Auto Insurance

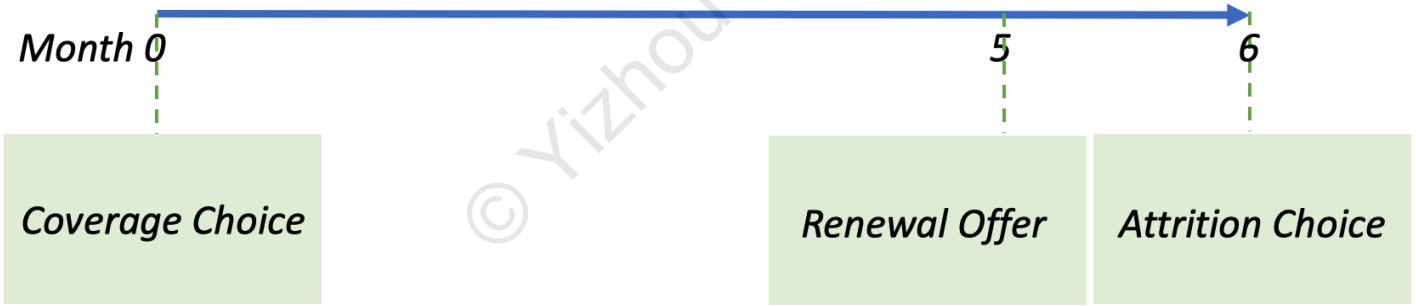
Insurance is big business. Auto is one of the largest insurance industries.

- USA: $316.2bn premiums written in 2022, more than 1% GDP
  - Private passenger + commercial (trucking/taxis…)
  - Globally: ~$700bn in 2022 but projected to reach 1.2tn by 2030 (Acumen Research)

- Traffic accidents are even more costly
  - ~1.4mn fatalities globally in 2019; ~$1tn annual loss in the U.S. (US DOT 2015)
  - US fatality rate rose by 21% in 2020 (US DOT 2021)
  - 94% of US fatalities involve risky driving (US DOT 2019)

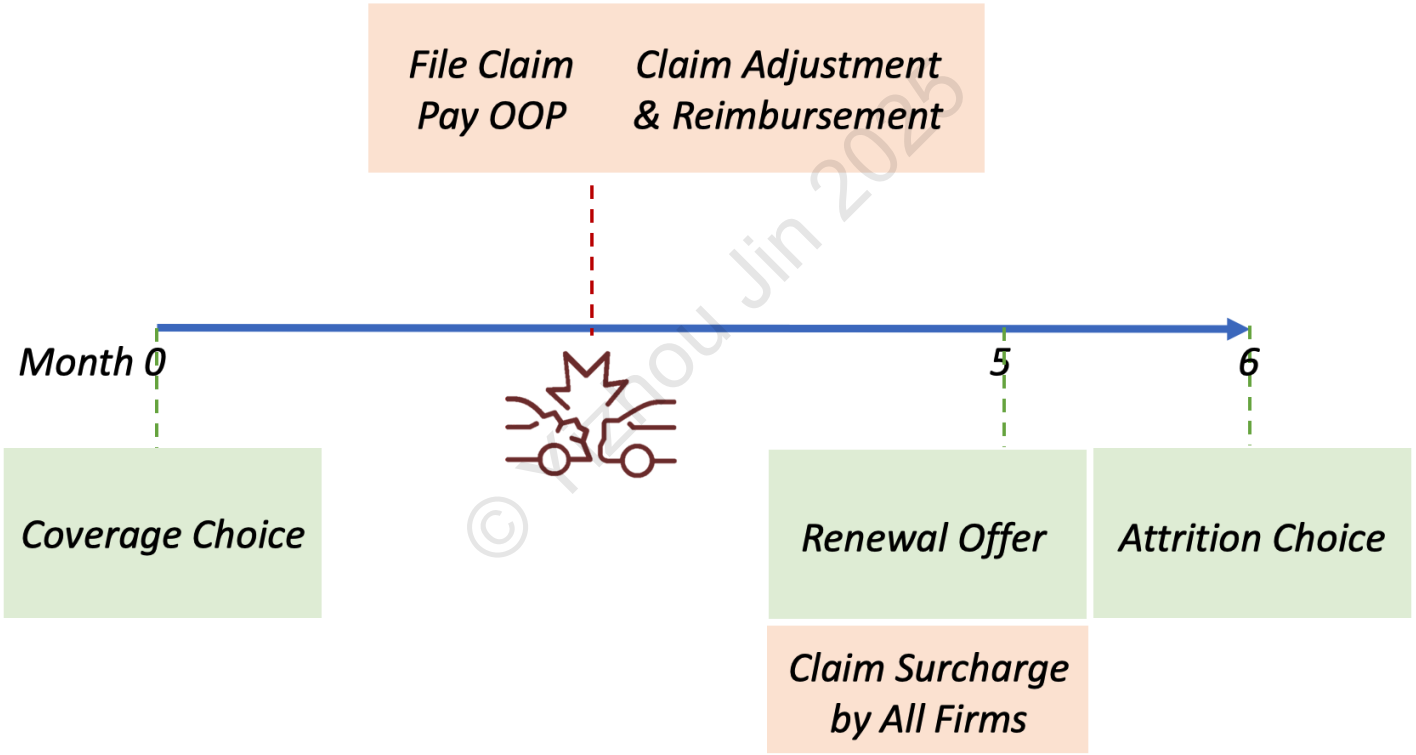
Auto Insurance

What does an auto insurance contract look like?



Auto Insurance

What does an auto insurance contract look like?

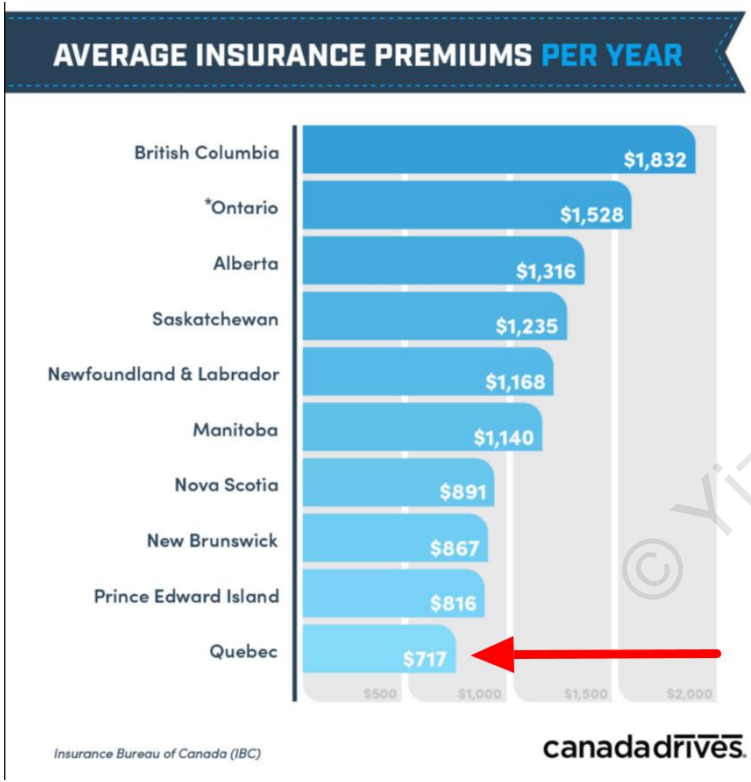


Solving Asymmetric Information

- **Risk Rating** to mitigate <u>adverse selection</u>
  - Even though the insurer does not observe risk type, there are systematic differences across observable groups
    - Old vs. Young
    - Luxury car vs. utility car
  - Segmenting the market reduces the uncertainty in insure risk
    - But often imperfect (there are always safe young drivers)
    - Raises moral issues (race/gender based discrimination can occur even if those factors are banned)

