ELDER RESEARCH
DATA SCIENCE • MACHINE LEARNING • AI

Machine Learning: Data-Driven Insight in Health Care

About Elder Research

60+ Expert Data Science Practitioners

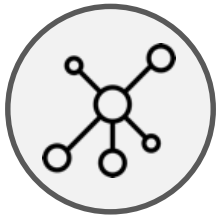
23 Years of Experience

5 Locations

Charlottesville, VA
Baltimore, MD
Washington, DC
Raleigh, NC
London, UK

Data Science and Machine Learning

Text Mining and NLP



SNA and Graph Analytics

Advanced Data Visualization

Training and Teaching

Using Analytics to Drive Medical Value

Operational

- build provider profiles
- identify fraud waste and abuse
- business process improvement

Financial

- optimize claims management
- collections and payment model
- improve readmission rates

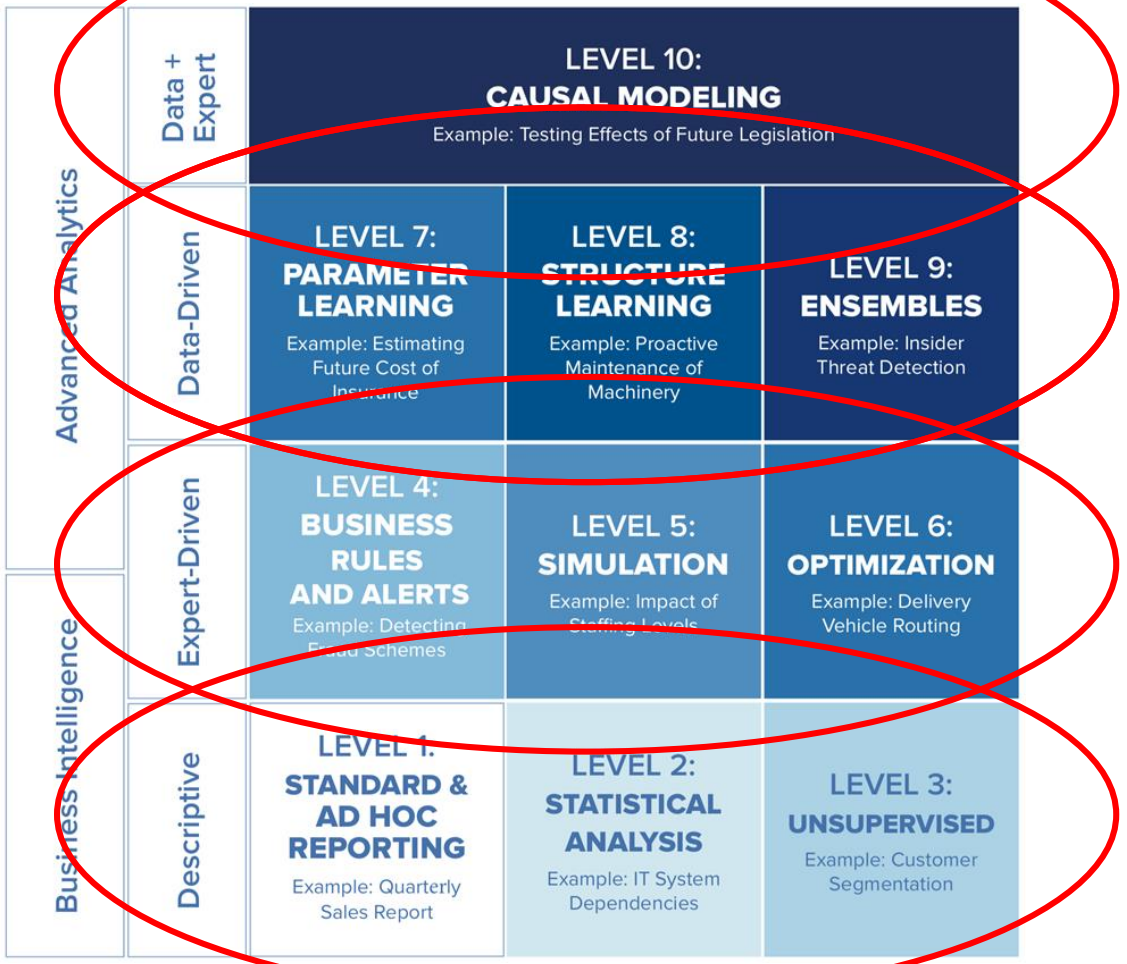
Clinical

- predict disease, severity, and progression
- treatment optimization
- patient risk segmentation

Governance

- improve with analytics screening
- data engineering
- infrastructure (cloud management)

The 10 Levels of Analytics



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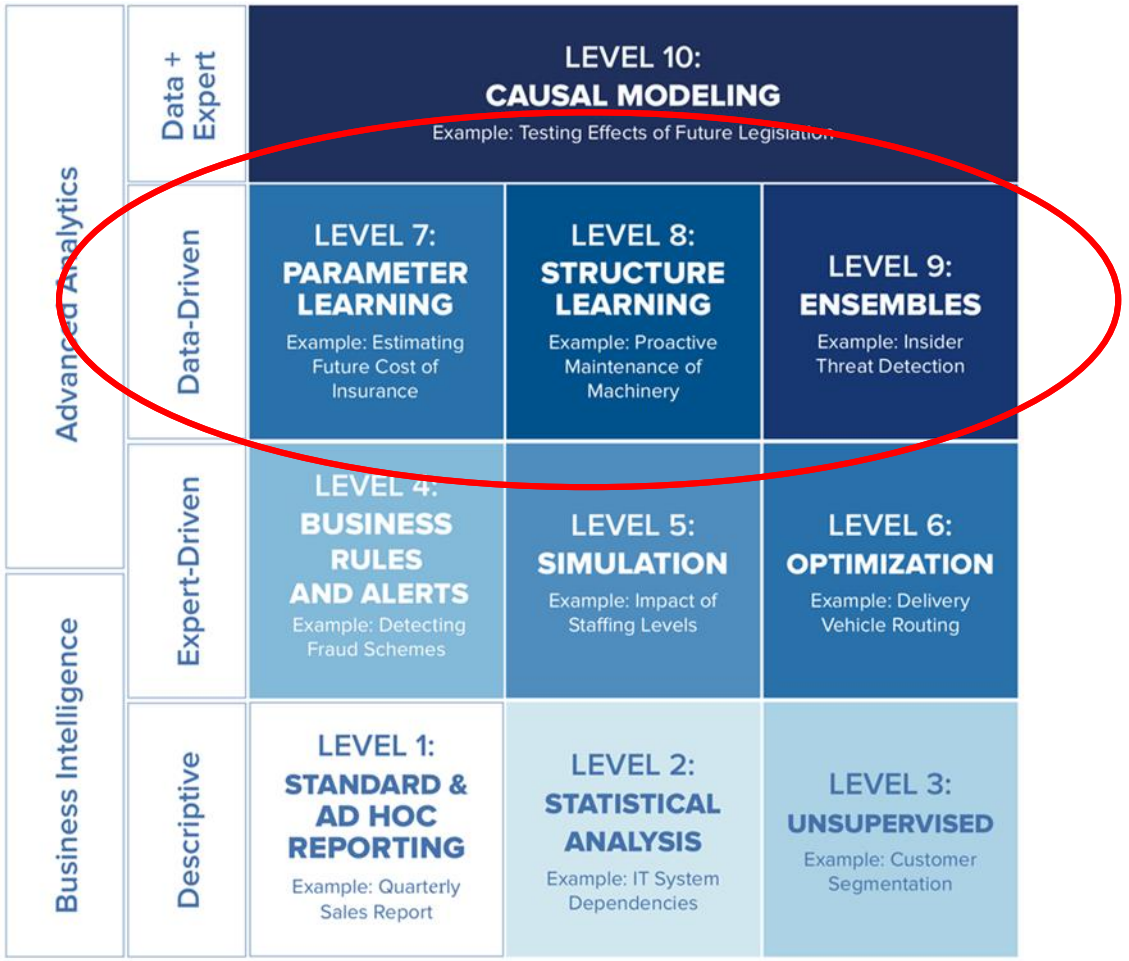
Increase Patient-Responsible Pay Rate

