Conservative Party Actually Wins the Popular Vote in the 2019 Canadian Federal Election with a Full Voter Turnout

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Abstract

In the last Canadian Federal Election, the Liberal Party narrowly won the most of the seats in the parliament and its biggest adversary the Conservative Party has gained more seats than the last election. In this paper, we aim to identify how the 2019 Canadian Federal Election would have been different if "everyone" had voted. We ran a multilevel logistic regression model using observations from the results of online survey data provided by the 2019 Canadian Election Study (CES). To provide more robust conclusion, we utilize the regression with post-stratification method using 2017 General Social Survey (GSS) data provided by Statistics Canada. Our research finds out that Conservative actually wins the popular vote. Hence, our finding shows the importance of converting people to your cause, getting them to turn out to vote, and how the two are linked.

Keywords: 2019 Canadian Federal Election; Liberal; Conservative; Multilevel regression with post-stratification; Voter turnout

1 Introduction

Voter turnout has been declining in recent Canadian federal elections[Ouellet, 2019]. Just over three-quarters (77.1%) of Canadians reported voting in the 2019 Federal Election. Statistics Canada conducted a supplement to the November 2019 Labour Force Survey that asked respondents about the voting in the October 21, 2019, federal election. Among the 22.9% of Canadians who did not vote in 2019 Federal Election, the main 18 different reasons collected were grouped into four categories: Everyday life reasons (45.9%), Political reasons (41.9%), Electoral process reasons (5.4%), All other reasons (6.8%)[Government of Canada, S. C., 2020, February 26]. For the nation's democracy to function properly and for the government to provide fair representation, all eligible Canadians must have the opportunity to vote and be encouraged to do so.

Even though the final result of the Canadian federal elections involves a stable percentage of non-voting, does it really have an effect on the election outcome? We are interested in identifying how the 2019 Canadian Federal Election might be changed with a full voter turnout. To accomplish this, we construct a multilevel logistic regression model based on the party preference of the respondents from the survey data as the dependent variable, and their demographic background as explanatory variables, where data is provided by the 2019 Canadian Election Study - Online Survey. We then obtain the fitted estimations by utilizing the model with post-stratification method using the 2017 General Social Survey (GSS) data provided by Statistics Canada.

This paper is structured in the following manner. The two datasets that we used for the model will be discussed in Section 2 along with the description of the data cleaning process. Section 3 introduces the model we choose to construct, that is the methodology of the multilevel regression with post-stratification. Section 4 presents our result on the estimated 2019 Canadian Federal Election outcome. Lastly, we comment on our findings, address limitations, and suggestions for future work in Section 5.

2 Data

2.1 CES Survey Data

The survey data used to train our model for this report is the subset data obtained from the 37,822 observations from the results of online survey data provided by the 2019 Canadian Election Study (CES). We do not consider the surveys conducted in the previous years since we want to focus on the 2019 Canadian Federal Election specifically. 2019 CES is a survey designed to document the attitudes of Canadians during and after the 2019 election. It provides data on a variety of political and social topics, such as views of democracy, political interest, opinions of current leaders and parties, and topics of interest in the corresponding election cycle. In 2019, the CES is conducted via online and phone-based surveys. In this paper, we will examine the data resulting from the online CES, partially on the factors of sex, education, employment, province, born in Canada, and age group that can have an impact on the vote for the Liberal Party or the Conservative Party.

The target population of the survey includes all Canadian citizens and permanent residents, aged 18 or older, which is exactly the desired population we are interested in. The Campaign Period Survey (CPS) held from September 13th to October 21st, 2019, produce an online sample of 37,822 members of the Canadian general population through Qualtrics platform, with targets stratified by region within Canada and balanced on gender and age within each region with an aim for 50% men and 50% women and an aim for 28% respondents aged 18-34, 33% aged 35-54 and 39% aged 55 and higher[Stephenson et al. 2020]. To be noticed, the survey target was increased during the last five days of the campaign for increasing the total number of respondents. The the Post-Election Survey (PES) held from October 24th to November 11th, 2019, that re-contacted 10,340 respondents from the CPS for a follow-up survey. And, the survey instrument was also presented on the Qualtrics online platform. The weights of the survey sample have been created for the dataset using an iterative "raking" process, as provided by the ipfraking command in STATA15[Stephenson et al. 2020].

