

Portfolio Forecasting Tools: What You Need to Know

by Joseph L. Breeden

After discussing the uses and benefits of forecasting, this article introduces the reader to three areas of analysis: historical (*if you don't know where you've been, you can't know where you're going*); baseline (*if you don't like where you're going, change direction*), and multiple-scenario (*if you can't change direction, install airbags*).

The world of portfolio forecasting is never static. The demands placed on forecasting continue to grow along with the challenges. At the same time, better internal data availability, new external data sources, and new modeling techniques offer hope of meeting these demands.

What Is Forecasting?

Almost every activity in lending involves some form of forecasting. For the present discussion, we focus primarily on retail loan portfolio forecasts. This is a pooled analysis of some performance metric of interest, such as attrition or prepayment, balances or utilization, delinquency, losses, fees, up-sell or cross-sell, recover-

ies, etc. The goal is to predict monthly performance from one month to several years into the future. In this definition of forecasting we are including the annual budgeting process, delinquency and loss forecasts by credit risk, revenue forecasts by marketing, profitability forecasts by finance, collections inventory forecasts, and lifetime value forecasts, just to name a few.

Any forecast is relative to a scenario for marketing and sales plans, management policies, and the macroeconomic environment, whether implicit or explicit. To make the best business decisions, we want to be able to explain how these assumptions drive the forecasts. Forecasts should therefore be scenario based—they are

more useful.

Excluded from this discussion are scoring models. Scoring models usually focus on ranking account-level behavior over a period of time, such as delinquency in the next two years. Scoring models are usually designed to provide a rank ordering of accounts rather than to predict specific performance metrics in a given macroeconomic environment. Although extremely important in account decisions, scoring models are not designed to address the portfolio forecasting questions just described and are best left to a separate discussion.

Areas of Current Industry Focus

Portfolio forecasting methodologies are under constant revi-

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sion. The current high-volatility environment is steering development efforts toward the following goals.

- Predicting over long time horizons—more than six months forward.
- Modeling at the vintage level.
- Incorporating macroeconomic factors into the models.
- Incorporating management scenarios into the forecasts.
- Modeling profit over the life cycle—timing mismatches between revenue and loss.

What good is forecasting?

What is the return on investment for better forecasts? With scoring models, the answer is simple. Many companies make claims such as, “Using our score will immediately lower attrition by an average of 13%. Our clients have saved on average \$3 million.” If you are trying to implement a better internal forecasting process, what should the sales pitch be?

The problem is that a forecast methodology is only as good as what you do with it. Accurate scenario-based forecasting should drive better strategic decision making. Unfortunately, the classic sentiment is, “If we made a good decision, it was due to our keen business insight. If we made a bad decision, it was the fault of the forecast.”

Improved strategy is perhaps the highest value an organization can obtain, yet it is the most difficult to quantify. Who would admit that they would have made a poor decision if not for the forecast?

To make the case for the value of forecasting, perhaps the

best place to look is the newspaper. 2002 was a year of interesting news. During that period, you could have read the following items on consumer lenders.

Bear Stearns’s David Hochstim lowered his rating to “peer perform” from “outperform,” citing “an inability to confidently forecast the extent of an increase in losses and earnings.” The stock value fell \$1.5 billion that day.

“...announced unexpected credit losses in its large finance subsidiary that caused a one-day loss in market value of \$3.4 billion.”

“We have been on a great ride over the past nine years with the economic expansion and a lot of our modeling never picked up on negatives in the credit cycle. So it has been a challenge to get these models to look at the risks associated with the bad times.”

Clearly shareholders understand the value of greater performance visibility. On a personal level, portfolio managers know that setting and meeting realistic targets can only be to their benefit. But perhaps most important, accurate forecasting has the potential to become the core of strategic planning, budgeting, and decision making.

Knowing where you’ve been. When planning a journey, you need to know where you’ve been before you can decide where you want to go. Managing a portfolio is no different. For example, you cannot predict whether an economic recovery

will bring lower losses until you know the extent to which macroeconomic changes have affected your portfolio in the past.

