Best Practices for Stress Testing your Private Firm C&I Portfolio

Douglas Dwyer, Managing Director – RiskCalc Research
Mehna Raissi, Director, RiskCalc Product Management
Christian Henkel, Director, Enterprise Risk Solutions

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Agenda

• Overview and impact(s) of stress testing
• Risk management and stress testing for private C&I portfolio
• RiskCalc™ Plus stress testing solutions
  o PD & LGD Approach
  o Ratio Based Approach
• Q&A
Overview and Impact(s) of Stress Testing

Christian Henkel, Director – Enterprise Risk Services
As a result of the financial crisis, the Fed has adopted rules for stress testing and, in turn, capital adequacy

» Regulators now expect banks to demonstrate they will be able hold sufficient capital to enable them to continue lending even under adverse economic conditions

» Accordingly, stress testing is a tool that helps banks and supervisors measure capital adequacy through periods of stressed economic conditions

» The Dodd-Frank Wall Street Reform and Consumer Protection Act (“Dodd-Frank”) requires annual stress tests for banks with assets greater than $10b:
  – Comprehensive Capital Analysis and Review (“CCAR”) for the top (18) BHCs
  – Capital Plan Review (“CapPR”) for non-CCAR BHCs > $50b
  – Banks $10b - $50b

» The stress test cycle (year) is the period between October 1st and September 30th; with the requirements for non-CCAR banks coming into play this fall
“A company will be required to calculate for each scenario, over each quarter of the planning horizon, pre-provision net revenue, losses, provision for loan and lease losses, and net income; and the potential impact of the scenarios on pro forma regulatory capital levels and pro forma capital ratios”

- Federal Reserve
While scope varies by institution, a common objective is to link macroeconomic factors to credit risk measures

<table>
<thead>
<tr>
<th>HISTORICAL DATA</th>
<th>PREDICTIONS (Via regression model)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>Δ in 10-yr Treasury Yield</td>
</tr>
<tr>
<td>S1</td>
<td>?</td>
</tr>
<tr>
<td>S2</td>
<td>?</td>
</tr>
<tr>
<td>S3</td>
<td>?</td>
</tr>
<tr>
<td>S4</td>
<td>?</td>
</tr>
<tr>
<td>S5</td>
<td>?</td>
</tr>
</tbody>
</table>

%ΔFactor = \alpha + \sum_i (β_i \times ΔX_i) + ε

- The macroeconomic variables are often drawn from those specified by the Federal Reserve in the CCAR process but the final set are jointly determined.
- Banks and the Fed alike use PD, LGD, and EAD models are used to calculate the EL – and translate those to charge-offs at the segment level.
- The PD for a C&I loan is projected over the planning horizon by first calculating the PD at the beginning and projecting it forward.
- The output can also be used to calculate rating migrations, trends in credit quality, and influencing portfolio decisions.

--- FOR ILLUSTRATION

**Independent “explanatory” variables (macroeconomic factors)**

- Δ in Probability of Default
- Δ in 10-yr Treasury Yield
- Δ in Corporate Tax Rate
- Δ in 1-year Fed Funds Target
- Δ in Core Goods CPI
- Δ in Wage and Salary
- Δ in Consumer Confidence
- Δ in Spec Grade Spreads
- Δ in Non-Farm Biz Productivity
- Others…

**Dependent variables (credit risk measures, such as PD)**

- Values of macro factors from forecast scenarios

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Moody's Analytics
Federal Reserve Supervisory Scenarios 2012 (Real GDP)

Real GDP Growth (%)


Baseline
Adverse
Severely Adverse
Federal Reserve Supervisory Scenarios 2012 (DJIA)
Recent representative engagements in the US

Stress Testing Engagements (where RiskCalc was included)

1. Regional Bank
   » Development of a stress testing framework for C&I portfolio
   » Stressed at the ratio-level (i.e., stressed financial statement items)
   » Used RiskCalc v3.1 US (and v4.0 Corporate) as primary engine for generating stressed NCOs

2. CCAR Bank
   » Development of challenger models following Fed methodology described in the CCAR disclosures
   » C&I loan portfolio
   » PD, LGD, EAD framework
   » Use of Moody’s analytical resources and data

