Welcome to Unifying Data Science!

Nick Eubank

Three Goals of the Course

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   Causal Inference

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2. Understanding how different approaches to data science relate to one another, and know when to employ different toolsets.
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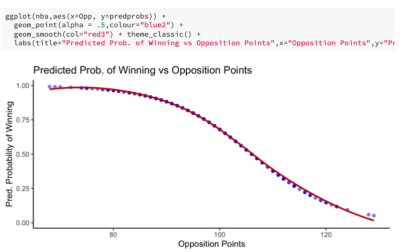
   The "Unifying" in Unifying Data Science
3. Execute a data science project from conception to delivery
   Complete with step-by-step models

Part One: Causal Inference

Modeling and Representation of Data



You learned a *lot*:

- Model selection
- Interpreting BIC, AIC, AUC, R-squared
- Residual Plots

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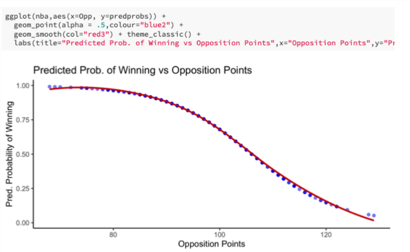

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$\Rightarrow$ Develop model to faithfully represent patterns in the data

Causal Inference

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- Does that imply that more advertising would increase spending further?

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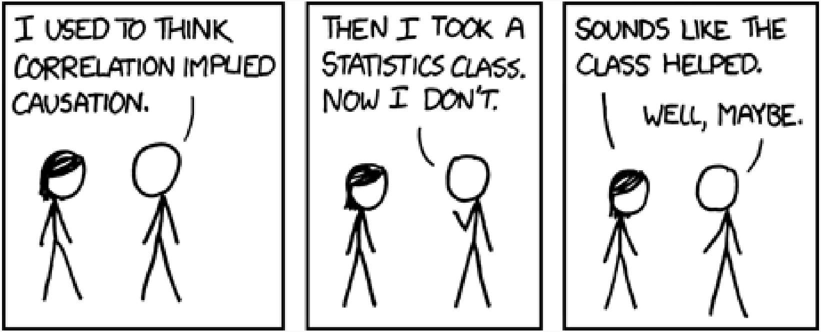
$\Rightarrow$ Given those models, what can we conclude **about the world**?

Suppose we find a correlation between car advertising and consumer spending across neighborhoods in North Carolina.

- Does that imply that more advertising would increase spending further?
  In other words, based on this model, do we think advertising is *causing* more consumer spending?

Causal Inference

Correlation does not imply causation


I USED TO THINK CORRELATION IMPLIED CAUSATION.
THEN I TOOK A STATISTICS CLASS. NOW I DON'T.
SOUNDS LIKE THE CLASS HELPED.
WELL, MAYBE.

Causal Inference

Does advertising cause increased consumer spending?

Causal Inference

Does advertising cause increased consumer spending?

- “Well, correlation does not imply causation, so I can’t say.”

Causal Inference

Does advertising cause increased consumer spending?

- “Well, correlation does not imply causation, so I can’t say.”
- “Well, correlation does not imply causation, *but* yea probably.”

Causal Inference

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By learning the *assumptions* that are required for a correlation to be a good estimate of a causal effect, you can:

- Evaluate whether those assumptions are likely to be met,
- Come up with different research designs whose assumptions *would* be met.

Causal Inference

Modeling

Developing Model to Faithfully Represent Data

$\Downarrow$

Inference

Interpreting Model Parameters

Causal Inference

Modeling

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Inference

Interpreting Model Parameters

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- *Fundamental Problem of Causal Inference*

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- *Fundamental Problem of Causal Inference*

Causal inference is unavoidably about:

- Critical thinking
- Case knowledge

Causal Inference

After introducting Potential Outcomes, we'll explore a range of causal research techniques:

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$\Rightarrow$ Each of these designs will provide causal estimates if certain assumptions are met,

- But it will always be is up to you, the researcher, to evaluate whether those assumptions are reasonable!

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- Understand why causal inference is hard,

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- And develop research designs to answer those questions.