

# Decision Management Demystified

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# 4 main Dimensions



**Business  
Rules  
Management  
System**

**Decision  
Management**

**Business  
Rules  
Engine**

**Decision  
Discovery**

## 1. Increase Confidence in Strategy Performance

- ✓ Deploying a new strategy introduces risk
- ✓ Deciding which strategy to deploy is often based on gut feel

## 2. Address more Sophisticated Decisions

- ✓ What if my historical data knew something my experts have not yet discovered?
- ✓ Can the generated product configuration be improved according to my business objectives?

## 3. Connect Decisions

- ✓ Are my overall decisions educated enough or made in silos?

## **DECISION MANAGEMENT**

**is an approach that automates, improves & connects decisions to enhance business performance**

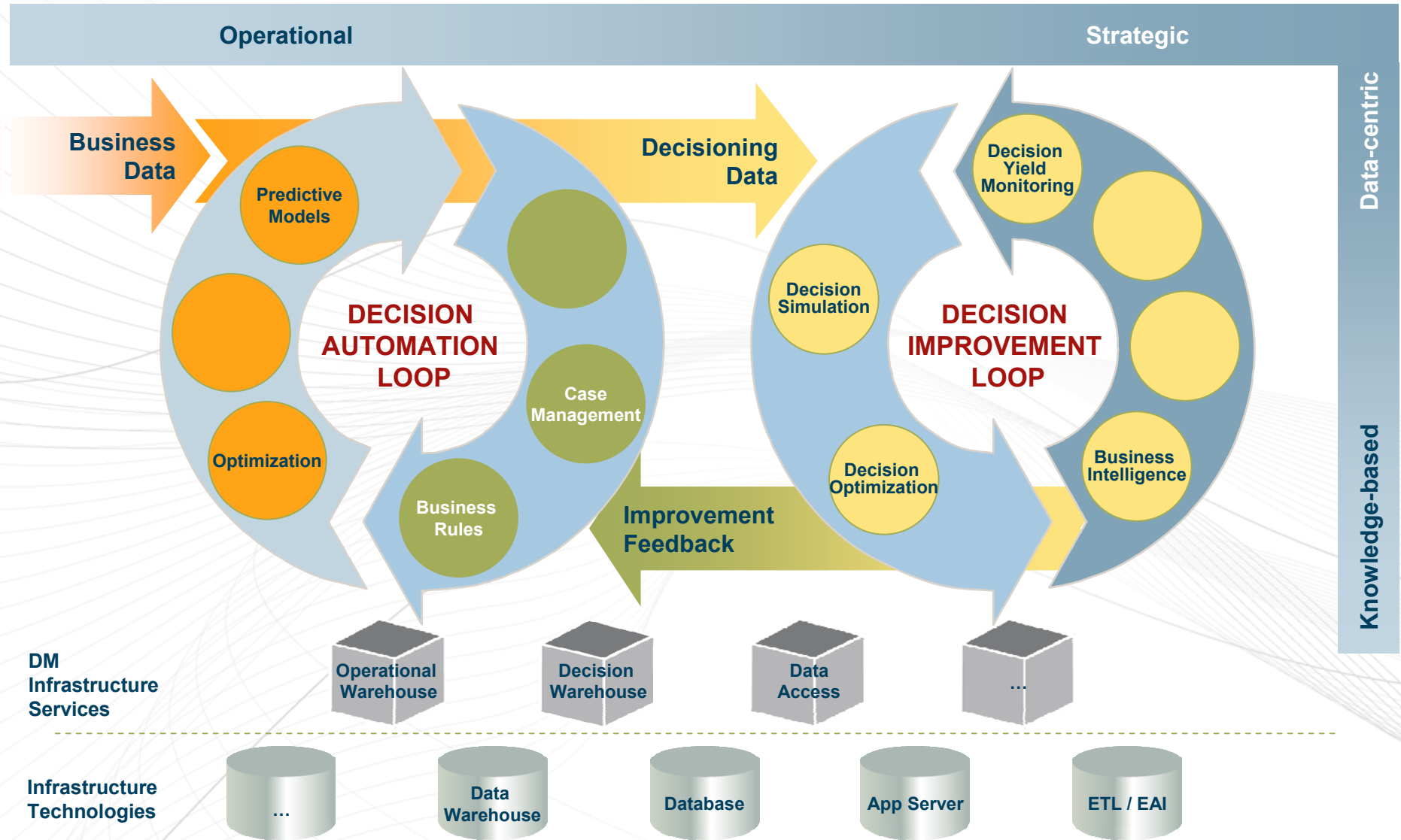
### » **Automate, Improve & Connect**

- » Automate for speed and consistency
- » Improve targeting, relevance and results
- » Connect decisions across functions, channels, customer touchpoints

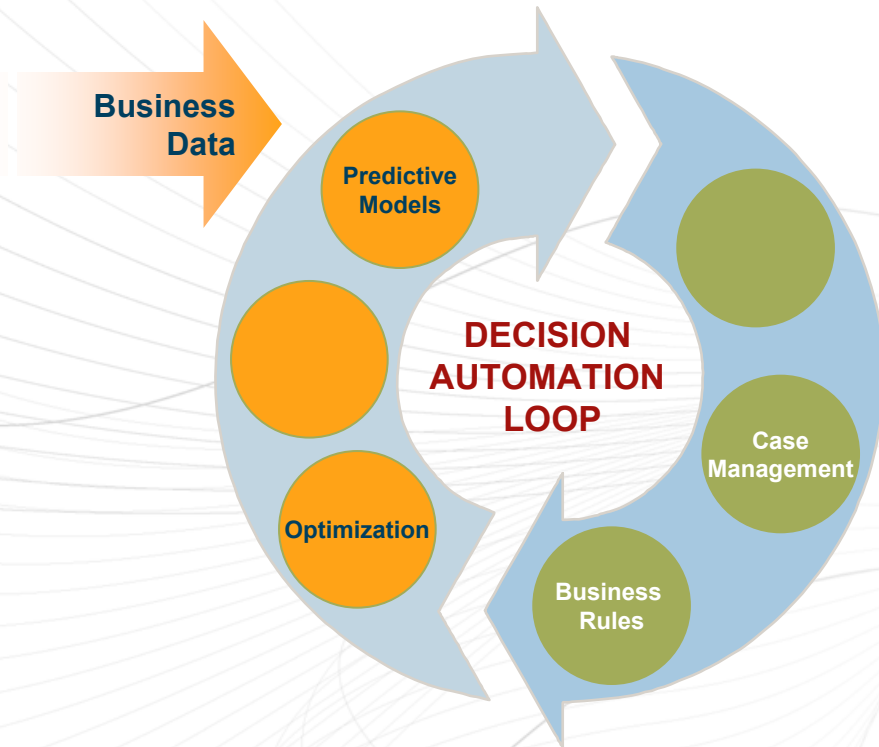
### » **Enhance Business Performance**

- » Increase customer profitability
- » Grow and strengthen customer relationships
- » Reduce fraud and credit risk
- » Lower costs of making decisions

# Decision Management Blueprint



# Address more Sophisticated Decisions



» Combination of technologies increase your Decision Yield

» Predictive Models

- » Improve precision
- » Forecast customer behavior
- » Leverage data assets

» Optimization

- » Find best compromise
- » Fit business objective
- » Ensure compliance to imposed constraints

» Case Management

- » Empower case workers
- » Capture human knowledge

## Goal: Precision Enrich decision logic using predictive analytics



### » Key preoccupation

- » How to take advantage of the available business and performance data to improve / optimize the performance of the automated decisions?
- » How to do it in a way that remains manageable and controlled?

### » Approach

- » Leverage powerful predictive analytics combined with business rules
- » Deployed and managed through the same decision management services

### » Adding predictive analytics to decision enables the automation of a further section of the business transactions

- » For example, from 75% to 90% automation in Insurance Underwriting
- » Provides significant competitive edge to the corresponding applications

Goal: Precision  
Enrich decision logic using predictive analytics



» Leverage sophisticated statistical analysis of the data to create predictive models

» Mathematical objects which synthesize & evaluate relevant customer facts to estimate likelihoods and quantities of future events

***“customers between the ages 45 and 54 with a net worth over \$500k are will not default in 96% of the cases”***

» In general used to assess risk or likelihood levels

» An input into actual decision logic

***“if customer’s potential\_default\_rate is lower than 0.04 and customer’s request’s amount is less than \$100,000 then set customer’s request’s approved\_state to true”***

» Managed in the context of larger business decision logic

» Best if explainable / legally challengeable: scorecards, decision trees

# Model Building Capabilities



## Access

- » SAS Datasets
  - » Special Values
- » Teradata
- » Oracle
- » SQL Server
- » Fixed-Width & Delimited Text; ASCII & EBCDIC
- » MB Native Files

## Prepare

- » Replace Missing
- » Sample
  - » Stratified
  - » Random
- » Partition Train/Test
- » Sort
- » Join/Merge
- » Append
- » Filter/Where
- » Variable Creation
  - » Arrays, Regular Expressions, etc.

- » **Data Spiders**
  - » Thorough & Automated Transaction Summary

## Explore

- » View Table
- » Statistics
  - » Summary
  - » Frequency
  - » Correlation
  - » By-Variable
- » Dataset Comparison

## Model

- » Linear Regression
- » Logistic Regression
- » Neural Networks
- » Reason Codes
- » K-Means & Bang Clustering
- » PCA
- » Evaluation Reports
  - » ROC, GINI, KS, etc.

- » **Scorecard**
  - » Binary Outcome
  - » Continuous Outcome
  - » Multiple Goal
  - » Hazard/Survival
  - » Reject Inference
  - » Bootstrap Validation
  - » Scaling
- » **Segmentation ART**
  - » Streamlined Segmented Modeling

## Deploy

- » Services-Oriented-Architecture
  - » Batch
  - » Transactional
- » PMML
  - » Blaze Advisor
  - » Teradata
- » Tracking
  - » Score Stability
  - » Population Stability

