the Advertising Research Foundation

AUDIENCE xSCIENCE 2024

Business Outcomes in Advertising Powered by Machine Learning

Brett Mershmann

NCSolutions

#ARFAxS

BUSINESS OUTCOMES IN ADVERTISING POWERED BY MACHINE LEARNING

March 2024

Brett Mershman
Sr. Director, Data Science
NCSolutions

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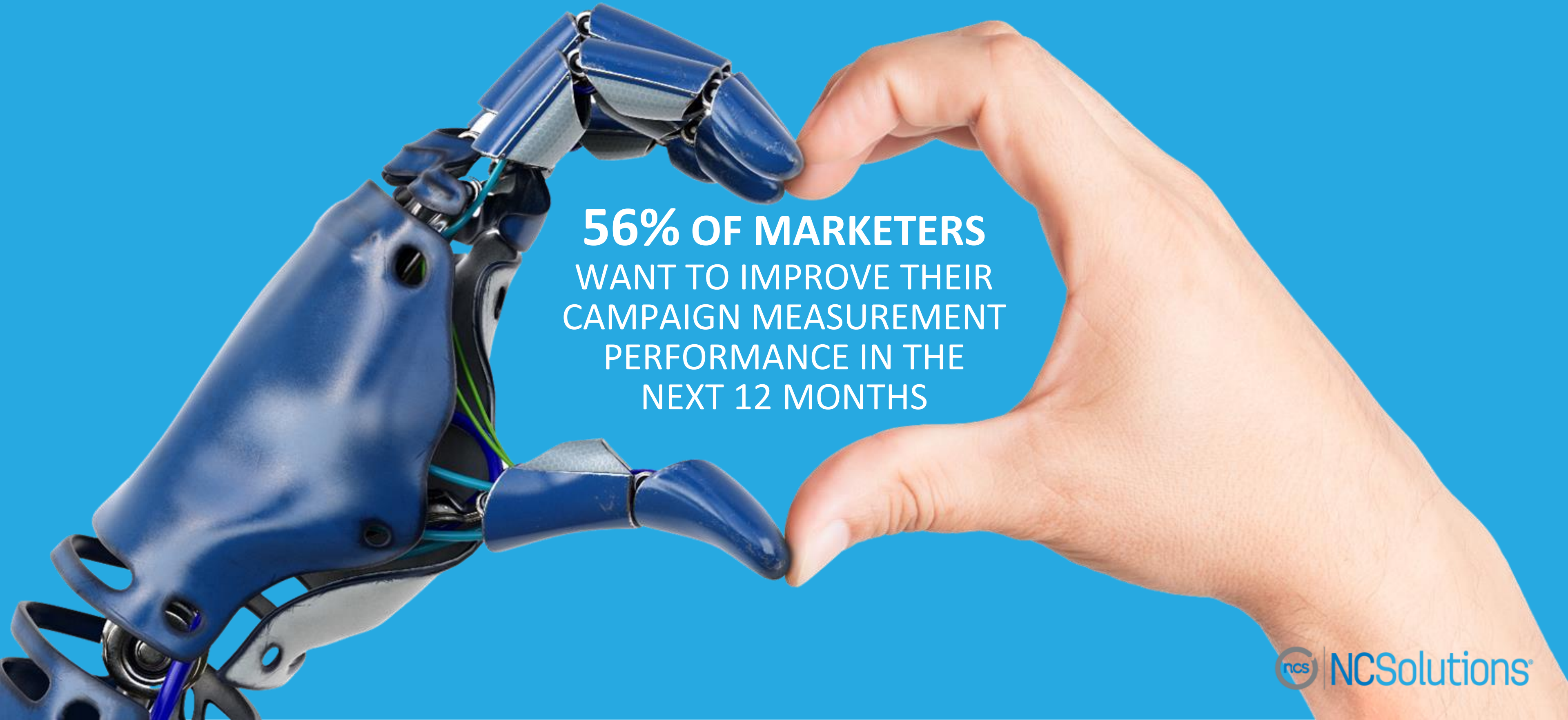
Better advertising begins here.

