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Modelling the impact of unemployment on Calgary Food Bank usage

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Calgary Food Bank

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Joseph Mercado

I) Introduction

- If unemployment increases by one percent, how much more food will the Calgary Food Bank (CFB) distribute?
- CFB serves the city's working poor, unemployed, and vulnerable.
- A predictive model was created, which also describes how food distribution has historically been impacted by unemployment.

II) Research approach

- Data for monthly food hamper distribution was collected from CFB's client database.
- Data for Calgary's monthly unemployment rate (seasonally unadjusted) was collected from Statistics Canada.
- Data for Calgary's monthly population was collected from Statistics Canada.
- Data from sources organized into sets according to month and year.
- 153 sets of observations (Sep. 2004 - May 2017).
- Various statistical tests at 5% significance.

Pictured on the right is a food hamper being assembled. They are packages that contain enough food for a week and are distributed to CFB's clients.

III) Results

- There is a positive relationship between unemployment and hamper distribution, which can be utilised to create linear models.
- Population and month was included in final model alongside unemployment to increase modelling precision.
- 88.59% of the variation in food distribution can be explained by the final model.

IV) Seasonal trends

Food hamper distribution peaks during December
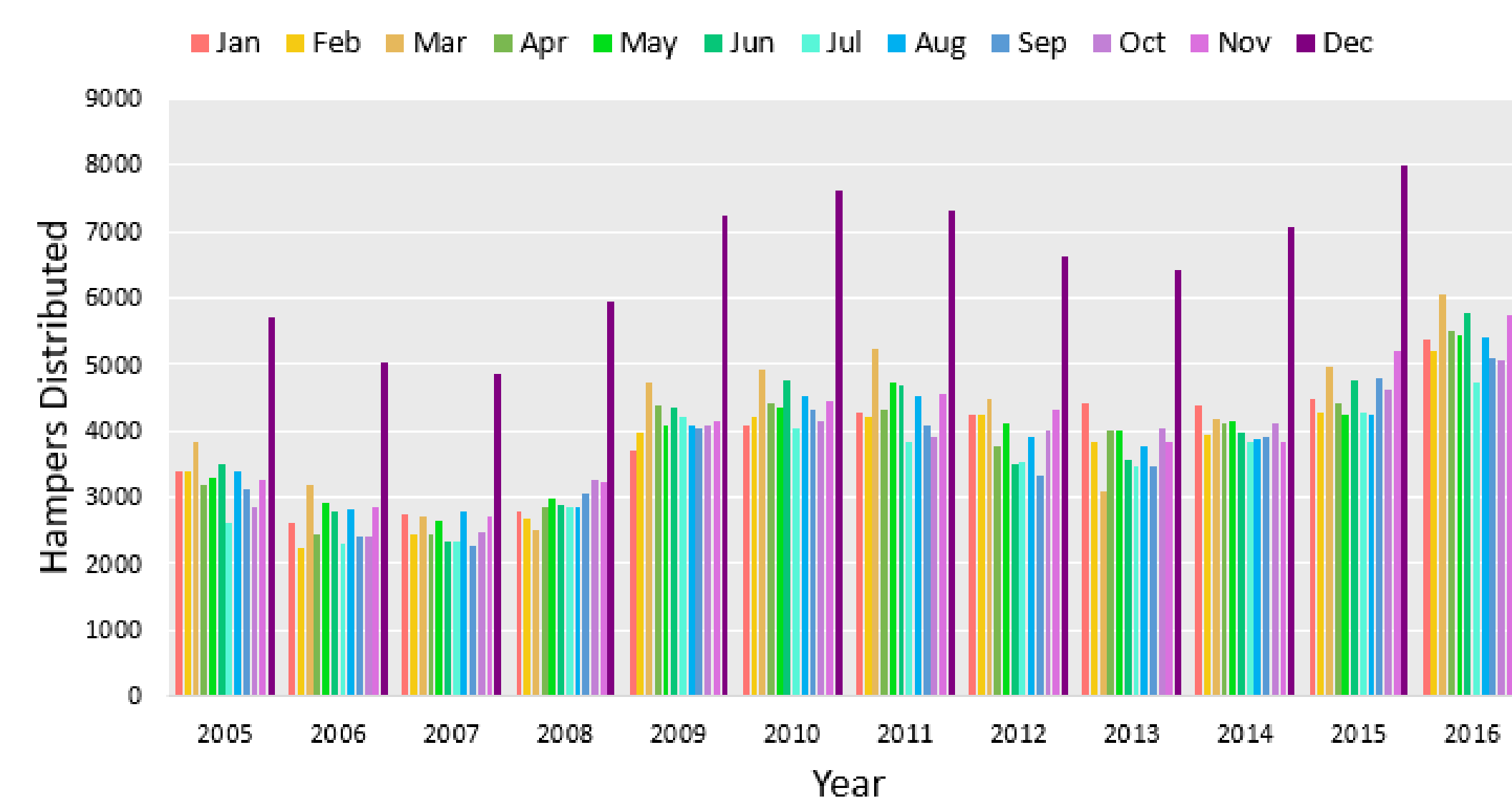
- Mean (average) monthly distribution during December is significantly greater compared to other months (T-tests/$p < 0.05$).
- CFB employees say difference is due to increased need, donations, and capacity during the holidays.
- Mean distribution between non-December months are not significantly different (ANOVA/$p = 0.907$).
- Accounting for whether or not distribution occurred in December increased modelling precision (SLR $R^2 = 0.4092$ to MLR with December dummy variable adj. $R^2 = 0.8552$).