# Have you ever built a Predictive Model?

## Scorecard case study



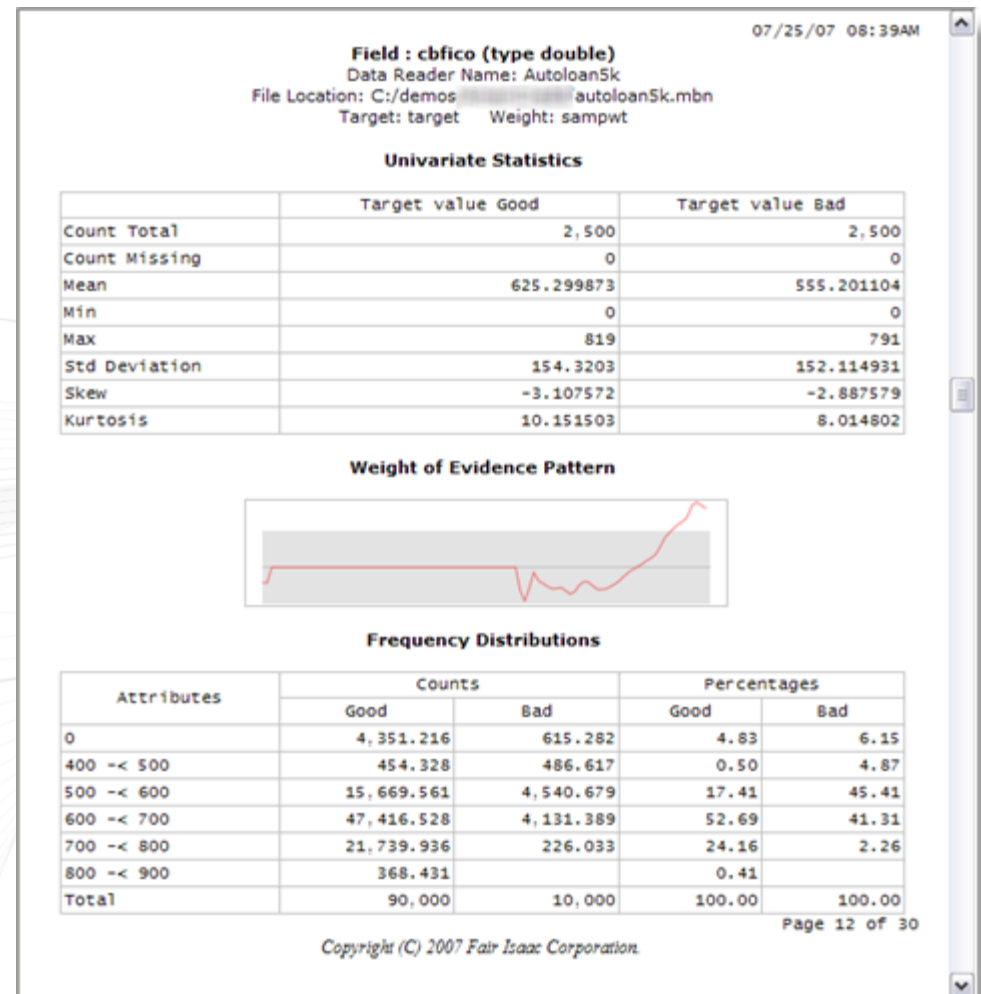
Variable	Weight	Reason
<b>creditLineUtilization %</b>		
0—30	64	
31—82	55	
83—100	48	Over Extended
<b>monthsSinceDelinquent</b>		
0—3	45	Late Payments
4—8	55	
9—NeverLate	74	
<i>No Information</i>	60	Insufficient History
<b>monthsAsACustomer</b>		
0—36	51	New Customer
37—Maximum	75	

- » Scorecards are simple (in a good way)
- » They can be understood by a business person
  - » Legal / Regulatory Audit
- » They can be engineered
  - » Enforce constraints (regulatory for example)
  - » Combine experience and empirical data

# Explore and Understand your Data



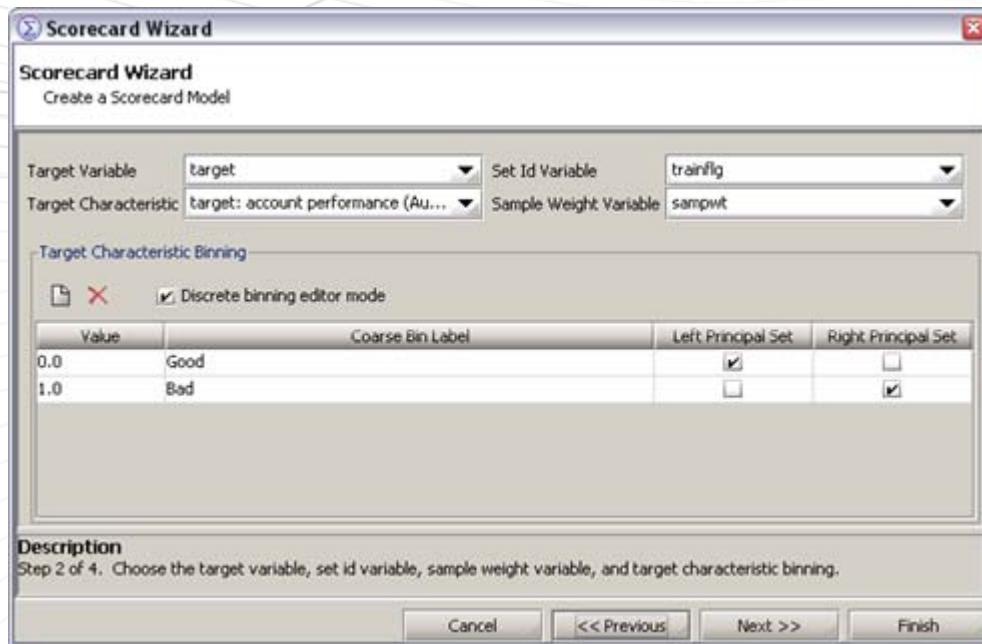
- » Generate standard Data Analysis Reports with one click
  - » Dataset Summary
  - » Data Print
- » Spot data quality issues with Field Statistics
- » Identify predictive patterns with Weight of Evidence Sparklines



# Focus on each Variable independently

- » Setup scorecard analysis with a wizard that manages all steps in binning and scorecard configuration
- » No need to administer Libraries & Workspaces

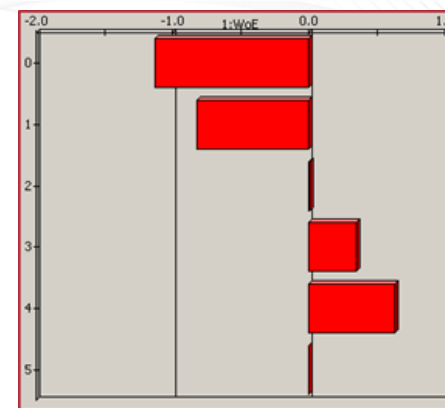
- » Capture & visualize predictive patterns
- » Address outliers and missing values



Binning statistics and operations - sc1.appage:Applicant Age

	Label	1:WoE	1:Odds	1:IVC
0	Below 21.0	-1.130	2.898	0.119
1	21.0-<23.0	-0.818	3.957	0.076
2	23.0-<33.0	0.006	9.017	0.000
3	33.0-<42.0	0.350	12.721	0.024
4	42.0-<High	0.632	16.873	0.082
5	No Information	-	9.877	-

Bin Detail | All Other SVs SV0



# Select Predictors to include in your Model



- » Recommends the most predictive set of variables
- » Powerful feedback on the relative predictive value of each variable
- » No need to worry about common statistical issues
  - » Multi-Co-Linearity
  - » Over-Fitting
  - » etc.

The screenshot shows the 'Scorecard Workspace' interface. At the top, it displays 'Primary Target' as 'target: account performance' and 'Validation Scheme' as 'Set ID: trainfig: train/test split'. Below this, there are sections for 'Scorecard Characteristics' and a table of predictors. The table includes columns for 'In', 'Tier', 'Name : Description', 'IB', 'User - In', 'Auto - In', 'Training M.C.', and 'Test M.C.'. The 'Auto - In' column is highlighted in green for several predictors, indicating they are selected for the model. The 'Model Status' at the bottom indicates 'Trained with Divergence'.

In	Tier	Name : Description	IB	User - In	Auto - In	Training M.C.	Test M.C.
<input checked="" type="checkbox"/>	1	cbfico: CB FICO score	...	In	In	0.351	0.348
<input checked="" type="checkbox"/>	1	cbutilzn: credit utilization	...	In	In	0.253	0.228
<input checked="" type="checkbox"/>	1	cbinq5mos: # inquiries last 5 m...	...	In	In	0.228	0.218
<input checked="" type="checkbox"/>	1	appocc: Applicant Occupation	...	In	In	0.156	0.089
<input checked="" type="checkbox"/>	1	appchksv: Checking/Savings R...	...	In	In	0.121	0.096
<input checked="" type="checkbox"/>	1	dealloantoal: ratio loan amoun...	...	In	In	0.106	0.073
<input checked="" type="checkbox"/>	1	appage: Applicant Age	...	In	In	0.094	0.116
<input checked="" type="checkbox"/>	1	appfinanceco: Finance Compan...	...	In	In	0.077	0.051
<input checked="" type="checkbox"/>	1	cb90ever: # times 90+ ever	...	In	In	0.042	0.048
<input checked="" type="checkbox"/>	1	dealnewused: new or used veh...	...	In	In	0.041	0.030
<input checked="" type="checkbox"/>	1	cbpctgood: % accounts never ...	...	In		0.008	0.000
<input checked="" type="checkbox"/>	1	cbtimefile: length of credit history	...	In		0.007	0.000
<input checked="" type="checkbox"/>	1	apptimeaddress: Time at Address	...	In		0.006	0.000
<input checked="" type="checkbox"/>	1	appincome: Applicant Income	...	In		0.006	0.000
<input checked="" type="checkbox"/>	1	cbmosdlq: months since most r...	...	In		0.004	0.000
<input checked="" type="checkbox"/>	1	appresidence: Residential Status	...	In		0.003	0.000
<input checked="" type="checkbox"/>	1	cbmosinq: months since most r...	...	In		0.002	0.000
<input checked="" type="checkbox"/>	1	cbmosavg: average months on ...	...	In		-0.000	0.000

# Engineer the Generated Model



- » Combine empirical and judgmental expertise
- » Enforce regulatory constraints

Characteristic Details: cbfico: CB FICO score

Current Specification

Bin...	Bin Label	Operator	Expression	Reason Code
0	Set selected binning restrictions in descending pattern		Ctrl+Shift...	
1	1.0-<565.0	<	2	
2	565.0-<584.0	<	3	
3	584.0-<597.0	<	4	
4	597.0-<609.0	<	5	
5	609.0-<629.0	<	6	
6	629.0-<645.0	<	7	
7	645.0-<654.0	<	8	
8	654.0-<661.0	<	9	
9	661.0-<671.0	<	10	
10	671.0-<681.0	<	11	
11	681.0-<705.0	<	12	
12	705.0-<739.0	<	13	
13	739.0-<High			
14	No Information	=	0	