The 10 Levels of Analytics



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Increase Patient-Responsible Pay Rate

Challenge

Elder Research needed to identify patients who were not likely to pay their bill, and how to persuade those patients to pay

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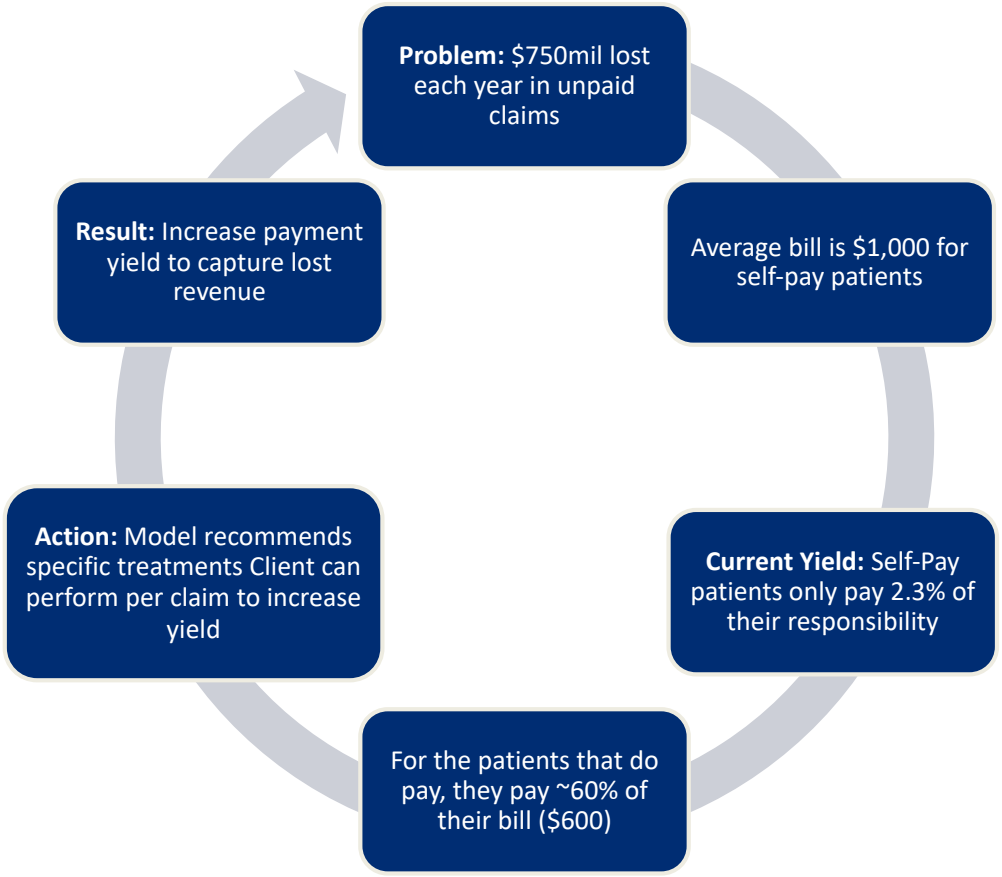

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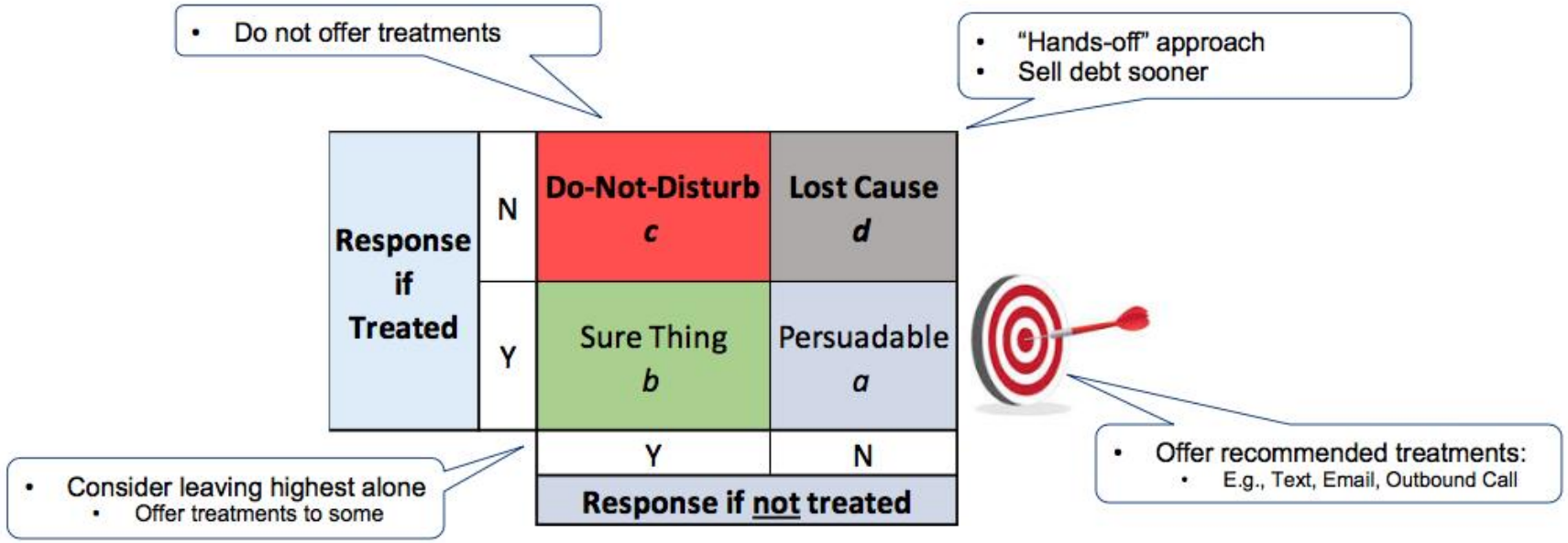
Increase Patient-Responsible Pay Rate