To an insurer, a product is an insurance contract sold to a particular insuree, and the "quality" of that product is the riskiness of the insuree

Auto Insurance Premiums



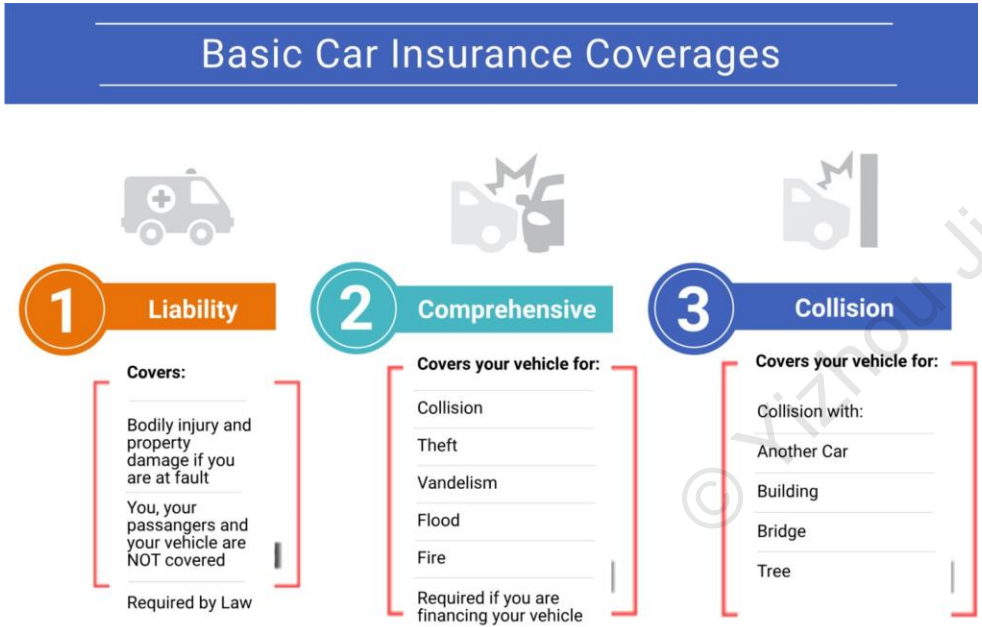
Solving Asymmetric Information

UNIVERSITY OF TORONTO

- **Limited Risk Sharing** to mitigate moral hazard
  - Instead of fully insuring drivers (*A*) against accident risk, insurers (*P*) now share some of the risk with the drivers (*A*)
    - copay: *A* pays x% of its claim
    - limits: *P* pays *A*'s claim up to $x, the rest is *A*'s responsibility
    - deductibles: *A* pays its own claim up to $x, the rest is *P*'s responsibility
  - Two types of moral hazard here:
    - Driving behavior
    - Utilization (e.g. reporting, replace vs. fix windshield)

If driver risk is, to some extent, determined by a driver's own choice of driving safely (as opposed to a fixed uncontrollable type), then moral hazard issue will arise since driving behaviors are hidden to/unobservable by the insurer

Auto Insurance Coverages



Coverage Information

Coverage	*Limits (applicable to all vehicles)*
Bodily Injury Liability	$250,000 each person $500,000 each accident
Property Damage Liability	$100,000 each accident

Limits – you'll be covered up to this amount

Coverage	*Deductible*
Comprehensive:	$1,000
Collision:	$1,000

Deductibles: you must first cover this amount out-of-pocket, and the the insurer will cover the rest

Solving Asymmetric Information

Reduce asymmetric information directly (getting more info)

- Reduce adverse selection by revealing risk types
  - there are fixed risk differences across people – how far are they commute to work…
  - Without monitoring, companies relied on odometer readings, but it is easily gameable
- Reduce moral hazard by revealing driving behaviors
  - people can be incentivized/reminded to drive better – beeping after the device detects harsh acceleration / high speed when cornering…

Usage-Based Insurance: A Disruptive Tech

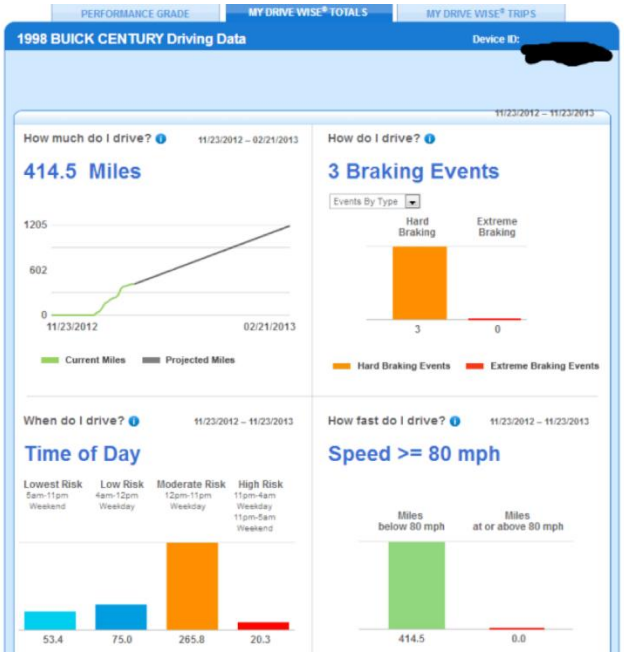
What is it?

Usage-Based Insurance: A Disruptive Tech

What is it?

Usage-Based Insurance: A Disruptive Tech

telematics technology enables pricing on how much/well you drive (vs. age etc.)

