BIASED DATA IN MACHINE LEARNING:
USING POLICE RECORDS TO TRAIN PREDICTIVE POLICING MODELS

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CARE conference
August 6, 2016
Machine learning models / algorithms

- logistic regression
- random forest
- k-means clustering
- support vector machines
- neural nets
- reinforcement learning
- generalized linear model
- nearest neighbors
- deep learning
- boosting
- ensemble models
- principal components analysis
- kernel density estimation
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Ways to learn patterns & structure in data

**Which model you pick defines how you learn the patterns and the types of patterns we can learn.**
Machine learning example
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What is your data measuring?

• Unless you have a complete census or a random sample (with known sampling weights) from the population of things you are trying to measure…
  • Data collected about Z is **not** a measurement of Z; It is a measurement of a complex interaction between Z and your ability to observe or record Z.

• Examples:
  • Data on reported fraud is measuring the interaction between a firm’s committing fraud and {the willingness of employees at that firm to be whistleblowers, regulatory agencies’ institutional priorities in the year fraud was committed, etc.}
Predictions

• Predictions using a model trained on Z are predictions about the future value of Z:
• In this case:
  • Models trained on observed fraud data make predictions about where fraud will be observed in the future.
  • Models will help you find the types of fraud you would have found anyway.
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Finding crime you wouldn’t have found otherwise?
Why do we think police records are not representative?

- Decades (maybe centuries) of criminological research
- Data from the National Crime Victimization Survey (NCVS) indicates that reporting rates vary substantially by demographic group, meaning that some crimes are more likely than others to be reported to police based upon who was victimized.
- Crimes that are committed in areas that are highly patrolled by police are more likely to be discovered by police than those committed in less patrolled areas.
- While white and black populations use marijuana at similar rates, blacks are arrested for marijuana possession at a rate several times that of whites.*

Drug Crimes in Oakland, CA

All drug crimes in Oakland PD data from 2009-2011

Estimate of drug use based on NSDUH [1] and detailed US Census data [2]

Drug Crimes in Oakland, CA

All drug crimes in Oakland PD data from 2009-2011

Ratio

Applying predictive policing

- The algorithm directs additional policing to the over-policed areas.
- Biases that previously existed in the police database are confirmed.
- Minority and low-income communities receive a disproportionate amount of targeted policing.
Simulating an alternative scenario

- We assume that sending targeted policing to an area results in a slight increase in the number of drug crimes discovered by police.
- Biases in the data are *amplified.*
- Minority and low-income communities receive a disproportionate amount of targeted policing.
A real example

Figure from Mohler et al., JASA 2015

training data  human predictions  machine learning predictions
A real example

machine learning predictions
Summary

- Crime is everywhere, and police data on crime is not representative of all crime.
- Biased data leads to biased predictions in any machine learning algorithm—predictive policing included.
- Predictive policing reproduces the biases that already exist in the police data in a much more precise and targeted way.
- If increased targeted policing leads to an increase in the number of arrests, targeted policing will magnify pre-existing biases.
- Because of the biases in the existing police data, predictive policing will disproportionately affect historically over-policed communities.
- There is no way to assess whether this is happening using police data—needs human judgment to find such issues.
Thanks!
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