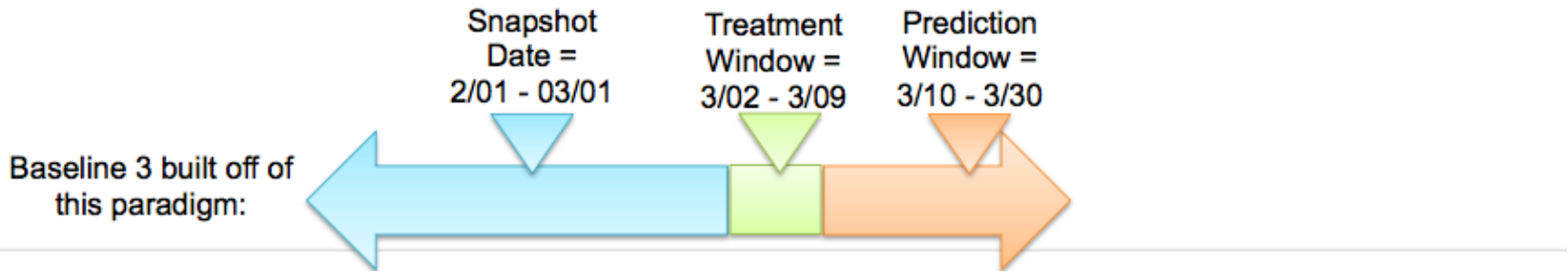
Our goal is to maximize potential value from all claims, by driving appropriate actions based on propensity-to-pay



Increase Patient-Responsible Pay Rate

Treatment effects model

- Look at the 10 different possibilities (including combinations)



Increase Patient-Responsible Pay Rate

Challenge

Elder Research needed to identify patients who were not likely to pay their bill, and how to persuade those patients to pay

Solution

Build a treatment effect prescriptive model testing various approaches

Results

Model accuracy of 88%

63% lift in patient-responsible pay rate

Recommended methods for contacting the Persuadable group

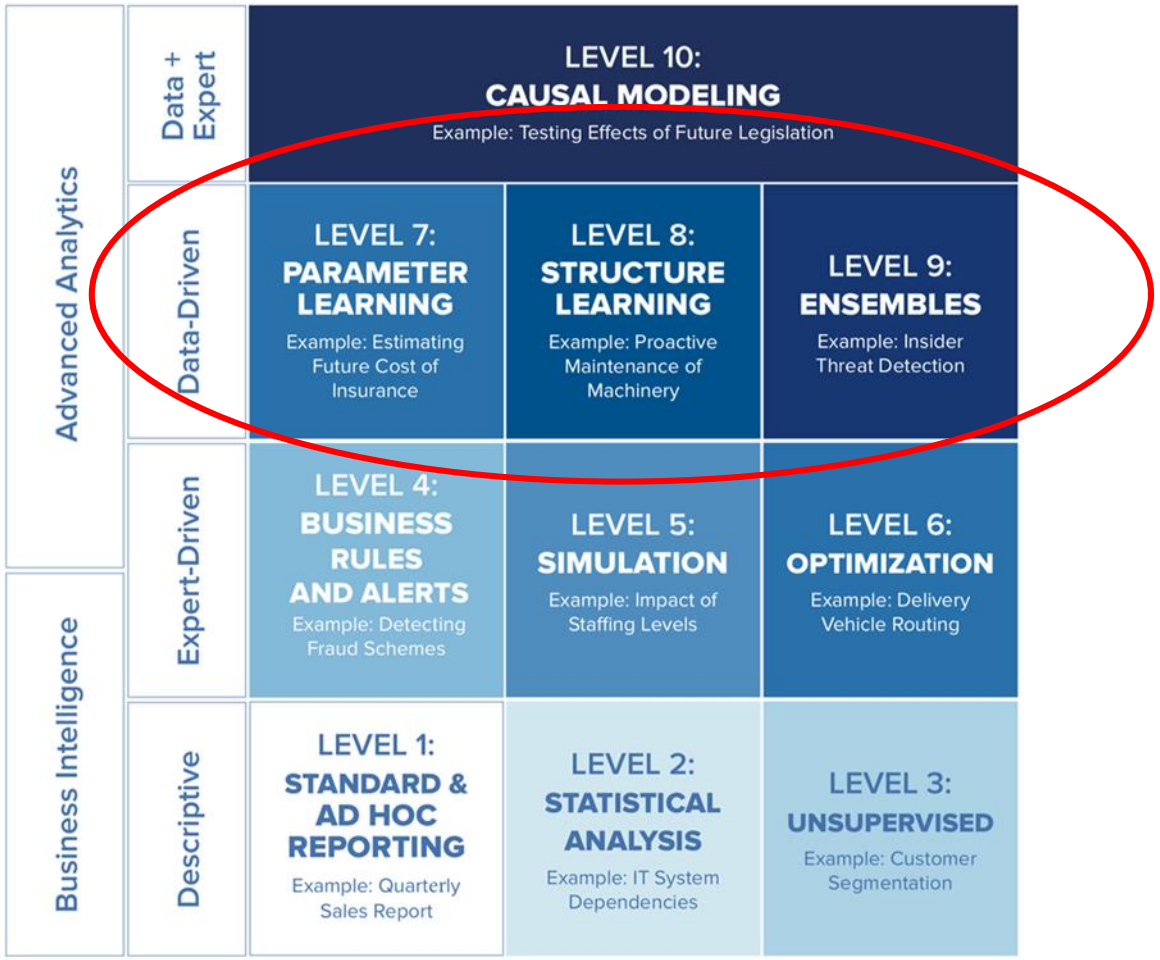
Parkinson’s Test Recommendation Engine

Parkinson's Test Recommendation Engine

Challenge

Research programs, treatment clinics, and physician's offices vary in the types of data and medical test results they collect on Parkinson's patients. Capitalizing on the extreme variability in patient data, Elder Research was eager to determine which tests offer the greatest value in disease prediction and if the importance of a key test be affected when data from further medical tests becomes available

The 10 Levels of Analytics



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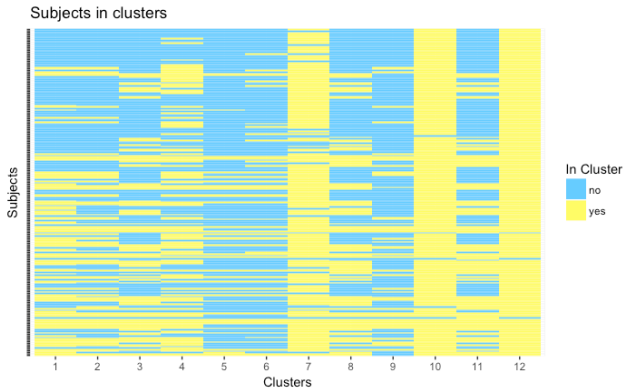
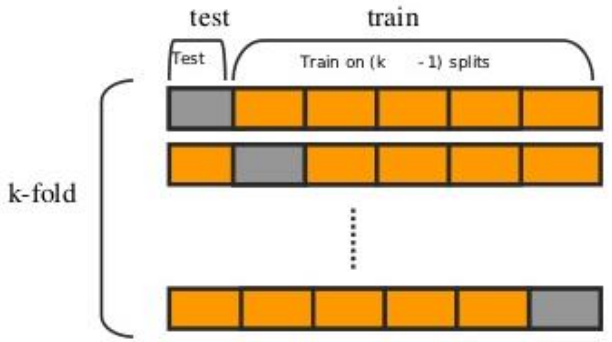
Parkinson's Test Recommendation Engine