Every portfolio metric is impacted to some degree by the same forces: originations quality, life cycles, seasonality, management actions, and the environment. Quantifying these impacts allows them to be included in a forecast or to change them in a scenario.

Originations Quality

What is the intrinsic quality of an account or a consumer? An account opened in a bad environment can be expected to perform worse than an account opened in a good environment, but it seems that such behavior should be assigned to the environment, not the account. Credit scores usually have a similar goal. Most scores are designed with the intent that a change in the environment does not change the relative ranking of accounts.

Naturally, credit scores are the primary tool for measuring account quality. Experience has shown that scores usually capture 60% to 80% of a vintage’s quality, depending upon the product and segment. However, other issues can also play a role in explaining originations quality. Loan-to-value, first versus second lien position, product mix, channel mix, and geographic mix are just some of the other factors that can drive quality.

Some factors driving quality are less predictable or controllable, such as system breakdowns and adverse selection due to things like competitor actions. For

this reason, score monitoring must always be accompanied by direct measurement of quality from the performance data with proper adjustments for changes in the environment and differences in maturity.

Keep in mind that a simple vintage plot does not convey this kind of information. Although a visual comparison of vintages is useful, vintage plots are ambiguous as to the cause of the differences between vintages.

Recent vintage quality.

Economic cycles tend to create industry-wide reactions. Although every portfolio has its unique aspects, similar patterns in vintage quality can be observed through most. Figure 1 shows a schematic representation of how vintage quality has changed over the last several years. Again, this is not vintage performance, but rather the component of performance attributable to the intrinsic quality of the accounts.

Much discussion has surrounded the *2000 Vintage* for its poor performance. Credit scores and economic conditions are not enough to explain this performance. In fact, none of the usual

metrics revealed anything abnormal. The best hypothesis seems to be adverse selection. As the economic shocks began in early 2000, better-quality consumers in any given score band became more cautious about taking on debt. The result was a vintage of unexpectedly poor quality.

Conversely, 2001 and 2002 were years of directed action. Most portfolio managers dramatically tightened their criteria because of the worsening economic environment and worrying delinquency trends. The resulting higher-quality vintages typically will not dominate portfolio losses for several more years, yet the reaction of being conservative in a bad economic period is quite common.

Anecdotal evidence suggests that this trend may be reversing. As managers see better economic prospects ahead, they may again start loosening underwriting criteria in a battle for market share. The established pattern repeats.

Life Cycles

Fundamental to any portfolio is an understanding of the life cycles in any performance metric. New accounts follow a natural life

cycle. A credit card account that starts empty will tend to mature by building a balance and increasing the risk of delinquency. When environmental impacts are removed, almost all performance metrics show accounts

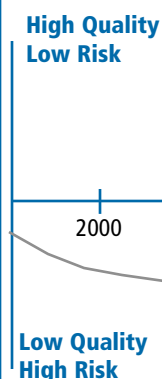
maturing relative to months-on-books.

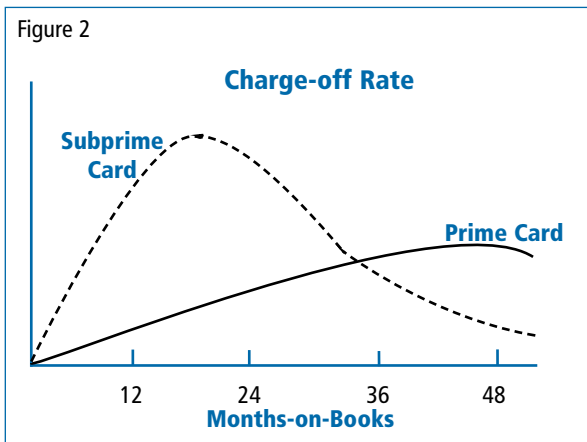
The maturation process is one of the most predictable aspects of the portfolio. When cleaned of variation in originations quality and environmental impacts, it provides an immediate boost for portfolio forecasting efforts.

