



BDO ADVISORY

Is Your Model Risk Management (MRM) Program Ready?

VALUATION & BUSINESS ANALYTICS

October 24, 2018



Why BDO?

BDO GLOBAL NETWORK

Accounting & Audit
57%
Tax
22%
Advisory
21%



 **162**
COUNTRIES

 **1,500**
OFFICES

 **73,854**
TOTAL PERSONNEL

EXCEPTIONAL SERVICE. WORLDWIDE.

With a network spanning more than 160 countries worldwide, BDO is the 5th largest global network of public accounting firms. Our seamless global approach allows us to serve clients through a central point of contact, granting access to relevant experience across borders - where and when our clients need us.

Statistics as of and for the year ended 9 -30-17.

BDO USA, LLP

Assurance
49%
Tax
34%
Advisory
17%



 **60+**
OFFICES

 **550+**
ALLIANCE FIRM
LOCATIONS

 **6,461**
TOTAL PERSONNEL

100 YEARS, AND COUNTING.

When M. L. Seidman founded Seidman & Seidman in 1910, there were just over 2,000 accountants in the entire United States, and by the 1980's the global network had been established - and the firm was renamed BDO Seidman.

Today, BDO's entrepreneurial spirit lives on, and the firm continues its history of growth as it expands across the country. Yet, no matter how large we become, we will continue to remain united under a common purpose: helping people thrive, every day.

Statistics as of and for the year ended 6-30-17.

Complex Financial Instrument (CFI) Valuation Services

Companies face additional scrutiny from regulators over complex financial instruments. CFI experts can assist with financial reporting, tax compliance, and financial management of these assets. We provide advice in a number of areas, including:

- ▶ Valuation of illiquid and complex securities
- ▶ Hard-to-value assets
- ▶ Derivative (including over-the-counter derivative) valuation
- ▶ Portfolio company valuation, and hedge advisory

Asset Classes	Specialized Asset Characteristics	Services	Business Needs
<ul style="list-style-type: none"> ▶ Equity ▶ Debt ▶ Option ▶ Warrants ▶ Futures ▶ Swaps ▶ Convertible Securities ▶ Embedded Derivatives ▶ Structured Notes ▶ Loan Guarantees 	<ul style="list-style-type: none"> ▶ Conventional or unconventional payouts ▶ Contingent considerations ▶ Illiquid, non-tradable ▶ Hybrid securities ▶ Other 	<ul style="list-style-type: none"> ▶ Pricing/valuation ▶ Modelling ▶ Model analysis ▶ Strategic assessment/advisory ▶ Bifurcation of derivatives ▶ Hedging 	<ul style="list-style-type: none"> ▶ Financial reporting ▶ Tax planning ▶ Investment decisions ▶ Joint venture structuring ▶ Acquisition strategy ▶ Compensation agreements ▶ Hedge effectiveness testing

Our expertise with the most complex debt, equity, derivative, and real estate investments allow us to process sophisticated quantitative models and deliver in-depth analysis of securities - no matter the size of the investment portfolio.

What's BDO's Advantage?

BDO Consulting's professionals specialize in **Valuation Of Illiquid And Complex Securities.**

Current Expected Credit Loss (CECL) Services

Gap Assessment



- ▶ Asset Segmentation
- ▶ System & Data Review
- ▶ Model Execution
- ▶ Calculation and Methodology
- ▶ CECL Models Inventory
- ▶ Accounting

Planning and Design



- ▶ Governance and Oversight
- ▶ Data Security & Repository
- ▶ Process Execution
- ▶ Change Management
- ▶ Disclosure Reporting
- ▶ Risk & Control Analytics

Implementation and Support



- ▶ Program Management
- ▶ People and Staff Support
- ▶ Technology and Vendor Assessment
- ▶ Process Design
- ▶ Training and Development
- ▶ Risk Assessment and Control Testing
- ▶ Predictive Analytics
- ▶ Model Validation

What is BDO's Value Proposition?