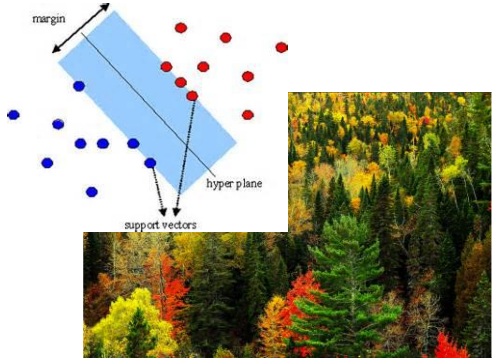


Boruta

All relevant features selected

RFE

Minimal Feature Selection



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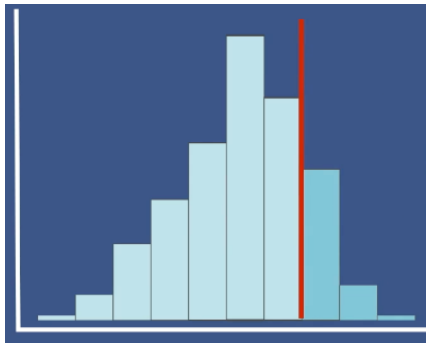


Target Shuffling

Quiz Score	Name	Gender	Age	Sisters	Brothers	Hair Color	Eye Color	Math Class	Pets
72	Sally	Female	16	0	2	Blonde	Blue	Algebra 2	Dog
87	Kyle	Male	15	1	1	Red	Green	Algebra 1	Cat
90	Juanita	Female	15	3	0	Brown	Brown	Algebra 1	Rabbit
99	Jordan	Male	16	0	0	Blonde	Brown	Geometry 1	None
79	Hiroki	Male	16	0	1	Black	Brown	Algebra 2	Fish
95	Diego	Male	15	2	2	Black	Brown	Geometry 1	Dog & Cat

① Build a model to predict the target variable, and note its strength

② Randomly shuffle the target vector to "break the relationship"

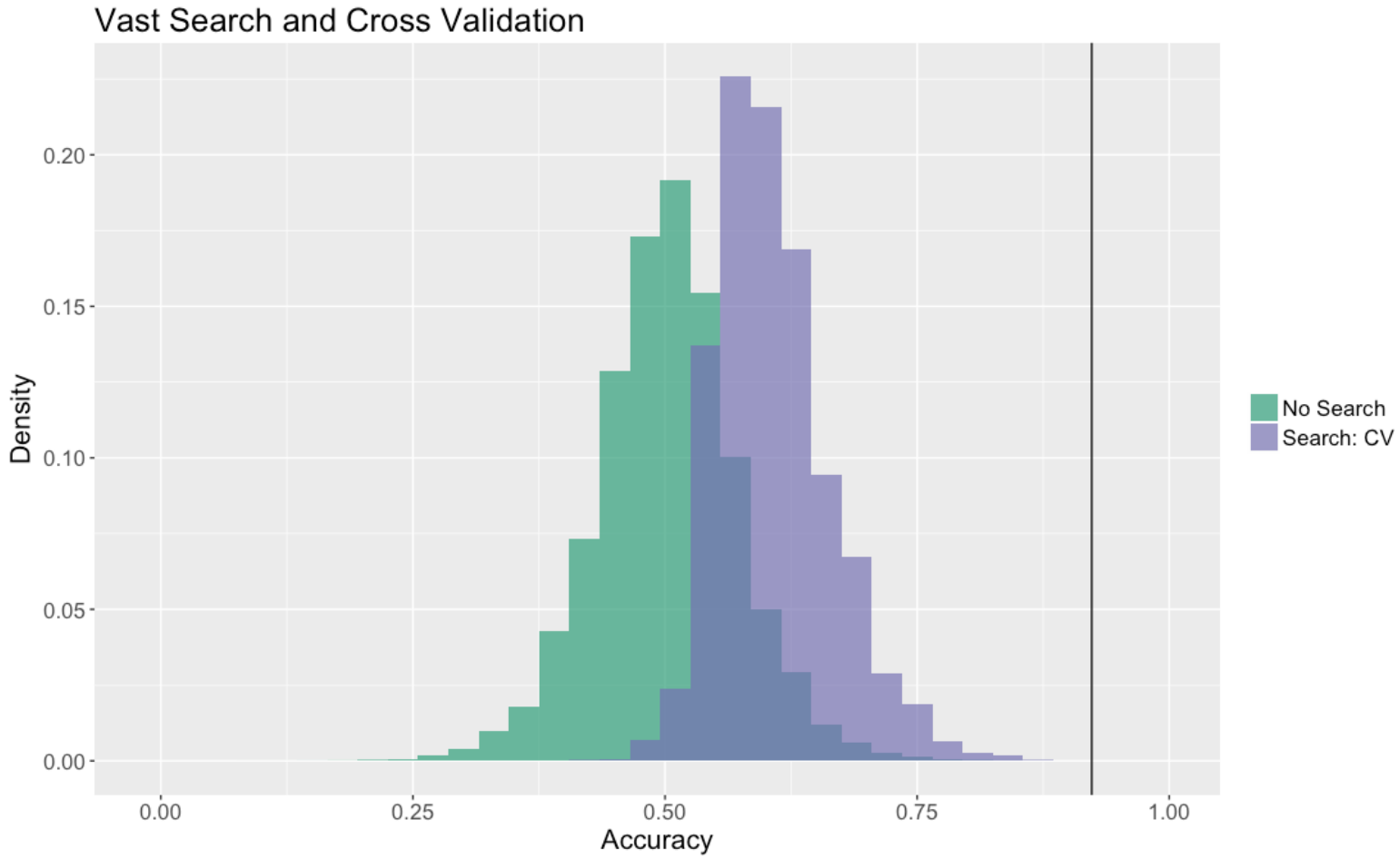
③ Build two models, one with the "broken" shuffled data and the other with normal (not shuffled data) and tabulate their strengths.

④ Repeat steps 2 and 3 many times to create a distribution of the strengths of the "Best Apparent Discoveries" (BADs).

