Strategy Comparison with Optimization

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Current Practice & Issue

Collection Strategy

- Implement two Challenger Strategies on M0 accounts from Sept08.
  - Champion (60%) : No Risk Segment
  - Challenger 1 (20%) : Risk Segment
  - Challenger 2 (20%) : Treatment – Manual call for High Risk Segment

- Leading Edge Flow

Test Result	Past Due --> M1 Leading Edge Flow Rate											Avg
	Sep08	Oct	Nov	Dec	Jan09	Febt	Mar	Apr	May	Jun	Julr	
Champion	48.4%	49.3%	46.8%	47.5%	55.6%	46.1%	51.0%	44.5%	51.9%	57.8%	49.4%	**49.9%**
Challenger 1	44.6%	46.3%	41.7%	44.1%	52.8%	41.9%	48.0%	39.6%	47.6%	54.1%	45.1%	**46.0%**
Challenger 2	38.1%	39.0%	34.6%	36.2%	46.7%	37.8%	41.4%	33.1%	40.5%	48.7%	38.7%	**39.5%**

Collection Strategy Result

❑ Test Result

(USD M)	Chall 1	Chall 2	Total
Estimated GCL Save	134	532	667
Estimated Expense Increase (Inc. Staff cost due to FTE inc)	(58)	(96)	(153)
Net Savings	**77**	**437**	**513**

- ✓ Calculated assuming portfolio full roll-out on an annualized basis. (vs. Champion)
- ✓ GCL save = (difference of leading edge flow)*(past-due amount)

- ✓ Estimated net saving amount of from two Challengers was US$ 513M with US$ 667M GCL reduction.

How to measure other impact

▪ Co-relation with other collection performance indicators, i.e, contact%, promise kept%, amount collected, roll-back, stabilization, etc. ▪ The most effective and efficient indicator in order. ▪ Collector Incentive Program - which indicator has to be improved. ▪ Optimal period to read strategy result	▪ Random Logic Assignment ▪ Bias from# account/$amount assigned. ▪ Uncontrollable factors: Staff turn-over, Seasonality, Social Work-out, Moral Hazard, Privacy Law, etc. ▪ Customer with multiple accounts ▪ Collection Tools, i.e, Triad, Auto-Dialer, Call Time Optimization, etc which can impact the result ▪ New technology such as SMS, mobile phone, cyber account, etc.
▪ Co-relation with expense used: # staffs assigned, # calls, letters, SMS, etc	▪ Conflict with other strategy for Line Management, Authorization, etc ▪ Impact from other bucket strategy (M1, M2, etc) ▪ Change in economic environment, business strategy

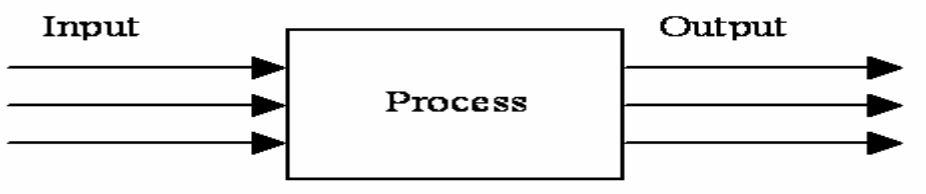
Analytical Solution

Things to Consider for Right Performance Evaluation

- Many elements can impact on collection performance.
- Small numbers of accounts with big balance can make difference
- Biased interpretation on new strategy performance.
- Test population is not random
- Big assumption for benefit calculation
- One measure for successful test

What is "*Efficiency*"?

- The degree to which the process produces the output (product/service) at a minimum resource level ("***Doing things RIGHT***")



Process	Labor Cost ($/week)	Throughput (jobs/week)	Efficiency (jobs/$)
A	2,000	1,500	0.750
B	1,500	1,100	0.733

Process	Office Area (ft^2)	Throughput (jobs/week)	Efficiency ($jobs/ft^2$)
A	10,000	1,500	0.15
B	6,900	1,100	0.16

- Ratio analysis based on single input & output may give different result. Thus, efficiency should be based on multiple inputs and outputs like below

$$\text{Efficiency} = \frac{\text{Weighted Sum of Outputs}}{\text{Weighted Sum of Inputs}}$$