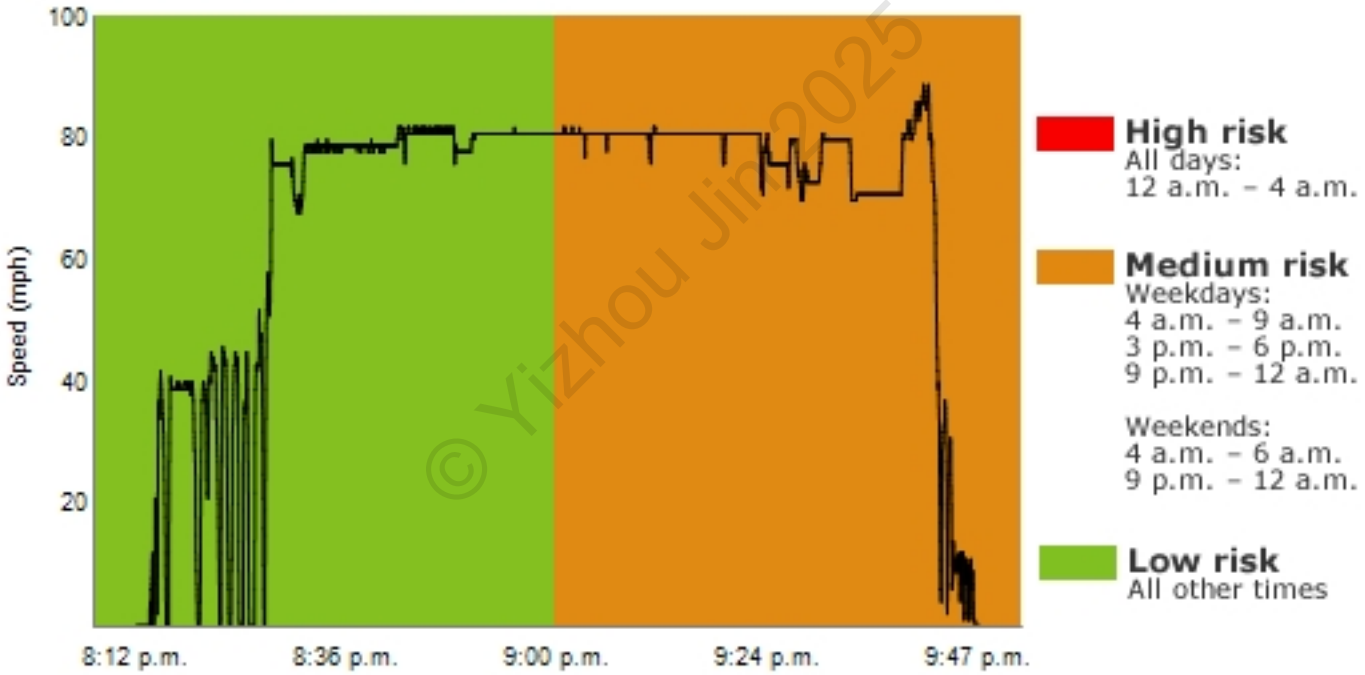


What we use to calculate your Snapshot result

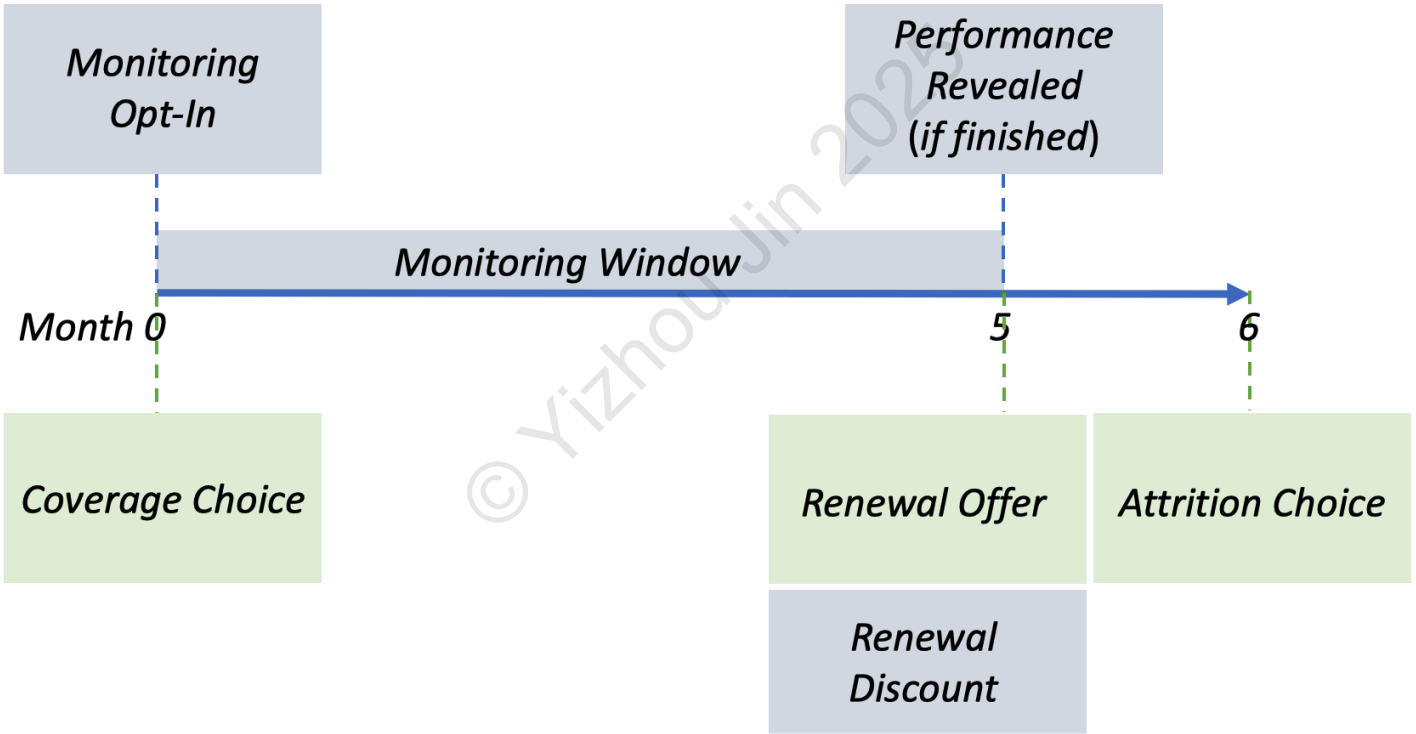
- Hard braking—Hard brakes are decreases in speed of seven mph per second or greater. Minimize hard braking to work toward a discount.
- Amount of time driven—The number of minutes that your engine is running during a trip. To earn a discount, try to minimize your time behind the wheel by combining trips, carpooling or using public transportation.
- Time and day—The number of minutes you spend driving during higher risk hours—the highest risk are between midnight and 4 a.m. on the weekends.
- Fast starts— Fast starts are increases in speed of nine mph per second or greater. Also known as "jackrabbit starts" or just "putting the pedal to the metal." Use a lighter foot on the gas pedal to work toward a discount.

