Cornell Bowers C·IS
College of Computing
and Information Science

Machine Learning Variance, Arbitrariness, and Due Process

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Presenting work in collaboration with
Madiha Zahrah Choksi (Cornell Tech), **Solon Barocas** (Microsoft Research & Cornell),
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https://cacioepe.pe

https://arbitrar.ai

ML does not remove unwanted variability

Recent legal literature claims ML will remove the “noise” of human decision-making

E.g., **“Governing by Algorithm? No Noise and (Potentially) Less Bias” (Sunstein)**

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A similar problem of instability can be seen in ML when we analyze **statistical variance**

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A similar problem of instability can be seen in ML when we analyze **statistical variance**

We show

how statistical variance can be interpreted as **arbitrariness** in ML

why this type of arbitrariness is important for legal analyses of ML rules, technological due process, and a few other things (to be scoped out)

An intuition for arbitrariness

Training 10 different logistic regression models on COMPAS using bootstrapping

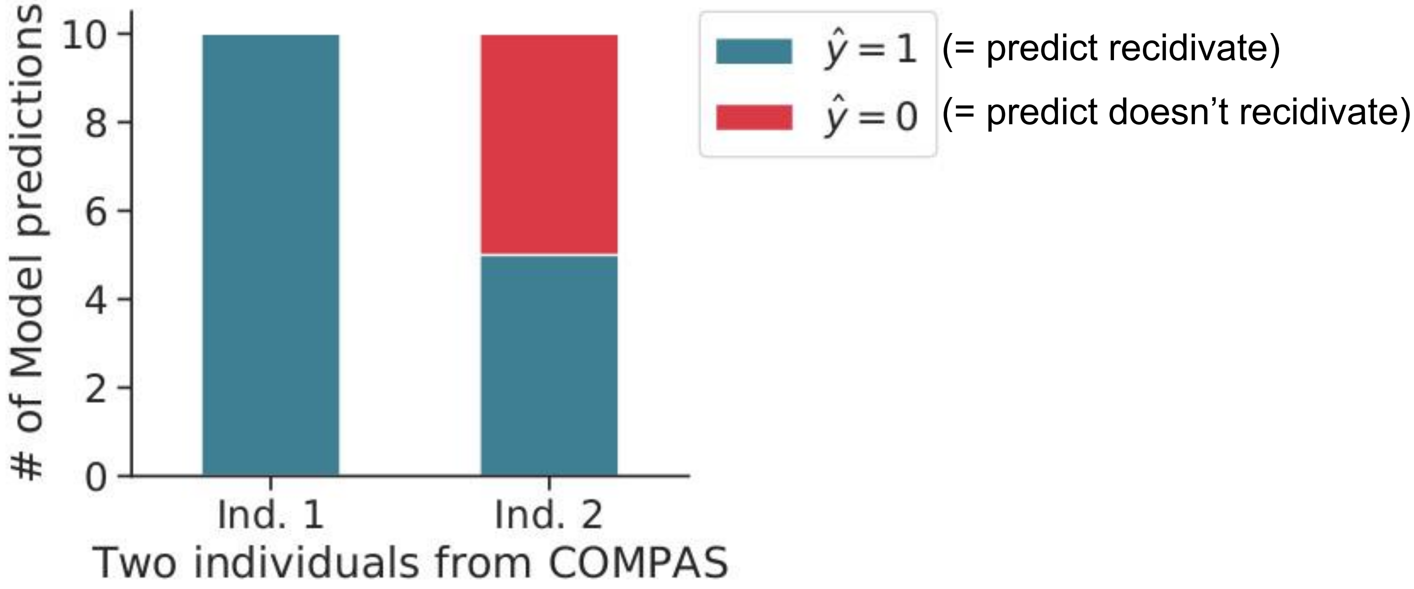
(Dataset used to predict whether or not a person will recidivate)

An intuition for arbitrariness

Training 10 different logistic regression models on COMPAS using **bootstrapping**

(split into train/test sets)
(resample train set)

