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Promoting Child Well-Being by Using Machine Learning Algorithms

Gaithersburg, MD 7/21/2017

THE STATE OF THE CHILD WELFARE SYSTEM

- 3.6 million child abuse & neglect referrals per year, 6.6 million children
- 5-7 child deaths per day
- A child abuse and/or neglect report every 10 seconds
- $124 billion in economic costs, annually
- NO significant change over the last 10 years
- One of the worst records among all industrialized countries

TOTALS AND AVERAGES DON'T HELP THOSE ON THE FRONTLINES

QUICK OVERVIEW OF TERMS

- Big data
- Social science
- Data science
- Analytics
- Machine learning

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BIG DATA

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WHAT ARE "BIG" DATA?

Big | **Large** | **Small**

Big

YouTube

Large

United States Census Bureau

salesforce

Social Solutions

Small

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SOCIAL SCIENCE
&
DATA SCIENCE

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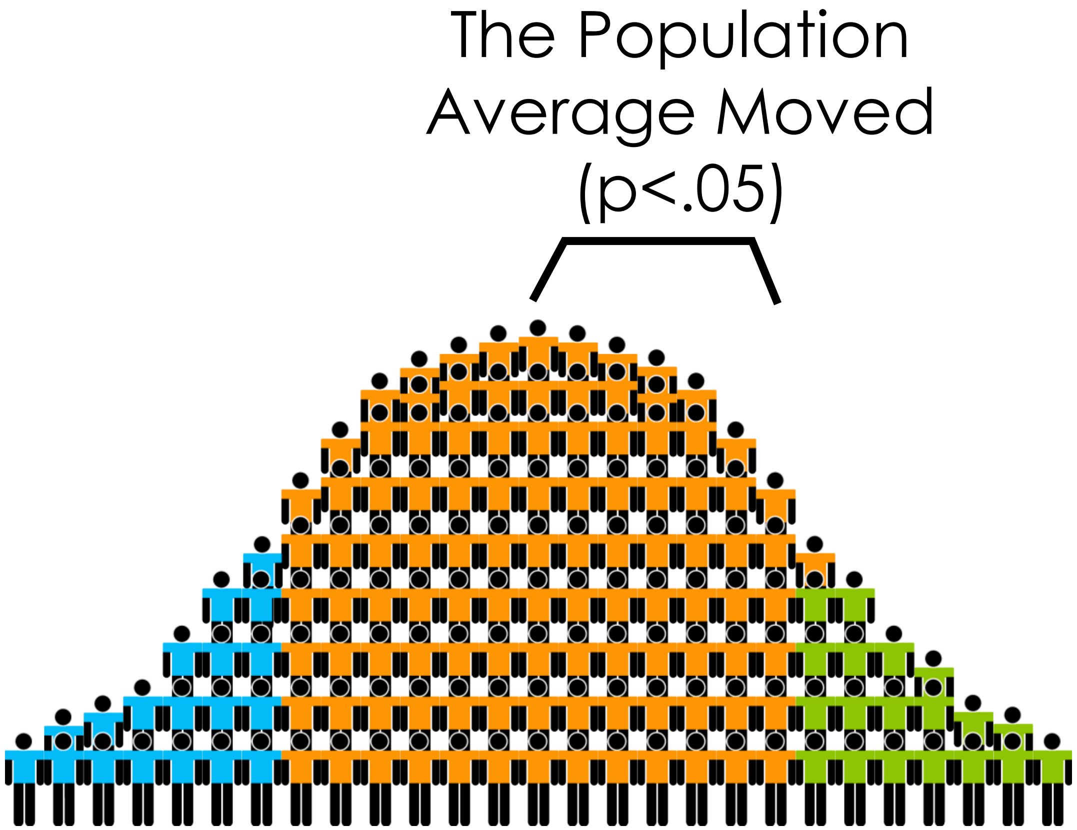
SOCIAL SCIENCE



Evidence-Based Decision-Making

If we repeat the intervention as it was implemented during the experiment, the population average will improve 95 times out of 100.

