Predictive Analytics in Life Insurance

ACLI Annual Conference
Sam Nandi, FSA, MAAA
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Predictive Analytics and Big Data

Actuaries have been analyzing data and making predictions for centuries…. so what's new?

- Availability of Data
- Computational Power
- New Approaches to Analyzing Data
- Technology to Automate Processes
- Cultural Shifts
DATA!

- Without data, nothing is possible!
- Companies need to:

  - Capture
  - Digitize
  - Organize
  - Acquire
  - Store and Manage
  - Cultivate a Data Culture
Data management platforms used across different industries

Client Data
- CRM/Sales
- Web sites
- Direct Mail

Marketing Data
- TV, Mobile, OOH, Radio
- Brand metrics, segmentation
- MMM, household sales data

3rd Party Data
- Experian, Axiom, etc

DMP
- ID
- Demos
- Media
- Sales

MTA
- Calibration
- Hygiene
- Analysis

Activation
- Display
- Video
- Mobile
- Search
- Personalization
- TV

Segmentation & Targeting
- Experian, Axiom, etc
Life Insurance Data Enrichment and Organization Framework

Underwriting

Life Administration Systems

Lifestyle

CLATIMS

Other Internal Data Sources

External Data Sources

Customer Relationship Management (CRM) and Leads Management databases

One single customer view across all products, distribution & communication channels
Life Insurance Applications

- We have observed companies use Predictive Analytics for the following:
  - Predictive Underwriting
  - Sales/Marketing
    - Customer segmentation
    - Cross and up-selling
    - Propensity to buy
    - Lead generation
  - Retention/Proactive Lapse Management
  - Fraud Detection
  - Distribution Management
  - Assumption Setting
  - Customer Value Analysis
Assumption Setting Example: VALUES Industry Utilization Study 2016

- Study covered 7 companies, 2 million policies, $200bn AV
- Studied both timing of first WB withdrawal and amount of withdrawals relative to MAWA using experience data from 2007 to 2015
- Impact of drivers and predicted behavior are analyzed by applying advanced statistical modeling.
- Study showed that policyholders who are older at issue tend to utilize their policies sooner
- Policyholders with rollup feature wait longer to utilize the GLWB.
- Less than half of all policyholders currently taking GLWB withdrawals utilize their GLWB benefit with 100% efficiency.

**Variable Annuity GLWB Utilization: Key Findings**

The life insurance industry is still chasing the property and casualty insurance industry in using advanced analytical techniques to understand its customers—both potential future customers and existing policyholders. We believe that there is great potential for life insurance companies to develop expertise in this area. This Milliman report focuses on using advanced analytic techniques to analyze GLWB utilization among variable annuity policyholders.

**HOW EFFICIENT ARE POLICYHOLDERS?**

**VARIABLE ANNUITY GLWB UTILIZATION: KEY FINDINGS**

The life insurance industry is still chasing the property and casualty insurance industry in using advanced analytical techniques to understand its customers—both potential future customers and existing policyholders. We believe that there is great potential for life insurance companies to develop expertise in this area. This Milliman report focuses on using advanced analytic techniques to analyze GLWB utilization among variable annuity policyholders.

**Tax Qualification Status Drives Utilization Timing**

After age 70%, qualified policyholders will begin to take required minimum distributions and are more likely to begin GLWB utilization in each of the subsequent quarters.

**Most Policyholders Don’t Use Their Benefits Efficiently**

- Take less than maximum allowed: 28%
- Withholds in an inefficient manner: 49%
- Take withdrawals: 23%

**Policyholders Who Are Older at Issue Utilize Their Policies Sooner**

- Policyholders who are older at issue tend to utilize their policies sooner.

**More Begin Utilizing Their GLWBs in the 1st Quarter and on Policy Anniversaries**

- Only 5.10% of withdrawals utilized are not within the first year of policy duration.

