How Do US Gas Prices Affect Alternative Methods of Travel?

Group #104

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Background Information

- Intuitively, there is an inverse relationship between methods of transportation, since they are substitutable goods.
- We can combine this with the relationship between automobile usage and gas prices.
- This relationship is unclear because it's difficult to tell exactly what alternatives consumers will take. If high gasoline prices are enough to deter some, they may choose any one of numerous options - if they decide to travel at all.

🚊 Research questions

1. How does the average US gas price over time affect ridership numbers of alternative transportation methods?

2. Which areas show the most increase in transit ridership in response to increased gas prices?

3. Do all grades of gasoline fluctuate in price at roughly the same rate? And if not, does one affect alternative transportation ridership more than others?

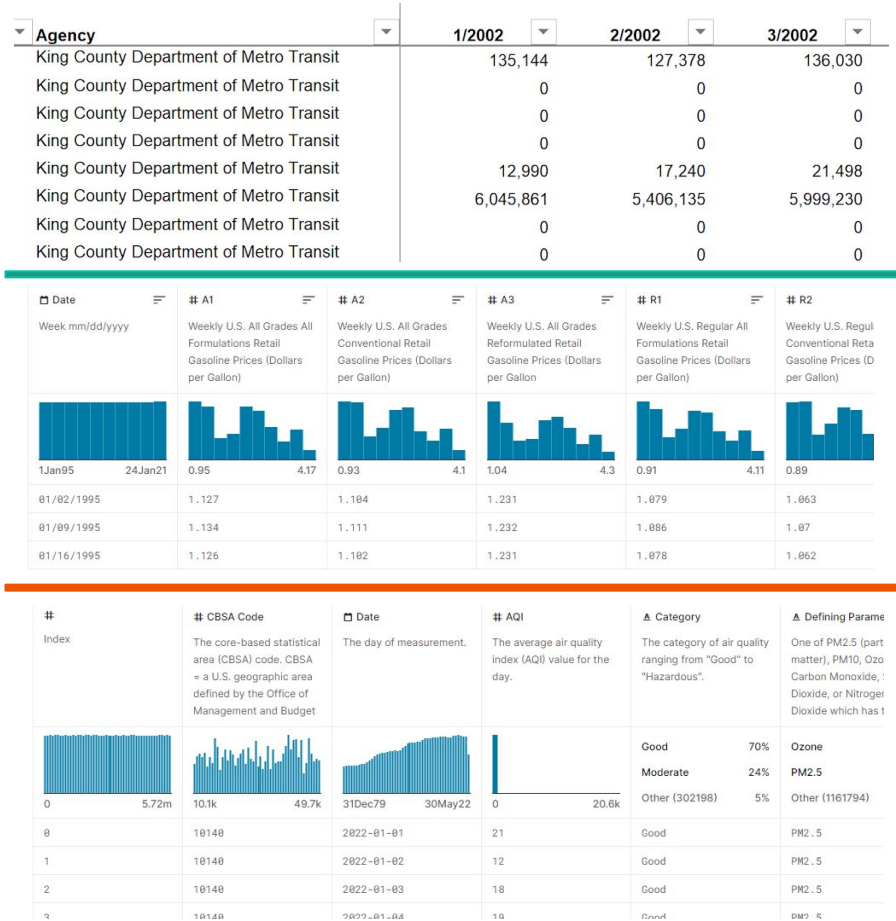
4. Are there any particular significant events that explain any sudden spikes in alternative transportation ridership numbers?