3. CCAR Bank
   » Development of a stress testing framework for a wholesale portfolio of a top 5 U.S. bank
   » Creation of challenger models using Moody’s data and analytical resources
   » Development of primary models using combined Moody’s and client datasets
   » Support through model validation, regulatory review
RiskCalc Plus and stress testing for private C&I portfolios

Mehna Raissi, Director, RiskCalc Product Management
RiskCalc: Credit Research Database (CRD)
The largest financial statement and default database in the world

RiskCalc Plus’s Global Presence:
Network of 29 World-Class Models

The RiskCalc Plus network is comprised of unique models covering:

**Americas:** USA, Canada and Mexico country models, plus U.S. Insurance, U.S. Banks and North America Large Firm

**Europe, Middle East and Africa:** Austria, France, Netherlands, Nordic (Denmark, Norway, Sweden, Finland), Portugal, Spain, UK, Germany, Belgium, Italy, South Africa, Switzerland, Russia, Banks

**Asia Pacific:** Japan, Korea, Australia, Singapore, China, Banks

**Other:** Emerging Markets

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Country | Last Updated | Borrowers | Defaults | Default Range | Statements | Statement Range | Default Statement Range |
---|---|---|---|---|---|---|---|
Africa | 65,408 | 1,813 |
China | 11/2012 | 580,789 | 1,275,864 | 2000-2010 |
India | 12/2011 | 13,179 | 1,275,864 | 2000-2010 |
Asia Pacific | 1,113,976 | 50,525 | 3,817,655 |
Finland | 5/2010 | 43,555 | 3,481 | 1994-2010 |
Italy | 1/2013 | 581,747 | 23,999 | 1992-2010 | 2,584,810 | 1990-2010 |
Europe | 10,010,950 | 756,308 | 40,961,829 |
Brazil | 2012 | 13,918 | - | 1993-2011 | 37,124 | 1993-2011 |
Americas | 336,674 | 55,919 | 1,091,105 |
World | 11,953,028 | 816,463 | 50,831,915 |

Data as of 05/01/13
RiskCalc™  Modeling Process

1. Collect Financials and Default Data
2. Select Relevant Ratios
3. Compute the Model Output
4. Calibrate the Model Output to Actual Defaults: Financial Statement Only EDF™ (Expected Default Frequency)
5. Incorporate a market signal to determine the Credit Cycle Adjusted EDF
Identifying the Relevant Ratios to Estimate Default

We first identify broad categories of ratios relevant to default. Within each category, we then select ratios with:

- High predictive power
- Data availability
- Intuitive behavior
Update the Risk Assessment Without New Financial Statement Information

The Impact of Industry Market Information

Credit Cycle Adjustment (CCA)
RiskCalc Plus Stress Testing Offerings

RiskCalc™ Plus

RiskCalc Plus Stress Testing Module

Ratio Based Modeling Approach
(loan-level, financial statement)
Available via RiskCalc Plus

PD & LGD Based Modeling Approach
(granular, by sector & credit quality)
Available via Scenario Analyzer™

Customized Solutions
Available via Scenario Analyzer & Customized Delivery Formats

Credit Research Database
(CRD™)
Financial Statements & EAD Data
# What's the difference between the two modeling approaches?

<table>
<thead>
<tr>
<th>RiskCalc Ratio Based Approach</th>
<th>RiskCalc PD&amp;LGD Based Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(Obligor-Level Modeling)</strong></td>
<td><strong>(Granular Modeling)</strong></td>
</tr>
<tr>
<td><strong>Access:</strong></td>
<td><strong>Access:</strong></td>
</tr>
<tr>
<td>– Via RiskCalc Plus website single and batch</td>
<td>– Via Scenario Analyzer or Custom Delivery</td>
</tr>
<tr>
<td><strong>Data:</strong></td>
<td><strong>Data:</strong></td>
</tr>
<tr>
<td>– Credit Research Database (CRD)</td>
<td>– Credit Research Database (CRD)</td>
</tr>
<tr>
<td><strong>Inputs:</strong></td>
<td><strong>Inputs:</strong></td>
</tr>
<tr>
<td>– RiskCalc US 4.0 Corporate Income Statement &amp; Balance Sheet Inputs</td>
<td>– Initial PD (from internal ratings or model)</td>
</tr>
<tr>
<td>– Macro Scenarios</td>
<td>– Sector</td>
</tr>
<tr>
<td><strong>Modeling:</strong></td>
<td>– Debt type (secured loans and unsecured loans)</td>
</tr>
<tr>
<td>– Financial ratios are linked to macroeconomic variables</td>
<td>– Macro Scenario</td>
</tr>
<tr>
<td>– CCA “credit cycle adjusted” view for forecasted EDFs under stressed scenarios</td>
<td><strong>Output:</strong></td>
</tr>
<tr>
<td><strong>Output:</strong></td>
<td><strong>Output:</strong></td>
</tr>
<tr>
<td>– Two years of pro-forma financials</td>
<td>– Segment-level stressed PD &amp; LGD, Expected Loss, Charge Offs</td>
</tr>
<tr>
<td>– Baseline EDF and Stressed</td>
<td></td>
</tr>
</tbody>
</table>