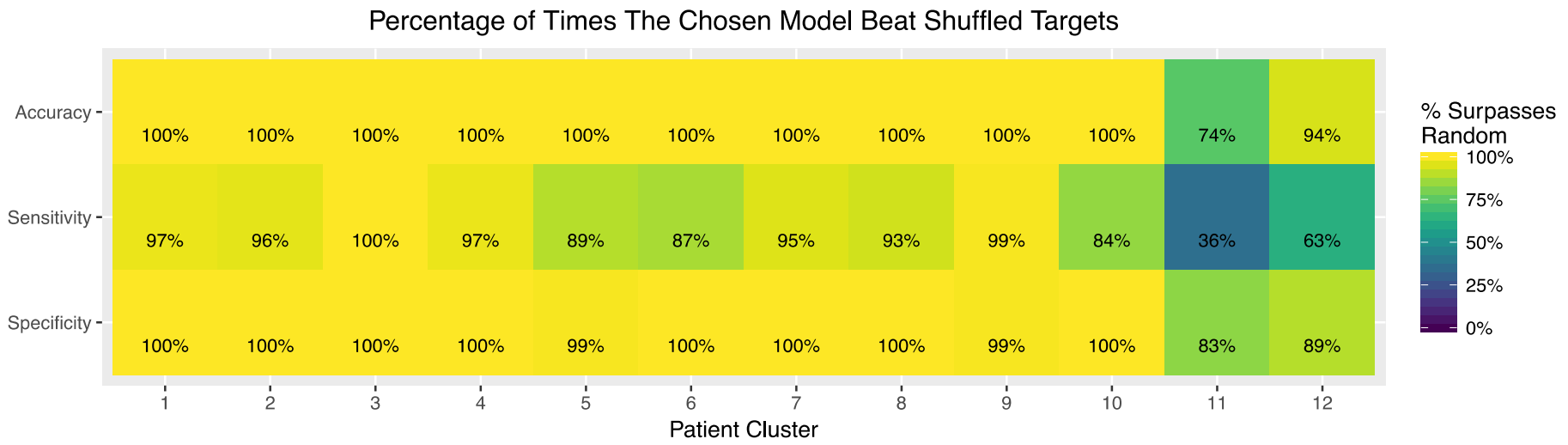
⑤ Evaluate where your true results (from step 1) are on this BAD distribution.

Target Shuffling

- Trained over 4 million models on a cloud-instance
- 36 cores
- 60 GB RAM
- Cost $44.75
- Active for 26 hours (run time ~14 hours)



Parkinson's Test Recommendation Engine



Parkinson's Test Recommendation Engine

Challenge

Research programs, treatment clinics, and physician's offices vary in the types of data and medical test results they collect on Parkinson's patients. Capitalizing on the extreme variability in patient data, Elder Research was eager to determine which tests offer the greatest value in disease prediction and if the importance of a key test be affected when data from further medical tests becomes available

Solution

A proprietary clustering method was used to identify twelve clusters of patients based on the test results available for each patient.

Find the best model-type per cluster and validate using target shuffling

Results

- Our models beat randomly shuffled data 100% of the time in 10 of 12 clusters
- Solution will help clinicians diagnose disease based on available tests, and recommend the fewest additional (or next best) tests to improve disease prediction

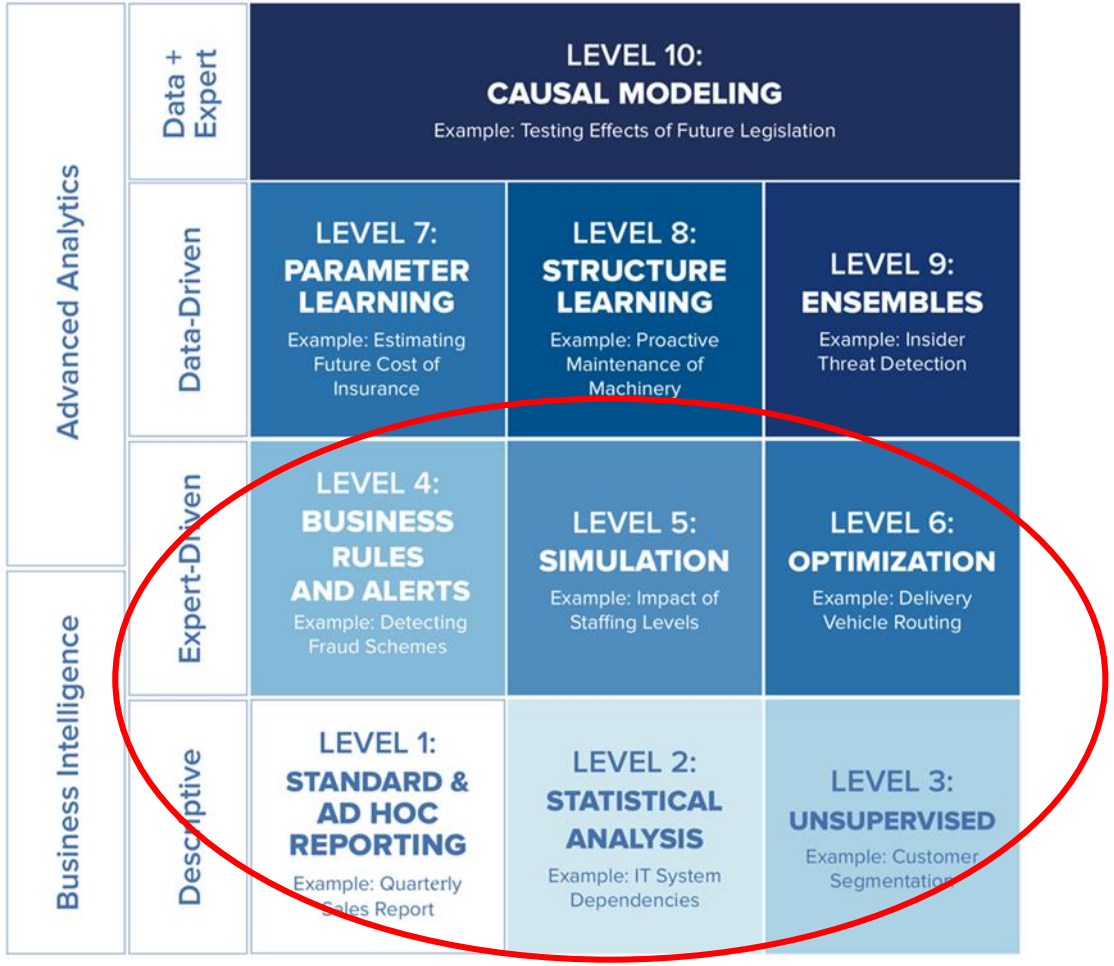
Detecting Kickback Schemes

Detecting Kickback Schemes

Challenge

GAO estimates that approximately 20% of medical fraud is from kickback schemes. Investigators need ways to identify these risky players without reliance on hotline tips. They also need a way to prioritize cases in order to maximize efficiency.

The 10 Levels of Analytics



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What is a Kickback?

