



Asset Liability Management 101 - Part Two of Three:

The Building Blocks for a Solid IRR Modeling Process & Testing Assumptions

Wednesday, August 25th, 2021

MountainView Risk & Analytics, a SitusAMC Company, provides model risk management services and loan and deposit behavior analytics that enable financial institutions to identify and manage risk.

Formerly McGuire Performance Solutions, MountainView's team of experts empowers our partners to make informed and confident decisions leveraging our unrivaled depth of expertise, dedication, and market knowledge.



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ALM / IRR Webinar Series 2021

2 - TODAY

Building a Sound IRR Model & Testing Assumptions

Webinar #1

**Laying The Foundation
For Interest Rate Risk Management**

Webinar #3

**How Good Governance Strengthens Your
Model Framework**

Date: November 17, 2021



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Stakeholder Expectations for IRR



Stakeholder Expectations for IRR

Stakeholders must have confidence in the Institution's Interest Rate Risk (IRR) management program.

- Confidence must be established to confirm that the model is appropriately implemented and is being used and is performing as intended.
- Verification of the model's ability to properly identify and model the Institution's balance sheet characteristics and forecast IRR exposures is critical.
- Accuracy within reason is mandated.

Stakeholders

- *ALCO*
- *Board of Directors*
- *Shareholders*
- *Regulators*

Stakeholders Expectations for IRR

The Board / ALCO / Management are **responsible** for the model's ability to accurately forecast even if the model is outsourced.

Key Components for an Accurate and Effective Model are:

- Data Quality
- Model Set Up and Segmentation
- Model Assumptions
- Risk Reporting

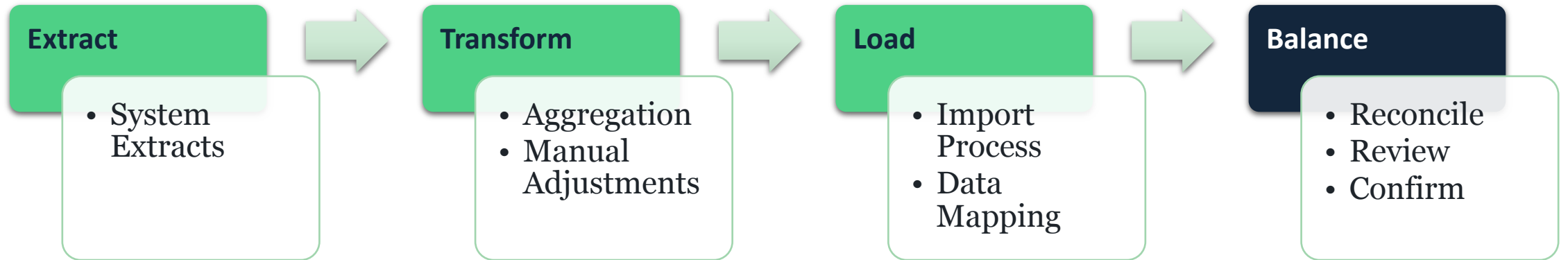
Ensuring Data Quality



Ensuring Data Quality

The key component to an accurate ALM Model is data integrity.

ETL Process:



The output is only as good as the input
“Garbage In – Garbage Out”.

Confirm Data Completeness and Mapping

Appropriate Fields

- Maturity Date
- Payment Amount
- Loan Rate
- Next Payment Date
- Payment Frequency
- Repricing Information if applicable (Repricing Date, Rate Change Code)
- Balloon Information if applicable
- Participation Information if applicable
- Caps and Floors

Confirm appropriate product mapping

- Variable and Fixed attributes
- Amortization Types (Bullet, Amortizing, Interest only)
- Maturity terms / Balloons
- Variable repricing data is complete
- Codes are identified i.e. payment frequency

Reconciliation Process

1 System Extracts to G/L

Confirm system extracts reconcile to G/L
Determine variances

2 Make Adjustments to Balances

Track and Trend Out of Balance Amounts
Compare to Variance Thresholds
Research if needed
Make Adjustments

3 Reconcile Model Balances



Review Current Position

Review maturity and repricing schedules including rates to ensure accuracy.

	Current	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20
	Position												
RE - ARM													
Maturity	2,378,920	111,462	196,200	25,511	28,450	25,094	83,063	80	42,258	18,388	69,346	17,176	185,230
Maturity Rate	6.60	6.86	6.05	6.40	6.43	6.38	6.13	6.52	6.81	6.55	7.71	6.49	6.95
Repricing	2,378,920	2,378,920											
Repricing Rate	6.60	6.60											

Why is the balance so low in July 2020?

	Current	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20
	Position												
6 Month CD													
Maturity	6,964,636	782,434	1,204,773	837,157	853,728	822,468	1,327,858	1,112,765	-	234,525	-	-	-
Maturity Rate	0.77	0.76	0.77	0.75	0.75	0.75	0.75	0.85	0.00	0.75	0.00	0.00	0.00

Why is there a balance in the 9th time bucket?

