Auto Days 2011
Predictive Analytics in Auto Finance

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SAS Risk Practice
# Agenda

## Introduction

### Changing Risk Landscape
- Key Drivers and Challenges

## Sample Predictive Analytics for Vehicle Finance Organizations
- Manage credit risk and protect your portfolio
- Establish in-house credit scoring
- Real time Decisioning
- Predict loan exposure, reduce the risk of loan losses
- Optimize lease offers
- Collections Optimization

## Best Practices – Case Study

## Questions and Answers
Leading Firms are investing in the ability to provide account holder “event” level information to manage customer relationships, risk, regulatory drivers, and return on capital.

Enhanced Operational & Capital Advantage
- Capital Allocation is directly tied to accounts & product profitability
- Risk processes are as integral as accounting & forecasting
- Velocity of financial analysis is changing

Enhanced Regulatory Reporting Capability
- Proactive risk & financial reporting to internal & external agencies
- Ability to report in multi jurisdictions
- Strategy embedded in forward looking capital planning

Enhanced Customer Relationships
- Siloed Channels replaced with “Events”
- Products are offered at anticipate life or firm level events
- Customer RM balanced by Risk RM

“The goal is to increase quality of relationships with profitable customers”
Convergence of Capabilities

There is a “convergence” between Risk, Marketing and Financial data that Financial Services organizations utilize every day.

Marketing
- Customer capacity
- Business Segments to Develop & Grow
- Market Segment Penetration

Risk
- Customer Credit Worthiness
- Exposures
- Geographic Concentration
- Risk Adjusted Pricing

Finance
- Loss Reserves and Allocations
- Accounting
- Planning and Budgeting
- Capital
- FTP and RAPM

Enterprise View
- Risk Factors Influence Buy Decisions
- Profitable Markets Identified
- Internal Hedging via Marketing
- Proactive Capital Management via “Firm Wide” stress testing

Quickly link Marketing and Sales direction with products that provide long term value while determining the “credit worthy” customers to sell to.
Integration of Risk & Finance
360 degree view on customer

Minimum regulatory requirements

Business requirements

1. "Graded loans"
2. "We need to price for risk"
3. "Advanced portfolio credit risk management"
4. "RWA reporting compliance & simple stress tests"
5. "Risk-based performance management"
6. "Integrated asset and liabilities management"

Integrated Risk and Finance 360 view of customer

SAS ERM, EPM and Customer Intelligence Solution

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SAS Analytical Solutions

Performance Management

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Profitability</td>
<td>Forecasting &amp; Budgeting</td>
<td>Activity Based Costing</td>
<td>Risk Based Pricing</td>
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</table>

- Credit Risk
- Customer Experience
- Economic Capital
- Marketing Optimization
- Social Media Analytics
- Real Time Decision MGMT
- Regulatory Capital
- Treasury Risk
- Workflow Management
- Fraud Detection
- Operational Risk
- Risk Analytics
- Governance & Compliance
- Optimization
- Customer Analytics

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SAS Analytical Application Platform
Common Infrastructure supporting SAS solutions
Agenda

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Best Practices – Case Study

Questions and Answers
Analytics for Auto Finance

Typical Predictive Analytics

Forecasting
- Loan Losses
- Cost of funds (Treasury, Interest Rates)
- Residual values at future point in time (behavioral)
- Loan Exposure

Data Mining
- Regression based models
  - PD, LDG at origination and on going
  - Residual value at lease origination
  - Optimal down payment
  - Segmentation

Simulation
- Portfolio risk
  - Credit Risk
  - Liquidity Risk
  - Capital Management
  - Forecasting Roll Rates

Optimization
- Optimization
  - Pricing
  - Lease offers & Buy backs
  - Collections
  - Design of Experiment
Brief Overview Analytics Solutions

Simulation  Forecasting

Optimization  Data Mining
Manage credit risk and protect your portfolio

- What is credit risk?
  - Default and Delinquency Analysis
  - Estimation at Origination vs. Behavior
  - Ratings Migration
  - Concentration Analysis

- How do I protect my portfolio?
  - Early warning systems
  - Behavioral scoring
  - Hedging

- How much capital should be held
  - Matching capital to assets

- Risk based pricing
Credit Performance Reporting
Delinquency Reporting

Delinquency Status by Ratings

Delinquency Status by FICO Score

<table>
<thead>
<tr>
<th>FICO</th>
<th>Delinquency Status</th>
<th>0-90</th>
<th>&gt;90</th>
<th>Charge-Off</th>
<th>Total</th>
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<tr>
<td>0 - 550</td>
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<td>$8,475,316</td>
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<td>$83,480</td>
<td>$8,643,015</td>
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<td>$13,275,745</td>
<td>$17,355,182</td>
<td>$1,393,914,870</td>
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Delinquency Status by Month & Region