A subset of the online 2019 Canadian Election Study (CES) dataset is selected and retrieved for this report. We use the subset data to build our model based on the respondents' vote choice as the dependent variable and their demographic background as explanatory variables. Key demographic divisions reflected in the contemporary Canadian political landscape are what we are focusing on in our model. The subset is cleaned by firstly selecting interested variables, and then renaming some variables to keep consistency with the census data. We also reconstruct many variables into binary or categorical variables for a more convenient model building later. Vote choice is the variable that only exists in the survey dataset indicating the respondent's vote for Liberal Party or Conservative Party only, which are the main two competitive parties we are focusing on. The other six explanatory variables are included in both survey data and post-stratification data. Figures 1-6 display the distribution of the six reconstructed variables from survey data by the party preference.

Figure 1: Respondent Vote Choice in 2019 CES by Sex
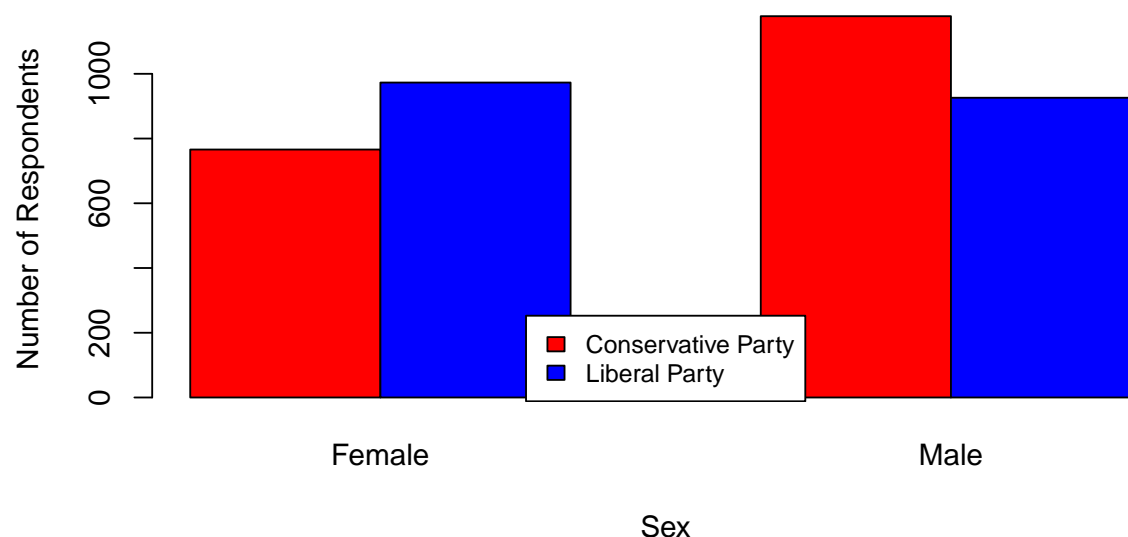
Sex is a binary variable by "Male" and "Female". According to Figure 1, females prefer Liberal better than Conservative, but males prefer the other way and support the Conservative.

Figure 2: Respondent Vote Choice in 2019 CES by Education
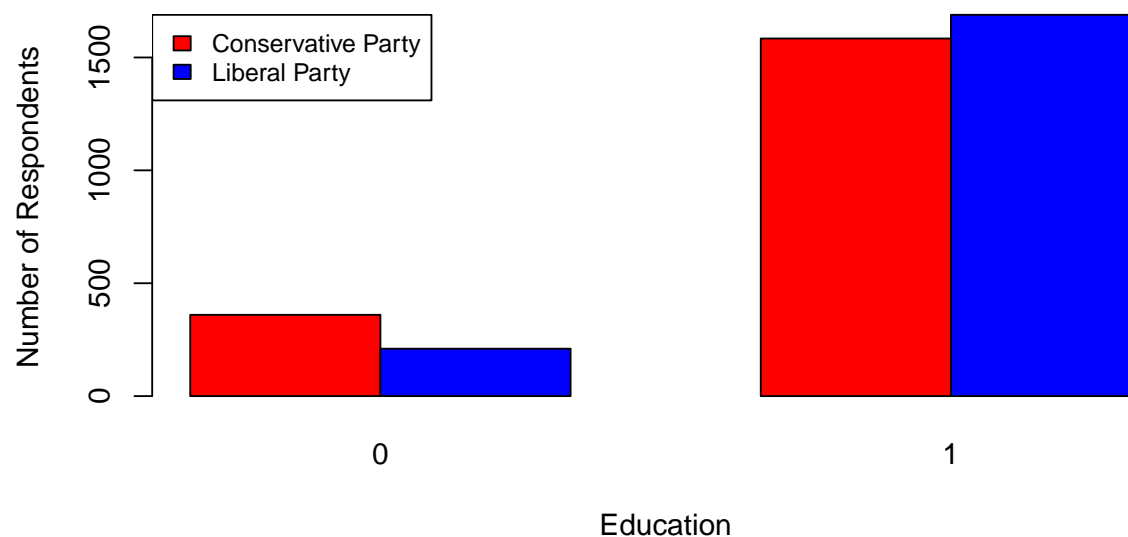
Education variable is a binary variable containing two groups of respondents: people who have received some college education(1) and those who have not(0). Similar to sex, these two groups of people also prefer different parties, that people with a higher educational level vote for Liberal more with a small difference via Figure 2.