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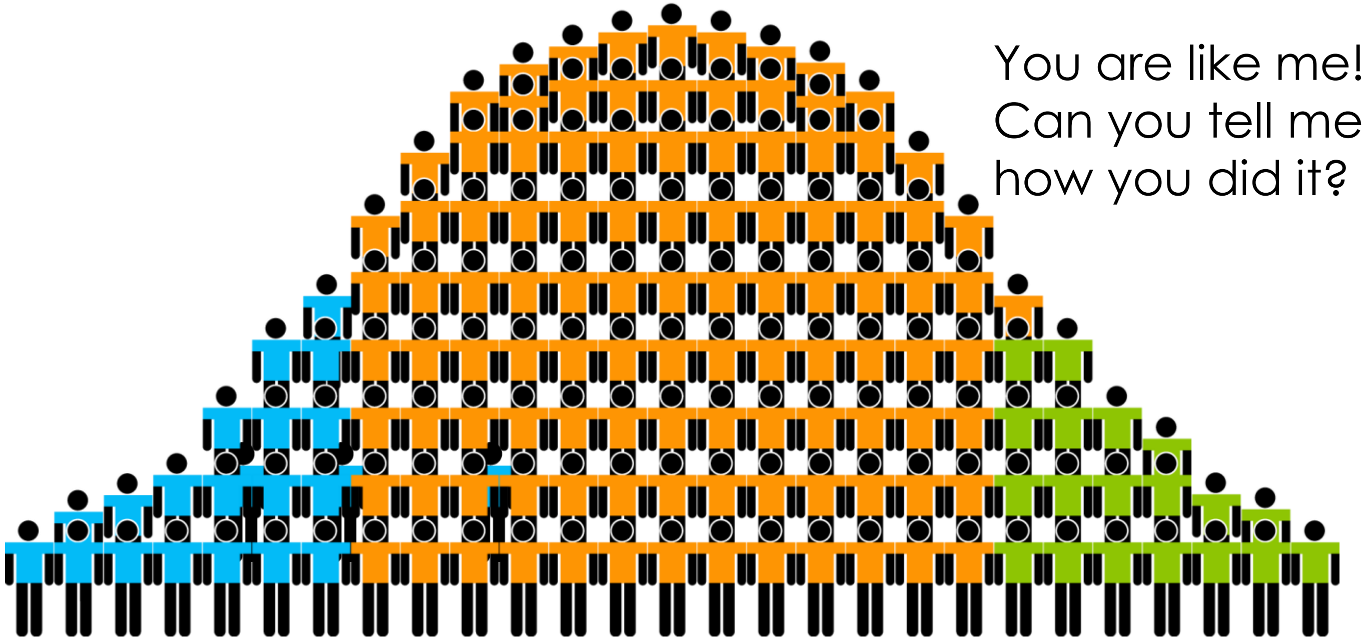
DATA SCIENCE



You are like me! Can you tell me how you did it?

Probability-Based Decision-Making

If a specific type of intervention experience worked for 90% of the cases that were very similar to the current case, then there's a 90% chance it will work.

ANALYTICS

DESCRIPTIVE ANALYTICS

PREDICTIVE ANALYTICS

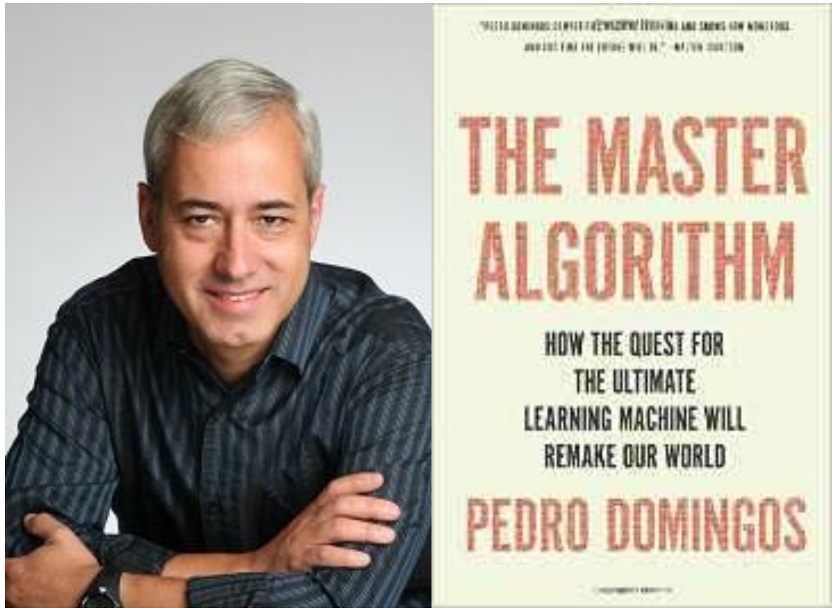
PRESCRIPTIVE ANALYTICS

"…prescriptive analytics tells you what to do about it."