DEA (Data Envelopment Analysis)

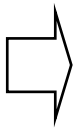
- Data envelopment analysis (DEA) is an LP application used to determine the relative operating efficiency of units with the same goals and objectives.
- DEA can handle multiple Inputs and outputs for calculating *efficiency*.
- The performance of each institution or organization (DMU) is measured relative to the performance of all operating units in the same system
- If $E < 1$, unit k is less efficient than the composite unit and be deemed relatively inefficient.
- If $E = 1$, there is no evidence that unit k is inefficient, but one cannot conclude that k is absolutely efficient.
- Applications:
  - Bank branches comparison
  - Hospital service comparison

DEA (LP Based Approach)

$$Max \quad \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{m} v_i x_{io}}$$

$$s.t \quad \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1, \quad j = 1, \ldots, n$$

$$u_r \geq 0 \ (r = 1, \ldots, s)$$
$$v_i \geq 0 \ (i = 1, \ldots, m)$$



$$Max \ z = \sum_{r=1}^{s} u_r y_{ro}$$

$$s.t$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0, \quad j = 1, \ldots, n$$

$$\sum_{i=1}^{m} v_i x_{io} = 1$$

$$u_r, v_i \geq 0$$

y_r : r^{th} output ($r=1,2\ldots s$),

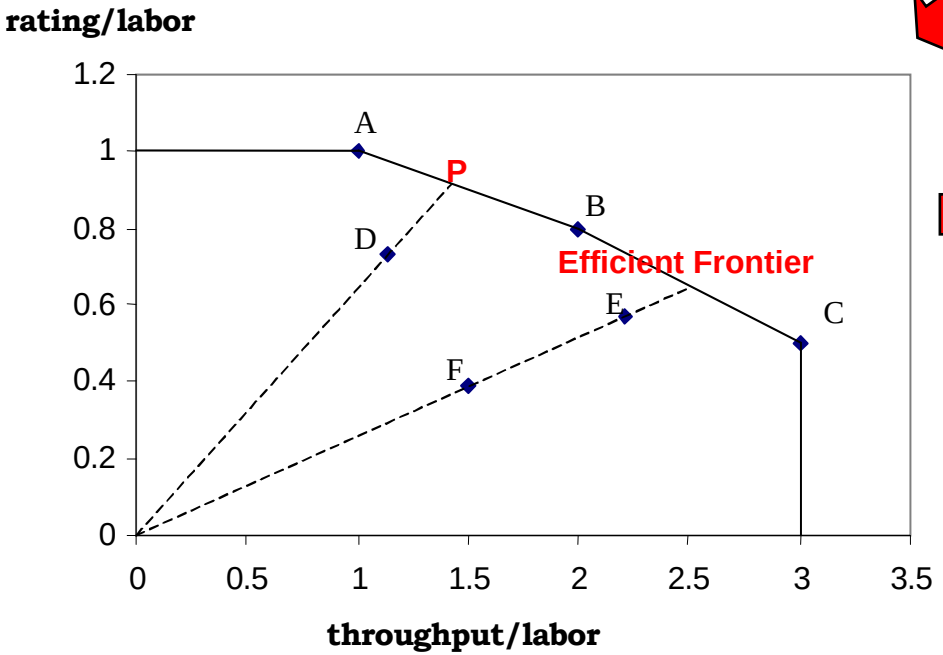
x_i : i^{th} input ($i= 1,2,3\ldots m$)

u_r , v_i : Weights

DEA - Example

Process	Labor Cost	Throughput	Customer Rating
A	10	10	10
B	15	30	12
C	12	36	6
D	22	25	16
E	14	31	8
F	18	27	7

Process	Throughput / Labor (x)	Rating / Labor (y)
A	1	1
B	2	0.8
C	3	0.5
D	1.136	0.727
E	2.214	0.571
F	1.5	0.389