**RiskCalc Ratio Based Approach**

- **Access:** Via RiskCalc Plus website single and batch
- **Data:** Credit Research Database (CRD)
- **Inputs:** RiskCalc US 4.0 Corporate Income Statement & Balance Sheet Inputs, Macro Scenarios
- **Modeling:** Financial ratios are linked to macroeconomic variables, CCA “credit cycle adjusted” view for forecasted EDFs under stressed scenarios
- **Output:** Two years of pro-forma financials, Baseline EDF and Stressed

**RiskCalc PD&LGD Based Approach**

- **Access:** Via Scenario Analyzer or Custom Delivery
- **Data:** Credit Research Database (CRD), Default & Recovery Database (DRD)
- **Inputs:** Initial PD (from internal ratings or model), Sector, Debt type (secured loans and unsecured loans), Macro Scenario
- **Modeling:** Calibrated on RiskCalc US 4.0, PD: Forecasting future change in PD based on PD level, sector and forecasted macro scenarios, LGD: Predict recovery rates based on debt type, sector, stressed PD levels and macro scenarios
- **Output:** Segment-level stressed PD & LGD, Expected Loss, Charge Offs
Stress testing models for your private C&I portfolio

Douglas Dwyer, Managing Director – RiskCalc Research
Stress Testing with RiskCalc
PD&LGD and A Ratio Based Approach
1

Overview
Stressed PDs can be computed with different degrees of granularity in RiskCalc

The PDs of private firms change due to changes in both the financial statements and changes in the credit cycle adjustment.

When the economy goes into a recession:
- The financial statements of private firms get worse.
- The cyclical risk of private firms increases as measured by the Credit Cycle Adjustment in RiskCalc.

One can stress the PD and LGD of a rating bucket/sector combination (PD/LGD):
- More top-down.

Alternatively, one can start at the financial statement level (bottom-up):
- One can estimate the impact of the adverse business environment on the financial statements.
- Further model the Credit Cycle Adjustment factor.
2.1 PD & LGD
Overview

» A model with the following features

» Similar to Fed’s CCAR model

"... estimation of a series of equations relating historical changes in the median PD for 12 different borrower industries, six credit quality categories, and countries of incorporation to macroeconomic variables, including changes in stock price volatility and the spread on BBB-rated corporate bonds ...“-- Comprehensive Capital Analysis and Review 2012: Methodology and Results for Stress Scenario Projections

» Generic: can be applied to any portfolio with initial PD assigned (“scenario analyzer” in CE+)

» Granularity: Different impact of macroeconomic variables for different sectors and credit qualities

» Most important: produce reasonable stress numbers
Model Specification

- **Dependent variable:** the shift of EDF distribution for each sector/rating bucket.
  » Change of Log-median EDF: $mEDF_{t+1} - mEDF_t$

- **Main Model: Two-way Fixed Effect Model**

  \[
  y_{s,r,t} = \rho y_{s,r,t-1} + \alpha_s + \alpha_r + \sum_{i=1}^{M} (\beta_{i,s} + \beta_{i,r}) X_{i,t+1} + \epsilon_{s,r,t},
  \]

  » $s$ denotes sectors, $r$ denotes ratings, $t$ denotes time points.
  » $X$s are macroeconomic variables.
  » Different variations of the main model: sector or rating effect only
  » 1$^{\text{st}}$ lag of dependent variable: high persistency of dependent variable
PD Model Specification

\[ y_{s,r,t} = \rho y_{s,r,t-1} + \alpha_s + \alpha_r + \sum_{i=1}^{M} (\beta_{i,s} + \beta_{i,r}) X_{i,t} + \varepsilon_{s,r,t} \]