Food hamper distribution and unemployment are strongly correlated

Legend: — Hamper Distribution — Unemployment Rate (%)
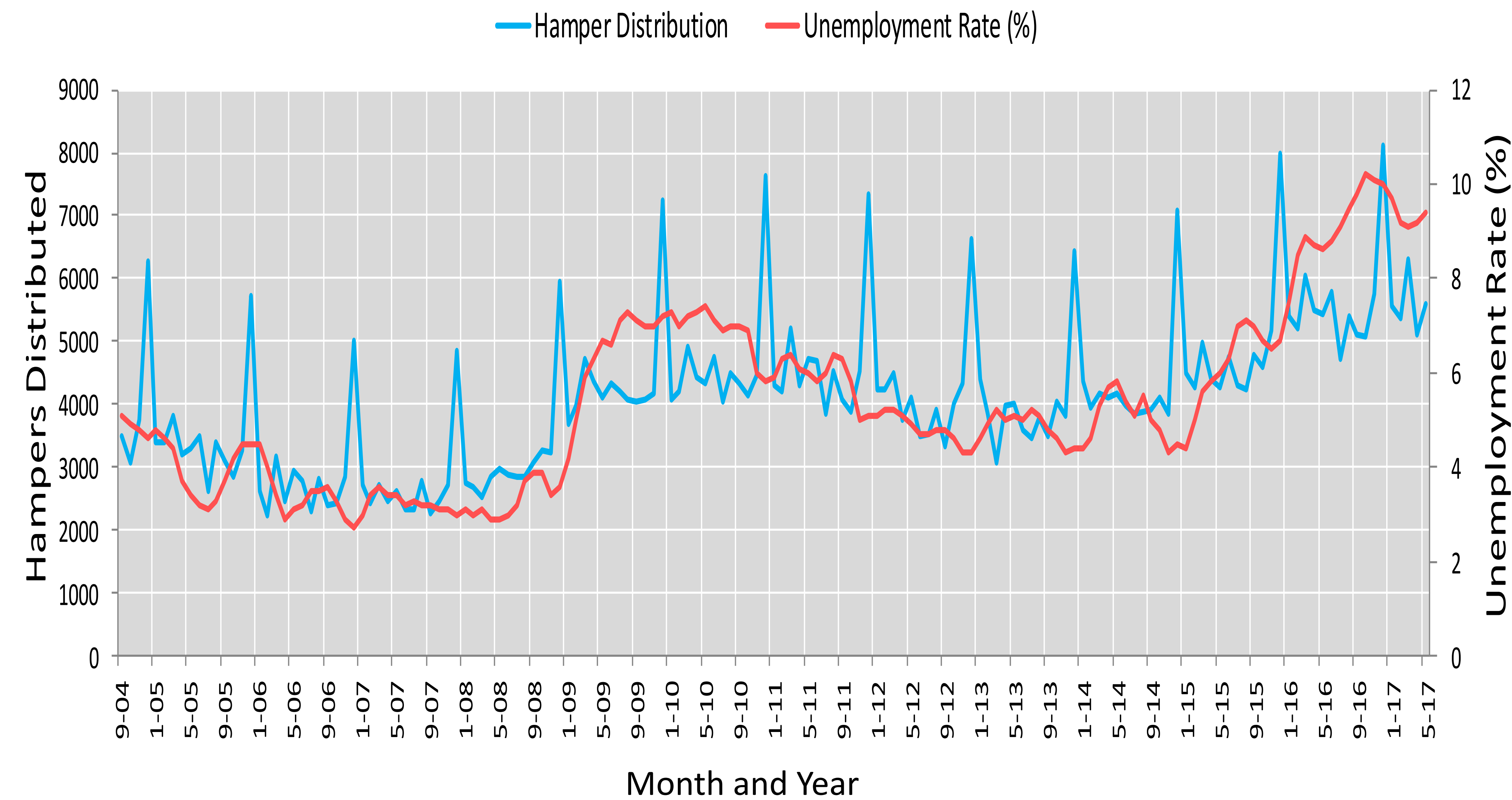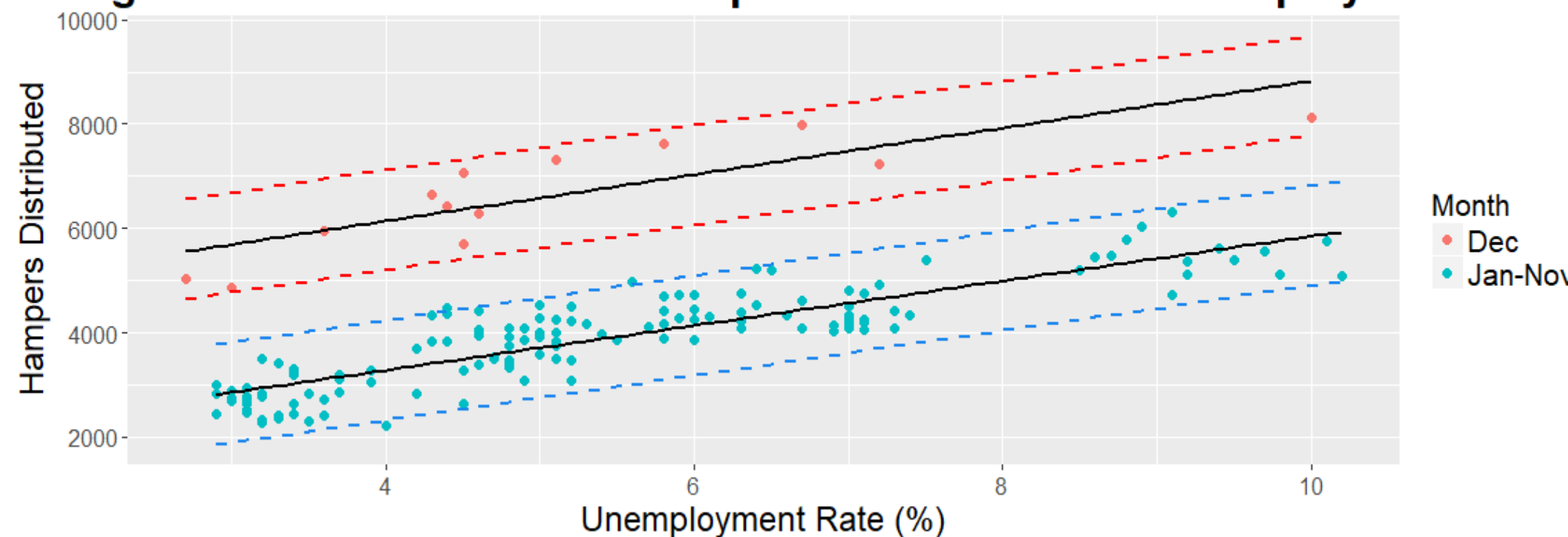
V) Unemployment

