Board of Governors of the Federal Reserve System

FEDERAL RESERVE
BANK OF BOSTON™

Advancing the Art of Scenario Analysis

Case Study: JPMorgan Chase & Co.

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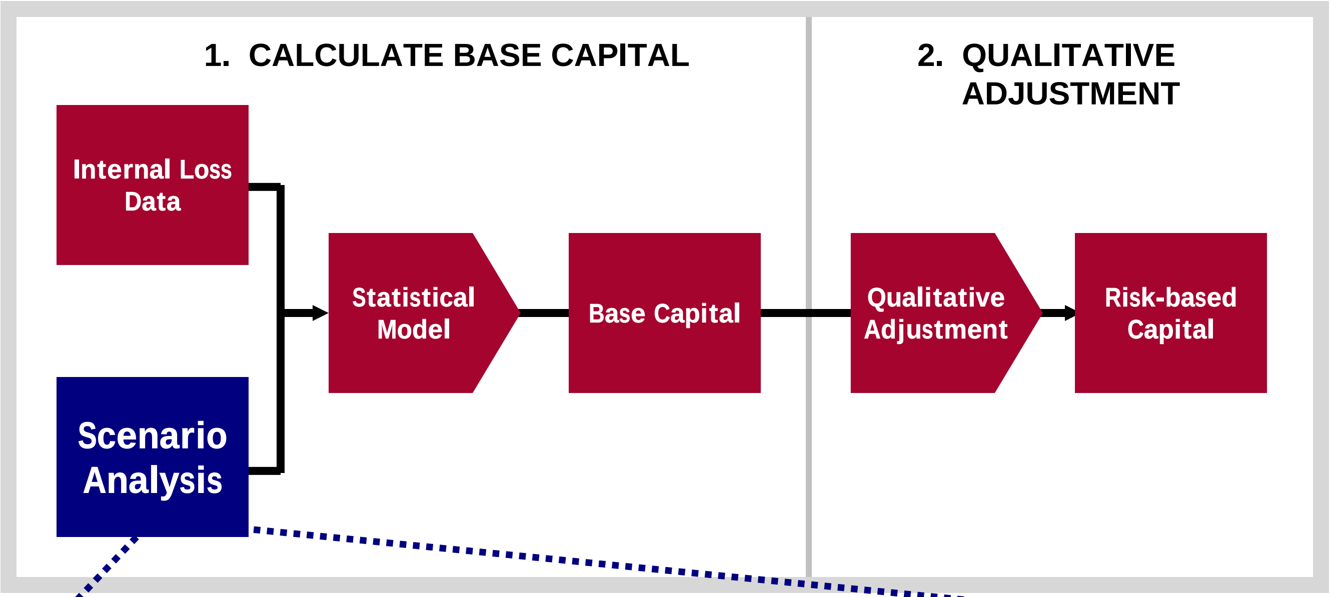
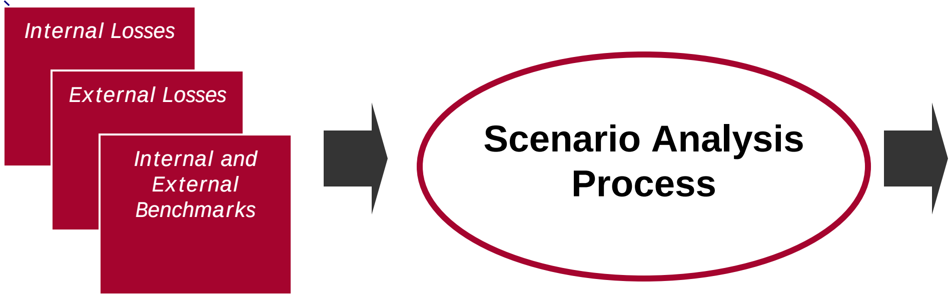
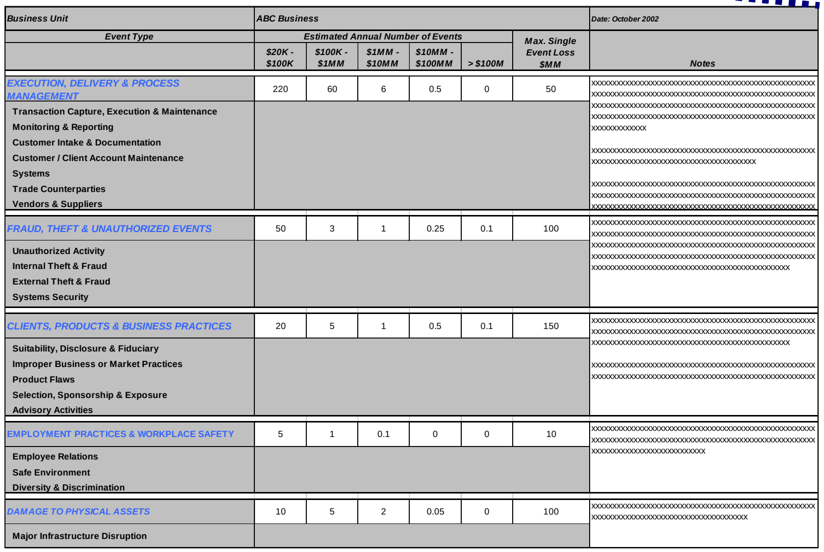
Agenda