Process	Efficiency	Peer Group	
A	1.0000		
B	1.0000		
C	1.0000		
D	0.7955	A	B
E	0.8827	B	C
F	0.5992	B	C

$$efficiency_D = OD / OP = 0.7955$$

Problem Description

	Leading Edge Flow (Amount)	Leading Edge Flow (Account)
Champ M1	14.7%	32.0%
Champ M2	24.0%	20.0%
Champ M3	9.3%	4.2%
Chal M1	12.5%	30.8%
Chal M2	20.0%	10.0%
Chal M3	26.5%	10.0%

	Input1	*Input2*	*Output1*	*Output2*	*Output3*	*Output4*
	# of Collectors (unit:10)	Numbers of Calls (unit:10)	Rollback Amt/ Starting Amt	(Rollback+Staying) Amt /Starting Amt	Rollback Acct/ Starting Acct	(Rollback+Staying) Acct/Starting Acct
Champ M1	4	400	44.1%	85.3%	40.0%	68.0%
Champ M2	5	350	36.0%	76.0%	40.0%	80.0%
Champ M3	7	410	51.2%	90.7%	41.7%	95.8%
Chal M1	6	450	62.5%	87.5%	30.8%	69.2%
Chal M2	6	370	44.4%	80.0%	40.0%	90.0%
Chal M3	5	400	32.7%	73.5%	50.0%	90.0%

- ✓ **Based on amount basis, *Champion* looks slightly better, however, *Challenger* looks better with account basis.**
- ✓ **2 inputs and 4 outputs were used for DEA approach.**
- ✓ **Strategy(Champ/Chal) at each month treated as DMU**

Result of DEA…

- ✓ **However, DEA gives all DMUs as "*Efficient*" as below**

	DMU					
	Champ M1	Champ M2	Champ M3	Chal M1	Chal M2	Chal M3
Efficiency	1	1	1	1	1	1

- ✓ **Due to limitation of Linear programming assigning max weight to specific input/output), got the all efficient result**

	Input1	Input2	Output1	Output2	Output3	Output4
	# of Collectors (unit:10)	Numbers of Calls (unit:10)	Rollback Amt/ Starting Amt	(Rollback+Staying) Amt /Starting Amt	Rollback Acct/ Starting Acct	(Rollback+Staying) Acct/Starting Acct
Champ M1	4	400	44.1%	85.3%	40.0%	68.0%
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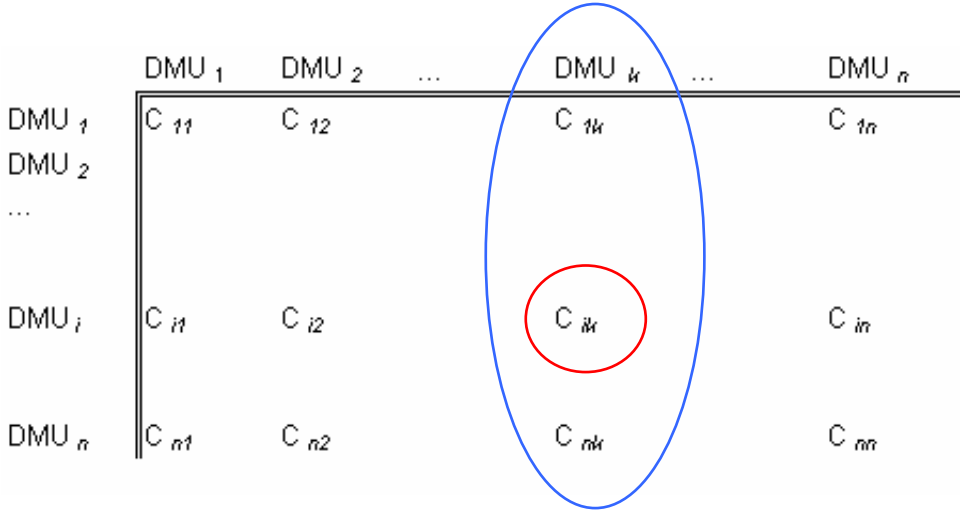
Cross Efficiency Matrix (CEM)

- Cross-efficiency matrix (CEM) provides information on the performance of a particular DMU with the optimal DEA weights of another DMU's(peer review)
- Cross efficiency provides an efficiency ordering among all the DMUs to differentiate between good and poor performers



- C_{ik} is the efficiency of DMU_k with the optimal weight of DMU_i
- The mean of cross-efficiency score(CEM column means) can be utilized for ranking efficiency.