- ✓ Accelerates implementation and steady state
- ✓ Leverages existing processes and tools
- ✓ Facilitates collaboration between stakeholders
- ✓ Offers options and access to technology

Model Risk Management Services



MODEL RISK GOVERNANCE FRAMEWORK

- ▶ Develop governance policies that provide a framework for model risk management throughout the organization
- ▶ Provide recommendations to the existing model risk management framework to ensure compliance with appropriate guidelines
- ▶ Develop appropriate documentation to ensure that models are compliant with Fed and OCC guidelines



MODEL VALIDATION

- ▶ Perform validations of in-house developed or third party vendor models through a process of theory review, code review, benchmarking, document and controls review, and implementation review
- ▶ Provide comprehensive validation documentation compliant with Fed and OCC guidelines that will withstand audit scrutiny



MODEL DEVELOPMENT

- ▶ Review the model development and execution process from beginning to end
- ▶ Ensure that process is compliant with necessary regulations
- ▶ Develop models that address a wide range of issues from credit risk, operational risk, market risk, stress testing and forecasting



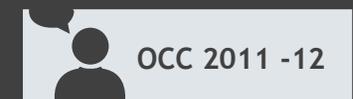
DOCUMENTATION AND CONTROLS

- ▶ Develop comprehensive model as well as process documentation that is compliant with all regulatory guidance
- ▶ Establish controls to ensure that regulatory compliance while minimizing human error
- ▶ Review controls prior to audit
- ▶ Develop a framework to ensure thorough and accurate control execution

● Where can BDO help your organization?

Our deep statistical modeling experience trickles down to our best in class validation services which generates value for an array of Model Types throughout the modeling Lifecycle.

ASK US ABOUT



Securitization Services

Historical Pool Analysis: provide an in depth analysis of the collateral by diving into the historical performance of the pool of loans.

Physical Loan File Due Diligence / Loan Review: Perform a complete file review by comparing original loan documentation files to their digital counterparts. Ensure that IT extraction is performed accurately and uploaded to the system correctly.

Structure Analysis and Modeling: BDO has developed cash flow models for clients that illustrate how their structures function. We can also perform various types of sensitivity analysis to show how the deal can perform under different types of scenarios.

Tax and Regulatory Advisory: BDO is a leading service provider of tax and regulatory matters.

Valuation: Using industry standard structuring tools such as INTEX or Moody's Analytics, BDO generates the future cash flows. By applying the appropriate spreads, fair market values are calculated

COLLATERAL ANALYSIS

RATING AGENCY PREPARATION

STRUCTURING ANALYSIS

PRE-CLOSING ACTIVITIES

POST-CLOSING & OTHER SECURITIZATION SERVICES

Rating Agency Preparation: BDO works with our clients closely to help prepare for the Rating Agency review. We ensure that our clients build a well supported structure when presenting the analysis to the Rating Agencies for rating.

Agreed Upon Procedures (AUP): BDO has proven expertise to perform all the activities required under an Agreed Upon Procedures and prepare a detailed report with all our observations.

Transaction and Asset Analysis: BDO has the right tools to model and analyze the deal. We can calculate the cash flows based on offering assumptions. BDO also has the right set of expertise in every asset class to perform due diligence, pool sampling and data validations on the collateral to ensure that information on the offering memorandum and other documentation is accurate for a smooth closing process.

Home Mortgage Disclosure Act (HMDA) Services

Current State Assessment



BDO can perform an independent assessment Of your current HMDA collection, storing and reporting processes. This service covers the review of your policies and procedures, Staff capabilities and controls. Our comprehensive assessment identifies and pinpoints risks that will help in the development remediation plans to address weaknesses and pain points as well as develop strategies to improve overall processes.

