Credit Risk Modeling and Examination Techniques
Objectives

- Board and Senior Management Oversight
- Policies, Procedures, and Limits
- Measurement, Monitoring, and MIS
  - Modeling
- Internal Controls and Audit
Board and Senior Management Oversight
Board and Senior Management Oversight

- Majority of work done to evaluate board and senior management oversight is done off-site and during preparation of the risk assessment
- Key objective is to evaluate the quality of management
- Primary exam technique is interviews with board members and senior management
- Also review board and committee packages
Questions to ask:

- Does management seem knowledgeable?
  - Discuss specific problem loans
  - Discuss the strategic direction of the portfolio
  - Discuss the budget and growth expectations
  - Discuss new or departed employees
  - Discuss changes in products or processes and the risks brought on by those changes
Board and Senior Management Oversight

Questions to ask (cont.):

- Does management seem aware of the risks present in their portfolio, underwriting guidelines, etc.?
  - Discuss specific underwriting guidelines and limits and why management chose them
  - Discuss the portfolio composition
- Does management seem aware of the health of the economy in their market?
  - Discuss future expectations for the economy
  - Discuss the impact of the economy on budget projections
Board and Senior Management Oversight

- **Board and Committee Packages**
  - Are the board and senior management getting the right amount of information to make good decisions?
  - Is the information useful?
  - Is the information detailed or summary?
  - Is there any written analysis with the information?
  - Are credit risk and credit risk management discussed?

- Are the board and senior management timely and effective in responding to audit, loan review, and exam findings?
Policies, Procedures, and Limits
Policies, Procedures, and Limits

- Off-site work is done to determine the adequacy of policies, procedures, and limits.
- Risk assessment focuses on defining the bank’s stated risk tolerance.
- On-site work focuses on testing the adherence to, and enforcement of policies, procedures, and limits.
Testing Adherence to Policies, Procedures, and Limits

- Loan file review
  - Adherence to loan approval policies
    - Exceptions
    - Conditional approvals
  - Adherence to loan monitoring policies
    - Covenants
    - Periodic analysis (occurrence and quality)
  - Accuracy and timeliness of internal loan grading
  - Loan grade supporting analysis
Testing Adherence to Policies, Procedures, and Limits

- Loan file review (cont.)
  - Problem loan identification
  - Adequacy of loan impairment analysis for LLR accounting
  - Adherence to accounting rules and regulations
  - Documentation
    - Loan docs
    - Collateral docs
    - Financial statements

- Review management reports → all bank, legal, or regulatory limits should have a report to monitor compliance with the limit.
Measurement, Monitoring, and MIS
Measurement, Monitoring, and MIS

- Management Reports
  - Types
  - Exam techniques

- Models
  - What is a model and why models are used
  - Types and uses
  - Model validation
  - Exam techniques
Types of Management Reports

- **Traditional**
  - Past dues
  - Charge offs/losses
  - Non-accrual/Non-performing
  - Technical exceptions

- **Forward Looking**
  - New loan reports (volume, pricing, credit quality)
  - Loss projections
  - Pipeline reports

- **Portfolio Management**
  - Transition matrix
  - Portfolio distribution
  - Economic capital
  - Credit scoring reports
    - Vintage analysis
    - Characteristic analysis
    - Population analysis
  - Credit risk model reports
  - Product line analysis
Exam Techniques for Evaluating Management Reports

- Timely, Accurate, and Useful
- Old information is not actionable
- Inaccurate data will lead to bad reports which will lead to bad decisions
- Useless reports will be ignored or worse, misunderstood
  - Too much detail/not enough detail
  - Poor labeling
  - Confusing information
Exam Techniques for Evaluating Management Reports

- Focus on how management reports are generated → automated vs. manual
  - Are there policies and procedures for generating the reports?
  - What is the process for getting a new report developed?
  - Ask how each report is validated and by whom especially if the report is manually prepared

- Identify the data sources for each management report
  - Loan systems and other databases, information from loan officers, models
  - Are the data sources secure?
  - How are they audited? Are they audited?
  - Do they capture the right information?
Exam Techniques for Evaluating Management Reports

- Evaluate what each report is used for and what information they are trying to convey
  - The higher up in the organization, the less detail is required, and the more global the reports should be
  - Many times, separate written analysis should accompany the reports
  - Summary reports should be backed up with supporting detailed reports
- Questions to ask:
  - Is the body of reports that goes to each level of management appropriate for that level?
  - Who decides what is appropriate?
  - How are new reports requested, developed, and produced?
What Is a Model?

