Liberal Party Could Have Attained Majority If All Eligible Voters Had Voted in the 2019 Canadian Federal Election - An Analysis using MRP

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December 22, 2020

Abstract

In this paper we will be using MRP Modeling on the 2019 CES data using the GSS 2017 data as a post-stratification dataset to see what the results of the election would be if everyone had voted. We then relay the results and discuss the potential implications of these findings, as well as any weaknesses/opportunities for future improvement.

Keywords: MRP; 2019 Canadian Federal Election; Eligible Voter; Liberal Party; Conservative Party

Introduction

Elections are one of the most vital events of the modern age - a submission of votes representing the will of the people, allowing members of the population to make major decisions from local, national, and even international scales. The importance of these events cannot be understated as they directly affect our lives, sometimes in small ways, sometimes much more so. As such, it's incredibly imperative that the "will of the people" mentioned above comes to fruition. In our current voting system, this is what's highlighted, making the majority of people happy with the result. However, can we really say the will of the people is truly being heard? There are many different issues contradicting this assumption, but perhaps is one of the most impactful is simply the lack of voting. In the 2019 Canadian Federal Election, roughly 66% of Canadians reported voting ("Canadian Election Drew Nearly 66" 2019). This is quite a lot at first glance, but that's still 34% of people that are not being accounted for. Frankly speaking it's hard to support the notion that the election was the will of the people given that so many people's votes weren't even heard. However, what if this wasn't the case? What if every single person that could vote did so? What then? Would the result change? Or are the final results truly the will of the people all along?

To approach this problem, we look at 2 datasets: The Canadian Election Survey and the General Social Survey. The CES is a survey enacted on the Canadian population around every election. It helps us to define various characteristics about respondents, but most importantly it shows their political views/who they support. This lends itself well to create a multilinear regression model for a respondent's political party of choice based on various characteristics, which can be used with our next dataset. The GSS is useful to gather a wide array of information regarding individuals, but more importantly it is a separate dataset with many of the same characterizes/equivalents of the last one. As such, we can apply post-stratification upon it using the previous dataset. This process is known as Multilinear Regression with Post-Stratification or MRP.

In this report, we will be using MRP Modeling to show what could have happened, in aims to answer these questions and go beyond.

Data

CES Data

The data used to generate the model was taken from the 2019 Canadian Election Study (Stephenson et al. (2020)). The Canadian Election Study is a large-scale survey conducted on each election year, going back to as early as 1965 ("Welcome to the 2019 Canadian Election Study," n.d.). Its purpose is to give a greater insight into the electoral democracy in Canada by measuring many sorts of details. The data for this report was taken from the 2019 Study, in particular the data gathered from the online survey component of the study. The questionnaire for this study was hosted and conducted via the Qualtrics Platform (Stephenson et al. (2020)), with the population being eligible voters in Canada. The data can be found and cleaned via the steps outlined in "ces_cleaning.R" in the git repository.

We made use of 5 different variables in order to create our model. The independent variable we looked at was cps19_votechoice, which described which party the respondent was going to vote for. There were 8 choices in response: "Green Party", "Conservative Party", "Liberal Party", "People's Party", "Bloc Québécois", "ndp", "Another party (please specify)", and "Don't know/ Prefer not to answer". For the model, we ended up removing last two options, as on the grand scale of things, neither of those two groups would impact the election as a whole. As such, we were left with 6 different parties to choose from. There was another option in terms of finding a variable describing the choice of party labeled pes19_votingchoice, which described who the respondents said they voted for after the election. This may have been a better choice in terms of what we wanted from the variable, but there simply was not enough data for this variable for this switch to have been worth it.

The first dependent variable we chose was cps19_age, which described the age of the respondent. We found that splitting the age into ranges would be better to see from an interpretation standpoint, so we split the variable into the following ranges: "18 to 24", "25 to 34", "35 to 44", "45 to 54", "55 to 64", "65 to 74", and "75 and above".

The next dependent variable we chose was cps19_education, which described the level of education the respondent had attained up to that point. There was a lot of reshuffling of data values for this variable, mainly due to the fact that the post-stratification dataset's education had a wildly different set of potential values. The initial values were [Insert Initial Values], but we ended up reorganizing them into the following values: "Less than High School", "High School", "Less than Bachelor's Degree", "Bachelor's Degree", and "Above Bachelor's Degree". While some information was lost, the ability to match up with the post-stratification dataset's education values and the simplicity from an observation standpoint made this a worthy endeavor.