**Analysis of Variance**

- Adj R-Sq 65%

**Selected macro variables**
- Negative effect
  - Dow Jones Index
- Positive effect
  - Unemployment Rate
  - CBOE volatility index
  - Credit Spread

**Transformations**

<table>
<thead>
<tr>
<th>Macroeconomic Variables</th>
<th>Transformations</th>
<th>Notation</th>
<th>Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dow Jones Index</td>
<td>Quarter-over-quarter Growth, Lag 1</td>
<td>DJX_QoQ_Growth_lag1</td>
<td>-</td>
</tr>
<tr>
<td>Log-Credit Spread</td>
<td>Quarter-over-quarter change</td>
<td>Log_CreditSpread_QoQ_change</td>
<td>+</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>Quarter-over-quarter change, Lag 1</td>
<td>Unemployment_QoQ_change_lag1</td>
<td>+</td>
</tr>
<tr>
<td>Log-CBOE VIX Quarterly High</td>
<td>Quarter-over-quarter change, Lag 1</td>
<td>LogVixHigh_QoQ_change_lag1</td>
<td>+</td>
</tr>
</tbody>
</table>
Historical & CCAR 2012 & CCAR 2013

Projected PD Under CCAR and Historical Scenarios

PD

Quarter

Moody’s Analytics
2.2 LGD Model
Moody’s Default Recovery Database (DRD)

» The DRD contains information for defaulted debts. It is updated on a monthly basis and contains default events going all the way back to 1883. The data contains post-default prices from the market as well as ultimate recovery values.

» Definition of Default and Recovery
  » Default types: Bankruptcy, Chapter 11, Chapter 7, Missed principal payment, Distressed exchange and Dividend omission for preferred stocks
  » Post default price: the trading price of the default debt, expressed as a percentage of par, as of the default date for distressed exchanges or 30 days after defaults for all other types of default.
  » Ultimate recovery: the discounted value (at the defaulted instrument’s effective interest rate) of these items where the bonds and the equity are marked to market using the first observable trading price
Information Used For LGD modeling

» Use data going from 1990 to 2011 Q3 and US only.
» Default
» PID (Moody's public company identifier)
» Issue rating
» Default date
» Recovery: 30-day Trading Prices with base =100
» Industry Classifications
» Debt type

Additional information:
» EDF (Moody’s PD) information based on PD
» Rating-implied PD for companies without available EDF
» Industry classification to sector mapping
» Macroeconomic variables and time series
Start with a linear model to ensure the predicted recoveries are corrected on average. Then adjust fit in the tails to further improve the in-sample fit and bound the predicted recovery prices between 0 and 100.

Function form:

\[ y_{i,t} = F \left( \alpha + \sum_{j} \beta_j \cdot DebtType_j + \sum_{k} \gamma_k \cdot Sector_k + \sum_{m} \delta_m \cdot X_m + \kappa \cdot EDF_{i,t-1} \right) + \varepsilon_{i,t} \]

where \( y_{i,t} \) is the recovery price based on par of 100 of instrument at time \( t \); \( DebtType_j \) is the debt type dummy; \( Sector_k \) is the sector dummy; \( X_m \) is the (transformed) CCAR macro variables; \( EDF_{i,t-1} \) is the EDF of the instrument \( i \) one quarter prior to default. \( F \) is certain non-linear transformation.
Default Price Data Validation

DRD data sufficiently represent of the recoveries for C&I loans of large banks. We treat the CO rate over the delinquency rate as a crude proxy for LGD (LGD~loss rate/default rate). We plot the average \((100\text{-def_price_adj})/100\) and the LGD proxy from Q4 of the given year scaled to match the average DRD LGD across years.
Adjusted Default Price vs. Predicted
Adjusted Default Price vs. Predicted (Loan Sample)
Ratio Based Approach
Ratio Based Approach

Links the key financial statement items to macro variables

Demonstrates how different balance sheet inputs behave under different hypothetical stress scenarios

Captures which types of firms are more vulnerable to a specific stress scenario
  Firms with tight margins are vulnerable to business downturns
  Firms with high leverage are vulnerable to increases in interest rates

Captures how different sectors respond to the credit cycle differently

Accommodate flexible stress testing scenarios

Good validation results both at the intermediate FSO level and at the final stressed EDF level
Modeling Stressed EDFs Using RiskCalc

