A Consumer Credit Portfolio Trend Analysis System in the Information Center Environment

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INTRODUCTION

This paper is the summary of a Cumulative Sums methodology application to Consumer Credit Portfolio management. A complete monitoring, control and forecasting system has been implemented in the Information Center environment to support credit policy, treasury, operational, and processing systems capacity planning decisions.

The Portfolio Monitoring System consists of several DATA steps with several PLOT AND MEANS procedures from the standard base SAS* software package as well as several ARIMA procedures from the SAS* ETS software package. The system requires financial and workload input by a user with minimal background in data processing and in statistics. The program is run with output in the form of plots, revised funding and workload equations and operations control limits for decision making and planning efforts. Using the output, interpretation is straightforward. This system has been in use since 1981 in several Citicorp domestic and European subsidiaries in the Credit Policy function and is currently being evaluated for integration into the Information Center environment. It has provided an "early-warning" mechanism and additional control which was not present before its implementation.

THE SITUATION

The situation which usually confronts management is an increasing or an out-of-control portfolio growth rate in accounts and in the receivable. There usually is no management information nor analysis which focuses attention on the changing financial and operational dynamics. As a result, a helterskelter approach to portfolio analysis provides information which may or may not generate valid signals about the state of the portfolio. This leads to the inability to make correct management decisions. This inability creates incremental losses, incremental funding costs, and incremental operating costs. It also creates opportunity costs in the form of lost revenues.

In recent years, several growth-oriented Citicorp businesses have experienced a need for a Portfolio Monitoring System to assess the underlying dynamics of consumer credit portfolios. A mechanism to provide a concise, consistent set of signals was required to control and manage the consumer credit portfolios. In each case, the following issues needed to be addressed:

- The net revenue growth rate(s).
- The portfolio growth rate(s).
- The portfolio aging category growth rate(s).
- The write-off growth rate(s).
- When the growth rate(s) changed.
- The extent to which the growth rate(s) changed.
- The implications of the timing and extent of growth rate change(s) on funding requirements.
- The implications of the timing and extent of growth rate change(s) on operational workload requirements.
- The implications of the timing and extent of growth rate change(s) on processing capacity requirements.

Once the financial, operational, and processing requirements implications were known, management decisions were made based on a forecast of the next three to four data points.

PROBLEM DEFINITION

Given the above issues, we needed to build a decision support system which would address the following needs:

- Provision of valid signals.
- Stability of analytical results.
- Provision of accurate forecasts.
- Provision of timely financial, operating and processing information.
- Ease of use.
- Ease of interpretation.
- Minimized run times.

PROBLEM SOLUTION

The decision support algorithm required a two-stage construct in order to address the above issues and which would satisfy the above needs. The two stages are defined...
Stage 1 - Summary Portfolio Sub-System

This sub-system is composed of the summary data, the Cumulative Sums, and the Forecasts thereon. Each piece is defined as follows:

**Summary Data**

The data is composed of the receivable amounts, the number of accounts, and the revenues reported on the billing cycle aging reports. These reports are produced at each cycle billing by the host system. We use the Sum-of-Cycles approach to monitor and forecast because it yields a data series with equally spaced observations. It also allows the flexibility to analyze the portfolio on a cycle-by-cycle basis. An accounting snapshot at the end of the month overstates or understates the true delinquency and revenues on a given cycle depending on when the snapshot is taken and on the time since a given cycle was billed. Pictorially, the two approaches are compared like this:

**Sum-of-Cycles**

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---|---|---|---|---|---|---|---|
observation observation observation
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**Snapshot**

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1 2 3 4 observation
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Of the many approaches to analyzing the aging and revenue schedules, the Johnson-Lewellwen [5] and the B. X. Stone [9] treatment of aging and revenue were the methods which provided the most stable results. (See [3] for a comparison between the most widely used methods and these methods.)

**The Cumulative Sums**

Preliminary calculations using the aging data are performed to generate the historical percentages of outstanding receivable as a function of the original billed receivable. The same calculations are performed on the Number of Accounts. These sets of calculations are the basis of the Cumulative Sums calculations. A set of MEANS procedures yield the diagnostics for the choice of target or base value from which the "drift" is measured by the Cumulative Sums. Once the base value is chosen, the Cumulative Sums are calculated and plotted for each Aging Category via the DATA step and the PLOT procedure. In addition, a rate-of-change in the Cumulative Sums calculation is performed to analyze the rate-of-change in the Cumulative Sums. At this point, the analyst has obtained the following information:

- The Cumulative Sum and the Cumulative Sum rate-of-change for the Portfolio Revenue stream.
- The Cumulative Sum and the Cumulative Sum rate-of-change for the Portfolio Total Receivable Base and the Number of Accounts.
- The Cumulative Sum and the Cumulative Sum rate-of-change for the Write-Off stream and the Number of Accounts.
- The Cumulative Sum and the Cumulative Sum rate-of-change for each of the Aging Categories and the Number of Accounts in each.