The third dependent variable we chose was cps19_gender, which described the gender of the respondent. Again, there was an issue in terms of matching the post-stratification set, specifically in terms of non-cisgender respondents. The post-stratification set has only male or female options available, as it uses sex rather than gender. Ultimately, we dropped the non-cisgender respondents, as like the voting choices, their impact was negligible relatively speaking (Canada (2020)).

Finally, our last dependent variable was cps19_province. We found that province was a very important variable as there can be great variation across provinces regarding political choice. Perhaps the largest change was that the post-stratification dataset did not contain data on the Northwest Territories, Nunavut, and Yukon. While this at first may seem like a reason to not use this variable, we found that the province of the respondent to be very important and stripped away the 3 options not found. Similarly, we're not losing much (Government of Canada (2020)).

GSS Data

The data used in this report was curated from the General Social Survey (Canada (2017)) program., specifically the results of the "General social survey on Family" from 2017. Unfortunately, we cannot provide the data itself, as it is restricted to only those that are allowed to view it. However, if you are a UofT student

or have a UofT login, you can follow the steps outlined in "gss_cleaning.R" located in the git repository to acquire and clean the data for use.

As stated in the overview for the GSS (Canada (2019)), the target population consisted of those aged 15 and over across all the provinces in Canada, apart from full-time residents of institutions. For this survey, the sample size was approximately 20,000 people, done via Stratified Random Sampling, where the strata were geographic areas within each province. The frame consisted of two aspects: the list of telephone numbers in use available to Statistics Canada and the list of all dwellings within the ten provinces.

Respondents were contacted via computer assisted telephone interviews. There were many measures for combating non-response. One of which was the resilience shown by the interviewers, including calling up to twice more to a respondent who initially refused, outlining the importance of the survey. In addition, numerous calls were made to those that didn't pick up. In addition, when dealing with actual non-response, it was not permitted for questions that required weighting. Furthermore, the non-response adjusted accordingly depending on the level of information available.

The dependent variables were the same as from the CES data, with the variable names being age, education, sex, and province. Age and education were the only two variables that had to have refactoring. Age was split into age ranges exactly as before. Education again was a struggle to work through, but was transformed into the same list of values: "Less than High School", "High School", "Less than Bachelor's Degree", "Bachelor's Degree", and "Above Bachelor's Degree".