⛽ Data sources

- National Transit Database complete monthly ridership
- U.S. Gasoline and Diesel Retail Prices 1995-2021
- US Air Quality 1980-Present

Possible use:

- Weekly Petroleum Status Report
- Bike Sharing Dataset

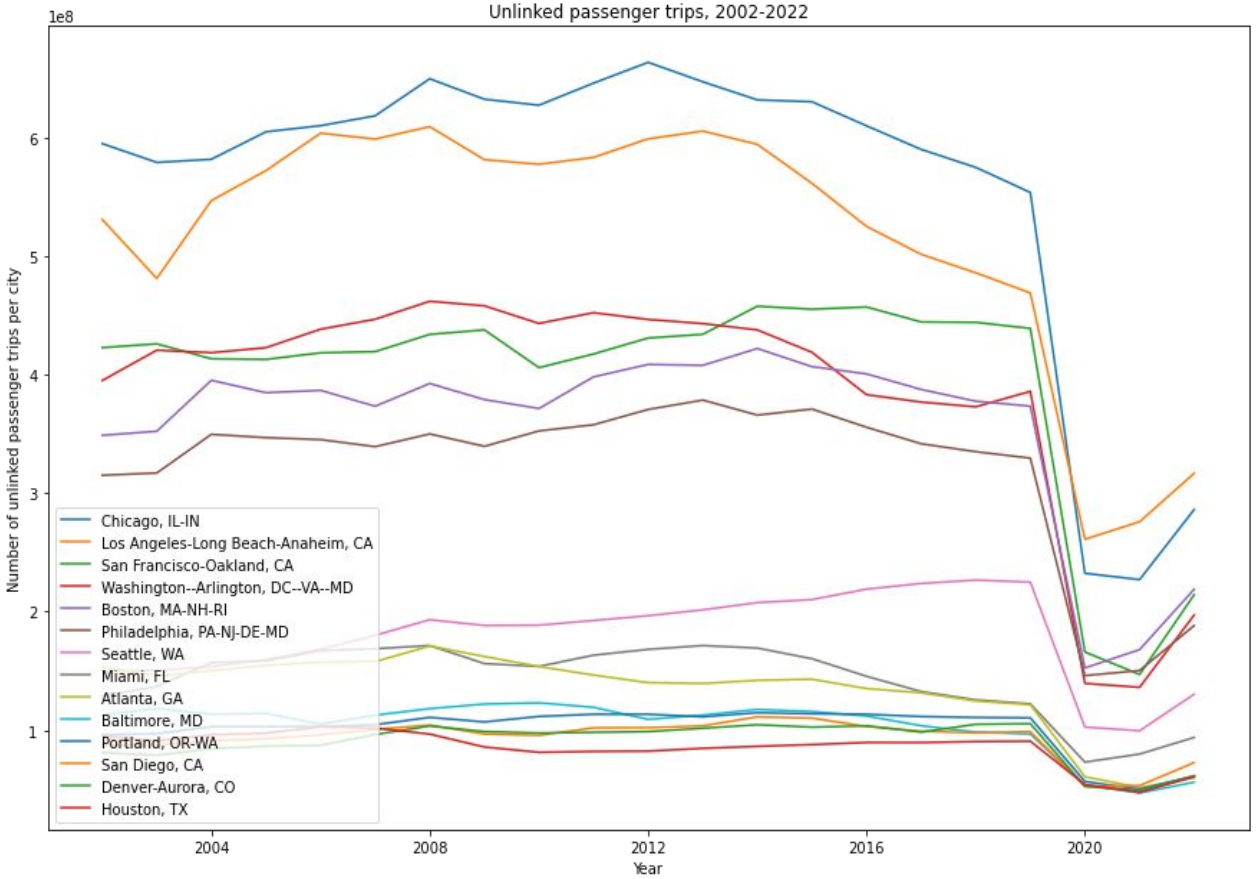


Agency	1/2002	2/2002	3/2002
King County Department of Metro Transit	135,144	127,378	136,030
King County Department of Metro Transit	0	0	0
King County Department of Metro Transit	0	0	0
King County Department of Metro Transit	0	0	0
King County Department of Metro Transit	12,990	17,240	21,498
King County Department of Metro Transit	6,045,861	5,406,135	5,999,230
King County Department of Metro Transit	0	0	0
King County Department of Metro Transit	0	0	0

An exploratory line plot of unlinked passenger trip counts from 15 of the highest-trip cities.