HMDA Future Roadmap Design



BDO can help you design and address any issues identified in your current state assessment and ensure compliance with Regulation C especially with the ever changing rules and regulations. Part of the service is creating a report that will include your preparedness assessment, grade, implementation plan and roadmap to help your organization get to your ideal HMDA state.

Loan Application Registry (LAR) Review and Testing



HMDA is all about accuracy. BDO can help you identify and remediate prior and potential inaccuracies in your collecting and reporting processes. BDO tests the process by taking a sample approach. BDO will ensure that all loans are covered and the probability of identifying errors in the process is maximized. BDO loan testing experts can identify systematic and one time errors ensuring that your process remains compliant.

Advisory Support



BDO can help clarify those areas of concern and confusion. Our subject matter experts can advise your organization whether it pertains to policy, data and technology or best practices. You can be sure that you have the right counsel and advisors at your side.

Tools and Technology Selection and Implementation

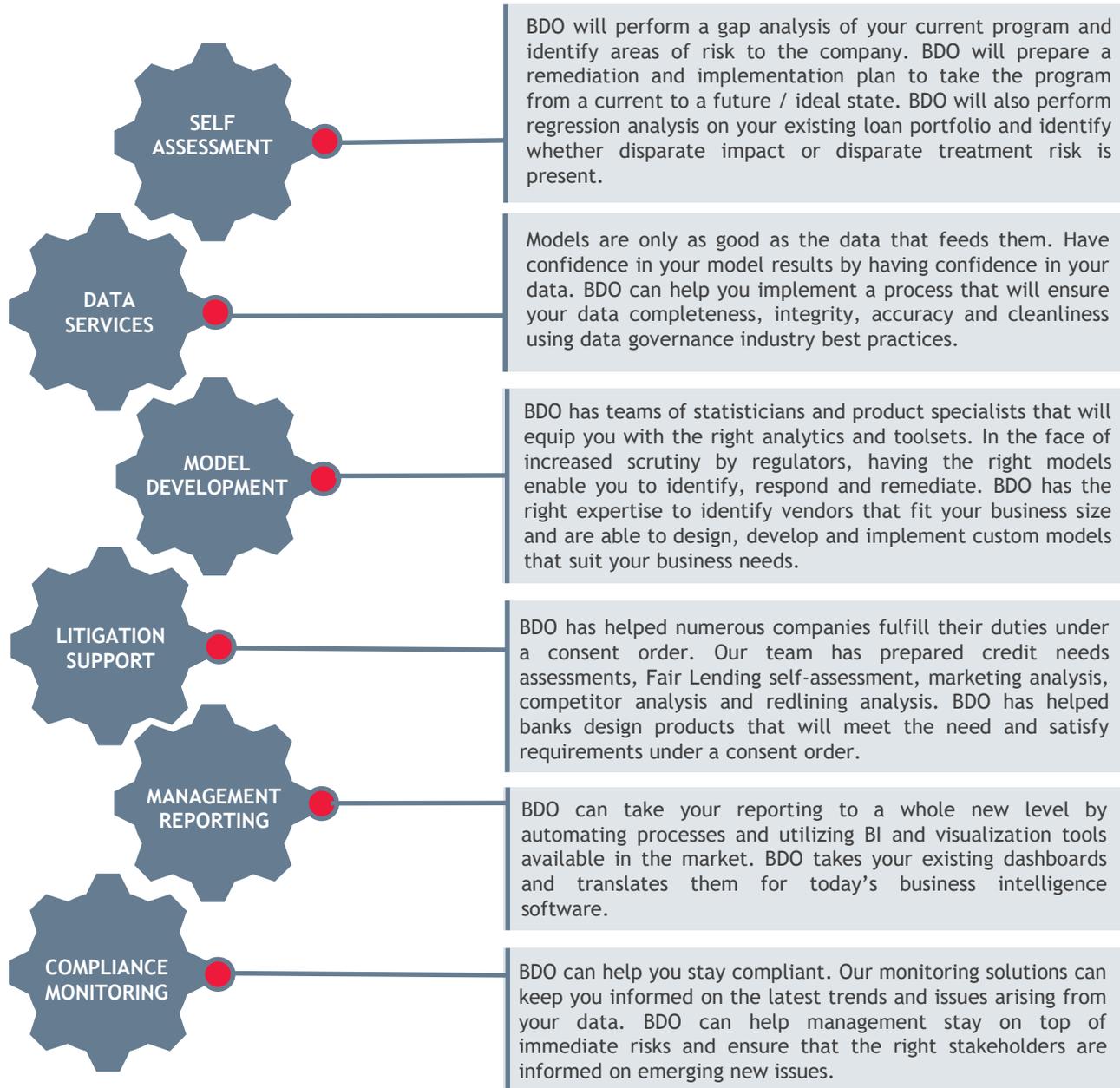


When collecting and testing data to preparing submission files, technology and automation can help ensure that the process is painless, seamless and consistent. BDO can help you identify the right software that will get the job done. Can't find the right fit? BDO can even develop custom solutions that will meet all your requirements.

What are your HMDA goals?

- Eliminate risks associated with non-compliance
- Achieve greater accuracy in HMDA reporting
- Leverage HMDA compliance practices

Fair Lending Services



Capital Stress Testing Services

Challenges



Data Development And Governance



Modeling and Quantification



Model Validation



Regulatory Reporting

Requirements

- ▶ Disparate sources require data quality due diligence
- ▶ Data gaps across business units
- ▶ Preparing relevant documentation

- ▶ Mapping macro-scenarios to micro outcomes
- ▶ Segmentation
- ▶ Model data, statistical logic, robust methodologies

