>36.97%</td>
<td>10.19%</td>
<td>11.74%</td>
<td>0.96%</td>
<td>2.10%</td>
<td>33.50%</td>
<td>0.10%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

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Loss Severity by Event Type and Each Business Line

- Severity data at the tail remains key area of focus, drives capital estimations and are frequently used in scenario analysis
- Stability in calculations increasing with growing breadth of data

### Table 4: Distribution of Total Loss Amount Across Event Type for Each Business Line

<table>
<thead>
<tr>
<th>KEY</th>
<th>Internal Fraud</th>
<th>External Fraud</th>
<th>Employment Practices and Workplace Safety</th>
<th>Clients, Products and Business Practices</th>
<th>Disasters and Public Safety</th>
<th>Technology and Infrastructure Failures</th>
<th>Execution, Delivery, and Process Management</th>
<th>Malicious Damage</th>
<th>% of Total Number of Losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>0% - 1%</td>
<td>0.08%</td>
<td>0.43%</td>
<td>0.18%</td>
<td>26.33%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.41%</td>
<td>0.00%</td>
<td>27.44%</td>
</tr>
<tr>
<td>1% - 5%</td>
<td>1.11%</td>
<td>0.31%</td>
<td>0.30%</td>
<td>5.35%</td>
<td>0.00%</td>
<td>0.28%</td>
<td>7.00%</td>
<td>0.00%</td>
<td>14.35%</td>
</tr>
<tr>
<td>5% - 10%</td>
<td>2.00%</td>
<td>7.09%</td>
<td>2.20%</td>
<td>8.45%</td>
<td>0.33%</td>
<td>0.58%</td>
<td>6.82%</td>
<td>0.02%</td>
<td>27.49%</td>
</tr>
<tr>
<td>&gt; 10%</td>
<td>1.09%</td>
<td>2.10%</td>
<td>0.32%</td>
<td>3.65%</td>
<td>0.01%</td>
<td>0.11%</td>
<td>4.20%</td>
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<td>11.48%</td>
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<tr>
<td>Corporate Finance</td>
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<td>0.53%</td>
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<td>Trading and Sales</td>
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<td>0.03%</td>
<td>2.12%</td>
<td>0.00%</td>
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<td>Commercial Banking</td>
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<td>0.00%</td>
<td>0.30%</td>
<td>0.00%</td>
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<tr>
<td>Clearing</td>
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<td>0.01%</td>
<td>0.67%</td>
<td>0.00%</td>
<td>4.03%</td>
</tr>
<tr>
<td>Agency Services</td>
<td>0.09%</td>
<td>0.08%</td>
<td>0.35%</td>
<td>1.62%</td>
<td>1.19%</td>
<td>0.03%</td>
<td>1.10%</td>
<td>0.01%</td>
<td>4.47%</td>
</tr>
<tr>
<td>Asset Management</td>
<td>0.19%</td>
<td>0.55%</td>
<td>3.96%</td>
<td>55.12%</td>
<td>1.56%</td>
<td>1.11%</td>
<td>22.48%</td>
<td>0.03%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

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Data Analytics

- Members’ Capital Methodologies
- A Case Study
- The Analytic Agent Work Program
Members’ Capital Methodologies

ORX formally surveyed its membership in Q3 2007 to assess how banks were using ORX loss data

- 29 Member banks participated in the survey
- The scope covered methodology and calibration results
- The results of the survey are currently being compiled and analyzed
- The following pages present a summary of the output related to the use of external data

The information presented is based on preliminary analysis and subject to change
Q: What is the predominant basis of your operational risk capital model?

- 69% (20) Standardized
- 14% (4) RCSA / Scorecard
- 3% (1) LDA
- 14% (4) Scenarios

(RCSA / Scorecard = 0)

- Two thirds of the respondents use an actuarial based LDA model
Q: How do you use external data in your model?