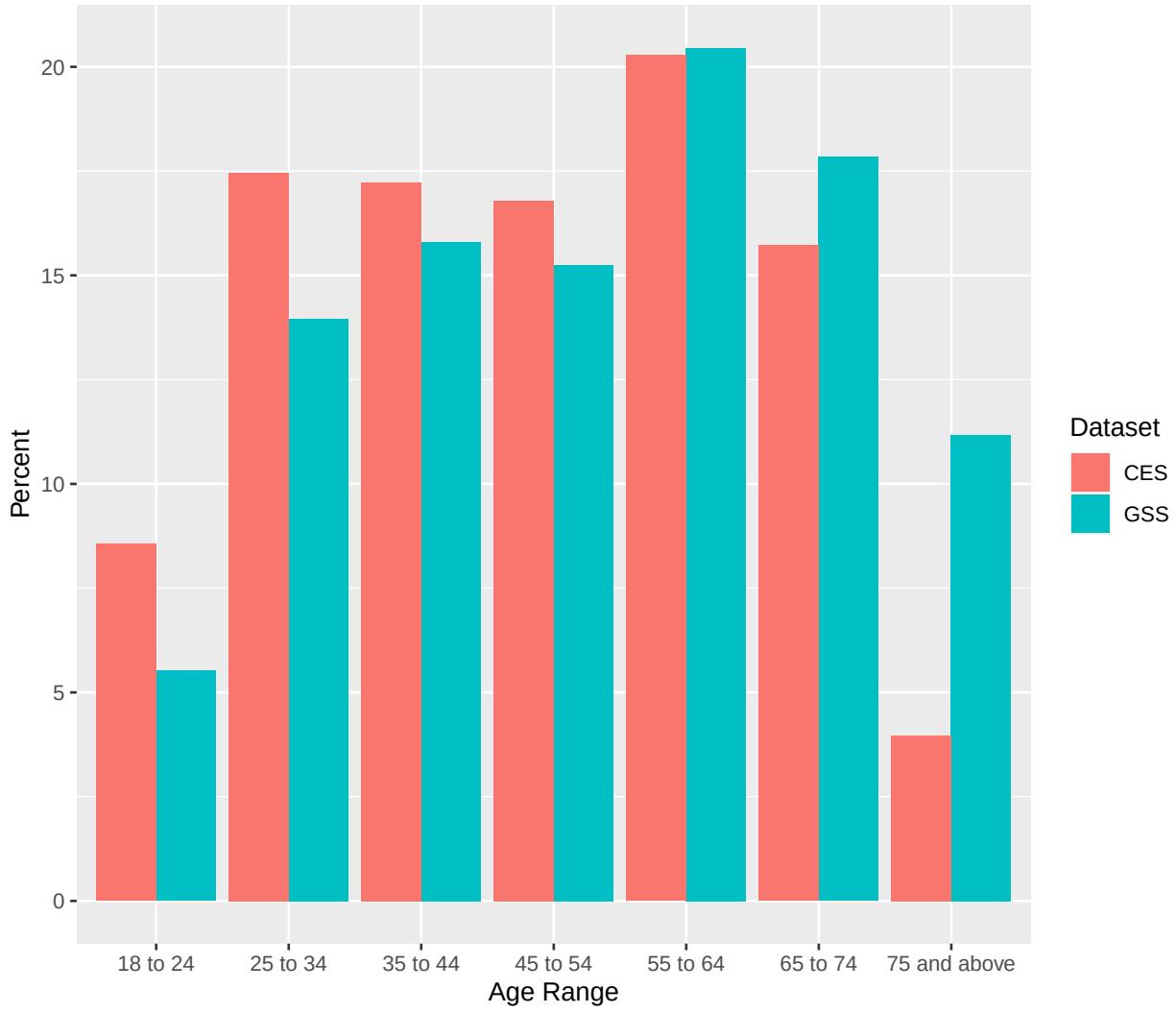

Figure 1: Distribution of Ages of CES and GSS Respondents.