- Analytical approximation of reality that simplifies complex relationships
- A tool to help management solve a business problem
- A set of very specific assumptions about how the world behaves
Reasons for Wider Use of Models

- Better technology at a lower cost
- Improved financial theories and engineering
- Industry acceptance of more active and dynamic risk management
- More competition in the financial sector
Types of Models

- **Commercial credit models**
  - Probability of default (PD) models
  - Loss given default (LGD) models
  - Exposure at default (EAD) models

- **Consumer credit models**
  - Default models
  - Bankruptcy models
  - Behavioral models
  - Loss given default (LGD) models
  - Exposure at default (EAD) models
Types of Commercial Credit Models

- **Probability of default (PD) models**
  - For a group of borrowers with similar characteristics, predicts the number of borrowers that are likely to default over a specific time horizon, e.g. 1 year
  - Is based on the characteristics of the borrower

- **Loss given default (LGD) models**
  - Attempts to predict the amount of loss in a credit in the event of default
  - Is based on the characteristics of the facility, i.e. collateral covenants, etc.

- **Exposure at default (EAD) models**
  - For unfunded lines of credit, attempts to determine the amount of exposure that will exist at the time of default
  - Is based on the characteristics and purpose of the facility and the behavior of the borrower
Commercial Credit Models

- Relatively new compared to consumer credit models
- Lack of data is the biggest problem in model development
- PD models are further along than LGD and EAD models
Commercial Credit Models

- General characteristics of commercial credit models
  - Strictly define what elements are considered in the measurement of credit risk
  - Strictly define the relative weight of those items considered in the measurement of credit risk
  - Can produce either a relative measure of credit risk or a specific measure of credit risk depending on whether judgmental factors are considered in the model
    - The probability of default or loss given default for credits with these characteristics is X%
    - Credits with these characteristics are stronger or weaker than other credits
Consumer Credit Models

- EAD and LGD models are basically the same for commercial and consumer
- Consumer models are based on borrower characteristics, but focus on different characteristics
- Default models
  - For a group of borrowers with similar characteristics, predicts the number of borrowers that are likely to default over a specific time horizon, e.g. 1 year
  - Focuses on amount of credit available to borrower, stability of borrower, and history of delinquency
Consumer Credit Models

- **Bankruptcy models**
  - For a group of borrowers with similar characteristics, predicts the number of borrowers that are likely to file bankruptcy over a specific time horizon, e.g. 1 year
  - Focuses on amount and the types of credit used by the borrower

- **Behavioral models**
  - Focuses on the behavior of an individual customer and the lender’s experience with that customer to focus the bank’s collection and marketing efforts
  - Focuses on payment history and spending patterns
Model Validation

- Models require validation because there is potential for error in modeling, which can lead to poor management decisions.
  - Data
  - Assumptions
  - Calculations
  - Output

- The existence of potential errors in modeling is called model risk
Why Does Model Risk Exist?

- At some level a model is always incorrect
- There is the potential for poor decisions from erroneous results
  - Actual losses
  - Foregone income from opportunity costs
- Some of the worst of the risks center around implementation
Guiding Principles of Model Validation

Balance the benefits for risk management with the costs of validation

BUT

All models need to be validated at some level
The one risk we didn't allow for was overspending so heavily on risk management that we went bust.
Model Components

- Data: organize and confirm
  - Stratification
  - Aggregation
- Theoretical approach and code:
  - select the “right” model and ensure that adequate vendor support exists
- Assumptions: describe behavior
  - The bank’s behavior – how planning will change
  - Customer behavior – pool level and behavior choices to be made
- Reports: the payoff for management
Theory

Development

Input

Processing

Output

• Data
• Assumptions

Calibration

Testing/Validation

Yes?

No?

Implementation Strategy

Approval

Production

• Data
• Assumptions

Risk Management

• Sensitivity (Broad)
• Benchmarking
• Stress Testing

Governance and Control Structures

• Board and Senior Management Oversight
• Policies, Procedures and Limits
• Risk Systems and Information Technology
• Independent Audit and Risk Management

Change Needed?

Yes?

No?

Periodic Review

Notification

Figure – 1: Model Risk Management Framework
Elements of a Sound Validation Policy

- Independent review
  - May not be practical at smaller institutions
    - But…input and output should always be scrutinized and tested
  - Potential substitute might be formal communication that ensures decision makers are informed regarding assumptions and potential limitations
Elements of a Sound Validation Policy

- Defined responsibilities
  - Initial approval of model
  - Approval of assumptions
  - Verification of data flows
  - Installation of new releases
  - Tracking of identified bugs
Elements of a Sound Validation Policy

- Model documentation
  - List of all models used by the company
  - Procedures for the use of each model
  - Descriptions of customized components of the models
  - Personnel responsible for running the model
  - Contingency plan for model and data “loss”
Elements of a Sound Validation Policy

- Change control
  - Limit frequency of changes
  - If practicable, independent review of all changes
  - Track changes and their expected/actual effects over time
  - Restricted access to all models and key support programs
  - Adequate backup
Elements of a Sound Validation Policy

- Audit oversight
  - Responsible for assessing efficacy of policy
  - Responsible for adherence to policy
  - May have responsibility for some aspects of validation
    - Make sure financial data foots
    - Ensure assumptions are correctly entered
Approaches to Independent Validation

- Third party review
  - Internal independent auditor
  - External auditor
  - Risk management consultant

- Compare against other models (benchmarking)
  - Most appropriate for individual instruments

- Comparison with actual events
  - Can be a challenge unless the environment that happened was actually modeled
Modeling Process—What are We Validating?

