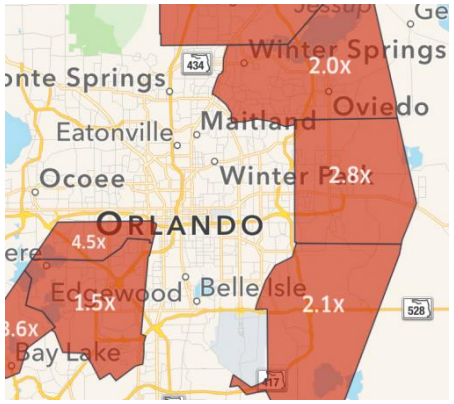
Driver Surge Pricing | Nikhil Garg and Hamid Nazerzadeh

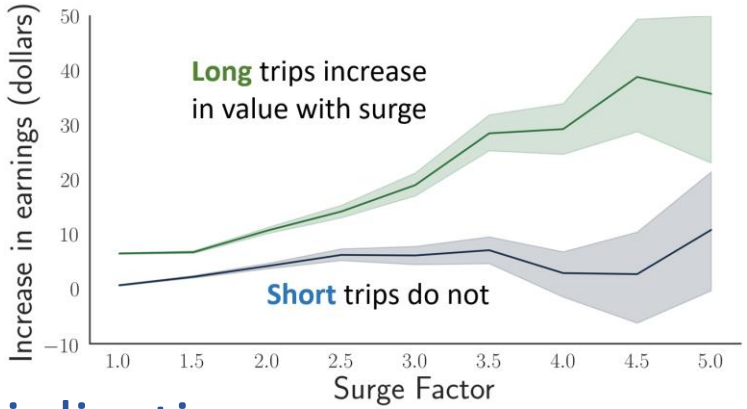
We present the theoretical foundation for additive surge, Uber's new driver surge mechanism

Theoretically study driver incentives with dynamic pricing

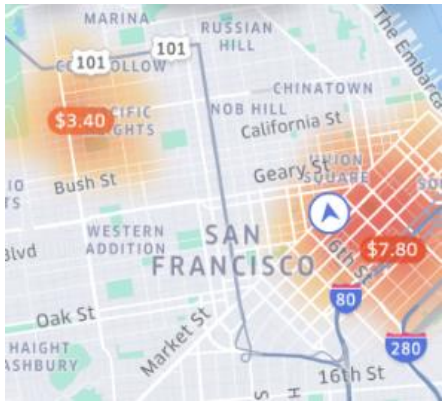
- Show multiplicative surge doesn't work
- Develop a pricing scheme that does work

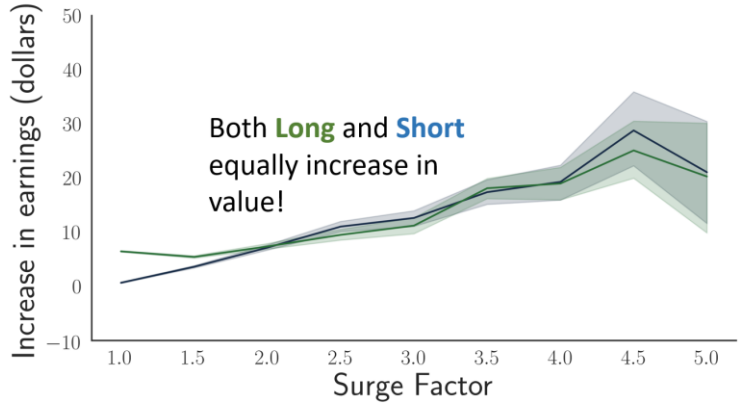
Empirically show that additive surge works in practical regimes of interest



