An Analysis of Public Transit Access on Labour Force Outcomes across Major Canadian Cities, 2023 and 2024*

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

1 Introduction

Public transit represents a significant foundation of any major metropolitan economy, enabling the efficient movement of residents on a daily basis. In 2024, the Canadian federal government announced an investment of over $3 billion into transit infrastructure, highlighting the growing need to build sustainable and transit-oriented cities across the nation. While these systems aim to provide reliable mobility, the impact of public transit is expansive. Benefits range from improved quality of life, environmental sustainability and the inclusion of underserved populations. (Foth, N., Manaugh, K., & El-Geneidy, A. M. (2013). This commitment is also seen through Canada's 2030 Agenda for Sustainable Development, specifically Goal 11, which mandates the creation of "inclusive, safe, resilient and sustainable" cities (Government of Canada, 2022). Among several indicators for Goal 11, Statistics Canada measures Canadians' transit proximity, emphasizing that transit is a core requirement for a modern economy.

To understand the vitality of public transit systems, we explore their economic value in major metropolitan areas. Previous literature has explored these relationships in varying degrees. Transportation infrastructure has shown to be a driver of employment growth, expanding the ability of people to engage in the workforce (Sobieralski, 2021). Chatman and Noland (2011) reveal that efficient transit enlarges the pool of accessible jobs, enabling economic productivity in dense urban populations. Research has found that poor transit accessibility, combined with socioeconomic disadvantages, results in "transport poverty." This can create a tangible barrier to economic participation, effectively reducing the labour market for residents without reliable

*Code and data are available at: https://github.com/arusansurendiran/CanadianAccessibilityEmployment.git.

access to transit. (Allen and Farber (2019, Jin et al., 2025). In Canada's largest municipality, Deboosere et al. (2018) found that transit accessibility improvements in Toronto were associated with increases in median household income and decreases in unemployment. As transportation networks develop through substantial investment and population patterns shift, this allows us to question how public transit accessibility relates to the economic impact on Canada's workforce.

This paper investigates the relationship between public transit accessibility and labour market outcomes across 41 Canadian Census Metropolitan Areas (CMAs). By retrieving Statistics Canada data from 2023 and 2024, we analyze four key variables: the proportion of the working-age population (ages 15 to 64) with access to a nearby transit stop, the ratio of average transit to private vehicle commute times, total population size, and our estimand of interest, labour force participation rates. We then use a linear mixed effects model to evaluate the association between public transit and specific outcomes of the Canadian labour market: labour force participation rates. The mixed linear model appropriately allowed us to capture the average effects of the transit accessibility and demographic variables while handling the unique baseline differences across 41 CMAs.

The results indicate that the measures for transit accessibility are significantly associated with participation rates. For every one-unit increase in the percentage of working-age Canadians (15 to 64 years old) with transit access, participation rates rose. This suggestions physical proximity to a transit stop can be a key component for healthy labour force participation. Interestingly, the transit commute time relative to private vehicle time positively correlates with participation rates. This suggests that in dense urban centres, workforce engagement remains high despite the time-intensive commute on transit. Although not necessarily a proponent for transit, this may reflect that productive labour markets occur in larger and more densely populated municipalities. Ultimately, our findings suggest that workforce participation is highest in regions where transit is most accessible and heavily utilized. Transit investment points towards being more than just a sustainability initiative, showing its role in economic growth by enabling our labour force

In the following Data Section 2, the Census Metropolitan Areas (CMAs) and it's characteristics are described, with overviews of the datasets selected to begin our analysis (Statistics Canda 2021, 2023-2024). The Models Section 3 outlines the linear mixed effects model used to estimate the effect of transit accessibility on labour force participation rates. It is followed by a review of the model results in the Results Section 4. Finally, in the Discussion Section 5, we summarize the results and limitations of this analysis.

Statistical programming language R (R Core Team 2023) is used in this report, with packages tidyverse (Wickham et al. 2019), here (Müller 2020), ggplot2 (Wickham 2016), knitr (Xie 2014), tibble (Müller and Wickham 2023), and kableExtra (Zhu 2021). Python (Python Software Foundation 2024) was utilized, with packages pandas (The pandas development team 2024), matplotlib (Hunter 2007), seaborn (Waskom 2021), statsmodels (Seabold and Perktold 2010), and pyarrow (Apache Software Foundation 2024).

