CS-2704 Final Project Report

Jamie Greening[1 [3543841]]

University of New Brunswick Saint John, Saint John NB E2L 4L5, CAN
jgreenin@unb.ca

1 Introduction and Background

Broadly, price increases or decreases on certain goods can affect consumer behaviour and purchasing decisions, as demonstrated by recent rises in inflation: "Demand in some categories, such as meat, is falling as consumers adjust their shopping habits to make their grocery spending go as far as possible." [3]. Some goods may respond differently than others: gasoline, for example, is cited as an inelastic good: "In effect, gasoline prices could be an "inelastic" good, economic parlance for a product or service for which demand does not change much in response to higher prices, Tal said." [4]. Others disagree: in an article published for the Federal Reverse Bank of Dallas, Lutz Kilian and Xiaoqing Zhou examine gas demand responding more to price changes than previously considered: "The interesting economic question is why the fuel consumption responses are so strong. Clearly, in the short run, consumers won't choose to replace their vehicle with a more fuel-efficient one. There are other margins of adjustment, however. For example, consumers may reduce their discretionary driving."[5]. If drivers may reduce discretionary driving as gas prices rise, would this mean that road collisions would decrease as well, implying an association between the two?

2 Hypothesis

I hypothesize that there will be some association between gas prices rising and road collisions decreasing, assuming that gas price fluctuations have some effect on demand for gasoline and therefore driving habits and choices. With people choosing to be on the road less (either by cutting down on non-essential driving or optimizing the time spent driving), fewer collisions should occur ideally. When gas prices go down, people might be motivated to leisure drive more and this could lead to more collisions.

That being said, other factors could influence collisions. Education programs that emphasize safe driving could have an impact on lowering collisions, as could efforts to reduce reckless driving and enforcing driving laws. Even if an association is found between gas prices and road collisions, this might not be telling the full story.

The two datasets I will be using are:

- National Collision data, from the National Collision Database [1]
- Monthly average retail prices for gasoline and fuel oil, by geography [2]

Both datasets have also been cleaned and summarized for easier analysis. This includes:

- Averaging monthly fuel prices for cities included in the gas dataset, to create an approximate national average for 1999-2005
- Removing columns and rows irrelevant to the analysis (the collision data had a significant amount of extra data included)
- Setting date formats to be equal so both series (gas prices and number of collisions, by month) could be charted in one figure

3 Analysis and Implication

As a start, average monthly gas prices and number of collisions per month were both charted using a line plot as can be seen in figures 1 and 2.

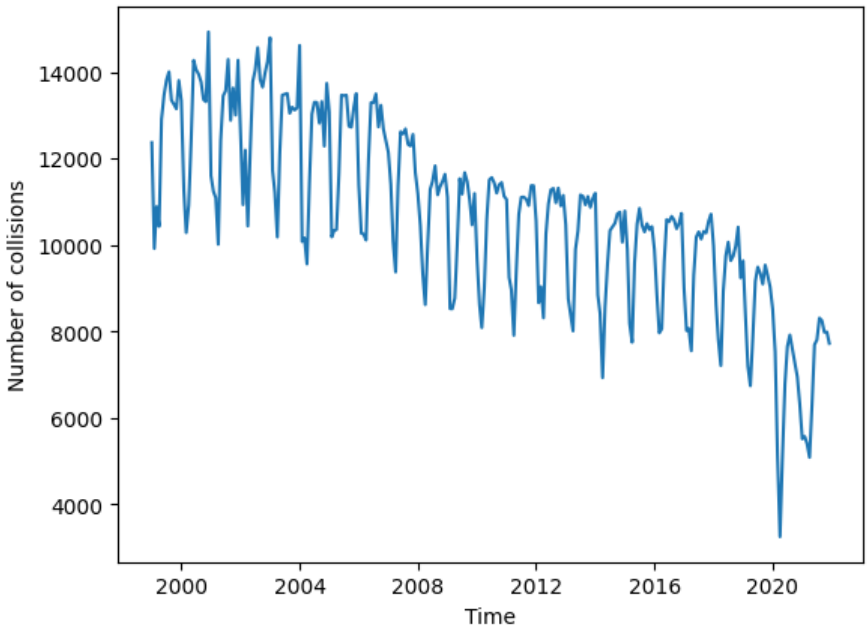

Fig. 1. Number of collisions over time, by month

Next, both variables were charted together in figure 3 and 4 to determine if there may potentially be a relationship between the two.