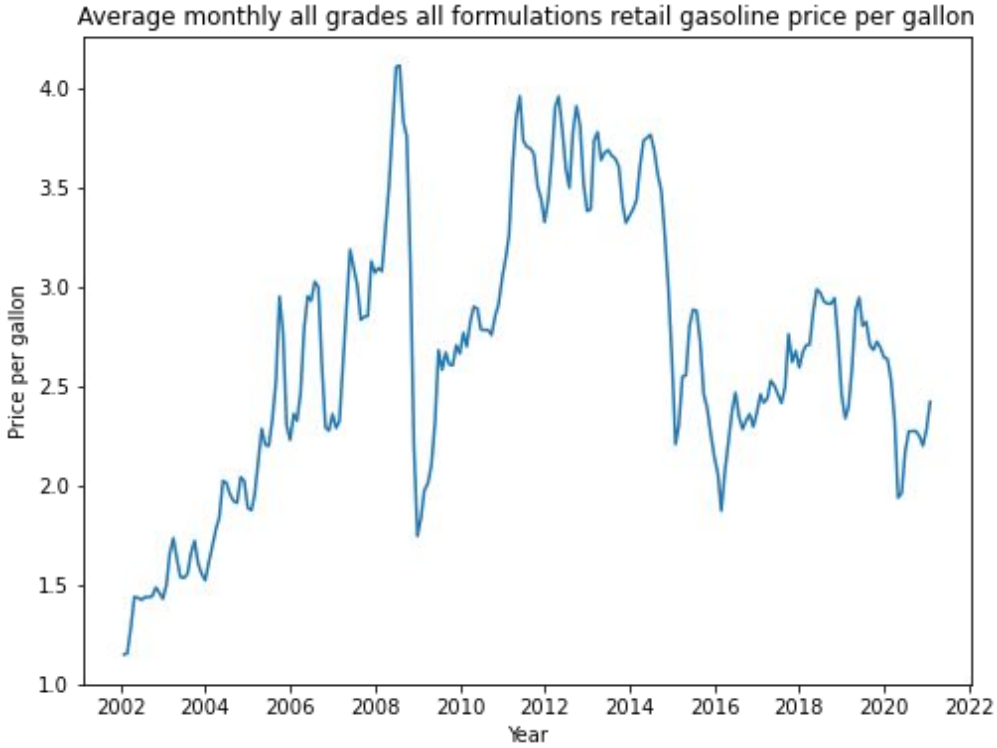
Unlinked passenger trips is a measure of passengers who board public transit vehicles -- unadjusted for linked trips, e.g. connecting to a bus from a train as part of the same trip.

Note: NYC is an extreme outlier and is not included in this plot.