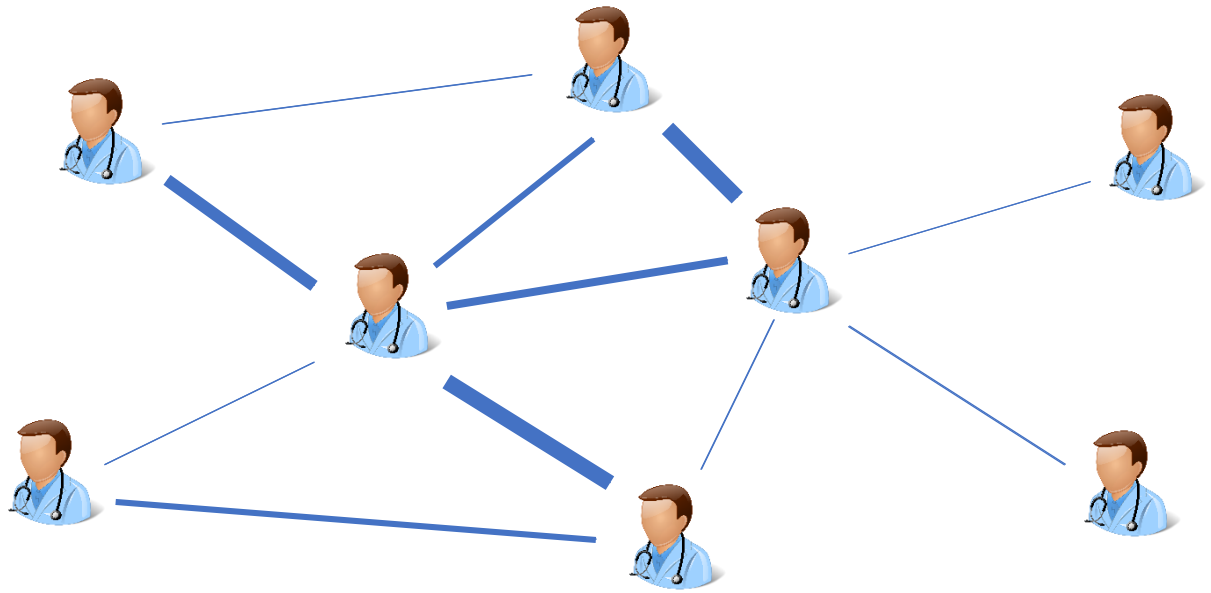
- Something of value being offered in return for a favorable action

- In health care:
  - Referrals
  - Prescribing the use of specific drugs/equipment

- As a result:
  - A large percentage of a doctor's patients will see the same doctor and/or receive the same drug or equipment

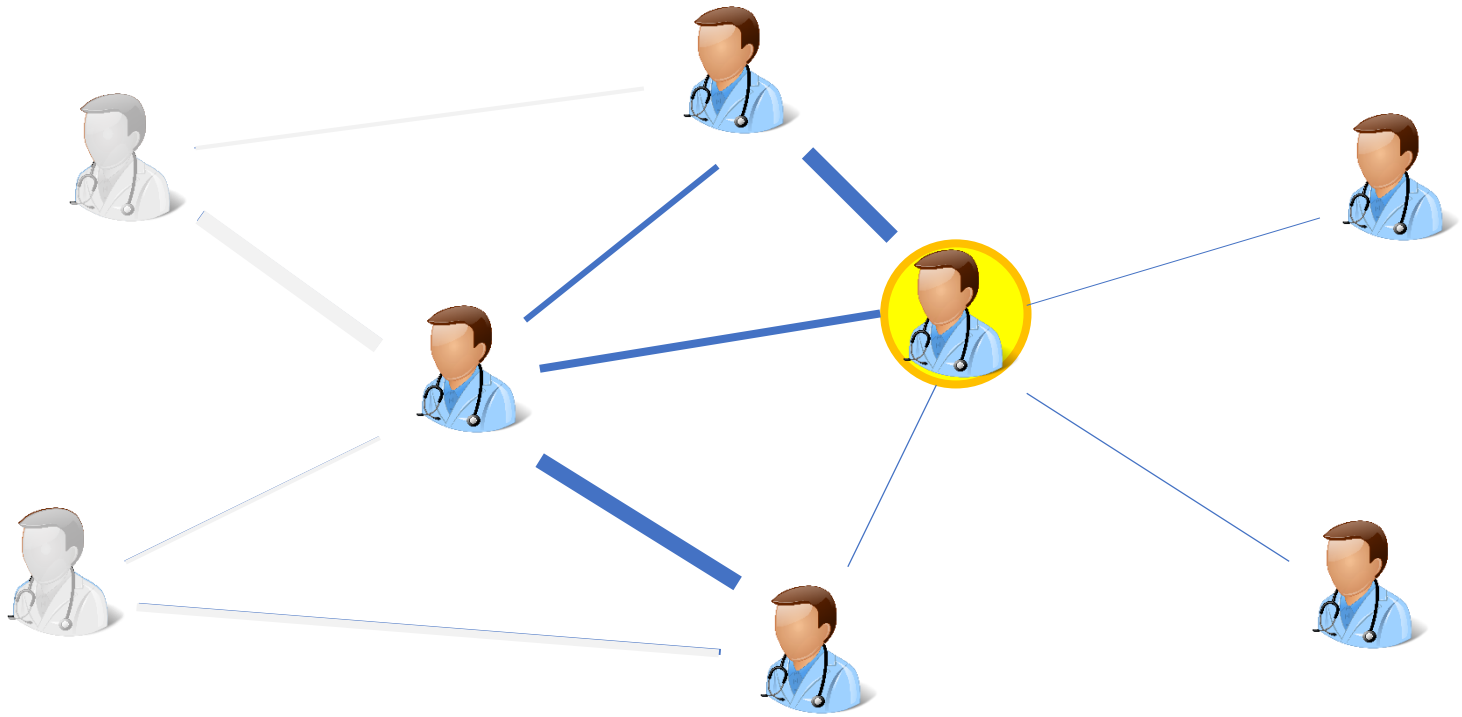
What are Networks?

- Represent relationships between entities
  - Start with nodes (doctors)
  - Connect nodes based on associations (shared patients)