Macroeconomic Scenarios
CCAR/MEDC/Custom

Financial Statements

Proforma 1 & 2 Statements Intermediate FSO EDFs

CCA Factors

Stressed EDF
3.1 FSO Model
Different Cyclical Behavior across Sectors

Construction

Consumer Products

Health Care

Services

Trade

Sales Growth Rates

GDP Growth Rates
We use Economic and Accounting Theory to Guide the Exercise

- During a recession, both sales and costs decline with GDP
- Interest expense increases if interest rates go up
- One can estimate the effects of the credit cycle on an income statement, which flows through to the balance sheet
A Pro-Forma Income Statement Relates Changes in Sales to Changes in Income

<table>
<thead>
<tr>
<th>Income Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales/Revenue</td>
</tr>
<tr>
<td>- Cost of Goods Sold (COGS)</td>
</tr>
<tr>
<td>- Selling, General and Administrative Expense (SGA)</td>
</tr>
<tr>
<td>- Depreciation/Amortization (AMORT)</td>
</tr>
<tr>
<td>- Other Operating Expense (OthrExp)</td>
</tr>
<tr>
<td>Total Operating Profit</td>
</tr>
<tr>
<td>+ Financial Income</td>
</tr>
<tr>
<td>- Interest Expenses</td>
</tr>
<tr>
<td>Profit before Tax</td>
</tr>
<tr>
<td>- Tax</td>
</tr>
<tr>
<td>Net Income</td>
</tr>
</tbody>
</table>

Variable costs such as Cost of Goods Sold move together with changes in Sales.

Fixed costs, such as Depreciation/Amortization move slowly when Sales decrease.

Sales Growth
COGS Changes
SGA Changes
Interest Expense Changes
We Modify the Balance Sheet to Be Consistent with the Income Statement

If losses exceed cash and marketable securities:

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liability + Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>∆Cash = -Cash&lt;sub&gt;t&lt;/sub&gt;</td>
<td>∆CL = -preTaxLoss – Cash&lt;sub&gt;t&lt;/sub&gt;</td>
</tr>
<tr>
<td>∆ LossCarryFwd = -tax*PreTaxLoss&lt;sub&gt;t&lt;/sub&gt;</td>
<td>∆TL = -preTaxLoss - Cash&lt;sub&gt;t&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>∆Retained Earnings =</td>
</tr>
<tr>
<td></td>
<td>(1-tax)*preTaxLoss</td>
</tr>
<tr>
<td>∆Total Assets = -tax * preTaxLoss – Cash&lt;sub&gt;t&lt;/sub&gt;</td>
<td>∆ (Liability + Equity) = -tax * preTaxLoss – Cash&lt;sub&gt;t&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

In doing the pro forma financial statements, there is discretion in the treatment of income: is it reinvested in the firm or distributed to equity holders? More conservative assumptions lead to more stressed EDFs.

Note: ∆PreTaxNI<sub>t+1</sub> = (∆SGR – ∆COGs – ∆SGA)* Sales<sub>t</sub> – ∆IntExp<sub>t+1</sub>
preTaxNI<sub>t+1</sub> = NI/(1-tax) + ∆PreTaxNI
preTaxLoss = Min(preTaxNI,0)
Model Selection Guidelines

» Clear theoretical justification
» RSQ (or Adj. RSQ)
» The sign and magnitude of coefficients are economically meaningful
» Significantly correlated with dependant variables

\[ y_{s,t}^g = \alpha^g + \sum_{j=1}^{N} \beta_j^g X_{j,s,t} + \varepsilon_{s,t}^g \]

- **g**: identifies sector group
- **s**: identifies state
- **t**: identifies times
- **X**: macroeconomic variables
- **Y**: SGR, COGS, SGA, or Interest Expense changes
One computes a Pro-Forma EDF

Starts with this year’s financial statement

Computes a pro-forma financial statement using next year’s macro variables that are supplied by the scenario.

