

Many Thanks!

The Deciding Factor



*The Power of ANALYTICS to
Make Every Decision a Winner*

Larry E. Rosenberger
John Nash

WITH ANN GRAHAM

Thomas H. Davenport • Dianne G. Harris

Competing on Analytics

The New Science
of Winning



Harvard Business School Press

Agenda

» **Rules Everywhere/ OR applications and Rules**

- » What problems do we solve in FS/Insurance/Retail
- » Rules for Segmentation and Dynamic Pricing
- » Treatments – Offer Optimization
- » More.....
- » Generate Rules
- » Select Rules
- » Robust Rules

Applications: Retail

Rule-Based Systems

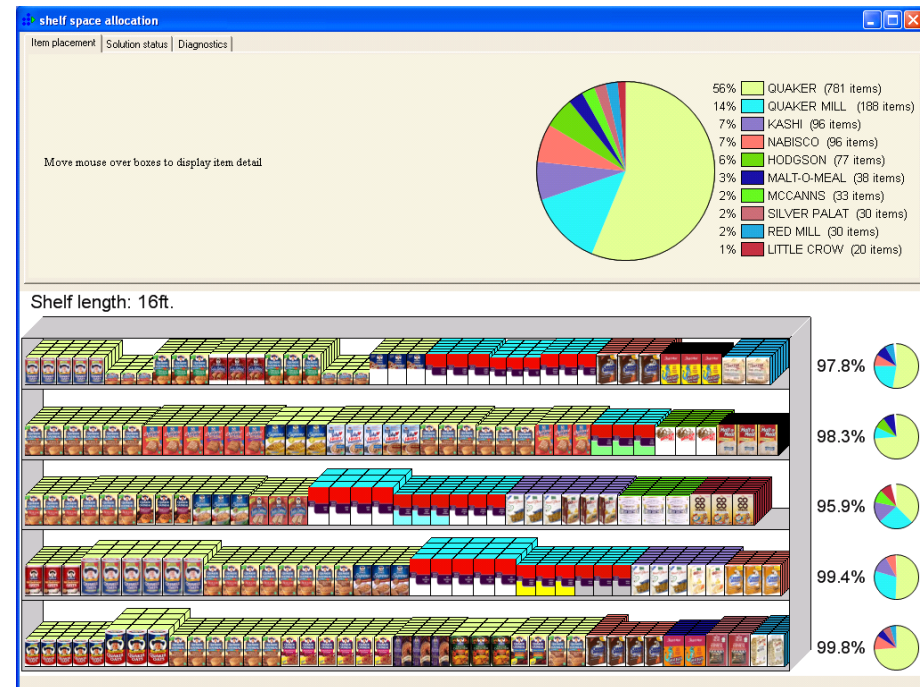
Macro Space Planning



Goal: To reduce manual effort in merchandising 6,000+ adjacencies

Goal: Link POS stats to merchandising quality

Micro Space Planning



Decision Areas Inside Space Planning Solution

Micro Space Example

Fair Isaac
BLAZE ADVISOR
Rules Management Technology

Space Planning Application

admin, signed in since : 9/28/07 6:50 PM | Sign Out | Help

Location: MicroSpacePlanning / Business Rules / Store Optimization / Micro Planning

Delete | Check Out | Cancel Check Out | Check In | Refresh View | Search

☐	Name	Status	Version	Owner	Last Modified
☐	Assortment Rules		1	admin	9/6/07 2:14 PM
☐	Blocking Rules		1	admin	9/5/07 5:59 PM
☐	Inventory Rules		5	admin	9/6/07 2:14 PM
☐	MonthlyDemandForecast		1	admin	11/28/06 8:08 PM
☐	Objective Function		2	admin	9/6/07 1:48 PM
☐	Shelf Layout Parameters		1	admin	9/6/07 2:14 PM

Powered by Blaze Advisor Business Rules Engine

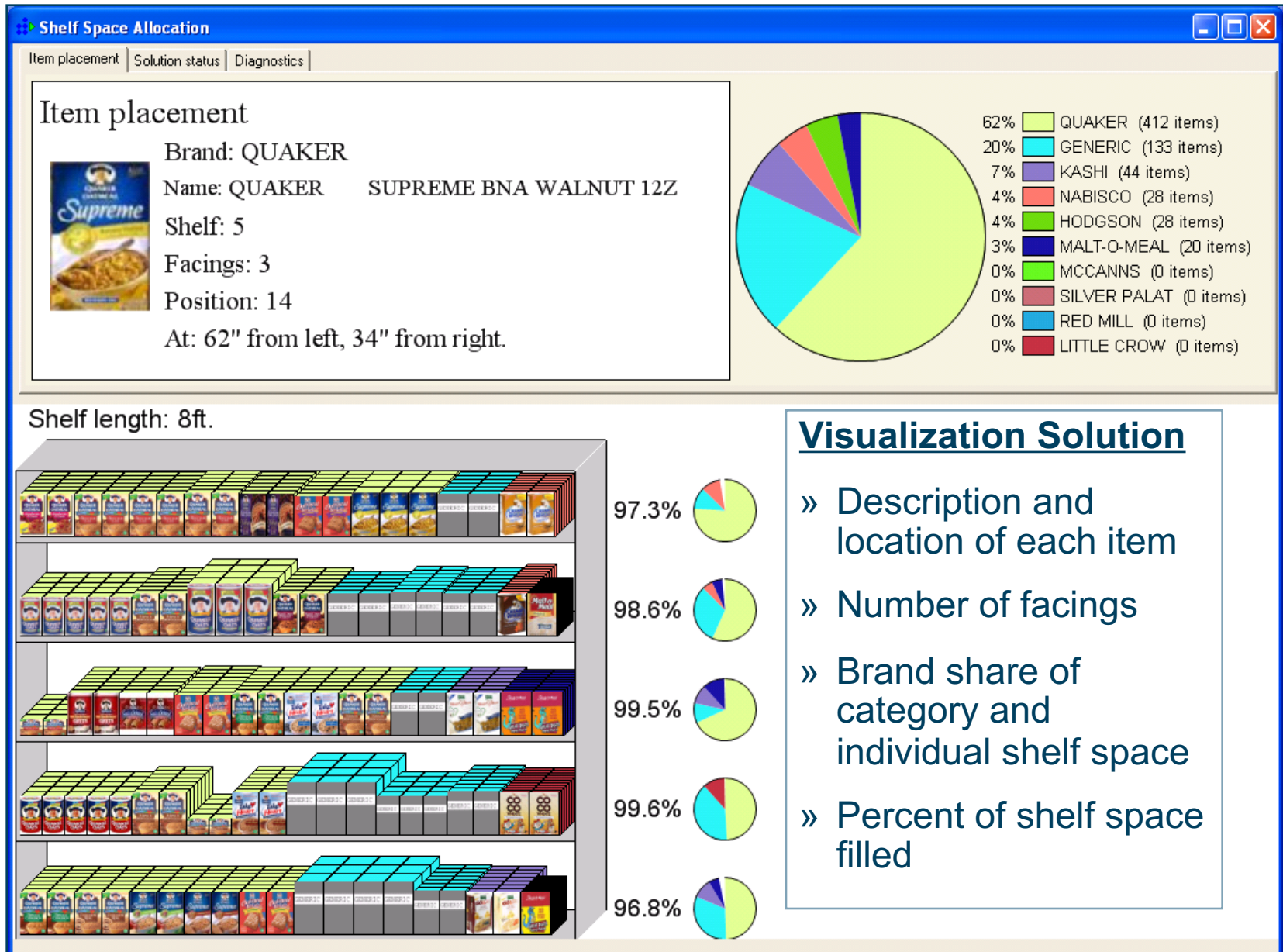
Assortment/planogram rules codified for future use

- »Manage key learnings as a corporate asset
- »Assign priority / ranking to rules
- »Create different rule sets & rule flows by store / cluster

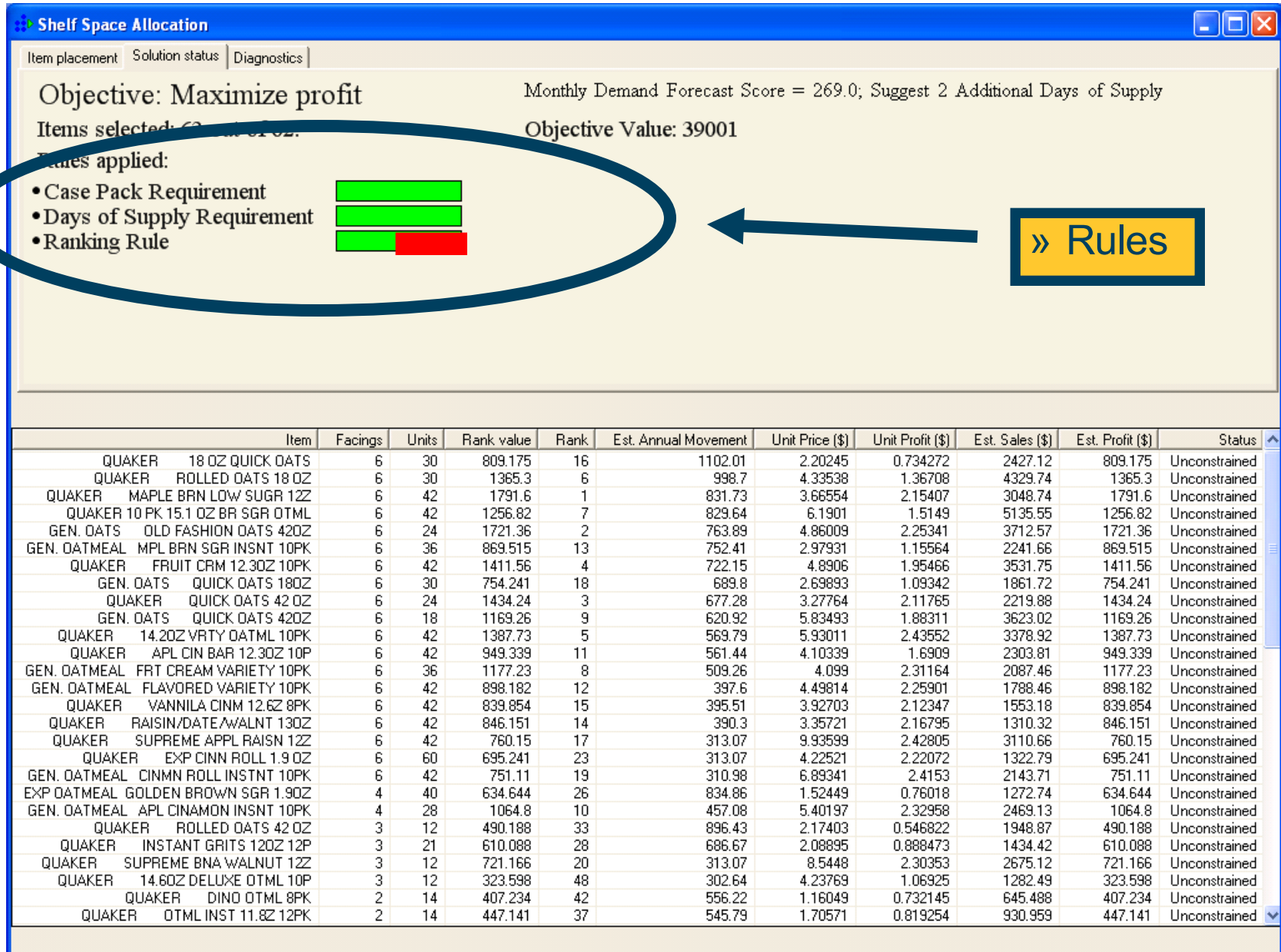
**Assortment/planogram decisions
based on customer demand**

Shelf layout parameters factored in — by cluster or store

Space Optimization: Visualization Results — 8 foot shelf



Space Optimization: Constrained Assortment Optimization



Applications: Healthcare

Rule-Based Systems

Staff Scheduling



Physician Scheduling Software, Call Scheduling Software, Medical Staff Scheduling Software from - Windows Internet Explorer

http://lightning-bolt.com/WebSchedule4.9.0/CalController.aspx

File Edit View Favorites Tools Help

Windows Live Hotmail ESPN - Streak for the Cash - ... Physician Scheduling Soft...