Effective Model Set Up and Segmentation



Chart of Accounts Segmentation

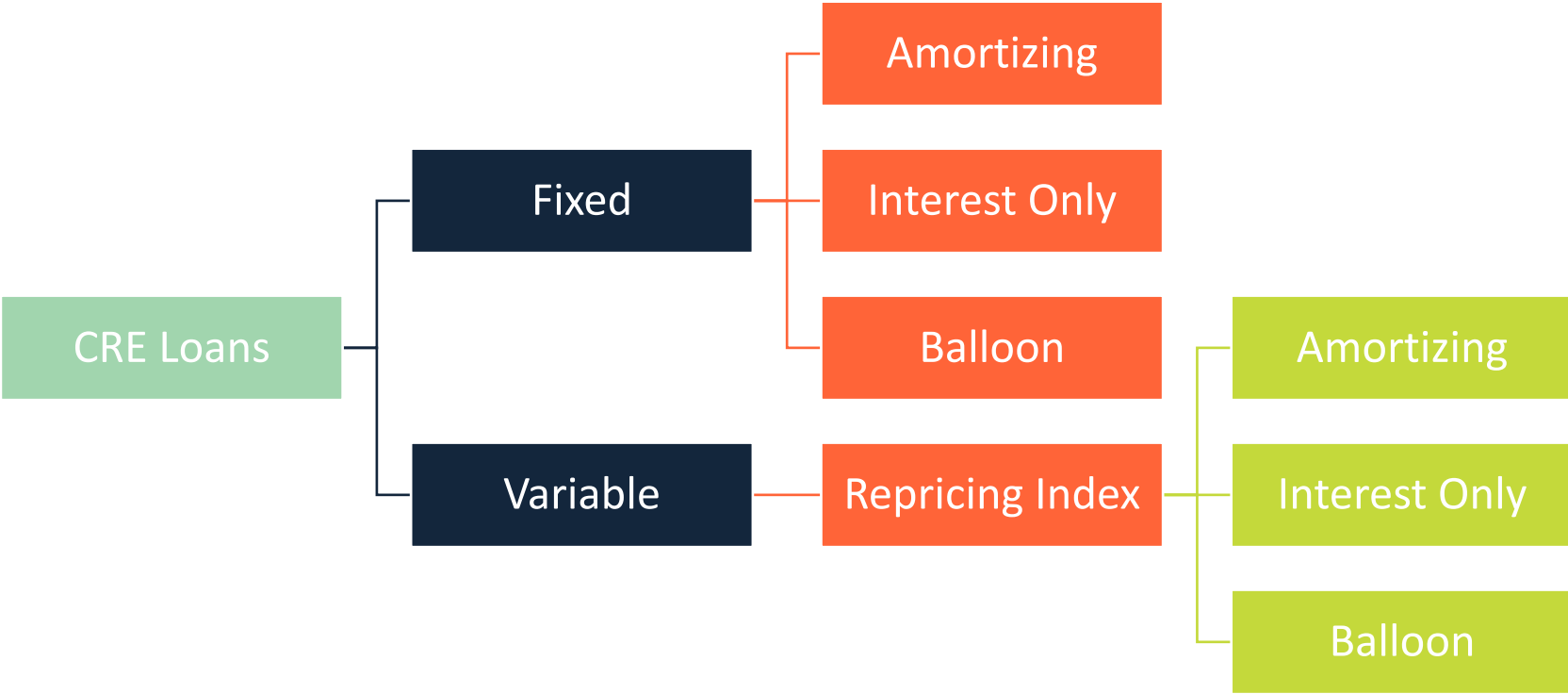
Goal is to capture key behaviors and optionality

General ledger chart of accounts are rarely detailed enough for ALM

Segmentation	Types	Goal
Loans & Investment	Fixed vs. Variable Amortization Type Balloons Collateral / Term (Mortgage) Repricing Indices	Segment so new business contractual terms align Prepayments can be applied based on collateral
Optionality	Callable vs. Non Callable MBS vs. CMOs (structure)	Confirm optionality behavior is evident
Liabilities	Product Pricing / Behavior CDs by maturity term / Options Insured vs. Uninsured	Pricing behavior is consistent New business aligns with maturity Liquidity assessment aligns

Chart of Accounts Attributes or Settings

Defines the contractual aspects of the data and how the forecasting or projections of new (future balances) are handled.



Instrument / Transaction Level Data is Key to Ensure Individual Terms are Captured or Defined.

Rate Options (Caps and Floors)

Rate limits (caps and floors) ideally are modeled at the instrument level. If the rate limits are only applied at the aggregate total they may be “*averaged away*”.

Loan Sample with Floors:

Outstanding Balance	Spread	Floor	Correct Rate
600,000	1.50%		4.75%
425,000	1.25%	5.00%	5.00%
250,000	2.00%	6.00%	6.00%
325,000	1.75%	5.50%	5.50%
180,000	1.50%		4.75%
1,780,000	1.56%	3.04%	5.12%

Repricing Base Case:

Transaction Level Detail:

Balance	Repricing Rate – Month 1
1,780,000	5.12%

Aggregated Inputs – Averaged Floors Rate:

Balance	Repricing Rate – Month 1
1,780,000	4.81%

Set Up and Discount Rates for EVE / NEV

Goal is for discount rates reflect the current market pricing

Product	Yield Curve	Discount Rate
Loans	Pricing Curve (U.S. Treasury)	<ul style="list-style-type: none">Based on Current New business pricing
Investments	U.S. Treasury Curve	<ol style="list-style-type: none">OAS SpreadCurrent pricing spread (at Par)
NMD & Borrowings	FHLB Advance Curve U.S. Treasury Curve plus Liquidity Spread	<ul style="list-style-type: none">Represents the alternative cost of funding
CDs	FHLB Advance Curve CD Curve	<ul style="list-style-type: none">Represents the alternative cost of funding

Additional Segmentation

Product Category	Treatment
Nonaccruals	Proper treatment for NII and EVE/NEV
Goodwill	Typically Ignored for EVE/NEV
BOLI	At Market Value if Separate Account BOLI At Book Value if General
Mortgage Servicing Rights (MSRs)	Market Impact of MSRs
Derivatives	Model OBS

Assumption Inputs



Assumption Inputs - Prepayments

Prepayments on investments and loans represent principal dollars that are paid back before contractually due.

Investments

Mortgage related securities (*MBS & CMOs*)

- Ensure investment scenario specific cash flows are modeled
- Rate scenario prepayment inputs

Loan Prepayments

Prepayments should be rate scenario specific

- Industry prepayment inputs or peer inputs – *Tuned to the institution*
- Institution specific prepayment inputs – *Best practice*

Review Prepayment Evidence

Interest Income results by rate scenario

	-200	-100	Base	+100	+200	+300	+400
RE MTG - FX	105	117	128	139	150	160	171
NonResid RE - FX	1,204	1,228	1,253	1,277	1,302	1,326	1,351

Comparing the normalized changes of each rate scenario to Base Case

	-200	-100		+100	+200	+300	+400
RE MTG - FX	-8.82%	-8.78%		8.67%	8.57%	8.51%	8.48%
NonResid RE - FX	-1.95%	-1.95%		1.95%	1.95%	1.95%	1.95%

Conclusions:

- RE MTG – FX has decreasing normalized changes indicating that prepayments are decreasing.
- NonResid RE – FX has static normalized changes due to missing prepayments.