The specific shape of the maturation curve varies across products and demographic segments. Figures 2 and 3 show examples of maturation curves. Prime versus subprime creates one of the strongest disparities in the shape of maturation curves. Figure 2 compares charge-off rates for prime and subprime credit cards. Subprime products in general tend to peak high and fast compared to prime products. It may be a bit optimistic to have subprime drop below prime even after years of maturing, as shown in the figure, but one can always hope. Although subprime loss rates can be quite high, the good side is that the origination-to-attrition cycle is short, and therefore the portfolio can be actively managed. For prime products, the lag between origination and peak delinquency is so long that course corrections are very slow to affect portfolio performance. Today's prime portfolio performance is often a remnant of the actions of previous management.

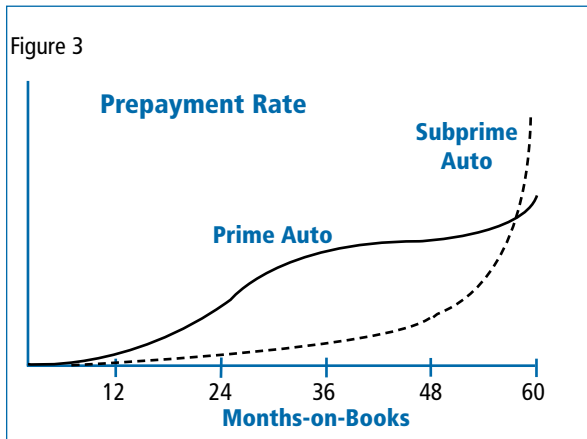
With prepayment rates, the patterns tend to be reversed. Prime auto loans, for example, will show important levels of prepayment in the first few years as the lowest-risk customers pay off their loans. With subprime, few consumers have surplus funds with which to make advance pay-

Figure 1





ment, so loan payoffs tend to occur predominantly at the end of the term.



Life cycles are important in understanding portfolio performance, because yesterday's accounts perform *differently* tomorrow, even if nothing in their universe changes. Accounts booked today may have peak revenue or delinquency up to several years in the future. Although conceptually simple, this effect creates a great deal of confusion when interpreting performance data. Changes in originations criteria today can dominate the portfolio years into the future under a different economic environment. Many portfolios have poor vintages from 2000 dominating their portfolios today.

Underwriting criteria are set by calibrating to the most recent year or two of data. (This is how credit scores are commonly used.) New accounts are originated, and peak delinquency risk may not occur until several years into the future. This can, and often does, make origination policies exactly out of phase with the environment, where the worst loans mature in the worst environment and the best loans mature in the best environment.

Seasonality

Maturation curves and originations quality describe vintage performance in isolation. Consumers live in the real world, so we

For those same portfolios, a recovery in 2004 would coincide with a portfolio composed largely of today's high-quality bookings.

Timing originations policies to the environment is one of the most difficult aspects of portfolio management.

must consider shocks to this idealized behavior. Seasonality, management actions, and macroeconomic impacts all have the power to alter the observed vintage performance.

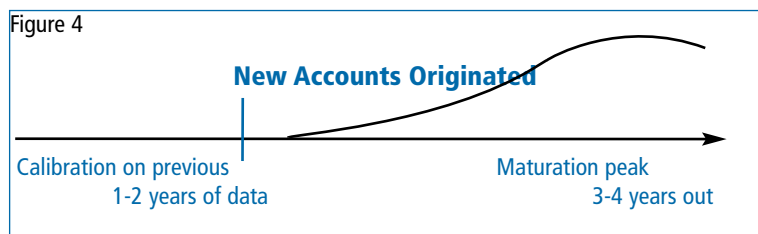
Seasonality is the most obvious of all portfolio impacts. Holidays, tax refunds, summer vacations, and back-to-school spending are the most common examples. Almost all portfolio metrics show the effects of seasonality.