Training Results

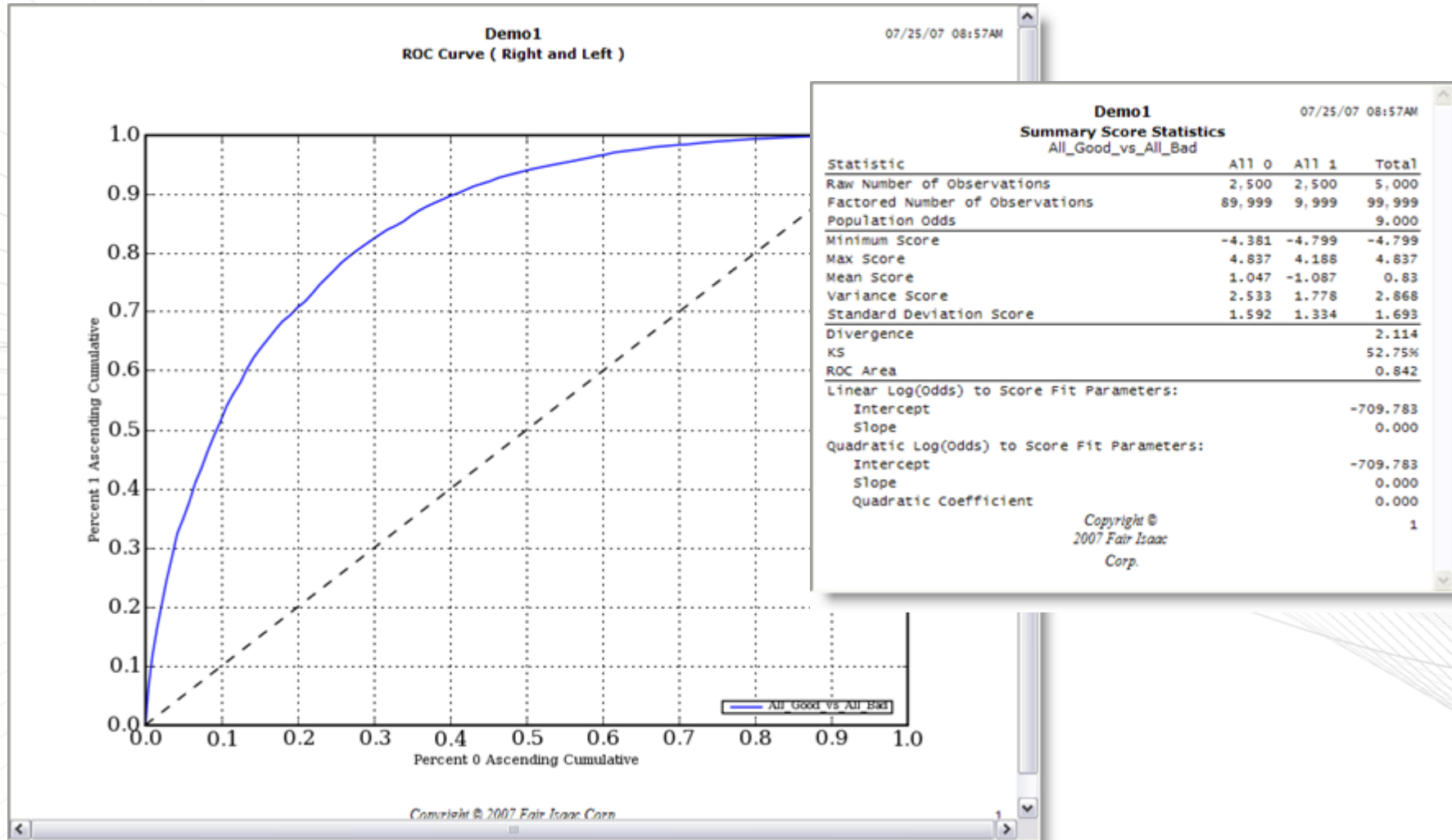
Bin In...	Bin Label	Restrict...	Good(%)	Bad(%)	Train ...	Test WoE	Weight	Train M...	Test M...
0	0.0-<1.0		4.73	5.91	-0.224	-0.306	0.263	-0.002	-0.003
1	1.0-<565.0	< 2	8.02	30.94	-1.350	-1.543	-1.083	0.144	0.124
2	565.0-<584.0	< 3	4.91	10.78	-0.787	-0.676	-0.460	0.016	0.008
3	584.0-<597.0	< 4	4.40	7.12	-0.482	-0.947	-0.417	0.007	0.019
4	597.0-<609.0	< 5	4.83	8.57	-0.574	-0.332	-0.417	0.009	0.004
5	609.0-<629.0	< 6	9.08	12.28	-0.302	-0.516	-0.190	0.004	0.007
6	629.0-<645.0	< 7	9.99	8.45	0.168	0.025	0.428	0.004	0.001
7	645.0-<654.0	< 8	5.14	3.67	0.338	0.625	0.552	0.005	0.008
8	654.0-<661.0	< 9	5.27	2.94	0.584	0.532	0.552	0.007	0.007
9	661.0-<671.0	< 10	5.56	2.91	0.648	0.849	0.552	0.009	0.008
10	671.0-<681.0	< 11	5.34	2.40	0.799	1.885	0.643	0.011	0.017
11	681.0-<705.0	< 12	10.72	2.43	1.483	1.405	0.928	0.045	0.042
12	705.0-<739.0	< 13	10.43	1.13	2.219	2.192	0.928	0.050	0.059
13	739.0-<High		11.59	0.46	3.221	2.642	0.928	0.060	0.048
14	No Informa...		0.00	0.00	0.000	0.000	0.000	0.000	0.000

OK Cancel

# Review the Quality / Robustness of the Model

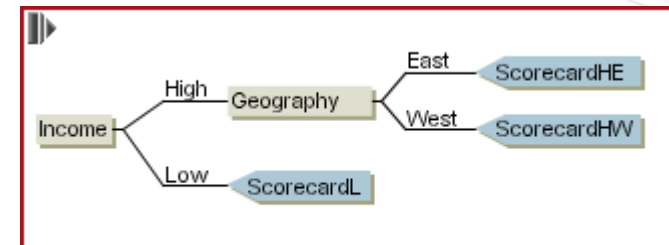
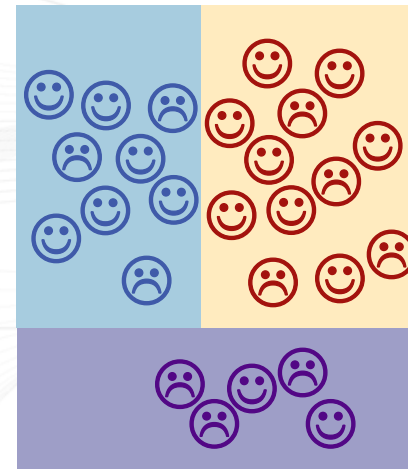
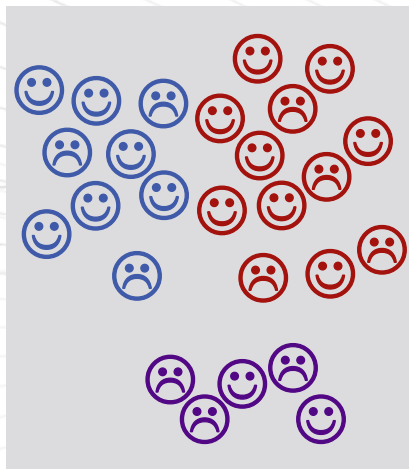


» Evaluate models with standard statistics and charts



# How do you increase predictive model precision?

- Apply the “divide and conquer” philosophy to predictive modeling
- Build multiple specialized models rather than a single portfolio-level model
- Portfolio-Level Approach
- Segmented Approach

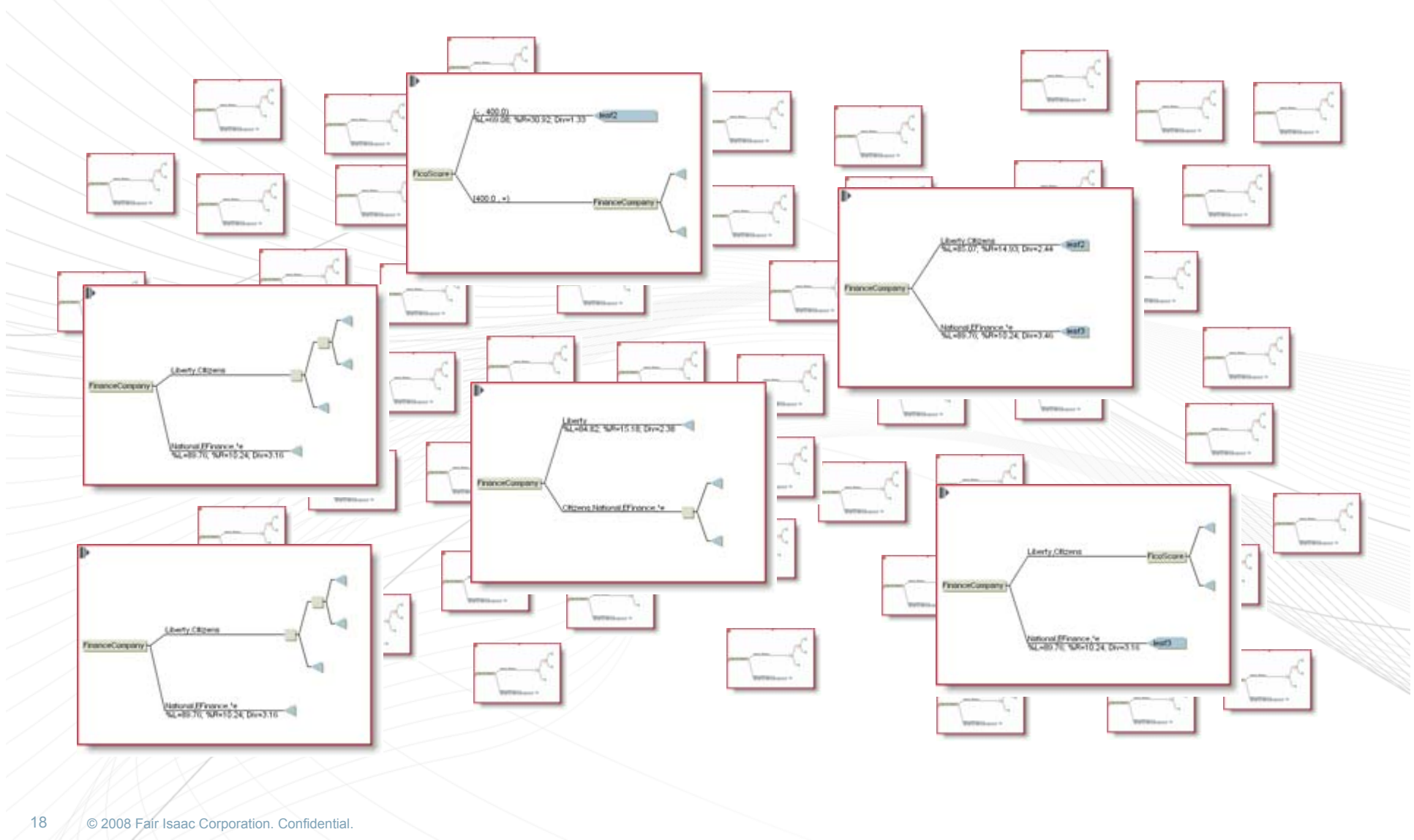


- Ideal when...
  - There are tens of thousands of examples of the outcome that is being predicted
  - When interactions provide important predictive information
  - When behaviors are driven by vastly different factors in each segment
- Challenging because...
  - Greedy tree algorithms yield sub-optimal segments
  - Modeling task amplified by the number of segments
  - Assembling the segment-level models into a segmented model system is time consuming and tricky

# Segmented trees



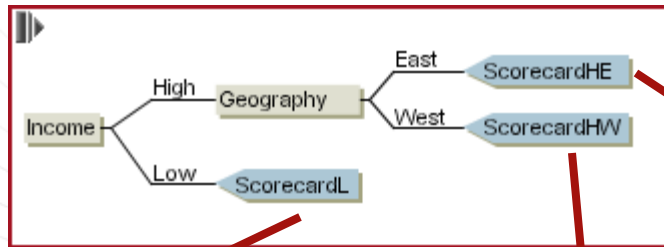
- ART generates thousands of potential segmentation schemes



# Automatic Segment-Level Models



- Naïve Bayesian scorecards are automatically trained for each segment



Continued ( 2 of 2 )  
**Model Weights Report - Scaled**  
 Model Name : SC1  
 Project Name : TourArt

Char / \$In	weight
<b>Income :</b>	
Below 4800	50.000
4800.0-<35000.0	82.000
35000.0-<100000.0	81.000
100000.0-<125000.0	99.000
125000.0-<high	112.000
No Information	67.000
<b>CoInquiriesLast3Months :</b>	
Below 1	108.000
1.0-<2.0	94.000
2.0-<4.0	86.000
4.0-<6.0	80.000
6.0-<8.0	74.000
8.0-<9.0	66.000
9.0-<high	51.000
No Information	80.000
<b>LoanToValueRatio :</b>	
Below 50	72.000
50.0-<90.0	67.000
90.0-<high	50.000
No Information	61.000

