

CANADA CRIME ANALYTICS

Prepared By

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SMART POLICY

Data Science. Decision Science. Hypothesis Testing. City Building



EXECUTIVE SUMMARY



Business



Policy



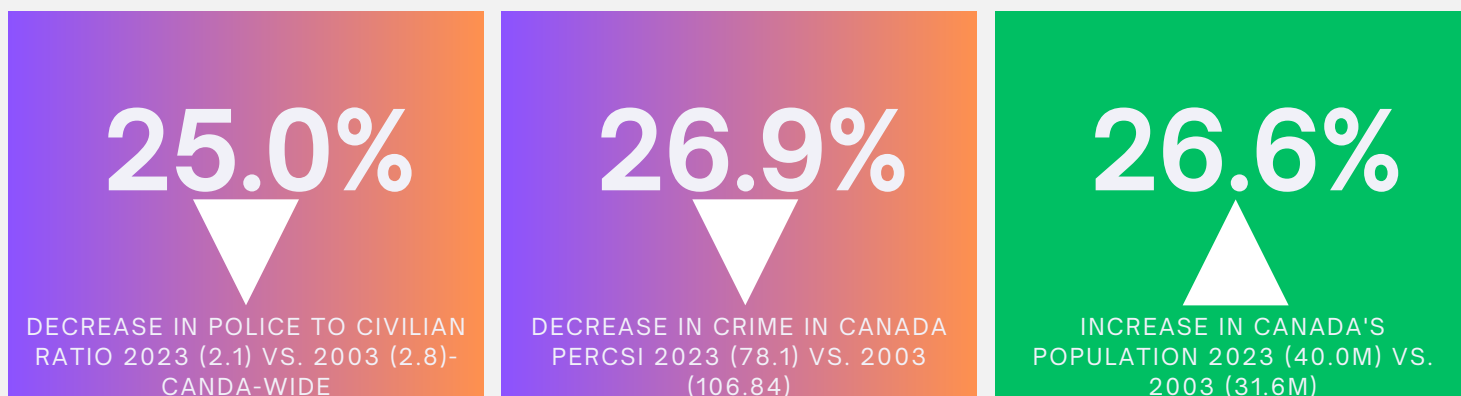
Municipal

Policy Problem: The Halifax Regional Municipality (HRM) in Nova Scotia (NS) is projecting a 9.7% tax increase, primarily via property taxes in the upcoming budget scheduled for release in April 2024. This analysis is at the request of the Unnamed Advocacy Group (UAG), which opposes the November 2023 Police Board Proposal to add 24 new personnel, 22 of whom are police staff, at a cost of \$4 million to the 2024/25 budget. HRM is consequently proposing a 6.3% increase in the police budget, amounting to \$5,787,100 citing population increase. Despite the opposition from nearly 40 people at the police board meeting, the police and city officials believe increasing police staff is necessary to maintain public safety and reduce crime in the H.R.M. This analysis examines the data around crime and policing.