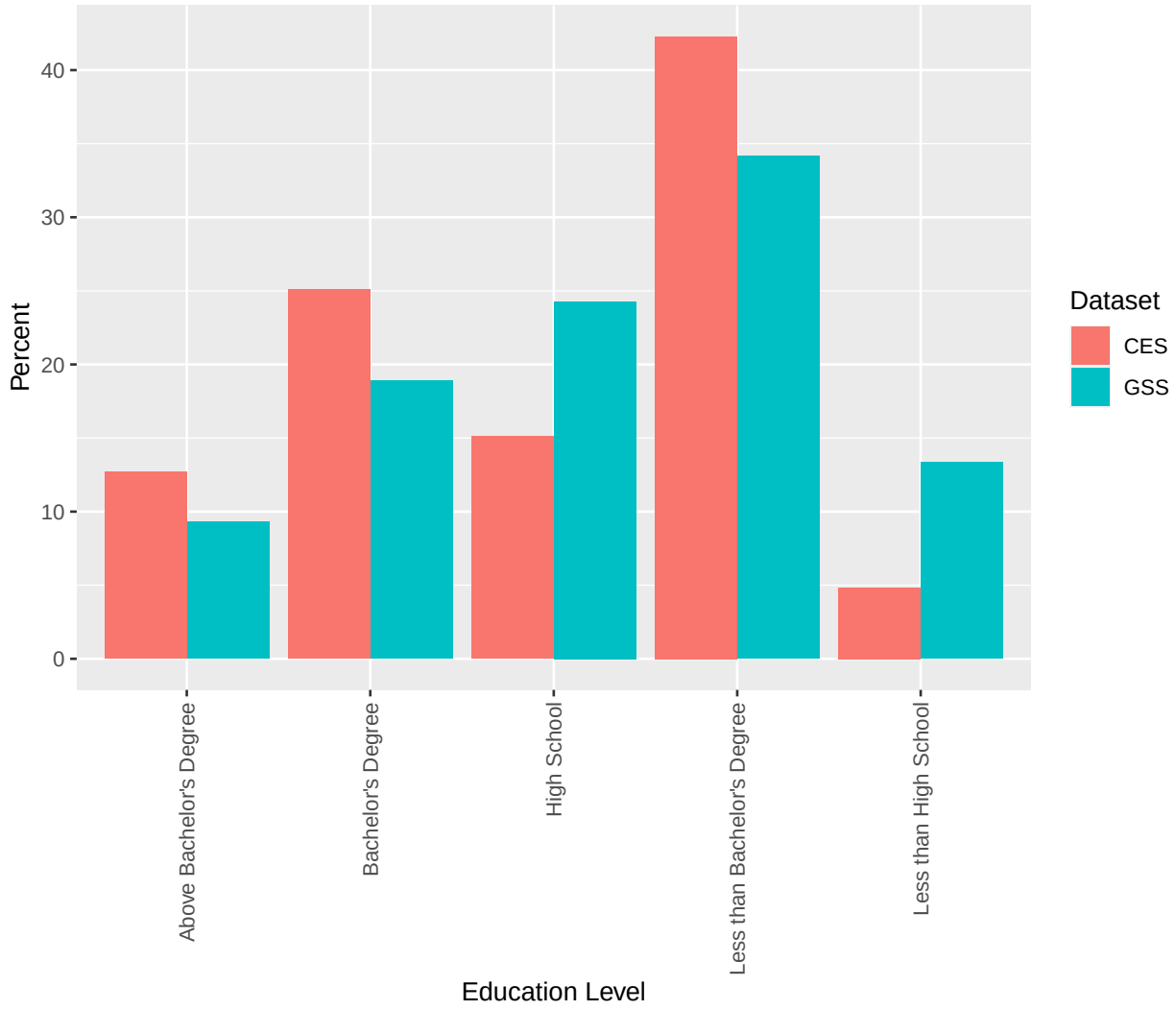

Figure 2: Distribution of Education Level of CES and GSS Respondents.