- ▶ Regulatory compliance
- ▶ Benchmarking
- ▶ Logic and methodology soundness
- ▶ Implementation - different types of models and techniques

- ▶ Reporting packages
- ▶ Qualitative and quantitative disclosures

BDO Services

- ▶ Operational Gap Analysis and Remediation
- ▶ Compliance Program Design and Implementation
- ▶ Model Development and Implementation
- ▶ Independent Model Validation
- ▶ Model Governance Policies and Procedures Creation
- ▶ Regulatory Exam Response Support
- ▶ Data Integrity and Capture
- ▶ Data Governance
- ▶ Project Management, Vendor Selection and Technology Enablement
- ▶ Staff Augmentation

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“It was a calculated risk, and we forgot to carry the one.”

Introduction

Adoption of Supervisory Guidance on Model Risk Management (FIL-22-2017)

Summary

On June 7, 2017, The FDIC adopted the **Supervisory Guidance on Model Risk Management** previously issued by the Board of Governors of the Federal Reserve System ("FRB") (SR 11-7) and the Office of the Comptroller of the Currency ("OCC") (OCC Bulletin 2011-12), with technical conforming changes, thereby making the guidance applicable to certain FDIC-supervised institutions. The guidance addresses supervisory expectations for model risk management, including:

- ▶ Model development
- ▶ Model implementation and use
- ▶ Model validation
- ▶ Model governance, policies, and controls

The FDIC is adopting this guidance to facilitate consistent model risk-management expectations across the banking agencies and industry

Statement of Applicability to Institutions under \$1 Billion in Total Assets

It is not expected that this guidance will pertain to FDIC-supervised institutions with under \$1 billion in total assets unless the institution's model use is significant, complex, or poses elevated risk to the institution.

Where are you in the process?

Definition of a Model

According to the regulatory guidance

A model is defined as:

“a quantitative method, system, or approach that applies statistical, economic, financial, or mathematical theories, techniques, and assumptions to process input data into quantitative estimates”.

