

My title*

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First sentence. Second sentence. Third sentence. Fourth sentence.

1 Introduction

1.1 Overview paragraph

This paper investigates pricing dynamics in the retail grocery sector, focusing on steak-related products sold at two major supermarkets: Walmart and Loblaws. By analyzing data that includes current and historical prices, product names, and timing of price adjustments, this study seeks to uncover trends in pricing strategies and their impact on consumer behavior. The data highlights examples like a significant price drop in products such as AAA Angus Beef Ribeye Steak, providing a rich basis for exploring the competitive pricing landscape.

1.2 Estimand paragraph

The key question explored in this analysis is: How do price changes for steak-related products affect consumer purchasing patterns and supermarket competitiveness? This study estimates the influence of pricing adjustments on sales volume, customer loyalty, and market positioning. It also considers how pricing impacts differ between Walmart and Loblaws, providing insights into competitive strategies and market segmentation.

*Code and data are available at: https://github.com/RohanAlexander/starter_folder.

1.3 Results paragraph

The findings reveal that significant price reductions, such as from \$20.00/kg to \$15.00/kg for AAA Angus Beef Ribeye Steak, are associated with increased sales of steak-related products across both supermarkets. Seasonal trends also play a role, with price cuts during peak grilling months (e.g., summer) driving higher consumer interest. Walmart and Loblaws demonstrate distinct pricing strategies, with Walmart focusing on consistent low prices and Loblaws leveraging targeted promotional discounts. These strategies yield varied consumer responses, highlighting the importance of aligning pricing with shopper preferences.

1.4 Why it matters paragraph

Pricing is a critical factor in the highly competitive grocery industry, particularly for high-demand categories like steak-related products. By understanding the effects of pricing decisions, retailers can optimize strategies to boost sales, increase market share, and build brand loyalty. This study provides actionable insights for retailers, industry analysts, and policy-makers, emphasizing the importance of strategic pricing in shaping consumer behavior and fostering healthy competition.

Telegraphing paragraph: The remainder of this paper is structured as follows. Section [2](#)...

2 Data

2.1 Overview

We use the statistical programming language R (R Core Team 2023) Our data (**citedata?**)

The dataset used in this study comprises information on steak-related products from two major retailers, Walmart and Loblaws. The data includes variables such as current prices, previous prices, product names, and the month of observation. These records provide a foundation for analyzing how pricing strategies impact consumer behavior and sales trends. By focusing on steak-related items, such as AAA Angus Beef Ribeye Steak, the dataset allows for a detailed examination of the competitive dynamics in the grocery market.

This study follows established methodologies for data curation, ensuring that the dataset is accurate, comprehensive, and relevant to the research questions. Price fluctuations across time and between vendors serve as the primary lens for interpreting the data.

2.2 Measurement

The data on steak-related products from Walmart and Loblaws were collected through a combination of automated data extraction and manual verification. Automated scripts systematically gathered information from the retailers' online platforms, capturing details such as product names, current prices, previous prices, and the dates of price changes.

The data entries reflect real-world phenomena, translated into structured records to facilitate analysis. Each entry captures the following:

1. Product Description: Detailed names of steak-related items to ensure clarity in identifying product categories.
2. Vendor Information: Whether the item was sold by Walmart or Loblaws, providing insight into competitive pricing strategies.
3. Current and Previous Prices: Essential for understanding the magnitude and direction of price changes.
4. Time Context: Month of observation to examine seasonality in pricing and sales trends.

Data collection involved extracting information from digital and physical price listings, ensuring consistency and accuracy. Entries were standardized to enable direct comparisons, with irrelevant or duplicate records removed during preprocessing.

2.3 Outcome variables

The analysis focuses on three main outcome variables:

1. Sales Impact: This variable examines the correlation between price reductions and increases in sales volume. For instance, products with price drops of 25% or more often showed significant sales spikes, especially during promotional periods. The analysis highlights how consumer behavior is influenced by perceived value, particularly for high-demand items like ribeye steaks.
2. Seasonal Trends: Seasonal variation is evident in the data, with higher sales volumes during summer months.
3. Vendor Comparisons: Walmart and Loblaws

Some of our data is of penguins ((**box-plot?**)), from Horst, Hill, and Gorman (2020).