- 36% (10) Direct Input
- 39% (11) Indirect Input
- 7% (2) Both Direct and Indirect
- 18% (5) Not Used

Q: What is the source of the data?

- 0 5 10 15 20 25
- Number of Respondents
- ORX
- First
- Self-collected
- Other

* Note: multiple answers were permitted to this question

- Over 90% of the respondents use external data as direct or indirect inputs into their capital model
- ORX data is used by the majority of the respondents in their models. The First database (FitchRisk) is a secondary source of data used by over 40% of respondents
Members’ Capital Methodologies: Frequency Modelling

Q: Is the data used to help determine frequency?

![Pie Chart]

- 25% (7) No
- 75% (21) Yes

Q: How is the data used?

![Bar Chart]

- Validate loss proportion by event type: 2 respondents
- Calibrate frequency of tail loss: 3 respondents
- Validate losses vs. exposure indicator: 2 respondents
- Scale ORX frequencies directly: 4 respondents
Q: Is the data used to help determine severity?

- 82% (23) Yes
- 18% (5) No

Q: How is the data used?

- Pool all internal and external data
- Pool when internal data insufficient
- Model external then combine with internal fits
- Use data exclusively to model tail
- Use data to constrain tail
- Validate results derived from internal data
- Validate results derived from scenarios

* Note: multiple answers were permitted to this question

8 banks scale the data before use
Q: What data is used in estimating correlation?

- Internal and External data is used alone or in combination with expert opinion in a majority of cases
- Some Members rely on expert opinion alone supported by analysis of losses e.g. common causes

*Note: multiple answers were permitted to this question*
Members’ Capital Methodologies: Scenarios

Q: Do you use scenarios in your model?

- Yes: 18% (5 respondents)
- No: 82% (23 respondents)

Q: How many scenarios are used as input to the capital model?

- None: 15 respondents
- 1 - 10 scenarios: 2 respondents
- 11 - 20 scenarios: 2 respondents
- 21 - 30 scenarios: 1 respondent
- > 30 scenarios: 13 respondents

Q: What sources of input are used to generate scenarios?

- Expert Judgment: 20 respondents
- Other External Data: 15 respondents
- ORX Data: 10 respondents
- Other: 5 respondents
- BEICF: 5 respondents

*Note: multiple answers were permitted to this question*
A Case Study: One bank’s use of ORX data to fit severity

Below is sample output from one bank’s use of ORX data in fitting severity

Summary Metrics for Fitted Severity Distribution: Unit-of-Measure 1

Data used in estimation: Pooled Internal loss event data and External ORX loss event data

<table>
<thead>
<tr>
<th>Summary of Event Data:</th>
<th>Internal</th>
<th>Pooled ORX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Events</td>
<td>47</td>
<td>612</td>
</tr>
<tr>
<td>Mean Event</td>
<td>294,119</td>
<td>385,102</td>
</tr>
<tr>
<td>Mean of 10 Largest Events</td>
<td>1,037,006</td>
<td>9,987,120</td>
</tr>
<tr>
<td>Largest Event</td>
<td>2,559,137</td>
<td>19,468,217</td>
</tr>
</tbody>
</table>

Assessment of Fit: Fitted vs. Data Used to Fit

Fit vs. Actual:

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Actual</th>
<th>Fitted</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td>41,682</td>
<td>42,774</td>
<td>0.97</td>
</tr>
<tr>
<td>50%</td>
<td>76,521</td>
<td>83,032</td>
<td>0.92</td>
</tr>
<tr>
<td>75%</td>
<td>192,775</td>
<td>195,158</td>
<td>0.99</td>
</tr>
<tr>
<td>90%</td>
<td>575,167</td>
<td>668,181</td>
<td>0.86</td>
</tr>
<tr>
<td>91%</td>
<td>690,830</td>
<td>740,560</td>
<td>0.93</td>
</tr>
<tr>
<td>92%</td>
<td>873,095</td>
<td>841,778</td>
<td>1.03</td>
</tr>
<tr>
<td>93%</td>
<td>1,012,143</td>
<td>954,494</td>
<td>1.06</td>
</tr>
<tr>
<td>94%</td>
<td>1,252,141</td>
<td>1,095,940</td>
<td>1.14</td>
</tr>
<tr>
<td>95%</td>
<td>1,390,726</td>
<td>1,286,759</td>
<td>1.08</td>
</tr>
</tbody>
</table>

