## Predictive Modelling for Customer Targeting A Banking Example

Pedro Ecija Serrano

## Customer Targeting

- What is it?
- Why should I care?
- How do I do it?


## What Is Customer Targeting?

- I want to sell more to my customers. I want to propose only relevant products.
- Product targeting: "What products may this person want to buy?"


## WETFLIX

## amazon

- Customer targeting: "I have a product, who may want to buy it?"
- Modelling approaches vary (recommender systems vs. propensity modelling)


## What Is Customer Targeting?



- Amazon: "Customers who bought this item also bought..."
- Netflix: "Trending Now", "Because you liked..."
- These are recommender systems - Product Targeting.


## What Is Customer Targeting?

Propensity modelling: identify customers likely to buy a specific product.

## Propensity Models forkarketing <br> English (United States), Roles, Issuers

Would you like to take advantage of sophisticated analytics without a major investment?
Mastercard Propensity Models for Marketing draw from transaction behavior to provide objective information about likely future behaviors in the areas of card use, likely preference and retention.

Account scores help you make more profitable decisions by directing the right messages and offers to the cardholders most likely to respond. The top 10-20\% of accounts identified through these models typically represent $50 \%$ or more of the desired activity across all accounts, or are 23 times more likely than average to engage in the forecasted behavior.
These models are available on consumer debit, consumer credit and commercial portfolios.

Card Expansion

- Cross Border
- Cross Border
- Recurring
- PayPass© High Activation
- PayPass© High Usage

Cross-sell

- Small Business
- Product Cross-Sell

Card Activity

- Category Spend
- Early Months on Book (EMOB)
- Luxury Spend
- Category Expansion
- Overall Card Usage


## Retention

- Spend Attritio
- Reactivation
- Balance Attrition
(MasterCard Advisors: http://bit.ly/2gHgkUP)


## What Is Customer Targeting?

- Recommender systems are useful (required) when your product range is very large.
- Have you seen the catalogue in US Netflix?
- Amazon UK had nearly 490 million items in 2015.
- Propensity modelling is suited to a product-specific model approach.
- A model per product.
- Contact the right customers with the right offer through the right channel at the right time.
- Caravan insurance (https://www.kaggle.com/uciml/caravan-insurance-challenge)


## Why Should I Care?

## The Netflix Prize

21 ${ }^{\text {st }}$ September 2009: Netflix awards a $\$ 1$ million prize to "BellKor's Pragmatic Chaos" after three years of ongoing competition.
https://en.wikipedia.org/wiki/Netflix_Prize


## Amazon's Cross-Selling

Amazon's many recommender systems are jointly responsible for $35 \%$ of the company's sales.


## Why Should I Care?

"Our industry has been quite traditional in terms of marketing and cross-selling, but consumers now expect you to pop up at the most relevant point and in the most relevant way to them, which is not necessarily on your own website." He clarifies that this targeted approach to customer engagement uses customer analytics and internal or external data.

## TheActuary

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The digital revolutionary
Andrew Brem, chief digital officer of Aviva, talks with Richard Purcell and Stephen Hyams about the challenges of digital transformation to create a better customer experience

01 DECEMBER 2016 | RICHARD PURCELL \& STEPHEN HYAMS


## How Do I Do It?

## Banking Telemarketing: selling bank deposits to your customers.

- Acknowledgement: [Moro et al., 2014] S. Moro, P. Cortez and P. Rita. A DataDriven Approach to Predict the Success of Bank Telemarketing. They made the database public.
- Lichman, M. (2013). UCI Machine Learning Repository [http://archive.ics.uci.edu/ml]. Irvine, CA: University of California, School of Information and Computer Science.
- 41,188 customers; 4,530 historical buyers, many customer-related variables (age, education, etc.)


## How Do I Do it?

There are a few challenges...

- Define the problem.
- Internal data and external data.
- Class imbalance.
- Model choice.
- Is there an optimal solution?
- What does it look like?



## Define The Problem

- Classification vs. Regression
- Does it actually matter? Do we really need the probability of buying?
- Ideal model vs. reality. The ideal model might not be good enough. What then?