- Scenario Analysis – 1st Generation
- Revised Approach to Scenario Analysis
  - Assessing internal vs. external data
  - Assessing model outputs
- Discussion Points

Our 1st Generation Model Relied Heavily on Scenario Analysis as Input







Business Unit	ABC Business						Date: October 2002
Event Type	Estimated Annual Number of Events					Max. Single Event Loss $MM	Notes
	$20K - $100K	$100K - $1MM	$1MM - $10MM	$10MM - $100MM	> $100M		
EXECUTION, DELIVERY & PROCESS MANAGEMENT	220	60	6	0.5	0	50	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Transaction Capture, Execution & Maintenance Monitoring & Reporting Customer Intake & Documentation Customer / Client Account Maintenance Systems Trade Counterparties Vendors & Suppliers							
FRAUD, THEFT & UNAUTHORIZED EVENTS	50	3	1	0.25	0.1	100	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Unauthorized Activity Internal Theft & Fraud External Theft & Fraud Systems Security							
CLIENTS, PRODUCTS & BUSINESS PRACTICES	20	5	1	0.5	0.1	150	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Suitability, Disclosure & Fiduciary Improper Business or Market Practices Product Flaws Selection, Sponsorship & Exposure Advisory Activities							
EMPLOYMENT PRACTICES & WORKPLACE SAFETY	5	1	0.1	0	0	10	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxx
Employee Relations Safe Environment Diversity & Discrimination							
DAMAGE TO PHYSICAL ASSETS	10	5	2	0.05	0	100	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Major Infrastructure Disruption							

Approach was Very Beneficial, but Contained Structural Weaknesses

Scenario Analysis – Generation 1:

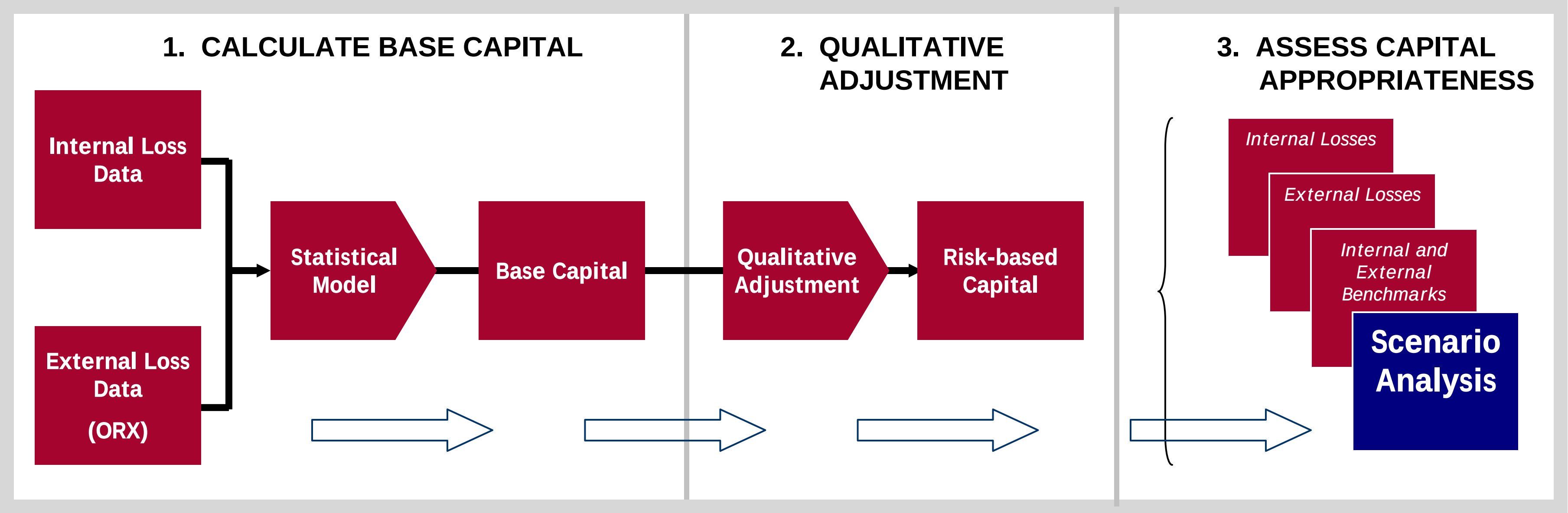
Benefits

- Engaged senior business managers and cross section of subject matter experts in assessment of stress scenarios
- Early foundation for End-to-End assessment of operational risk
- Created synthetic loss data on consistent basis within Basel II categories and across business units

Weaknesses

- Data integrity questionable; synthetic, not actual data
- Process is very labor intensive with diminishing returns
- Use of data as direct input for capital modeling distorts results / integrity
- Structural bias vs. tail events

We Have Evolved Scenario Analysis into a Tool to Assess the Appropriateness of Capital Estimated by the Model



- ➢ We now have six years of internal loss data, vs one year initially
- ➢ ORX data is now available (ca. 100,000 data points)
- ➢ Eliminates the challenges of subjectivity, repeatability and statistical incorporation of results
- ➢ Scenario Analysis process now used for risk management and stress environment discussion with senior business executives
- ➢ Effort is part of validation, not calibration, process

The Review Process Starts with an Assessment of the Data

Internal Loss Data

External Loss Data

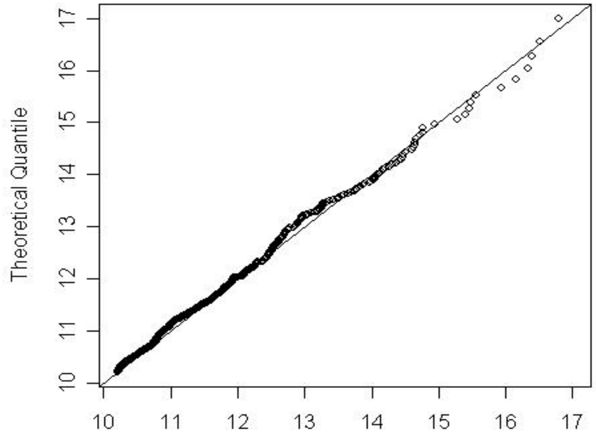
Confidential Data
Not included in distributed material

Contains analysis of loss data, by event type by quarter
- Frequency
- Aggregate loss
- Maximum event loss

For both internal and ORX data

Sample Model Output Reviewed

Ex 1. Review Actual Data Points vs Fitted Distribution



Top Ten Losses

Percentile	Actual	Fitted	Ratio
98.37%	4,911,671	3,802,590	1.29
98.53%	5,224,713	4,240,578	1.23
98.69%	5,283,921	4,782,892	1.10
98.86%	5,737,969	5,469,831	1.05
99.02%	8,309,342	6,356,863	1.31
99.18%	10,436,700	7,541,107	1.38
99.35%	12,502,278	9,157,198	1.37
99.51%	13,156,517	11,545,788	1.14
99.67%	14,839,880	15,469,660	0.96
99.84%	19,468,217	23,963,853	0.81

- Data points reviewed:
  - Internal
  - ORX
  - Algo FIRST
  - Other sources

Ex 2. Review Large Loss Event Predictions

Large Event Prediction:

Event Prediction with Frequency = 18	Prediction	Ratio to Internal Mean	Ratio to Internal Max
Largest event in 10 years	10,448,705	35.53	4.08
Largest event in 20 years	17,278,192	58.75	6.75
Largest event in 50 years	29,566,074	100.52	11.55
Largest event in 100 years	41,650,661	141.61	16.28
Largest event in 1000 years	109,274,534	371.53	42.70
Largest event in 3333 years	166,494,045	566.08	65.06