Top Ten:

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Actual</th>
<th>Fitted</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>98.37%</td>
<td>4,911,671</td>
<td>3,802,590</td>
<td>1.29</td>
</tr>
<tr>
<td>98.53%</td>
<td>5,224,713</td>
<td>4,240,578</td>
<td>1.23</td>
</tr>
<tr>
<td>98.69%</td>
<td>5,283,921</td>
<td>4,782,892</td>
<td>1.09</td>
</tr>
<tr>
<td>98.86%</td>
<td>5,737,969</td>
<td>5,469,831</td>
<td>1.05</td>
</tr>
<tr>
<td>99.02%</td>
<td>8,309,342</td>
<td>6,356,863</td>
<td>1.31</td>
</tr>
<tr>
<td>99.18%</td>
<td>10,436,700</td>
<td>7,541,107</td>
<td>1.38</td>
</tr>
<tr>
<td>99.35%</td>
<td>12,502,278</td>
<td>9,157,198</td>
<td>1.37</td>
</tr>
<tr>
<td>99.51%</td>
<td>13,156,517</td>
<td>11,545,788</td>
<td>1.14</td>
</tr>
<tr>
<td>99.67%</td>
<td>14,839,880</td>
<td>15,469,660</td>
<td>0.96</td>
</tr>
<tr>
<td>99.84%</td>
<td>19,468,217</td>
<td>23,963,853</td>
<td>0.81</td>
</tr>
</tbody>
</table>

QQ Plots:

- **All Events**
- **Events > $100k**
- **Events > $1m**

In this case, the bank chose to pool its internal data with a ORX data for a given unit-of-measure

The unit-of-measure is Level 1 LOB/ET level of granularity

Goodness-of-fit is assessed against the pooled data
A Case Study: Assessment of “appropriateness” of fitted severity

Below is sample output from one bank’s approach to assessing appropriateness of fitted severity

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Actual</th>
<th>Fitted</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td>39,380</td>
<td>42,814</td>
<td>0.92</td>
</tr>
<tr>
<td>50%</td>
<td>100,000</td>
<td>83,194</td>
<td>1.20</td>
</tr>
<tr>
<td>75%</td>
<td>301,660</td>
<td>196,662</td>
<td>1.53</td>
</tr>
<tr>
<td>90%</td>
<td>905,000</td>
<td>648,141</td>
<td>1.40</td>
</tr>
<tr>
<td>79.17%</td>
<td>312,092</td>
<td>263,585</td>
<td>1.18</td>
</tr>
<tr>
<td>81.25%</td>
<td>331,440</td>
<td>311,289</td>
<td>1.06</td>
</tr>
<tr>
<td>83.33%</td>
<td>386,140</td>
<td>369,836</td>
<td>0.98</td>
</tr>
<tr>
<td>85.42%</td>
<td>399,928</td>
<td>441,639</td>
<td>0.91</td>
</tr>
<tr>
<td>87.50%</td>
<td>437,464</td>
<td>531,220</td>
<td>0.82</td>
</tr>
<tr>
<td>89.58%</td>
<td>905,000</td>
<td>648,141</td>
<td>1.40</td>
</tr>
<tr>
<td>91.67%</td>
<td>950,000</td>
<td>810,612</td>
<td>1.17</td>
</tr>
<tr>
<td>93.75%</td>
<td>1,000,000</td>
<td>1,061,815</td>
<td>1.79</td>
</tr>
<tr>
<td>95.83%</td>
<td>2,213,856</td>
<td>1,533,594</td>
<td>1.44</td>
</tr>
<tr>
<td>97.92%</td>
<td>2,559,137</td>
<td>2,976,026</td>
<td>0.86</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Event Prediction with Frequency = 18</th>
<th>Prediction</th>
<th>Ratio to Internal Mean</th>
<th>Ratio to Internal Max</th>
<th>Ratio to Pooled Mean</th>
<th>Ratio to Pooled Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Largest event in 10 years</td>
<td>10,448,705</td>
<td>35.53</td>
<td>4.08</td>
<td>27.13</td>
<td>0.54</td>
</tr>
<tr>
<td>Largest event in 20 years</td>
<td>17,278,192</td>
<td>58.75</td>
<td>6.75</td>
<td>44.87</td>
<td>0.89</td>
</tr>
<tr>
<td>Largest event in 50 years</td>
<td>29,566,074</td>
<td>100.52</td>
<td>11.55</td>
<td>76.77</td>
<td>1.52</td>
</tr>
<tr>
<td>Largest event in 100 years</td>
<td>41,650,661</td>
<td>141.61</td>
<td>16.28</td>
<td>108.15</td>
<td>2.14</td>
</tr>
<tr>
<td>Largest event in 1000 years</td>
<td>109,274,534</td>
<td>371.53</td>
<td>42.70</td>
<td>283.75</td>
<td>5.61</td>
</tr>
<tr>
<td>Largest event in 3333 years</td>
<td>166,494,045</td>
<td>566.08</td>
<td>65.06</td>
<td>432.34</td>
<td>8.55</td>
</tr>
</tbody>
</table>