Delinquency Monthly Table

DQ Analysis by Region

Weighted by Exposure

<table>
<thead>
<tr>
<th>Region</th>
<th>Current</th>
<th>30-59</th>
<th>60-89</th>
<th>90+</th>
<th>Charg-Off</th>
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<td>3.80</td>
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<td>Midwest</td>
<td>88.56</td>
<td>3.62</td>
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<td></td>
<td>Southeast</td>
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<td>3.16</td>
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<tr>
<td>05/01/06</td>
<td>East</td>
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<td>3.33</td>
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<td>Southeast</td>
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<td>3.32</td>
<td>0.58</td>
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<tr>
<td></td>
<td>West</td>
<td>89.80</td>
<td>3.35</td>
<td>0.66</td>
<td>8.86</td>
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<tr>
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<td>3.64</td>
<td>0.86</td>
<td>8.80</td>
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Establish in-house credit scoring

- 3 Choices
  - Using FICO or similar scores
  - Outsourcing modeling
  - In housing credit scoring

Why?

Develop analytical skills in house
Gain deeper insight into credit portfolio and customer behavior
Ability to use analytics develop for other uses
(PD, Delinquency, Collections, Marketing Campaigns)
Aligning risk, finance, and marketing
In house Credit Scoring Framework
Real Time Decisioning or Batch Processing

GUI Framework for:
- Navigate Data Model
- Dataset creation (select variables and target, create variables)
- Create Segments / Pools
- Map pools to Master Scale
- Schedule scoring

GUI Framework for:
- Data modeling
- Variable Selection
- Model Benchmarking
- Model Metadata Registration
- Model Documentation

GUI Framework for:
- Model Monitoring
- Model Input monitoring
- Model Output monitoring
- Configurable statistical measures

GUI Framework for:
- Reports building
- Performance Reports
- Parameter Reporting
- Portfolio Reports

GUI Framework for:
- Model Management
- Model Lifecycle
- Real time deployment
- Automation and workflow Model Validation
Credit Scoring Solution
Process Flow

DDS = Detailed Data Store
ABT = Analytic Base Table

Legend
- Data Object
- Report Object
- Analytic Object
- Workflows

*Model Packaging Using Metadata Repository
### Credit Scoring Analytics Solution

#### Model Monitoring & Validation

**Monitoring Models**

- **Reporting** > **Monitoring Models** > **Select Models**

**Monitoring Ongoing PD models**

- **Model Type**: Models for Ongoing Risk Management
- **Product Type**: Mortgage Product

**Notes:**
1. Select up to two models for comparison and select a period to display the measure level dashboard.
2. The model names for production models are specified in red.

<table>
<thead>
<tr>
<th>Model Name</th>
<th>APR04</th>
<th>MAY04</th>
<th>JUN04</th>
<th>JUL04</th>
<th>AUG04</th>
<th>SEP04</th>
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<td>PD Model 1 for Mortgages (Outcome period: 12 months)</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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<tr>
<td>PD Model 2 for Mortgages (Outcome period: 12 months)</td>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

- Months 4 - 15 of 15

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Real Time Auto-Decisioning Criteria

What-if analysis

- Enable business analysts to easily access suite of models built by 3rd-party vendor
- Enable deeper / more robust auto-loan/lease application analysis
- Monitor population score shifts & model input calibration
- Enable what-if / scenario analysis based on changes to
  - Population of applicants (perturbing input data)
  - Auto-decisioning criteria
  - Both (decisioning criteria and characteristics of applicants)
- Process flow templates processes to catalog and automate library of what-if analysis scenarios
Predict Loan exposure, reduce the risk of loan losses

- Loan Loss Forecasting
  - Accounting based
  - Predictive Analytics
    » Data Mining or Econometric Time Series Based
    » Multi-Level Forecast

- Stress test
  - Economic factors
  - Sales volumes
  - Promotions
Goal: Historical Time Series and Forecast
E.g. Auto Loan Loss Forecast

- History
- Forecast
- Confidence Intervals

Local Model
Winters Method — additive

Actual  Forecast  Lower  Upper
Stress Testing Analytics

Impact of Stress test on Mark-to-Market Value (US$ Billions)

Financial Indicators
- Net Income (US$ Billion): Current 4.03, Stressed 1.05, Time Series
- Return on Equity (%): Current 2.2, Stressed 4.7, Time Series
- Fair Value ( Fair Value US$ Billion): Current 12.6, Stressed -272.3, Time Series
- Return on Assets (%): Current 1.47, Stressed -31.6, Time Series