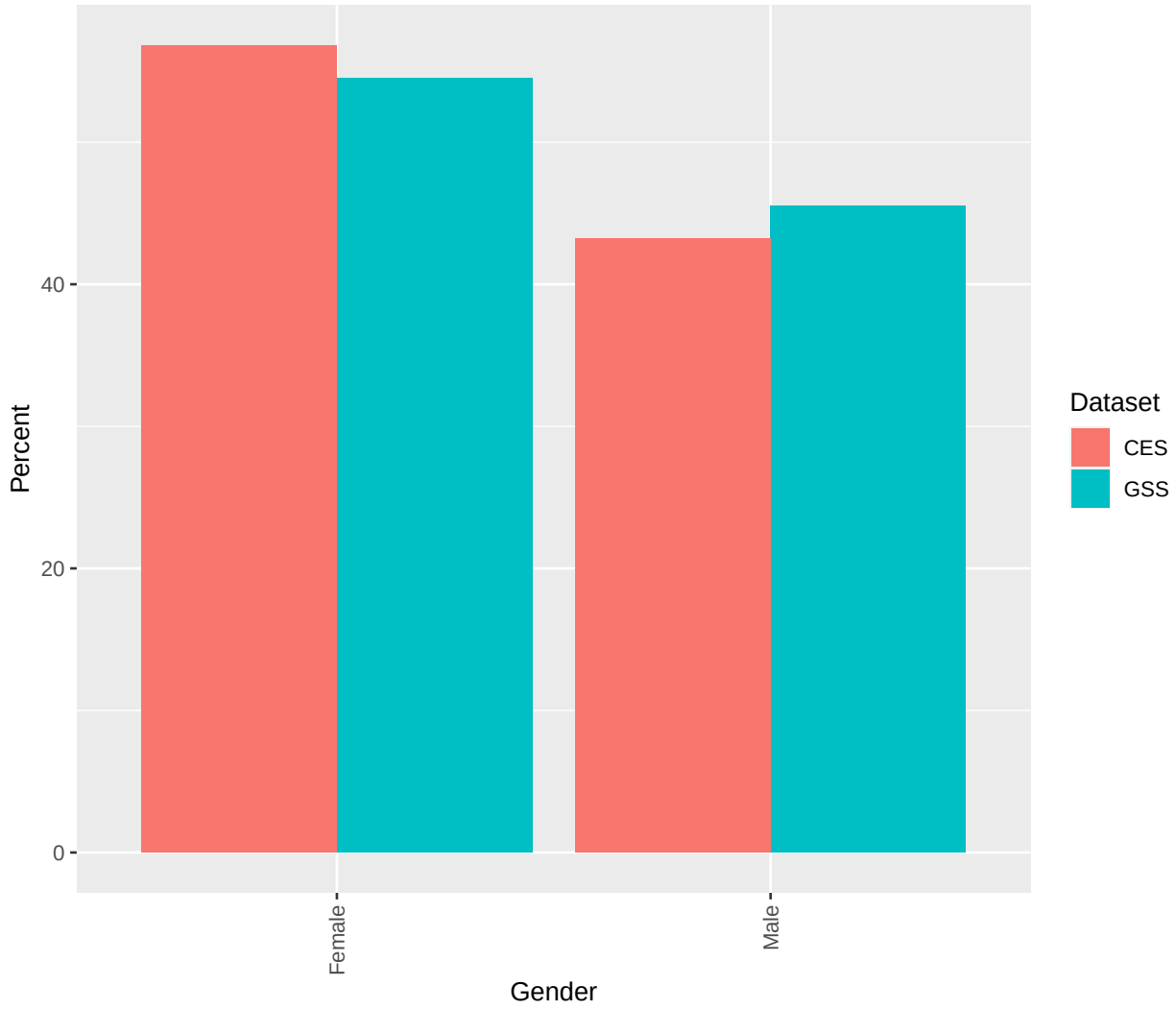

Figure 3: Distribution of Gender of CES and GSS Respondents.