Figure 3: Respondent Vote Choice in 2019 CES by Employment
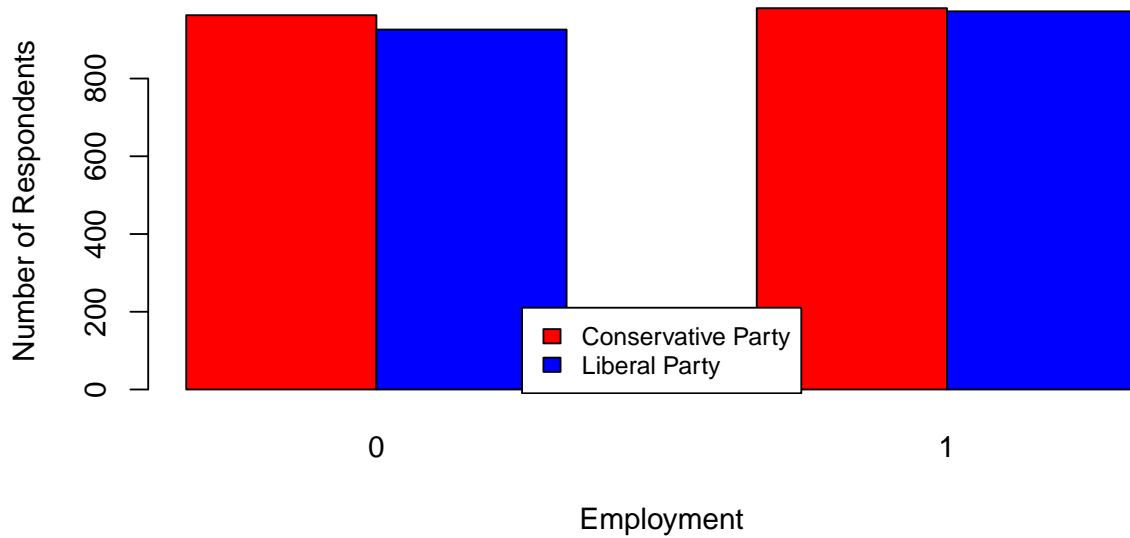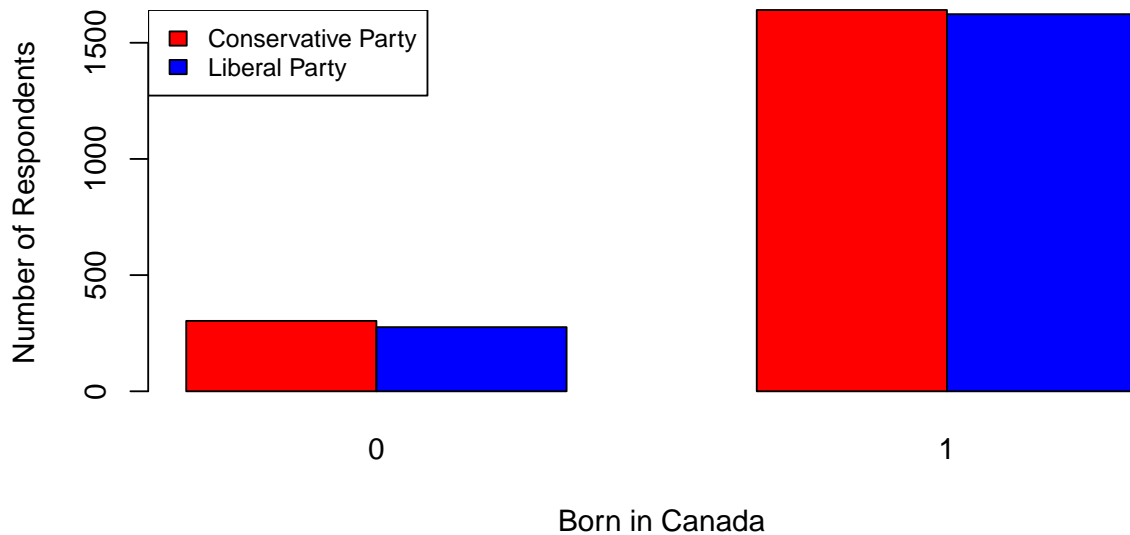