Capital Indicators
- Tier 1 Capital Ratio (%): Current 0.22, Stressed 6.09, Time Series

Risk Indicators
- Current Credit Risk Exposure (US$ Billion): Current 23.84, Stressed -48.87, Time Series
- AT Risk Value (US$ Billion): Current 20.59, Stressed 183.69, Time Series
- RAROC (%): Current 1.84, Stressed -30.82, Time Series
Forecast Server

- Automatic model diagnosis and selection
- Can be run batch or interactively
- Incorporates Event Calendars and discrete event modeling
- Deconstructs forecast into seasonal, cyclical, trend and “unobserved” components

Popular Forecasting Methods
- ARIMA
- Exponential Smoothing
- UCM
- Croston’s Method
- Intermittent Demand Model
- Curve Fitting
- Moving Average (window)
- Multiple Regression
- Random Walk
- SAS Code
- Compare models
Forecasting Process

Primary Elements

- **Seasonality**
- **Trend** *(up, down, or function)*
- **Random** *(error)*

* Sometimes it is helpful to add causality (known as regressors, explanatory, or independent variables) to explain the 1st and 2nd components.
Multi Level Forecasting
Automatic Reconciliation
Optimize lease offers

- Optimizing lease offers
  - What is the value of different customer options?
  - What is the propensity of customer to take any options?
  - How does one develop an optimization logic for which product to present in which order?

- Design of Experiment question to answer:
  - What is the propensity to accept an offer at the end of the lease end process, conditioned upon the specifics of an offer?

**Cost of each option can be calculated given a residual value
**Optimization of the profit equation given acceptance rates and alternatives
Optimize lease offers – Design of Experiment

**Experimental unit** is a combination of these values

Example 1 unit:
Northeast Honda Civic
Negative
High loss position

**Treatment** is the factor (i.e. form of offer) and level of factor (i.e. 2% vs. 3%) combination applied to the experimental unit

Example treatment:
- **Purchase**
  - 50% of underwater amount
  - 75% of underwater amount
- **Buy new car**
  - Rebate 50% of underwater amount
  - Rebate 75% of underwater amount

* Channel is one of the key dimension for experimental unit which was left out for simplicity.
Design of Experiment Framework

- **System 1**
- **System 2**
- **Others**
- **Finance**

**SAS Data Management and Transformation**

**Managed Analytical Mart for Analytics Projects**

**Analytical Layer**

**Operational Layer**

**Record Responses to Finance**

**Method:** Segmentation/Blocking  
**Tool:** SAS E-Miner  
**Data:** Historical

**Method:** Design of Experiments  
**Tool:** Base SAS or JMP  
**Data:** New

**Decisioning engine**
- Apply Scenarios  
- Collect Response Data

**Analyze Response data**  
**Tool:** E-Miner / JMP  
**Formulate Messaging Strategy**

**Operationalize the Messaging Strategy in Decision engine**
Collection Optimization

Collection Optimization requirements:

- Segments of customers based on PD and LGD calculation
  - Behavioral score cards
- Historical collection response rates for PD/LGD buckets
- Historical success rates /channel (channel sequence)
- Formulate collection strategies

Benefits

- Optimize collection actions to maximize $ collected per $ spent
- Prioritize strategies (channel & agent) based on customer’s Expected Loss Amount (PD*LGD*EAD)
- Minimize $ spent on collection effort
  - Prioritizing high cost contact strategy with high risk accounts
  - Minimize collection contacts for self-cure accounts.

** PD - probability of default
** LGD - loss given default (% of exposure at default)
** EAD - $ exposure at default
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Best Practices – Case Study

Questions and Answers
In House Credit Scoring Management

Problem:
- No ability to extract data for analysis in a timely fashion
- Required ability to create models for delinquency and collections very quickly as credit crisis spread.
- Ability to support multiple modelers and feed results to collections team to operationalize model feedback on collection priorities

Solution: SAS CSFB Solution
- Ability to generate modeling dataset via web interface for over 5000+ variables
- Ability to use state of the art modeling capability in creating models in less than 1/3 of the time it used to take
- Collections team performance and staffing improved drastically enabling firm to generate an ROI at more than 10 x the solution price.
Decisioning Auto Finance - Case Study

**Real Time Model Deployment**

**Problem:**
- No ability to deploy model without recoding and re-testing
- Need to reduce time to update model in strategy management very quickly
- Ability to support multiple strategies but production and on an ad hoc basis on large scale dataset for batch and real time decision

**Solution:** SAS Model Manager and Real Time Decision Solution
- Ability to store all models in a single repository for promotion to production
- Promotion to production decision engine required no re-coding
- Ability to implement strategy change often and very quickly to react to changing market conditions
- Run large scale decision project under tie constraints allotted