Seasonality is not difficult in concept, nor particularly difficult to measure. The key to success is keeping long time series. A two-year rolling database is insufficient to provide a reliable estimate. Seasonality can be masked by recurring policies, e.g., the timing of line increases to Christmas spending can exaggerate the effect.

Seasonality tends not to vary significantly across demographic segments, which can provide additional clues about seasonal patterns.

Management Actions

Every portfolio history includes course corrections. This is what management is paid to do. Yet management actions can confound any portfolio analysis. Embedded in the portfolio performance metrics are changes in collections policies, credit line assignment, system outages, database changes, etc.



These effects must be identified and extracted so that the forecast does not implicitly assume a replay of past actions. Few organizations maintain detailed logs of policy changes. This must change with the Basel II focus on operational risk, but it is also extremely valuable to forecasting and management.

Measuring these impacts and extracting them is much easier when a process is employed that first removes the portfolio variability caused by origination changes and vintage maturation.

Macroeconomic Impacts

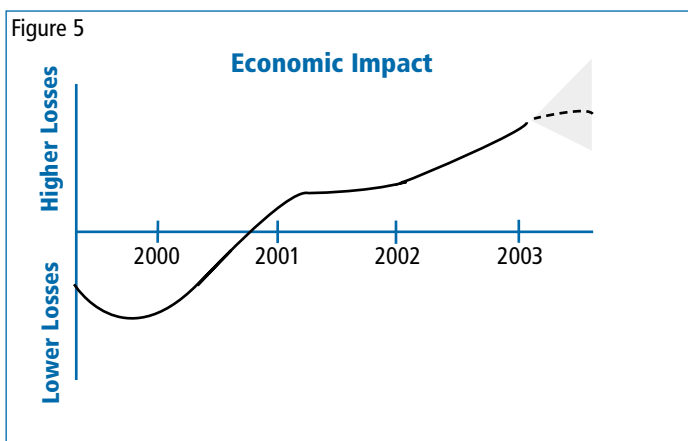
The business cycle is not dead. Intuitively, everyone knows the economy drives portfolio performance. Quantification, however, is quite difficult. Long time series are essential.

Originations volume and quality, vintage maturation, management actions, and seasonality must all be removed before macroeconomic impacts become clear. Yet, early warning of these changes is extremely valuable, allowing managers to implement contingency plans.

Industry-wide indices can help, but they can be masked by industry-wide management trends. For example, the recent move to higher-quality originations will affect any industry-average performance metric. Therefore, an accurate internal measurement is always essential to understanding how macroeconomic impacts are affecting the portfolio.

The current macroeconomic environment for losses continues to be difficult. (See Figure 5.) Many portfolios are at recent highs

for losses driven by macroeconomic factors. This is not to say that total portfolio performance is at its worst. Some of the better-quality vintages from 2001 may be starting to bring down overall loss rates. Nevertheless, most portfolios are showing the contribution to losses from the outside environment to be at recent highs. The real question, of course, is where do we go from here?



Measurement

The preceding discussion lays out the components of historical behavior that should be measured and understood. The key to success is to estimate them such that they are roughly independent of each other. Achieving statistical independence in the measurement is not easy, but very valuable. This article has not focused on how those pieces are measured, but a thorough discussion of that subject can be found in "Becoming a Better Vintner," *The RMA Journal*, September 2002.

Predicting where you're going. Historical analysis is necessary, but everyone's burning question is, "Where is the portfolio headed?" Even though the com-

ponents driving portfolio behavior are obvious and universal, a broad range of techniques exists for incorporating these features into a forecast. Further confounding the effort are an endless number of hybrids incorporating aspects of different techniques. For these reasons, no overview can be truly exhaustive, but we will try to review some of the dominant techniques in use and under

development.

Forecasting techniques differ greatly in their handling of scenarios. Some provide explicit and extensive support for scenarios,

while others operate more as a black box with no obvious controls. Nevertheless, all forecasts make certain assumptions:

- New originations quality and volume.
- New management actions.
- Economic conditions.