## Figure 4: Respondent Vote Choice in 2019 CES by Born in Canada

Moreover, employment and born in Canada are two variables also constructed into binary variables. For employment, 1 represents respondents who are employed for pay, and 0 otherwise. For born in Canada, 1 indicates "yes", and 0 indicates "no". Interestingly, there is not much difference in the preference of party between the two groups for both variables, that a very little more vote goes for Conservative Party in all four groups.

Figure 5: Respondent Vote Choice in 2019 CES by Provinces
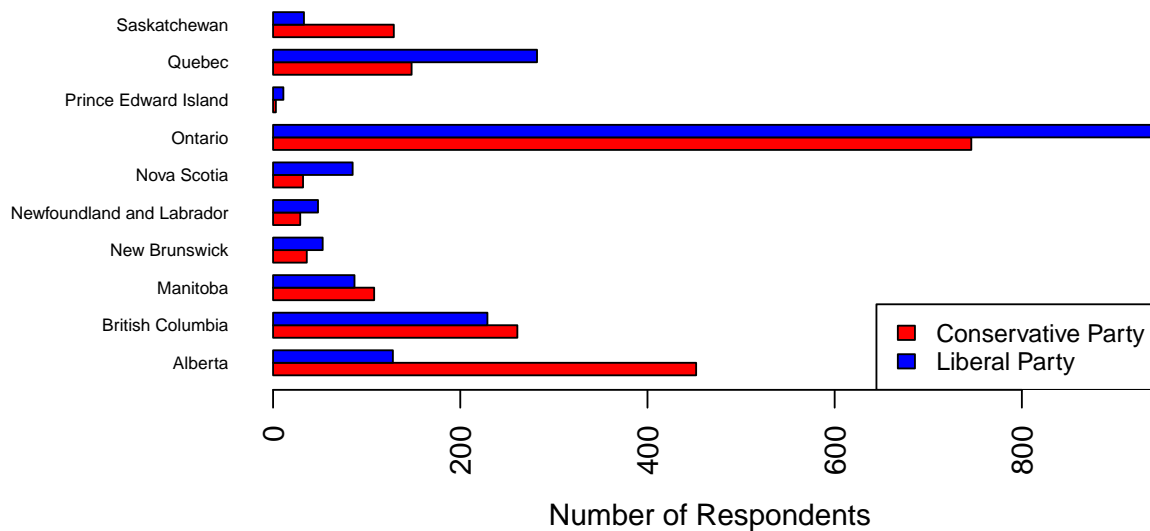
Province has also shown to be associated with voter preference with our survey data. According to Figure 5, more than half of people from Alberta and Saskatchewan more likely to vote for the Conservative, but more than half of people from Quebec, Prince Edward Island, and Nova Scotia more likely to vote for the Liberal. And, province Ontario with its most population also prefers the Liberal.

Figure 6: Respondent Vote Choice in 2019 CES by Age Groups
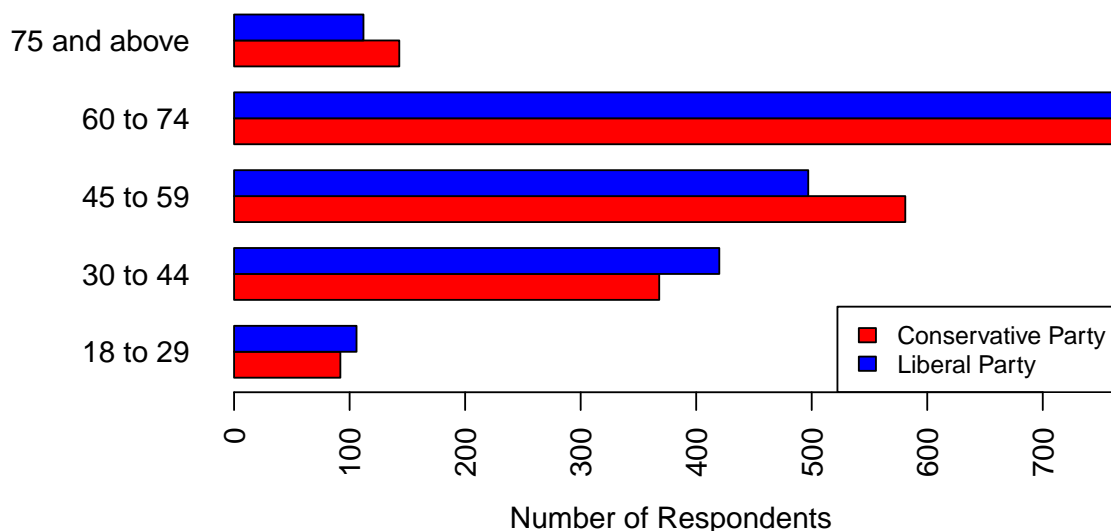
Younger voters under 44 years old prefer the Liberal more. Respondents over this age prefer the Conservative more. However, an exception occurs that there is a tie for the 60 to 74 age group.