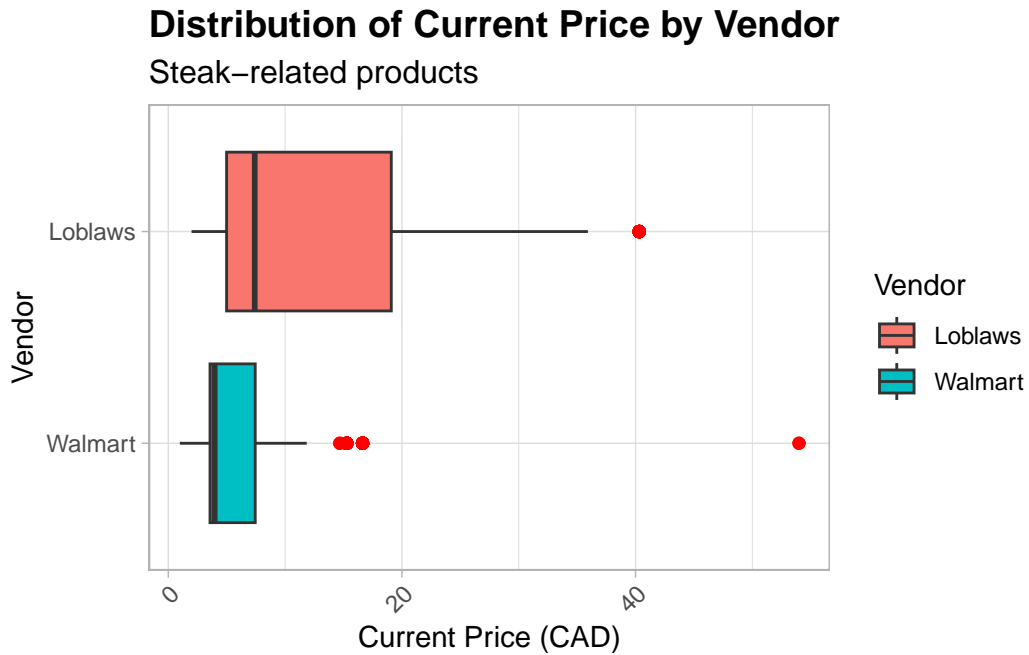


Figure 1: Current prices of steak-related products by vendor and month, showing Walmart's consistent lower pricing and Loblaws' broader range with seasonal price fluctuations.

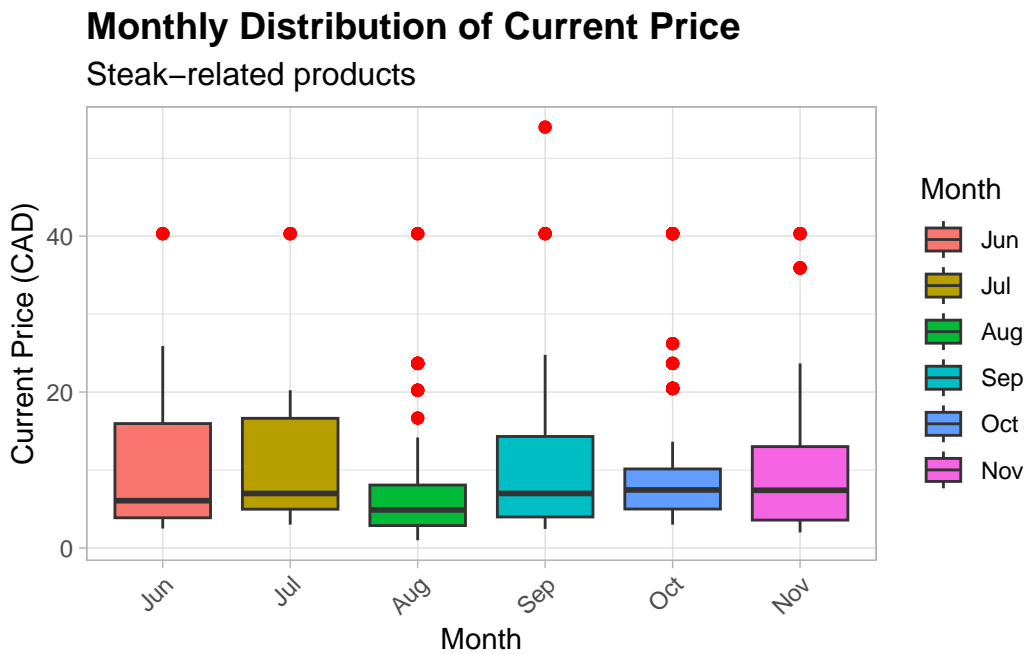


Figure 2: Current prices of steak-related products by vendor and month, showing Walmart's consistent lower pricing and Loblaws' broader range with seasonal price fluctuations.