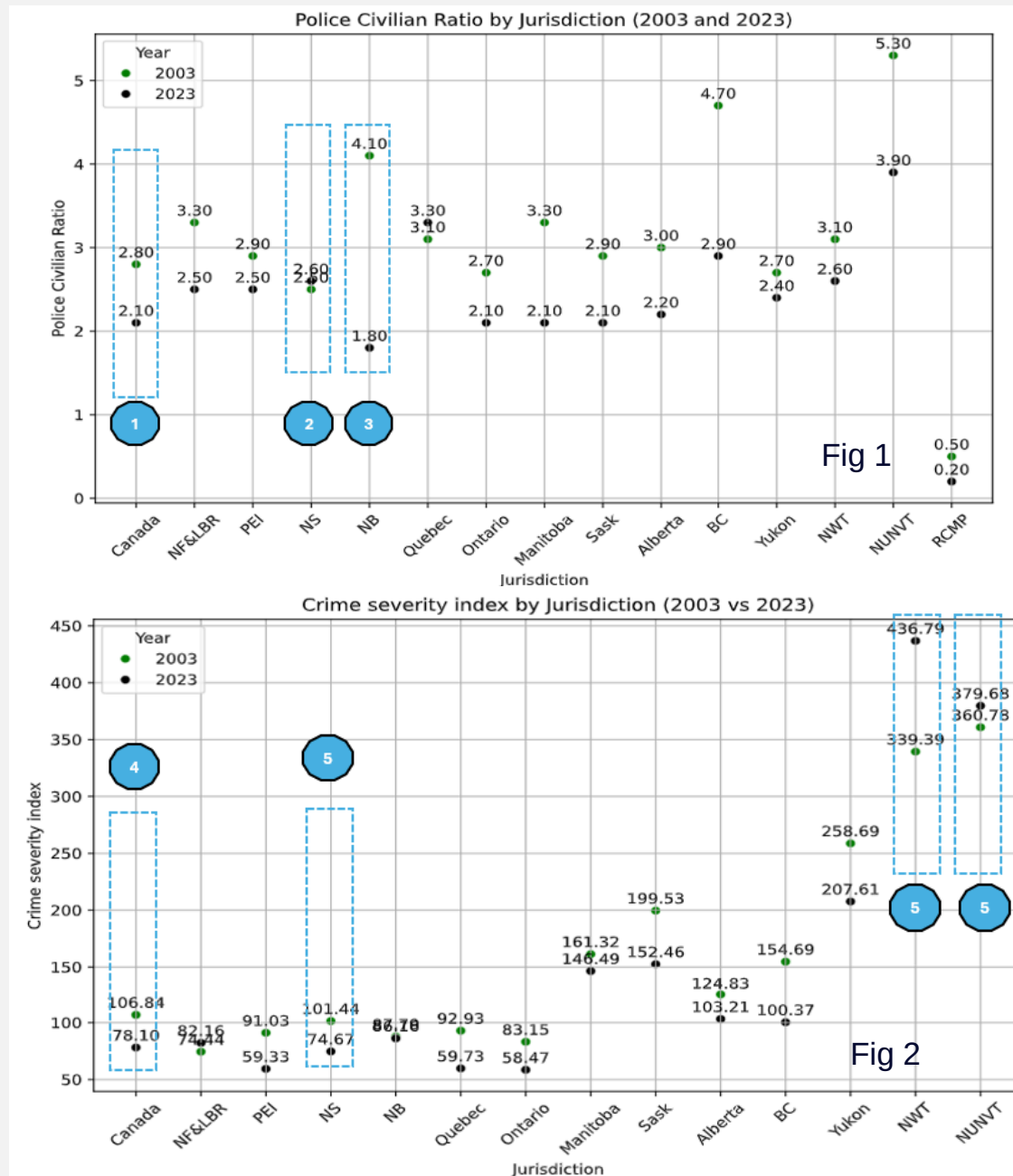
Project Goal: Is to answer the question - Do we need to hire more police to bring down crime per HRM's claim?

Key Result(s): In Canada, over the past 20 years (2023 vs. 2003), the Police-to-civilian ratio has gone down by 25%, within the same time period, Canada's population has increased by 26.6% and crime has decreased by 26.9%. This suggests more police may not translate to lower crime.

In Nova Scotia (mostly HRM), police-civilian ratio in 2023 is higher (2.6) vs. 2003 (2.5) against the overall Canadian trend (see key findings, next slide)