Positive relationship between hamper distribution and unemployment
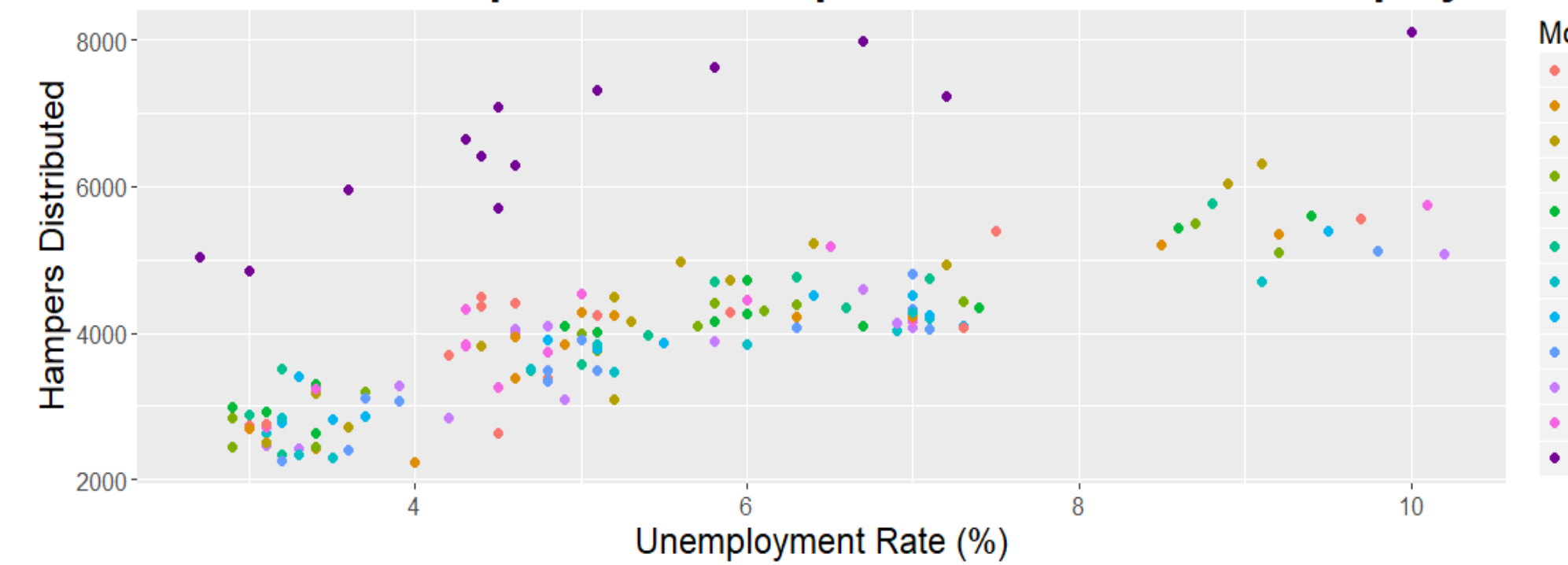
- Minimum unemployment rate recorded: 2.7%
- Maximum unemployment rate recorded: 10.2%
- Hamper distribution can be modelled as a positive, linear function of unemployment rate and December variable (MLR adj. $R^2 = 0.8552$).
- Hamper distribution model was improved upon by incorporating population variable.

Pictured below is the lines of best fit (solid lines) and the prediction intervals (dashed lines) for hamper distribution regressed against unemployment rate and the December variable.

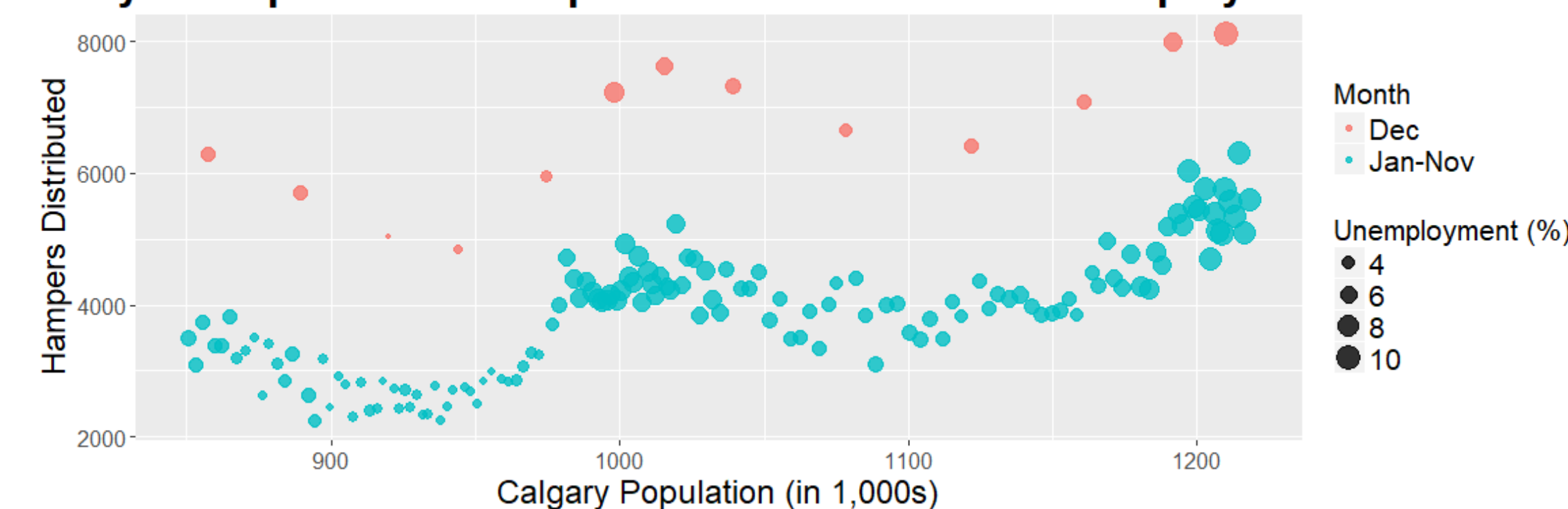### Regression model between hamper distribution and unemployment