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Continued ( 2 of 2 )  
**Model Weights Report - Scaled**  
 Model Name : SC1  
 Project Name : TourArt

Char / \$In	weight
<b>Income :</b>	
Below 4800	50.000
4800.0-<35000.0	82.000
35000.0-<100000.0	81.000
100000.0-<125000.0	99.000
125000.0-<high	112.000
No Information	67.000
<b>CoInquiriesLast3Months :</b>	
Below 1	108.000
1.0-<2.0	94.000
2.0-<4.0	86.000
4.0-<6.0	80.000
6.0-<8.0	74.000
8.0-<9.0	66.000
9.0-<high	51.000
No Information	80.000
<b>LoanToValueRatio :</b>	
Below 50	72.000
50.0-<90.0	67.000
90.0-<high	50.000
No Information	61.000

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07/02/07 02:14PM  
**Model Weights Report - Scaled**  
 Model Name : SC1  
 Project Name : TourArt

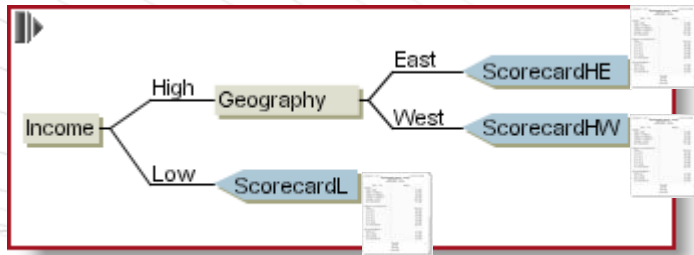
Char / \$In	weight
<b>FicoScore :</b>	
Below 350	51.000
350.0-<400.0	54.000
400.0-<450.0	64.000
450.0-<500.0	64.000
500.0-<540.0	89.000
540.0-<580.0	90.000
580.0-<610.0	109.000
610.0-<high	128.000
No Information	100.000
<b>FinanceCompany :</b>	
Liberty	139.000
Citizens	140.000
National	51.000
EFinance	52.000
No Information	101.000
<b>Occupation :</b>	
Manager	50.000
Other	52.000
Executive	66.000
Banker	108.000
Doctor	126.000
Lawyer	128.000
No Information	66.000
<b>CoUtilization :</b>	
Below 25	100.000
25.0-<75.0	87.000
75.0-<high	51.000
No Information	83.000

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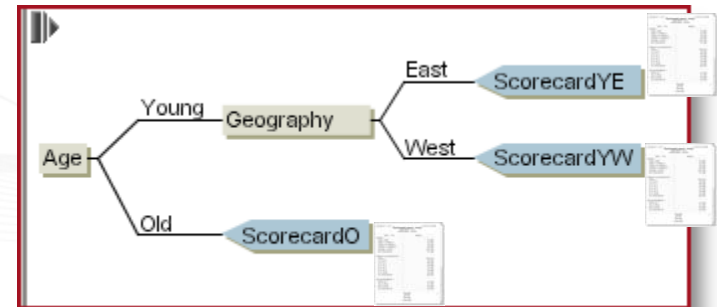
# Segmented System Ranking



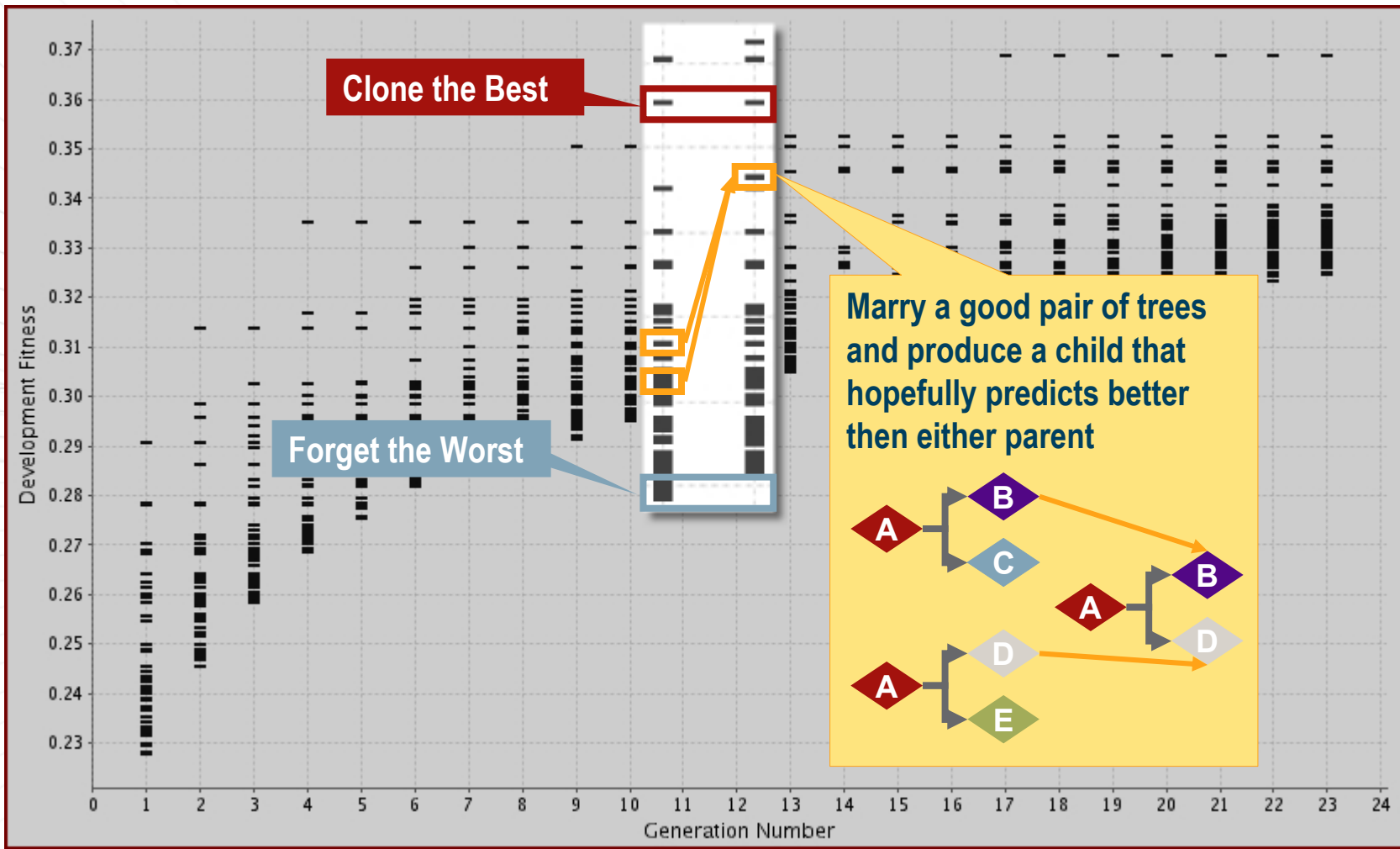
- Segmented models are ranked by the performance of their segmentation and the automatically generated segment-level models
- Which segmented model has higher test set divergence?



>?<



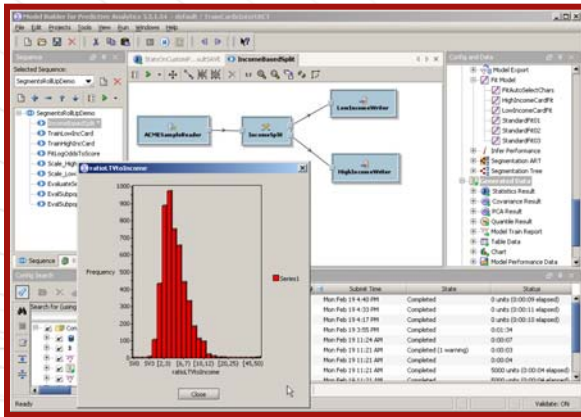
# Genetic Algorithms



# Deploy the Model with your Business Rules



- » Imported models are executed as Java components in the decisioning service. Rule developers and business users cannot see / modify them



Model Builder

Black Box (Java)

- Create SmartForms Webstep...
- Import PMML Model...
- Import Decision Tree from Model Builder for Decision Trees...
- Import Ruleset from Model Builder for Decision Trees...
- Import Function for MBPA Model...

White Box (PMML)

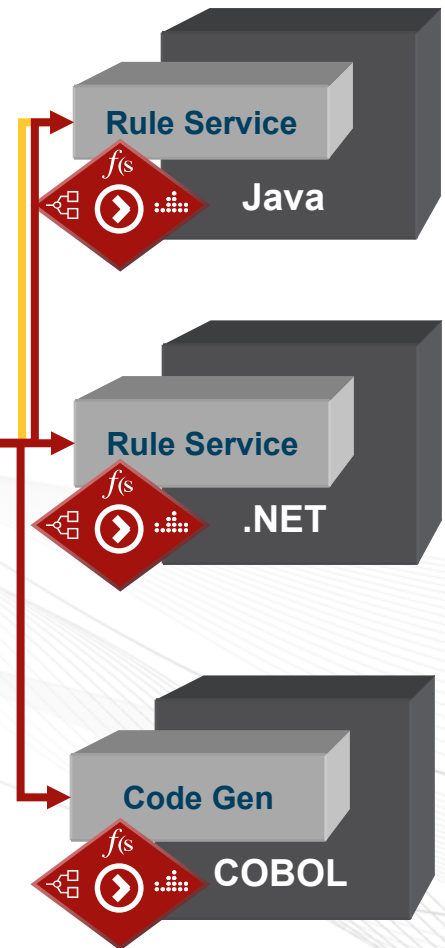


- » Imported models are available to rule developers and authorized business users can see and modify them
- » PMML integration

Characteristics		Rawline Score		Description		
Bin	Range	Description	Score	Unexpected	Reason Code	Reason Message
Student	True		6	<input type="checkbox"/>	Student	The applicant is a student.
Nonstudent	False		7	<input type="checkbox"/>	Non_student	The applicant is not a student.
All Other			8	<input checked="" type="checkbox"/>	Other	An unexpected value was encountered.

Income		Rawline Score		Description		
Bin	Range	Description	Score	Unexpected	Reason Code	Reason Message
Low	<= 25,000		-25	<input type="checkbox"/>	Low_income	The applicant has a low income level.
Average	25,000 <-> 65,000		14	<input type="checkbox"/>	Average_Inc	The applicant's income is within an aver
High	> 65,000		32	<input type="checkbox"/>	High_income	The applicant has a high income level.
All Other			8	<input checked="" type="checkbox"/>	Other	An unexpected value was encountered.