A forecasting approach that does not allow users to input scenarios for these items must be either assuming "no change" or creating scenarios using some form of extrapolation. Therefore, all forecasting approaches should be viewed as scenario based. The only question is whether you can change the scenario.

What follows is a short encyclopedia of forecasting techniques, providing a brief descrip-

tion along with the pros and cons of each. Although some are more sophisticated and seemingly more capable than others, the correct choice of forecasting technology is a multi-faceted question that will be addressed later.

Cohort Averages

Accounts are segmented into many small cohorts based upon a range of criteria. Recent historical averages are computed for each segment and taken as a prediction of future performance.

Pros:

- Extremely simple.
- Doesn't require much historical data.

Cons:

- Extremely inaccurate. Should be used for monitoring only.
- Doesn't provide insight into what drives a portfolio.
- Can't incorporate any scenarios or outside factors, since no historical dynamics have been learned.

Cohort averages had to be included in this list because they are so simple to create. However, they are so prone to failure that no important decision should be based solely upon a cohort average forecast.

Industry-wide Forecasts

Many industry-wide data and forecasts have become available from consortia, bureaus, or other vendors. These can be used as a proxy or starting point for an internal forecast.

Pros:

- Useful when internal data is short or noisy.
- Useful as a guide for new products.

Cons:

- Not specific to the portfolio. Incorporates industry trends in booking mix, originations quality, and economic impacts that may not be appropriate for individual portfolios.
- Availability for near-prime, subprime, and regional portfolios limited to just a few variables.

Industry-wide indices or forecasts are really best when integrated with an internal forecasting methodology in order to overcome data shortcomings.

Roll Rates

The classic roll-rate model is a structural model of the net rate at which accounts roll through delinquency buckets. (See Figure 6.) Predictions are made by computing a moving average of historical roll rates.

Pros:

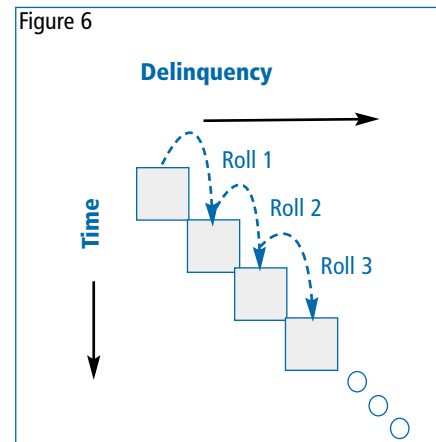
- Simple to implement.
- Easy to manipulate.

Cons:

- Slow to adapt to changes in originations quality and economic conditions. Best in a steady-state portfolio.
- Usually adjusted intuitively to account for future changes in the environment.

Markov Models

Roll-rate models are a simplified subset of the broader class of Markov models. State transi-



tions are modeled by transition probabilities. (See Figure 7.) Probabilities are usually computed as a moving average on the historical data.

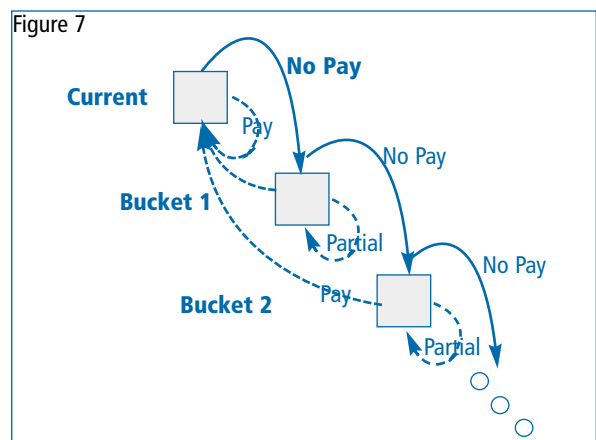
Pros:

- May be used to model revenue and delinquency.
- A logical extension of roll-rate models.

Cons:

- More difficult with line-of-credit products.
- Needs additional models to adjust weights for life cycles, seasonality, management actions, or economics (see below).

Markov models have seen some limited use, but they are not generally flexible enough to be



used across the range of portfolio forecasting problems.