Key Appropriateness Questions:

- How well does the fitted severity fit pure internal data
- What are the “large event predictions” and how do they compare to actual loss experience
Analytic Agent Work Program

- In May 2007, ORX appointed IBM Research Laboratory (Zurich) as ORX Analytic Agent to fully leverage and exploit the analytic value of this unique data pool

- The program utilizes 2 FTE research staff with access to a unique data set that retains the link between anonymised firm and its loss population

- Objective:
  - Tackle industry level problems that no individual institution can tackle alone;
  - Establish the feasibility and the appropriate methods for using pooled loss data;
  - Advance the measurement of operational risk

- Two initial work packages have been completed to date:
  - **Homogeneity analysis**: How similar are the loss distributions among banks that fall in various business line / event type categories?
  - **Scaling analysis**: How should losses from one bank be transformed in order to make them comparable to losses from another bank?

The work to this point has focused primarily on the distributions of loss severity
Goal: Determine what similarities exist in the size and shape of the loss distributions from Members

Similarity was measured in terms of:

- Statistical measures of goodness-of-fit among loss distributions
- Reduction of error in predicting large losses as a result of using pooled data rather than internal data alone

Clustering techniques were used to determine groupings of banks with similar loss distributions

Overall results:

- A high level of homogeneity was evident in the shapes of various loss distributions across all levels in the sample
- Simple scaling relations were effective in aligning many loss distributions
- Pooling losses among banks with similar loss distributions can result in (estimated) error reductions when estimating high quantiles of the loss severity distribution
Clusters were often associated with distinct distributional shapes

Retail Banking
cluster sizes 25, 3

Employee Practices
cluster sizes 15, 4

RetlBank cluster CDFs

EmPracWS cluster CDFs
Differences in loss scale were often evident across regions.

Corporate Finance

Internal Fraud

CorrFin bank CDFs by REGION (unscaled) (log)

IntFraud bank CDFs by REGION (unscaled) (log)
Analytics Agent Work Program: Scaling Analysis

Goal: determine how losses scale according to various exposure indicators, including firm size (gross income, headcount) and the region where the loss was incurred:

- Provide the scaling relationships with an economic interpretation
- Enable benchmarking and efficiency analyses among banks of varying sizes and geographies

In many loss categories (business line, event type), the scale of the loss distribution was strongly correlated to the exposure indicators:

- Both increasing and decreasing relationships between loss sizes and firm size were observed
- Large differences were seen between Western European and North American losses in several categories
- In many cases, large losses were observed to scale differently from small or medium-size losses
Some categories showed correlations between firm size and loss scale.