## Internal Data and External Data

- The existing variables were not enough.
- We use external, publicly available data to supplement.

Internal Data

- Customer
- Internally available
- Age, education, occupation, etc.


## External Data

- Environment
- Publicly available
- Interest rates, employment rates, consumer confidence, etc.


## Class Imbalance

- 41,188 customers with 4,530 historical buyers (11\%). Pause for thought.
- There is a wild suggestion... no one wants our product. This is correct for $89 \%$ of customers ( $100 \%$ correct for non-buyers and $0 \%$ correct for buyers).
- I challenge you to find a model with better accuracy than $89 \%$ !


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## Class Imbalance

- The problem is the 89:11 proportions. If only it were $50: 50 \ldots$
- We can try the following:

Do nothing


Undersample


Oversample


Synthetic sample - SMOTE!

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## Model Choice

- Just a few suggestions:
- Naïve Bayes, Support Vector Machines, Logistic Regression, Decision Trees, Random Forests, XG Boosting, K-Nearest Neighbours, Neural Networks, Lasso Regression, Elastic Net, etc...
- How did we define the problem? Classification vs. Regression.
- Are predictions enough or do we also need information on model factors?
- Black box vs. transparent model.
- Wishful thinking vs. reality: do we really have a choice?
- Let's focus on two: Naïve Bayes and Support Vector Machines.


## Naïve Bayes

- Bayes theorem for conditional probabilities.
- It allocates observations to their most probable class.
- Some assumptions may be hard to meet (normality, non-correlation...)
- However the classifier can be very effective even when assumptions are not met.



## Support Vector Machines

- Geometric approach.
- SVM with different kernels:
- Linear
- Polynomial
- Radial
- Sigmoid
- There is room for error.
- We can play with that room for error.



## Naïve Bayes vs. Support Vector Machines

## Naïve Bayes

## SVM

- Regression
- Transparent
- Rigid
- Fast
- Classification
- Black box
- Customisable room for error
- Iterative (i.e.: slow)


## Is There an Optimal Solution?

- How do we assess if a solution is good?
- Training (2/3) and testing (1/3) datasets.
- Confusion matrix.

| Truth \ Predictions | Buyer | Non-Buyer |
| :--- | :--- | :--- |
| Buyer | True Positive | False Negative |
| Non-Buyer | False Positive | True Negative |

- We want to maximise True Positives. What about...
- False positives?
- False negatives?
- We do not have a cost-benefit matrix to provide an optimal solution.


## Is There an Optimal Solution?



## What Does an Optimal Solution Look Like?

| Model | Buyers | Calls | Success Rate |
| :--- | :---: | :---: | :---: |
| Vanilla SVM Radial | $801(18 \%)$ | $1,195(3 \%)$ | $67 \%$ |
| Vanilla Tree | $1,010(22 \%)$ | $1,566(4 \%)$ | $64 \%$ |
| Synthetic Tree | $1,956(43 \%)$ | $4,325(11 \%)$ | $45 \%$ |
| Synthetic SVM Radial | $2,668(59 \%)$ | $6,632(16 \%)$ | $40 \%$ |
| Undersampled Naïve Bayes | $3,021(68 \%)$ | $10,586(26 \%)$ | $29 \%$ |
| Calling all customers | $4,530(100 \%)$ | $41,188(100 \%)$ | $11 \%$ |

## Anything Else?

- An accurate model is good....
- ...but a good model that provides information on customers too is better.
- We can use Naïve Bayes' conditional probabilities and descriptive statistics to learn about buyers.


## Anything Else?

## Number of previous contacts



Previous outcome


## Anything Else?

The average buyer is:

- An existing customer who has bought our products before.
- Well educated.
- Best contacted by mobile phone.
- Free from family responsibilities (student or retired)
- Of good credit standing (no past loan defaults)

We have also learned that timing is critical. The following factors favour sales:

- Increasing unemployment.
- Low interest rates.


## And That's All!

Now you know:

- What customer targeting is.
- How it adds value to your business.
- How to do it.

In addition:

- You might be inspired to apply these techniques in your actuarial work!


## Questions

## Comments



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