12/1/2008 - 1/4/2009 Default Schedule View Radiology: Daily Schedule Last modified: 6/3/2009 4:29 PM by radview

Printable PDF Dec 29 - Jan 04, 2009

Assignment	Monday Dec 29	Tuesday Dec 30	Wednesday Dec 31	Thursday Jan 1	Friday Jan 2	Saturday Jan 3	Sunday Jan 4
AM Fluoro	M. Brown	T. Peltola	L. Stoll	R. Granit	G. Blobel		
AM Body CT	Susumu	E. Lewis	T. Peltola	D. Bovet	L. Hartwell		
PM Body CT	M. Brown	T. Peltola	L. Stoll	R. Granit	G. Blobel		
PM Body MR	Susumu	E. Lewis	T. Peltola	D. Bovet	L. Hartwell		
AM Neuro	E. Lewis	A. Gilman	E. Lewis	R. Roberts	E. Neher		
PM Neuro	T. Peltola	Susumu	E. Lewis	R. Roberts	E.N. A.G. X		
IR	R. Roberts	S. Brenner	S. Cohen	R. Sperry	R. Roberts		
Mammo	D. Bovet	R. Granit	Susumu	A. Gilman	S. Cohen		
Ultrasound	S. Brenner	R. Sperry	L. Hartwell	G. Blobel	L. Stoll		
AM General	R. Granit	L. Hartwell	A. Gilman	N. Jerne	Susumu		
PM Vienna	R. Granit	L. Hartwell	A. Gilman	N. Jerne	Susumu		
PM General	E. Neher	J. Black	M. Brown	S. Cohen	S. Pruisner		
Late Shift 5-10	E. Neher	J. Black	M. Brown	S. Cohen	S. Pruisner		
WestHealth	L. Hartwell	S. Pruisner	S. Pruisner	T. Peltola	J. Black		
Imaging Center	J. Black	R. Roberts	J. Black	S. Pruisner	E. Lewis		
Monticello	Pollock	Pollock	Pollock	Pollock	Pollock		
AM Paris Clinic	N. Jerne	N. Jerne	R. Roberts	E. Neher	N. Jerne		
PM Paris Clinic	N. Jerne						
Admin			S. Brenner				
AM Extra Rad	.	.	.	.	.		
PM Extra Rad	E. Lewis	A. Gilman	J. Murray	E. Neher	N. Jerne		
General Call	M. Brown	L. Hartwell	R. Granit	G. Blobel	L. Stoll	S. Pruisner	D. Bovet
IR Call	.	.	.	.	.		
7 AM Start	.	.	.	.	.		
Day Off	E. Fischer	G. Blobel	N. Jerne	J. Black	A.G. E.N. X		
Day Off	J. Murray	L. Stoll	R. Sperry	Susumu	M. Brown		
Day Off	S. Pruisner	S. Cohen	E. Neher	L. Hartwell	T. Peltola		
Extra Day Off	.	.	.	.	.		
Vacation	.	.	.	.	.		
Vacation	.	.	.	.	.		

Filter mode
☐ Info mode
☐ Swap mode

Apply filters

All personnel Clear

A. Gilman
D. Bovet
E. Fischer
E. Lewis
E. Neher
G. Blobel
J. Black
J. Murray
L. Hartwell
L. Stoll
M. Brown

All assignments Clear

AM Fluoro
AM Body CT
PM Body CT
PM Body MR
AM Neuro
PM Neuro
IR
Mammo
Ultrasound
AM General
PM Vienna

Internet 100%

» Using Xpress in Complex Rule-Based Systems

» Yuri Smirnov

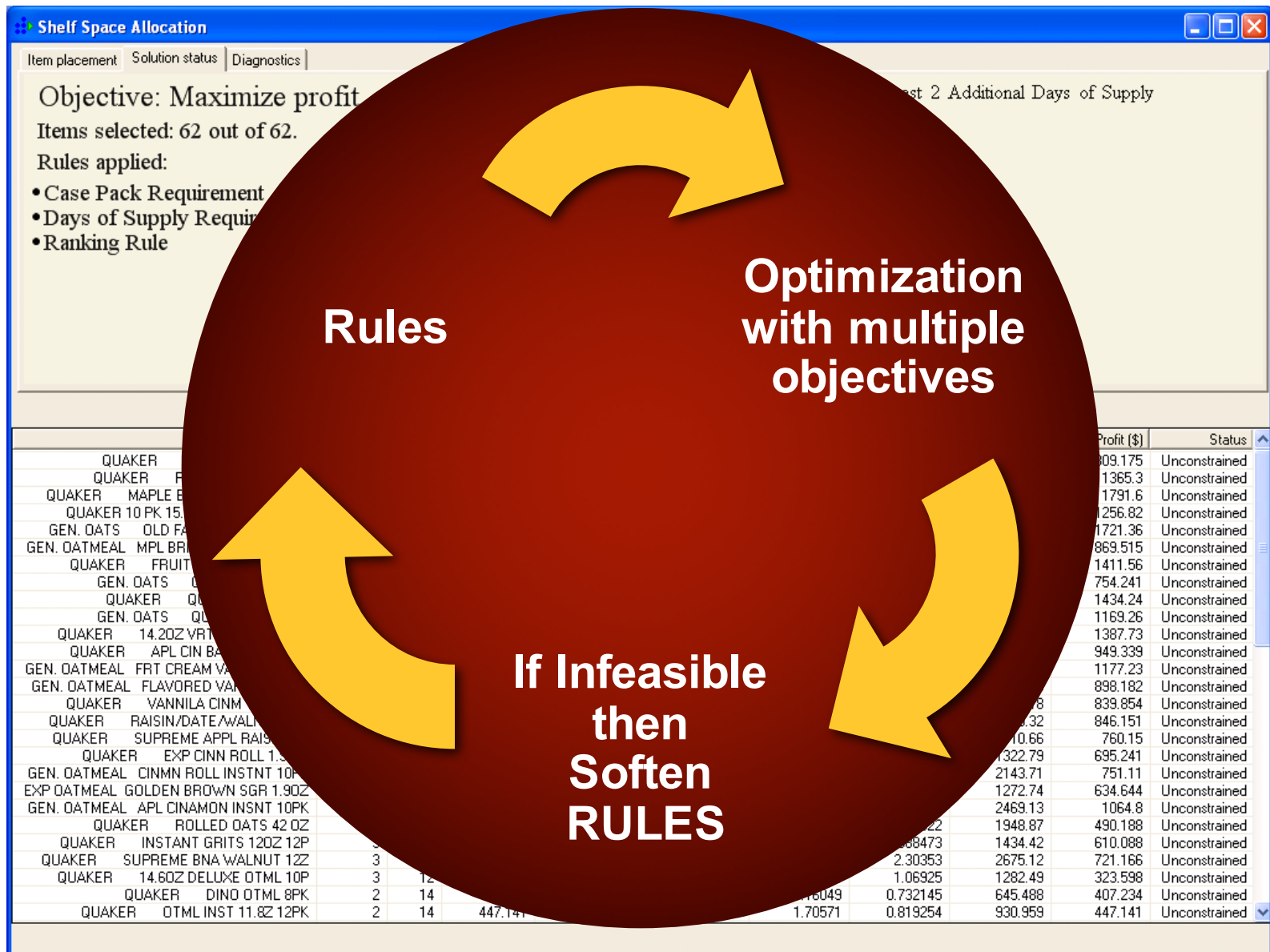
» Coffee Chat



Goal: To reduce manual effort of 20-80 hours/month spent on Doc & Nurse Scheduling

Future Goal: Recommend staffing policy

Space Optimization: Constrained Assortment Optimization



Agenda

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- » **What problems do we solve in FS/Insurance/Retail**

- » Rules for Segmentation and Dynamic Pricing

- » Treatments – Offer Optimization

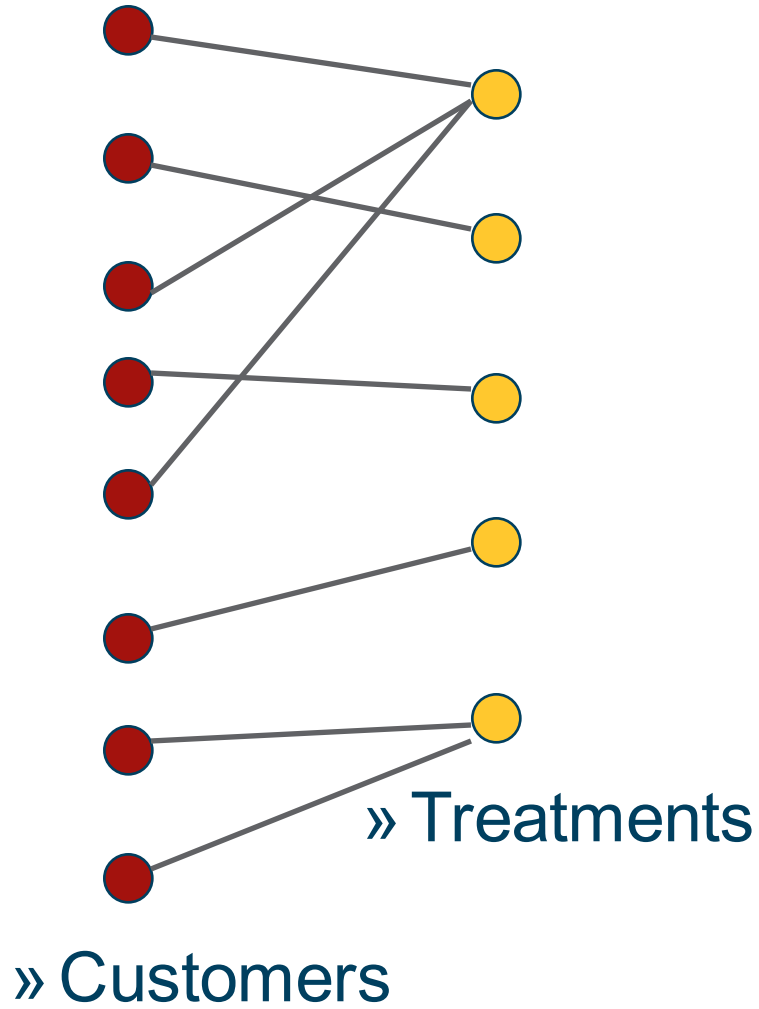
- » More.....