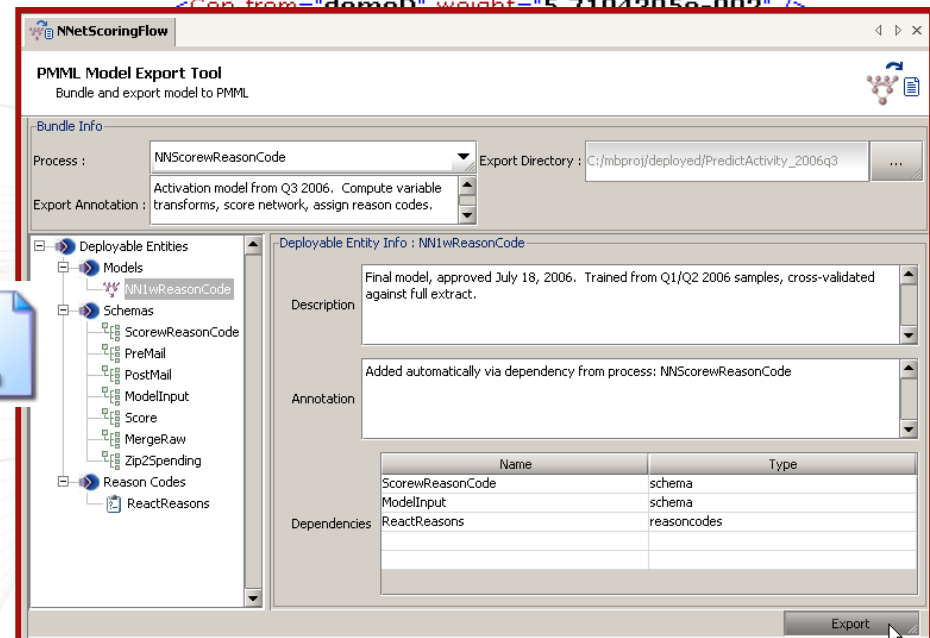
# Model Deployment to Business Rules



- » Capture model suite in PMML
  - » Predictive Model Markup Language
  - » Model weights & structure
  - » Reason codes
  - » Input & output interfaces
  - » Model types included:
    - » Scorecard
    - » Linear regression
    - » Logistic regression
    - » Neural network
- » Document critical metadata
  - » Trace exported bundle to source project and model developer



```
- <NeuralLayer numberOfNeurons="2" activationFunction="tanh">  
- <Neuron id="0" bias="-1.4394778e-001">  
  <Con from="income2" weight="1.8085394e-001" />  
  <Con from="demoA" weight="1.6428517e-001" />  
  <Con from="monthsInactive" weight="-1.6210760e-001" />  
  <Con from="income1" weight="3.0118328e-001" />  
  <Con from="demoD" weight="5.7194205e-002" />
```

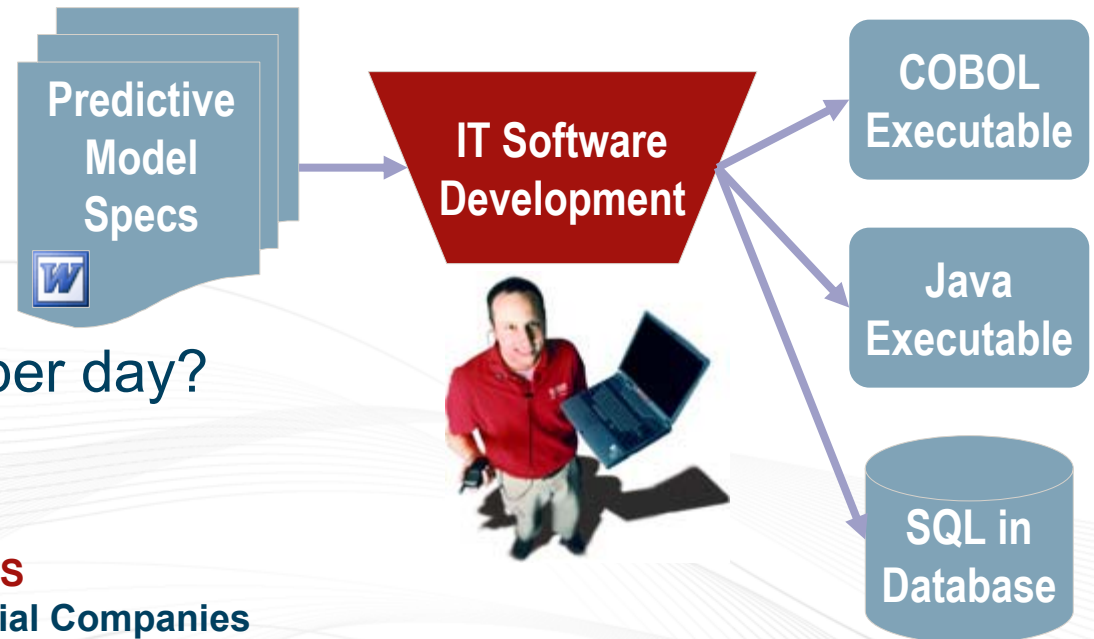


```
- <Neuron id="2" bias="-9.2077750e-001">  
  <Con from="0" weight="5.0548548e-001" />  
  <Con from="1" weight="7.1809024e-001" />  
</Neuron>  
</NeuralLayer>  
- <NeuralOutputs numberOfOutputs="1">  
- <NeuralOutput outputNeuron="2">  
  - <DerivedField dataType="double" optype="continuous">  
    <FieldRef field="isReactivated" />
```

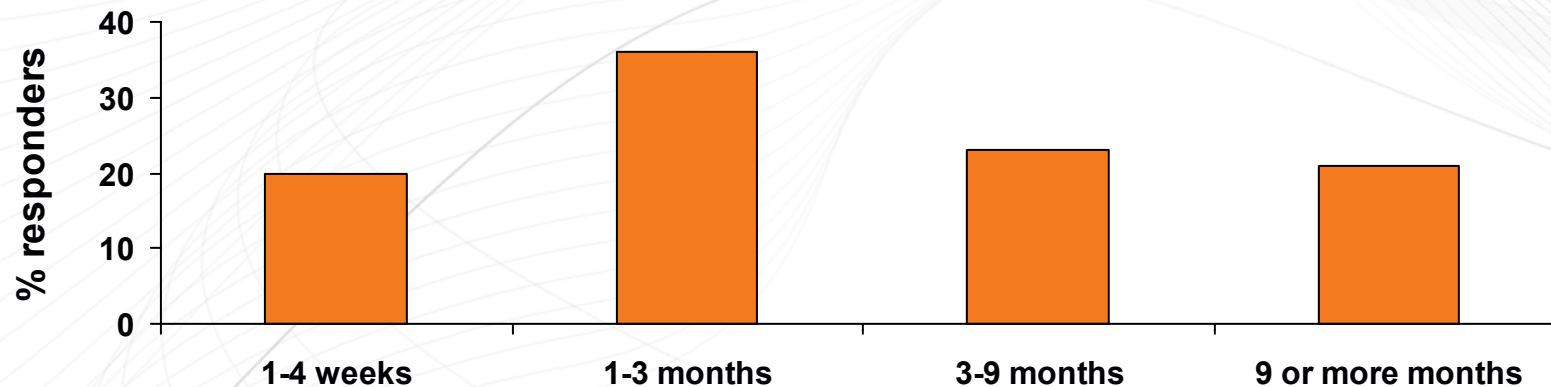
# Why do Companies care?

- » Traditional technique
  - » Document model
  - » Ask IT to recode
  - » Lengthy testing

» How many € £ \$ lost per day?



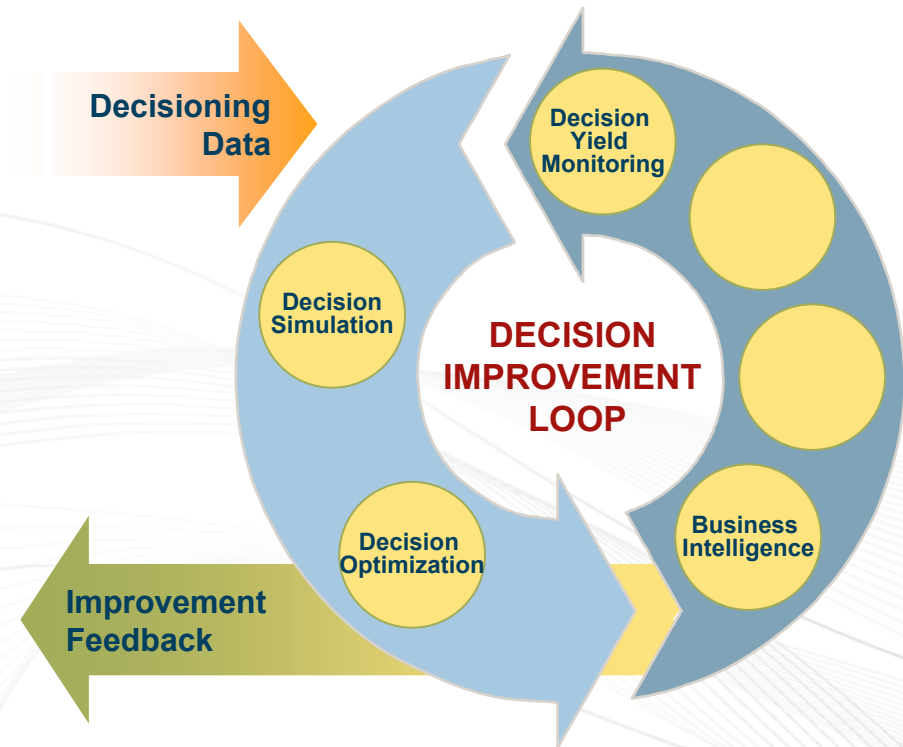
**TIME TO DEPLOY PREDICTIVE MODELS**  
Self-Reported Measures, Global Financial Companies