Prepayment Considerations

Repricing Attributes

- Fixed vs. Variable

Collateral

- 15 Year vs. 30 Year Loans (Real Estate) or Securities (MBS)

Age vs. financial incentive:

- When using age, the origination date or original term must be included to determine the age of the loan

Multi-factor vs. single factor:

- Multi-factor based upon age, refinance incentive, seasonality and burnout
- Single factor is based upon refinance incentive

Assumption Inputs – Call Options

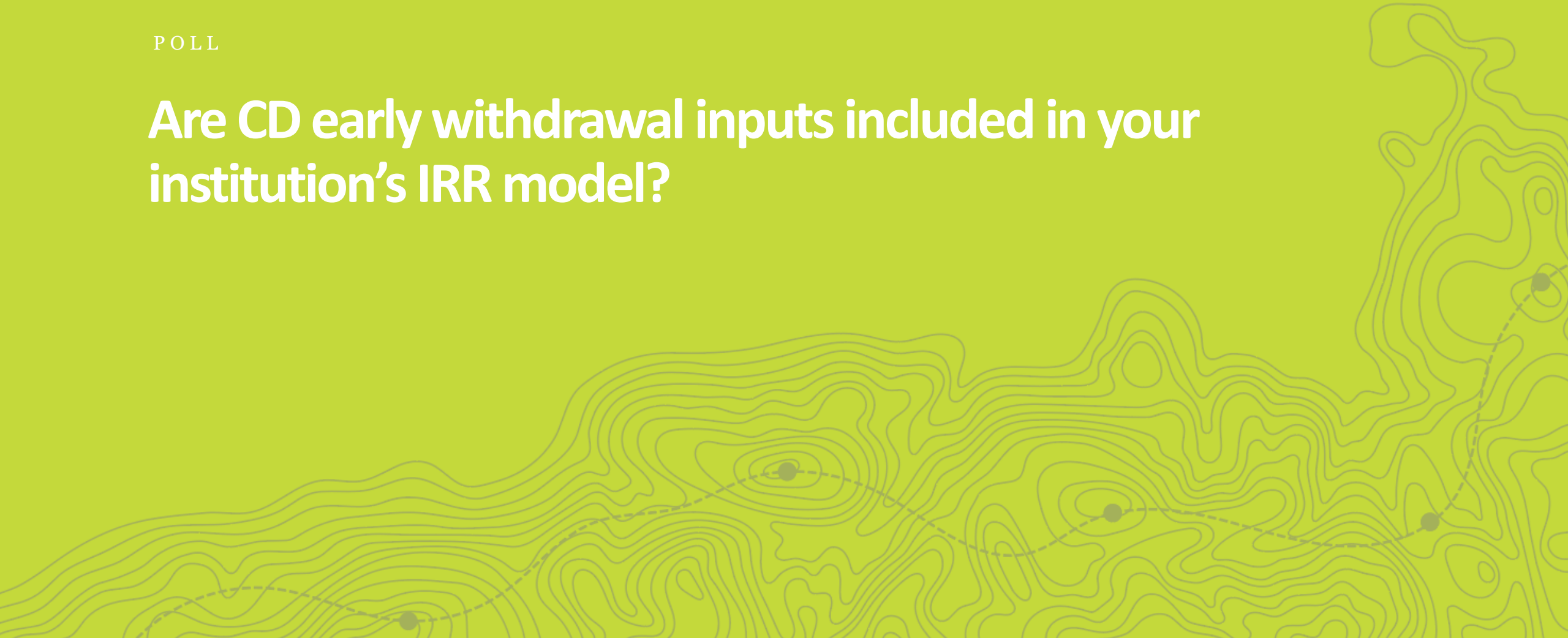
Call options on Investments allows the issuer to “Call” the security.

- Call information should be included in the investment application file if possible.
- Ensure all components of the Call are modeled:
 - Strike price
 - Rate (assign a yield curve)
 - Remaining Term
- Verify calls are occurring by reviewing cashflows

Principal Cashflows					
	-200	-100	Base	+100	+200
Agency Calls	100,000	100,000	0	0	0

POLL

Are CD early withdrawal inputs included in your institution's IRR model?



Assumption Inputs – CD Early Withdrawals

During rising rates customer (member) withdrawals are more likely to occur.

- Ideally track early withdrawals and apply inputs in the Model.
- If early withdrawal inputs are not part of the regular IRR analysis, then conduct a “what-if” analysis”.
- Include modeling of CD early withdrawals in both sensitivity and stress testing.

Break Even New Volume CD Rates					
CD Coupon Rate	Remaining CD Term				
	12 mo	24 mo	36 mo	48 mo	60 mo
0.25%	0.38%	0.31%	0.29%	0.28%	0.28%
0.50%	0.75%	0.63%	0.58%	0.56%	0.55%
0.75%	1.13%	0.94%	0.88%	0.84%	0.83%
1.00%	1.50%	1.25%	1.17%	1.13%	1.10%
1.25%	1.88%	1.56%	1.46%	1.41%	1.38%
1.50%	2.25%	1.88%	1.75%	1.69%	1.65%
1.75%	2.63%	2.19%	2.04%	1.97%	1.93%
2.00%	3.00%	2.50%	2.33%	2.25%	2.20%
2.25%	3.38%	2.81%	2.63%	2.53%	2.48%
2.50%	3.75%	3.13%	2.92%	2.81%	2.75%

Assumption Inputs – Contractual Liabilities

Break out the chart of accounts to represent the different type of options:

TERM DEPOSITS

- Variable rate CDs should be segregated from fixed
- Rate option CDs - “Step-up” or “Bump-up” should be separated and option modeled
- Retail vs. Jumbo should be segregated.

BORROWINGS

- Overnight
- Amortizing instruments
- Bullet advances
- Advances with options (calls/puts)

Assumption Inputs – Non-Maturity Deposits (Shares)

Assumptions/ behaviors for repricing (betas) significantly affect the Institution's **NII Results**.