Vintage Models

Vintage models start by estimating rates as a function of months-on-books by computing average curves from the historical data. Vintage models are often used as the starting point in hybrid approaches.

Pros:

- Immediate boost in accuracy because life cycles are essential elements and comparatively easy to estimate.
- Apply to many variables: roll rates, utilization, attrition, etc.

Cons:

- Must be adjusted for the quality of each vintage.
- Require intuitive adjustment for economic impacts.
- Many groups find vintage models technically difficult to implement in full detail with good accuracy.
- Macroeconomic impacts are usually the confounding factor.

Neural Networks, Etc.

Many sophisticated statistical approaches have been tested on consumer loan portfolios. Desktop computing power has ushered in an era of nonlinear models for many applications. Neural networks, etc., really refer to the many nonlinear statistical techniques available in the common statistics packages today.

Pros:

- Able to estimate a broad range of nonlinear functions.

Cons:

- No innate knowledge of consumer loan dynamics.
- Often constructed as a black

box providing no insight into what drives the prediction.

- Extremely difficult to modify intuitively.
- Few real successes to point to.

The current generation of nonlinear statistics packages is probably best suited to account level scoring. To be effective in portfolio forecasting, these seemingly sophisticated techniques are best hybridized with a more structural approach that understands retail lending. Unmodified off-the-shelf implementations are rarely useful.

Nonlinear Decomposition

As a categorical term, *nonlinear decomposition* is not in wide use. It is defined here to refer to techniques that attempt to quantify all the historical components first (originations quality, life cycle, seasonality, management impacts, and economic impacts) and then combine those components at the vintage level to create a forecast.

Many different approaches are in use today within this category. They cover the spectrum from completely manual and labor-intensive techniques to fully automated modeling engines and many stages in between.

Pros:

- Can be designed to capture nonlinearities.
- Can be applied to any variable of interest.
- Can provide a coherent mathematical structure for incorporating intuition and scenarios.

Cons:

- Require specialized knowledge of consumer lending. Not available in mass-market statistical packages.

- Technically difficult to implement.

Econometric Models

Modeling macroeconomic impacts is of great interest for portfolio forecasting today. Although in some texts *econometric modeling* is even defined to include simple regression, here we are interested in relating macroeconomic variables to portfolio performance. The goal is to understand and predict the economy's impact on the portfolio. A wide variety of models are used to create this relationship.

Pros:

- The economy is the most important uncontrolled driver of portfolio performance. Any model can serve as a qualitative guide.

Cons:

- Finding a good portfolio performance measure to predict is difficult. To get a clean signal, the many other portfolio drivers need to be removed.
- Getting a long enough time series to model is a challenge. Most businesses have two to five years of history stored, representing less than one economic cycle.

Which Technique Is Right for Me?

This is the most obvious question, but it does not have a one-line answer. Instead, consider the following factors when choosing a modeling technology.

How much data history do you have? All historical data can be normalized for today's conditions. Keep all you can. You don't need account-level data to support these modeling activities.

Segments by vintage and demographics are usually sufficient.

When data length is a problem, the modeling will need to focus on capturing the life cycles and vintage quality. This is usually 70% of the battle. Scenario-based tools can substitute best guesses where data is missing.

How complex are your products? When revenue and loss timing are matched and environmental impacts are small, simple methods may work well enough. These cases are rare, but for some subprime card portfolios the life cycle plays out in a single calendar year, removing the uncertainty of long-term impacts.

Probably 95% of the portfolios today contain all the component dynamics described in the section on historical analysis. As such, simple approaches are likely insufficient to provide the detail needed to support modern portfolio management.

What is your access to technical resources? Small portfolios usually lead to small modeling budgets. Most portfolios have some stray pieces that are not sufficiently valuable to invest in large forecasting efforts. In such cases, a simple roll-rate model in Excel may be sufficient.

Conversely, do not scrimp on analyzing and understanding products that constitute 90% of your business. Money spent on gaining knowledge is rarely wasted.