# Increase Confidence in Strategy Performance



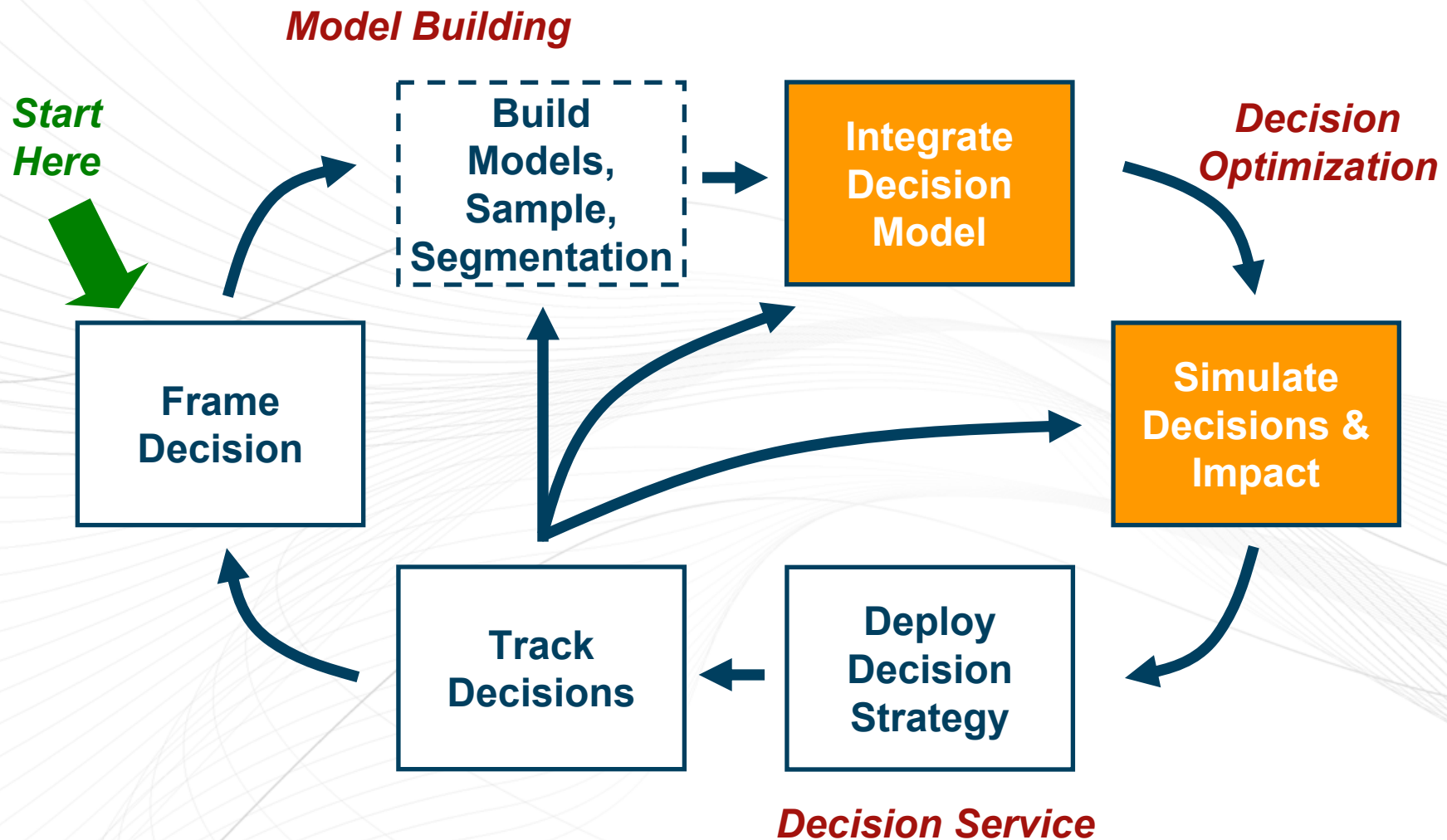
- » Champion / Challenger strategy orchestration
  - » Test-drive strategies in Production
- » Decision Simulation
  - » What-if scenarios
  - » Distribution reports
- » Decision Optimization
  - » Predict outcome
  - » Sensitivity analysis
  - » Strategy Optimization



## What is Decision Optimization?

- » Support for **representing, simulating, optimizing** and **reviewing** the business impact of automated decisions
- » Core concept: Decision models
  - » Encapsulate the business impact of decisions
  - » Translate possible actions into business measures
  - » Incorporate key performance indicators, like profit and revenue
  - » Comprehend business constraints/goals, like loss and resources
  - » Expose risks
- » Decision Optimization: improving business decisions by leveraging decision models

# Decision Optimization: The Entire Process



# Business Impact Analysis



## Customer:

- ❑ Risk score=680
- ❑ Revenue score=720
- ❑ Balance=\$2,250

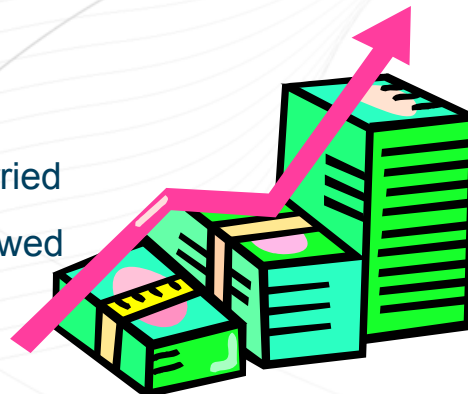


## Treatment (actions):

- ❑ Mail offer of new terms? = YES
- ❑ Offer lower APR = 9.9%
- ❑ Offer higher Credit Line = \$8,000

## Reactions:

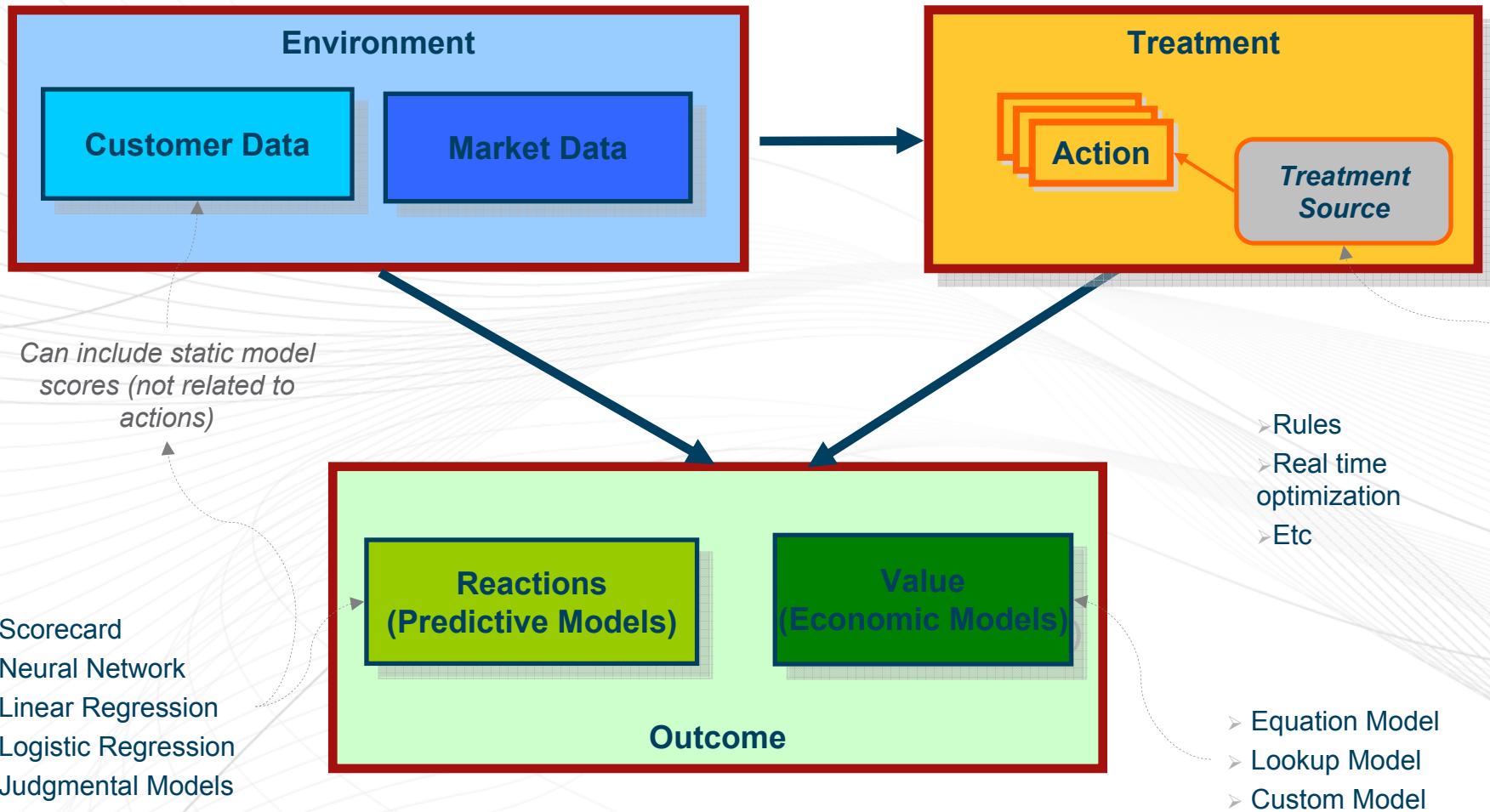
- ❑ Accept offer
- ❑ Increase balance carried
- ❑ Default on balance owed



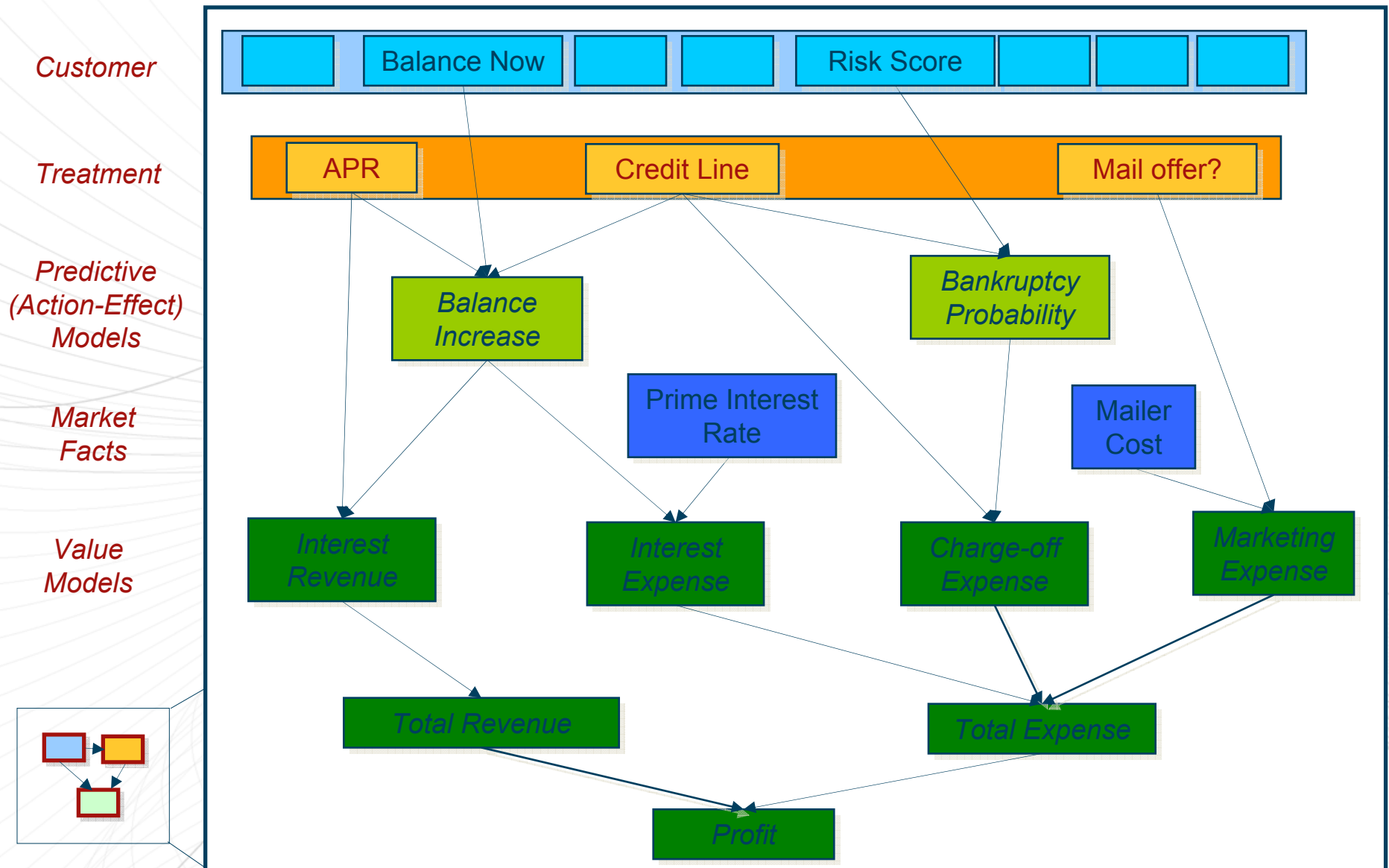
## Value:

- ❑ + Increased Interest income
- ❑ (-) possible cost of charge-off
- ❑ (-) cost of mailing

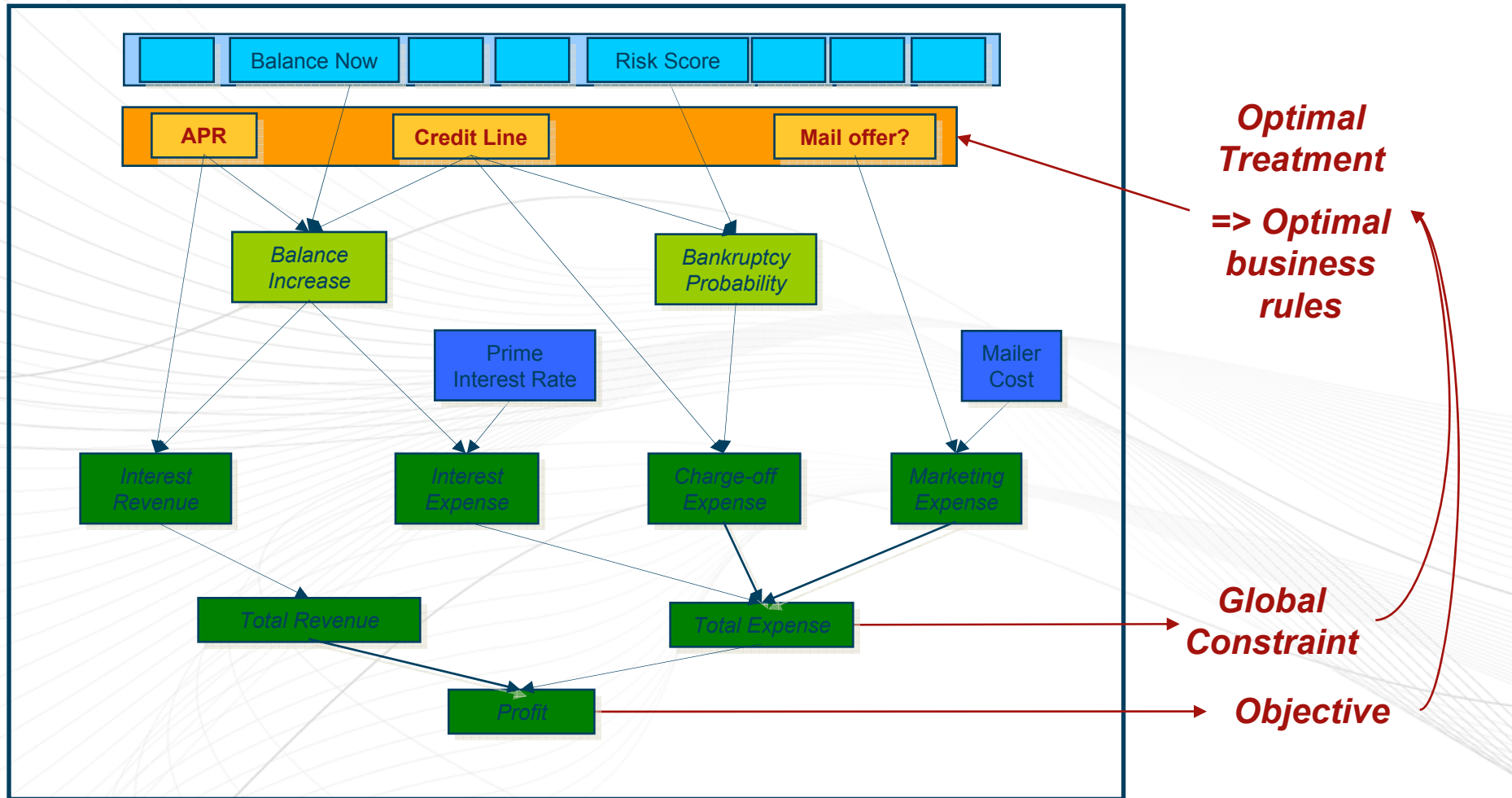
# Decision Model Decomposition



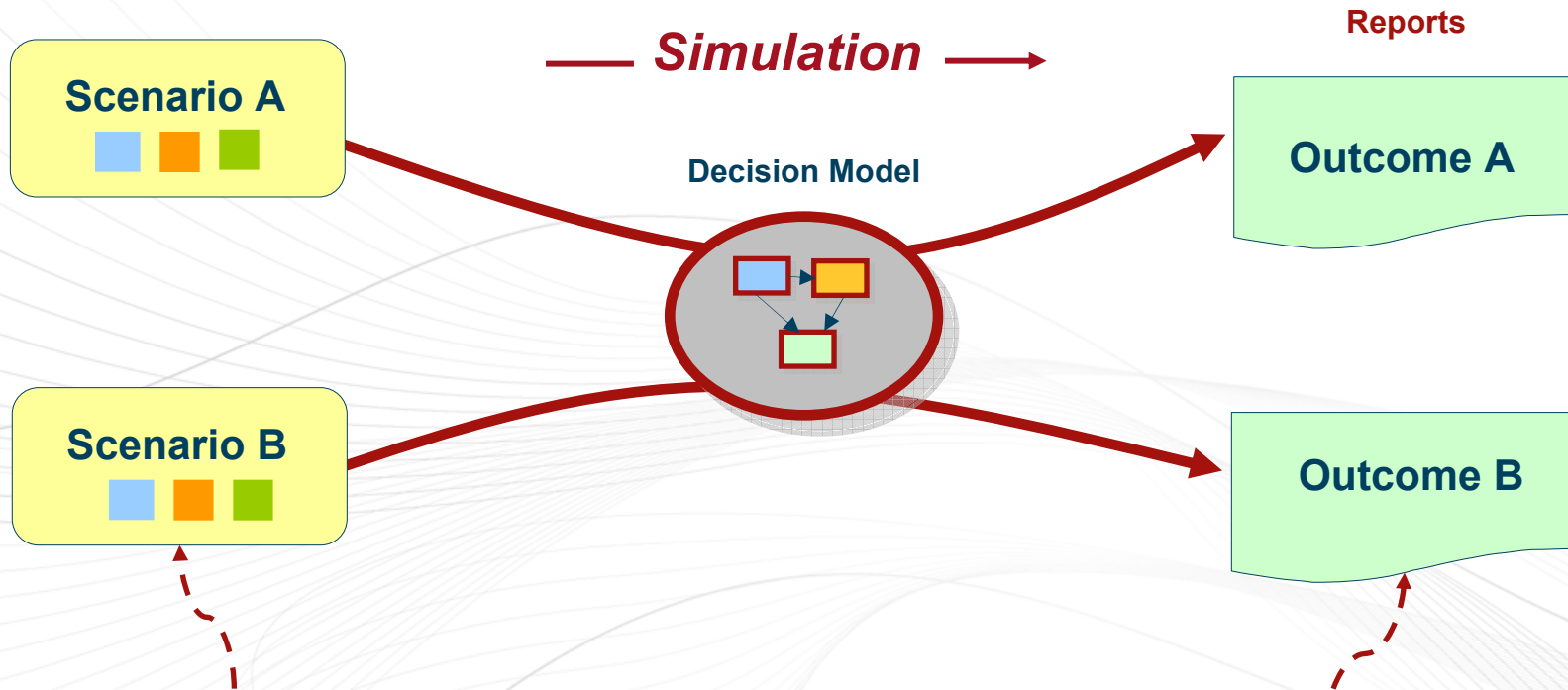
# Decision Model



# Decision Model + Optimization



# What-if analysis using a decision model



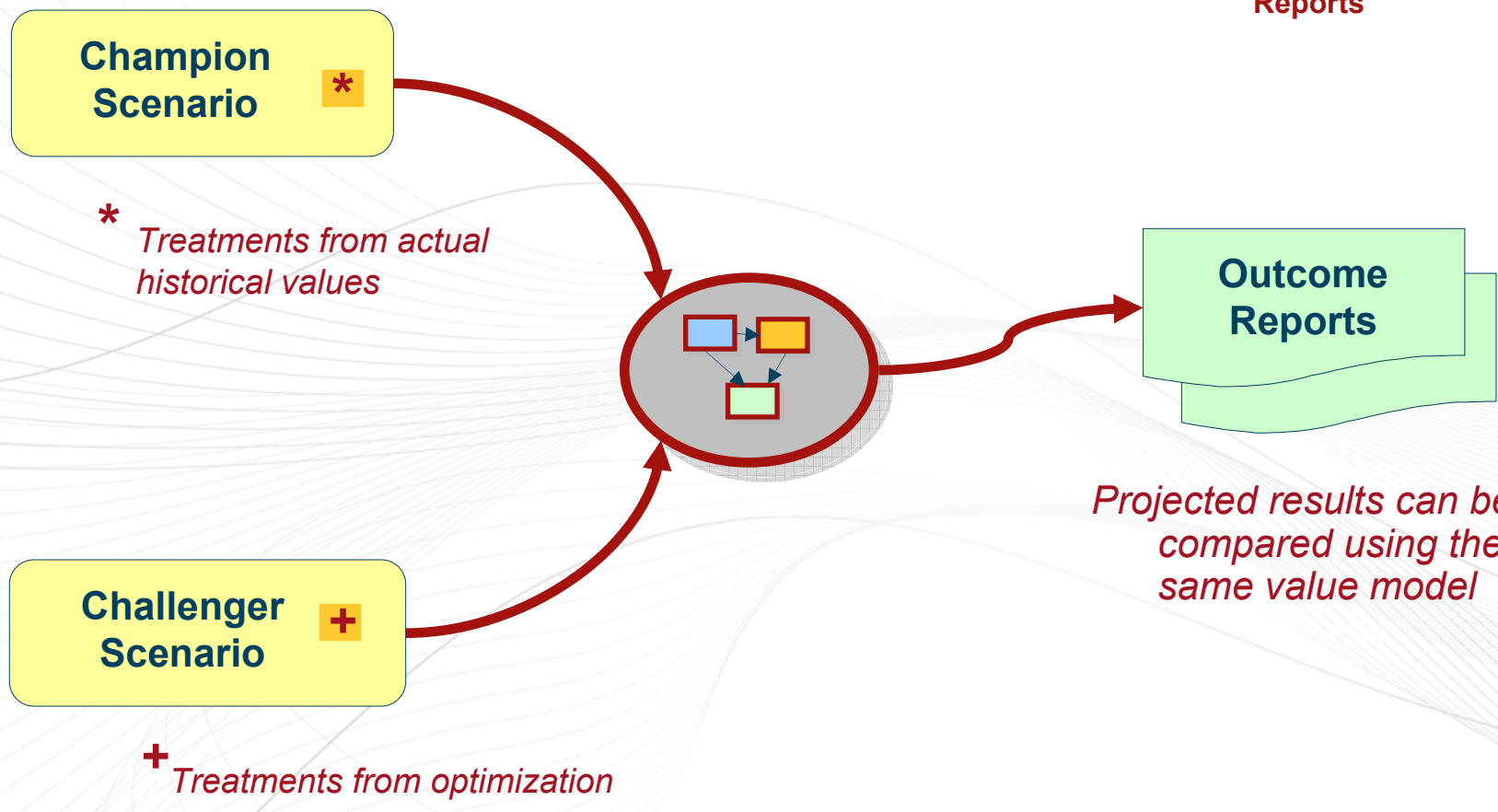
## What if ...

