Bayesian Analysis of Safe Ride Program with Safe Ride Home Versus Anywhere Policies

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Collegiate Safe Ride Programs: RamRide

- Traditional college aged students are at increased risk for traffic-related fatalities many of which are due to driving under the influence of alcohol or other illicit substances.
- Safe Ride Programs provide transportation to college students in an effort to reduce drugged driving.
- We compare ridership under safe ride home and safe ride anywhere policies.
  - Home is defined as a house, apartment, residence hall, or hotel,
  - Anywhere is defined as any home or business address.
- Specifically, we evaluate the effects of a collegiate safe ride program, RamRide at Colorado State University (CSU), switching from a safe ride home to a safe ride anywhere. This intervention included two major changes:
  1. students could be dropped off at any establishment in the service area, Fort Collins, CO,
  2. students could be picked up at the residence halls.

The Model

- To estimate the effect of the intervention on ridership we implemented a fixed effect log-linear Poisson regression model. For the day i in year j the model is

$$Y \sim \text{Poisson}\left[\exp(\mu_0 + \mathbf{X}^T\boldsymbol{\beta})\right], \quad (1)$$

where $\mu_0 = \log\left(\frac{1}{n}\sum_{i=1}^{n} Y_i\right)$ is an offset, $\mathbf{x}_{ij}$ is the data from the $(i,j)^{th}$ observation and $\boldsymbol{\beta}$ is a vector of our parameters.

- We apply Zellner's g prior to the regression coefficients. The prior is

$$\boldsymbol{\beta} \sim \mathcal{N}(\mathbf{0}, \tau^2\boldsymbol{\Sigma})$$
$$\boldsymbol{\Sigma} = (\boldsymbol{X}^T\boldsymbol{X})^{-1}$$
$$\tau^2 = 2$$

- We estimated the unknown parameters β using Markov chain Monte Carlo by implementing an elliptical slice sampler[2].
- Primary Model
  - Model 1: Fixed effects for day of week, week of semester, the interaction between the two, and an indicator for fall 2019
- Secondary Models
  - Model 2: Model 1 with additional fixed effect for year
  - Model 3: Model 1 only for fall 2018 and fall 2019
  - Model 4: Model 1 with a fixed effect for home football game
  - Model 5: Model 1 with fixed effects for indicators of the 3 possible locations that a home football game could have been

The Data

- Data is used for the the first 8 weeks of operation for each fall semesters from 2013 to 2019.

Results

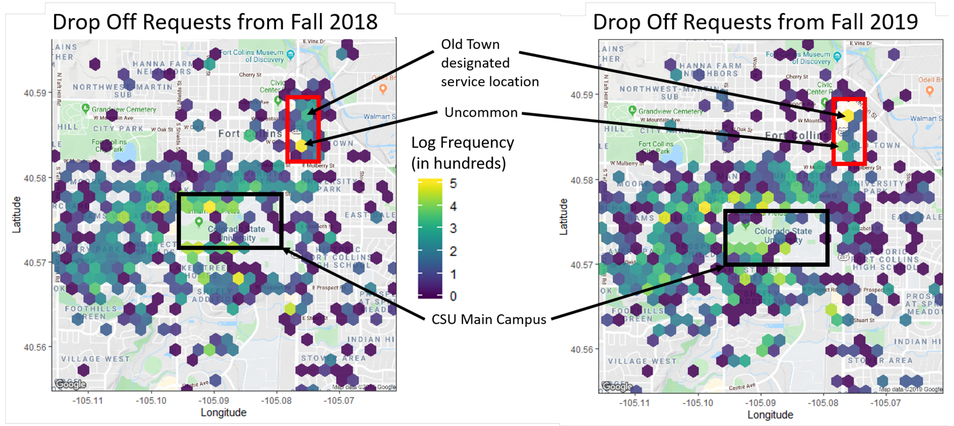
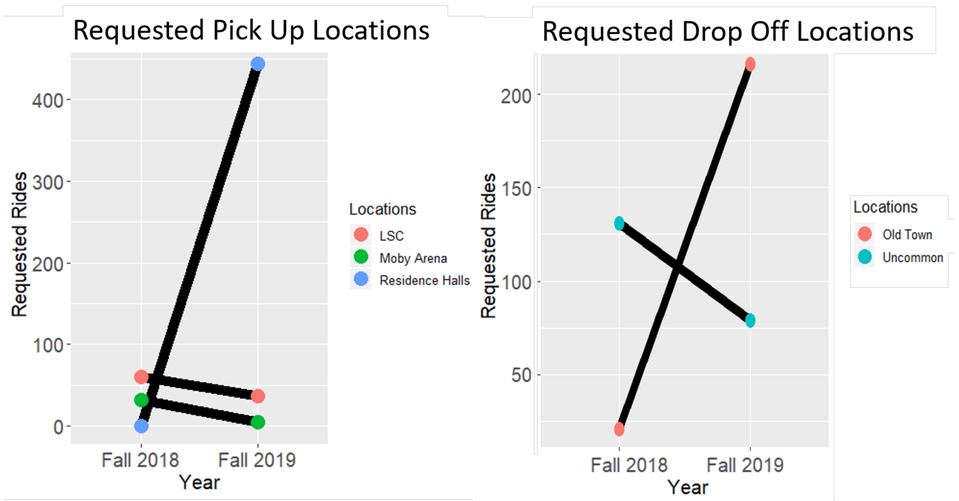


Fig. 1: Heat maps of pick up and drop off locations from fall 2018 and 2019. All heat maps generated using `ggmap` package in R [1].



Results

Model	Estimate	Lower Bound	Upper Bound
Model 1	1.16	1.12	1.21
Model 2	1.18	1.13	1.25
Model 3	1.23	1.17	1.29
Model 4	1.16	1.12	1.21
Model 5	1.19	1.15	1.24

Fig. 3: Estimated relative risk of completed rides following safe ride anywhere intervention. The table shows that there was a significant increase in the numbers of rides serviced in fall 2019.

Model	Estimate	Lower Bound	Upper Bound
Model 1	1.70	1.63	1.78
Model 2	1.86	1.75	2.01
Model 3	1.62	1.52	1.71
Model 4	1.73	1.66	1.81
Model 5	1.70	1.62	1.78

Fig. 4: Estimated relative risk of cancelled rides following safe ride anywhere intervention. The table shows that there was a significant increase in the numbers of rides cancelled in fall 2019.

Conclusions

- More students requesting to use RamRide's services
  - 16% increase in rides serviced with a relative risk estimate of 1.16 (CI: 1.12, 1.20)
  - 70% increase in the amount of rides cancelled with a relative risk estimate of 1.70 (CI: 1.63, 1.78)
  - More rides than RamRide can process in a timely manor
- Change in usage pattern
  - Students requesting to be picked up directly at a residence hall
  - Students requesting to be dropped off directly at Old Town (night life location) instead of near-by apartment complex (Uncommon).
- Expansion of service area leads to an increase in ridership
  - Additional incentive for student to use a ride share program instead of driving themselves
  - Removes potentially intoxicated drivers from the road
  - Ultimately making communities safer

References

[1] David Kahle and Hadley Wickham. "ggmap: Spatial Visualization with ggplot2". In: *The R Journal* 5.1 (2013), pp. 144–161. URL: https://journal.r-project.org/archive/2013-1/kahle-wickham.pdf.

[2] Iain Murray, Ryan Prescott Adams, and David J. C. MacKay. *Elliptical slice sampling*. 2009. arXiv: 1001.0175 [stat.CO].