2.2 GSS Census Data

The census data used for post-stratification is the data collected by the 2017 General Social Survey (GSS) on the Family. We use the data from the closest year available to 2019, which is 2017, because we want to focus on the 2019 Canadian Federal Election specifically. GSS is a survey done by the Social and Aboriginal Statistics Division of Statistics Canada, and it is objective to gather data on social trends to monitor changes in the living conditions and well-being of Canadians over time, and then to provide information on specific current social policy issues or emerging interest. In this paper, we will examine the data resulting from the 2017 GSS, partially on the factors of sex, education, employment, province, born in Canada, and age group that can have an impact on the vote for the Liberal Party or the Conservative Party.

The data for the GSS is collected from February 2 to November 30, 2017[GSS 2017]. The target population is non-institutionalized people aged 15 and older, living in the ten provinces[GSS 2017]. To be noticed, people from Yukon, Northwest Territories, and Nunavut are excluded from the dataset, and this can cause bias in the final results. Moreover, this survey is further reduced by it's chosen frame. It uses a new frame that combines telephone numbers (landline and cellular) with Statistics Canada's Address Register, and collects data via telephone[GSS 2017], which excludes people who do not have phones or do not have a stable address. The frame is sampled by cross-sectional design, where geographical regions are split into strata. Each strata was then randomly sampled without replacement. However, non-sampling errors occur as a weakness of the survey, when the respondent did not understand or misinterpreted a question, refused to answer a question, or could not recall the requested information. Finally, the target sample size is 20,000 while the actual number of respondents is 20,602. The overall response rate for the 2017 GSS was 52.4%, and non-response was handled by adjusting the weight of households who responded to the survey to compensate for those who did not respond[GSS 2017].

A subset of the 2017 General Social Survey (GSS) on the Family dataset is obtained for this report, which includes selected demographics and retrieved to post-stratify. The subset is cleaned by firstly selecting interested variables that match with the selected variables from survey data, then renaming some variables to keep consistency with the survey data. The selected variables contain sex, education, employment, province, born in Canada, and age group, which are all the factors that can be used to determine the vote for the Liberal Party or the Conservative Party. Similar to survey data, for the census data, we also reconstruct many variables into binary or categorical variables to fit the model later. Figures 7-12 display an even distribution trend for all the six reconstructed variables from census data. Due to the length of the six pie plots for the six variables, please refers to appendix part 2 for Figures 7-10 for the binary variables sex, education, employment, and born in Canada.
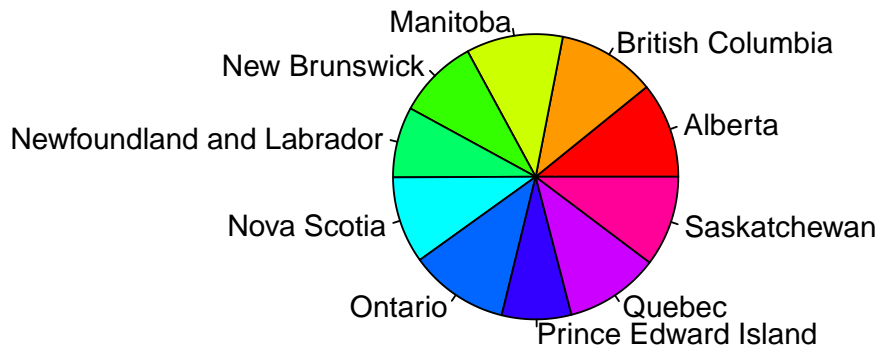
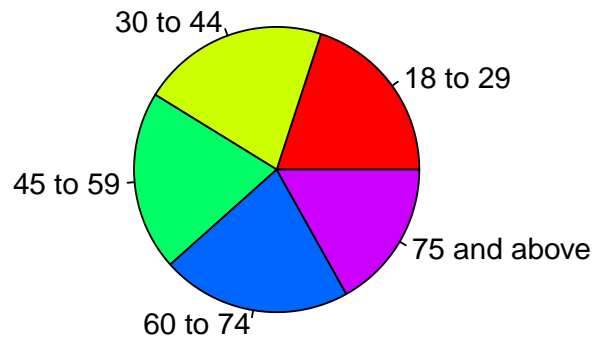**Figure 11: Province Proportion in 2017 GSS**