Usage-Based Insurance

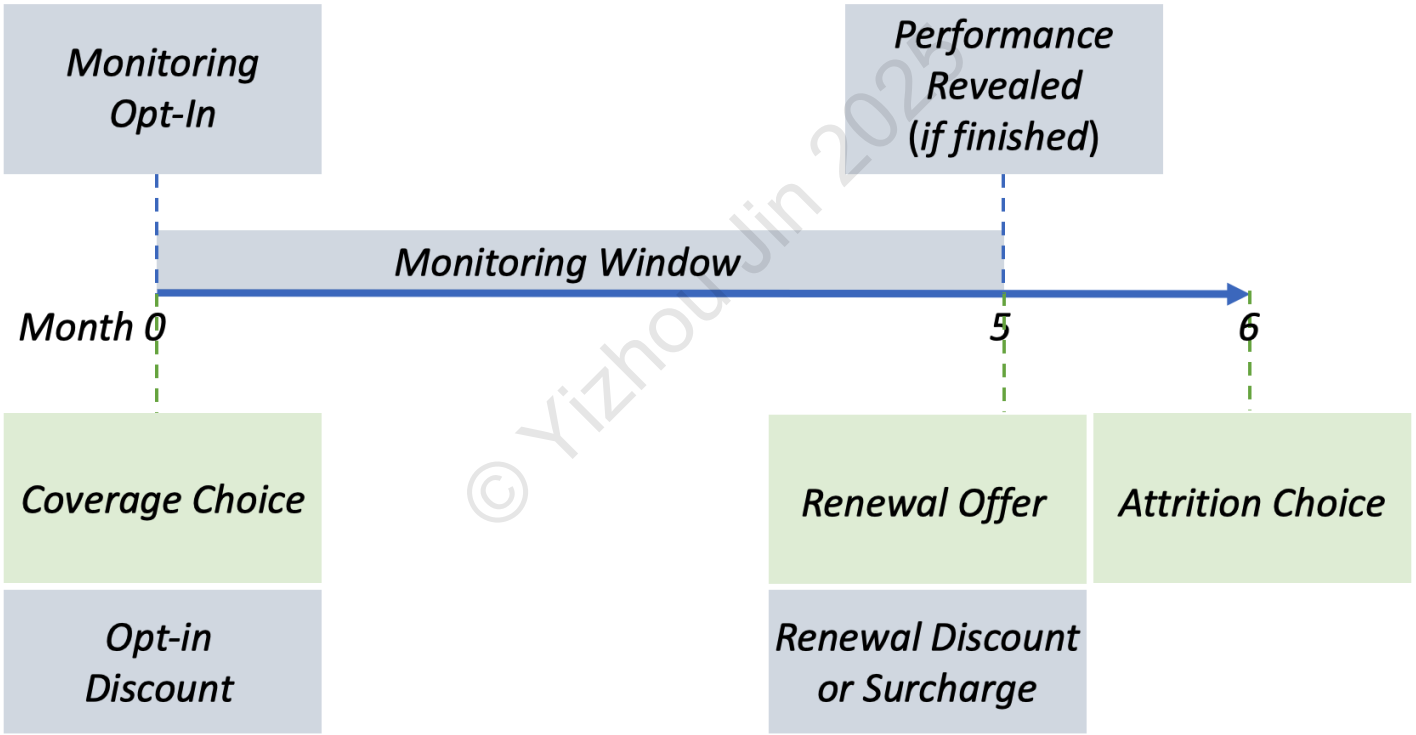
How does the technology work?



Auto Insurance (Monitoring)

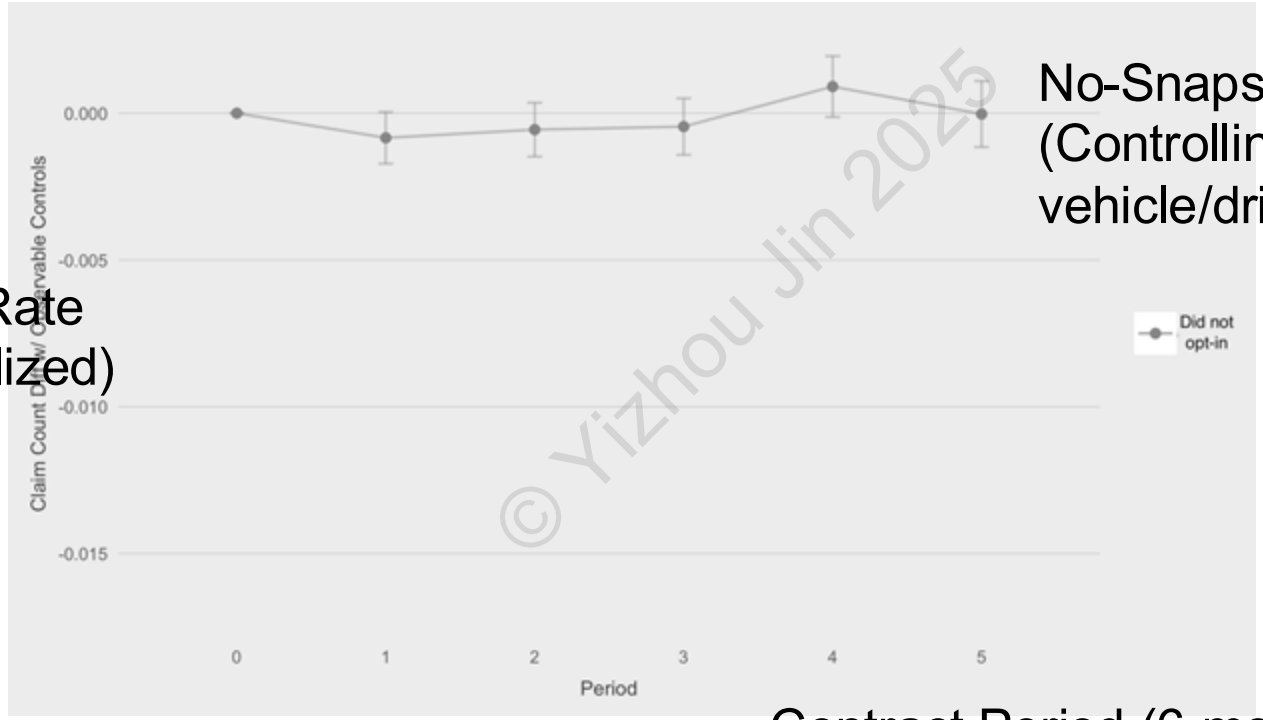


Auto Insurance (Monitoring)



My research on UBI

I worked with a UBI unit to conduct a comprehensive evaluation.