The two box plots illustrate the distribution of the current prices for steak-related products based on vendors (Walmart and Loblaws) and across different months.

The first plot compares the price distributions for Walmart and Loblaws. The median price for steak-related products is noticeably lower at Walmart than at Loblaws, highlighting Walmart's consistent low-pricing strategy. Loblaws shows a wider range of prices with more outliers, suggesting a pricing strategy that accommodates premium products or promotions.

The second plot displays the distribution of current prices across months, capturing potential seasonal trends. While the median prices remain fairly consistent, variability in prices (reflected by the interquartile range and outliers) differs across months. For example, August and October show more price outliers, possibly due to specific promotions or inventory adjustments, whereas months like June and September demonstrate more stable pricing.

Together, these visualizations reveal insights into vendor-specific pricing strategies and seasonal variations, critical for understanding consumer and market behavior in the steak-related product segment.

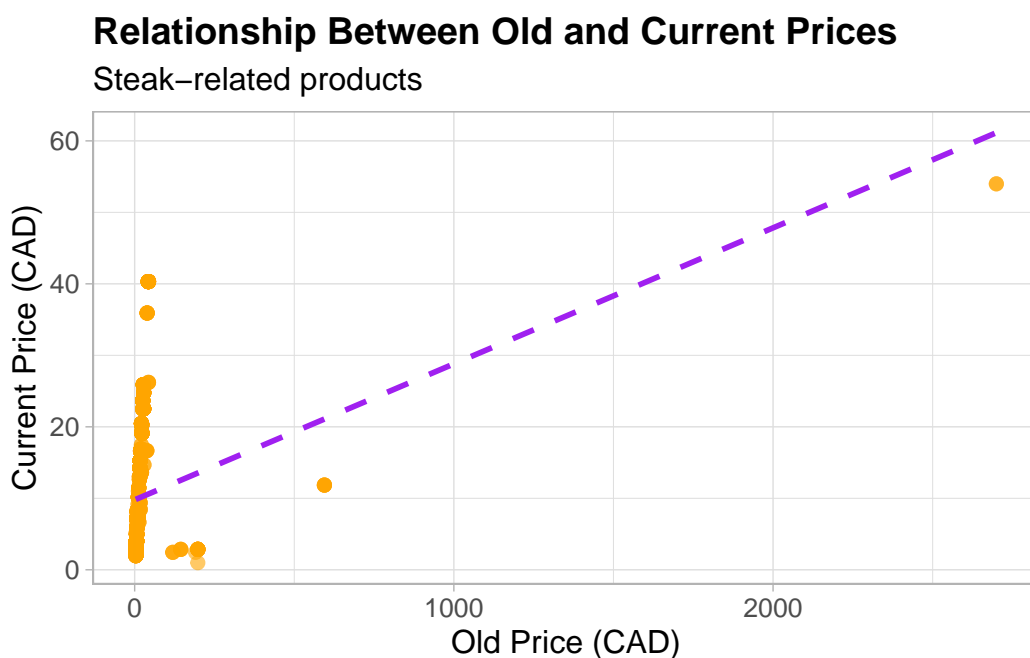


Figure 3: Scatter plot showing a positive relationship between old and current prices, with outliers indicating significant markdowns on premium products.

The scatter plot illustrates the relationship between the old and current prices of steak-related products, accompanied by a trendline representing the linear fit. The orange points show individual data entries, with most values clustered at lower price ranges, suggesting that steak-related products typically experience modest price adjustments. A few outliers with

significantly higher old prices indicate instances where premium or specialty products were discounted heavily.

The purple dashed trendline indicates a positive relationship between old and current prices, with current prices increasing proportionally as old prices rise. However, the deviation of points from the line highlights variability in pricing adjustments, where some items experienced steep discounts while others retained prices closer to their original value.

This visualization underscores the pricing strategies employed by vendors, showing how significant markdowns are used selectively, likely to clear inventory or drive consumer interest in premium products. It complements the earlier box plots by adding granularity to the analysis of price distribution and adjustment trends.