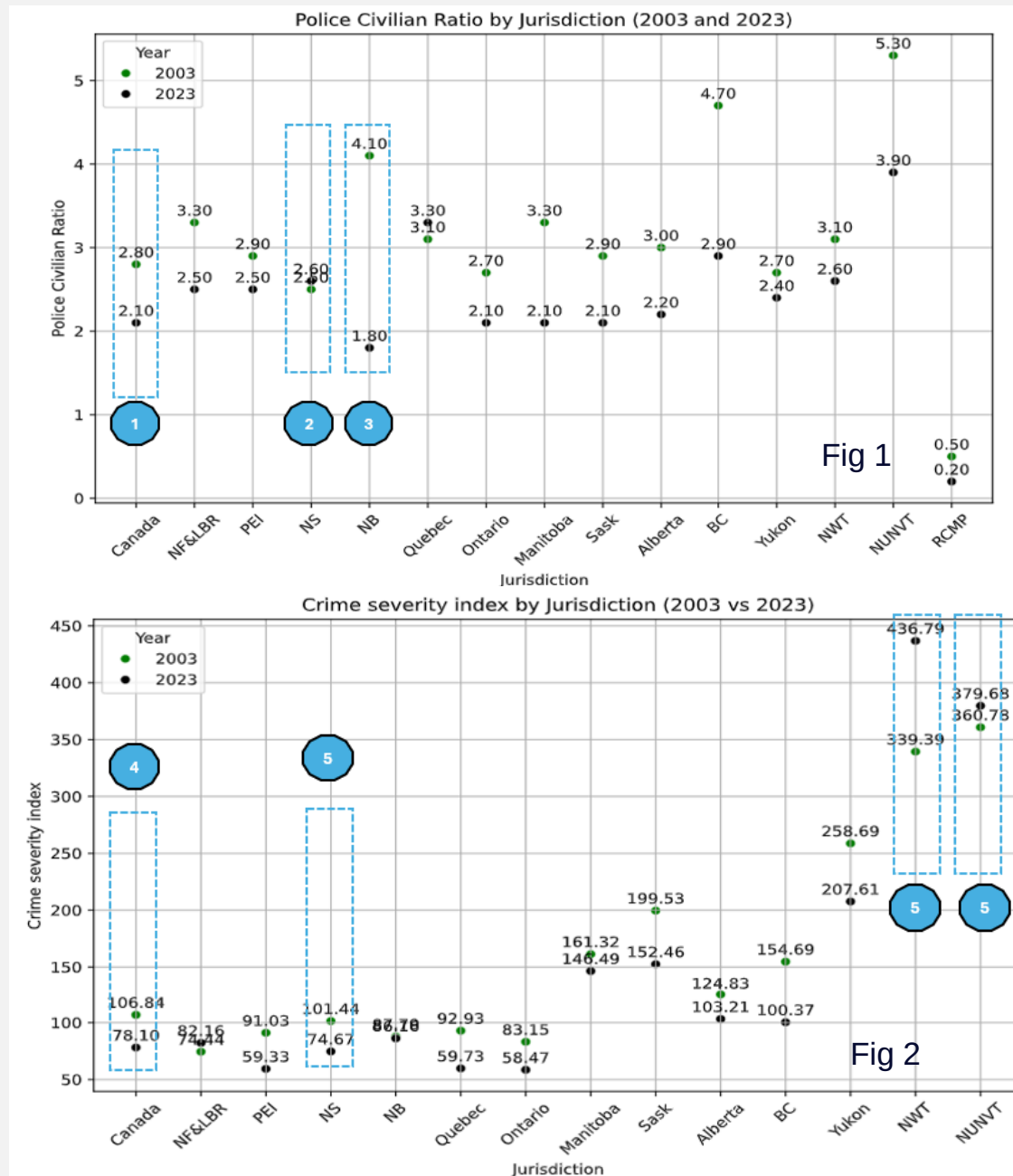


KEY FINDINGS - 1



1. Over the past 20 years, comparing 2023 to 2003, the police-to-civilian ratio has **decreased by 25%** across Canada from 2.80 to 2.10
2. The province of Nova Scotia (with mostly H.R.M) reflects an increase in police-to-civilian ratio comparing 2023 at 2.6 to 2003 at 2.5 - a **3.8% increase** and against the overall trend in Canada.
3. New Brunswick -A neighbouring province to NS recorded the largest drop in police-to-civilian ratio from 4.10 to 1.80 during the same period. A **62% decrease** and largest in Canada