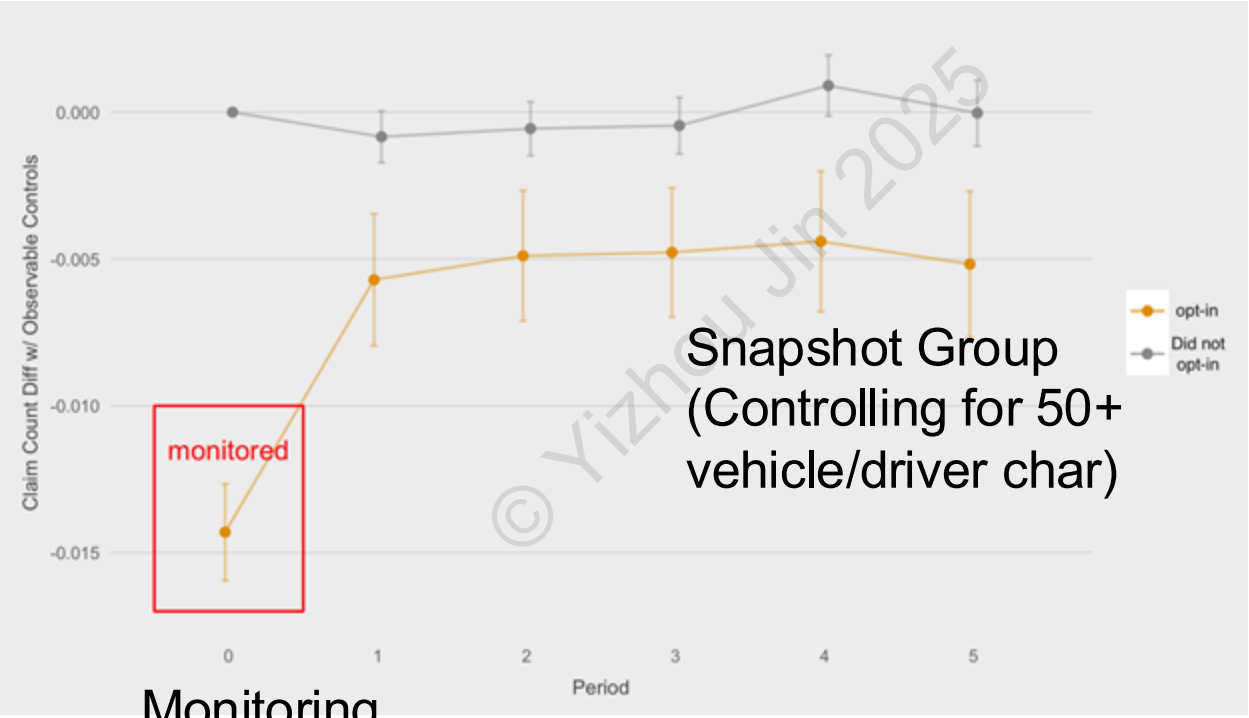
No-Snapshot Group (Controlling for 50+ vehicle/driver char)

Claim Rate (normalized)

Contract Period (6-month per period)

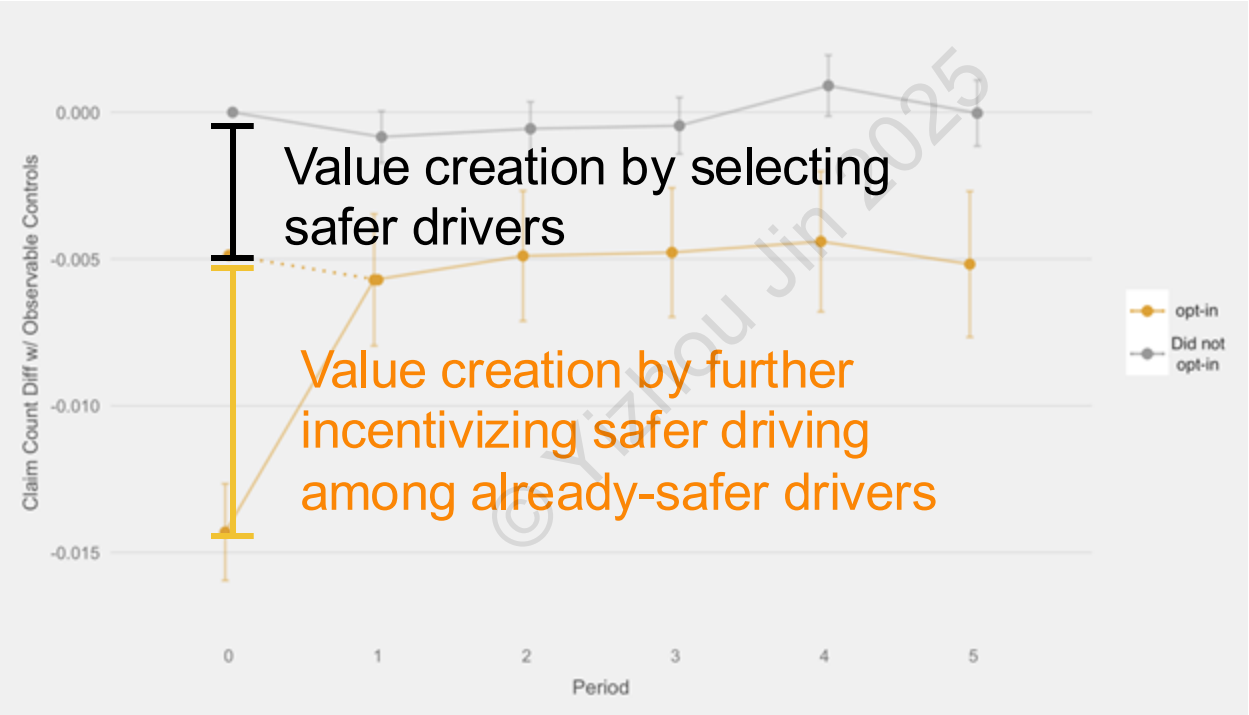
UBI as Disruptive Tech – Value Creation

New ways to create value.

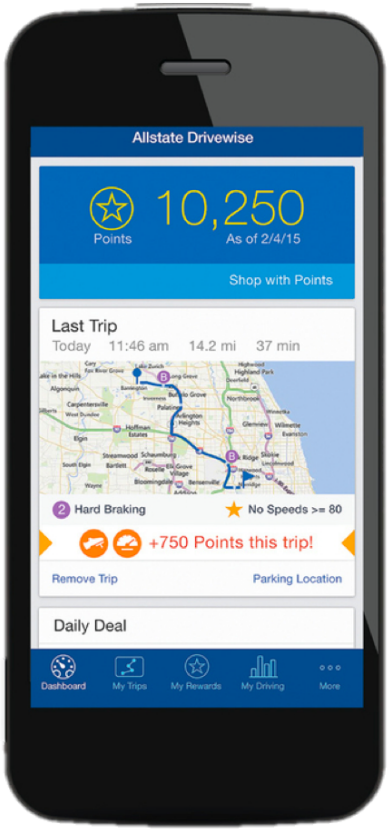


UBI as Disruptive Tech – Value Creation

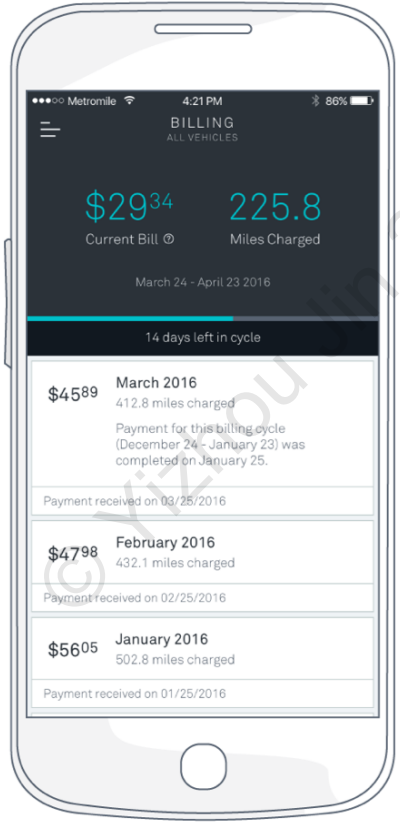
New ways to create value.