- » Generate Rules

- » Select Rules

- » Robust Rules

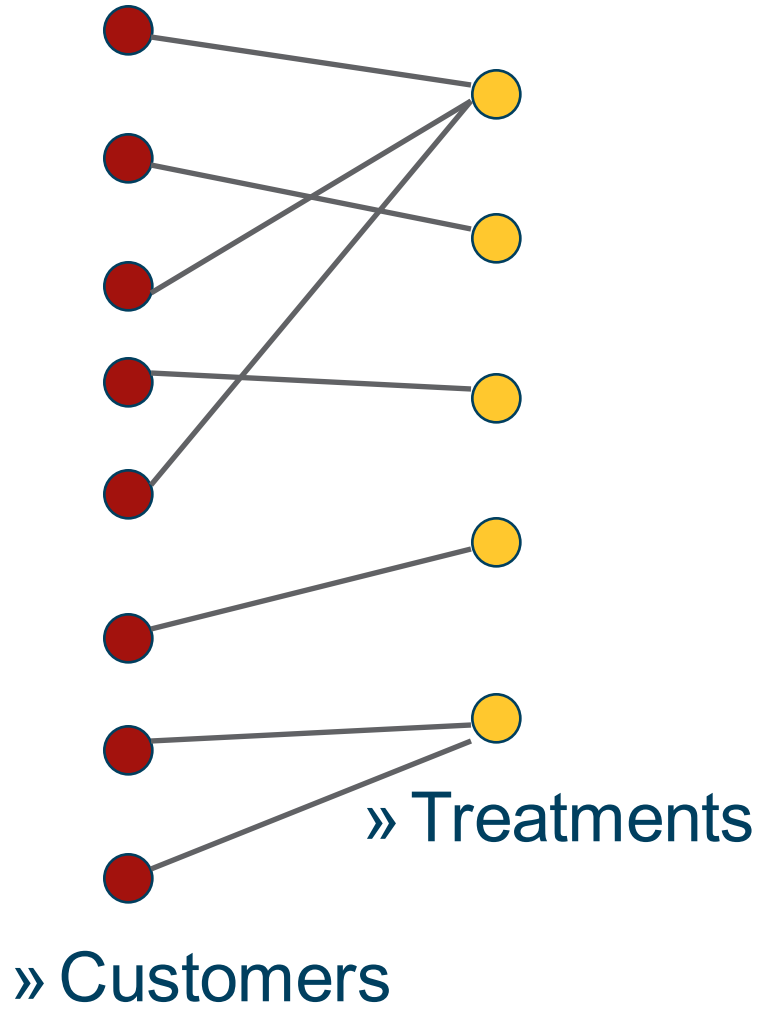
Solving problems in FS and Insurance



- » Objective
- » Maximize profit
- » Assign customer to treatments

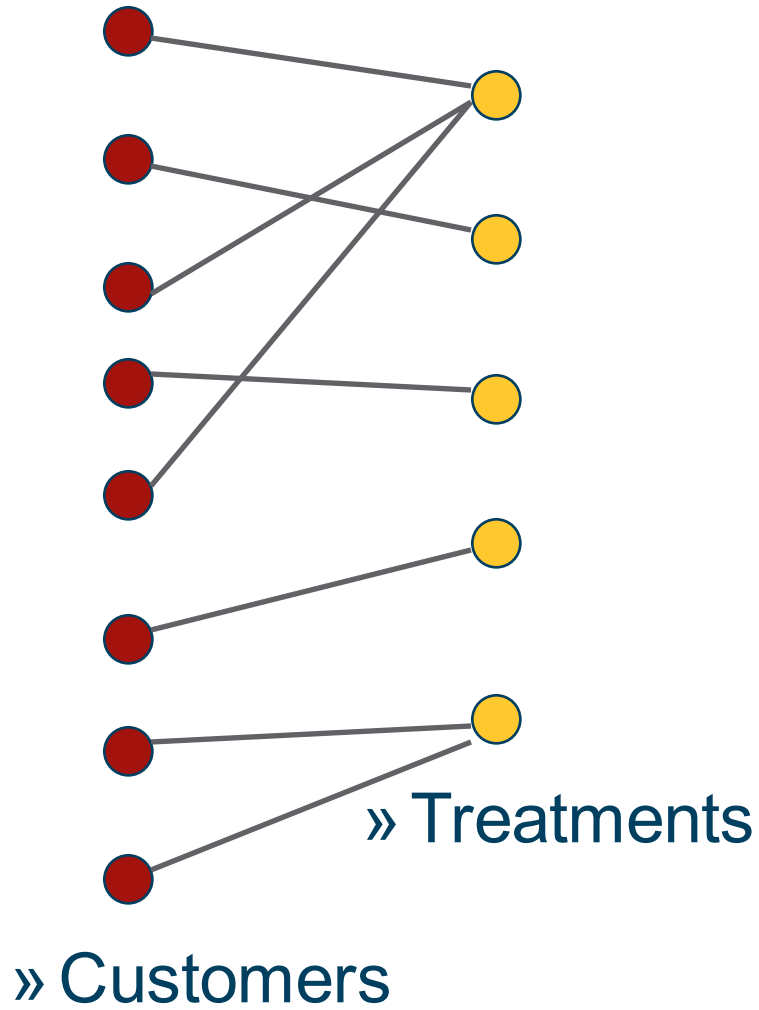
- » Marketing
- » Pricing
- » Initial Credit Line
- » Credit Line Management
- » Retention
- » Fraud
- » Collections

Where are the rules ?



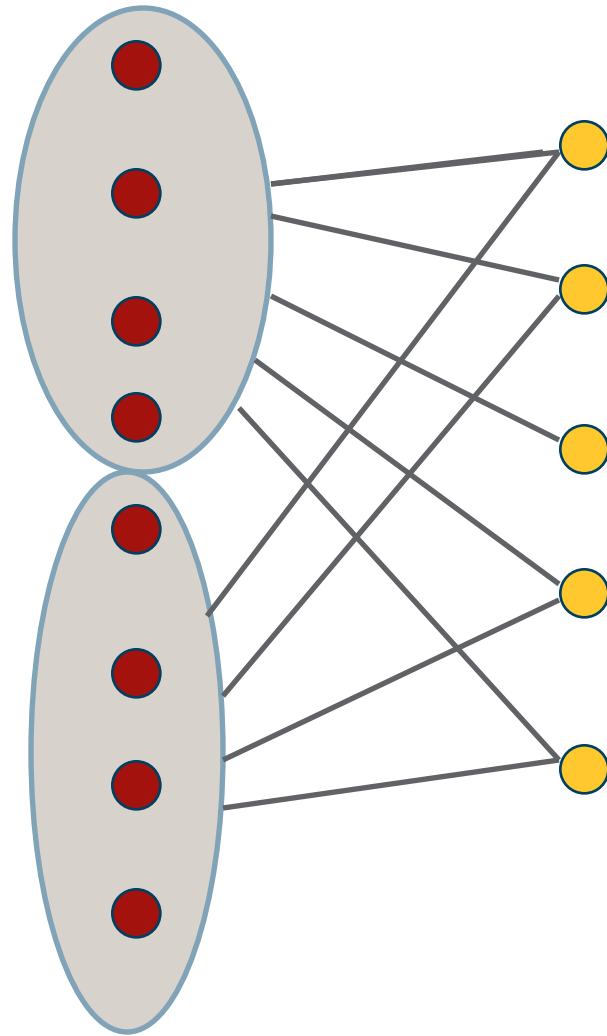
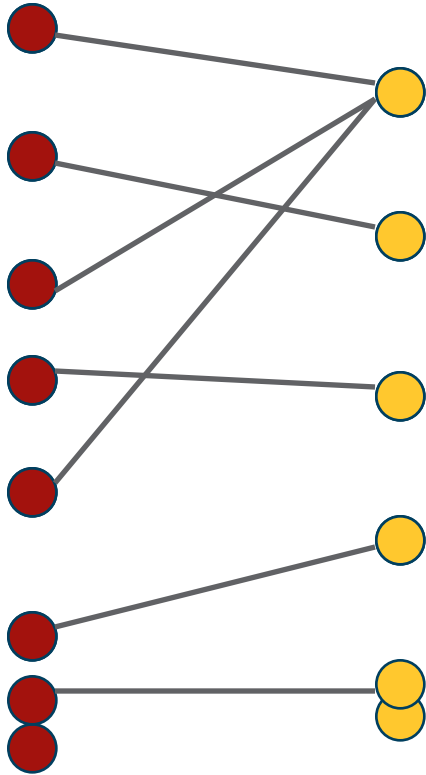
- » Constraints
- » Objectives
- » Eligibility for treatment
- » Product configuration

Typical problems in our FS and Insurance



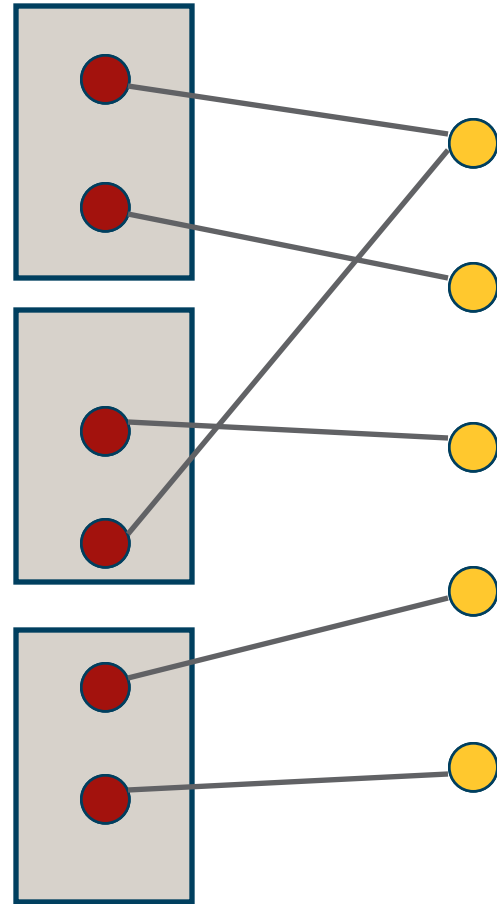
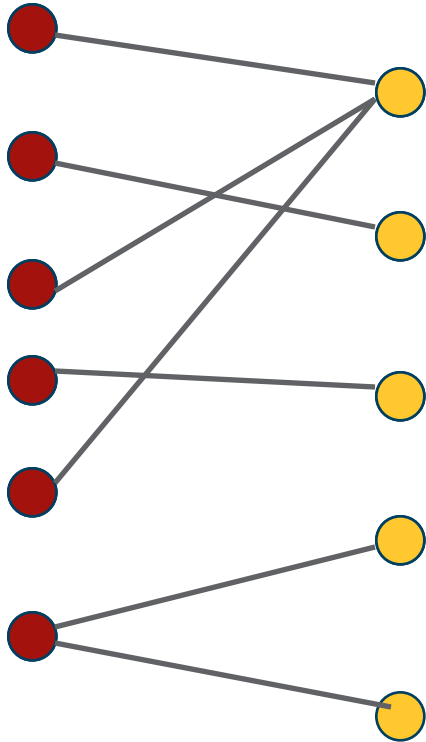
» Decision Optimizer

Segment and Solve



» Create Segments and solve a smaller problem

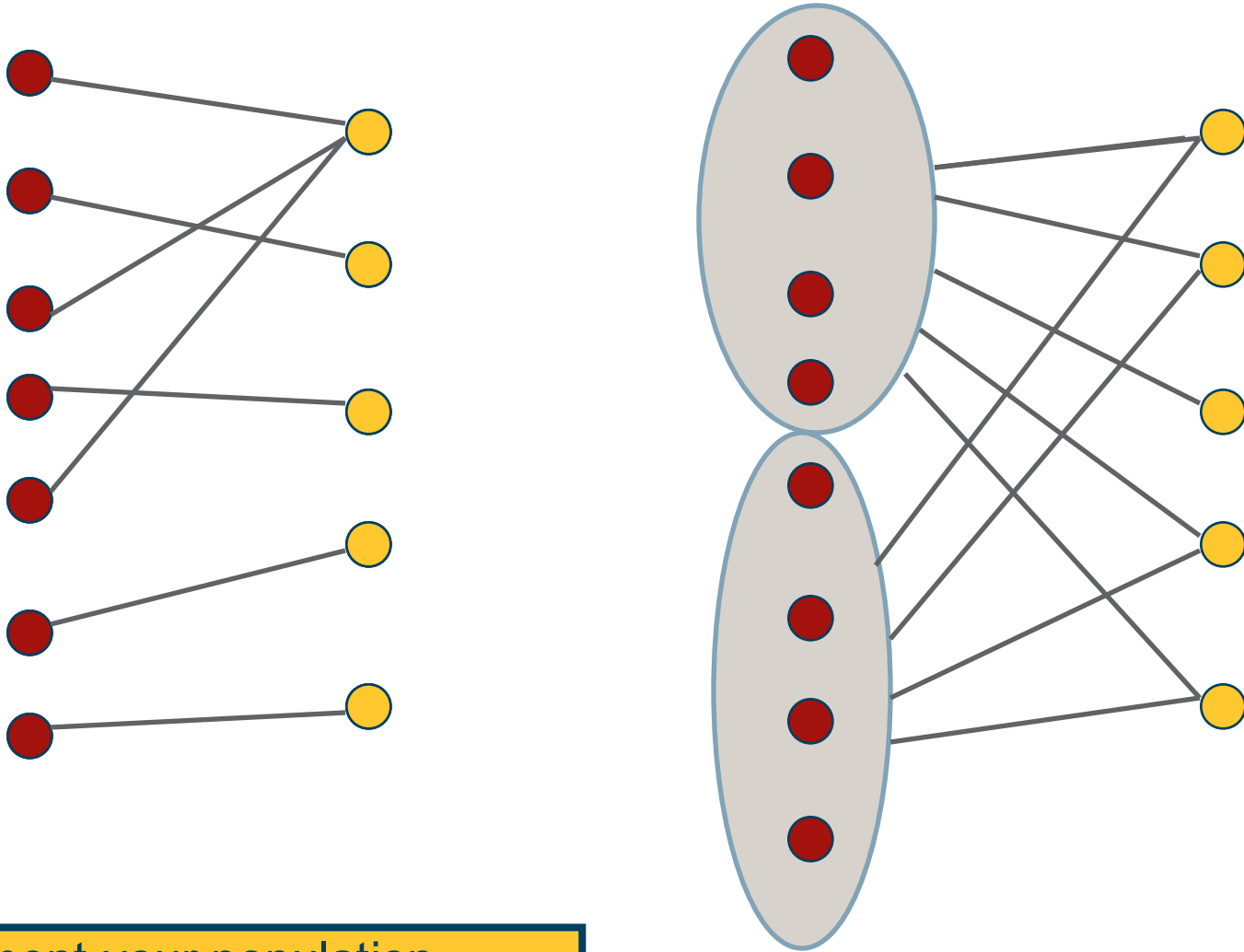
Randomized partitioning and Solve



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- » Generate Rules
- » Select Rules
- » Robust Rules
- » Rules for Monitoring Systems

Another way for looking at the Segmentation !!!!

