Calgary Unemployment Analysis

A Statistical Analysis project

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Introduction

Calgary, the largest city in Alberta, has historically experienced fluctuations in its unemployment rate due to its close ties to the oil and gas industry. As a key economic hub in western Canada, Calgary's job market is influenced by global energy prices, government policies, and economic diversification efforts.

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Background

During the past decade, Calgary has faced economic challenges, including downturns in the energy sector, the impact of the COVID-19 pandemic, and shifts in labor demand between industries. Although efforts have been made to expand sectors such as technology, finance, and renewable energy, employment trends continue to be shaped by market conditions.

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Background

Understanding regional economic trends requires a close look at employment data. In this analysis, we will examine and compare the unemployment rates in Calgary, Alberta, and Canada as a whole, using data from January 2020 to June 2021. By understanding these rates, we aim to identify potential disparities and gain insight into how Calgary's employment situation aligns with both the broader provincial and national trends. This comparison will shed light on the relative economic health of Calgary within Alberta and Canada, highlighting areas of strength or vulnerability.

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The data

Date	Calgary	Alberta	Canada
2020-01-01	0.07	0.07	0.06
2020-02-01	0.07	0.07	0.06
2020-03-01	0.08	0.08	0.06

Table: Unemployment Rates

The Data

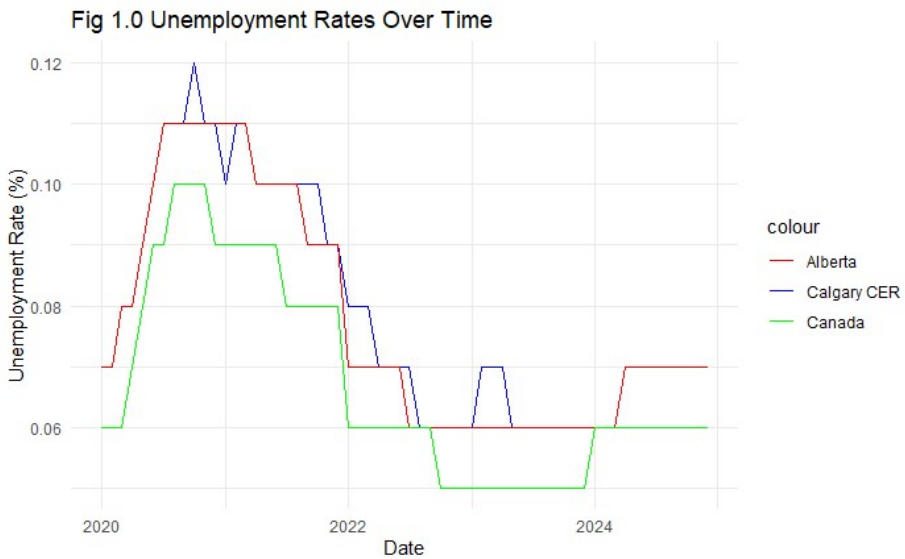

Figure: Unemployment rates.

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How is the data distributed?