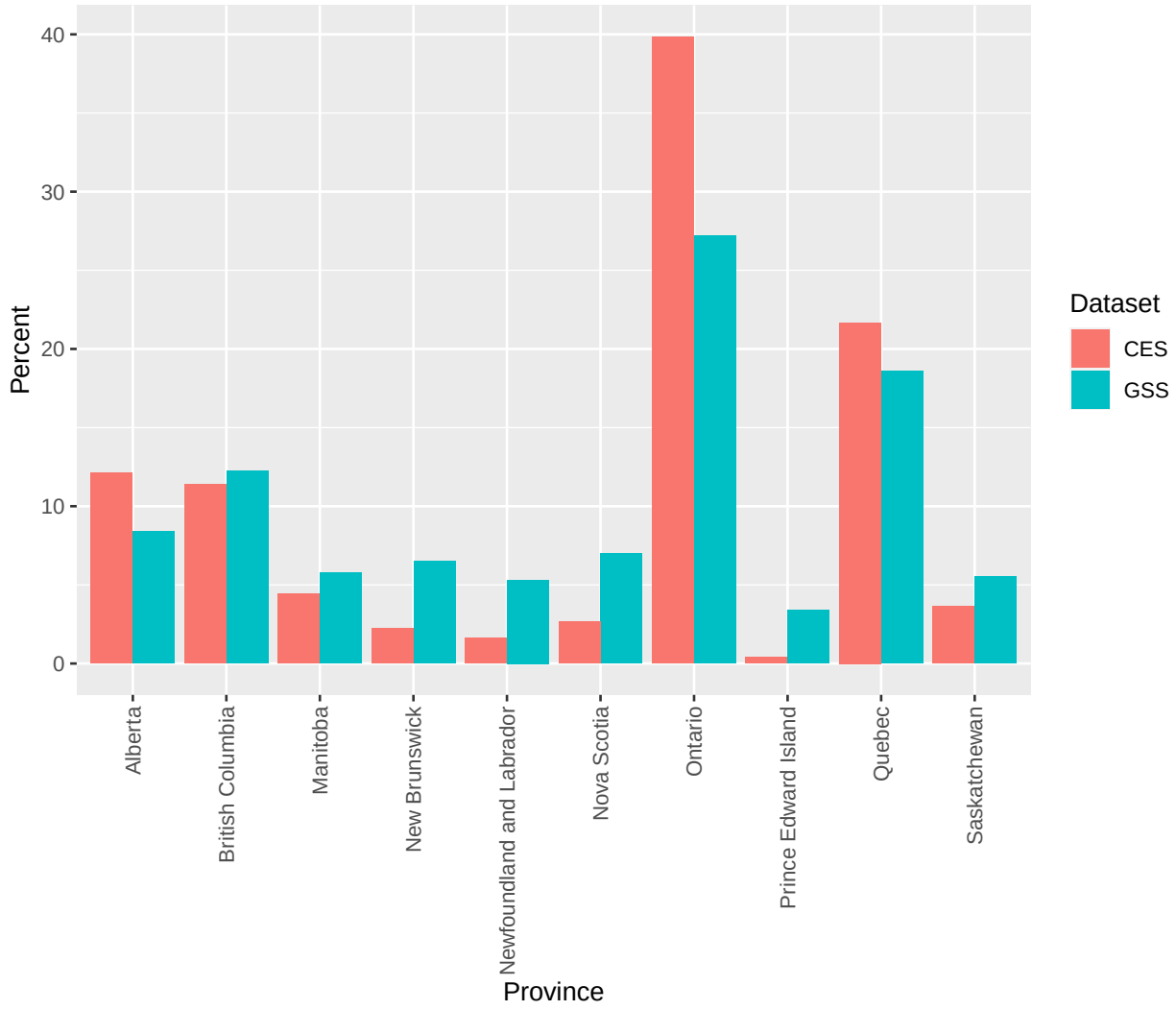

Figure 4: Distribution of Province of CES and GSS Respondents.

For future reference, the supported party of each respondent, after our cleaning, is outlined below.