AI IS ALL THE BUZZ



56% OF MARKETERS
WANT TO IMPROVE THEIR
CAMPAIGN MEASUREMENT
PERFORMANCE IN THE
NEXT 12 MONTHS

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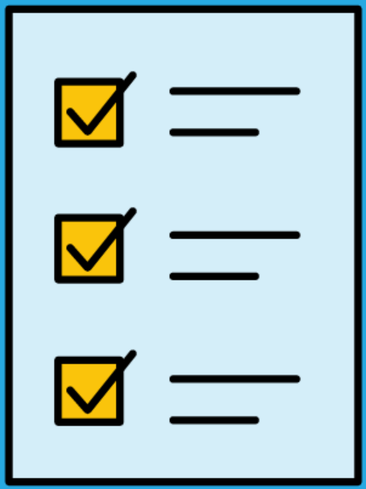
TODAY, WE WILL:

- Provide an overview of traditional and machine learning campaign measurement techniques
- Share how each traditional technique performed in a head-to-head comparison with machine learning
- Help you determine if you’re accounting for all of the right variables



CAMPAIGN MEASUREMENT TECHNIQUES

TRADITIONAL

Household matching (Nearest-Neighbor)
Household matching (Propensity)
Inverse propensity weighting (IPW)

- Based on simple statistical models applied uniformly
- Simulates balanced test and control groups to estimate group-wise counterfactual

MACHINE LEARNING

NCSolutions' Measurement Methodology

- Computationally robust for large, complex data sets
- Understands that data is not one-size-fits-all
- Estimates counterfactual for individual observations

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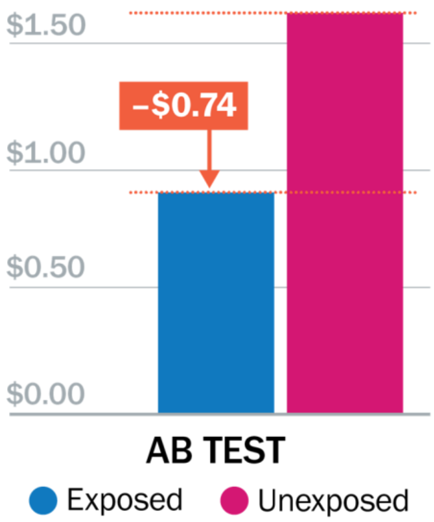
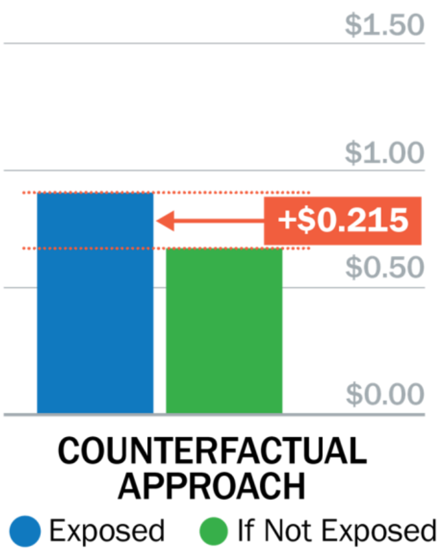
WHY PREDICTIVE MODELING?

Simple
A/B testing
does not capture
true effect





COUNTERFACTUAL
uses a
What-If MODEL
to estimate
true effect

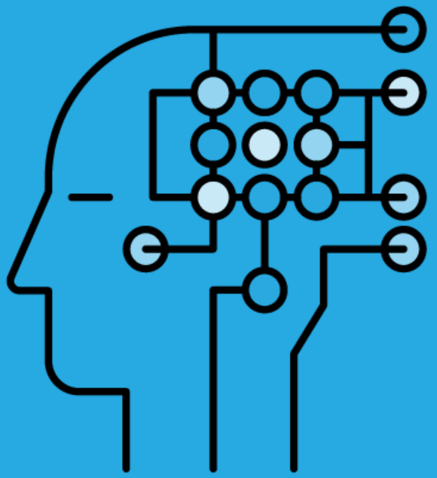
HOW DOES MACHINE LEARNING COMPARE TO TRADITIONAL METHODS?