Over the last two decades, it appears that monthly collisions have trended down as gas prices have gone up. Unfortunately, collision data is only available up until around 2022, so the potential effect of the large spike in gas prices after that same period on collisions cannot be determined.

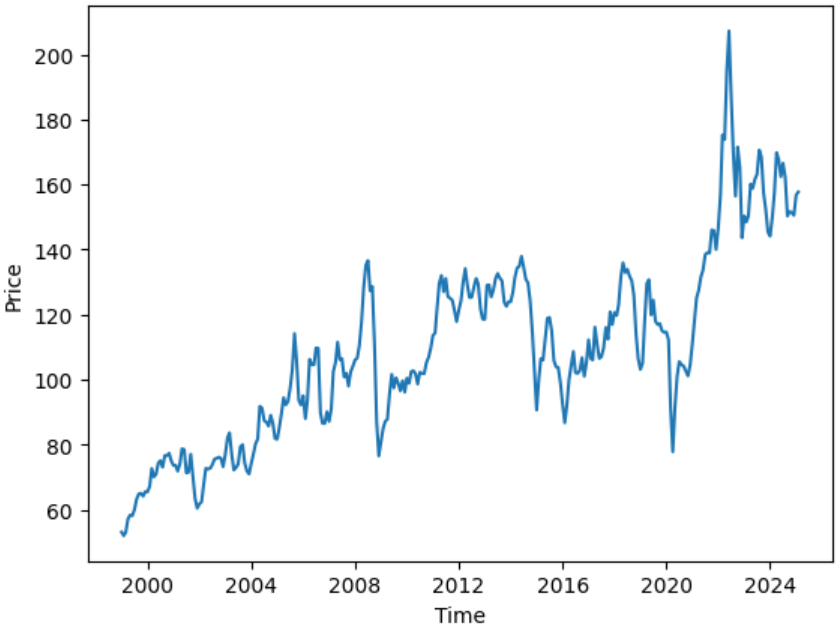

Fig. 2. Average gas prices over time, by month

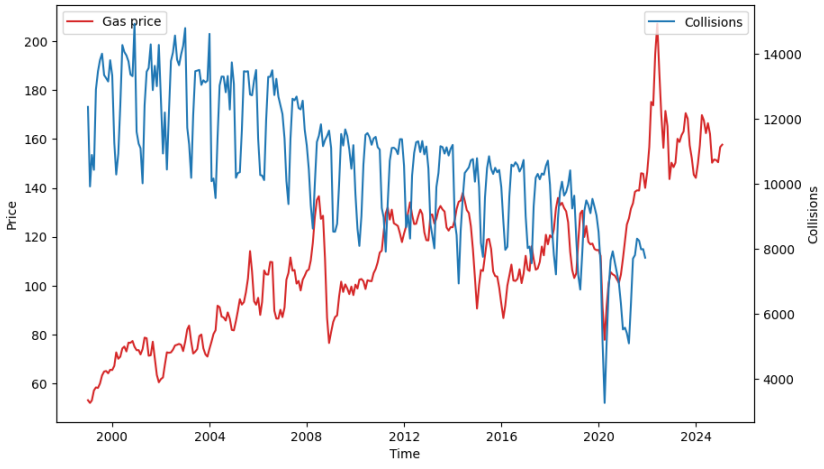

Fig. 3. Average gas prices and number of collisions over time, by month

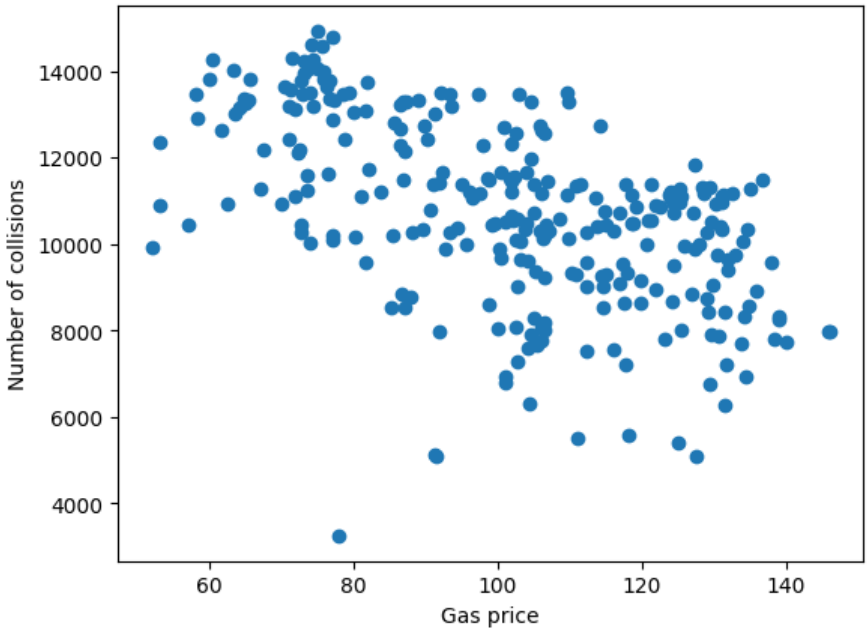

Fig. 4. Average gas prices and number of collisions by month, in a scatterplot

Using Linear Regression, a model was created and tested using average gas prices by month as the predictor variable and number of collisions by month as the outcome variable. The model was tested with a variety of test sizes, as can be seen below in figures 5 and 6. From this, it appears that the linear regression model was able to predict values better than a baseline model, as all R^2 values are above 0 for each test size.

4 Conclusion

Based on the results of the analysis done, it appears there is some sort of predictive relationship between gas prices and number of collisions. The linear regression model's R^2 scores stayed above 0 no matter the test size, indicating the model performed better than a baseline model. This validates the relationship we can see in figures 3 and 4, but there also appears to be a lot of variance - notably, there are periodic increases and declines in collisions within every year when looking at the line plot. Further research and experimentation could be done with the additional data that the National Collision Database[1] can provide. As an example, could gas prices have more of a relationship with the severity of a crash (lower gas prices, potentially more risky driving and speeding, increase in fatalities)?

Code can be examined via the GitHub repository for this project [6].