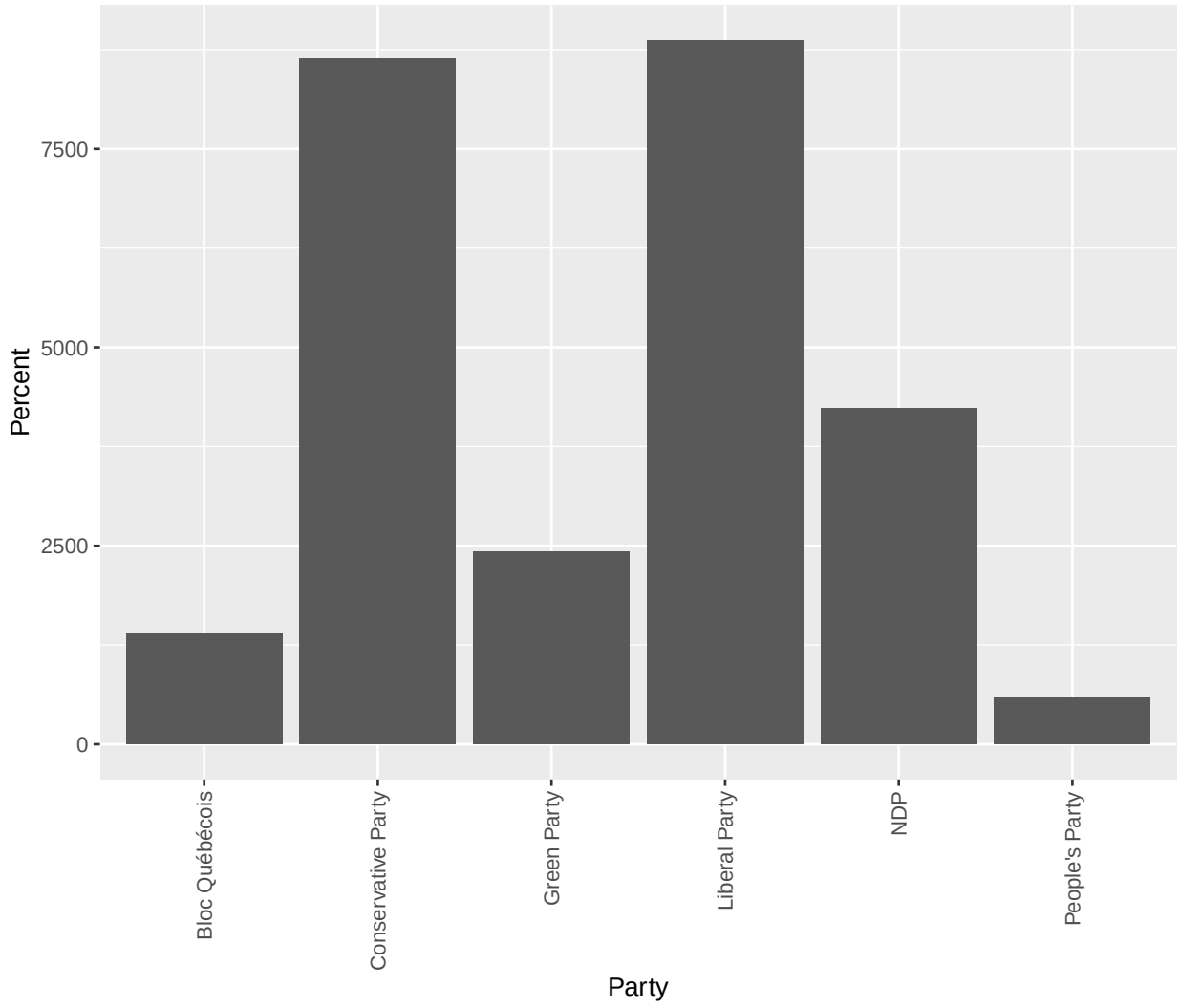

Figure 5: Distribution of Party Choice of CES Respondents.

Model

We used bayesian regression using the brms package (Bürkner (2018)) in R (R Core Team (2020)). However, we have 6 parties to deal with, which can be hard to deal with given all of our categorical variables. So, we actually created 6 different models, with each one's independent variable being a vector of binary values, with a value of 1 for the party in question and 0 for the rest.

The formula for each was $(Party) = \beta_1 * age\_range + \beta_2 * education + \beta_3 * gender + \beta_4 * province$.

Model Results

Our final results were the following:

Table 1: Green Party

	Estimate	Est.Error	Q2.5	Q97.5
Intercept	-2.2348310	0.1215923	-2.4749346	-1.9992469
age_range25to34	-0.4028523	0.0770865	-0.5546931	-0.2553099
age_range35to44	-0.6159174	0.0804070	-0.7691971	-0.4594417
age_range45to54	-0.6431392	0.0801072	-0.7978174	-0.4848711
age_range55to64	-0.7480068	0.0791945	-0.9013809	-0.5966370
age_range65to74	-0.7357888	0.0847990	-0.9050629	-0.5702838
age_range75andabove	-1.0313121	0.1415981	-1.3175852	-0.7597052
educationBachelorsDegree	-0.2052988	0.0701068	-0.3454597	-0.0675567
educationHighSchool	-0.2114871	0.0800320	-0.3655130	-0.0532817
educationLessthanBachelorsDegree	-0.1201281	0.0661158	-0.2519249	0.0053397
educationLessthanHighSchool	-0.1599852	0.1146923	-0.3928018	0.0641953
genderMale	-0.2119018	0.0456947	-0.3002606	-0.1219916
cps19_provinceBritishColumbia	1.3180387	0.1024347	1.1186434	1.5257102
cps19_provinceManitoba	0.6975346	0.1382812	0.4255805	0.9709012
cps19_provinceNewBrunswick	1.7209656	0.1329428	1.4577482	1.9741643
cps19_provinceNewfoundlandandLabrador	-0.4038042	0.2910954	-1.0078407	0.1249036
cps19_provinceNovaScotia	1.2275472	0.1406656	0.9634353	1.5080282
cps19_provinceOntario	0.7130175	0.0955256	0.5294891	0.9048376
cps19_provincePrinceEdwardIsland	2.0094335	0.2457139	1.5168198	2.4866101
cps19_provinceQuebec	0.6236470	0.1001988	0.4259382	0.8225418
cps19_provinceSaskatchewan	0.1644846	0.1635535	-0.1549413	0.4767902