MEASURES:

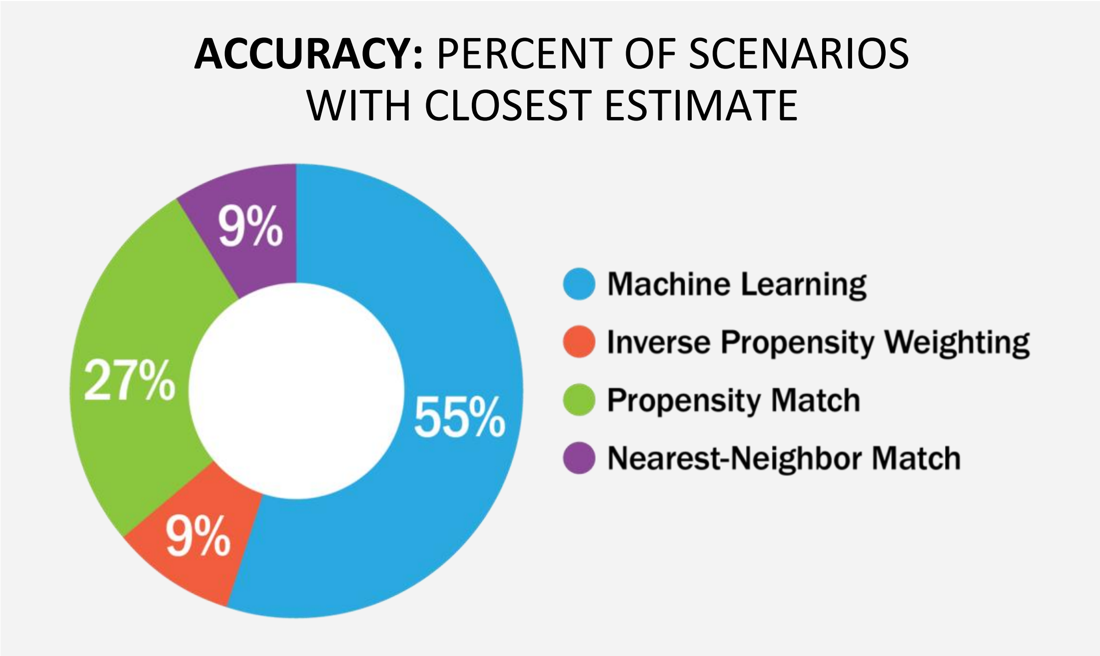
1. **ACCURACY:** percent of experiments where the method was closest to the true effect
2. **VALIDITY:** percent of experiments where the true effect was in the 80% confidence interval
3. **POWER:** average width of the confidence interval

APPROACH:

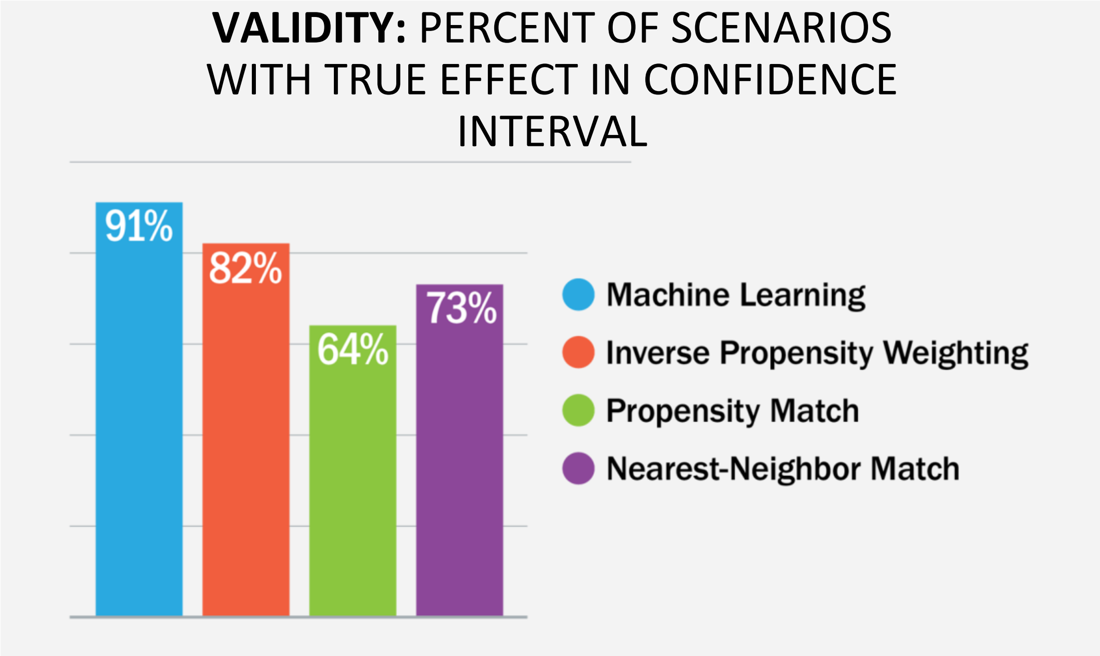
- 11 experiments
  - Real observational input data across CPG departments
  - Simulated brand purchase with a known true effect