This does not adjust for the stage of the cycle
3.2 CCA FACTOR MODEL
CCA Factor Model

$$y_{i,s,t}^{sector} = \alpha_s^{sector} + \sum_{j=1}^{M} \beta_{j,s}^{sector} X_{j,t} + \epsilon_{i,s,t}$$

Dependent Variable: $m\left(\log_2\frac{CAEDF_t}{FSOEDF_t}\right)$

<table>
<thead>
<tr>
<th>Macro Variables</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment rate</td>
<td>+</td>
</tr>
<tr>
<td>Stock Price Index</td>
<td>-</td>
</tr>
<tr>
<td>Market Volatility Index (VIX)</td>
<td>+</td>
</tr>
<tr>
<td>Spread= Baa corporate yield-10-year</td>
<td></td>
</tr>
<tr>
<td>Treasury yield</td>
<td>+</td>
</tr>
<tr>
<td>Oil Price Index</td>
<td>+</td>
</tr>
<tr>
<td>House Price Index</td>
<td>-</td>
</tr>
</tbody>
</table>

Final variable selection

» Selection Guidelines for Macro variables
  - Meaningful coefficient signs
  - Sign stability across time periods
  - Regression RSQ, AIC, BIC, t value, p value
Regression Models

Different sectors respond differently to macro-scenarios

<table>
<thead>
<tr>
<th>Sector</th>
<th>Estimate</th>
<th>Std. Error*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployment</td>
<td>0.18</td>
<td>0.0027***</td>
</tr>
<tr>
<td>lag(Dow Jones, 1)</td>
<td>-0.21</td>
<td>0.0205***</td>
</tr>
<tr>
<td>Log_VIX</td>
<td>0.27</td>
<td>0.0085**</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.80</td>
<td></td>
</tr>
<tr>
<td>Adj. R-Squared</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>Sample Size</td>
<td>3500</td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lag(Unemployment, 1)</td>
<td>0.17</td>
<td>0.0074***</td>
</tr>
<tr>
<td>lag(Dow Jones_R, 1)</td>
<td>-0.17</td>
<td>0.0642***</td>
</tr>
<tr>
<td>lag(Log_VIX, 1)</td>
<td>0.21</td>
<td>0.0283***</td>
</tr>
<tr>
<td>lag(WTI, 2)</td>
<td>0.08</td>
<td>0.0228***</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.55</td>
<td></td>
</tr>
<tr>
<td>Adj. R-Squared</td>
<td>0.54</td>
<td></td>
</tr>
<tr>
<td>Sample Size</td>
<td>1150</td>
<td></td>
</tr>
</tbody>
</table>

* Robust Standard Errors

CCAR 2012: CCA Factor
VALIDATION RESULTS
We take the financial statements of each year, get Proforma EDFs, apply the sector-specific fitted CCA factor and finally transform them to get the stressed EDF. We average the stressed EDF and the actual CCA EDF for same set of obligors for each year month and plot them as above.
Validation: Actual vs. Stressed EDF
Validation: Actual vs. Stressed EDF

Consumer Products

Business Products

Moody’s Analytics
Validation: Actual vs. Stressed EDF

![Graphs showing Actual EDF and Stressed EDF for Business Services and Mining sectors.](Image)

Moody's Analytics
Validation: Actual vs. Stressed EDF

**HiTech**

**Services**
Validation: Actual vs. Stressed EDF

**Agriculture**
- Actual EDF
- Stressed EDF

**Utilities**
- Actual EDF
- Stressed EDF

Moody's Analytics
Validation: Actual vs. Stressed EDF

Construction

Communication
Bank Charge-Offs and Delinquency Rates for C&I loans

Commercial and Industrial Loans through 2012Q2
Charge-Offs implied PD (=Charge-Offs/LGD) is computed assuming an LGD of 40%

Expected Loss (2011Q4-2013Q4)= 4.05% (Predicted based on RC Stress Testing Model)
Conclusion

A top down approach stresses both PD and LGD

Broadly applicable
Reasonable Results

A bottom up approach based on RiskCalc Corporate model

Link the financial statement inputs as well as CCA factors to macro variables

Validation results show that the predicted values line up well with the realized values

The model provide meaningful variations across different stress scenarios

Users can provide customized scenarios
Join us this year for our largest conference yet!

• Learn from your peers how regulation has driven risk management best practices within their organizations

• Hear from industry, regulatory, academic and economic experts how a firm’s practices can produce business benefits well beyond compliance

• Network with 250+ senior risk management executives from the industry

• Build knowledge and gain CPE Credits

• Explore Moody’s Analytics award-winning solutions, and roadmap for future enhancements

New Location for 2013 – Beautiful Scottsdale, Arizona!