**Our Data**

Our analysis of policyholder withdrawal behavior is based on 2 million unique policies issued from 2003 to 2015 by seven different companies. We track the same policies from time of issue to the first guaranteed lifetime withdrawal, and then thereafter, to study how policyholders utilize their withdrawal benefit riders. This provides a rich data set with which to study policyholder withdrawal behavior.
VA Data Enrichment Study (1)

1. Enrich with external data

2. Use analytical tools to develop customer segmentation

- **In Debt:** Low credit scores, high counts of credit delinquencies in the last five years
- **Lower Income:** Lower than average education levels, home values, and income levels
- **Middle Income:** Slightly higher than average education levels, home values, and income levels
- **High Income:** Highest education levels, home values, and income levels
- **Urban Renters:** Live in high population density areas, with low proportion of homeowners
- **Families:** More likely to have children living at home, younger on average
- **Retired:** Likely to be older, and live in areas with high proportions of individuals over the age of 65
VA Data Enrichment Study (2)

3. Use Predictive Modeling to develop distinct behavioral profiles

4. Visualize results of customer profitability individually and by segment
VA Data Enrichment Study (3)

**Potential applications**

- Retrospective pricing review
- Distribution strategy
- Targeted retention and buyout
- Targeted M&A
- Product strategy
- Improvement of assumptions for reserving, capital, hedging
Product Development Example: Vitality

- Vitality is a leading company in integrating wellness benefits in life insurance products, and has partnered to launch life insurance products in different countries.
- John Hancock has launched a UL product in partnership with Vitality.
- Customers accumulate points and rewards for maintaining a healthy lifestyle (diet, exercise, health screenings).
- Points status is used to determine discounts for each year’s premium.
- The product proposition is empowered by Predictive Analytics and new data:
  - Steady stream of data is captured from customer.
  - Historical dataset used to analyze impact of various lifestyle indicators on mortality rates.
  - Presented as a win-win proposition to customer.
  - Data from customer can be used for other purposes (cross-sell/up-sell).
Predictive Modeling with Prescription Histories

ACLI Annual Conference
Eric Carlson, FSA, MAAA
October 9, 2017
Agenda

- Milliman IntelliScript
- Big Data and Underwriting
- Big Data from an Rx Perspective
- Predictive Modeling using Rx
- Case Studies
IntelliScript History

2001
Founded as IntelRx

2005
Acquired by Milliman
3 clients / 3 employees

2008
1 million transactions processed

2009
RxRules launched

2010
GRx launched

2014
PopulationRx launched

2016
8 million transactions processed
Risk Score launched

2017
200 clients / 70 employees
Medical Data launched

2010
1 million transactions processed

2014
PopulationRx launched

2017
200 clients / 70 employees
Medical Data launched
Why is Big Data important?

The Future of Underwriting...

### Increasing
- Electronic requirements (Rx, MIB, MVR, Medical, Credit …)
- Decision engines driven by data
- Predictive Models
- Automation

### Decreasing
- APS, Labs
- Cycle times
- Costs

Better Customer Experience
Access (with authorization) to Rx Histories on more than 200 million Americans.

Milliman has accumulated a large Rx and mortality data set.

2015
Milliman mortality study
- 53M exposure years
- 13M lives
- 231,000 deaths
- Created Milliman Risk Score
## Rx Histories

<table>
<thead>
<tr>
<th></th>
<th>Prescription</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Prescription</strong></td>
<td>Brand and generic name</td>
<td>Dosage and quantity</td>
<td>Date of fill</td>
</tr>
<tr>
<td>2</td>
<td><strong>Physician</strong></td>
<td>Specialty</td>
<td>Contact information</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>Pharmacy</strong></td>
<td>Contact information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><strong>Dates of eligibility</strong></td>
<td>With or without prescriptions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td><strong>Underwriting significance indicator</strong></td>
<td>Red, yellow, green</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RxRules interprets big data.