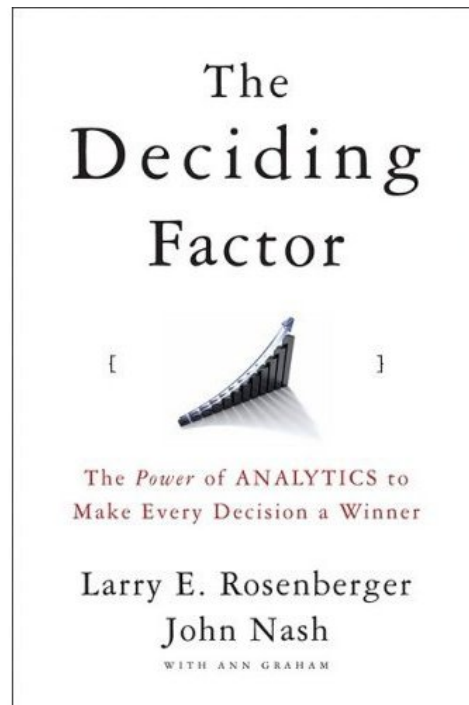


» Segment your population according to rules

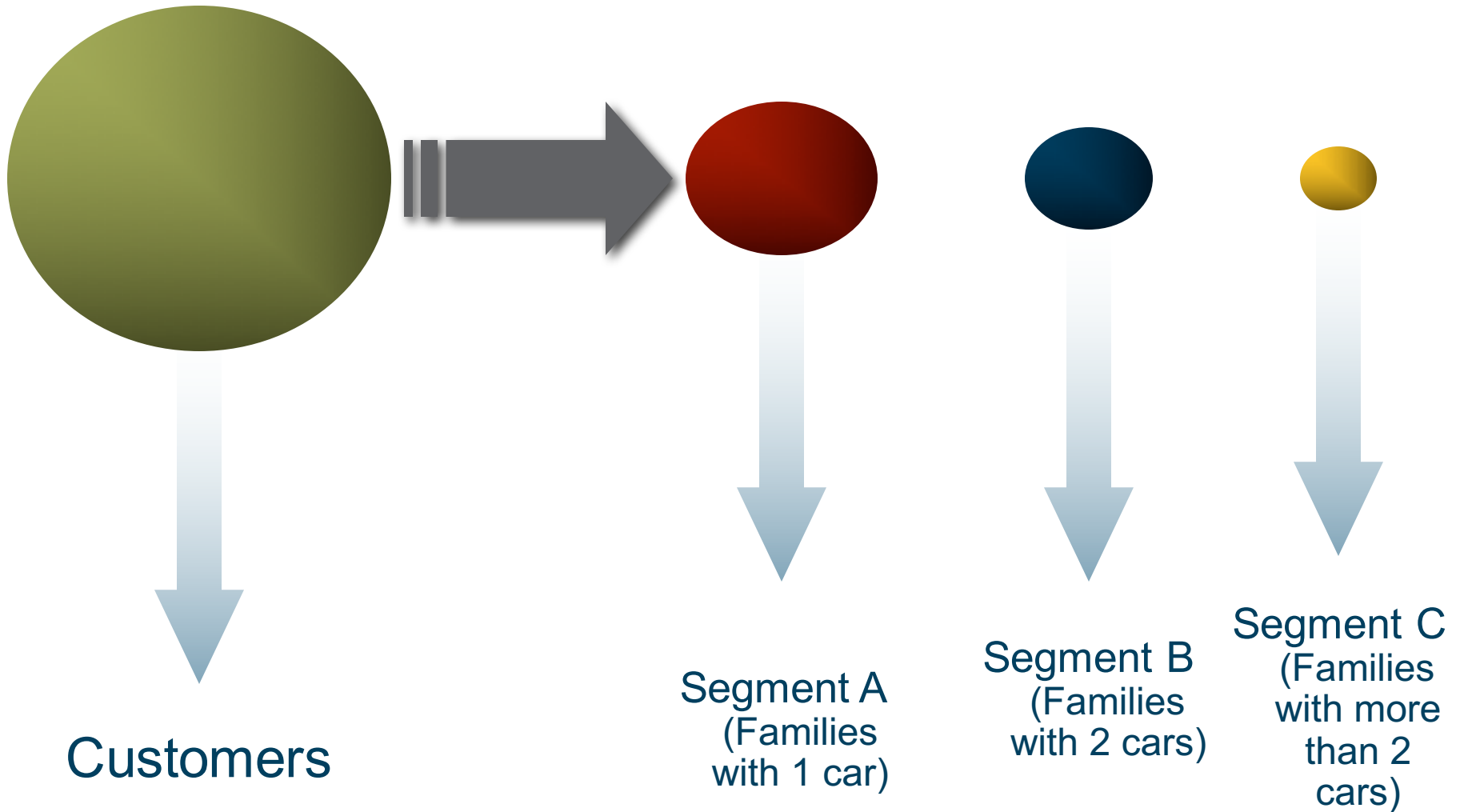
Business Problem

Auto Insurance Price Optimization

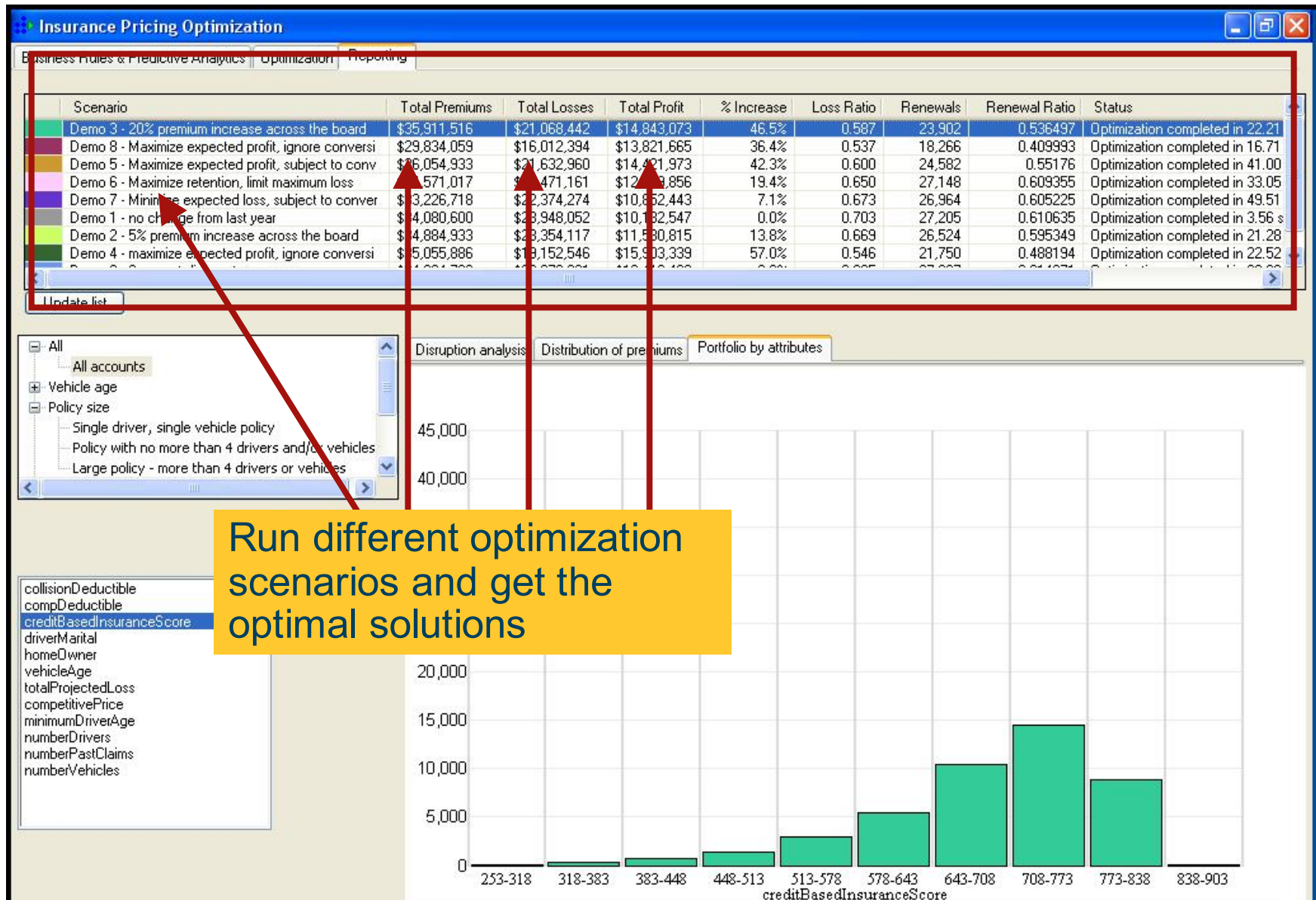
- » Given a set of policyholders and prospects, what premium amount should I offer them so as to meet an overall business objective



Use rules to do segmentation



Insurance Pricing: Run Scenarios



Insurance Pricing: Decisions

» Visualize the results

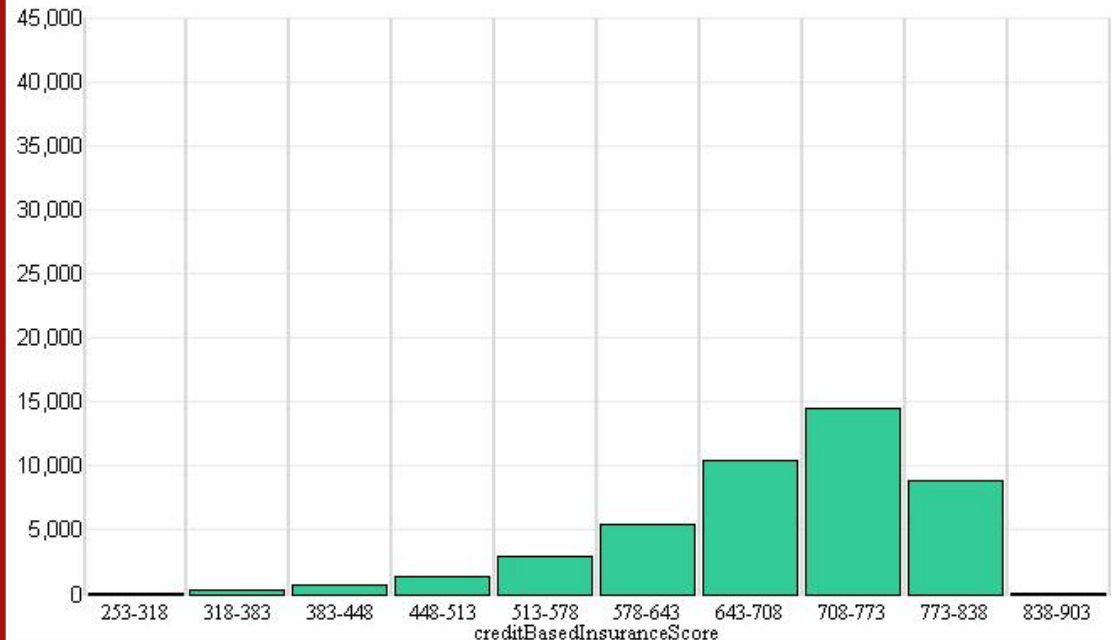
- » Disruption analysis
- » Distribution of premiums
- » Portfolio by attributes