MACHINE LEARNING OUTPERFORMS ON ACCURACY



MACHINE LEARNING GIVES VALID ESTIMATES MOST OFTEN



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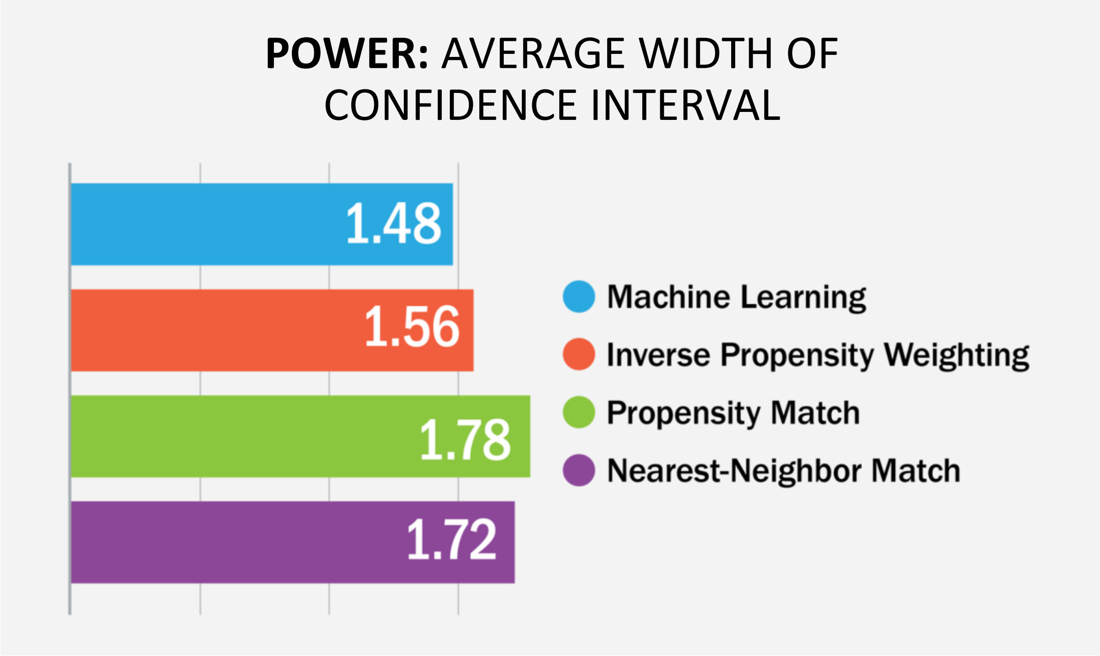
MACHINE LEARNING IS MORE STATISTICALLY POWERFUL



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ML vs. RCTs

In tightly controlled experiments, randomized controlled trials (RCTs) are considered very accurate.

(These are costly, and not always feasible)

APPROACH:

- Ran both RCT & ML analysis
- 4 technicians created test-control groups on real, limited data
  - Given 250,000 HH, not all needed to be used
- Applied the same outcome function to each, depending on a larger set of variables