An intuition for arbitrariness



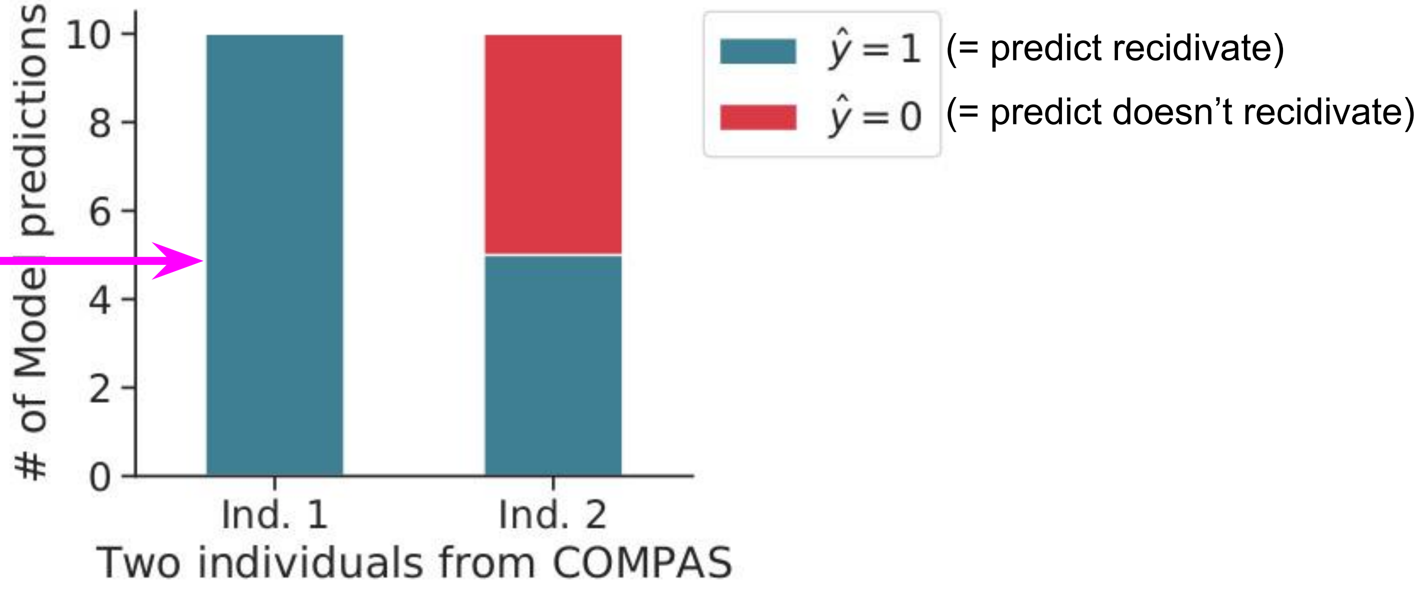
Training 10 different logistic regression models on COMPAS using bootstrapping

Looking at the resulting predictions for 2 individuals in the test set (not used in training)

An intuition for arbitrariness

Learning process is **really confident**

All 10 models predict the same outcome for Ind. 1



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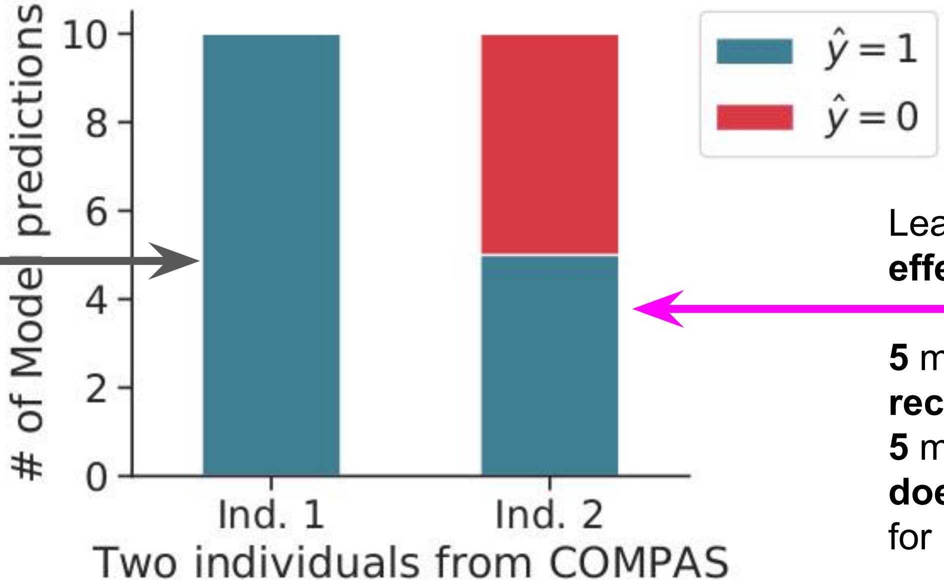