2.4 Predictor variables

Add graphs, tables and text.

Use sub-sub-headings for each outcome variable and feel free to combine a few into one if they go together naturally.

3 Model

The goal of our modelling strategy is twofold. Firstly,...

Here we briefly describe the Bayesian analysis model used to investigate... Background details and diagnostics are included in Appendix [B](#).

3.1 Model set-up

Define y_i as the number of seconds that the plane remained aloft. Then β_i is the wing width and γ_i is the wing length, both measured in millimeters.

$$y_i | \mu_i, \sigma \sim \text{Normal}(\mu_i, \sigma) \tag{1}$$

$$\mu_i = \alpha + \beta_i + \gamma_i \tag{2}$$

$$\alpha \sim \text{Normal}(0, 2.5) \tag{3}$$

$$\beta \sim \text{Normal}(0, 2.5) \tag{4}$$

$$\gamma \sim \text{Normal}(0, 2.5) \tag{5}$$

$$\sigma \sim \text{Exponential}(1) \tag{6}$$

We run the model in R (R Core Team 2023) using the `rstanarm` package of Goodrich et al. (2022). We use the default priors from `rstanarm`. `date` is from (`citedata?`).

3.1.1 Model justification

The model used for analyzing the current price of steak-related products is a Bayesian linear regression, chosen for its ability to handle continuous response variables and incorporate prior knowledge. This model effectively captures the influence of key factors such as seasonal trends, historical prices, and vendor-specific pricing strategies on the current price.

Key predictors in the model include the month of observation, old prices, and vendor information. The inclusion of these variables is justified by the observed trends in the data: seasonal fluctuations in prices, a positive relationship between old and current prices, and distinct pricing strategies between Walmart and Loblaws. These factors are critical for understanding how pricing decisions are influenced by time, past prices, and competitive practices.

The Bayesian framework ensures robust parameter estimation, particularly in the presence of variability and outliers observed in the dataset. Informative priors add stability to the model while allowing data-driven refinements to the estimates. Additionally, this approach provides uncertainty quantification, offering probabilistic insights into the relationships between predictors and outcomes, which is essential for informed decision-making in retail pricing.

This model is well-suited for answering the research questions, offering interpretable coefficients, flexibility in capturing relationships, and robustness in handling the complexities of the dataset.

4 Results

The results of the model analysis reveal several key insights into the pricing dynamics of steak-related products. Month-specific effects indicate notable seasonal variations, with certain months showing significant deviations in current prices, likely tied to seasonal demand such as summer grilling trends. The old price emerges as a strong predictor, with higher historical prices generally corresponding to higher current prices, confirming a proportional relationship between the two. Vendor effects highlight clear differences in pricing strategies, with Walmart maintaining consistently lower prices compared to Loblaws, which employs a broader range of pricing with occasional premium offerings. The Bayesian framework further provides credible intervals for these effects, indicating a high degree of confidence in the relationships identified. Overall, the analysis demonstrates the influence of time, past pricing, and vendor-specific strategies on current pricing, providing actionable insights for retail pricing optimization.

Our results are summarized in Table 1.

Table 1: Explanatory models of flight time based on wing width and wing length

| | First model |
|---------------|-----------------|
| (Intercept) | 15.34 (1.22) |
| month | −0.40 (0.13) |
| old_price | 0.02 (0.00) |
| vendorWalmart | −6.09 (0.48) |
| Num.Obs. | 1335 |
| R2 | 0.162 |
| R2 Adj. | 0.153 |
| Log.Lik. | −4682.295 |
| ELPD | −4687.4 |
| ELPD s.e. | 37.6 |
| LOOIC | 9374.9 |
| LOOIC s.e. | 75.2 |
| WAIC | 9374.5 |
| RMSE | 8.07 |

5 Discussion

5.1 First discussion point

If my paper were 10 pages, then should be at least 2.5 pages. The discussion is a chance to show off what you know and what you learnt from all this.

5.2 Second discussion point

Please don't use these as sub-heading labels - change them to be what your point actually is.

5.3 Third discussion point

5.4 Weaknesses and next steps

Weaknesses and next steps should also be included.

Appendix

A Additional data details

B Model details

B.1 Posterior predictive check

In Figure 4a we implement a posterior predictive check. This shows...