Jeff Bertolucci, Information Week

MACHINE LEARNING

MACHINE LEARNING



Machine learning is "like the scientific method on steroids, making observations, forming hypotheses, testing hypotheses, and refining hypotheses, millions of times faster than any scientists could do."

Pedro Domingos
Professor
Dept. of Computer Science & Engineering
University of Washington

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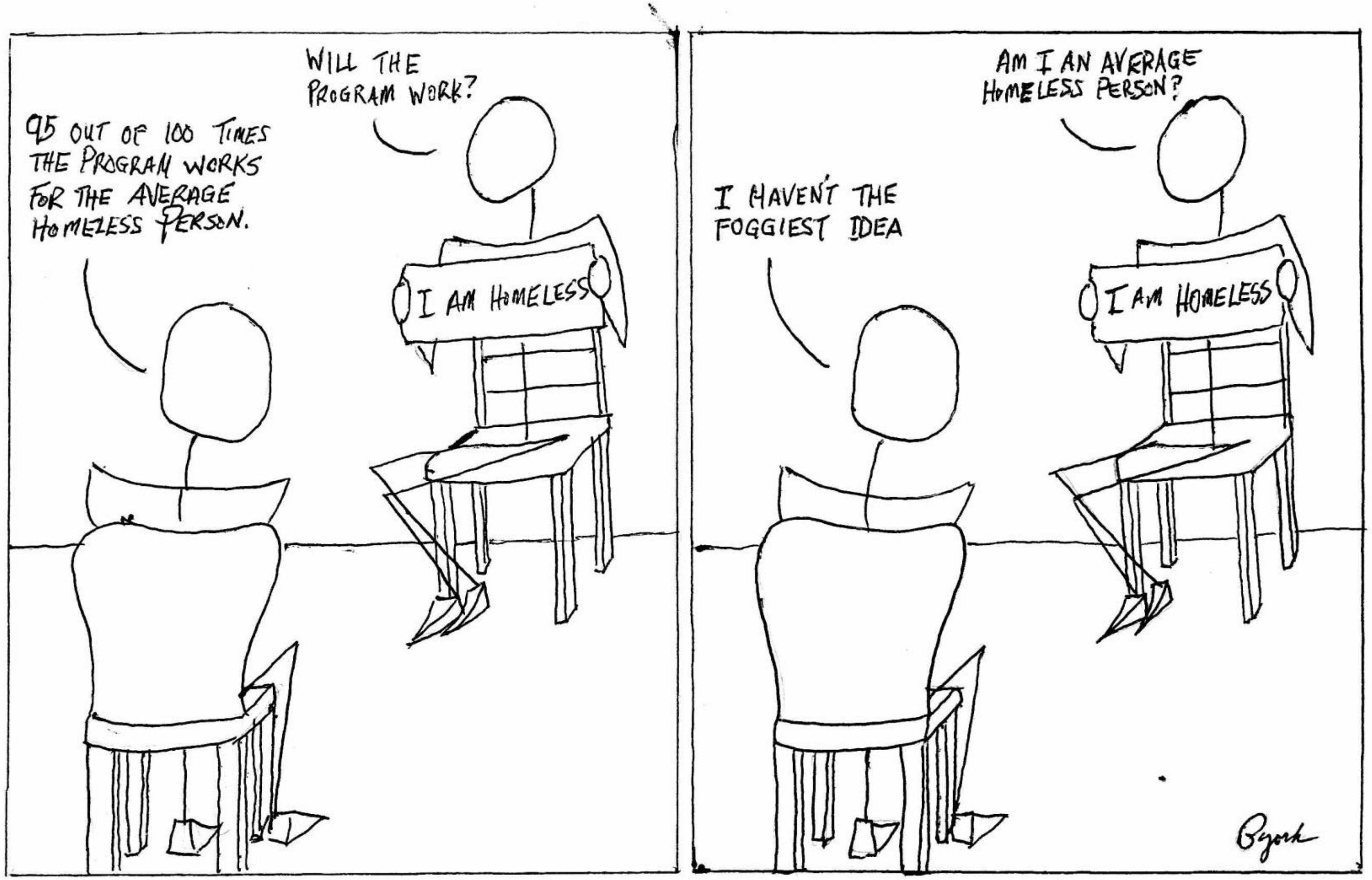
HOW DO WE LEARN ABOUT WHAT WORKS?