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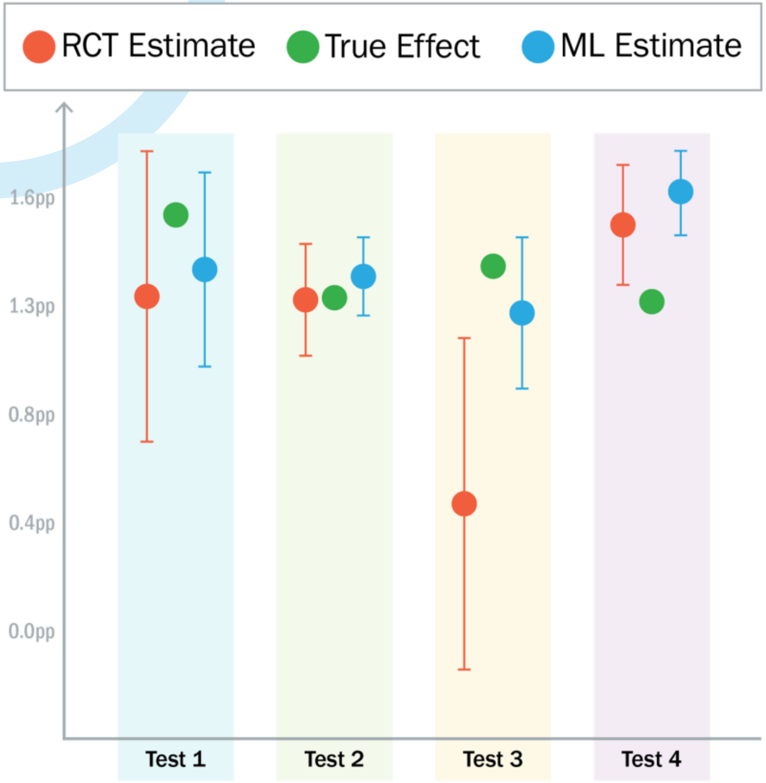
HEAD TO HEAD: ML VS. RCT



- Both ML and RCT are **ACCURATE**
- Both methods are generally **VALID**
- ML is **MORE POWERFUL**
- Test 3 had very small control group relative to the total population
  - Control = 12,864
  - Test = 24,000
  - RCT **ACCURACY** requires large test AND control populations

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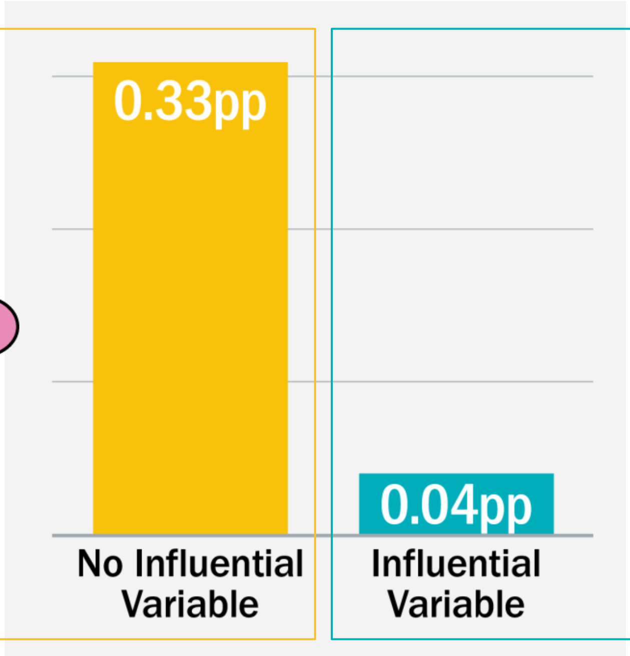
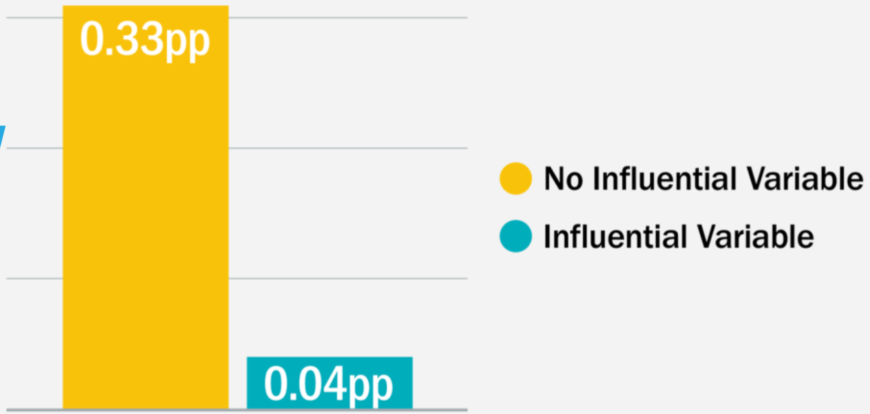
HOPPING INTO INSIGHTS