(= predict recidivate)
(= predict doesn’t recidivate)

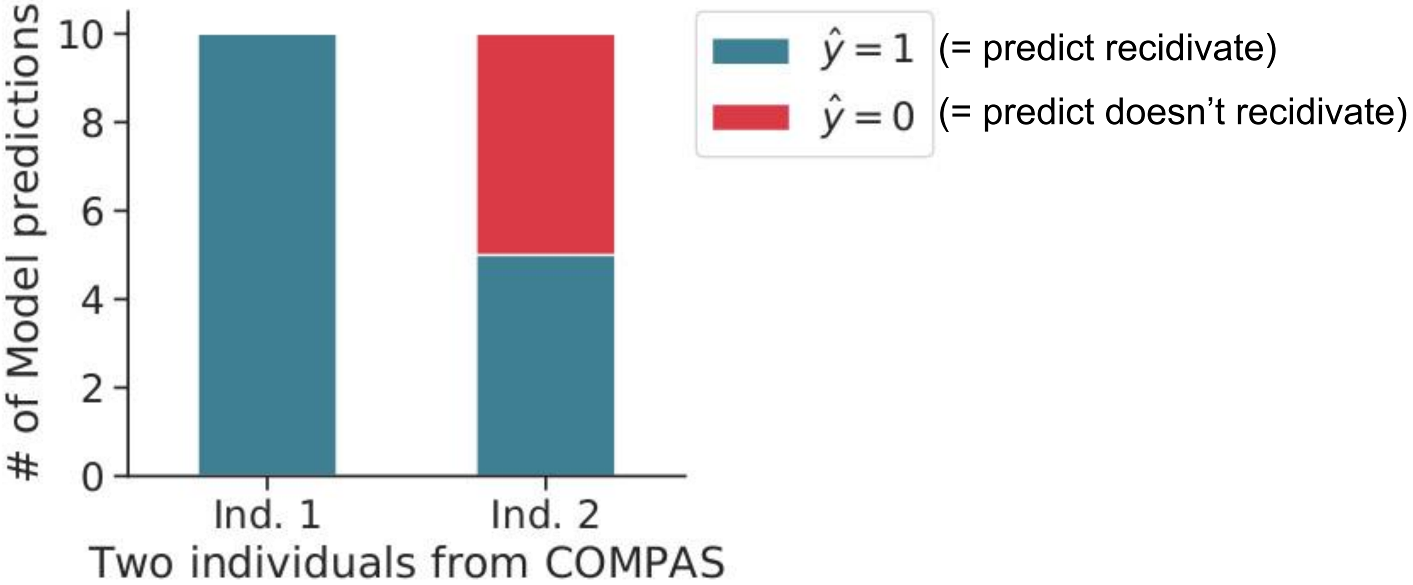
Learning process is
effectively random

5 models predict
recidivate,
5 models predict
does not recidivate
for Ind. 2

Training 10 different logistic regression models on COMPAS using bootstrapping

Looking at the resulting predictions for 2 individuals in the test set

What does this mean for the law?