EXPERIMENTS

Purpose:	Understand causation for a population
Method:	Conduct small to large scale experiments, collecting new data on subjects, ideally using the scientific method
Metric of Success:	Significant [average] difference between experimental and control group
Pro:	Determines what actually causes improvement for a population (tries to remove bias)
Con:	Can't guide decision-making on case-by-case basis
Implication:	Good for policymaking and funding decisions, not for individual decision-making



WHEN EVIDENCE-BASED RESEARCH MEETS THE REAL WORLD

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ANALYTICS

Purpose: Predict an outcome for an individual

Method: Conduct algorithmic modeling (statistical, machine learning/AI) on existing datasets to learn patterns of associations

Metric of Success: Predictive accuracy across every member of the population

Pro: Accurate decision-making for individual cases

Con: Not causation (includes bias in the models)

Implication: Good for case prediction, not for unbiased prescription or evaluation

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THE BIG IDEA

BRIDGING SOCIAL SCIENCE AND DATA SCIENCE, USING MACHINE LEARNING

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SIMPLE INSIGHTS FOR ACTION

SIX STEPS

STEP 1: ACCESS & PREPARE ADMINISTRATIVE DATA

MACHINE LEARNING CAN ADDRESS THE 'GARBAGE IN, GARBAGE OUT' DATA QUALITY PROBLEM

Intake
History
Background
Situation

Interventions
Dosages
Methods
Experiences

Outcomes
Results
Milestones
Goals

1. More than a few hundred cases
2. Clean up missing data issues
3. Don't sweat statistical assumptions

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STEP 2: DISCOVER WHAT WORKS

MACHINE LEARNING ALGORITHMS FIND EVERY PATHWAY TO SUCCESS

Services
Programs
Environments
Conditions
Situations

- Placement + Parenting Program + >365 Days of Case Management
- Placement + >180 Days of Residential Treatment
- Placement + Permanency w/Other Family Member w/in 180 Days
- No Placement + 180 Days of Residential Treatment + 6 or More Family Counseling Sessions
- No Placement + Completion of Parenting Program + Job Placement w/in 90 days