Other Reviews

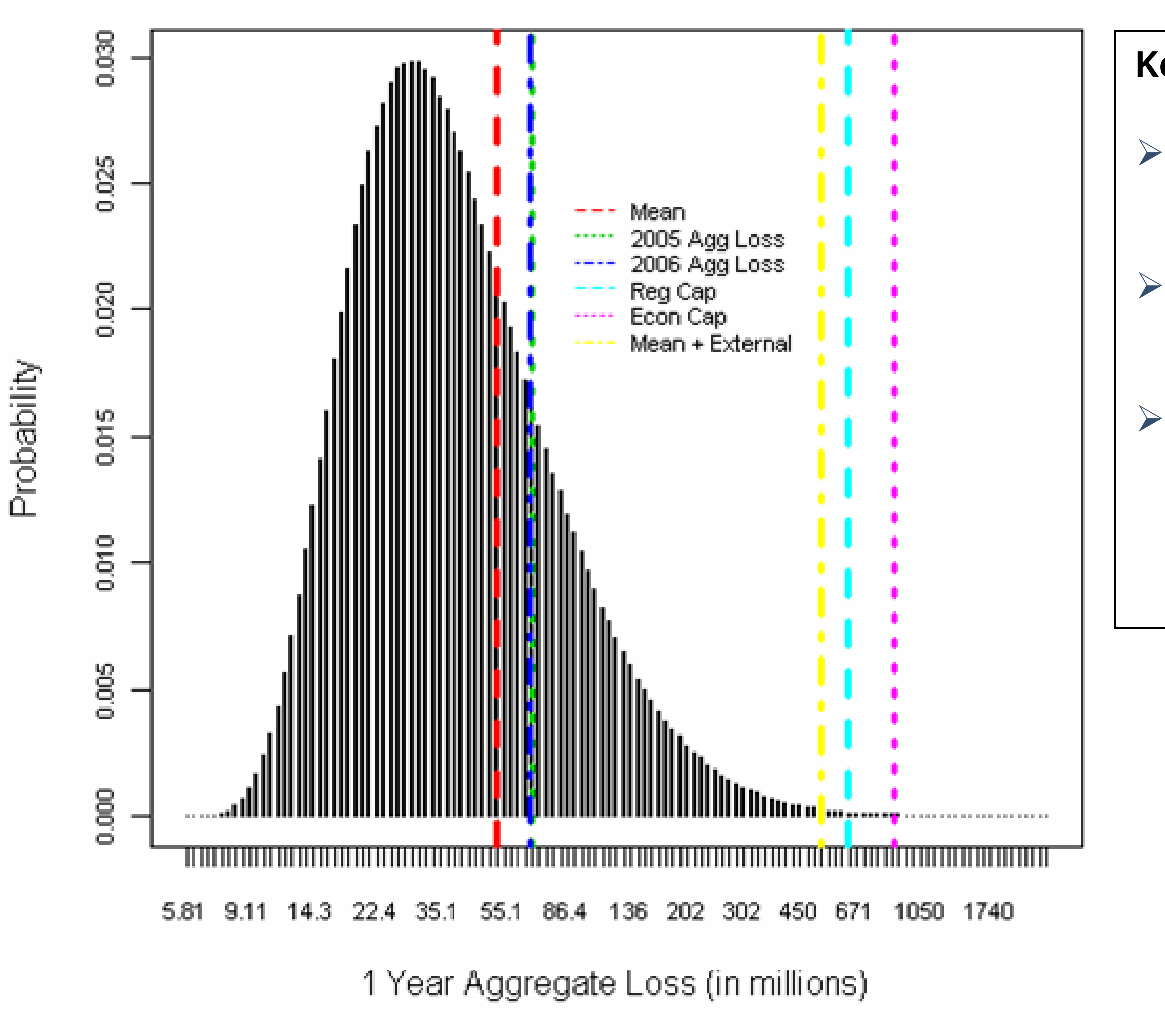
- Internal data points at different percentiles
- Comparison of internal and ORX distributions
- Various ratios and cross-business comparisons
- Etc.

Key Appropriateness Questions

- How well does the fitted severity compare to internal data points?
- How do the large event predictions compare to internal and external data points
- Are the predictions (a) understated, or (b) unrealistically large given the business profile?

Model Results Assessment – Aggregate Loss Distribution

Aggregate Loss Distribution



Key Appropriateness Questions

- How do actual aggregate losses in a year compare to the model output?
- Would capital absorb the largest industry loss if that occurred here?
- Additional reviews include:
  - ratios of capital-to-mean
  - capital to largest internal and external loss
  - comparative ratios to other businesses
  - etc.

Management Discussion Points

1. **Review Data Profiles**
   - Internal: “What does my data look like?”
   - External: “What does other firms’ data look like?”
2. **Review Model Calculation Results**
   - Capital output
   - Analysis: Ratios and Comparatives
3. **Scenario Analysis: “Does the model output reasonably represent my op risk exposure?”**
   - Does the capital appropriately assess op risk exposure during periods of business stress?
   - Does the capital appropriately cover exposure to a single large loss event?
   - Are there other op risk exposures that have not been adequately captured in the model?
4. **Are adjustments to inputs or capital justified? On what basis?**