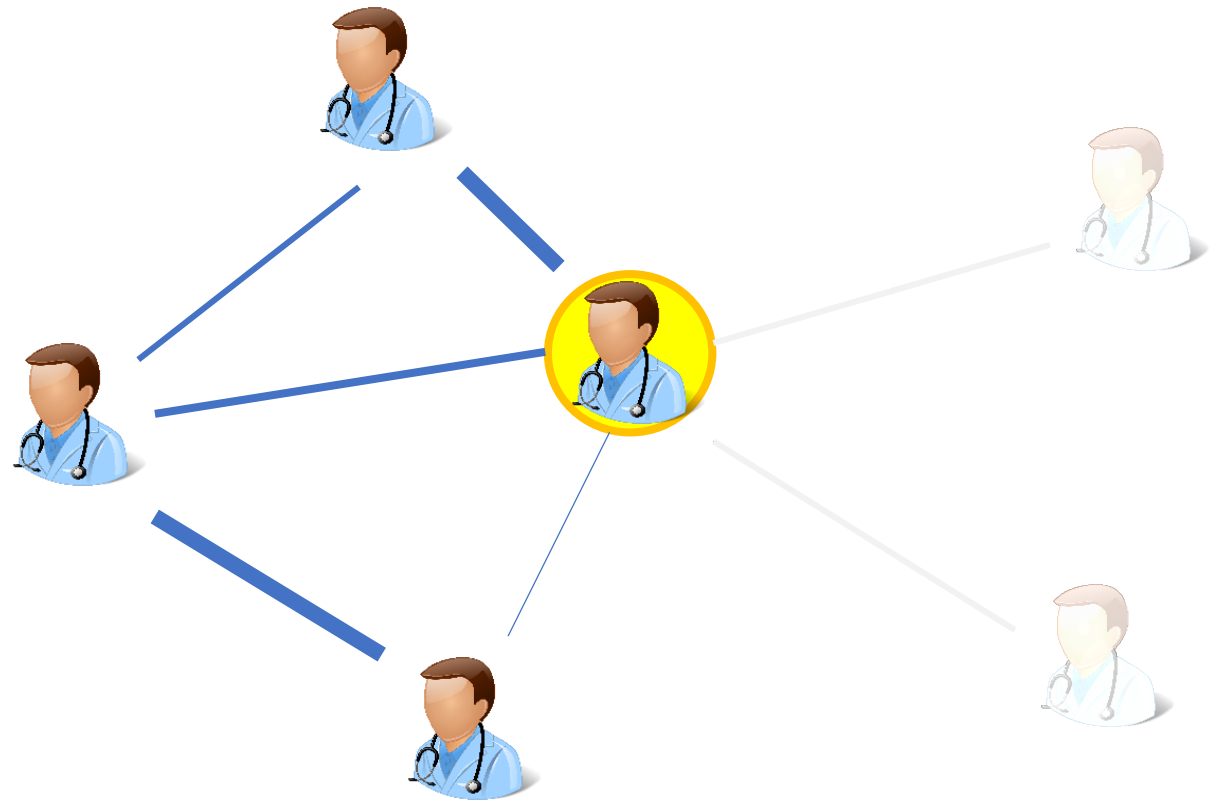
The Problem

- Only care about **direct** connections between doctors



The Problem

- Only want the strong connections, not the weak ones



The Solution

- Formula that measure's the strength of a doctor's immediate connections

- Benefits
  - The addition of weak edges brings down the value
  - Each resulting network has a value for ranking

  - Networks with the highest values are good candidates for investigation

Detecting Kickback Schemes

Challenge

GAO estimates that approximately 20% of medical fraud is from kickback schemes. Investigators need ways to identify these risky players without reliance on hotline tips. They also need a way to prioritize cases in order to maximize efficiency.

Solution

- Method was created that emphasizes which other physicians a doctor has the strongest connections with
- Generates a metric summarizing the strength of these connections

Results

- Outcomes can be ranked, highlighting where to allocate resources
- Quickly synthesizes information that would have previously taken investigators weeks to process

RADR & Risk Assessment Tools

RADR & Risk Assessment Tools

Challenge

Need a way to present different risk metrics and data sources, while providing insight into why a given score was assigned.

Solution

- Build a risk assessment tool to augment risk scores

Augment Risk Scores

- **Goal**: make scores interpretable and insights actionable

- Why does a doctor have a high score?
  - Highlight contributing factors
  - Compare to the “norm”
  - Point back to data
  - Create visuals

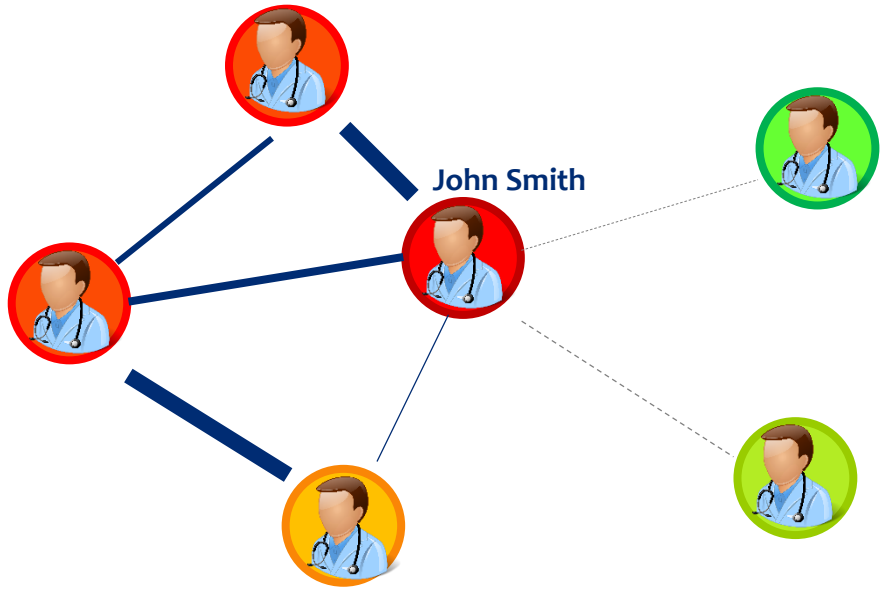
Augment Risk Scores

Doctor Name	Score
John Smith	100
Rachel Brown	99
Robert Jones	72
David Williams	64
James Miller	58
Sarah Johnson	53
⋮	⋮

