Direct marketing campaign profitability estimation with Markov Chain Models

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Agenda

I. Introduction to Markov Chain Models
II. Methodology of campaign profitability estimation
III. Case study
IV. Summary
Elements of an MCM

- Discrete measure of time
- Collection of states
- Starting customer population
- Profit associated to each state
- Transition probabilities between states
Formal representation of an MCM

Starting population vector

Transition probabilities matrix

Profit vector

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<tr>
<th>Starting pop.</th>
<th>Segment</th>
<th>p0</th>
<th>p1</th>
<th>p2</th>
<th>p3</th>
<th>p4</th>
<th>Profit</th>
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MCM Capabilities

1. Allows to model evolution of a customer or customer groups over time
2. Allows LTV computation for a customer or customer group over a finite or infinite time span
3. Allows measurement of discounted profit from changes in customer relationships
Properties of an MCM

1. Transition probabilities are constant in time
   - Seasonal fluctuations or external factors cannot be included
   - The property can be alleviated for the sake of the model complexity

2. No memory property
   - The future of customer evolution is determined only by the current state
   - A convenient "workaround" exists to overcome this property without high increase in model complexity
No memory property workaround

Creation of $n$ intermediary states allows to determine the future basing on the past $n$ periods
Agenda

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Methodology of profitability estimation

1. Estimate MCM representing base customer relationships.
2. Gather assumptions regarding the planned campaign
3. Create MCM reflecting the relationships after the introduction of the campaign.
4. Calculate LTV for both models and compare the results to obtain campaign profitability
5. Calculate campaign profitability estimation error
Agenda

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Case study description

ABC is a major fixed line telecommunications provider. The company is considering a major investment (500 000 c.u.) in a data mining model driven marketing campaign to combat two types of churn:

a) **Contract churn** – customers (mass market) canceling their contracts with the company

b) **Value churn** – customers (mass market) beginning to use services of a virtual operator

The task is to evaluate the profitability of the investment.
Case study facts

Number of mass market customers: 96500
Mass market customer ARPU: 790 c.u.
Monthly contract churn ratio: 0.44%
Monthly value churn ratio: 0.64%

For the sake of the project, the customers have been divided into two segments:
a) Segment I: ARPU over 800 c.u.
b) Segment II: ARPU below 800 c.u.
Customer data available

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- **id** – customer identifier
- **period** – history embracing past 12 months
- **segment** – customer segment classification
- **revenue** – customer revenue for a given month
- **revenue_optimized** – customer revenue in case of tariff optimization
Current customer relationships
MCM estimation

Enterprise Miner diagram:

RESULTS:

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<th>starting_dist</th>
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<th>p2</th>
<th>p3</th>
<th>p4</th>
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Current customer relationships model

Key findings:
- Segment A customers generate proportionally very high revenues
- Both value and contract churn of segment A customers results in significant revenue loss
Assumptions regarding the planned campaign

**Target group**: segment A customers

**Target group size**: 1% of the customer base

**Target group overlap**: 50% starting from the second month

**Offer**: tariff reduction by on average 14.2% for 3 months

**Offer viable for**: 71% of target group customers

**Campaign customer retention rate**: 60% of customers with tariff optimized

**Churn prediction model lift**: 20

**Higher churn rate in target group holds for**: 3 months
Calculation of the MCM reflecting the enhanced relationships
Churn from campaign nodes only partially shown
Flows from last campaign nodes omitted or simplified
### Campaign MCM matrix (for connoisseurs)

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Calculation of the CLV for both MCM models

- **Time horizon**: 3 years – 36 periods
- **Yearly discount rate**: 5%
Calculation of the CLV for both MCM models - results

CLV before the campaign: 2 245 302 182
CLV after the campaign: 2 247 073 262

\[ 1 \; 771 \; 080 \]

Conclusion:
The net present value of revenue generated by the campaign over 3 years more than triples the initial investment (500 000 c.u.) needed to launch it.
Campaign profitability estimation errors

There are two types of estimation errors:

1) The MCM models are biased towards real customer revenue
   How to calculate: compare real customer net present value with the one indicated by the model.

2) The campaign MCM does not perfectly embrace the campaign
   How to calculate: Construct an MCM of a blank campaign and compare its customer lifetime value with the one indicated by the pre-campaign model.
Campaign profitability estimation
errors computation

- Calculate real customer net present value
- Compute LTV of a blank campaign
- Campaign effectiveness set to 0%

Create MCM reflecting post-campaign relationships
Compute and compare LTV of Markov chain models
Estimate transitions matrix, profit vector and starting population

CUSTOMER_SEGMENTS

SAS Code
- High churn rates from campaign nodes (campaign effectiveness = 0%)
- No tariff optimization for campaign nodes
Campaign profitability estimation errors - results

Real customer LTV: 852 575 017
MCM campaign LTV: 836 688 856
\[ \text{Real customer LTV} - \text{MCM campaign LTV} = -15 886 161 \ (-1.9\%) \]

Pre-campaign model LTV: 2 245 302 182
Blank campaign model LTV: 2 245 380 453
\[ \text{Pre-campaign model LTV} - \text{Blank campaign model LTV} = 78 271 \ (4.4\%) \]

Conclusion:
Both errors partially cancel each other.
The estimation error is between 2% and 3%. Compared to campaign customer LTV
Agenda

I. Introduction to Markov Chain Models
II. Methodology of campaign profitability estimation
III. Case study
IV. Summary
Summary

1. MCM can handle a broad range of customer relationships to precisely calculate their NPV.

2. MCM enables profitability estimation of complex campaigns where simple computational methods are not sufficient.

3. Campaign profitability estimation using MCM is a viable tool for calculating ROI of data mining projects.
Questions

Software used throughout the presentation can be obtained at my email address:
ks23826@sgh.waw.pl