Repricing Betas

Ideally, use institution specific inputs based upon history with management overlay for non-maturity deposit (share) betas.

- Betas should be individualized for each category (product) by rate tier if applicable.
- Betas should also change across rate scenarios (non-linear).
- Sensitivity and stress testing should be conducted regularly.

Repricing Limits (Rate Floors)

- Rate floors need to consider both non-rate and rate related depositor motivators, market conditions, competitive strategy, and recent supply experience.
- Be aware of both the lowest rate the Institution can pay and the lowest rate it will pay, based on culture, etc.

Assumption Inputs – Non-Maturity Deposits (Shares)

Assumptions for average lives (decay rates) significantly affect the Institution's **EVE / NEV Results**.

Average Lives (Decay Rates)

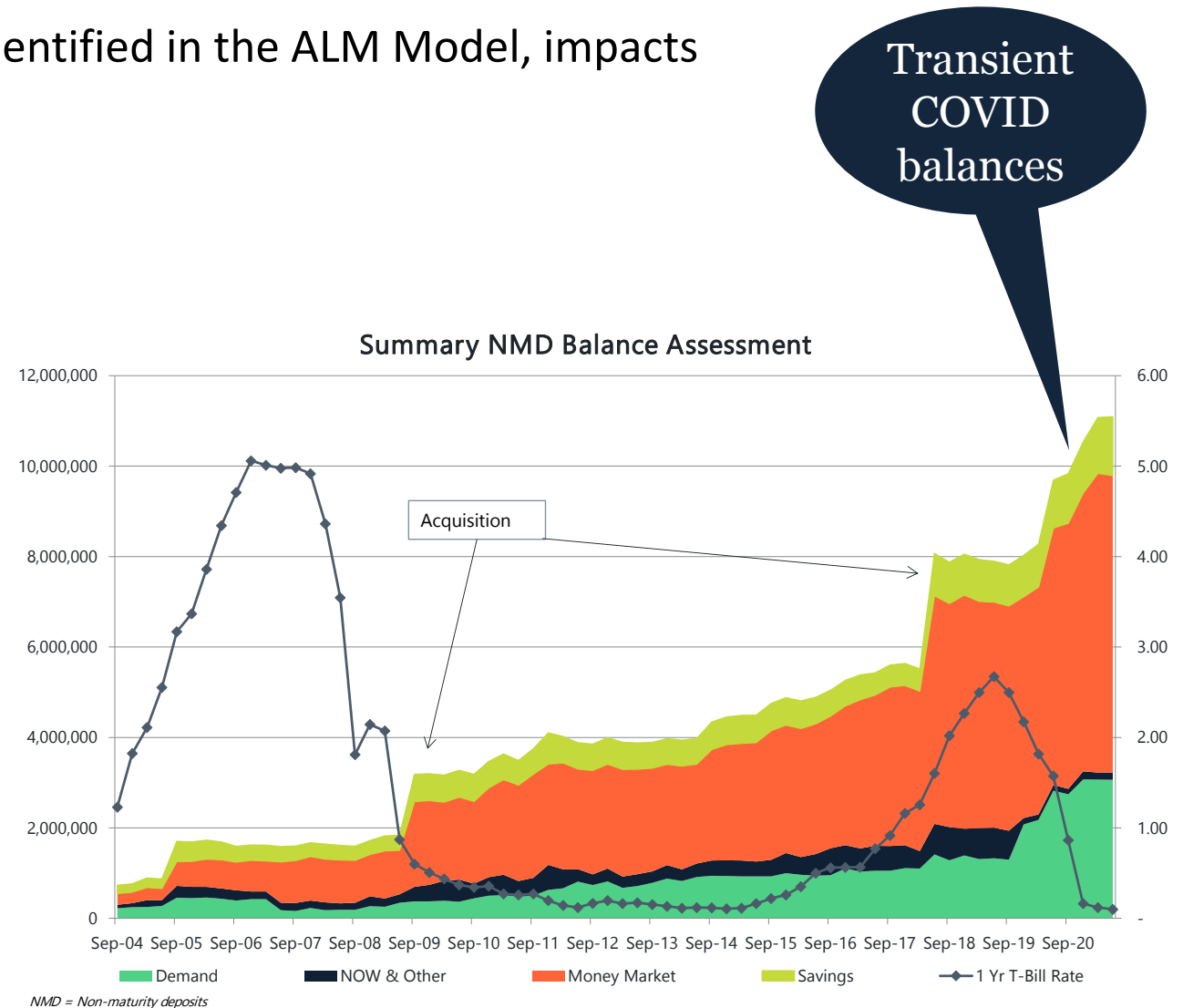
Ideally, use institution specific inputs based upon history analysis.

- Decay Rates or Average Lives should be individualized for each category (product).
- Change across rate scenarios.
- Typically, non-maturity lives shorten as rates increase.
- Sensitivity and stress testing should be conducted regularly.

Non-Maturity Deposits (Shares) – Transient Balances

Transient balances or volatile money should be identified in the ALM Model, impacts **EVE / NEV**.

- Conduct a historical analysis regularly to identify transient or volatile dollars.
- Segregate the transient balances in separate sub-categories.
- Model a more rapid decay rate or shorter average life for these balances.
- COVID surge, some component is likely transient.