Profit	% Increase	Loss Ratio	Renewals	Renewal Ratio	Status
3,073	46.5%	0.587	23,902	0.536497	Optimization completed in 22.21
1,665	36.4%	0.537	18,266	0.409993	Optimization completed in 16.71
1,973	42.3%	0.600	24,582	0.55176	Optimization completed in 41.00
3,856	19.4%	0.650	27,148	0.609355	Optimization completed in 33.05
2,443	7.1%	0.673	26,964	0.605225	Optimization completed in 49.51
1,547	0.0%	0.703	27,205	0.610635	Optimization completed in 3.56 s
1,115	13.8%	0.669	26,524	0.595349	Optimization completed in 21.28
1,119	57.0%	0.546	21,750	0.488194	Optimization completed in 22.52
1,119	0.0%	0.605	27,227	0.611074	Optimization completed in 22.52

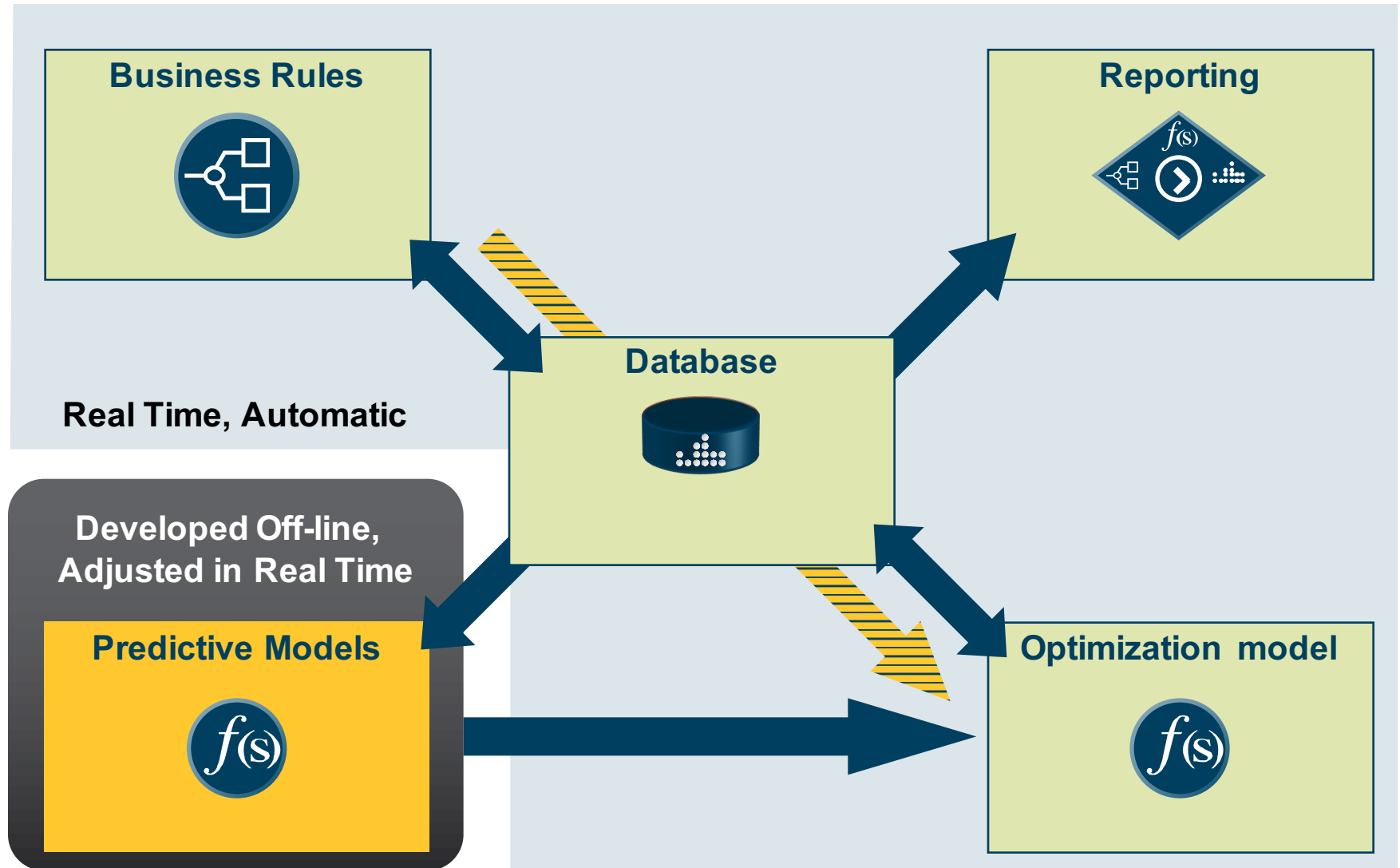
- All
 - All accounts
- Vehicle age
- Policy size
 - Single driver, single vehicle policy
 - Policy with no more than 4 drivers and/or vehicles
 - Large policy - more than 4 drivers or vehicles

collisionDeductible
compDeductible
creditBasedInsuranceScore
driverMarital
homeOwner
vehicleAge
totalProjectedLoss
competitivePrice
minimumDriverAge
numberDrivers
numberPastClaims
numberVehicles

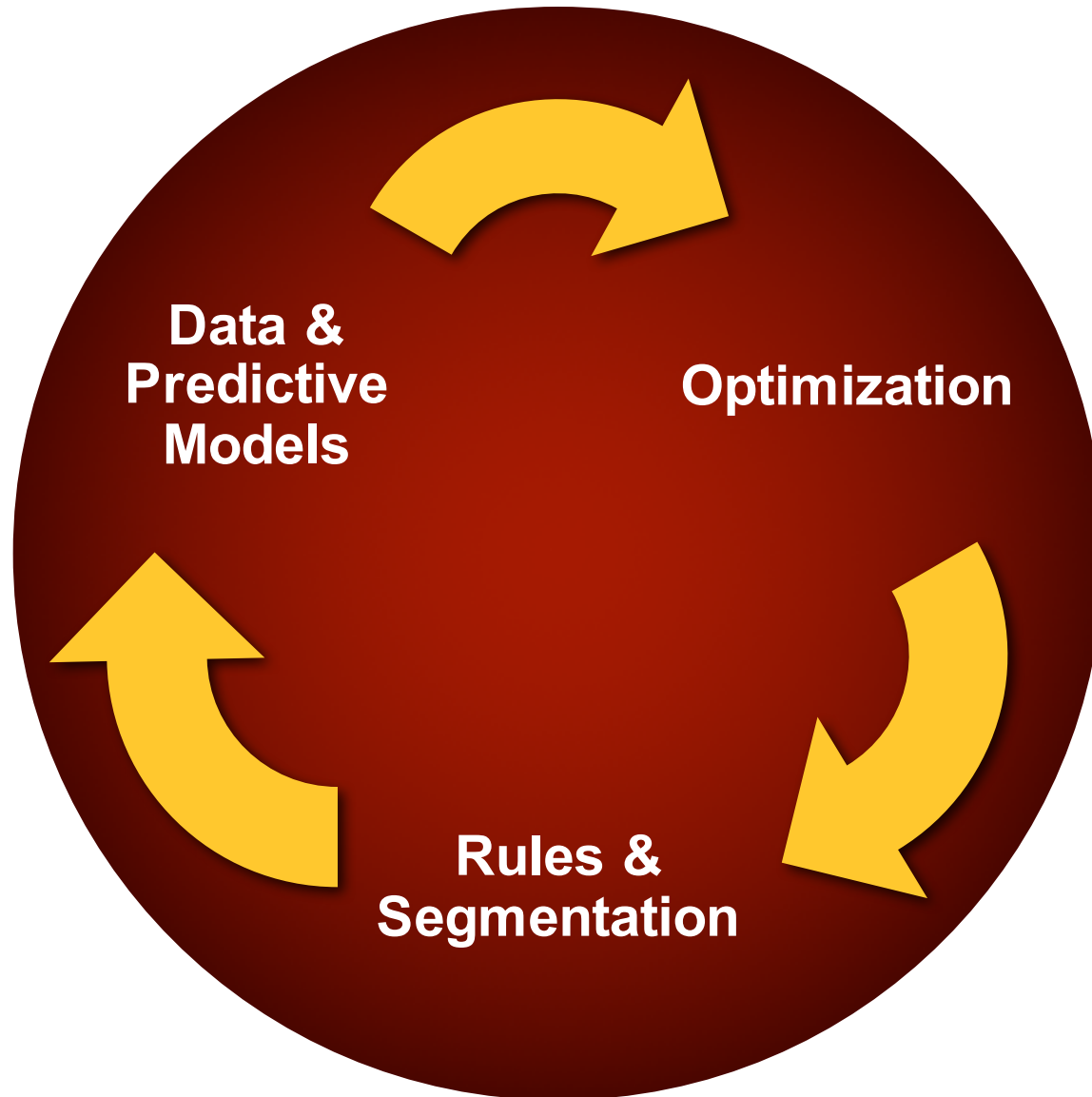
Disruption analysis | Distribution of premiums | Portfolio by attributes