With CEM Approach…

	Champ M1	*Champ M2*	*Champ M3*	*Chal M1*	*Chal M2*	*Chal M3*
Champ M1	1.0000	0.8502	0.8088	0.7941	0.6989	0.7722
Champ M2	0.6528	1.0000	0.8624	0.6994	0.8979	0.8000
Champ M3	0.5952	0.9113	1.0000	0.7299	0.9446	0.5952
Chal M1	0.5128	0.6901	0.8001	1.0000	0.6325	0.5128
Chal M2	0.6253	0.9404	0.9698	0.7341	1.0000	0.6667
Chal M3	0.5921	0.8625	0.7308	0.5878	0.8020	1.0000
Average	**0.66**	**0.88**	**0.86**	**0.76**	**0.83**	**0.72**
SD	0.17	0.11	0.10	0.14	0.14	0.17
Average by Strategy		**0.8003**			**0.7704**	

- Cross-efficiency matrix (CEM) shows that *Champion* strategy performs better than *Challenger* in terms of efficiency.
- *Champion* strategy shows more stable than *Challenger* in terms of SD of CEM

Trend Analysis using DEA

	1	2	3	4	5	6	7
Champion							
Window1	0.80	0.83	0.84				
Window2		0.82	0.86	0.90			
Window3			0.85	0.87	0.91		
Challenger							
Window1	0.79	0.77	0.79				
Window2		0.80	0.81	0.82			
Window3			**0.76**	**0.70**	**0.50**		

- By measuring out the efficiency with different windows, can track the efficiency by months.
- Sudden drop or continuous deterioration in efficiency requires the process/portfolio review – **Early Warning Indicator!!**

Strategy Evaluation with Benchmark

	Input1	***Input2***	***Output1***	***Output2***	***Output3***	***Output4***
	# of Collectors	Numbers of Calls	Rollback Amt/ Starting Amt	(Rollback+Staying) Amt /Starting Amt	Rollback Acct/ Starting Acct	(Rollback+Staying) Acct/Starting Acct
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Champ M2	5	350	36.0%	76.0%	40.0%	80.0%
Champ M3	7	410	51.2%	90.7%	41.7%	95.8%
Benchmark	**5**	**400**	**60.0%**	**85.0%**	**50.0%**	**95.0%**
Chal M1	6	450	62.5%	87.5%	30.8%	69.2%
Chal M2	6	370	44.4%	80.0%	40.0%	90.0%
Chal M3	5	400	32.7%	73.5%	50.0%	90.0%

	Champ M1	*Champ M2*	*Champ M3*	*Chal M1*	*Chal M2*	*Chal M3*
Benchmark	0.80	0.99	0.96	1.00	0.98	1.00

- Just comparing between Champion and Challenger is not enough, since both two strategies' performance might be behind the benchmark
- If the actual performance is better than the benchmark, then need to change the benchmark for further improvement.

Improvement with DEA solutions

- By using slack variables information, can improve the strategy efficiency more and allocate resources efficiently
- And with this information, can improve strategy treatments(# of calls, letters etc)

$$\begin{cases} \hat{x}_{io} = \theta^{*} x_{io} - s_i^{-*} \\ \hat{y}_{ro} = y_{ro} + s_r^{+*}, \qquad s_i^{-*}, s_r^{+*} \ is \ slack \ \text{var} \end{cases}$$

Applications

- Collector incentive program
- Branch performance review
- Outside agency (for recovery) comparison
- Collection call sequence

- Credit line increase/decrease
- Account renewal

- Segmentation for collection/portfolio management

Conclusions

- Current collection strategy performance might be misread with only focusing on one single number.

- Considering all the elements which can impact on collection performance, strategy evaluation should be based on multiple inputs and outputs

- DEA (Data Envelopment Analysis) measures the efficiency of DMUs which have multiple inputs and outputs. However, due to the limitation of LP approach, cross-efficiency matrix (CEM) approach also required for some cases.

- By reviewing DEA results, financial institution can use the resources efficiently and have better idea on portfolio performance.

Thank You

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