KEY FINDINGS - 2



- In Canada, although the police-to-civilian ratio has **decreased by 25%** as shown in figure 1, crime has also **decreased** over the same comparative years (2003 vs 2023) by **26.9%** -from 106.84 crime severity index (C.S.I) to 78.10 as shown in figure 2
- In Nova Scotia (NS), crime is down in 2023 vs 2003 in line with overall Canada trend. Crime measured by C.S.I has **decreased by 26.4%** in 2023 vs 2003. From 101.44 to 74.62. New Brunswick: Due to proximity and being in the same region as NS (H.R.M), the crime severity index in absolute terms dropped from 87.79 to 86.16 - in statistical terms (95% confidence) crime remained unchanged but still insightful considering the large drop in police-to-civilian ratio



CONCLUSION & RECOMMENDED NEXT STEPS

- This analysis challenges the notion that a growing H.R,M population necessitates more police to keep crime down.
- The data reveals significant positive deviance in New Brunswick, showing a 62% decrease in the police-to-civilian ratio without a statistically significant impact on the crime rate when comparing 2003 figures to 2023. A recommendation beyond the scope of this work is to conduct a focused jurisdictional scan on New Brunswick.
- There is a caution: while this data analysis challenges the idea that population growth alone justifies hiring additional police, it cannot rule out other factors that may indeed necessitate more police.
- Ifurther analysis beyond the scope of this engagement is recommended to obtain a more comprehensive understanding. For example, a more complete picture may emerge if budget spending or police budget spending per capita is included in the comparison metrics. New Brunswick's security cost structure, matched with its per capita spending on police against its relatively low police-to-civilian ratio, may uncover valuable lessons

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STATISTICAL SUMMARY

Hypothesis Testing: Significance Test

1. Business / Policy Question: Is there a drop or difference in crime in New Brunswick (NB) in 2023 versus 2003 especially considering the large drop in police to civilian ratio?

- H_0 = There is no difference or impact on crime measured by the crime severity index (C.S.I) in 2003 vs 2023 despite drop in police ratio
- H_1 = There is a difference (drop or increase in crime) in 2003 vs 2023.

Result:

Statistical test at a 95% confidence level shows that crime in New Brunswick, measured by the crime severity index did not change when comparing 2023 crime severity index for NB vs 2023. Recall that over this time, the Province of New Brunswick saw the largest drop in police-to-civilian ratio from 4.10 in 2003 to 1.80 in 2023. New Brunswick's police-to-civilian ratio in 2023 of 1.80 was still below Canada's 2.10 average while maintaining relatively low levels of crime.

Next Step(s)

What can other provinces learn from New Brunswick ?;
How does cost instead of police-civilian-ratio help us better understand and qualify the positive deviance that is NB and extract lessons that can be applied to maintain low crime rate and low police-to-civilian ratio

STATISTICAL SUMMARY

Hypothesis Testing - other out of scope questions

Based on this data and exploratory analysis: Here is some potential policy and business questions and some hypothesis worth investigating.

1. Business / Policy Question: Is there an impact/difference in crime resolution based on the ratio of police to civilians in Canada ? This question relates to weighted clearance rate values across Canada and within each Province

- H_0 = There is no impact on crime resolution (weighted clearance rates) in 2003 vs 2023 based on change in police to civilian ratio
- H_1 = There is an impact on crime resolution in 2003 vs 2023

2. Business or Policy Question: Is there an impact / difference in crimes resolved (weighted clearance rates) in 2003 vs 2023 considering the difference in overall security spend ?

- H_0 = There is no impact of security spend on crime resolution (in 2003 vs 2023)
- H_1 = There is an impact of increased security spend in 2023 vs 2003 in crime resolution.

STATISTICAL SUMMARY

Hypothesis Testing: Code

1. Business / Policy Question: Is there a drop or difference in crime in New Brunswick (NB) in 2023 versus 2003 especially considering the large drop in police to civilian ratio?

- H_0 = There is no difference or impact on crime measured by the crime severity index (C.S.I) in 2003 vs 2023 despite drop in police ratio
- H_1 = There is a difference (drop or increase in crime) in 2003 vs 2023.