“the definition of model also covers quantitative approaches whose inputs are partially or wholly qualitative or based on expert judgment, provided that the output is quantitative in nature”

Examples of Models

1. Vendor models such as Expected Loss Models (ALLL), Loan Pricing Models, Asset Liability Management (ALM) , Unexpected Loss (Capital Stress Testing) and Fair Lending Models
2. Excel Models used to calculate the above

Understand your exposure to model risk

Model risk rears its ugly head as a consequence from the following:

- ▶ Poor Business and Strategic Decisions
- ▶ Financial Losses
- ▶ Regulatory Penalties
- ▶ Legal Ramifications

Results from using models whose data, assumptions, design, underlying theory, output or use is inappropriate

Understanding the risk that each model will pose will help you better understand your institutions exposure

Creating and maintaining a comprehensive model inventory

Key Steps to an effective Model Inventory

- 1) Identification:
 - 1) Establish the organizations definition of a model
 - 2) Translate into a set of rules that can be used to assess the models in the organization

- 2) Model Risk Assessment:
 - 1) Things to consider when determining the risk of each model
 - ✓ Financial impact
 - ✓ Impact on customer outcomes
 - ✓ Regulatory risk
 - ✓ Data quality
 - ✓ Level of sophistication
 - ✓ Level of complexity
 - ✓ Output and how it is used
 - ✓ Potential for reputational risk

- 1) Accountability
 - 1) Identify key model users
 - 2) Identify model owners, developers

Develop Model Risk Management Documents and Tools

- 1) **Model Risk Management Policy:** The policy should cover procedures for the following
 - ✓ Model Development
 - ✓ Model Validation
 - ✓ Model Inventory
 - ✓ Model Documentation

- 2) **Model Risk Management Templates**
 - ✓ Model Documentation
 - ✓ Model Validation

- 3) **Model Risk Tiering**

BDO offers a free service where we can assess and risk tier your model.

Final Points

1. Hire / designate a champion who will be responsible for Model Risk Management
2. Implementing a plan to bring existing models into compliance with the new MRM framework by remediating any gaps in model documentation and validation

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EXPERIENCE SUMMARY

Matthew Goldberg is a Principal in the Seattle office of BDO and leads the firm's Complex Financial Instruments Practice. Having almost 15 years of consulting and financial services experience, he has performed valuation analyses for clients in numerous industries including investments, energy, life sciences, technology, media, industrial, retail, and manufacturing.

Mr. Goldberg has extensive experience valuing a wide range of complex derivatives including adjustable stock options and warrants, restricted stock units, performance-based shares, convertible debt instruments, and other hedging instruments such as interest rate swaps and put/call strategies.

He has been involved in numerous engagements including assisting management in strategic planning, performing projects for financial reporting and tax reporting, and providing consulting services related to mergers and acquisitions.

Mr. Goldberg has worked on numerous valuation assignments for purposes of ASC 718 and ASC 805 intangible asset valuation and purchase price allocations, ASC 350 goodwill impairment analyses, and international tax valuations.

Prior to joining BDO, Mr. Goldberg worked in Ernst & Young LLP's Transaction Advisory Services Practice providing valuation services. His experience includes providing consulting services for buy- and sell-side transactions, investment banking, pre-acquisition due diligence, and business interruption analyses.

EDUCATION

M.B.A., Global Finance and French, Thunderbird School of Global Management

B.S., Finance, Colorado State University

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EXPERIENCE SUMMARY

Sudip Chatterjee is a Managing Director in the New York office of Valuation and Business Analytics practice of BDO. Sudip specializes in complex securities and derivatives valuation and asset/liability management. Prior to joining BDO, Sudip has led several engagements related to valuation and validation of complex instrument models and led risk management teams at Navigant, Merrill Lynch and Mortgage IT Holdings. Sudip has worked in research group at Donaldson, Lufkin & Jenrette Securities for six years. During this period, the research group was ranked #1 for four years in a row by Institutional Investor (1994 - 1997).