When did you last review your process? Much has changed in data availability, forecasting technology, and external resources. If your forecasting tech-

nology has not changed in a few years, it is time to reexamine your approach.

What does your forecast explain? Part of evaluating your forecasting technology is deciding what you want to achieve. Baseline and scenario-based forecasts are clearly high value. Perhaps equally valuable is being able to explain the factors contributing to a forecast.

Figure 8 shows an example of a portfolio where the forecast was \$500 million. This could be a prediction of delinquent receivables 12 months in the future. If you do not know where that number comes from, it is difficult to assess how much impact management can have on it.

By running through a contribution analysis, you might learn that 72% of delinquencies are “baked in.” That is, if no accounts are originated, no policies change, and the economy does not change, this is the level of delinquency one would expect.

Twelve percent of the delinquency will arise from accounts booked during the upcoming 12-month period. Delinquency is expected to decrease 15% due to recent changes in the quality of accounts being originated. Miscellaneous policy changes will decrease delinquency by an additional 4%. Lastly, a worsened economy is

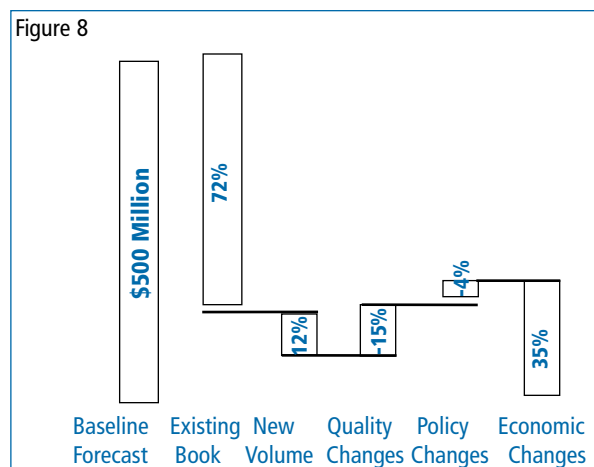
expected to add 35% to the delinquent volume.

Although a hypothetical example, this is quite representative of the contributions to 2002 delinquency and loss performance experienced within the industry. A 15% to 35% contribution from the economy was normal. Projecting decreased delinquency due to improvements in originations quality is also normal.

A contribution report like that in Figure 8 can be produced from any forecasting technology that is explicitly scenario based. The columns in your report will correspond to the scenario inputs in your forecasting software. The trick is simply to compare how performance changes when you take the scenario from “no change” to your “best-case” assumptions.

How Accurate Is Your Forecast?

Before changing to a new forecasting methodology, you need to be able to quantify the accuracy of your current methods. Although the concept is simple, you will again need to consider a range of possibilities.



Which forecast? Accuracy will vary by product, segment, variable, and more. Choose a reference set for assessing forecast accuracy.

Over what horizon? Short-term forecasting (< 6 months) is much easier than long term. If your primary goal is to support the annual planning process, use an 18-month horizon.

Are you flying to the forecast? Do not credit the model for unplanned actions taken during the year to meet the target. Consistent benchmarks are essential.

What should you be accountable for? Errors should be attributed to cause. Most portfolio forecasting groups do not pick the economic scenario. It is often chosen by senior management or a staff economist. Many management actions may be out of the forecaster's control. Decide whether you want to condemn a forecast for failing to predict a change in the economy. The contribution report can help decide what caused the observed performance and which forecast components should be enhanced.

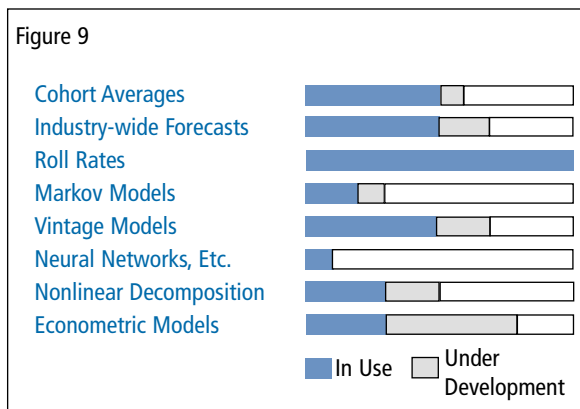
Adopting Forecasting Tools

What are people using? This question is never easily answered. It depends upon which group you talk to and what their objectives are. A survey about Basel II modeling will give a very different answer from asking how forecasts are made for the operating plan.