Insurance Pricing Framework Structure – User Classification



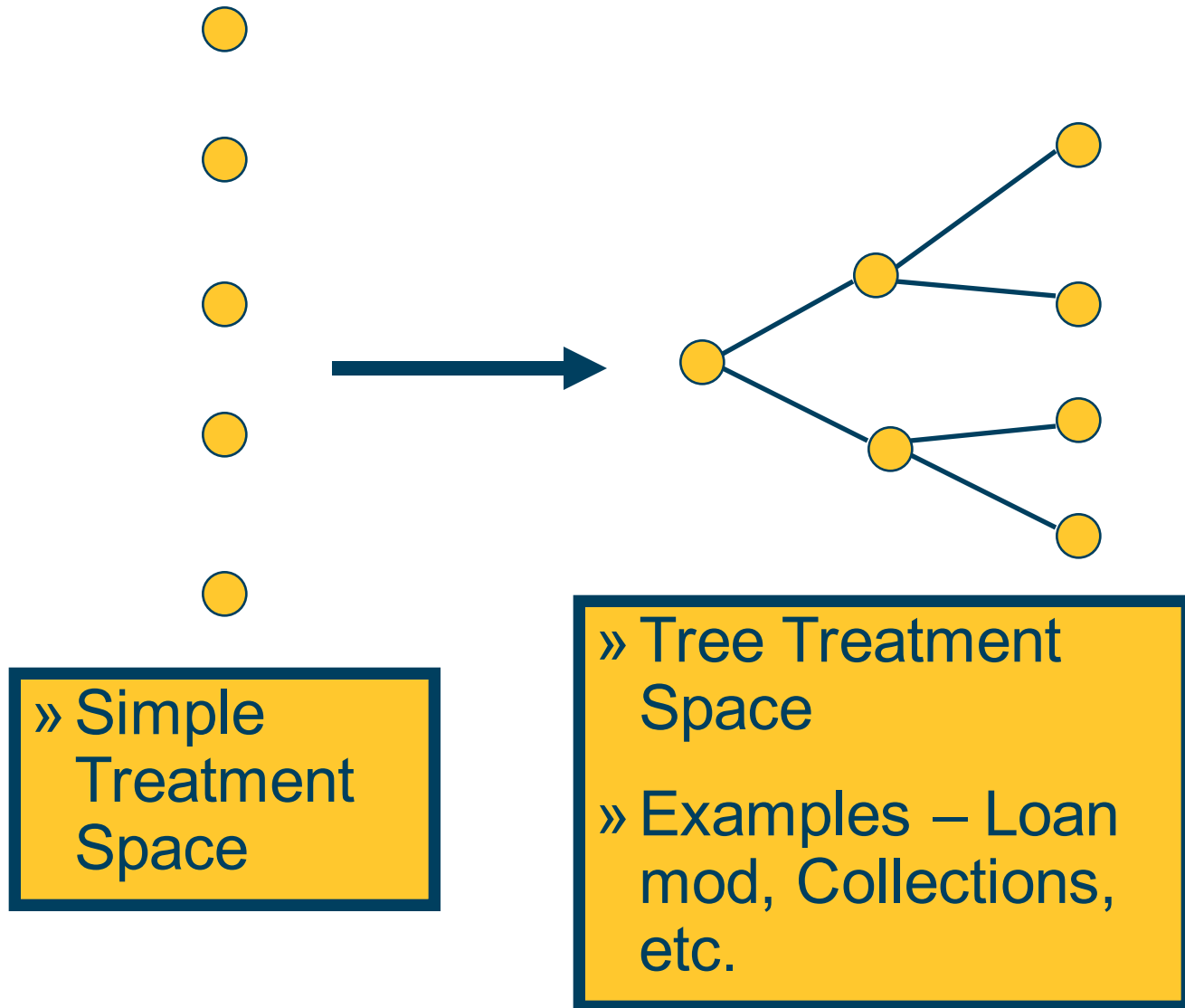
Insurance Pricing Framework



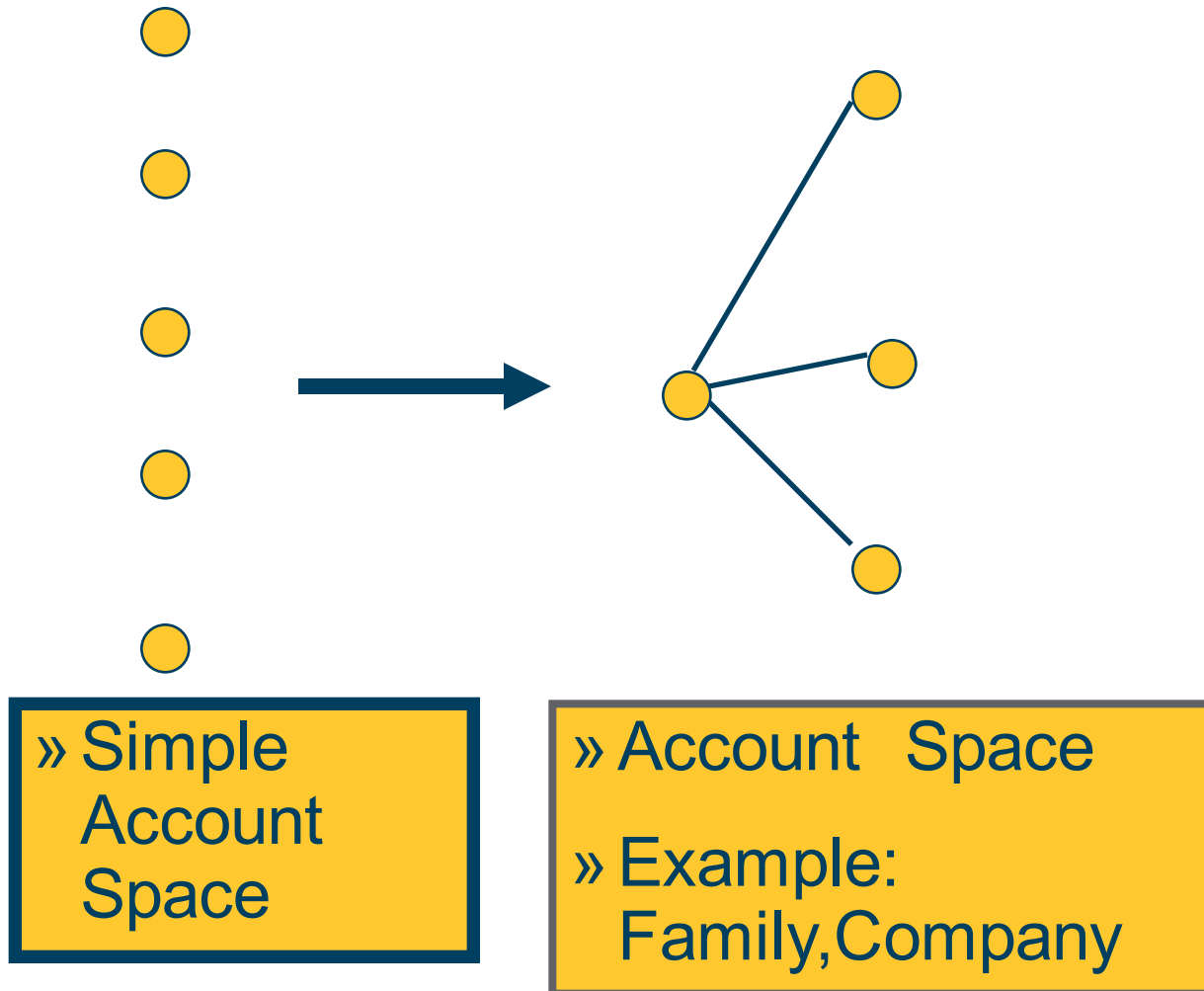
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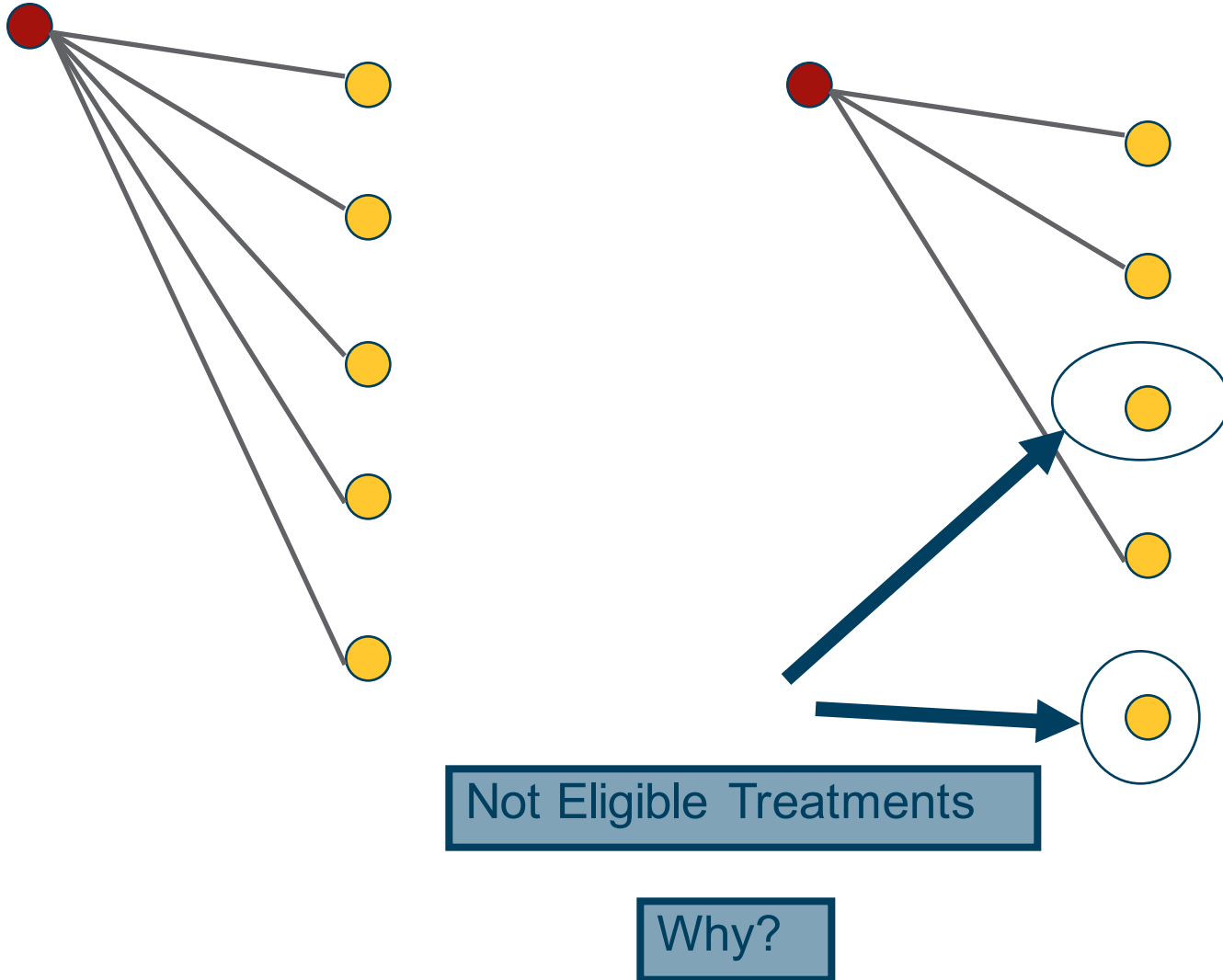
Trends: Explosion of Treatment space



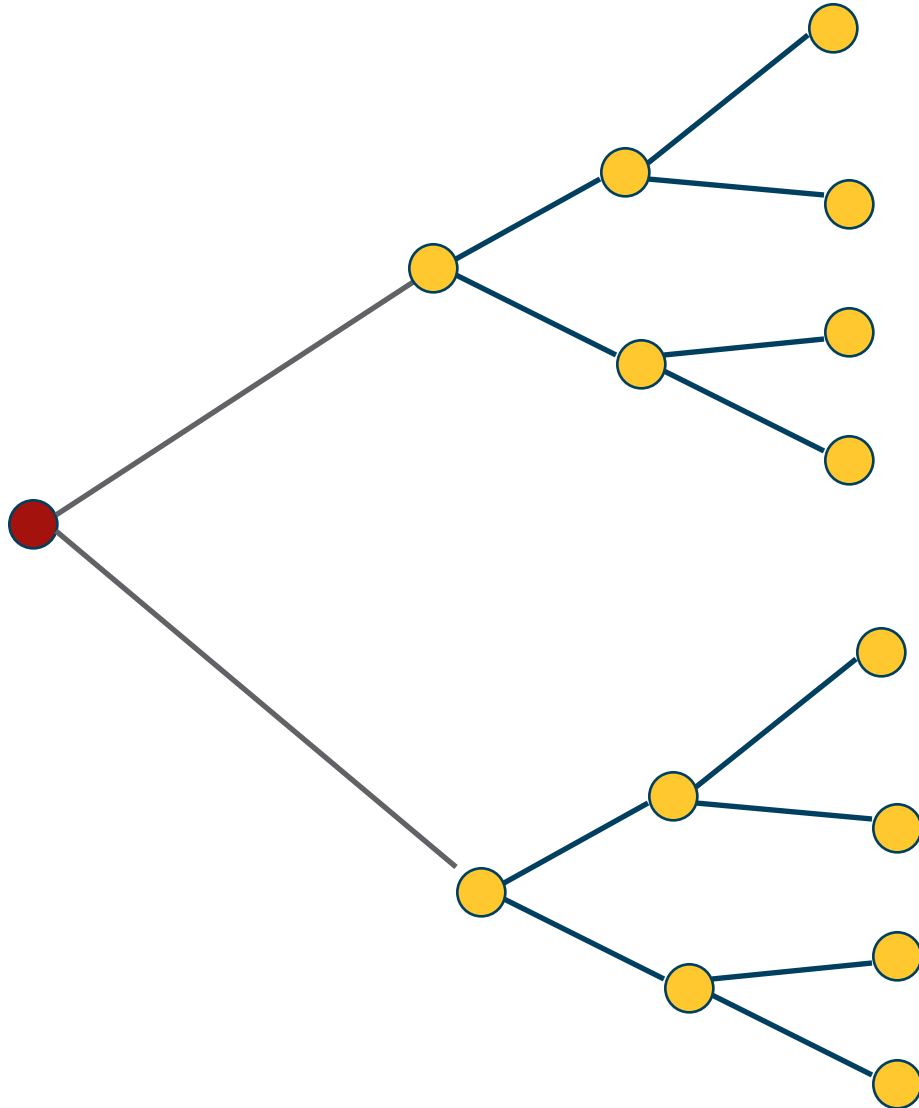
Trends: Segmentation of Account base



Reduce the space for Treatments using rules ?
Why?