2 Data

2.1 Overview

We use the statistical programming language R (R Core Team 2023)…. Our data (Toronto Shelter & Support Services 2024)…. Following Alexander (2023), we consider…

Overview text

2.2 Measurement

Some paragraphs about how we go from a phenomena in the world to an entry in the dataset.

2.3 Outcome variables

Add graphs, tables and text. Use sub-sub-headings for each outcome variable or update the subheading to be singular.

Some of our data is of penguins (Figure 1), from Horst, Hill, and Gorman (2020).

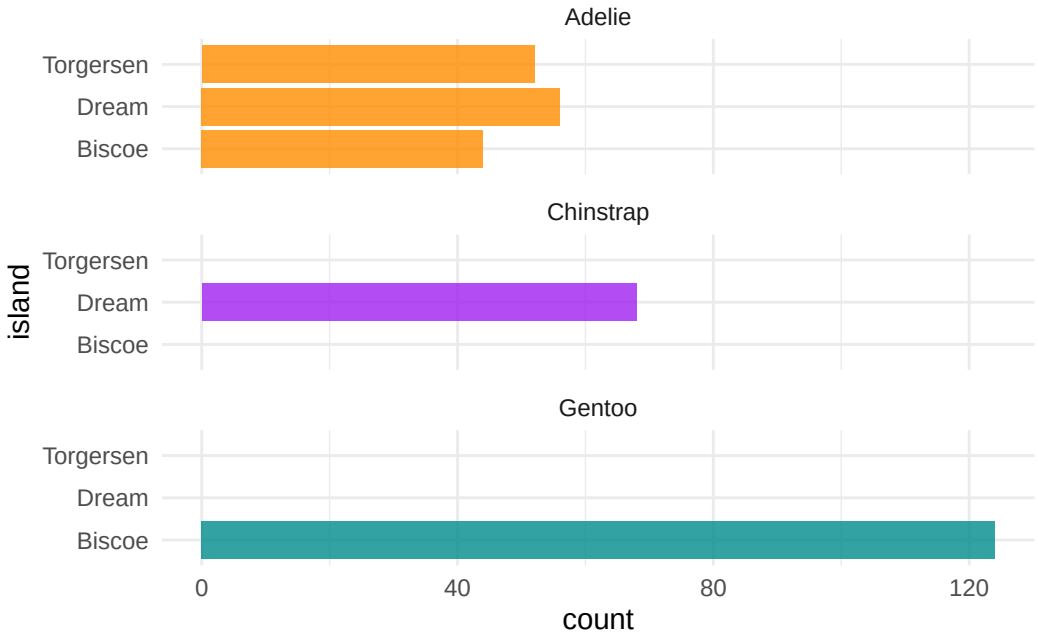

Figure 1: Bills of penguins

Talk more about it.

And also planes (fig-planes). (You can change the height and width, but don't worry about doing that until you have finished every other aspect of the paper - Quarto will try to make it look nice and the defaults usually work well once you have enough text.)

Talk way more about it.

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`.

3.1.1 Model justification

We expect a positive relationship between the size of the wings and time spent aloft. In particular...

We can use maths by including latex between dollar signs, for instance θ.

4 Results

Our results are summarized in tbl-modelresults.

5 Discussion

5.1 First discussion point

If my paper were 10 pages, then should be 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 fig-ppcheckandposteriorvsprior-1 we implement a posterior predictive check. This shows...

In fig-ppcheckandposteriorvsprior-2 we compare the posterior with the prior. This shows...

Examining how the model fits, and is affected
by, the data

B.2 Diagnostics

fig-stanareyouokay-1 is a trace plot. It shows... This suggests...

fig-stanareyouokay-2 is a Rhat plot. It shows... This suggests...

Checking the convergence of the MCMC algo-
rithm

References

Alexander, Rohan. 2023. *Telling Stories with Data*. Chapman; Hall/CRC. https://tellingstoriesswithdata.com/.

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.

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Toronto Shelter & Support Services. 2024. *Deaths of Shelter Residents*. https://open.toronto.ca/dataset/deaths-of-shelter-residents/.