- » We change how treatments are assigned?
- » We change assumptions about the real world?
- » We adjust behavioral predictions?

## How would that affect ...

- » What decisions get made?
- » The impact of those decisions?

# Champion – Challenger Comparison



# Managing business trade-offs

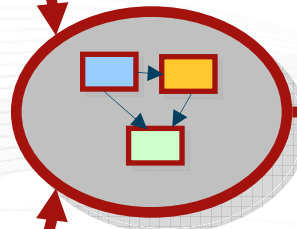


**Short-term ROI Scenario** \*

\* *Treatments from optimization ... maximizing short-term return on investment*

**Long-term ROI Scenario** +

+ *Treatments from optimization ... maximizing long-term return on investment while constraining short-term losses*



Reports

**Outcome Reports**

*Results show tradeoffs between competing business objectives and can reveal opportunity for increased decision value*

# Exploring an Efficient Frontier

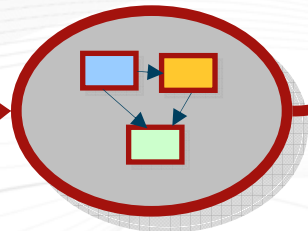
## Exploratory Optimization Scenario

Sub-scenario 1  $C_1$

Sub-scenario 2  $C_2$

...

Sub-scenario n  $C_n$



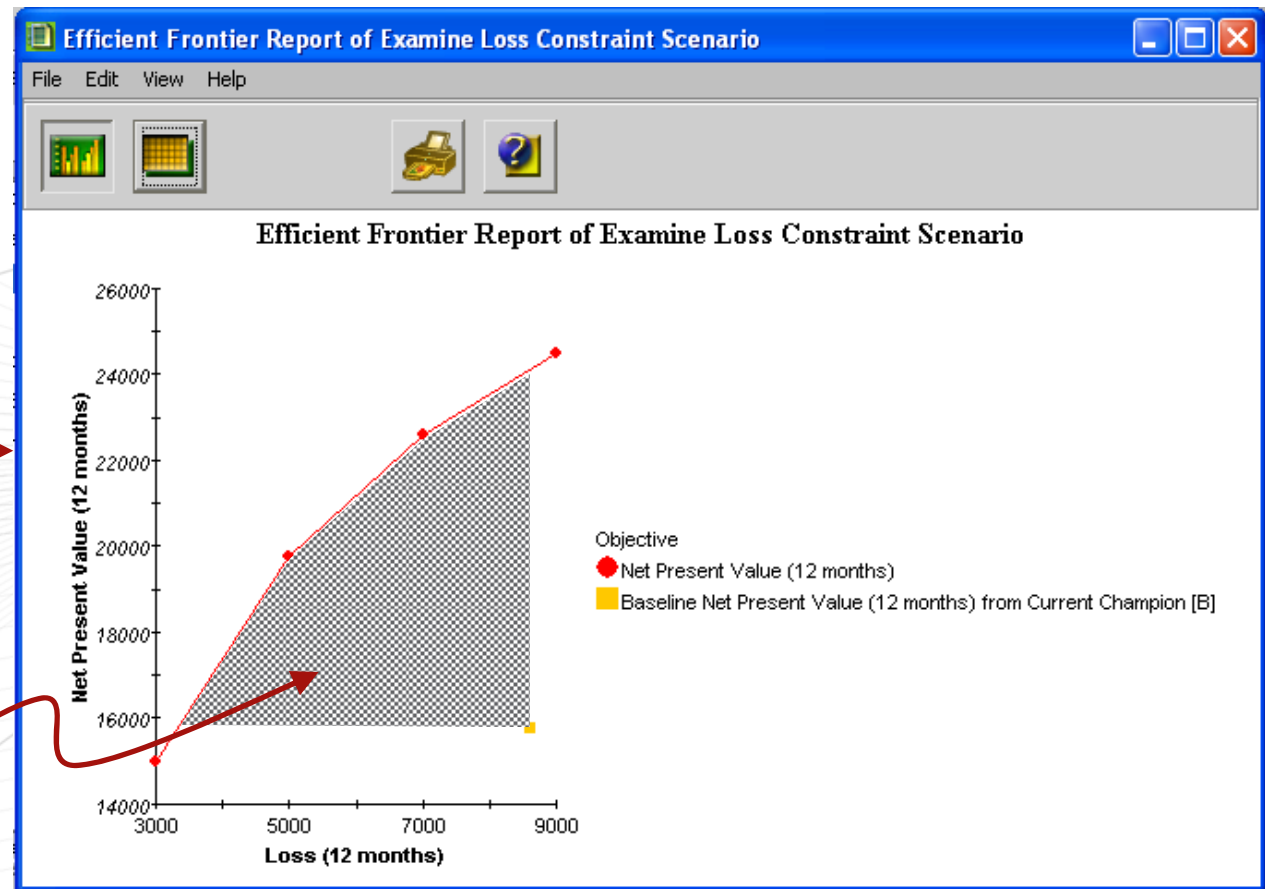
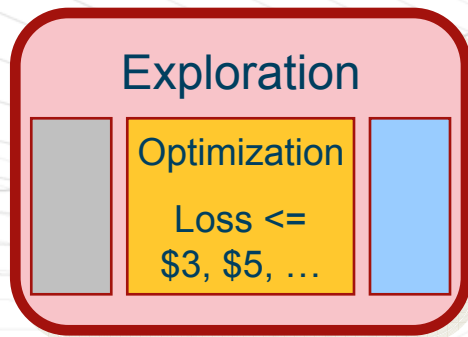
Reports

Outcome Reports

*Exploratory Optimization results can show the maximum return available at different operating points on a risk or investment spectrum*

$C_n$  *Treatments from optimization with differing constraint thresholds*

# Increase Confidence in Strategy Performance Optimization To See What's Possible



*The gap to what's possible*

*Assess where you're at and where you could go*

# Stress testing a strategy

**Original Scenario** \*

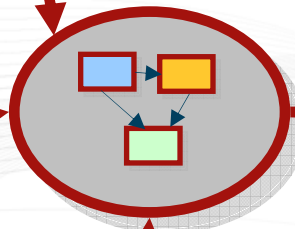
\* *Treatments from any source; same treatments for all three scenarios*

**Degraded Outlook** \*  
+

+ *Cost of capital is 1% higher*

**Improved Outlook** \*  
#

# *Cost of capital is 1% lower*



**Reports**

**Outcome Reports**

*Stress testing can give confidence in the performance range of a strategy after deployment into a changing environment*

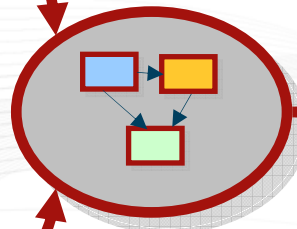
# Tuning a deployment strategy

**Optimal Scenario** \*

\* *Treatments from optimization*

**Deployment Scenario** +

+ *Treatments from a decision tree being tuned to approach optimal performance before deployment*

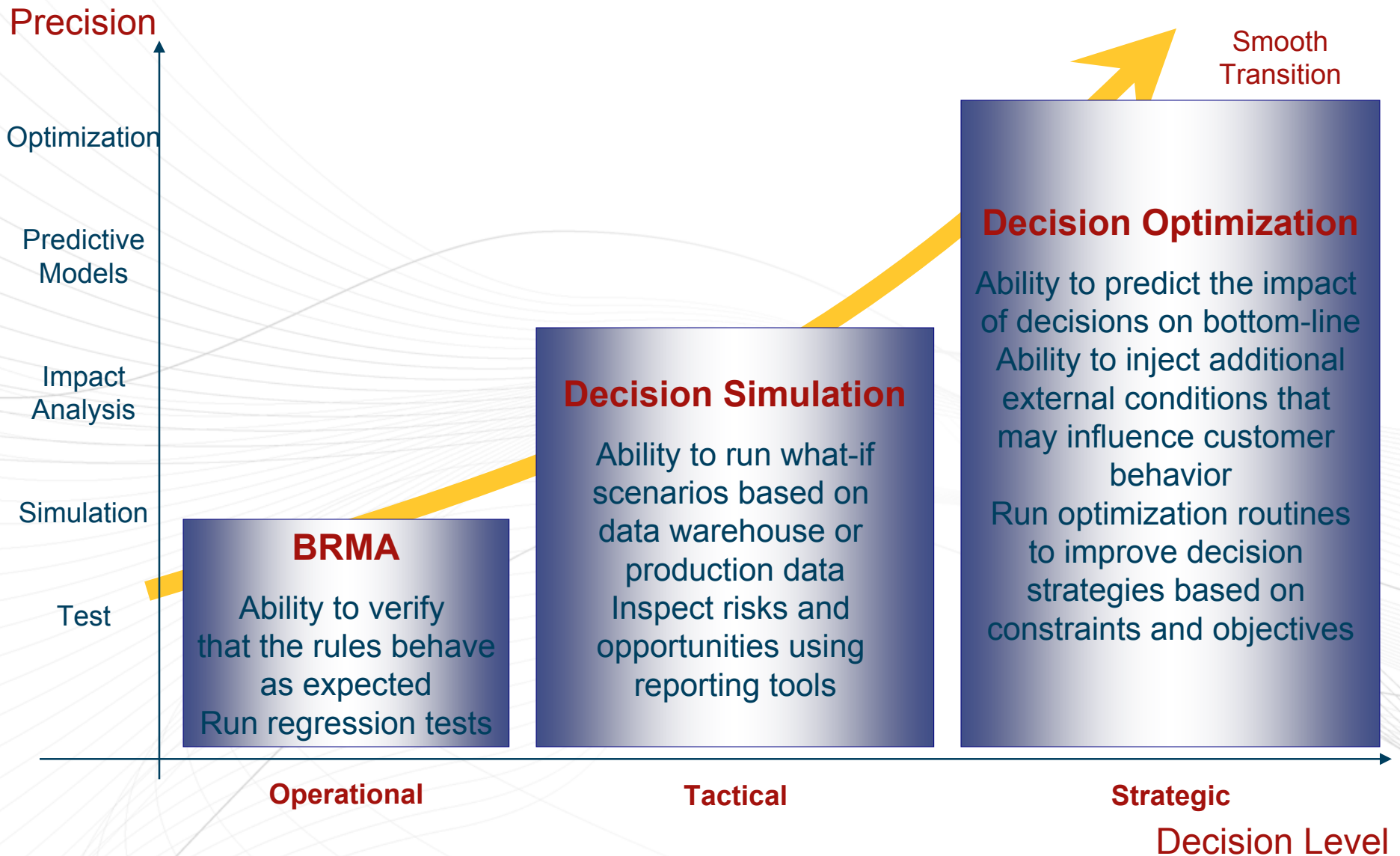


**Reports**

**Outcome Reports**

*Optimization can show best possible results and help tune rules or decision tree*

# Increase Confidence in Strategy Performance Testing-Simulation-Optimization Continuum



## **DECISION MANAGEMENT**

**is an approach that automates, improves & connects decisions to enhance business performance**

### » **Automate, Improve & Connect**

- » Automate for speed and consistency
- » Improve targeting, relevance and results
- » Connect decisions across functions, channels, customer touchpoints

### » **Enhance Business Performance**

- » Increase customer profitability
- » Grow and strengthen customer relationships
- » Reduce fraud and credit risk
- » Lower costs of making decisions

# Thank you!

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