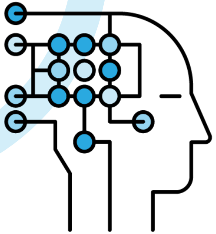
ACCOUNTING FOR ALL OF THE RIGHT VARIABLES

IMPACT OF LEAVING OUT AN INFLUENTIAL VARIABLE



ROBUST DATA IS CRITICAL FOR ANY MEASUREMENT TECHNIQUE TO BE SUCCESSFUL WITH MORE ACCURACY

TAKEAWAYS & BEST PRACTICES



MACHINE LEARNING IS A PROVEN APPROACH TO MEASURE ROI

- Accurate, valid and powerful
- Reliable and a great alternative to RCTs

MACHINE LEARNING BENEFITS:

- Versatile, agile and applies the right models
- Faster and offers more precision and granularity
- Supports smaller brands and smaller campaigns

QUESTIONS TO ASK:

- Is the data robust and informative for the questions you are asking?
- Are the sample populations large enough?
- Are the methodologies provably accurate, valid and powerful?
- Are your sales lift results driving and informing your strategic decisions?

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THANK YOU!

CONNECT WITH US:

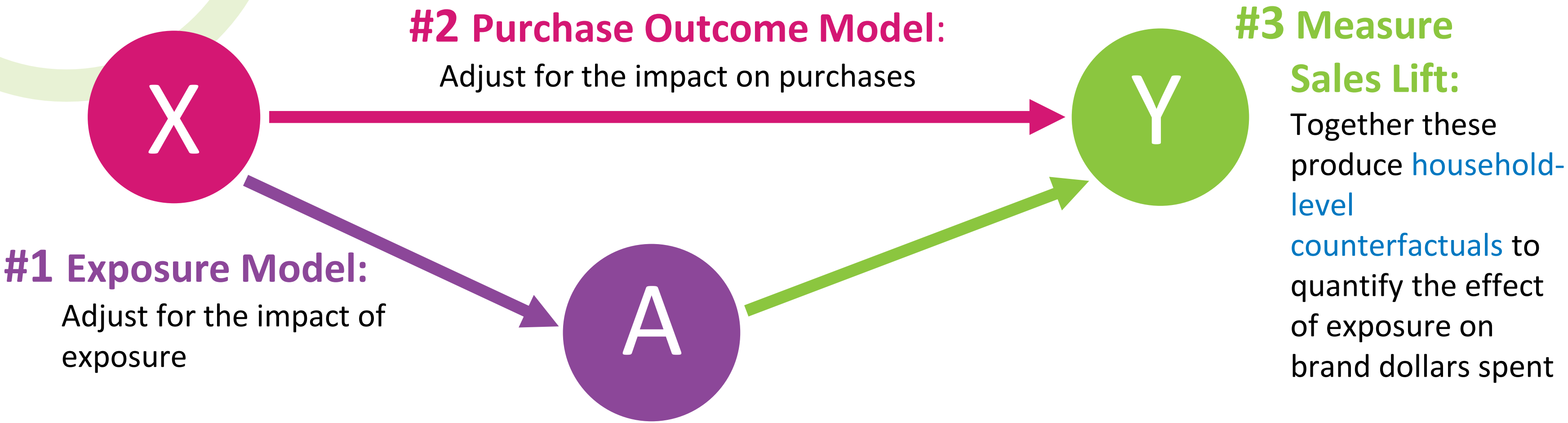
Learn how NCS Next Gen machine learning measurement can help your outcomes:

- Faster Results
- Flexible
- Actionable
- Precise Insights

SCAN ME

APPENDIX

MACHINE LEARNING NEXT GEN CAUSAL FRAMEWORK: POWERED BY *SUPERLEARNERS*



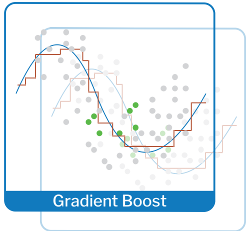
X = Variables (i.e., HH demos, previous category and brand buying, etc.)