Assumption Inputs – New Business Assumptions

Proper Chart of Account Set Up assists in New Business assumptions

- Review current historical average pricing for new business spreads
- Apply caps and floors if current production warrants
- Consider maturity terms reflective of product and production

CRE Fixed New Business Spread 4.00%

May need to review

- Discount rate spreads should mirror new business assumptions to reflect the current market pricing landscape

CRE New Loan Originations					
Month	Volume	WAR (Rate)	WAM (Term)	Avg Index	Avg Spread
Jan-20	1,230,000	4.20%	5	0.45%	3.75%
Feb-20	1,180,000	4.20%	5	0.54%	3.66%
Mar-20	1,560,000	4.29%	5	0.82%	3.47%
Apr-20	1,400,000	4.32%	5	0.86%	3.46%
May-20	1,010,000	4.40%	5	0.82%	3.58%
Jun-20	900,000	4.25%	5	0.84%	3.41%
6 Mo	7,280,000	4.28%	5 Yrs	0.72%	3.55%

Testing Assumptions



Assumption Goals



1. To **Accurately Predict** assumption inputs / behaviors
 - Institution specific data for empirical analysis
 - If industry – tune to institution actuals
2. **Test Assumptions**
 - **Quantify** exposure to variables
 - Sensitivity / Stress Testing
 - Benchmarking
 - **Back-test** assumptions

Quantify

Sensitivity to Key Assumption Inputs

Models are riddled with assumptions

- It is vital to quantify the risk to the key assumptions.
- Educate management

The goal is to **test** key assumption inputs by alternating the inputs to **quantify** the impact to the Model results.

Regulatory guidance requires examination and testing of the Institution's IRR position from alternative inputs need to be conducted periodically.

Assumption Tests

- Non-maturity deposit/share repricing (betas)
- Loan prepayments
- Non-maturity deposit/share runoff (decay)
- New business pricing
- CD early withdrawals
- Non-maturity deposit/share mix change

Sensitivity “What-If” Testing Process

Typically, the Base Forecast “ALCO” is the one used for the ALCO/Board IRR reports.

- This is the best estimate based on empirical data for the Institution’s reaction to Rate Shocks.
- Results of scenarios using alternative assumptions are compared:
 - NII IRR and EVE/NEV Profiles
 - Performance ratios (Margin, ROA, etc....)

Sensitivity Testing - Alternative inputs that could be observed in the normal course of business.

Stress Testing - Alternative inputs to examine extreme events.

Deposit Repricing Betas Testing

- Quantify exposure to alternative deposit pricing
- Increase non-maturity deposit/share betas by alternative degrees

Example:

Rates Increase by 200 bps

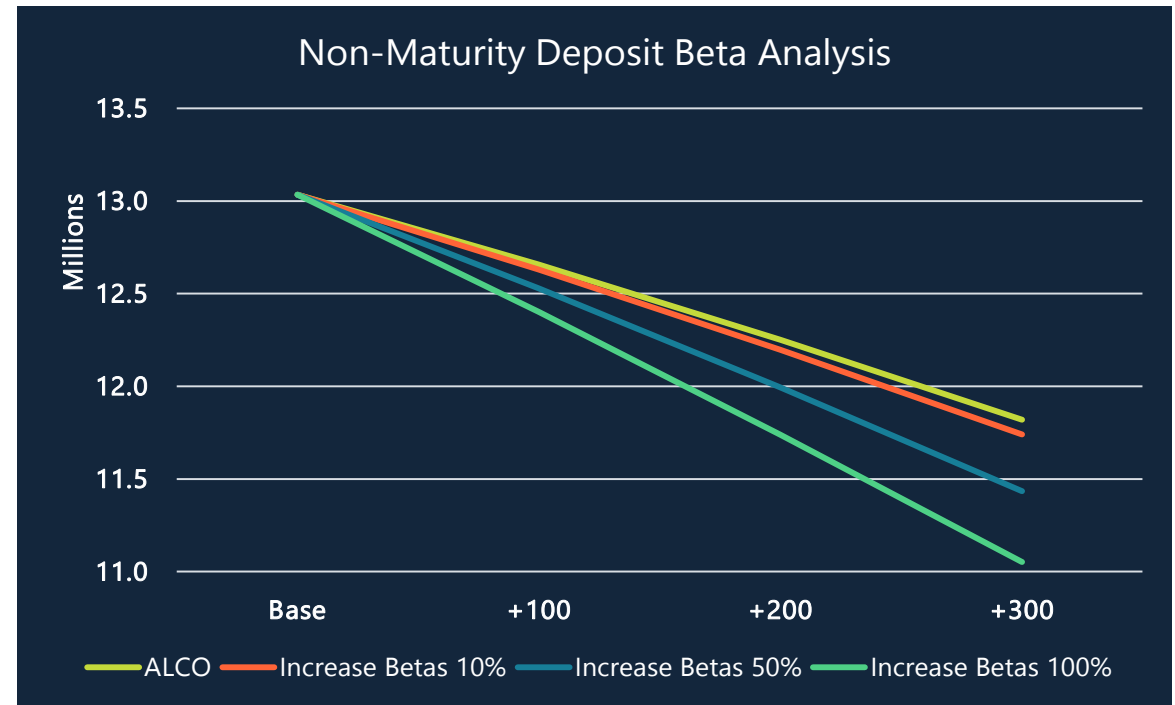
Betas increase by 50% of forecast

NOW 5bp to 8bp

Savings 26bp to 39bp

MMDA 34bp to 51bp

Lose ~ \$1 million or 8% of NIM



	Base	+100	+200	+300
ALCO	13,035	12,658	12,251	11,820
Increase Betas 10%	13,035	12,631	12,198	11,740
Increase Betas 50%	13,035	12,529	11,994	11,434
Increase Betas 100%	13,035	12,401	11,739	11,052

	Base	10% Increase	50% Increase	100% Increase
NOW	0.05%	0.06%	0.08%	0.10%
Savings	0.26%	0.29%	0.39%	0.52%
MMDA	0.34%	0.37%	0.51%	0.68%

Loan Prepayment Sensitivity Testing

- Quantify exposure to loan prepays, if loan prepays were lower than forecasted
- As prepayments decrease in rising rates less cash flows are repriced at higher rates, decreasing income

	-100	Base	+100	+200	+300
Base Model Scenario					
Net Interest Income	7,320	7,377	7,498	7,308	7,190
Percent Change	0.76%		1.64%	-0.93%	-2.54%