### Trading and Sales

**TradSale bank CDFs by AVG.GI (unscaled) (log)**

### Clients, Products, and Business Practices

**ClPrBuPr bank CDFs by AVG.GI (unscaled) (log)**
Analytics Agent Work Program: Producing Scaled Data

- Develop a complete statistical modeling framework incorporating both the homogeneity and scaling analyses:
  - Group banks according to similarities in observed loss distribution patterns
  - Explain between-group and within-group differences using exposure indicators
  - Validate the robustness and consistency of the models over time

- Establish processes to operationalize the analysis:
  - Provide Members with the means and procedures to use scaled ORX data together with their internal loss data
  - Create benchmarks for regulatory capital models and capital allocations

- Aim to roll-out scaled data to Members at Q3 2008
Using the Output

Banks may use the CDFs which are generated as output from this analysis as a:

- set of quantile estimates of a loss distribution within a category
- benchmark to compare with internal loss distributions
- means to generate random samples from a loss category
- basis for fitting a parametric distributional model for a loss category

We estimated the loss distribution for each partition corresponding to a Western European bank with given quarterly gross income figures

- In most cases the scaled datasets appeared to differ significantly from unscaled ORX data previously used by the bank
- Majority of those showed a closer match between scaled data and the internal data than did the unscaled data
Continuing Work

- In 2008 the work programme will continue:
  - Capital benchmarking
  - Diversification and correlation
  - Quality assurance tools
- We intend to publish full papers on the results of our research starting in early 2008
ORX Outlook 2008 and Beyond

- Strategic Initiatives
- 2008 Objectives
- Opportunities
- Summary
Strategic Initiatives

- At year-end 2006 the Executive Committee commissioned a comprehensive strategic review to determine the appropriate strategic and implementation plan to leverage the key strengths of the Association:
  - Unique and high quality database
  - Breadth and engagement of ORX membership base
  - Quality and service of ORX affiliated vendors

- Strategic review incorporated a broad-based assessment of ORX, its potential markets, products and reviews, technology and staff needs, and governance structure

- We envision ORX serving a dual role going forward
  - Providing value-added products and services to its Members
  - Serving as an industry utility for the development of the discipline of operational risk management
ORX 2008 Objectives

- Continue to grow general membership
- Advance analytical understanding of operational risk
- Expand basic data services to include other metrics
- Develop peer group (national & sector) services
- Develop other value added services
  - Bespoke benchmarking
  - Scenario library
  - Capital benchmarking
- Streamline governance structure and processes
- Implement new, more flexible, technology platform
- Increase outreach to regulators, non-members and other constituents
- Explore opportunities in operational risk transfer
National and Sector Services

➢ ORX is seeking to establish National and Sector database from within current membership and as a service to future members

➢ National and Sector Services would use the ORX legal, security and system platform but have the capacity to:
  • Define own loss data categorisation and standards including: loss attributes; text fields; business metrics and KRIIs
  • Define own frequency of loss submission and distribution
  • Set own quality assurance testing and reporting regime
  • Create own reports and benchmarking
  • Use ORX global analytical tools and routines

➢ ORX objective is to develop bespoke National and Sector services as business level tools

➢ Creating new trend and comparative data directly relevant to business units and directly in support of business decisions
Summary

- ORX has a unique quality and breadth of membership
  - 41 leading international banks and strong growth
  - Emerging as industry utility

- ORX has a unique quality and breadth of data
  - Specifications and on-going efforts to enhance consistency and quality
  - Best source for industry analysis of operational risk

- ORX is becoming a leading forum for exchange of ideas and leadership
  - Developing standards around around loss data classification
  - Leading in analysis, commentary and initiatives