Figure 12: Age Proportion in 2017 GSS

By the pie plots for province and age group according to Figure 11 and 12, we can see people from ten provinces and five age groups equally split the entire population in the census dataset, which means people from every province and every age group are well represented in the final vote outcome result.

3 Model

3.1 Multilevel Logistic Regression Model

We are interested in determining the popular vote outcome for the Conservative Party for the 2019 Canadian Federal Election by using a multilevel logistic regression based on the factors of sex, education, employment, born in Canada, and age group for different intercept for each province.

Multilevel logistic regression model:

$$\log\left(\frac{\hat{p}_{ij}}{1-\hat{p}_{ij}}\right) = \beta_0 + \beta_1 x_{ij}^{sexMale} + \beta_2 x_{ij}^{educationed} + \beta_3 x_{ij}^{employed} + \beta_4 x_{ij}^{bornCA}$$

$$+\beta_5 x_{ij}^{age30-44} + \beta_6 x_{ij}^{age45-59} + \beta_7 x_{ij}^{age60-74} + \beta_8 x_{ij}^{age75above}$$

where $i = 1, ..., 711$(number of observations), $j = 1, ..., 10$(number of provinces),

p represents the probability of voting for the Conservative Party,

$\frac{p}{1-p}$ represents the odds of voting for the Conservative Party,

β_1 coefficient represents the change in log odds for male respondents,

β_2 coefficient represents the change in log odds for respondent who has received some college education,

β_3 coefficient represents the change in log odds for respondent who is employed for pay,

β_4 coefficient represents the change in log odds for respondent who was born in Canada,

β_5 coefficient represents the change in log odds for respondent age between 30 to 44,

β_6 coefficient represents the change in log odds for respondent age between 45 to 59,

β_7 coefficient represents the change in log odds for respondent age between 60 to 74,

β_8 coefficient represents the change in log odds for respondent age from 75 and above,

x represents each factor respectively.

The general aim of multilevel logistic regression is to estimate the odds that an event will occur (the yes/no outcome) while taking the dependency of data into account. Practically, it will allow you to estimate such odds as a function of lower level variables, higher level variables, and the way they are interrelated (cross-level interactions). Specifically, a multilevel logistic regression can be used when the outcome variable describes the presence/absence of an event or a behavior[Sommet 2017].

We considered using a linear regression model, but finally we kept with logistic regression model. As in our situation, the response variable, whether vote for the Conservative Party, is a binary variable where 1 represent vote for the Conservative and 0 represent vote for the Liberal. Thus, it is more appropriate to use a logistic regression model in predicting the popular vote outcome for the Conservative Party for the 2019 Canadian Federal Election. Moreover, layers were added to our model, so we can get different intercepts for each state in order to make a preciser determination.

Whereas linear regression gives the predicted mean value of an outcome variable at a particular value of a predictor variable, logistic regression gives the conditional probability that an outcome variable equals one at a particular value of a predictor variable (e.g. the likelihood of vote for the Conservative for a male respondent aged at 35 who has received some college education, and he was born in Canada, and also he is employed for pay).

The expression on the left hand side of the equation is often called logit function, it is used to predict such a probability. In our model, it describes the relationship between a series of explanatory variables(sex, education, employment, born in Canada, and age group) and the conditional probability that an outcome variable Y_i equals one(vote for the Conservative). Also, a multilevel regression is used to smooth noisy

estimates in the cells with too little data by using overall or nearby averages[Multilevel regression with poststratification 2020].

We use `glmer()` from `lme4` package in `R` to fit the model to our data. We use `as.factor()` for age variable, because even though age is numerical in the original dataset, but it becomes categorical as we group them into age groups during the data cleaning process. For each categorical variable(sex, education, employment, born in Canada, and age group) with n levels, we need $n-1$ dummy variables to fully study its influence on our response variable(vote for the Conservative).

3.2 Post-stratification Calculation

$$\hat{y}^{PS} = \frac{\sum N_j \hat{y}_j}{\sum N_j}$$

where $\hat{y}_j$ is the estimate in each cell and $\sum N_j$ is the population size of jth cell based off demographics.

