2018 Predictive Analytics Symposium

Session 06: Customer Segmentation and Profitability Analysis

SOA Antitrust Compliance Guidelines
SOA Presentation Disclaimer
Customer segmentation and profitability analysis

Moderator: Michael Niemerg

Presenter: Talex Diede
SOA Antitrust Compliance Guidelines

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The United States antitrust laws aim to protect consumers by preserving the free economy and prohibiting anti-competitive business practices; they promote competition. There are both state and federal antitrust laws, although state antitrust laws closely follow federal law. The Sherman Act, is the primary U.S. antitrust law pertaining to association activities. The Sherman Act prohibits every contract, combination or conspiracy that places an unreasonable restraint on trade. There are, however, some activities that are illegal under all circumstances, such as price fixing, market allocation and collusive bidding.

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- Do not discuss what you or other entities plan to do in a particular geographic or product markets or with particular customers.
- Do not speak on behalf of the SOA or any of its committees unless specifically authorized to do so.
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- Do alert SOA staff and/or legal counsel to any concerning discussions.
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Who is Talex?

- MS in Computational Finance & Risk Management - University of Washington
- Been with Milliman for 5 years, focused on data science and predictive analytics
  - Seattle Life Practice
  - Primarily modeling policyholder behavior for annuities
- Favorite programming language: R
DO WE HAVE ANY ACTIONABLE ANALYTICS FROM OUR BIG DATA IN THE CLOUD?

YES, THE DATA SHOWS THAT MY PRODUCTIVITY PLUNGES WHENEVER YOU LEARN NEW JARGON.

MAYBE IN-MEMORY COMPUTING WILL ACCELERATE YOUR APPLICATIONS.

PLUNGE, PLUNGE, PLUNGE.
Agenda

• Motivation
• Business applications: Profitability analysis
• Segmentation: the technical side
• Questions
Why does this matter?
Customer segmentation

- Understand the needs of the customer
- Build tailored products
- Efficiently market existing products
Profitability analysis
Current paradigm

- Same Product
- Same Issue Date
- Same Gender
- Same Initial Premium
- Same Age
Understanding your customers
Data enrichment

INNSURANCE COMPANY DATA
- Policy values
- Product features
- Prior withdrawals

ENRICHED DATASET

VENDOR DATA
- Consumer Data
- Credit Data
- Mortgage Data
- Census Data
- Health data

Analytics
Customer segmentation
Segmented assumptions

• Fit behavior models to each customer segment revealing how people use their insurance differently.
Project profitability

• Calculate “profitability” measure at seriatim level
Join to other available information

- Propensity to buy
- Cost of marketing
- Financial advisor
Business applications

- Marketing
- Distribution
- Product development
- New Business Management
- Inforce Management
- Targeted retention
- Buyback strategy
- Targeted M&A
Marketing

Higher Profitability

Lower Profitability
Product development

Qualified

Profitability relative to expectation

Non-qualified

Profitability relative to expectation
Targeted retention

- Policy 5
- Policy 4
- Policy 3
- Policy 2
- Policy 1

Profitability Relative to Expectation

Probability of Lapse

No action
Consider buyback
Target for retention
No action
Track impact of actions taken

Sales volume

Year

2018

2019
But wait, how do I determine customer segments?
Questions before we move on?
Segmentation: A technical look
Types of clustering

• Connectivity-based clustering
• Centroid-based clustering
• Distribution-based clustering
• Density-based clustering
Types of clustering

• Connectivity-based clustering
• Centroid-based clustering
• Distribution-based clustering
• Density-based clustering
Connectivity-based clustering

- **Defining principal:** data points are more related to nearby data points than to data points far away

- **Algorithm:** Hierarchical clustering
  - Agglomerative or Divisive

- **Pros:**
  - Easy to interpret
  - Can choose # of clusters after

- **Cons:**
  - Not scalable
Process

1. Standardize variables
2. Treat each data point as its own cluster
3. Select distance metric
4. Combine two closest clusters into one
5. Select and cut to number of clusters

Iterate
Process

*https://towardsdatascience.com/the-5-clustering-algorithms-data-scientists-need-to-know-a36d136ef68
Dendrogram: *tree diagram*
Types of clustering

• Connectivity-based clustering
• Centroid-based clustering
• Distribution-based clustering
• Density-based clustering
Centroid-based clustering

- **Defining principal:** data points are defined by their closeness to the centroid of the clusters

- **Algorithm:** K-means, K-medians

- **Pros:**
  - Computationally efficient

- **Cons:**
  - Spherical
  - Must choose # of clusters in advance
Process

1. Select number of clusters (k)
2. Randomly select k points (starting cluster centroids)
3. Classify every point relative to closest centroid
4. Re-compute cluster centroids
5. Repeat for other values of k

Iterate
Choosing k

[Graph showing the relationship between the number of clusters and the between-cluster sum of squares, as well as the total within-cluster sum of squares.]
Types of clustering

• Connectivity-based clustering
• Centroid-based clustering
• Distribution-based clustering
• Density-based clustering
Distribution-based clustering

- **Defining principal:** clusters are defined as objects belonging to the same distribution

- **Algorithm:** Expectation-maximization
  - Gaussian mixture models

- **Pros:**
  - Can capture correlation and dependence between attributes
  - Can have multiple clusters per data point (mixed membership)

- **Cons:**
  - Suffer from overfitting
  - Must choose # of clusters in advance
Process

1. Select number of clusters (k)
2. Randomly initialize distribution parameters for each cluster
3. Compute probability each data point belongs to particular cluster
4. Compute new parameters to maximize probabilities
5. Iterate

Iterate
Process

*https://towardsdatascience.com/the-5-clustering-algorithms-data-scientists-need-to-know-a36d136ef68*
Types of clustering

• Connectivity-based clustering
• Centroid-based clustering
• Distribution-based clustering
• Density-based clustering
Density-based clustering

• **Defining principal:** clusters are defined as areas of higher density than the remainder of the data set

• **Algorithm:** Density-based spatial clustering of applications with noise (DBSCAN)

• **Pros:**
  • No pre-set number of clusters needed
  • Arbitrarily sized and shaped clusters

• **Cons:**
  • Struggles with clusters of varying density
Process

1. Select arbitrary starting point
2. Points within ε distance of the point are considered neighborhood points
3. If sufficient points exist within the neighborhood clustering process starts
4. Points within ε distance neighborhood become part of the same cluster
5. Retrieve unvisited point

Iterate
Process

epsilon = 1.00
minPoints = 4

Clustering toolbox

- Connectivity-based clustering
- Centroid-based clustering
- Distribution-based clustering
- Density-based clustering
Questions?

Talex Diede
talex.diede@milliman.com