VI) Population

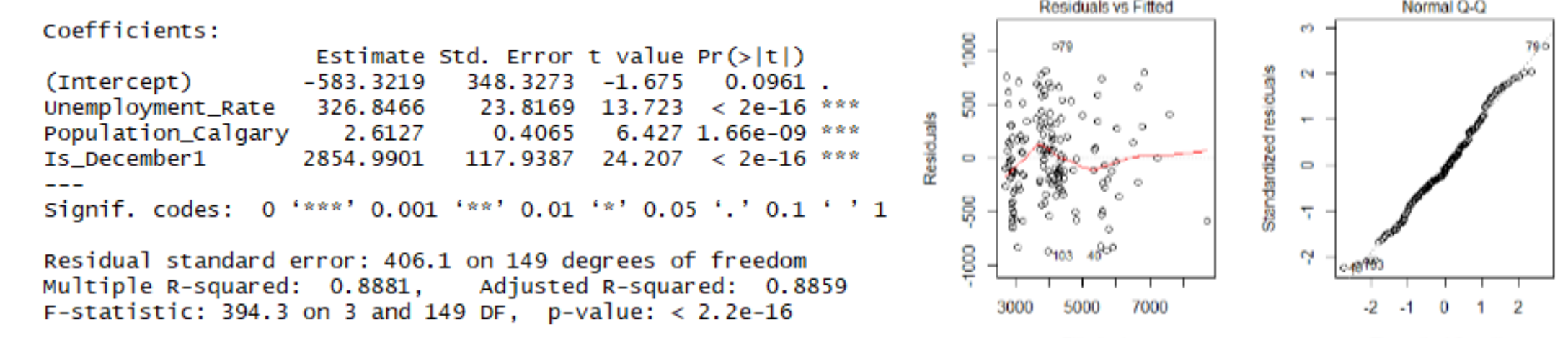### Positive relationship between hamper distribution and population
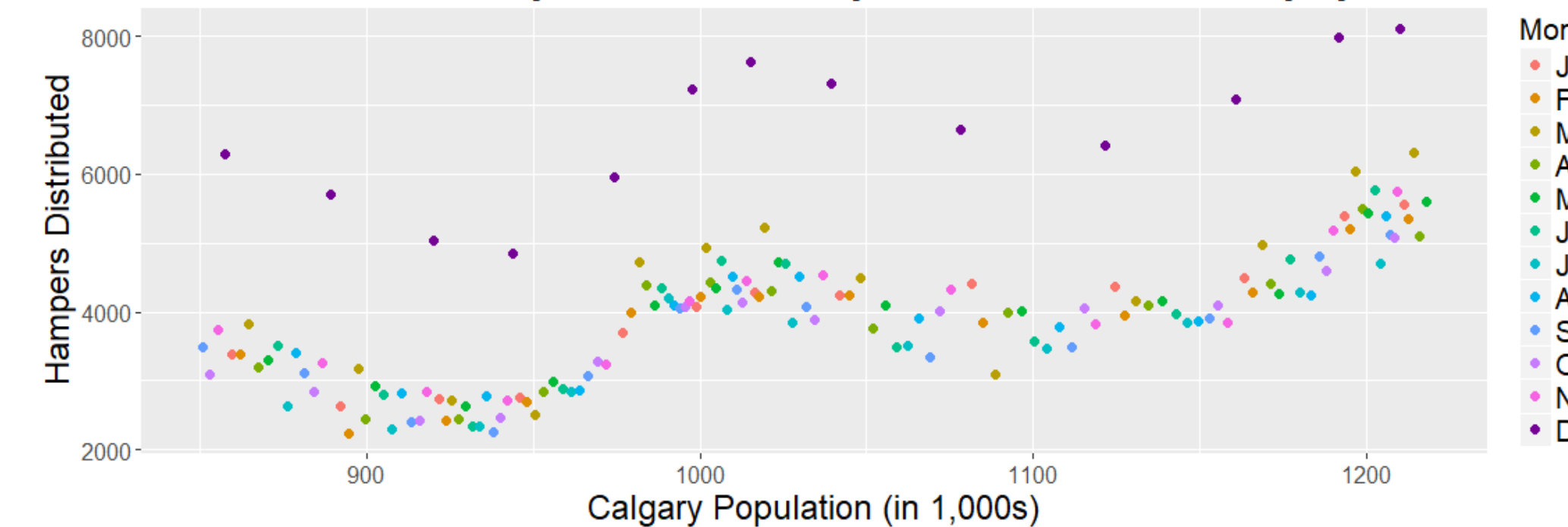
- More individuals could be using the food bank due to more people living in Calgary, regardless of unemployment.
- It would be beneficial to account for population growth/decline when making a statement regarding the impact of unemployment on food bank usage.
- Minimum population recorded (in 1,000s): 850.6
- Maximum population recorded (in 1,000s): 1218.1
- Hamper distribution can be modelled as a positive, linear function of population and December variable (MLR adj. $R^2 = 0.7434$).