In order to estimate the proportion of voters who will vote for the Conservative Party, we performed a post-stratification analysis. We make predictions using our model above with census data from 2017 GSS, specifically estimate y from each cell using our multilevel model, meaning use demographics to extrapolate how entire population will vote.

Response recorded basic demographics: age(5 categories), gender(2 categories), education(2 categories), born in Canada(2 categories), employment(2 categories), thus partitioning the data into 80 cells.

We weight each proportion estimate by the respective population size and sum those values and divide by the entire population size. The post-stratification weights are a sophisticated weighting strategy that help to reduce sampling error and potential non-response bias[ESS Methodology. n.d.].

4 Results

4.1 Model Result

Multilevel logistic regression model estimates by interpreting regression coefficients:

$$\log \left(\frac{\hat{p}_{ij}}{1 - \hat{p}_{ij}} \right) = 0.37 + 0.57 x_{ij}^{sexMale} - 0.66 x_{ij}^{educationed} + 0.01 x_{ij}^{employed} - 0.24 x_{ij}^{bornCA}$$

$$-0.05 x_{ij}^{age30-44} + 0.24 x_{ij}^{age45-59} - 0.02 x_{ij}^{age60-74} + 0.14 x_{ij}^{age75above}$$

Table 1: Summary of Model Estimates

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	0.3663	0.3307	1.1077	0.2680
sexMale	0.5684	0.0708	8.0252	0.0000
edu	-0.6606	0.1006	-6.5689	0.0000
employed	0.0103	0.0835	0.1229	0.9022
bornin_canada	-0.2385	0.0967	-2.4663	0.0137
as.factor(age)30 to 44	-0.0488	0.1696	-0.2877	0.7736
as.factor(age)45 to 59	0.2416	0.1654	1.4610	0.1440
as.factor(age)60 to 74	-0.0184	0.1686	-0.1092	0.9131
as.factor(age)75 and above	0.1446	0.2122	0.6813	0.4957

From the summary table and the model with its estimated coefficients above, we can see male voters have the biggest impact on the favor of voting for the Conservative then followed by voters aged between 45 to 59 and 75 and above as they all have a relatively large positive estimated coefficients. Conversely, voters who have received some college education have the largest negative coefficients, which means the largest negative effect on the favor of voting for the Conservative. Further, we know for voters who are employed for pay, aged between 30 to 44 and 60 to 74 tend to be neutral since their estimates are close to zero, which interprets a very small impact on determining the vote outcome.

4.2 Post-stratification Calculation Result

Table 2: Vote Outcome for the Conservative Party of 2019 Canadian Federal Election with Full Voter Turnout

voting_for_conservative
0.5051

Table 3: Vote Outcome for the Conservative Party of 2019 Canadian Federal Election with Full Voter Turnout by Province

province	voting_for_conservative
Alberta	0.7988
British Columbia	0.5665
Manitoba	0.5889
New Brunswick	0.4587
Newfoundland and Labrador	0.4565
Nova Scotia	0.3316
Ontario	0.4746
Prince Edward Island	0.3689
Quebec	0.3763
Saskatchewan	0.8176

According to Table 2, we have found the Conservative Party wins more votes in the 2019 Canadian Federal Election with a 50.51% winning rate when a full voter turnout is performed based on our estimation, which means the Conservative Party is the actual winner for the 2019 Canadian Federal Election. Specifically, Table 3 shows the winning rate in each province. We can see the biggest fan of the Conservative Party are voters from Saskatchewan and Alberta, then followed by voters from Manitoba and British Columbia, that all four voting estimations from the four provinces are over half for the Conservative Party. Ontario, New Brunswick, and Newfoundland and Labrador have a nearly half voting percentage for the Conservation. However, people from Nova Scotia, Quebec, and Prince Edward Island do not like the Conservatives much.

5 Discussion, Limitations, and Future Work

In this paper, we have found the Conservative Party is the actual winner for the 2019 Canadian Federal Election if all eligible voters are motivated to vote based on our estimations by a multilevel logistic regression model with post-stratification via data from the 2019 Canadian Election Study (CES) and the 2017 General Social Survey (GSS). Specifically, we know people from Saskatchewan, Alberta, Manitoba, and British Columbia are the mainstay for the Conservative Party as they all have over half vote outcome percentage to the Conservative Party. Hence, to win the election, the Conservatives should try the hardest to encourage

voters from these four provinces to show up and vote for them because they have a larger chance of voting for them. Then voters from a close half winning rate provinces, such as Ontario, New Brunswick, and Newfoundland and Labrador are the potential winning provinces that the Conservatives should target and work on their votes. Based on our estimation, male voters have the maximum potential in voting for the Conservative then followed by voters aged between 45 to 59 and 75 and above. Also, the Conservatives should works harder on converting votes from voters who are employed for pay, aged between 30 to 44 and 60 to 74 to their cause, because these voters are neutral and can be easier to influence. In this way, the Conservative Party can reach their desired result and wins the Canadian Federal Election by combining attracting votes and realizing votes.