Observation from exploratory data analysis: The Province of New Brunswick saw the largest drop in police-to-civilian ratio between 2003 and 2023 (20 years)

The related business and policy question: Is there an impact in crime rate in NB in 2003 vs 2023?

Statistical translation:

NULL: There is no statistically significant difference in crime rates in the province of New Brunswick (NB) in 2003 vs 2023

Alternative: There is a statistically significant difference in crime rates in NB over the past 20 years (2003 vs 2023)

Assuming normality:

Level of Significance is 5%

```
[ ] # Extracting mean value for crime severity index in 2023 for NB
province_name = 'NB'
nb_data = filtered_df2.loc[filtered_df2['JURISDICTION'] == province_name]

# Get the crime severity indices for the years 2003 and 2023 for NB
nbcrime_rate_2023 = nb_data.loc[nb_data['REF_DATE'] == 2023, 'VALUE'].values[0]
nbcrime_rate_2003 = nb_data.loc[nb_data['REF_DATE'] == 2003, 'VALUE'].values[0]

print(f"The crime rate for {province_name} in 2023 is: {nbcrime_rate_2023:.2f}")
print(f"The crime rate for {province_name} in 2003 is: {nbcrime_rate_2003:.2f}")
```

The crime rate for NB in 2023 is: 86.16
The crime rate for NB in 2003 is: 87.79

```
[ ] # Perform a two-sample t-test with equal variances
t_value, p_value = stats.ttest_ind(nbcrime_rate_2003, nbcrime_rate_2023, equal_var=True)
# Check if the p-value is less than alpha (0.05)
if p_value < 0.05:
    print("Reject the null hypothesis: Means are different.")
else:
    print("Fail to reject the null hypothesis: Means are not significantly different.")
print("t_value = ", t_value, ", p_value = ", p_value)
```

Fail to reject the null hypothesis: Means are not significantly different.

TABULAR SUMMARY

Police-to-Civilian Ratio

JURISDICTION	2003	2023
Alberta	3	2.2
BC	4.7	2.9
Canada	2.8	2.1
Manitoba	3.3	2.1
NB	4.1	1.8
NF&LBR	3.3	2.5
NS	2.5	2.6
NUNVT	5.3	3.9
NWT	3.1	2.6
Ontario	2.7	2.1
PEI	2.9	2.5
Quebec	3.1	3.3
RCMP	0.5	0.2
Sask	2.9	2.1
Yukon	2.7	2.4

Crime Severity Index

JURISDICTION	2003	2023
Alberta	124.83	103.21
BC	154.69	100.37
Canada	106.84	78.1
Manitoba	161.32	146.49
NB	87.79	86.16
NF&LBR	74.44	82.16
NS	101.44	74.67
NUNVT	360.78	379.68
NWT	339.39	436.79
Ontario	83.15	58.47
PEI	91.03	59.33
Quebec	92.93	59.73
RCMP	nan	nan
Sask	199.53	152.46
Yukon	258.69	207.61

ABOUT THE DATA SET

The data-set was fetched from Statistics Canada (website) and captures policing and crime data in Canada from 1986 to 2023. The raw data consist of 15 different features (columns) that consists of integers, objects and floats with about 7770 rows of data see figure below. Object like “Geo” and “statistics” were are strings renamed to *Jurisdiction* and *Description* respectively.

7771

['REF_DATE', 'GEO', 'DGUID'	
REF_DATE	int64
GEO	object
DGUID	object
Statistics	object
UOM	object
UOM_ID	int64
SCALAR_FACTOR	object
SCALAR_ID	int64
VECTOR	object
COORDINATE	float64
VALUE	float64
STATUS	object
SYMBOL	float64
TERMINATED	object
DECIMALS	int64

Data Source Citation: Statistics Canada. Table 35-10-0064-01 Crime severity index and weighted clearance rates, police services in the Territories

GITHUB REPOSITORY

https://github.com/YNWA-Algo/Canada-Crime-Analytics/Police_Canada_Crime.ipynb