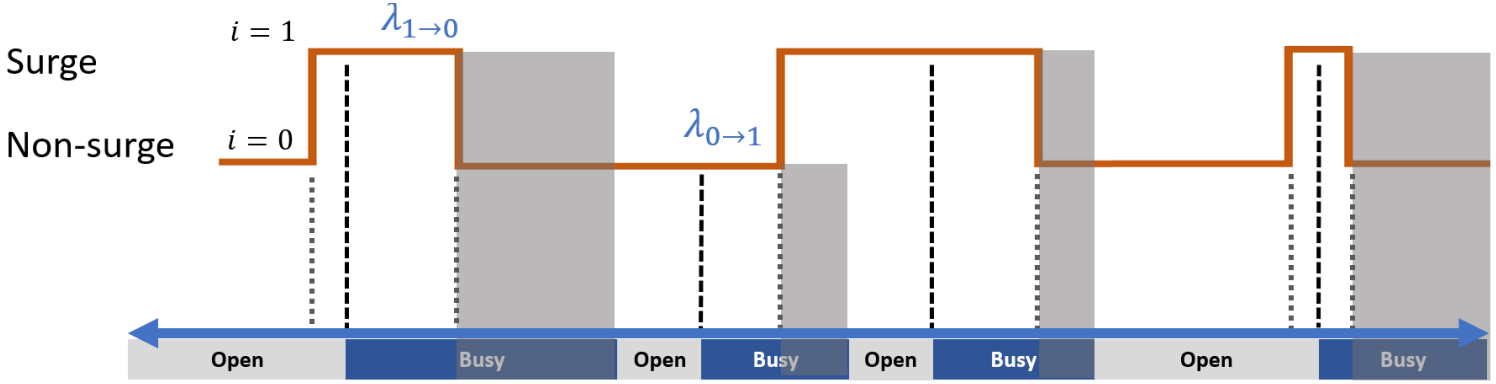


Multiplicative surge





Additive surge



Key effect: lock in surge payments with long trips

"I thoroughly dislike **short** trips ESPECIALLY when I'm picking up in a **waning surge zone**"
-- Anonymous driver

Theoretical results

Ignoring demand dynamics, naïve old pricing model works well.

Theorem: In the static model, Proportional pricing $w(\tau) = m\tau$ is incentive compatible.

With demand dynamics, it doesn't.

Theorem: Proportional pricing may not be incentive compatible

If payout during **surge** is proportional, $w_1(\tau) = m_1\tau$

then $\sigma_1 = (T_1, \infty)$, i.e., rejecting **short** trips, is optimal

With demand dynamics, additive surge approximately works.

Theorem: For $\frac{P_0}{P_1} \in [C, 1]$, we have IC prices of the form:

$$w_i(\tau) = m_i\tau + z_i \left[\frac{\lambda_{i\to j}}{\lambda_{i\to j}+\lambda_{j\to i}}\right]\left[1 - e^{-(\lambda_{i\to j}+\lambda_{j\to i})\tau}\right]$$

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with $m_0, m_1, z_1 \geq 0$.

If surge is too valuable compared to non-surge on average, then cannot build fully IC prices

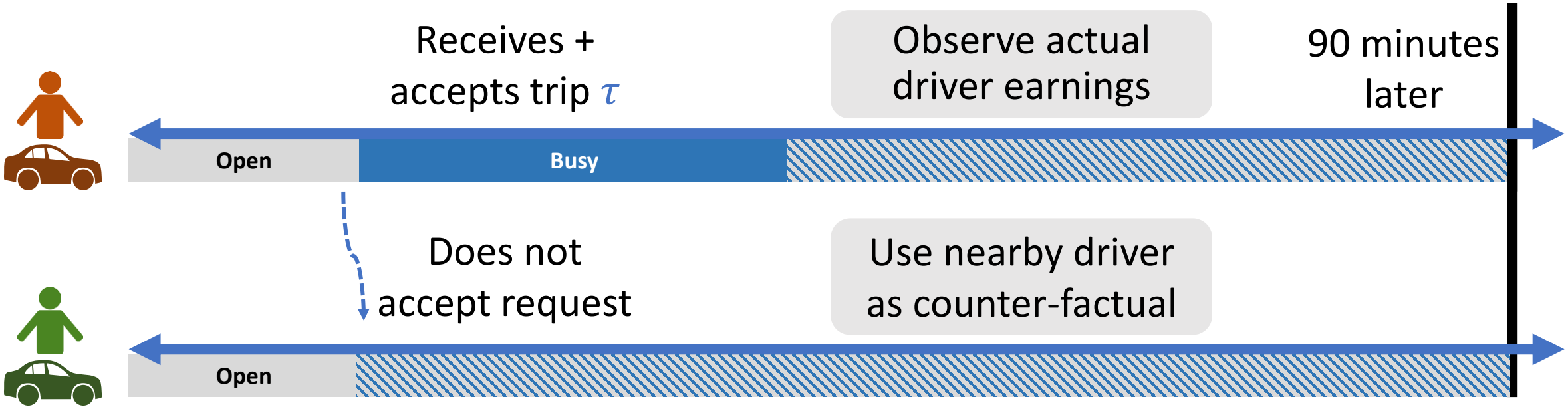
We have m_i, z_i, C in closed form in terms of the model parameters

Probability that a trip of length τ that starts in state i ends in state j

Continuation value: compensate drivers for taking them out of surge

Empirical goal: Estimate value of a request

How does accepting a given trip request change
a driver's expected earnings over the next 90 minutes?



Find a nearby driver match by checking trips that were recently completed with a nearby destination