However, inevitable limitations occur in our datasets and model that may cause bias for our final result. Firstly, the datasets we use for this paper is relatively small. Especially for the GSS census data that we used for post-stratification, there is only 711 observations left after cleaning and removing missing values as there is a large number of missing values. Also, as mentioned in Section 2 for the GSS census data before, due to the methodology of the survey, people from Yukon, Northwest Territories, and Nunavut, and people who do not have phones or do not have a stable address are further excluded from the dataset. Then it is not sufficiently large to represent the entire population, and the estimations might be biased. To resolve this problem, we should spend more money and use more effective strategies during the data collecting period to prevent non-response in the future. Secondly, to keep the consistency between the survey data and census data for the model to apply, we are unable not include all potential factors, such as race, belief, or income level, factors that can also have an impact on determining the vote outcome between the Liberal Party or the Conservative Party. For the future, we should contain as many as possible potentials factors in our model, then we can result in more precise estimations. Thirdly, limitations occur as we only consider two parties as to the voting outcome for our model, the Liberal Party or the Conservative Party. However, there are many more eligible parties can vote for in the real life, and a binary logistic regression model is not satisfied for an accurate prediction. Hence, for the future, we should consider a multinomial logistic regression model instead of a binary logistic regression model, that multinomial is more appropriate to use by involving more candidates.

In conclusion, voter participation rates are symbolic of the health of a democracy. And surprisingly we have found the outcome for the 2019 Canadian Federal Election can actually change from the Conservative Party to the Conservative Party when all eligible voters vote. Research shows that when communities have strong associations, they are in fact more likely to participate in national and local politics.[How can we encourage more Canadians to vote? n.d.] For a country as diverse as Canada, that's a sure win for everyone.

Appendix

1. Github link which contains all the code, dataset(except for original 2019 CES and 2017 GSS data, method to download is attached in readme.md), and report for the project: https://github.com/ma521yyy/Difference-in-2019-Canadian-Federal-Election-if-Everyone-had-Vote

2. Figures 7-10 display the distributions for binary variables of sex(female, male), education(1 indicates some college education, 0 otherwise), employment(1 indicates employed for pay, 0 otherwise), and born in Canada(1 indicates "yes", 0 otherwise) from census data.

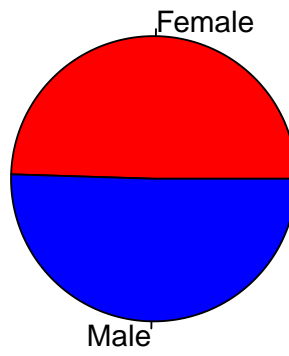**Figure 7: Sex Proportion in 2017 GSS**
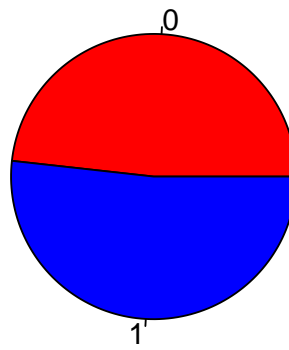

Figure 8: Education Proportion in 2017 GSS

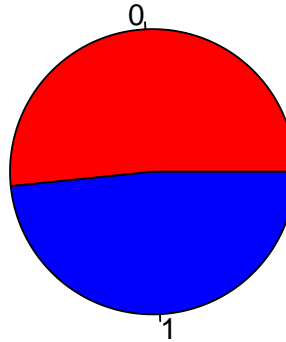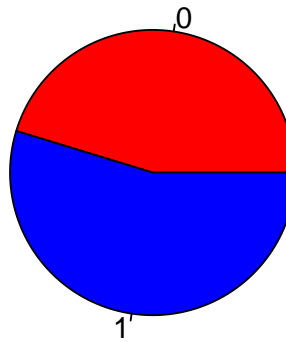**Figure 9: Employment Proportion in 2017 GSS**

Figure 10: Born in Canada Proportion in 2017 GSS

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