- ▶ **Price Verification:** Developed and implemented independent price verification processes for investment portfolio of global asset managers. Coordinated teams that valued several hundred positions including agency and non-agency CMOs, ABS, CMBS, CDOs and derivatives.
- ▶ **CCAR / DFAST Stress Testing:** Assisted a multi-national bank to meet all reporting standards outlined by CCAR-14A's guidelines. The task involved developing "challenger" models, which included three (3) Fed scenarios and two (2) internally developed forecasts, for the Bank's retail customer deposit accounts. The results of the forecast were presented to the senior management for "review and challenge" sessions between the Finance Division and the Business Units.
- ▶ **Model Governance:** Validated several market, credit and operational risk models - based on SR 11-7 / OCC 2011-12 guidance for model validation and model risk management. Recently validated models which include PolyPaths, QRM, Summit and various other pricing models for fixed income instruments. Managed teams of consultants to validate and document Pyramid and Calypso derivative pricing systems.
- ▶ **Risk Management:** Led a team of analysts to manage interest rate risk of a multibillion dollar financial institution. Presented market value of equity and income simulation analysis to the ALCO meetings on a quarterly basis. Assisted the senior management of a global asset management firm with \$3 billion in mostly single-name CDS transactions in fair and equitable allocation of positions that distributed value as well as risk, return, liabilities and liquidity among the existing class and the redeeming class of shares.
- ▶ **Basel III:** Assisted clients with converting from risk-weighted, asset-based capital distribution model to liquidity and stress-scenario-based model.

EDUCATION

M.B.A. Finance and Marketing, University of Rochester, Simon School of Business, New York
B.S. Mechanical Engineering and Management, Illinois Institute of Technology, Chicago

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Director



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EXPERIENCE SUMMARY

Anthony Ruda is a Director in the New York office of BDO, supporting the Valuation and Business Analytics practice. He has over 14 years of hands-on industry experience providing financial services for various size banks. He specializes in valuation, structuring, model risk governance, model development and implementation, big data analysis, automation and data governance. He has experience working with Legal Counsel in matters of Valuation and Regulatory Compliance.

- ▶ **Structured Finance and Valuation:** Anthony's experience in structured products include structuring, creating waterfall models for complex structures using SAS, R and Excel, valuation of securities backed by various types of assets such as RMBS, Auto, Commercial and Specialty Assets. He has worked with Audit Partners and Investment Banks performing Agreed Upon Procedures (AUP). He has experience using tools such as Intex Dealmaker and Intex Desktop.
- ▶ **Model Risk Management:** Performed SR11-7 compliant validation and documentation of in-house developed models as well as vendor models. Anthony has performed validation of ALLL models and systems (Primatics EVOLV), anti-money laundering systems, predictive and machine learning models, internal and third-party vendor developed models and Asset Liability Systems such as QRM ALM. Anthony's has expert knowledge in various programming languages such as SAS, VBA, SQL, and C++.
- ▶ **Fair and Responsible Banking:** Anthony's consumer product experience (Mortgages, Auto, Credit Cards and Student Loans) in underwriting, pricing and Servicing in conjunction with over 10 years of experience in consulting has cemented him as a subject matter expert in the field of Fair Banking. Anthony has the insight and experience in the development and implementation of statistical models and analysis and has regulatory remediation experience through advising and working with banks under consent orders (credit needs assessment, competitor analysis, product assessment). His extensive knowledge of Fair Lending regulations (FHA and ECOA) has helped in the development and review of policies, procedures, and training. He has worked with Legal Counsel and Regulators when address MRAs (Matters Requiring Attention).
- ▶ **Regulatory Compliance:** Experience in various regulatory compliance such as Fair Credit Reporting Act (FCRA), Unfair Deceptive Acts and Practices (UDAAP), Home Mortgage Disclosure Act (HMDA) and Consumer Reinvestment Act (CRA)

Prior to joining BDO, Anthony worked at Navigant Consulting, Inc. and prior to that he held positions with two of the top mortgage lenders in the nation.

EDUCATION

B.B.A., Finance, Information Technology, Baruch College, City University of New York.