Any One of these Solutions Reduces the Odds of Return ***by at Least 50%***

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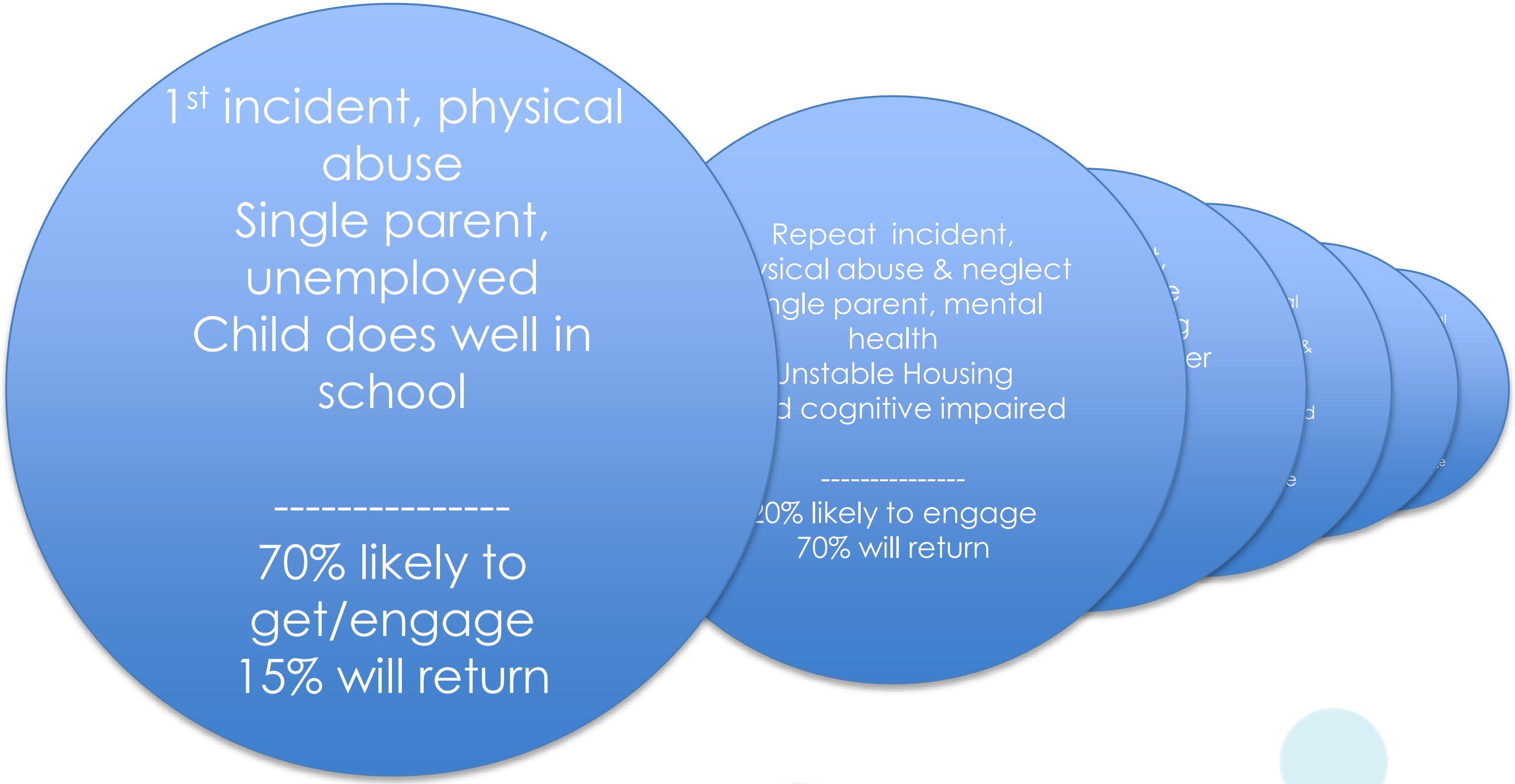
STEP 3: FIND MATCHED COMPARISON GROUPS