This information allows the analyst to study the underlying dynamics and growth/decline rates required to develop prudent funding, operating, and processing capacity decision alternatives. Note that this is the control mechanism which will provide an "early-warning" signal to potential or actual problem areas. Comparisons are then made between the growth/decline rates-of-change in the Revenue, the Receivable Base, the Aging categories, and the Write-Off components. Interpretation of these comparisons is enhanced by plotting each rate on the same graph against time.

**Forecasts**

Based on the original data, the Cumulative Sums, and the Cumulative Sums rate-of-change, forecasts are generated using ARIMA, Regression or Exponential Smoothing techniques. Monitoring of actual results against forecast is accomplished via Variance calculations for all components in the Sub-System. New forecasts are generated when the Variance is 50% of the total fore-
cast base in each respective component.

See Flowchart 1 for the Summary Portfolio Sub-System processes.

Stage 2 - Account Transition Sub-System

The Summary Portfolio Sub-System provides a robust mechanism to monitor, to control and to forecast the Portfolio Revenue, Receivable Base, Aging Category, and Write-Off macro components. Experience has shown that this macro approach is limited in its ability to produce meaningful and sufficiently detailed information and accuracy for managing the delinquent account collection, the customer service, and the processing capacity (both machine and personnel) functions.

Combining both the basic theory of the Summary Portfolio Sub-System and the Delinquency Movement Matrix, the Account Transition Sub-System was built. (See [4] for a detailed explanation of the Delinquency Movement Matrix.) Using the Leading Edge (Accounts which transitioned to the next Aging Category), the Holding Edge (Accounts which remained classified in last month’s Aging Category), the Trailing Edge (Accounts which transitioned to the immediate previous Aging Category) and the Write-Off Edge (Accounts which transitioned to the Write-Off Category), a Cumulative Sums and Cumulative Sums rate-of-change scheme was built.

The Account transition Sub-System is composed of the same basic components as the Summary Portfolio Sub-System:

- The Delinquency Movement Matrix data (generated at Billing Cycle)
- The Cumulative Sums
- The Forecasts

All three components exist for the number of accounts and the receivable balances associated with each of the Leading, the Holding, the Trailing, and the Write-Off Edges. The revenue statistics are deleted from this sub-system since operational workloads are the focus.

This structure allows more accurate monitoring, control and forecasting of delinquent account collection, customer service and authorization system workloads on the host system. An additional contribution this sub-system makes is the provision of a reconciliation mechanism for the Summary Portfolio Sub-System forecast delinquent account and balance estimates. Where and when differences of more than 10% between the two estimates exist, a major review of the data, the Cumulative Sums/rate-of-change occurs. See Flowchart 2 for the Account Transition Sub-System processes.

EPILOGUE

This paper summarized the construction of the Portfolio Management System. The system is divided into two sub-systems:

- The Summary Portfolio Sub-System
- The Account Transition Sub-System

Use of both sub-systems results in an enhanced ability to detect dynamic changes and magnitudes thereof. More importantly, these changes are detected on an "early-warning" basis to minimize adverse impacts on the portfolio or to maximize management's ability to exploit positive trends. Forecast accuracy is enhanced because of the understanding of the underlying trend dynamics.

We would be happy to respond to any inquiries on the construction and on the use of the system. Our address and telephone number are listed below:

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BIBLIOGRAPHY


STAGE 1

READ REVENUE, AGING DATA

CHOOSE BASE VALUE FOR CUSUMS (PROC MEANS, FREQ)

CALCULATE CUSUMS

CALCULATE CUSUMS RATE OF CHANGE

GENERATE CUSUM PLOTS (PROC PLOT)

REVENUE, RECEIVABLE, WRITE-OFF AND AGING CUSUMS + RATES OF CHANGE EVALUATIONS

YES NO

EARLY WARNING PROBLEMS?

YES

REPORT