Data Input
- Rx data
- Application data
- MIB / MVR
- Medical data

Rule Variables
- Indication / Therapeutic class
- Drug combinations
- Fill timing (date or duration ranges)
- Fill counts / patterns
- Dosage / quantity
- Physician specialty / count
- Gender / Age
- Other variables

UW Guidance
- Conditions
- Severity
- Decisions
Corticosteroids are very common among insurance applicants.
RxRules – Dosage Matters

Trazodone
147% relative mortality

Low Dose
132%

High Dose
224%
**RxRules – Drug Combinations Matter**

**Spironolactone**
209% relative mortality

**With 2 out of 3 of:**
- Thiazide Diuretics (102%)
- Ace / Angio II (ARBS) (116%)
- Beta Blocker (122%)

328%

**Without 2 out of 3 of:**
- Thiazide Diuretics (102%)
- Ace / Angio II (ARBS) (116%)
- Beta Blocker (122%)

166%
RxRules – Morphine Equivalence Matters

Opioids
156% relative mortality

<table>
<thead>
<tr>
<th>Low MED*</th>
<th>High MED*</th>
</tr>
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<tbody>
<tr>
<td>135%</td>
<td>322%</td>
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</tbody>
</table>

* MED = Morphine equivalent dosage
Predictive Modeling: Milliman Risk Score

- **RxRules-driven Predictive Model**
  Predicts relative mortality of a life or group of lives

- Multi-variate Rx based score
The Milliman Risk Score is built on RxRules.

- 250,000 NDC codes
- 7,500 GPI codes
- Hundreds of RxRules
- 1.27 Milliman Risk Score
Milliman’s Risk Score effectively predicts mortality.
What’s so great about this predictive model?

- Evidence based and data driven
- Stratify risk within a given medical condition
- Detect unintuitive patterns
- Quickly and consistently interpret large amounts of data
- Relatively easy to test, implement, use, and update
Risk Score stratifies platelet inhibitor risk.
Risk Score stratifies insulin risk.
# Predictive Model Applications

<table>
<thead>
<tr>
<th></th>
<th>Application</th>
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<tbody>
<tr>
<td>1</td>
<td>Individual Underwriting</td>
</tr>
<tr>
<td>2</td>
<td>Group Underwriting</td>
</tr>
<tr>
<td>3</td>
<td>Inforce Analysis</td>
</tr>
<tr>
<td>4</td>
<td>Market Segmentation</td>
</tr>
<tr>
<td>5</td>
<td>Pension Risk Transfer</td>
</tr>
</tbody>
</table>
SI Case Study Background

- Mostly auto-decision via RxRules
- Risk Score as of time of underwriting
- Have deaths on issued and declined cases
SI Case Study #1 – Distribution of Lives

Risk Score Distribution by UW Decision
SI Case Study #1 - Hits Only

<table>
<thead>
<tr>
<th></th>
<th>Average Score (Hits Only)</th>
</tr>
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<tbody>
<tr>
<td>Issue</td>
<td>0.96</td>
</tr>
<tr>
<td>Decline</td>
<td>1.52</td>
</tr>
</tbody>
</table>

![Graph showing the distribution of lives with average scores for Issue and Decline cases.](image-url)
SI Case Study #1 - Relative Mortality

Relative Mortality by Risk Score and UW Decision
SI Case Study #1 - (Hits Only)

Risk Score Range

0.00 ≤ x < 1.00
1.00 ≤ x < 1.50
1.50 ≤ x < 2.00
2.00 ≤ x < 3.00
3.00 ≤ x

Relative Mortality

Decline
Issue

Milliman
Thresholds can be adjusted to achieve desired business results.
Set Risk Score threshold to issue the same amount of business.

- Some issued premium now gets declined
- Equal amount of declined premium now gets issued

<table>
<thead>
<tr>
<th>Issued Cases Relative A/E</th>
<th>Same amount of business issued</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Risk Score</td>
<td>After Risk Score</td>
</tr>
<tr>
<td>83%</td>
<td>75%</td>
</tr>
</tbody>
</table>

9% Mortality improvement
$4 Million increase in profit
Set Risk Score threshold to maintain the same mortality A/E.

- Some issued premium now gets declined
- More declined premium now gets issued

<table>
<thead>
<tr>
<th>Premium Issued</th>
<th>Before Risk Score</th>
<th>After Risk Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>$56.1 M</strong></td>
<td></td>
<td><strong>$66.0 M</strong></td>
</tr>
</tbody>
</table>

18% More issued business
$2.9 Million increase in profit
Risk Score adds value to fully underwritten policies.
Questions?
Thank you

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