BACKGROUND & HISTORY THAT PREDICT LIKELIHOOD TO ENGAGE IN AND/OR RECEIVE WHAT WORKS



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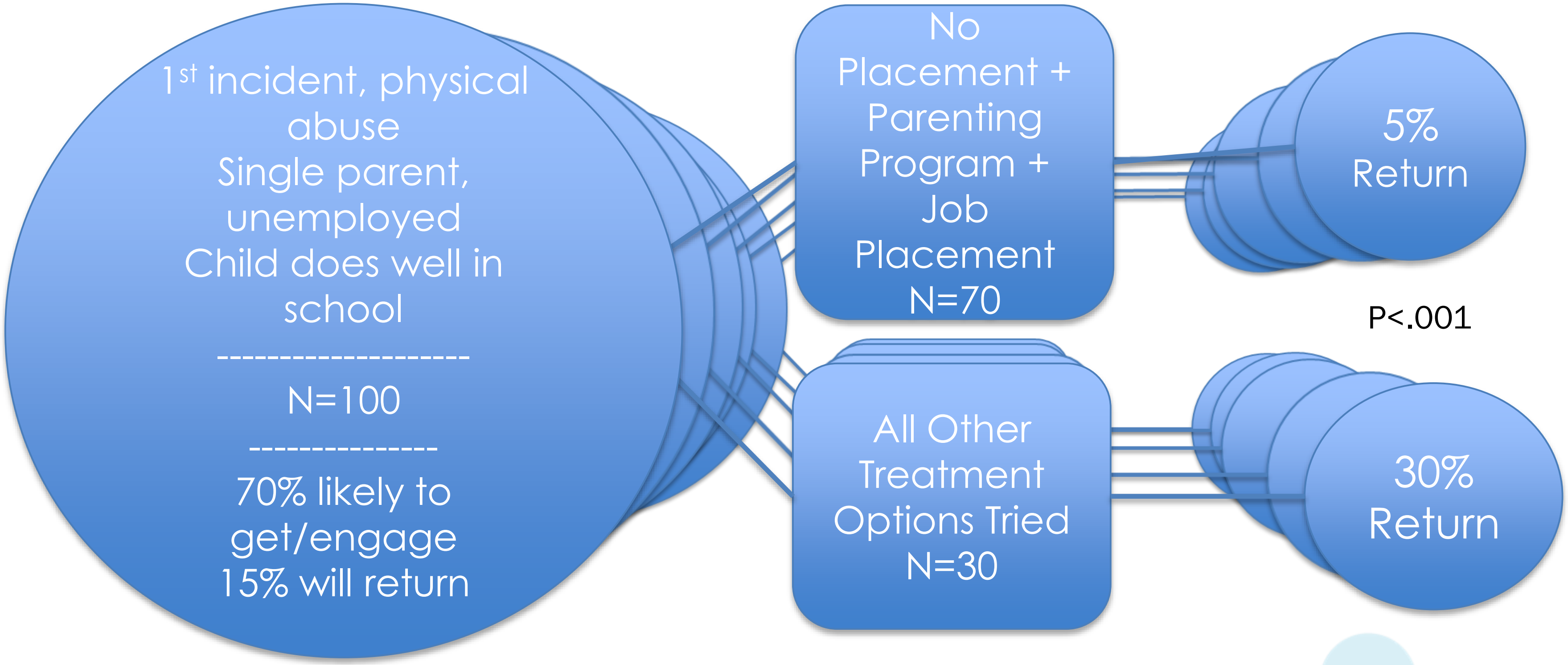
STEP 4: DETERMINE WHAT WORKS FOR EACH GROUP

MACHINE LEARNING FINDS NATURALLY OCCURRING EXPERIMENTS WITHIN THE DATA



STEP 5: EVALUATE SUCCESS

MODELS EVALUATE HOW MANY CASES GOT WHAT WAS NEEDED, NOT POPULATION AVERAGES

	Group #1 N=100		Group #2 N=100		Group #3 N=100		Group #4 N=100		Group #5 N=100		
Got What Worked & Didn't Return	**70**	**+**	**90**	**+**	**85**	**+**	**75**	**+**	**55**	**=**	**375**

75% Didn't Return

Due to Receiving the Right Solutions

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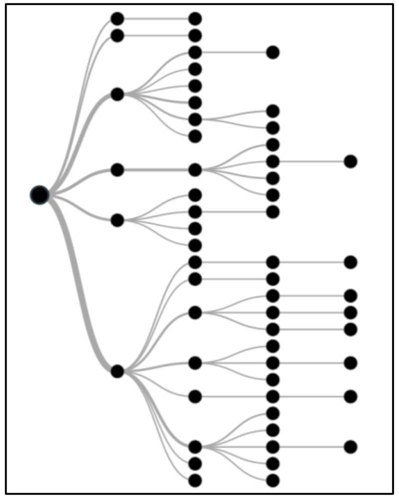
STEP 6: USE THE MODELS FOR DECISION MAKING

BUILD APPLICATIONS & LEARNING COMMUNITIES

NO NEW DATA SYSTEM REQUIRED!