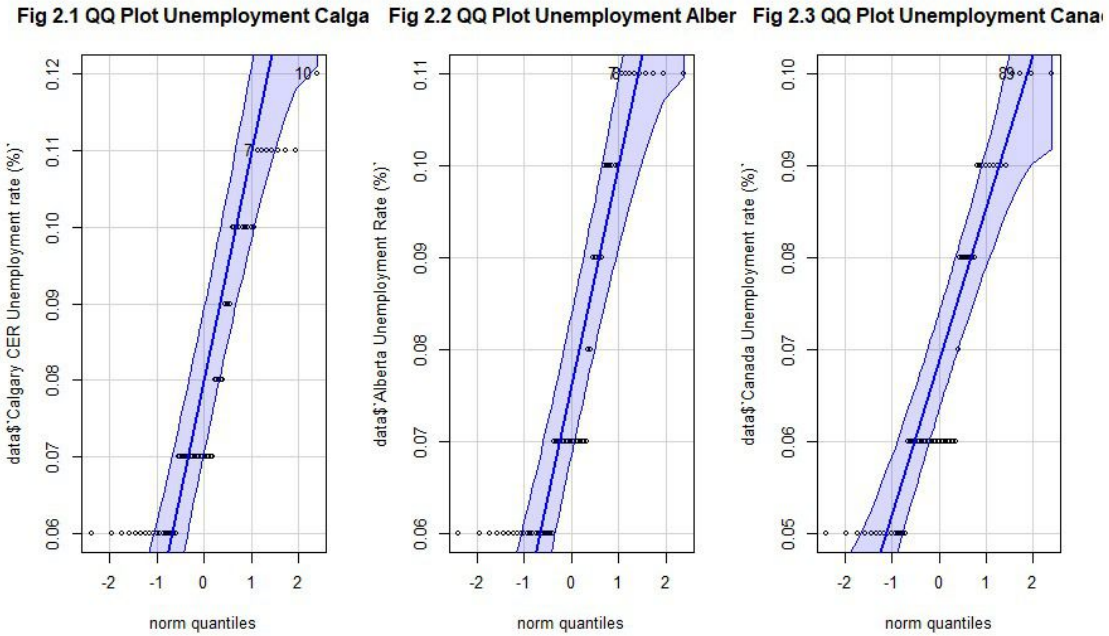

Figure: distribution.

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Hypothesis testing

Let the null hypothesis be that the difference in mean of both unemployment rates is 0.

$H0 : \mu 1 - \mu 2 = 0$

Let the alternate hypothesis be the opposite.

$H1 : \mu 1 - \mu 2 \neq 0$

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Hypothesis testing(Calgary & Alberta)

Then, p-value=0.6604,
95 percent confidence interval: [-0.00544653, 0.008244653]

Thus, The null hypothesis (Calgary vs Alberta) is not rejected: There are no significant differences in the mean unemployment rates.

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Hypothesis testing(Alberta & Canada)

Then, p-value = 0.001684,
95 percent confidence interval: [0.003969651, 0.016697015]]

The null hypothesis (Alberta vs Canada) is rejected: There is a significant difference in the mean unemployment rates.

Hypothesis testing(Calgary & Canada)

Then, p-value = 0.0003279,
95 percent confidence interval: [0.005503419, 0.018163248]

The null hypothesis (Calgary vs Canada) is rejected: There is a significant difference in the mean unemployment rates.

permutation tests

However these results are based on a t-test where we assume the distributions are approximately normally distributed; there is another way to conduct the test based on permutations.This involves resampling the data and calculating the p-value, this provides a 'simulated' result with sampled data and is more accurate as it does not assume any distribution of the proportion.

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Permutation testing (Calgary vs. Alberta)

p-value = 0.6955
95% CI: -0.0065 to 0.0065

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Permutation testing (Alberta vs. Canada)

p-value = 0.0012
95% CI: -0.006666667 to 0.006333333

Permutation testing (Calgary vs. Canada)