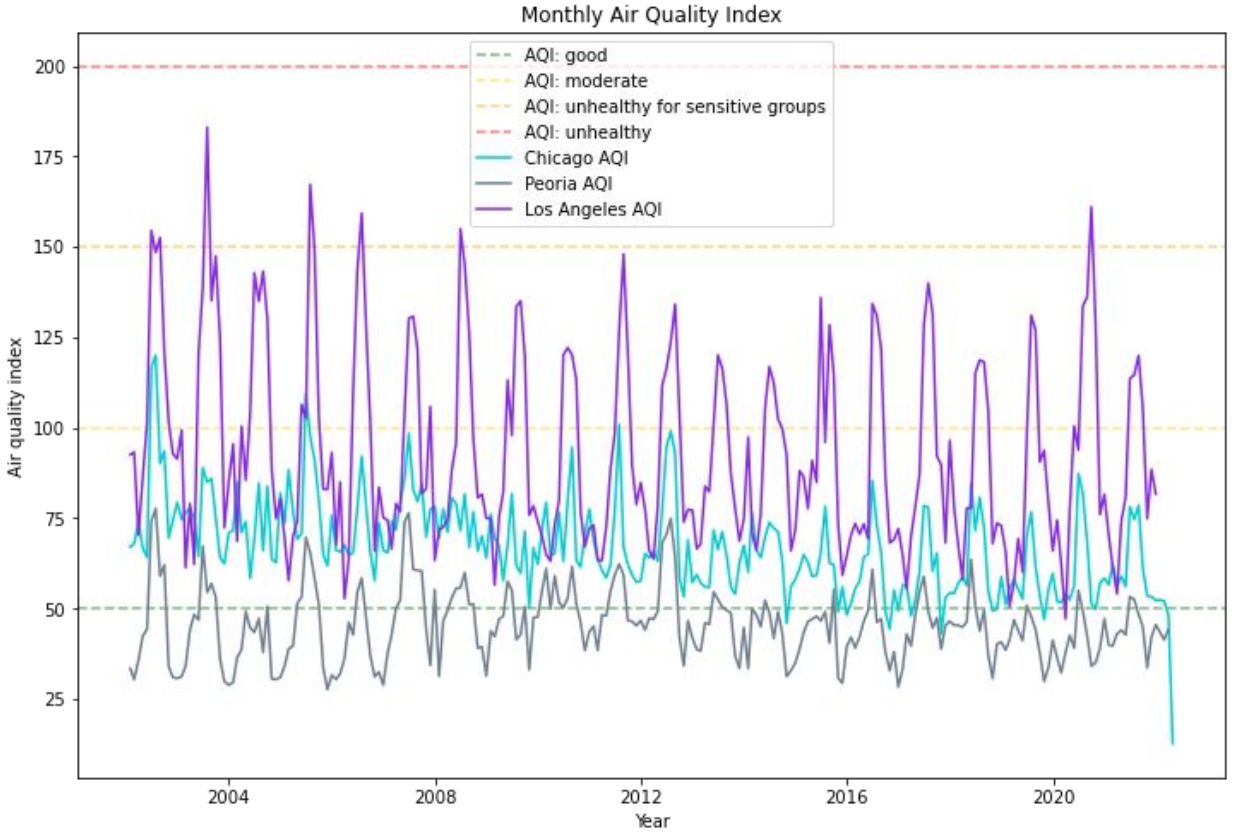
An exploratory line plot of average monthly gasoline prices, across all grades and formulations.

Note the obvious impact of the 2008 recession, the 2014-2016 oil price collapse, and COVID-2019.



An exploratory plot of the air quality index (AQI) in Chicago, IL, Peoria, IL, and Los Angeles, CA.

Note substantial variation at the state level between Chicago (urban) and Peoria (rural), though similar seasonal/periodic patterns across all cities.



Planned Approach

Data Cleaning

- Aggregate our data to different time periods.
- Perform necessary transformation

Build Time-Series Models

- Hyperparameter Optimization (ACF and PACF plots, grid searching, and auto-ARIMA)
- Utilizing multiple different model types to test data

Evaluation

- Model accuracy by MAE, MAPE, RMSE
- Goodness of Fit

🔎Models

Because we are analyzing data revolved around changes over time. We will be utilizing the following Time-Series Models:

Multivariable models

Vector Autoregressive

Generalized Autoregressive Conditional Heteroskedasticity models

GARCH models

Decomposition models

💡 Initial Hypothesis

- A positive relationship between gas prices and transit ridership will exist.
  - However, we would assume this relationship is only one of many factors that drives transit ridership.
- A positive relationship between transit ridership and air quality will exist.
- The most significant independent variable will be regular grade gas price.
- We will see different patterns in different cities due to different regional availability and existing use of public transit.

📌Citations

- Public transit usage and air quality index during the COVID-19 lockdown (PubMed)
- Transit Price Elasticities and Cross-Elasticities (Victoria Transport Policy Institute)