SCORING ENGINE



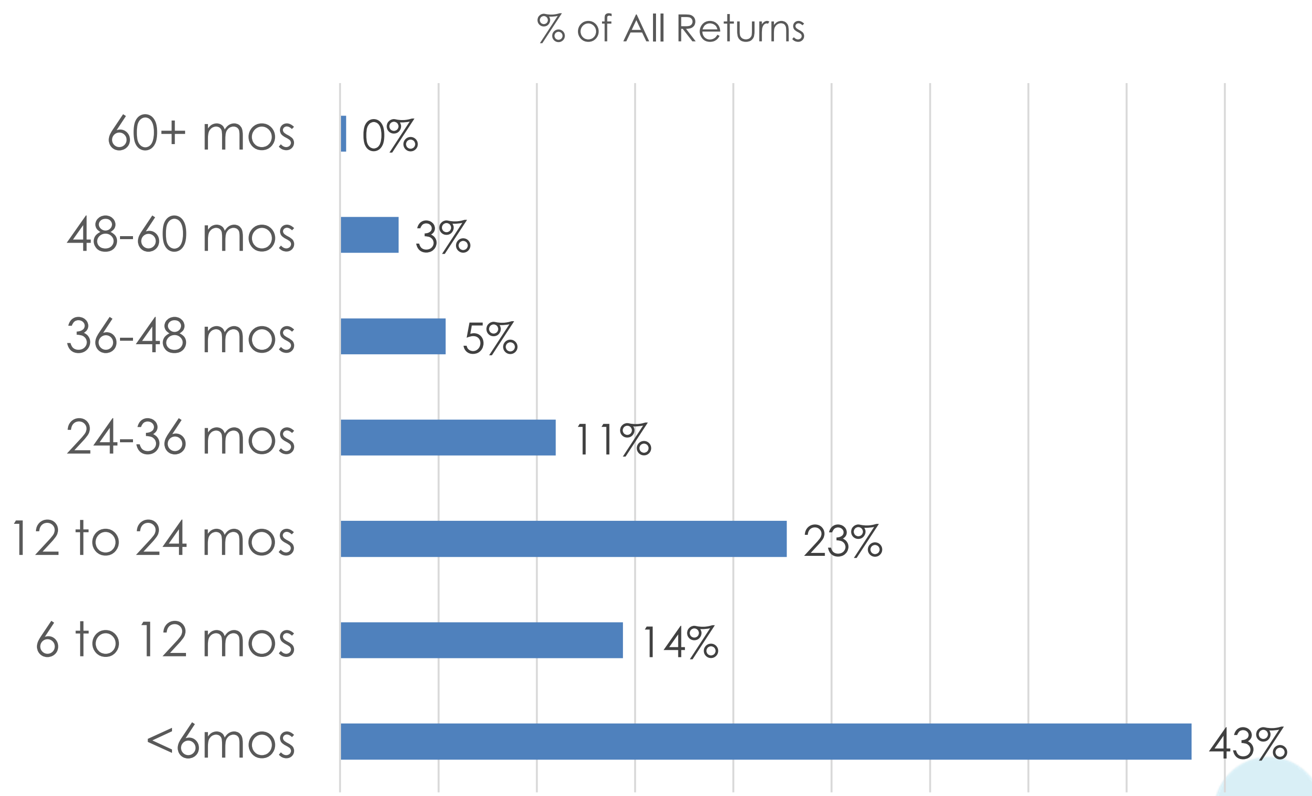
DECISION MAKING MODELS

CASE-SPECIFIC INSIGHTS

COMMUNITY OF LEARNING

BROWARD SHERIFF'S OFFICE

BROWARD SHERIFF'S OFFICE: 24% OF ALL CASES RETURN



BROWARD SHERIFF'S OFFICE

- Accurately predicts next incident in *83 cases out of 100*
- A prescription model that can accurately recommend which cases should go into either intensive out-of-home services or in-home community-based programs, and *if these recommendations were applied, the result would be a 30% reduction in return cases*
- A rigorous impact evaluation model, using machine-guided matching, that proves that in *60% of the cases, intensive out-of-home case management services from a specific provider significantly reduces their likelihood for a subsequent incident*.
- A rigorous impact evaluation model that also proves that *40% of the cases are misplaced in these intensive services, and as a direct result, are 175% more likely to return with a subsequent incident*.
- Specific investigators make a difference.

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CASEY FAMILY PROGRAMS

FIRST PLACE FOR YOUTH

SYSTEM IMPLICATIONS

IMPLICATIONS- A CAUTIONARY TALE

- Data analytics do not have to be the next "shiny new object;"
- Changing child welfare practice means developing the capacity of organizations, systems and communities;
- Outside knowledge is needed;
- Algorithms inherit system values and bias;
- Don't forget social or contextual factors; and
- The purpose is to accelerate learning how to protect and improve the well being of children and youth.

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QUESTIONS

CONTACT FOR FURTHER INFO

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