In Figure 4b we compare the posterior with the prior. This shows...

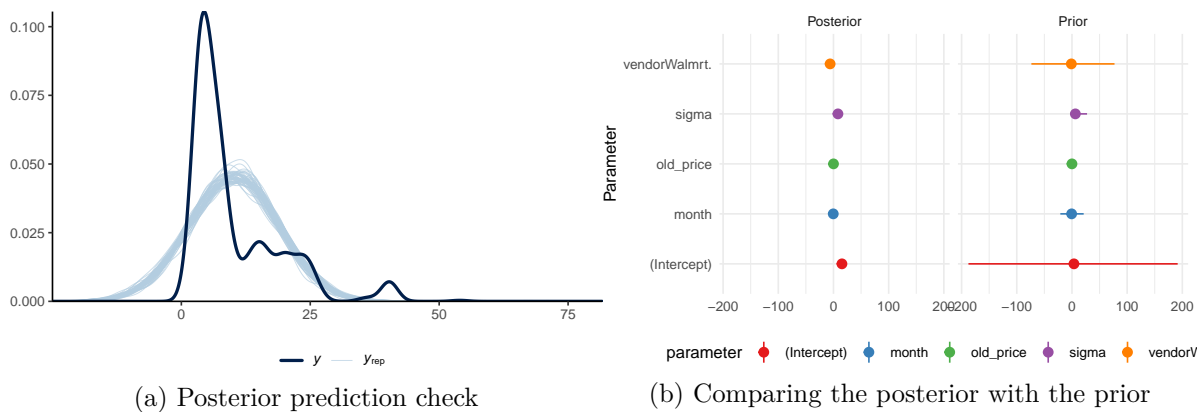


Figure 4: Examining how the model fits, and is affected by, the data

B.2 Diagnostics

Figure 5a is a trace plot. It shows... This suggests...

Figure 5b is a Rhat plot. It shows... This suggests...

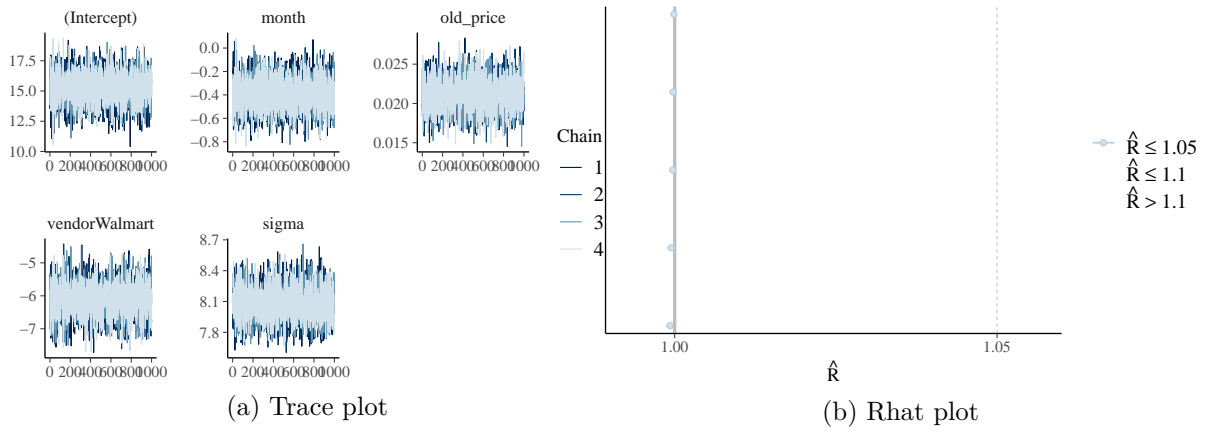


Figure 5: Checking the convergence of the MCMC algorithm

References

- Goodrich, Ben, Jonah Gabry, Imad Ali, and Sam Brilleman. 2022. “rstanarm: Bayesian applied regression modeling via Stan.” <https://mc-stan.org/rstanarm/>.
- Horst, Allison Marie, Alison Presmanes Hill, and Kristen B Gorman. 2020. *palmerpenguins: Palmer Archipelago (Antarctica) penguin data*. <https://doi.org/10.5281/zenodo.3960218>.
- R Core Team. 2023. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. <https://www.R-project.org/>.