Tax Collections Optimization
For New York State

June 2011
Why Operations Research and Business Analytics?

NYS Collections and Civil Enforcement Division (CCED)

<table>
<thead>
<tr>
<th>1995</th>
<th>2005</th>
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<tr>
<td>Staff of 1000 +</td>
<td>Staff of about 700</td>
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<tr>
<td>2/3 field staff, 1/3 Central</td>
<td>1/3 field, 2/3 Central</td>
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<td>All enforcement action manual</td>
<td>Major enforcement actions automated</td>
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<td>Single Skill ACD based call center</td>
<td>State of the art contact center</td>
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<td>Most cases start in central office, follow linear collection cycle</td>
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<td>Collections $500 million</td>
<td>Collections $1 billion</td>
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Already a success story, but something was missing.

Collections process was too linear – “one size fits all”
One Size Does Not Fit All

- Resource allocation: one size fits all rules
- Speed matters
- Use the right tool
- Correct action is not defined by what is allowable
- Taxpayers past behavior is predicative of future behavior; so why weren’t we considering it?
Our actions were based on what **could** be done.

We needed to find a way to base them on what **should** be done.
Challenges

- Size/diversity of inventory
- Complex set of laws, policies, and procedures
- Needed more than a scoring system; integration with work flow required
- Culture based on taking action when allowable
New Opportunity: Combining Analytics and Optimization

• Modeling has been applied extensively in Physics and Engineering
  – **Business automation and instrumentation enables**
    **Modeling of Business and Social Processes**

• With wealth of digital data, credible behavioral models can be built of processes that lack a “physics”
  – **Consumer buying behavior**
  – **Advertising effectiveness**
  – **No show forecasting**
  – **Debt collections**
The Technical Challenge

- The legacy collections process is a complex business process governed by deterministic process flow and a large number of business rules.
- There are complex, sometimes sequential, dependencies between the actions, making the modeling task nontrivial.
- Some of these need to be respected in the new automated collections system.

A Fragment of Legacy Process
The Framework: Constrained MDP

- Markov Decision Process (MDP) formulation provides an advanced framework for modeling tax collection process
  - “States”, $s$, summarize information on a taxpayer’s stage in collection process
  - “Action”, $a$, is a collection action (e.g. phone call, warrant, levy)
  - “Reward”, $r$, is the tax collected for the taxpayer in question

The goal in MDP(RL) is formulated as outputting a policy which maps TP’s states to collection actions so as to maximize the long term cumulative rewards

**Constrained MDP(RL)** requires additionally that output policy belongs to a constrained class adhering to certain constraints
Business Process Management

- CISS for Collections BPM provides user-configurable dashboards
- Dashboards allow monitoring of the performance of the system as well as CCED staff on real-time basis.
- For example, managers and executives can review key performance indicators, such as the number of warrants created in the last week

An example of Business Process Management dashboard
Results: The Numbers

Year to Year Increase in Revenue 2007-2010

2007: + 2.18%
2008: + 3.14%
2009: Levy $ + 1.47%, + 5.58%
2010: + 8.22%

+ $83 million
Was it CISS? Maybe economic recovery?


Was it CISS?

What about staffing?

**Tax Reps**
(Contact Center)

Down 7% (20)
In 2010 vs. 2009

**Tax Agents**
(Field)

Down 3% (6)
In 2010 vs. 2009
Were the expected results achieved?

What about in the field?

- Average age of cases when assigned to field decreased by 9.3%
- Dollars per staff day increased by 15% for field agents
- Overall collections from field staff increased by 12%
- CISS assignment of cases was only major change for field
Were expected results achieved? What about enforcement actions?

- Dollars per warrant increased by 22% in 2010 vs. 2009. This generated an overall increase in revenue of 13%.

- Dollars per levy increased by 11% in 2010 vs. 2009. This generated an overall increase in revenue of 7%.
Beyond Revenue

Number of warrants filed decreased by 9%

- 2009: 228,159
- 2010: 208,217

Number of levies served decreased by 3%

- 2009: 275,064
- 2010: 268,326

35,000 less taxpayers had these serious enforcement actions taken against them
Is CISS Fairer?

- Allowable ≠ take action
- Past behavior now impacts results

Many taxpayers that would have had action taken in the past had no action taken by CISS, yet debt was still collected.
CISS through the aggressive use of Operations Research and Business Analytics has made NYS Delinquent tax collections more productive, more efficient, and fairer

We only see it getting better!