- Inputs
- Processing
- Output
What Areas Should We Test?

- Logic
- Benchmarking
- Backtesting
- Stress testing
<table>
<thead>
<tr>
<th></th>
<th>Logic</th>
<th>Benchmarking</th>
<th>Backtesting</th>
<th>Stress-testing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inputs</strong></td>
<td>Do the inputs make sense?</td>
<td>Do inputs from other sources compare?</td>
<td>Is the quality of the input reviewed or tested?</td>
<td>Develop inputs that stress the model in meaningful ways.</td>
</tr>
<tr>
<td><strong>Processing</strong></td>
<td>Is there appropriate theoretical support for the logical code and/or equations?</td>
<td>Run test data through a second, validated model, or a similar methodological system.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td>Are model results being used appropriately?</td>
<td>Compare model results to known solutions (e.g., put/call parity) or previously validated models.</td>
<td>Compare realized results to forecast estimates</td>
<td>How does the model perform if illogical or “extreme” inputs are utilized??</td>
</tr>
</tbody>
</table>
Input Validation

- Financial data
  - Check against GL and other internal sources
  - Check third party sources
  - Is usually a challenge at first

- Assumptions
  - Should be based on bank’s experience
  - Perform comparisons between assumed and actual
Process Validation

- Compare results against a benchmark model
- Request vendor validation procedures and reports
- All technical processes should be understood in nontechnical or financial terms
Summary of Supervisory Expectations

- Bank’s decision-makers should understand the meaning and limitations of a model’s results
- As much as practicable model results should be tested against actual outcomes
- The information inputs to the model should be regularly audited
Summary of Supervisory Expectations

- The seniority of the management over the modeling process should be equal to the materiality of the risk being measured.
- Model validation should be independent from model construction.
- Model-validation responsibilities must be clearly defined.
Internal Controls
Internal Controls

- Policies lay the foundation for internal controls
- Procedures detail internal controls
- The risk assessment should include a hypothesis on the effectiveness of the internal controls.
- On-site testing should focus on the effectiveness of the internal controls.
Exam Techniques for Internal Controls

- **Credit granting**
  - Verify that loan approvals conform to policy and are done before the loan is funded
    - If loans are approved with conditions, confirm that the conditions are met
  - Understand the exception approval process and confirm that it is being adhered to
  - Determine who has access to each loan system and the general ledger and verify that no one in production has any level of system authority above read/review
Exam Techniques for Internal Controls

● Production and back office separation:
  - Verify who is responsible for booking new loans, posting loan payments, charging off loans, disbursing loan proceeds, releasing collateral, etc.
  - Determine the process for requesting changes to systems information such as address, loan grade, interest rate, etc. and verify that the policies are being followed
Exam Techniques for Internal Controls

- Back Office
  - Determine who is responsible for maintaining the bank’s original loan and collateral documentation
    - Verify that processes are in place to follow up on missing or expiring documents
  - Determine the process for tracking and reporting on exceptions
    - Policy exceptions
    - Documentation and other technical exceptions
Independent Validation
Independent Validation

- Loan Review and Audit both have roles
- The line between the two groups is not always clear
- For examiners it is important to understand the role and scope of each group and to ensure that no material risks fall between the cracks
The Role of Loan Review

- File review
- Testing for adherence to underwriting policies and procedures
- Assessing the adequacy and completeness of credit decisioning documentation
- Assessing the adequacy and completeness of credit analysis
- Confirming the accuracy of loan grades
The Role of Audit

- Test internal controls
  - Payment processing
  - Loan disbursements
  - Loan confirmations

- Assessing the effectiveness of credit administration in protecting the bank’s assets
  - Collateral perfection
  - Documentation
  - Technical exception identification and resolution
Exam Techniques for Loan Review and Audit

- Read their reports
- Review their work programs and understand the scope of the work and coverage
- Review their schedule and determine whether or not they are on schedule
- Review their workpapers to judge whether they are making good decisions
- Review staff qualifications
- Review the process by which findings are communicated, and followed up on
Questions?