10% Less Loan Prepayments

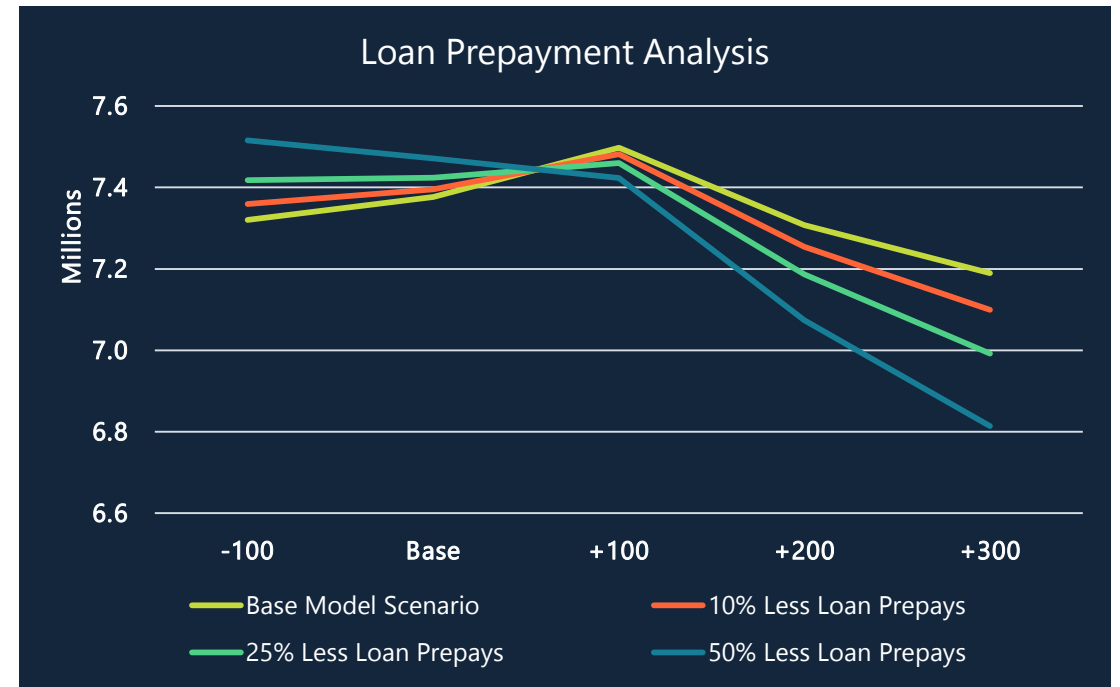
Net Interest Income	7,359	7,396	7,482	7,254	7,099
Percent Change	-0.49%		1.17%	-1.92%	-4.01%

25% Less Loan Prepayments

Net Interest Income	7,418	7,424	7,460	7,186	6,992
Percent Change	-0.08%		0.48%	-3.20%	-5.82%

50% Less Loan Prepayments

Net Interest Income	7,516	7,471	7,423	7,074	6,814
Percent Change	0.60%		-0.64%	-5.32%	-8.80%



Benchmarking

Benchmarking is the comparison of a given model's assumption inputs / results to alternatives.

Multiple types of benchmarking ...

Benchmarking can also establish the reasonableness of behavior inputs

- Compares model inputs to alternatives available from recognized behavior inputs sources.
- Goal is to ensure inputs fall within a logical band of behaviors.

Benchmarking – Loan Prepayments

Model Assumptions

Source: Bloomberg

Institution Model Results: Residential Loan Prepayment Forecasts (CPR)							
Loan Type	WAC	WA Age (Yrs)	-100 bp	Base	+100 bp	+200 bp	+300 bp
30y FRM	3.89	5	28.0	24.6	17.4	11.1	8.0
15y FRM	3.29	5.8	21.9	19.4	14.0	10.4	8.7
1/1 ARM	4.09	7.5	32.6	30.9	25.9	21.3	16.7
3/1 ARM	3.51	4.7	44.1	41.2	34.7	28.2	22.1
5/1 ARM	3.64	4.9	37.7	34.8	26.4	20.0	15.9
7/1 ARM	3.65	4.8	4.3	38.7	27.8	18.9	14.5

Question: How does it back-test?

Benchmark Data

Source: ADCO*

ADCO LDM 12Month CPR Forecast					
Loan Type	-100 bp	Base	+100 bp	+200 bp	+300 bp
30y Conf. FX	33.9	28.7	20.4	11.7	7.9
15y Conf. FX	31.5	25.6	18.3	11.4	8.4
1/1 Agy ARM	8.0	8.2	7.3	6.3	5.7
3/1 Agy HARM	20.7	18.7	12.0	7.9	6.2
5/1 Agy HARM	21.7	19.1	12.3	9.8	9.0
7/1 Agy HARM	36.9	24.4	13.7	8.9	7.5

*Forecasted conditional prepayment rates (CPRs) are from the LoanDynamics prepayment model developed by the analytics vendor Andrew Davidson & Co (ADCo). The first-year prepayment forecasts were derived using the weighted average note rate and age (as noted above) across available mortgage types in the Institution’s residential mortgage portfolio.

Back Testing of Assumptions

Key assumptions should be back-tested on a periodic basis.