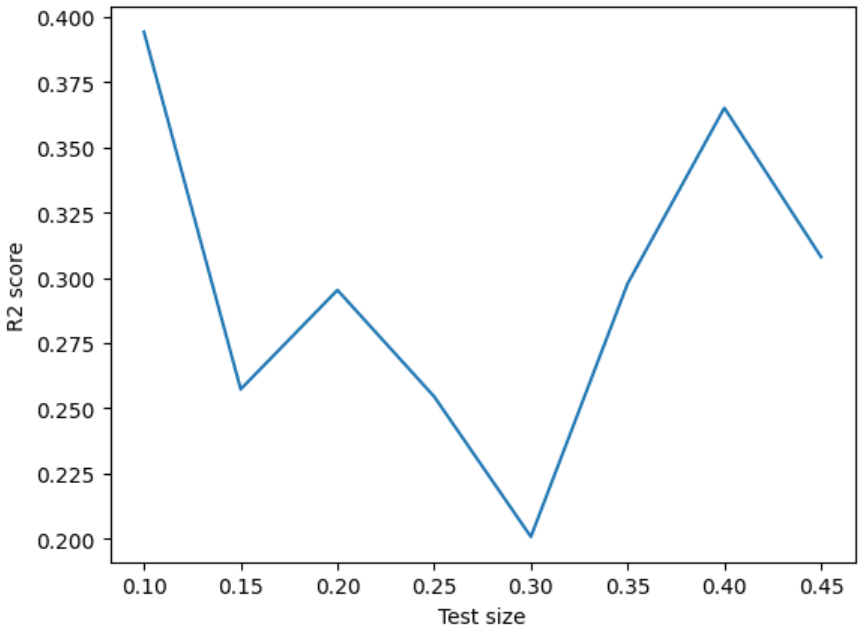

Fig. 5. R^2 score by test size, ran at 10:55 AM on April 17 2025

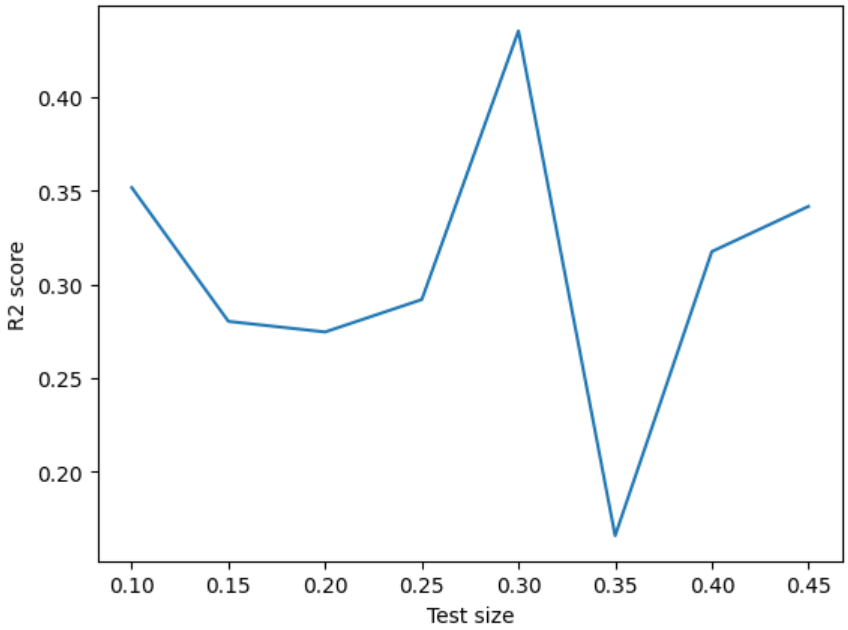

Fig. 6. R^2 score by test size, ran at 11:05 AM on April 17 2025

References

1. Transport Canada: National Collision Database Online. Online. https://wwwapps2.tc.gc.ca/Saf-Sec-Sur/7/NCDB-BNDC/p.aspx?l=en, last accessed 2025-03-28
2. Statistics Canada: Monthly average retail prices for gasoline and fuel oil, by geography. Online. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810000101, last accessed 2025-03-28
3. CBC: Prices for many foods coming down, but inflation has left a legacy. Kevin Yarr. Online. https://www.cbc.ca/1.7192916, last accessed 2025-04-16
4. CBC: Higher gas prices to bite Canadian drivers: CIBC. Online. https://www.cbc.ca/news/business/higher-gas-prices-to-bite-canadian-drivers-cibc-1.977899, last accessed 2025-04-16
5. Federal Reserve Bank of Dallas: Gasoline demand more responsive to price changes than economists once thought. Lutz Kilian and Xiaoqing Zhou. Online. https://www.dallasfed.org/research/economics/2020/0616, last accessed 2025-04-16
6. Github: vertesemash/CS2704-Final-Project-JG: Data Analytics Final Project. Online. https://github.com/vertesemash/CS2704-Final-Project-JG, last accessed 2025-04-17