Figure 9 is a personal assessment of what is being used for portfolio forecasting in retail lending across all product types. This

is based upon informal conversations with more than 30 portfolio forecasting teams over the last two years, reflecting only what they chose to reveal. The results are merely conceptual.

Roll-rate models are shown as being ubiquitous, because the groups not using them have simply moved on and no longer need them. Although the most interest lies in creating econometric models, it is unclear how many of these efforts have significant resources or will successfully reach completion.



Nearly all groups employ multiple forecasting techniques and are looking for ways to combine the strengths of each into a single model.

Preparing for the Unexpected

Creating a single baseline forecast cannot prepare you for the unexpected. A single forecast won't show your portfolio's sensitivity to changes in the economy, marketing plans, or management policies, and has limited value for strategic planning.

To be prepared, you must consider a range of possible scenarios and consider the consequences of each. Running multi-

ple scenarios allows management to better conduct several strategic activities.

- Set trip wires for action by agreeing in advance on how far is too far.
- Form prearranged contingency plans when trip wires are triggered so that calm decisions can be deployed in stressful situations.
- Integrate forecasting with economic capital estimation. Portfolio forecasting includes all your best information about the future of the portfolio.

Why not include that when estimating economic capital?

Scenarios on Autopilot

Any scenario-based forecasting system can be used to test a range of possible future scenarios

and create distributions of possible outcomes. In some cases, the user may want to move from creating scenarios by hand to putting them on autopilot. The basic idea is to wrap an automated scenario generator around the existing scenario-based forecasting system and accumulate the forecasts on the other end.

Monte Carlo simulation is the standard approach for generating large numbers of scenarios. However, most uses of Monte Carlo simulation are much simpler than what one faces in retail lending. A Monte Carlo simulator predicting stock market returns can assume that the time series has no

autocorrelation and that everything is random.

Consumer portfolios are much more complex, as made apparent in the discussion of historical analysis. Consumer life cycles, existing vintage quality, and seasonality are not random forces. They are extremely predictable with the correct tools. Marketing plans and management policies are hopefully not random. The only piece of portfolio performance that should be controlled via Monte Carlo simulation is the impact of the external shocks.

Furthermore, external shocks from the economy or competitive pressures are not purely random events month to month. These shocks are strongly autocorrelated. An upward trend in delinquency like that shown in Figure 5 takes time to reverse and return to levels of 1999, even under the most optimistic scenario.

For these reasons, any off-the-

shelf Monte Carlo simulation package will probably need to be modified to produce plausible scenarios for external impacts. Those impacts are then combined with the best-guess scenarios on marketing and management plans to run the necessary simulations. The process is not inherently difficult, but, as usual, retail lending has unique quirks that must be considered when designing a solution.

Where Does Forecasting Get You?

Forecasting is not just a cost of business or a regulatory requirement. Forecasting is at the heart of an effective business strategy. Increasing visibility of future profits aids management and investors.

Basel II is also not the final word on forecasting. In fact, almost any methodology discussed here could be used to meet the rather minimalist forecasting requirements of Basel II.

It is probably better to think of Basel II as the second step on a staircase of unknown height. Demand for better forecasting will continue to grow, and eventually the regulatory guidelines will begin to leverage the much better forecasting techniques already available in retail lending.

Lastly, recent advances in computer hardware, data availability, and forecasting techniques are creating new profit opportunities for those who push ahead. This statement could have been written 10 years ago or 10 years from now. The essential point is that opportunities will always exist to improve profitability by better understanding what drives the portfolio. □

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