Augment Risk Scores

John Smith 100

Doctors with the same Patients



LEGEND

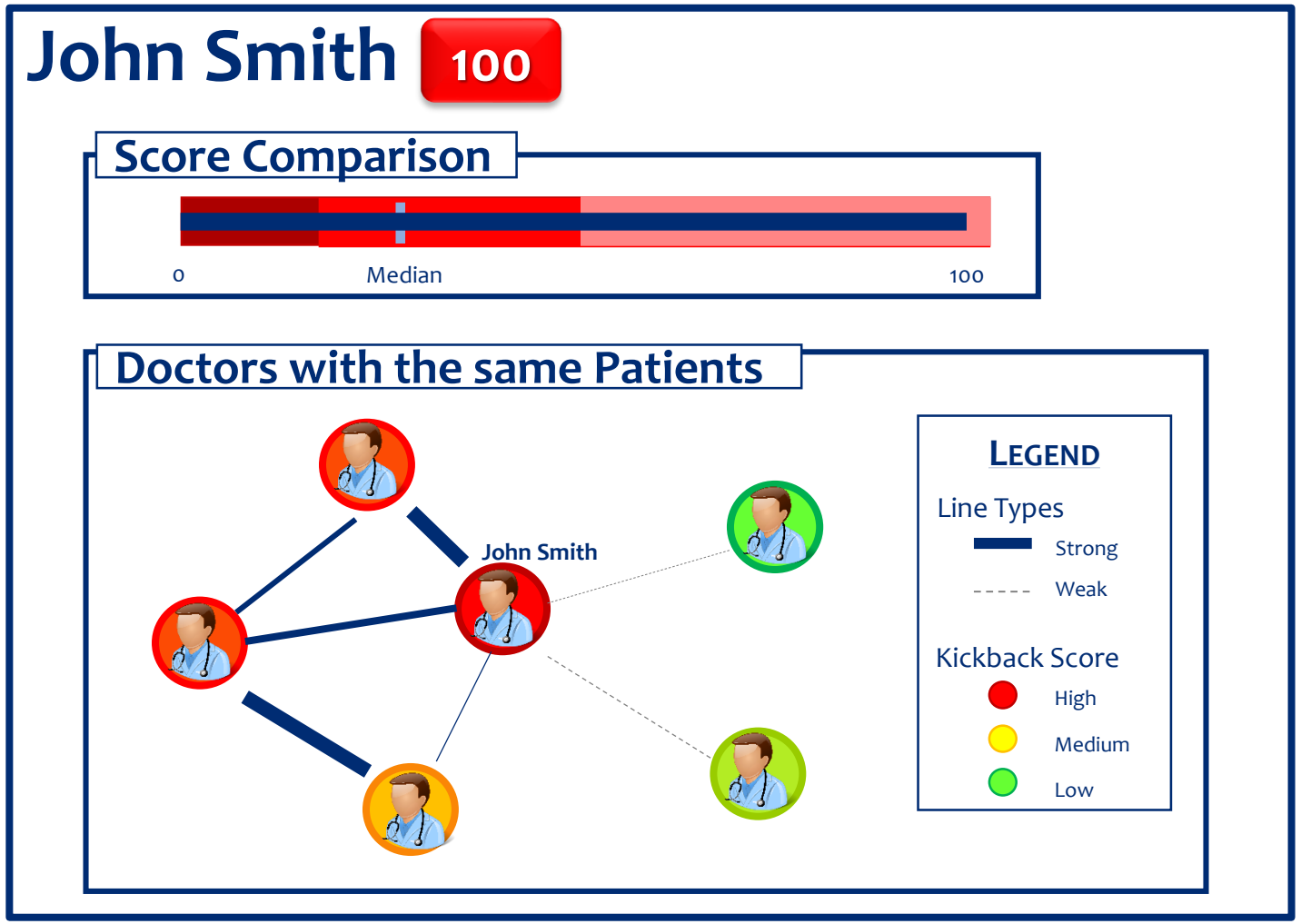
Line Types

- Strong
- Weak

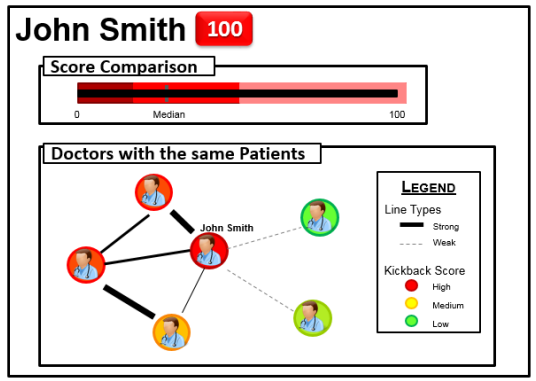
Kickback Score

- High
- Medium
- Low

Augment Risk Scores



Augment Risk Scores



Patient Comparison

John Smith

Kickback Score: 100

Patient Count: 576

Rachel Brown

Kickback Score: 99

Patient Count: 432

Patients in Common: 378

Patient Name	Diagnosis	Age
Patient 1	Broken Hip	72
Patient 2	Toothache	37
Patient 3	Ankle Sprain	16
Patient 4	Back Sprain	48
Patient 5	Insomnia	14

RADR Demo

RADR & Risk Assessment Tools

Challenge

Need a way to present different risk metrics and data sources, while providing insight into why a given score was assigned.

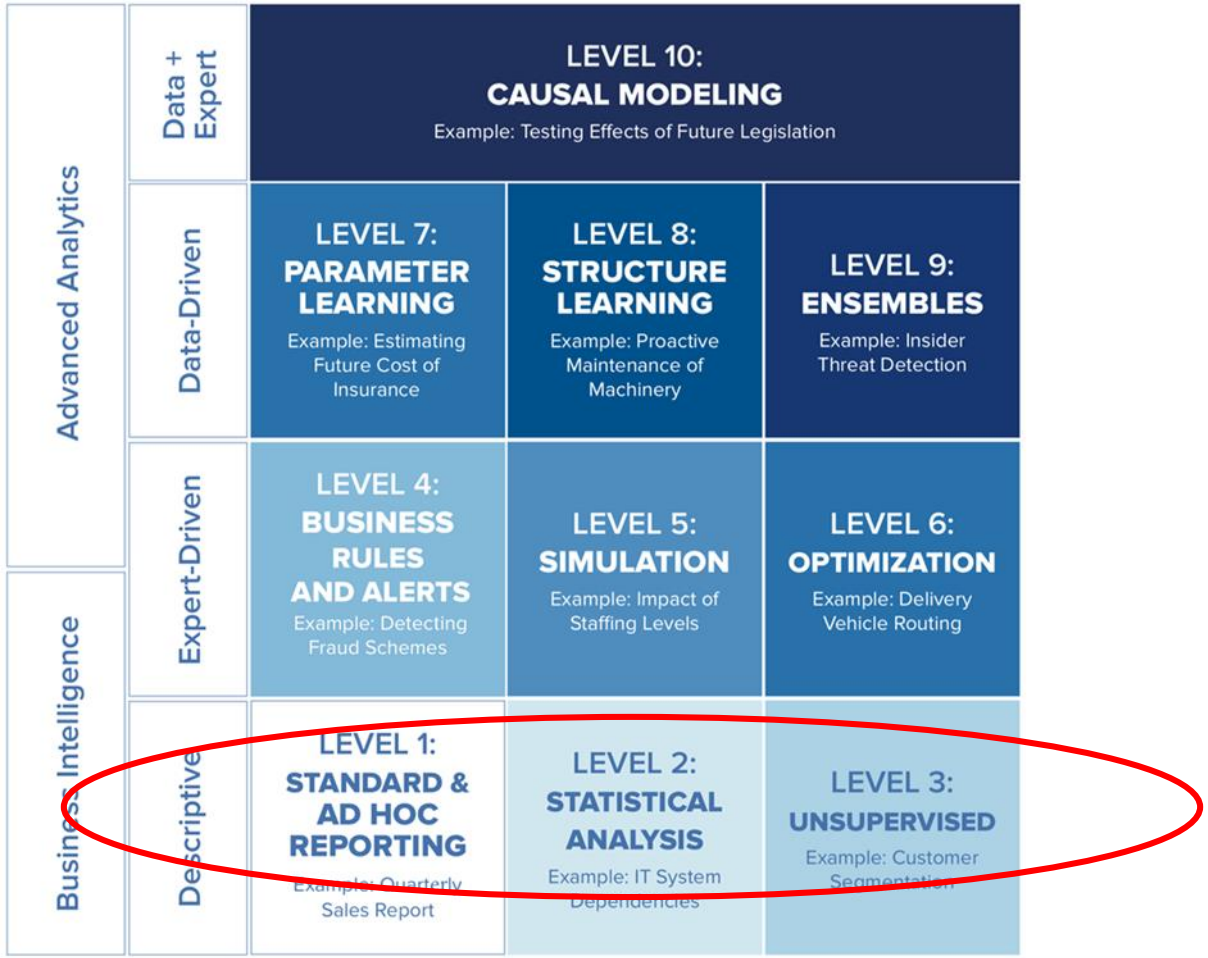
Solution

- Build a risk assessment tool to augment risk scores

Results

- RADR has become a standard tool among investigators where deployed
- Generates leads without reliance on hotline tips
- Initial investigations that would have taken weeks now are hours/days

The 10 Levels of Analytics



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Analytics Center of Excellence

Challenge

A Fortune 500 CPG corporation had no centralized analytics capability or long-term strategy. The executive team hired Elder Research to assess its current analytics needs, develop an strategic roadmap, and build an analytics center of excellence.

Solution

Elder Research facilitated an on-site, strategic assessment of current processes, culture, technology, and capabilities that impact analytics and data science.

We also created a long-term, multi-year roadmap focused around speed of delivery and agility in the marketplace.

Results

Our team developed a self-sufficient Analytics Center of Excellence.

We completed 30+ quick wins, POCs, and projects in the first year alone, each with potential ROI of dollars saved, additional sales captured, or time saved.

Q & A

Please submit questions using the questions tab.

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AI/ML Opportunities for the Industrial Internet of Things

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