Treatment Space explodes again?????



Business Problem: Offer Optimization

» **Given**

- » Customers
- » Offers
- » Channels
- » Strategies/Budgets/Constraints

» **The decisions are to**

- » Assign the customers to the right strategy (treatment)

» **And the Goal is to Maximize profit**

Offer Optimization: Data

Offer Optimization Solution

Optimization Manager

Data Strategies Control/Rules

Customer	Product	Strategy	Response rate	Cost \$	PV \$	Expected NPV
Cust 1	Product_A	Str 1	0.5000%	0.78	400	1.22
Cust 1	Product_A	Str 2	0.4000%	0.33	400	1.27
Cust 1	Product_A	Str 3	0.3500%	0.29	400	1.11
Cust 1	Product_A	Str 4	0.3200%	0.29	400	0.99
Cust 1	Product_A	Str 5	0.2000%	0.29	400	0.51
Cust 1	Product_A	Str 6	0.1700%	0.26	400	0.43
Cust 1	Product_A	Str 7	0.4700%	0.74	400	1.14
Cust 1	Product_A	Str 8	0.3800%	0.74	400	0.78
Cust 1	Product_A	Str 9	0.3000%	0.74	400	0.46
Cust 1	Product_A	Str 10	0.4300%	0.71	400	1.01
Cust 1	Product_A	Str 11	0.4200%	0.78	400	0.90

Optimization Solver

Scenario	Customers	Products	Avg. Budget \$	Avg. NPV \$	Run Time(s)	Notes
1	1000	10	unconstrained	2.582	4.11	Optimal

Optimization Reporter

Offers Statistics

Offer	Customer	Product	Mail	Email	B
1	1	Product_D			
2	1	Product_F			
3	5	Product_E			
4	5	Product_E			
5	8	Product_H			
6	8	Product_H			
7	9	Product_J			
8	9	Product_J			
9	11	Product_H			
10	12	Product_C			
11	12	Product_E			
12	14	Product_H			
13	14	Product_H			
14	16	Product_A			
15	16	Product_A			
16	17	Product_B			
17	17	Product_B			
18	19	Product_D			
19	19	Product_D			
20	20	Product_D			
21	20	Product_D			
22	21	Product_J			
23	21	Product_J			
24	23	Product_G			
25	23	Product_G			

Optimization Simulator

Channel costs (\$/offer)

Mail: 0.45 to 0.45

Email: 0.04 to 0.04

Banner: 0.0001 to 0.0001

Coupon: 0.0001 to 0.0001

Letter: 0.035 to 0.035

Inbound Phone: 0.255 to 0.255

Average Budget: 0.97 to 0.97

Simulate

» Customer Data
 » Response Rates
 » Strategies
 » Costs
 » Present Values (PV)
 » Expected PV

Offer Optimization: Channels

The screenshot displays the 'Offer Optimization Solution' software interface. It includes several panels: 'Optimization Manager' with tabs for Data, Strategies, and Control/Rules; 'Optimization Solver' showing a summary table; 'Optimization Reporter' with 'Offers' and 'Statistics' tabs; and 'Optimization Simulator' with input fields for channel costs and budget, and a 'Simulate' button. A yellow callout box points to the 'Offers' tab in the 'Optimization Reporter' and lists the following channels:

- » Channels / Costs
- » Mail
- » Email
- » Banner
- » Inbound Phone
- » Letter
- » ... etc

Optimization Solver Summary Table:

Scenario	Customers	Products	Avg. Budget \$	Avg. NPV \$	Run Time(s)	Notes
1	1000	10	unconstrained	2.582	4.11	Optimal

Optimization Manager Data Table:

Customer	Product	Strategy	Response rate	Cost \$	PV \$	Expected NPV
Cust 1	Product_A	Str 1	0.5000%	0.78	400	1.22
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Cust 1	Product_A	Str 9	0.3000%	0.74	400	0.46
Cust 1	Product_A	Str 10	0.4300%	0.71	400	1.01
Cust 1	Product_A	Str 11	0.4200%	0.78	400	0.90

Optimization Reporter Offers Table:

Offer	Customer	Product	Channel	Cost	NPV \$
1					2.06157
2					2.17352
3					2.84495
4					2.28224
5					2.54206
6					2.0903
7					2.49871
8					2.77212
9					2.28264
10					2.2171
11					2.01711
12					2.31661
13					2.13112
14					2.31069
15					2.14167
16					2.73008
17					2.69379
18					2.32667
19					2.14115
20					2.2454
21					1.77122
22					2.36113
23					2.34372
24					2.70378
25					2.70378

Optimization Simulator Input Fields:

- Channel costs (\$/offer): [Dropdown]
- Mail: [0.45] to [0.45]
- Email: [0.04] to [0.04]
- Banner: [0.0001] to [0.0001]
- Coupon: [0.0001] to [0.0001]
- Letter: [0.035] to [0.035]
- Inbound Phone: [0.255] to [0.255]
- Average Budget: [0.97] to [0.97]
- [Simulate Button]

Offer Optimization: Decisions

Offer Optimization Solution

Optimization Manager

Data Strategies **Control/Rules**

Volume limits, per product

Product_A 0.5
Product_B
Product_C
Product_D
Product_E
Product_F
Product_G
Product_H
Product_I
Product_J 0.5

Scenario: ☐ Limit Average Budget: 0
☒ Limit Channel Utilization

Letter 2 10000
Inbound Phone 2 10000

Optimize

» Solution Manager
» View solution
» Visualize the results

Products: 10
Customers: 1000

Optimization Simulator

Channel costs (\$/offer)

Mail 0.45 to 0.45
Email 0.04 to 0.04
Banner 0.0001 to 0.0001
Coupon 0.0001 to 0.0001
Letter 0.035 to 0.035
Inbound Phone 0.255 to 0.255

Average Budget 0.97 to 0.97

Simulate

Optimization Solver

Scenario	Customers	Products	Avg. Budget \$	Avg. NPV \$	Run Time(s)	Notes
1	1000	10	unconstrained	2.582	3.531	Optimal

Optimization Reporter

Offers Statistics

Scenario 1: 1000 customers, 10 products.

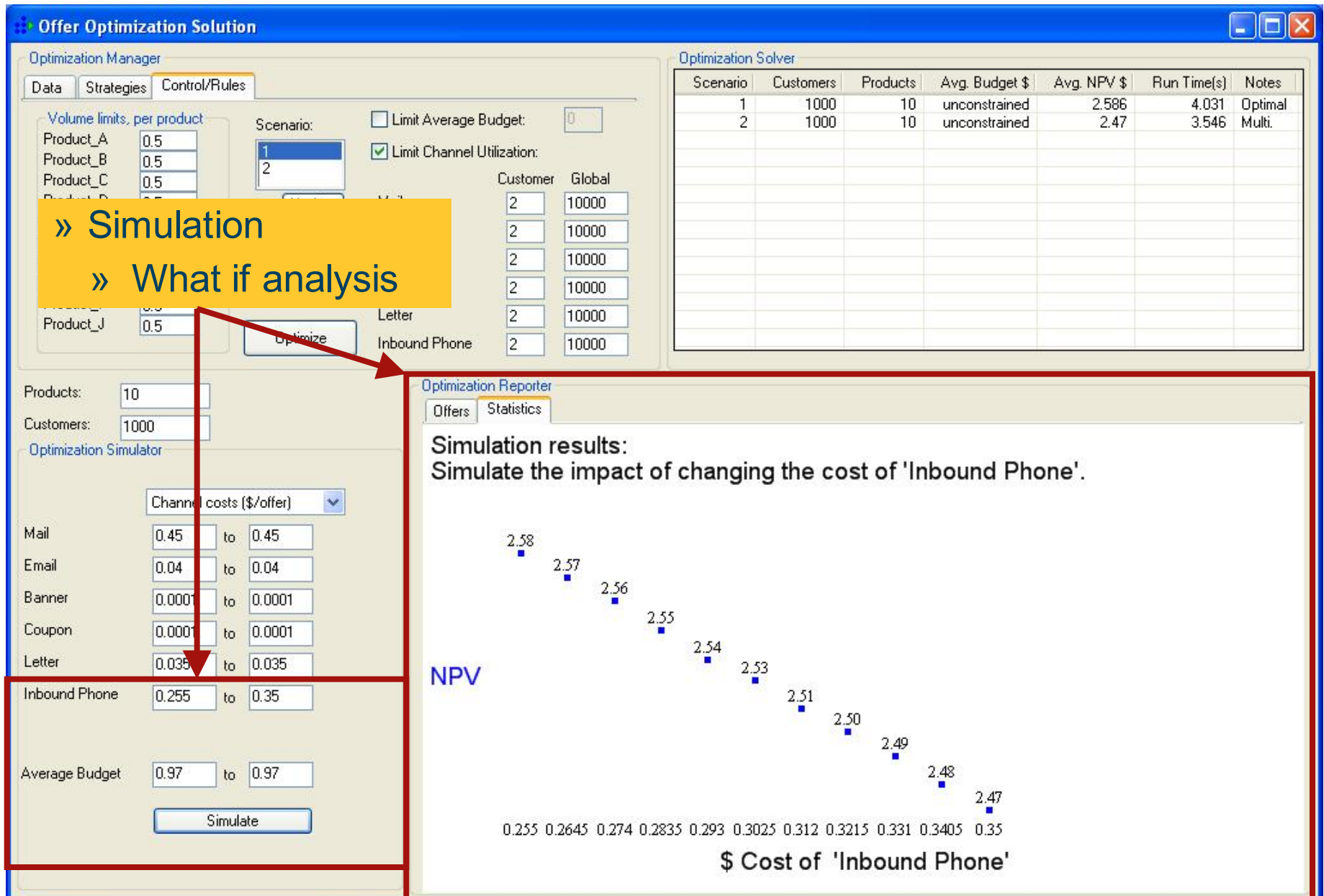
Channel utilization:

NPV \$= 2.582
Cost \$= 0.336
(1201 offers)

Number of products offered / takeup:

Product	Offered	Takeup
Product_A	119	0.5
Product_B	120	0.5
Product_C	120	0.5
Product_D	120	0.5
Product_E	121	0.5
Product_F	120	0.5
Product_G	121	0.499
Product_H	119	0.5
Product_I	120	0.499
Product_J	121	0.5

Offer Optimization: Simulation



Debt Consolidation: Dashboard – Single Account

Debt Consolidation Optimization

Fair Isaac Optimization Dashboard: Debt Consolidation Module

Confidential - do not copy

Customer profile

Income: \$85000

Home value: \$200000

☒ Past Bankruptcy

Reduce monthly payment: Important

FICO score: 750

Max monthly: 2500

☐ 90+ last 12 months

Shorten repayment period: Don't care

☐ 60+ current

Reduce closing costs: Maybe

Accounts Summary

\$ Limit	\$ Balance	% APR	Term	\$ Monthly	Type	Source	Consolidate
160000	130000	9	300	1090.96	Mortgage	Reported	☒
25000	20000	15	0	600	Revolving	Credit bureau	☒
11000	8000	19	0	240	Revolving	Reported	☒
6000	4000	13	0	120	Revolving	Reported	☒
15000	10500	8.5	41	295.99	Auto Loan	Credit bureau	☒
7000	5000	10	0	150	Revolving	Credit bureau	☒
5500	1500	9	0	45	Revolving	Credit bureau	☒

View more ...

Price Premium Sensitivity v. Competition

Channel: Branch

Adjust:

P=100%

P=75%

P=50%

P=25%

P=0%

Premium -6% -4% -2% 0 +2% +4% +6%

Credit Policy

APPLY POLICY

Knock-out rules

☒ Deny if bankruptcy ever

☒ Deny if 90+ delinquency in the last 12 months

☒ Deny if current 60+ delinquency

Product Eligibility

☒ Debt to income ratio must be < 35 %

☒ If any account > 90 % utilization, no revolving

☒ If > 5 revolving accounts, no revolving

☒ If home LTV > 80 %, no HELOC or HEL

☒ If FICO less than 550 , only HELOC, HEL, or refi

Eligible Products

☒ 70 Mortgage refi

☒ 35 Home equity loan

☒ 7 HELOC

☒ 14 Revolving

OPTIMIZE OFFER

Bank Optimal

Customer Optimal

Propose: 2 loans.