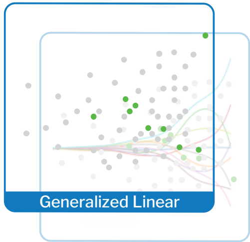
A = Ad Exposure (i.e., Targeting)

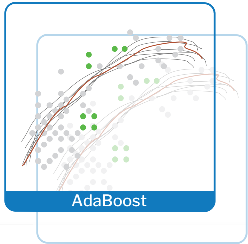
Y = Outcomes (i.e., Brand Dollars Spent)

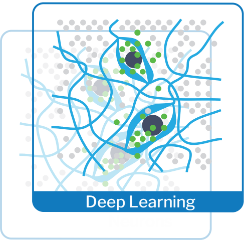
WHAT IS A SUPERLEARNER?

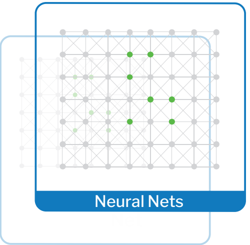
Step 1: Builds many different models
Step 2: Narrows them down based on a loss function
Step 3: Combines them into one ensemble model

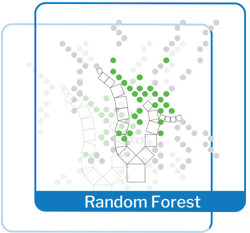

Gradient Boost


Generalized Linear


AdaBoost


Deep Learning

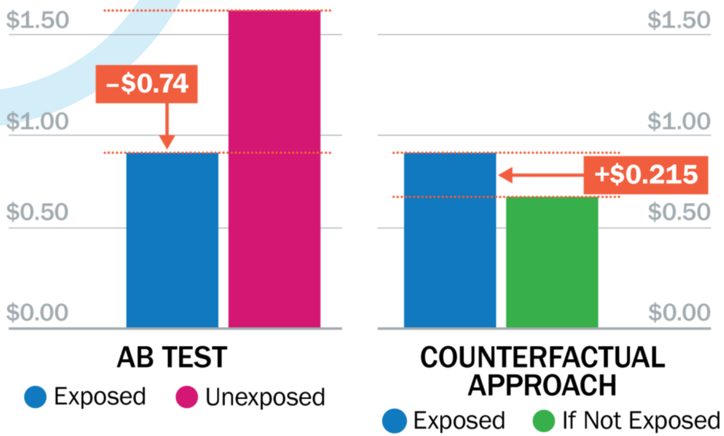

Neural Nets


Random Forest

SuperLearner - Built with Robust Statistics

HH with Lift

WHY PREDICTIVE VARIABLES?



Exposed?	Real Brand X $	Brand X $ (if unexposed)
Yes	$1.19	$1.00
No	$2.25	—
No	$1.00	—
Yes	$0.59	$0.35

SAMPLE OUTCOME FUNCTION

```
def prob(banner, pce,income,disc, hhsize, femage, gender, poc, csqty, catquart, popre,exposed):
    if pce == 1:
        if banner == 60:
            p0 = 0.005*income**0.5 + 0.15*disc*popre/4 +0.2*gender+ 0.1*poc + 0.05*hhsize - 0.1*((femage-2)**2-(
                + 0.08*exposed*(1-0.1*hhsize+0.3*gender+0.2*poc)
        elif banner == 19:
            p0 = 0.007*income**0.5 + 0.02*disc +0.2*gender -0.05*poc + 0.3*hhsize*popre/7 - 0.03*((femage-2)**2-
                + 0.1*exposed*(1+0.05*hhsize+0.3*gender+0.1*poc)
        else:
            p0 = 0.005*income**0.5 + 0.08*disc*hhsize/6 +0.2*gender+ 0.07*hhsize - 0.07*((femage-3)**2-0.5) +0.0
                + 0.07*exposed*(1+0.05*hhsize+0.3*gender+0.1*poc*catquart/4)
    elif pce == 0:
        if banner == 60:
            p0 = -0.3 + 0.001*income**0.5 + 0.1*disc  + +0.05*hhsize - 0.01*popre/10 + 0.01*poc + 0.06*exposed*(
        elif banner == 39:
            p0 = -0.3 + 0.01*np.log(np.max([income,1])) + 0.1*gender + 0.1*disc*hhsize  + 0.05*poc - 0.03*femage
                + 0.06*exposed*(1+0.05*hhsize+0.2*gender+0.5*disc)
        else:
            p0 = -0.3 + 0.005*popre/10+ 0.01*income**0.25 + 0.1*gender*(1+0.5*disc) + 0.12*hhsize - 0.1*((femage
```