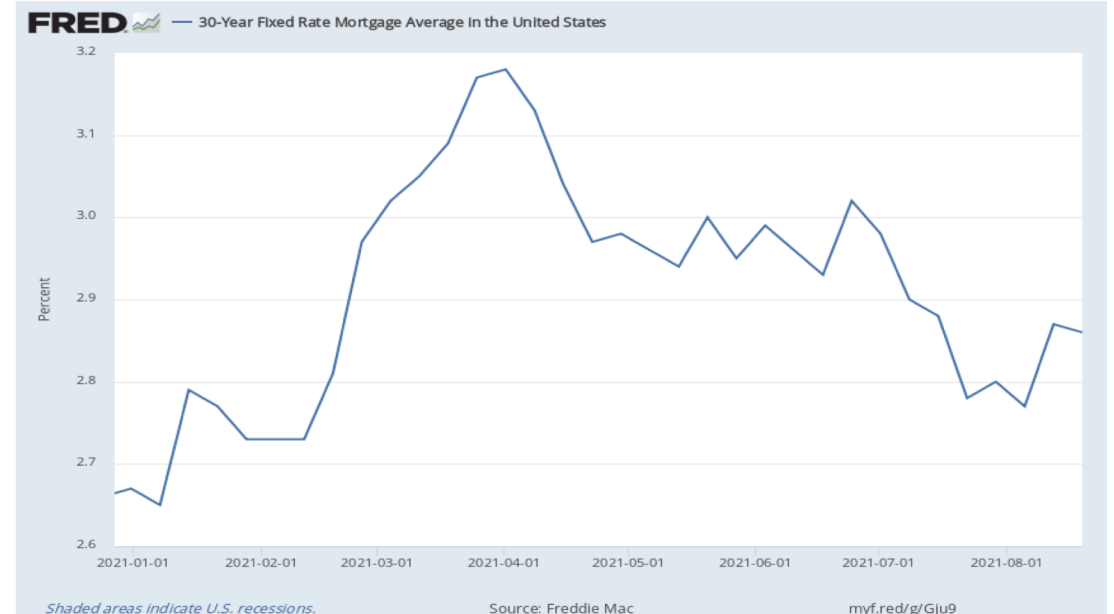
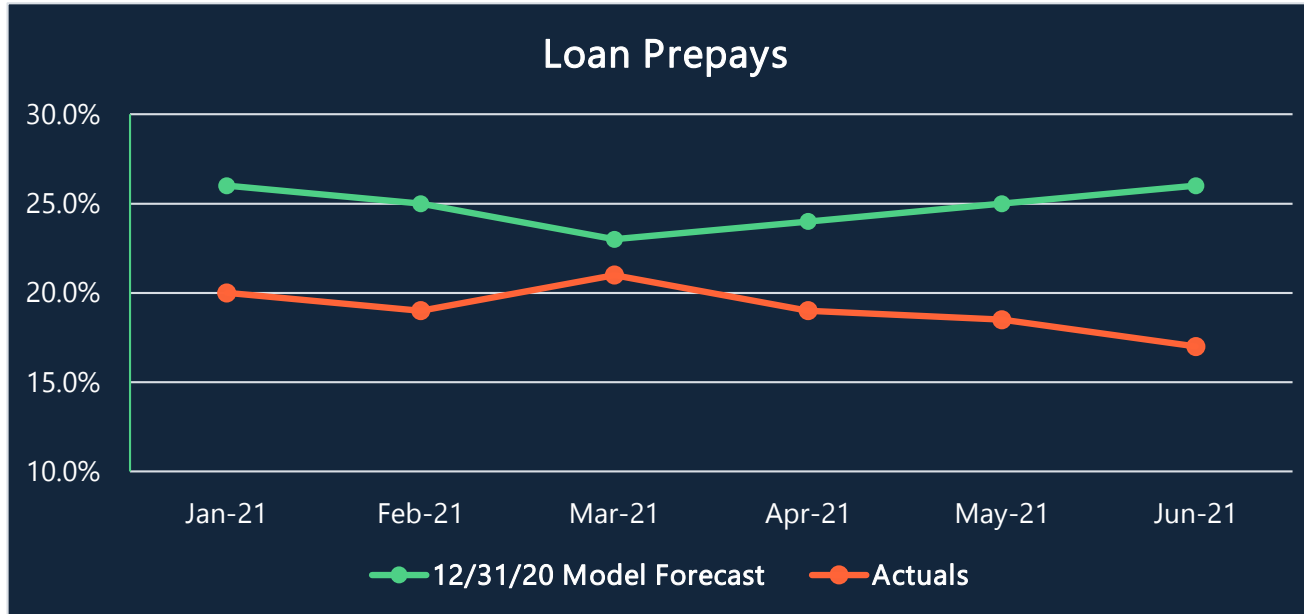
- Monitoring of behavior assumptions builds confidence in the model.
- Back-testing confirms the current practice of deriving assumptions is within reason and supports strategic decisions.
- Back testing of assumptions compares forecasted assumption inputs to actuals.
- Mismatches that are seen consistently indicate a need to adjust the assumptions (i.e., prepayment inputs).
- Abrupt differences indicated a new analysis is needed.

Examples include:

- Loan prepayments
- Non-maturity deposits/shares pricing
- CD early withdrawals

Loan Prepayment Back Test

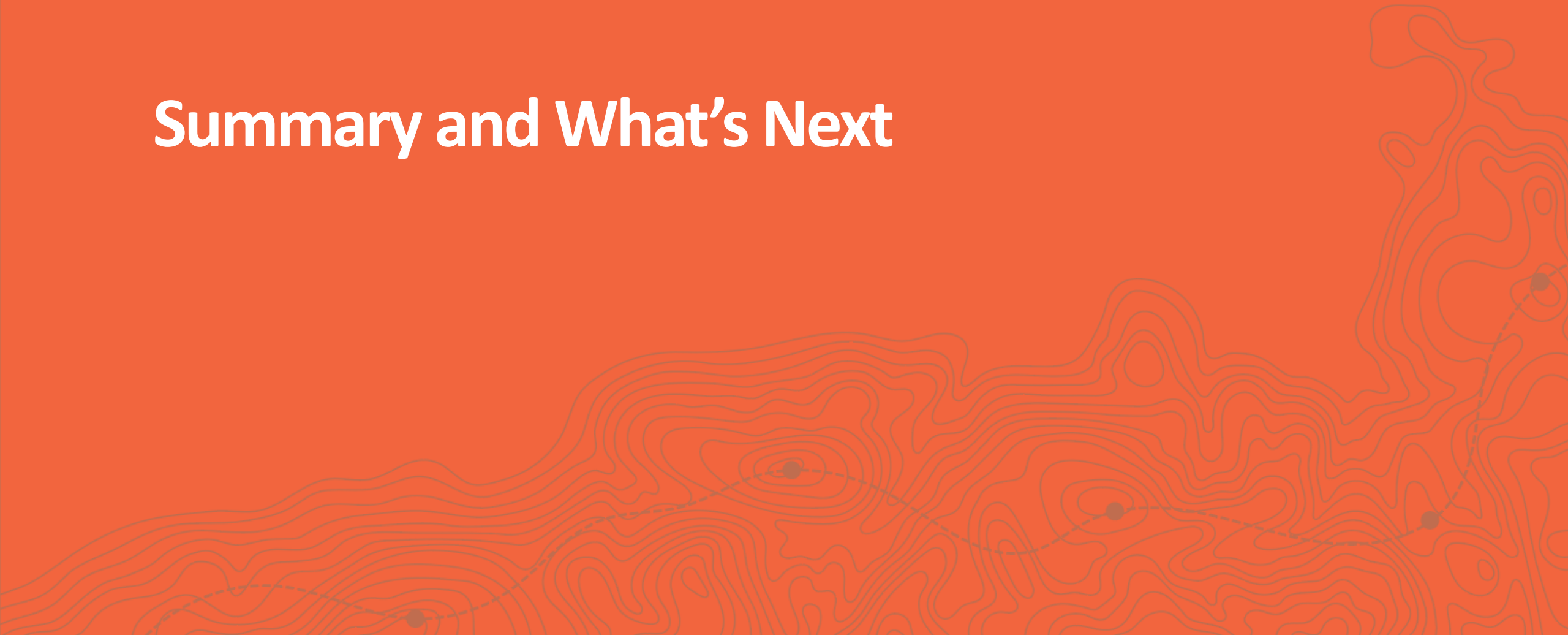
Model Forecast of Residential Fixed 30 Year Loan Prepays vs. Actuals