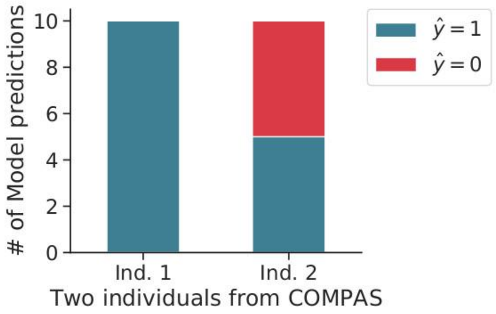
The randomness that leads to these results **is a feature of ML**

We need to change how legal and regulatory work talks about randomness

Non-determinism

Non-deterministic

Supplying the ***same*** inputs can produce ***different*** outputs.



Reasoning about *distributions over outcomes*

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(where the single rule is influenced by non-determinism in training)

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We will think about **distributions**

over **possible models** with different **deterministic decision rules**

(where the distribution of rules is influenced by non-determinism in training)

ML randomness in the legal literature

In a **single model**, randomness can cause a **deterministic decision rule**

to (nevertheless) **always** produce the **same output** for the **same input**

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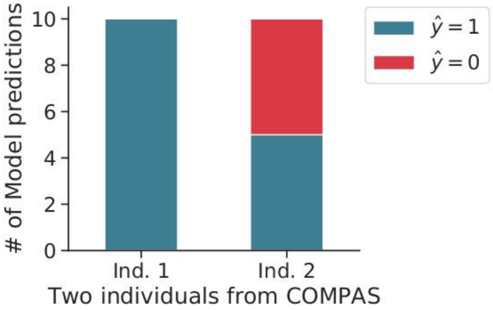

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"Small Change Makes a Big Difference" (Bambauer, et al.)

"Treat like alike" (TLA) principle (which has various critiques in the law)

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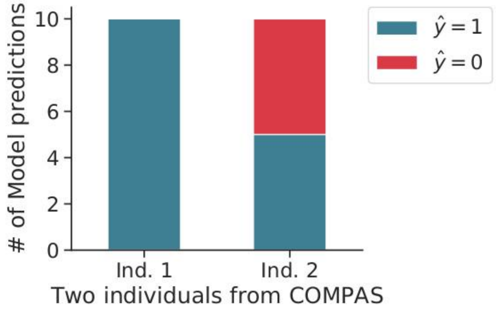

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In a **single model**, randomness can cause a **deterministic decision rule**

to appear "**unpredictable**," "**unconstrained**," or "**unreasonable**"

"The Algorithmic Leviathan" (Creel and Hellman)

"To the extent that an algorithm governs the decision, it will produce the **same result when run on the same inputs**. If the algorithm contains a degree of **randomness** within it, ... it is **still reproducible** at a higher level of abstraction"

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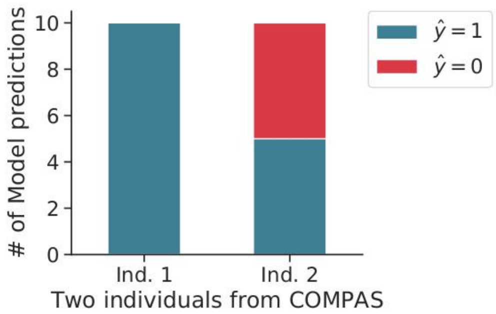

Future analysis using this frame

Understanding variance in ML…

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complicates fundamental, tacit understandings of **consistency**, **non-arbitrariness**, **predictability**, **determinacy** in the law

e.g., we can show ML rules to be ***consistently and predictably arbitrary***

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- can help provide greater precision of prior scholarship on ML and arbitrariness
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- presents under-explored implications for technological due process

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complicates fundamental, tacit understandings of **consistency**, **non-arbitrariness**, **predictability**, **determinacy** in the law

e.g., we can show ML rules to be ***consistently and predictably arbitrary***

presents under-explored implications for technological due process

suggests novel insights into when and how legal rules can break down

If you're interested in computer science results on this topic, please check out our ML paper!

(which by accident also broke fundamental, important things in fair classification & suggested serious scientific reproducibility problems in the subfield)

Variance, Self-Consistency, and Arbitrariness in Fair Classification

A. Feder Cooper [1] Solon Barocas [2 3] Christopher De Sa [1] Siddhartha Sen [2]

[Under Submission '23;

title is getting changed;

maybe please wait a week to read because I'm updating it]

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