Cyclical pattern in hamper distribution due to unemployment

VII) Final model

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)   -583.3219   348.3273 -1.675   0.0961 .
Unemployment_Rate 326.8466   23.8169 13.723 < 2e-16 ***
Population_Calgary   2.6127   0.4065   6.427 1.66e-09 ***
Is_December1   2854.9901   117.9387 24.207 < 2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 406.1 on 149 degrees of freedom
Multiple R-squared: 0.8881,   Adjusted R-squared: 0.8859
F-statistic: 394.3 on 3 and 149 DF, p-value: < 2.2e-16

VIII) Conclusions

I) Based on the data collected, the following can be concluded:

- Taking into account the effect of Calgary's population growth and the month of December on food bank demand, a one percentage point increase in the city's unemployment rate is associated with an **average** increase of 327 hampers distributed in a month.
- Controlling for unemployment rate and December distributions, a net increase of 1,000 individuals in the city is associated with an **average** monthly increase of 2.61 hampers distributed.
- Given the same unemployment rate and population, an **average** of 2,855 more hampers will be distributed on the month of December compared to a non-December month.

II) Equation for average monthly food hamper distribution:

Average Food Hampers Distributed = (327 x Unemployment Rate) + (2.61 x Calgary Population*) + (2,855 x December**) - 583***

* Population is in terms of 1,000s of individuals.

**December = 0 if month is between January and November. Else, December = 1.

***Constant term is statistically insignificant when all other variables equal 0.

III) To predict future hamper demand in a certain month:

Based on the largest difference between prediction and average estimates from the observed data, CFB should allow for a range of error of **851 hampers** if they wish to predict food bank usage.

Prediction Model = Average Food Hampers Distributed ± 851 Hampers

IX) Limitations

- Autocorrelation: Data collected exhibited non-independent characteristics. Alternative model can be made with time-series analysis.
- Model is based on the data collected and may change if same analysis is done but with additional data from future observations.
- Model is prone to extrapolation due to population variable.
- Can possibly incorporate more variables to explain food bank usage.

X) Sources

- Calgary Food Bank (2017, June). [Web-DAD client database]. Unpublished data.
- Statistics Canada (2017, June). [Labour Force Survey]. Canadian Socioeconomic Database (CANSIM) table 282-0135.

XI) Acknowledgements

CALGARY FOOD BANK

I would like to thank the Calgary Food Bank for giving me the opportunity to access their database and conduct student research over the summer. Thank you for the mentorship, support, and amazing experience.

Questions? Contact joseph.mercado@ucalgary.ca