p-value = 2e-04
95% CI: -0.0065 to 0.0065

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Comparision

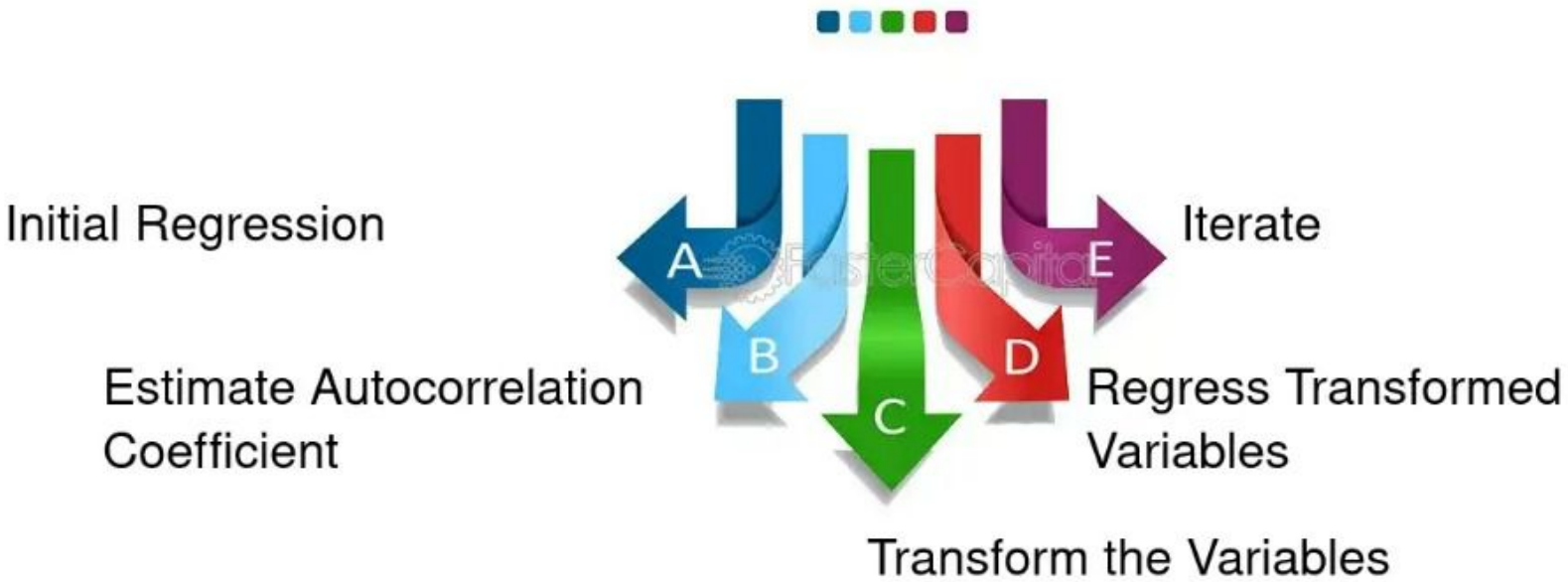
Comparison	Lower_Bound_Perm	Upper_Bound_Perm	Lower_Bound_Ttest	Upper_Bound_T-test
Calgary vs. Alberta	-0.0063333	0.0065000	-0.0052447	0.0052447
Alberta vs. Canada	-0.0066667	0.0066667	0.0039697	0.0166970
Calgary vs. Canada	-0.0065000	0.0065000	0.0055034	0.0181632

Table: Confidence interval from permutations vs confidence interval from t-test

Regression Analysis(cochrane-orcutt)

The Cochrane-Orcutt regression method is used to correct for autocorrelation (especially first-order autocorrelation) in time series regression models.Interactive method used to solve first-order autocorrelation problems. This procedure estimates both autocorrelation and beta coefficients recursively until we reach the convergence or where the difference between successive error terms stabilizes. The Durbin-Watson test is used to find autocorrelation in the residuals from the statistic model.

Understanding the Cochrane-Orcutt Procedure



Durbin-Watson test

To decide whether we need Cochrane-Orcutt, we check for autocorrelation in the residuals using the Durbin-Watson test

If DW statistic is close to 2, no autocorrelation.
If DW <2, positive autocorrelation (Cochrane-Orcutt should be applied).
If DW >2, negative autocorrelation.