Loan type	Amount	APR	Term (months)	Monthly
Mortgage	\$160000	6.95%	300	\$1125.75
HELOC	\$19000	7.65%	240	\$154.81
Total monthly payment new loans:				\$1280.56
Total new monthly payment:				\$1280.56

Started with \$2541.95 monthly.

\$ 2541.95 per month eliminated:

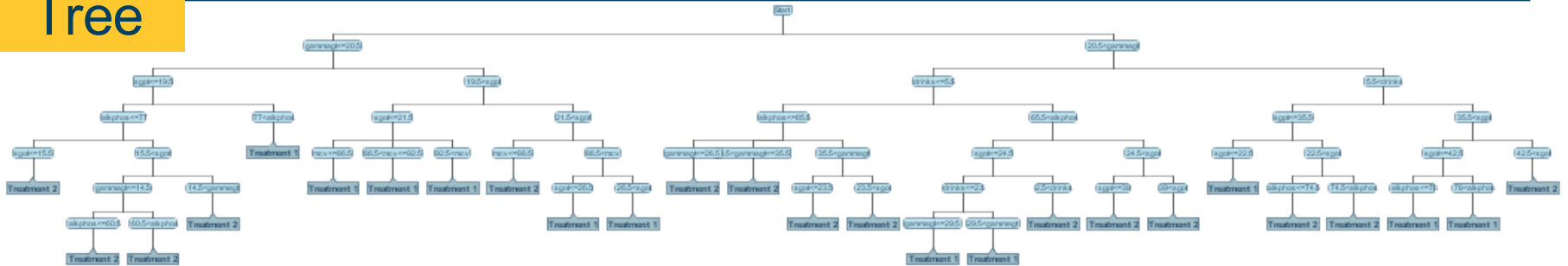
\$1090.96	130000	@	9%
\$600.00	20000	@	15%
\$240.00	8000	@	19%
\$120.00	4000	@	13%
\$295.99	10500	@	8.5%
\$150.00	5000	@	10%
\$45.00	1500	@	9%

Agenda

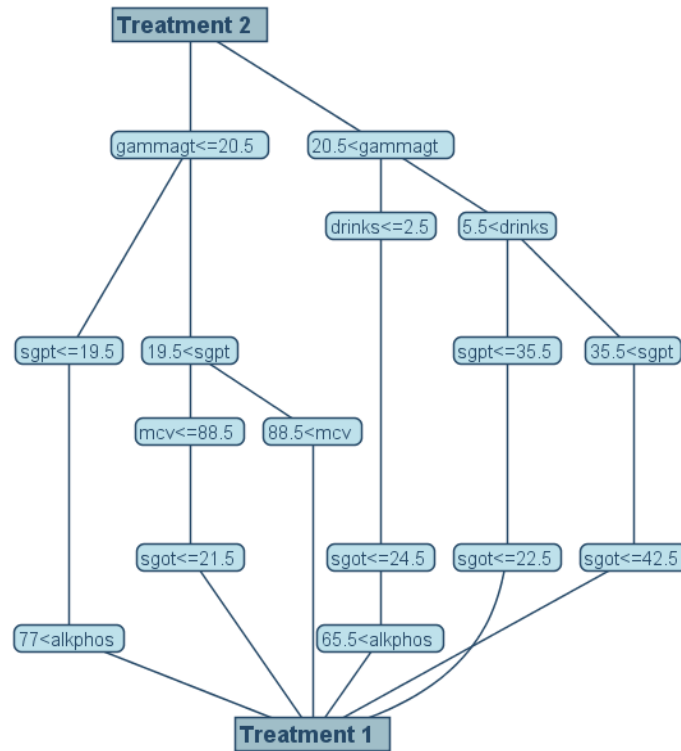
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- » **More.....**
- » **Generate Rules**
- » **Select Rules**
- » Robust Rules

Develop Rules - MBDT

Tree

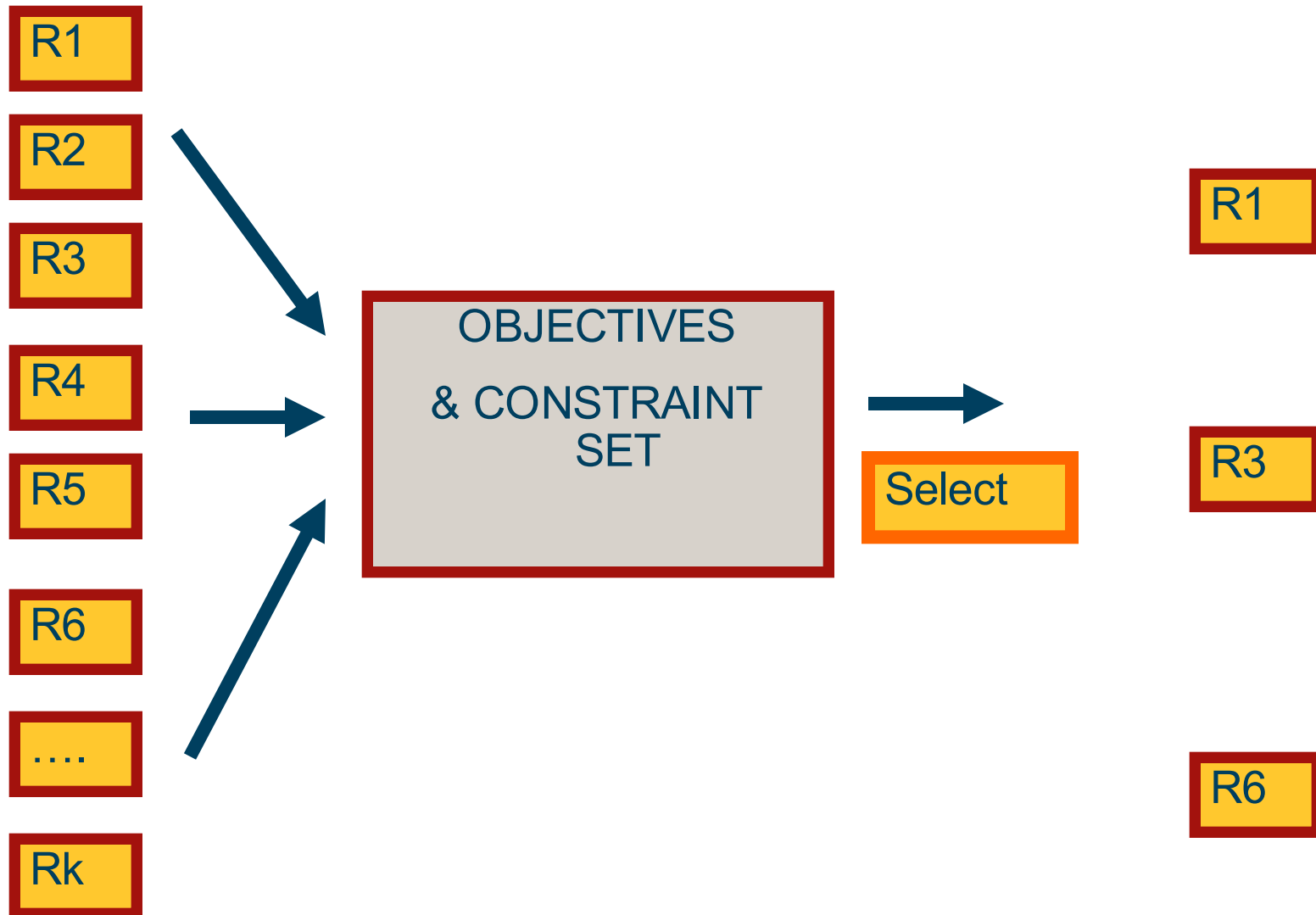


EDAG



Reduce size of the Tree

Select Rules (FRAUD other verticals)

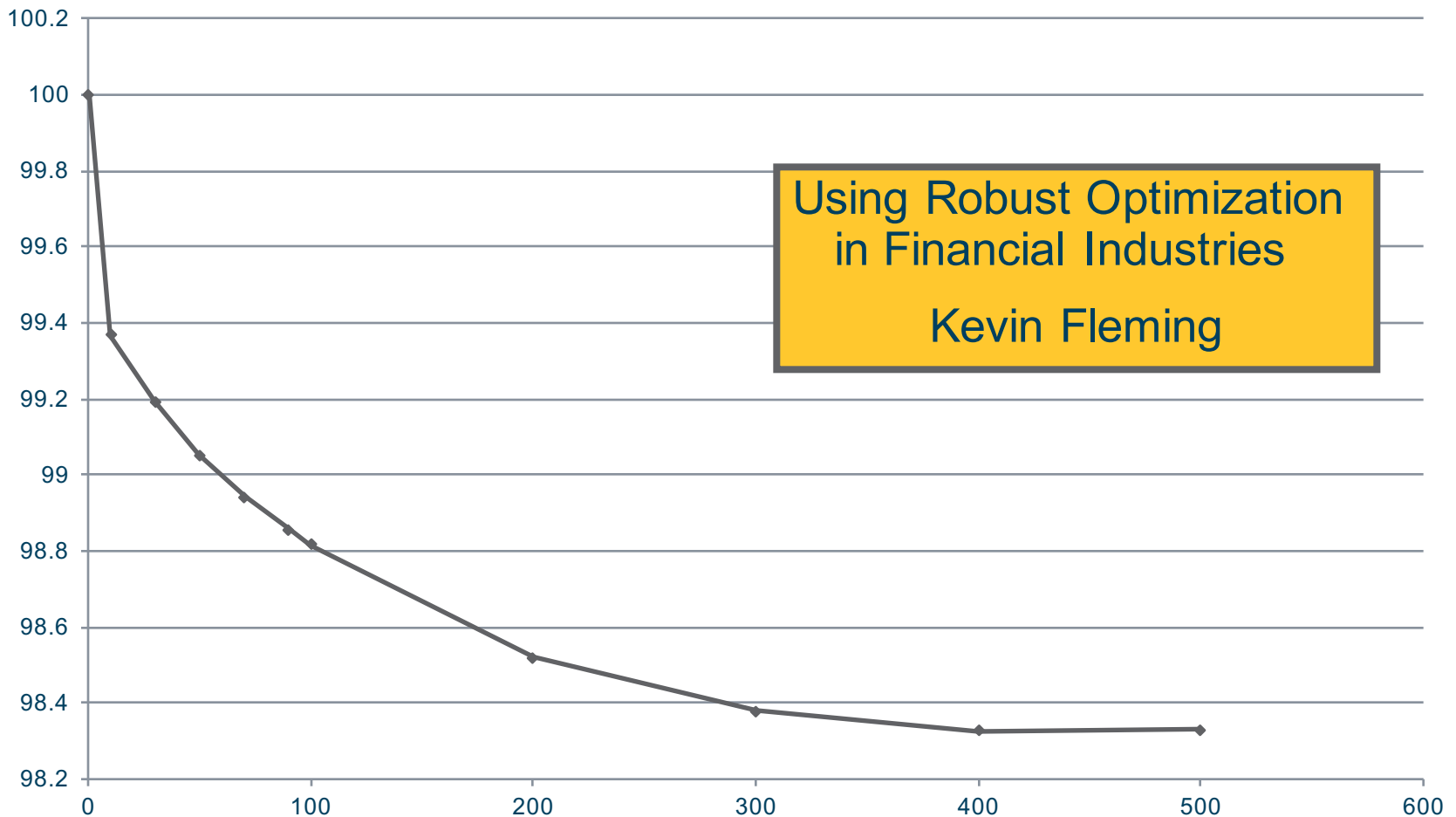


Agenda

- » Rules Everywhere/ OR applications and Rules
- » What problems do we solve in FS/Insurance/Retail
- » Rules for Segmentation and Dynamic Pricing
- » Treatments – Offer Optimization
- » More.....
- » Generate Rules
- » Select Rules
- » **Robust Rules**

Robust Optimization: Loan Modification project

Objective value vs. gamma



Robust Optimization: Loan Modification project

Objective value vs. gamma

