Multiple-Goal Scoring

Engineering a Scorecard to Trade-off Business Objectives

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What is it?

- A new goal programming approach for fitting scorecards when there is more than one dependent variable
- Optimizes rank ordering properties of a score with respect to competing business objectives
- Multiple-goal scores have shown benefits to simplify decision strategies and to improve business results

Motivation

- Risk-response tradeoff in credit card marketing
  - Very responsive individuals tend to be riskier
  - Targeting with response score alone attracts much risk
- Tradeoff addressed by:
  - Incorporating risk-related attributes into mailing decision ("matrix strategy")
  - Suppressing blatant risk-related predictors from the response score ("Risk-adjusted response score")
    - Risk-adjusted response score is less anti-correlated with risk score, while giving up a little response
    - Goal programming approach automates and improves on manual process

Ability to Negotiate Business Tradeoffs
For Credit Card Marketing Problem

- We compared targeting of a risk-eligible population with a traditional response score Vs. a risk-adjusted response score
- Projections for a fixed mailing volume:

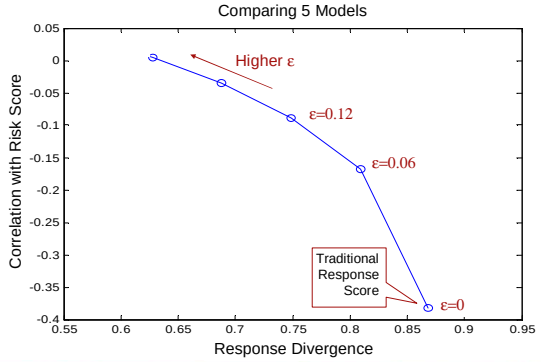
Development Approach	Response Rate	Booked Rate (as % of mailed)	Default Rate
Traditional Response Score	1.45%	0.62%	4.7%
Risk-Adjusted Response Score	1.38% ↓ (-5%)	0.65% ↑ (+5%)	4.35% ↓ (-7%)

- Risk-adjusted response score has lower response rate, but yields superior downstream results

Optimization Approach
Conceptually for Credit Card Marketing Problem

- Dependent variables:
  - *y1*: Response flag
  - *y2*: Risk score
- Goals:
  - High divergence with respect to *y1*
  - High correlation with respect to *y2*
- Optimization problem formulation:
  - Maximize correlation of developed score with *y2*
  - s.t.
  - Lower bound $D^*-\varepsilon$ on divergence with respect to *y1*, where:
  - D^* : Maximum achievable divergence with respect to *y1*
  - ε : Tuning parameter for maximum acceptable divergence loss
- Optimization algorithm:
  - Sequential quadratic programming

Tradeoff Curve for Statistical Properties of Multiple-Goal Scores for Varying ε

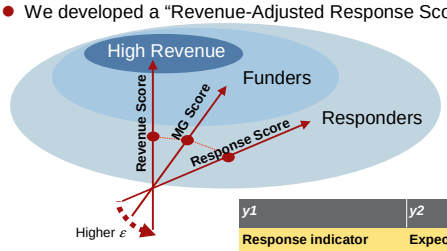


Traditional and Risk-Adjusted Response Models Emphasize Different Characteristics

Marginal Contribution Rankings			
Traditional Response Model		*Risk-Adjusted Response Model*	
No. Credit Cards	#1	…	
…		Total Mortgage Balances	#3
…		…	
Total Mortgage Balances	#7	…	
…		No. Credit Cards	#8

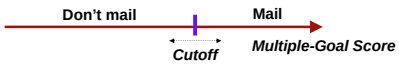
Application Study
Negotiating a Revenue-Response Tradeoff

- Client problem:
  - The most responsive individuals to a mortgage marketing were less likely to fund, and generated low revenues. Objective is to increase revenue, while maintaining an acceptable number of responses
- We developed a "Revenue-Adjusted Response Score"



y1	*y2*
Response indicator	**Expected revenue**

Implementing a Simple Mailing Strategy



- Picked ε based on projections of key business metrics
- Picked MG-score cutoff to obtain a desired mailing volume

Champion/Challenger Test Results

- Champion:
  - "Matrix strategy" depends on several scores and decision keys
- Test volume:
  - ~3 million solicitations mailed over more than 1 year
- Results:
  - **Response Rate of Multiple-Goal** strategy was acceptable
  - **Revenue per Funded Loan** was significantly higher than champion
  - **Revenue Minus Acquisition Cost** increased by more than **20%**
  - Client was satisfied with the results, while also appreciating simplicity of implementation

Discussion

- Simple ideas (sometimes) work
- We find that it is often possible to improve a lot on a secondary scoring objective, without giving up much on the primary scoring objective ("Almost-Free-Lunch" theorem)
- Business is full of tradeoffs and secondary objectives that multiple-goal scores could help to negotiate, e.g.:
  - Develop risk score that performs well on both, a short-term and a long-term default definition
  - Develop attrition score that targets higher revenue accounts
  - Re-develop scorecard on newer data, but without deviating too much from the old score distribution

    etc.