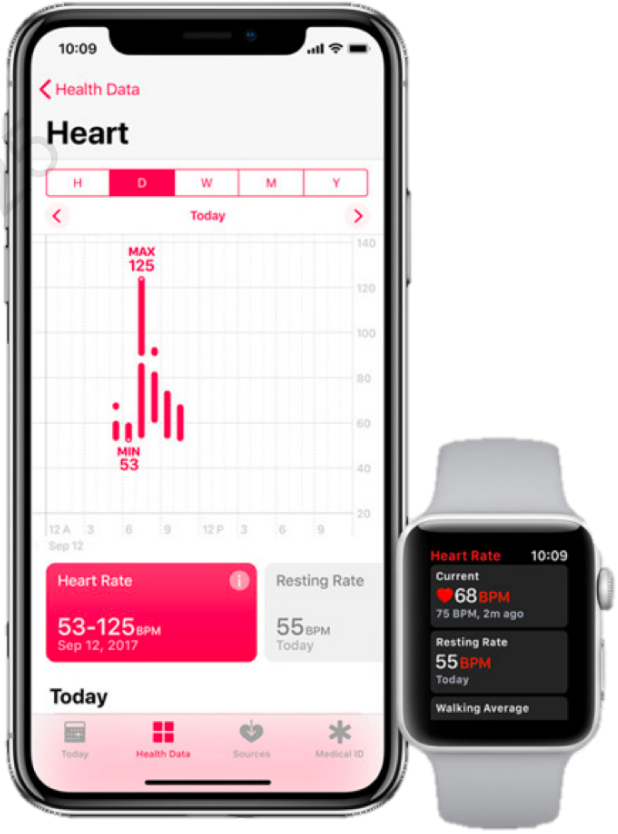
Monitoring Enabled by Smart-Phone Sensors



Allstate Drivewise



Metromile



Vitality - John Hancock Life Insurance

Full paper & slides at *YJIN.IO*

UNIVERSITY OF TORONTO

Re-examining Moral Hazard under Inattention

New Evidence from Behavioral Data in Auto Insurance

Yizhou Jin
UToronto

EC 2023
July 2023

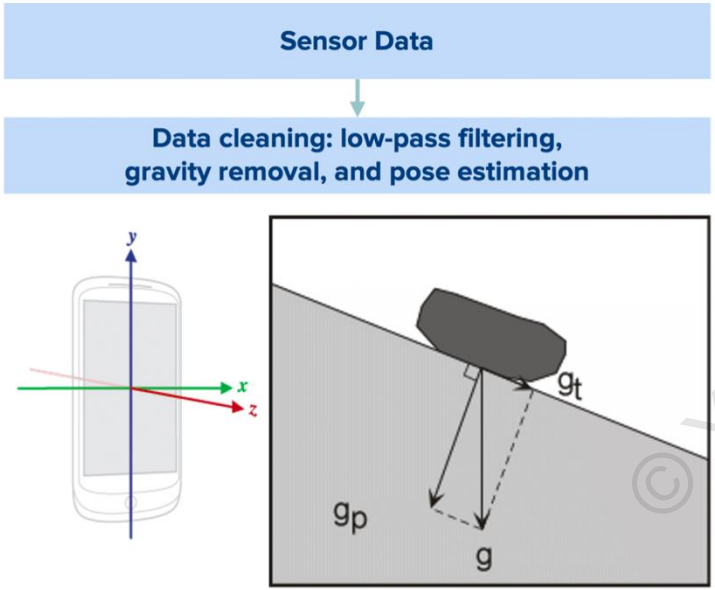
EVERYTHING AFTER THIS SLIDE IS OPTIONAL

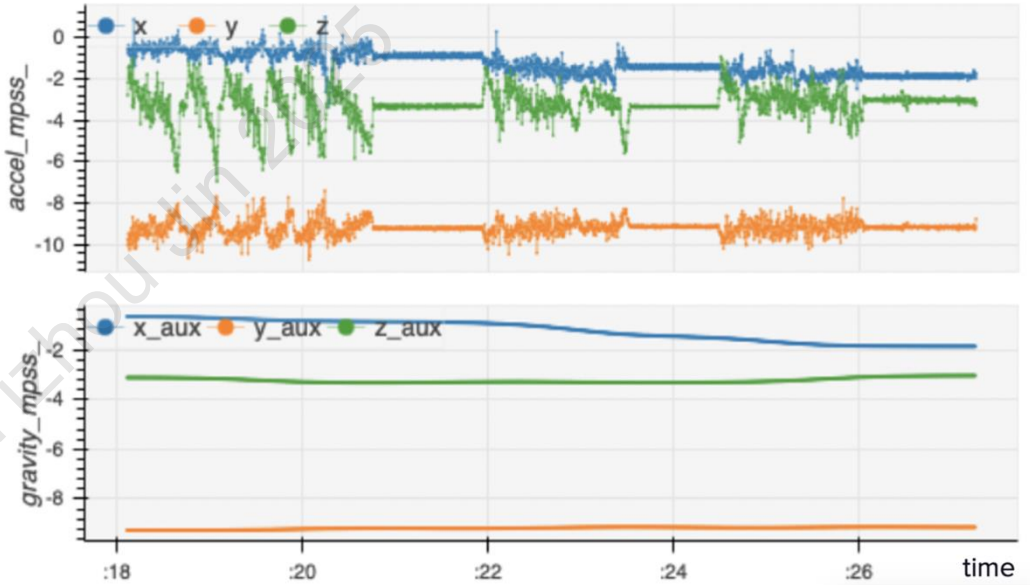
My Work at Lyft – Handheld Phone Use

Accident Prevention based on Smartphone Sensor Data

AI Algo Development

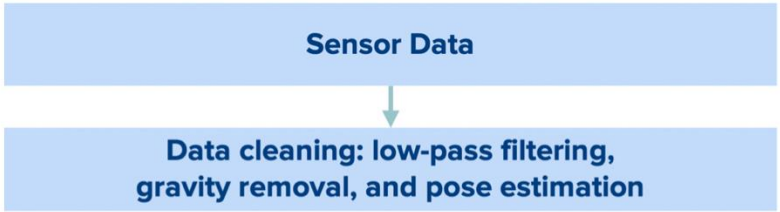
- smartphone sensor data → handheld phone use ("HPU") events