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Cochrane-Orcutt

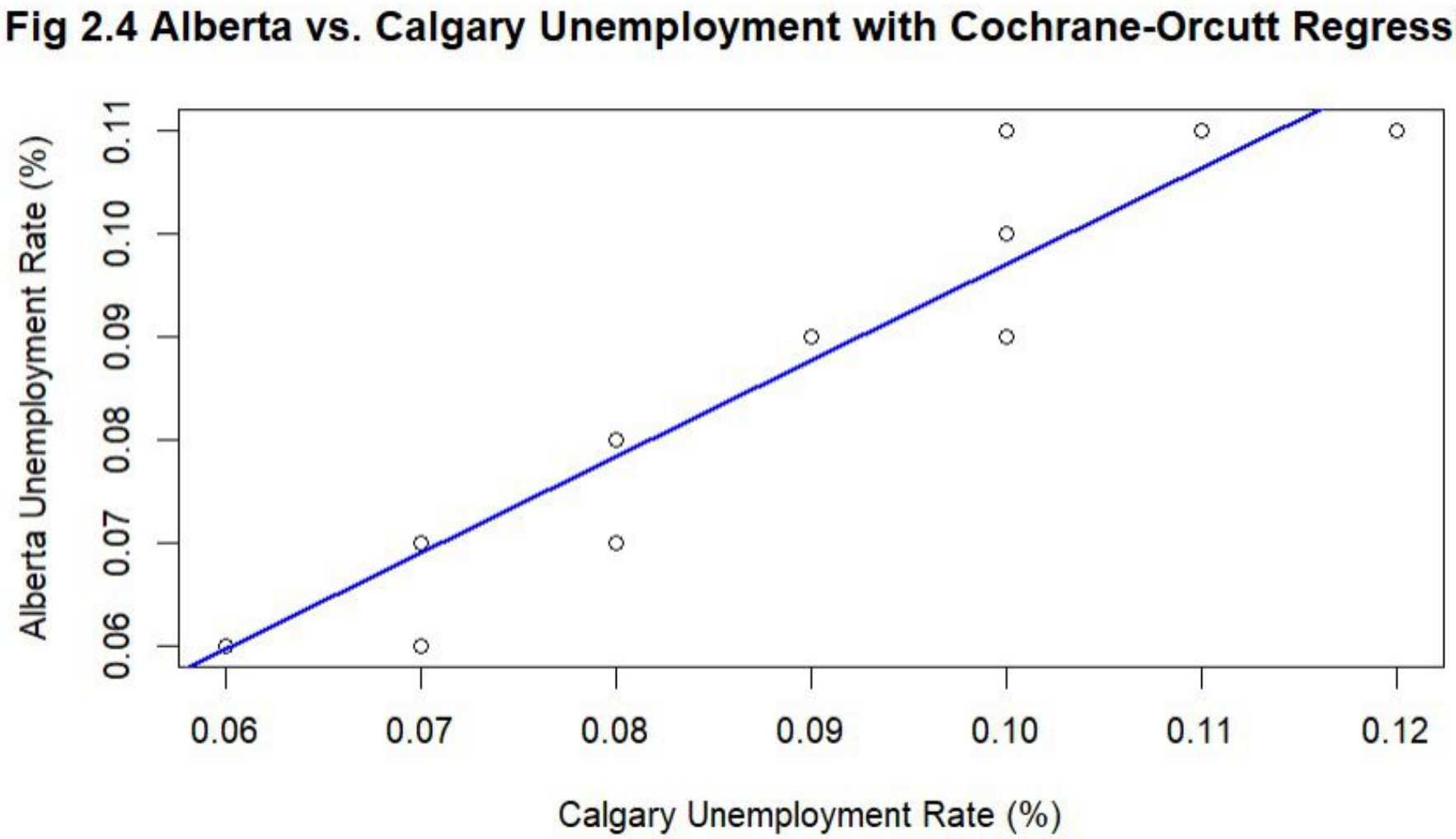

Figure: Regression plot

Cochrane-Orcutt

After performing the cochrane-orcutt estimation the coefficients obtained were 0.003817468 0.932498796, wherein the Intercept is 0.003817468 and the slope, of Calgary unemployment rate, is 0.932498796.
The intercept suggests that when the Calgary unemployment rate is 0%, the Alberta unemployment rate is estimated to be approximately 0.38%. It is crucial to consider if a 0% unemployment rate for Calgary is realistic within the context of the data. This is the key coefficient. It indicates that for every 1 percentage point increase in the Calgary unemployment rate, the Alberta unemployment rate is predicted to increase by approximately 0.93 percentage points, after accounting for the autocorrelation in the data.

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Cochrane-Orcutt(Durbin-Watson test)

Test result from linear model : DW = 1.2255, p-value = 0.0005343

Test result from cochrane orcutt model : DW = 1.9649, p-value = 0.4001

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Summary

the regression model is given as:

Alberta Unemployment Rate (%) = 0.003817468 + 0.932498796 * Calgary CER Unemployment rate (%) + error

Alberta Unemployment Rate (%) is the dependent variable. Calgary CER Unemployment rate (%) is the independent variable. 0.003817468 is the intercept. 0.932498796 is the slope (the coefficient for the Calgary unemployment rate). error represents the unexplained variation in Alberta's unemployment rate. This error term is assumed to have n autocorrelation due to the Cochrane-Orcutt correction.

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In simple terms: The model estimates that Alberta's unemployment rate is approximately 0.38% when Calgary's unemployment is at 0%. For each 1% increase in Calgary's unemployment, Alberta's unemployment is predicted to increase by about 0.93

Contributions

- Ammar - Data & Testing the normality
- Ria - T-tests, Hypothesis testing
- Gautham - Permutation Testing
- Romith - Regression analysis & Documentation

Thank You!!!

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