If variances? Are they reasonable? Influenced by actual rates?

- Continue to review
- Assess for trends

Summary and What's Next



Conclusions

In order to establish model confidence and “*buy in*” from management, we must confirm that the model is performing as intended and is accurate.

We do this by:

- Reviewing data to ensure quality inputs and outputs from the IRR Model
- Confirming segmentation allows for accurate segmentation and set up
- Enhance assumption inputs where applicable to be based on empirical data
- Test Assumptions
 - Quantify exposure to variables
 - Back test to determine accuracy

ALM / IRR Webinar Series 2021

Webinar #3

How Good Governance Strengthens Your Model Framework

Date: November 17, 2021

Key Takeaways

- Solid IRR Policy Components
- Defining IRR Exposures Limits
- User Controls and Documentation
- Effective Ongoing Model Monitoring (OMM) Plan



Thank You

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MountainView Risk & Analytics, a SitusAMC Company, is the leading provider of model risk management solutions and loan and deposit behavior analytics to financial institutions.

Formerly McGuire Performance Solutions, MountainView's team of experts leverage our Patented Advanced Assessment Methodologies and licenses to most major ALM models to empower our partners to make informed and confident decisions leveraging our unrivaled depth of expertise, dedication, and market knowledge.

OUR SERVICES

Model Validation

- Asset Liability Management "ALM" / IRR / FTP Models
- Liquidity Stress Testing Models
- CECL / ALLL Models
- Credit Models
- BSA / AML / Fraud Models
- MSR / Mortgage Pipeline Models
- Capital Stress Testing Models
- Pricing Models

Model Risk Management

- Model Risk Management Program Development
- Model Risk Management Gap Analysis
- Model Risk Management Program Review
- Model Documentation Development or Completion
- Liquidity Risk Management Function Review
- Policy Enhancements or Reviews
- ALCO or Board Training

Deposit Analysis

- Comprehensive Deposit Analysis
- Repricing/Runoff Analysis
- Summary Data Analysis
- Core Deposit Index
- Segmentation Analysis
- Structured Vintage Analysis

Loan Prepayment

- ALM Model Inputs Analysis
- CECL Model Inputs Analysis
- Loan Prepayment Index

CDI & Other Valuations

- Core Deposit Intangible Valuation Analysis
- CD Valuation Analysis
- Entity Valuation



By The Numbers

180+

Yearly Average of
180+ Model Validations

170+

Yearly Average of
170+ Deposit Studies

25+ Years

Robust Database & Experience
With Over 25 Years of
Data Collection and Delivery

Our Journey To Date

'95

McGuire is Formed


Dr. Bill McGuire and Dr. Richard Sheehan form McGuire Performance Solutions, an analytics firm providing loan and deposit behavior analysis and financial model validations

 18+ Colleagues

'14

MountainView Acquires McGuire

MountainView Financial Solutions, a leader in the valuation and brokerage of MSRs, Whole Loan and other financial instruments, acquires McGuire Performance Solutions.

 80+ Colleagues

'18

Situs Acquisition

MountainView Financial Solutions is acquired by Situs.

 800+ Colleagues

'14

Further Investment in Analytics Services


Company expands solutions and team to capture stress testing risk analytics including econometric credit models for DFAST/CCAR.

 95+ Colleagues

'19

SitusAMC is Formed & MVRA Rebrands

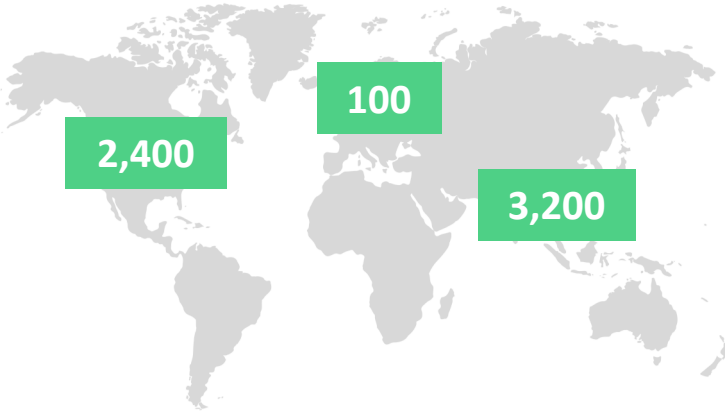
Situs merges with American Mortgage Consultants, Inc. to form SitusAMC, the leading technology and services provider to the real estate and corporate finance industry. MountainView's model risk management and loan and deposit offering is rebranded as MountainView Risk & Analytics, a SitusAMC Company.

 5,700+ Colleagues

SitusAMC is the leading independent provider of technology, data & analytics, strategic outsourcing, advisory, & talent solutions to the real estate & corporate finance industries



SitusAMC is a global firm that was formed in June 2019 by the merger of Situs Group Holdings Corp., American Mortgage Consultants, Inc., & associated firms



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