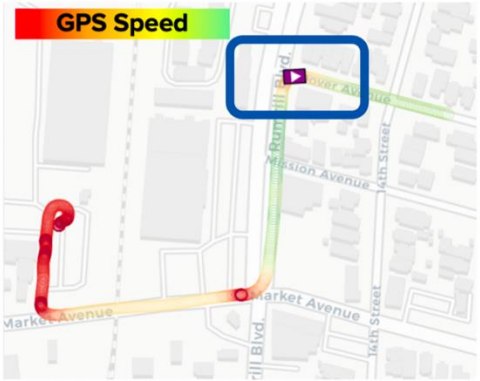


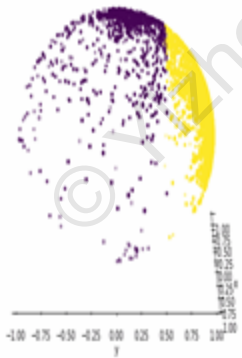


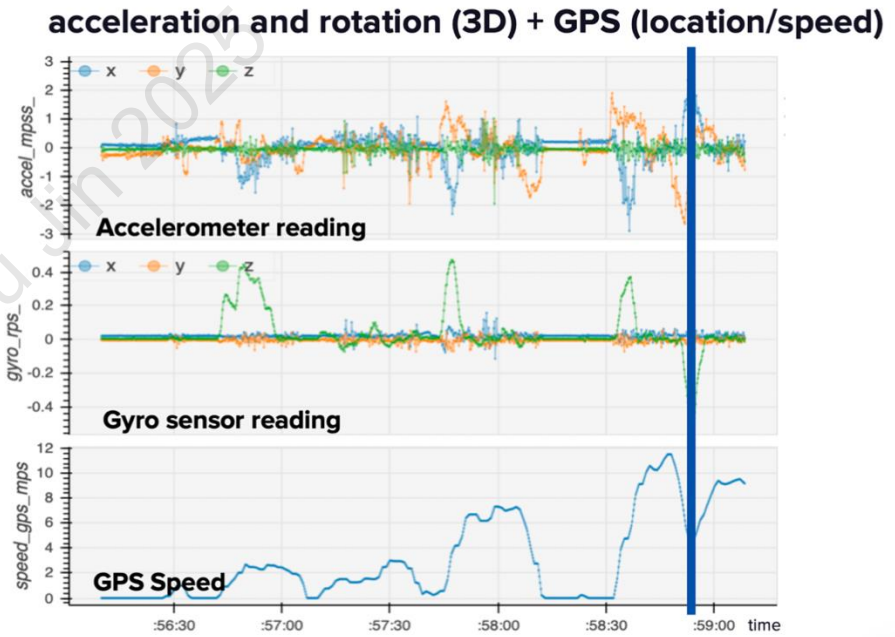
AI Algo Development

- smartphone sensor data → handheld phone use ("HPU") events









AI Algo Development

- smartphone sensor data → handheld phone use ("HPU") events

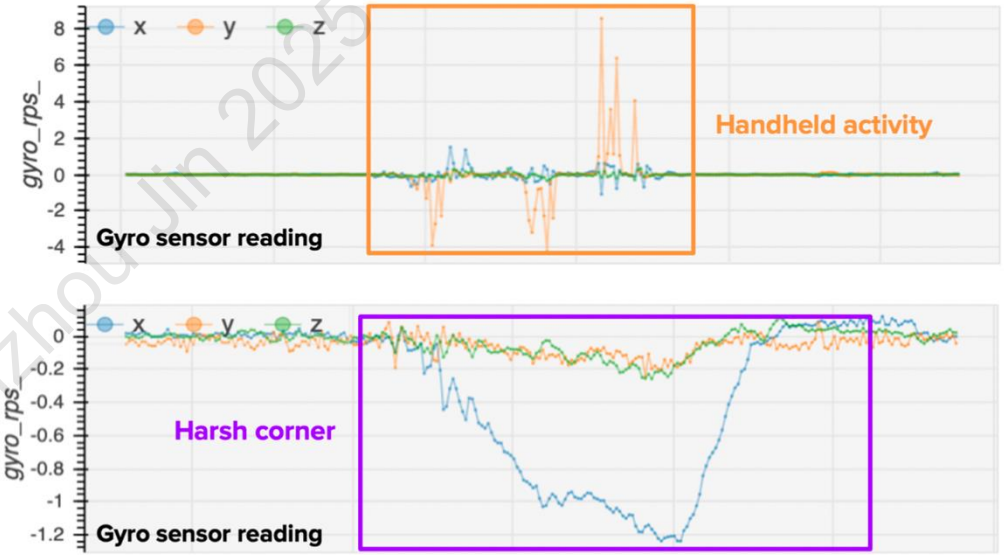
Sensor Data

↓

Data cleaning: low-pass filtering, gravity removal, and pose estimation

↓

Feature construction: abnormal sensor movement based on moment thresholds on all three sensors



AI Algo Development

- smartphone sensor data → handheld phone use ("HPU") events

Sensor Data

↓

Data cleaning: low-pass filtering, gravity removal, and pose estimation

↓

Feature construction: abnormal sensor movement based on moment thresholds on all three sensors

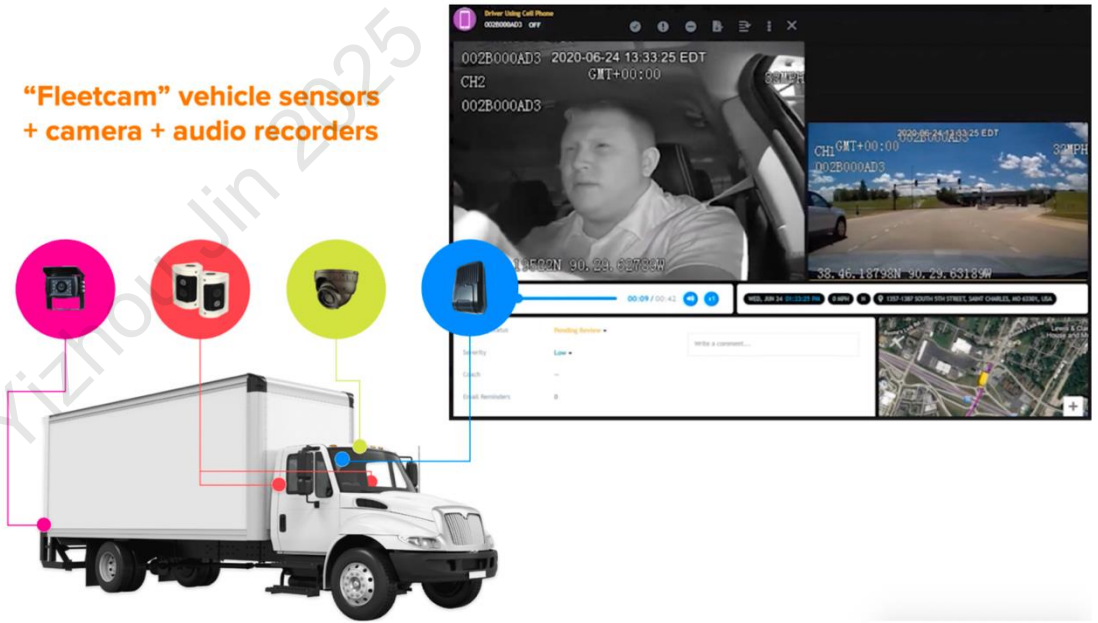
↓

Train: ML classification problem based on ground-truth training data (kNN/GBDT)

↓

Validation: model tuning based on ground-truth holdout data

"Fleetcam" vehicle sensors + camera + audio recorders



AI Algo Development

- smartphone sensor data → handheld phone use ("HPU") events

Sensor Data

↓

Data cleaning: low-pass filtering, gravity removal, and pose estimation

↓

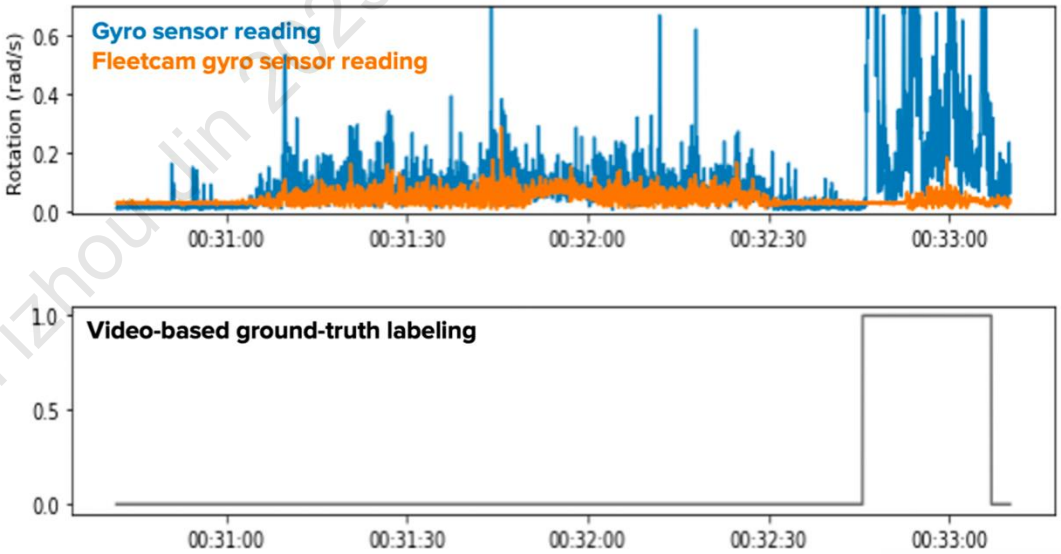
Feature construction: abnormal sensor movement based on moment thresholds on all three sensors

↓

Train: ML classification problem based on ground-truth training data (kNN/GBDT)

↓

Validation: model tuning based on ground-truth holdout data



UNIVERSITY OF TORONTO

Data & Reduced-Form Results: Is there Moral Hazard?

HPU strongly increases accident risk, but drivers do not reduce HPU when they are exposed to higher risk.

Handheld phone use ("HPU") is risky

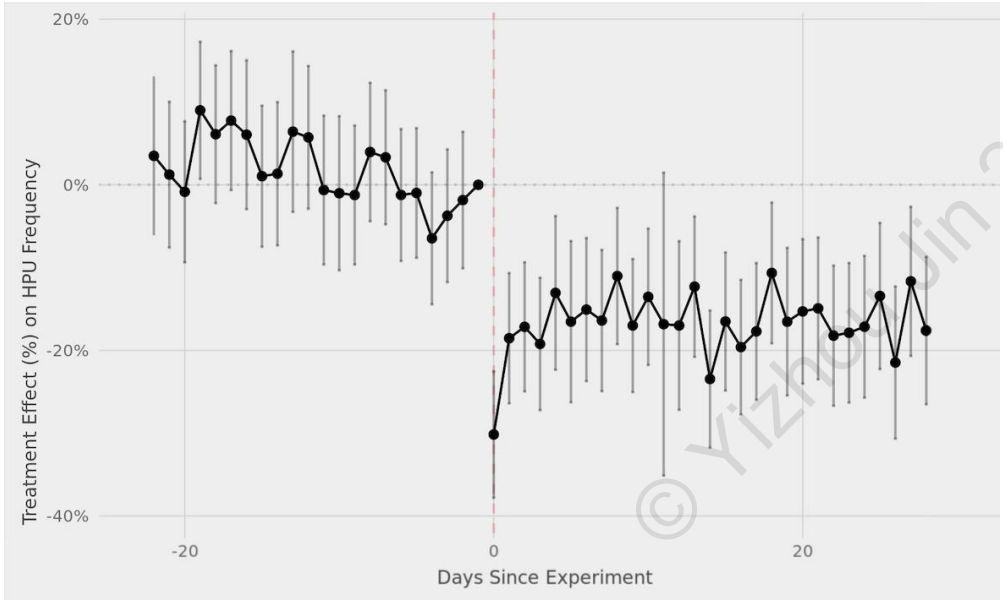
- Smartphone sensor data from self-insured ride-sharing firm
- HPU frequency jumps by 11X in the 30-second window before accidents
- Regression estimate $\Rightarrow$ + 1 second/trip HPU $\rightarrow$ + 1% accident rate

Little moral hazard w.r.t. HPU

- HPU is 38% (CI [17% 60%]) riskier in trips with rain, but only lower by 1% (IV estimate using within-trip precipitation change, CI [1% 2%])
- Insurance coverage (provided by the firm) dropped significantly in some states, but HPU did not change (synthetic control estimate, CI [-0.1 0.1]SD)

Field Experiment: Why is HPU Insensitive to Risk Exposure Changes?

Nudging RCT says the role of inattention > preference.



- treatment: one-time SMS to drivers top-5% HPU freq. (76% HPU miles)

Text Message
Today 3:30 PM

> Hi from [company]! Our app shows you may be holding your phone while driving. Passenger reports of unsafe driving, like handheld phone use, can lead to suspension. For more information, please visit link.

- 1/3 drop on the first day; weekly progression: -21%, -14%, -14%, -16%
- no detectable change in driving hours or other unsafe driving behavior
- “near-misses”/harsh braking: -8% (2%)