Table 2: Conservative Party

	Estimate	Est.Error	Q2.5	Q97.5
Intercept	-0.6941100	0.0786816	-0.8471409	-0.5399431
age_range25to34	0.5041659	0.0669567	0.3715900	0.6321400
age_range35to44	0.7846454	0.0661905	0.6543206	0.9121244
age_range45to54	0.9140605	0.0662456	0.7815579	1.0427610
age_range55to64	0.9060271	0.0651151	0.7766816	1.0340790
age_range65to74	0.9074498	0.0674794	0.7736495	1.0393025
age_range75andabove	1.1610179	0.0881750	0.9912704	1.3345350
educationBachelorsDegree	0.2011093	0.0496827	0.1037399	0.2975847
educationHighSchool	0.5642683	0.0529545	0.4605323	0.6696642
educationLessthanBachelorsDegree	0.4137654	0.0455843	0.3282715	0.5057604
educationLessthanHighSchool	0.3969635	0.0755979	0.2503869	0.5455515
genderMale	0.4086928	0.0288949	0.3519753	0.4665959
cps19_provinceBritishColumbia	-1.3986107	0.0550217	-1.5067743	-1.2904448
cps19_provinceManitoba	-0.9176071	0.0719677	-1.0564765	-0.7761204
cps19_provinceNewBrunswick	-1.5419809	0.0996792	-1.7371407	-1.3445083
cps19_provinceNewfoundlandandLabrador	-1.7371755	0.1215397	-1.9745362	-1.5041293
cps19_provinceNovaScotia	-1.8895889	0.0995932	-2.0890059	-1.6995993
cps19_provinceOntario	-1.3615497	0.0439145	-1.4472636	-1.2781365
cps19_provincePrinceEdwardIsland	-1.9673541	0.2594260	-2.4974111	-1.4831037
cps19_provinceQuebec	-2.1568148	0.0522419	-2.2598112	-2.0516528
cps19_provinceSaskatchewan	-0.3805940	0.0744206	-0.5251365	-0.2392625

Table 3: Liberal Party

	Estimate	Est.Error	Q2.5	Q97.5
Intercept	-1.2726655	0.0745128	-1.4164391	-1.1218807
age_range25to34	-0.0402315	0.0559322	-0.1471787	0.0708038
age_range35to44	0.0615779	0.0575678	-0.0497666	0.1738971
age_range45to54	0.0558493	0.0562854	-0.0516481	0.1701080
age_range55to64	0.2167205	0.0545892	0.1118224	0.3234472
age_range65to74	0.2725187	0.0567881	0.1624831	0.3864691
age_range75andabove	0.2638243	0.0802172	0.1070600	0.4131647
educationBachelorsDegree	-0.0657798	0.0443560	-0.1522245	0.0222471
educationHighSchool	-0.6202158	0.0510865	-0.7194591	-0.5202229
educationLessthanBachelorsDegree	-0.4324565	0.0415598	-0.5169730	-0.3506197
educationLessthanHighSchool	-0.6612954	0.0749328	-0.8103623	-0.5151046
genderMale	-0.1164326	0.0270483	-0.1685173	-0.0639801
cps19_provinceBritishColumbia	0.7184124	0.0603067	0.6028705	0.8365882
cps19_provinceManitoba	0.6783906	0.0789562	0.5280650	0.8305844
cps19_provinceNewBrunswick	1.0704950	0.0956078	0.8817713	1.2540032
cps19_provinceNewfoundlandandLabrador	1.5091544	0.1075576	1.2987605	1.7173040
cps19_provinceNovaScotia	1.3546686	0.0894229	1.1779914	1.5336360
cps19_provinceOntario	1.0696034	0.0505747	0.9712800	1.1685150
cps19_provincePrinceEdwardIsland	1.2190387	0.2165141	0.7927028	1.6392766
cps19_provinceQuebec	0.9606501	0.0545561	0.8546620	1.0678481
cps19_provinceSaskatchewan	-0.2523027	0.1050937	-0.4651330	-0.0519094

Table 4: People's Party

	Estimate	Est.Error	Q2.5	Q97.5
Intercept	-4.0390179	0.2244640	-4.4582794	-3.6093847
age_range25to34	0.2822197	0.1616345	-0.0337471	0.5994127
age_range35to44	-0.0221970	0.1672131	-0.3420167	0.3106716
age_range45to54	-0.0577844	0.1675959	-0.3827619	0.2875432
age_range55to64	-0.5568037	0.1761871	-0.8775102	-0.2022345
age_range65to74	-0.9320514	0.1993370	-1.3252889	-0.5397278
age_range75andabove	-0.8049346	0.2964277	-1.4065773	-0.2383099
educationBachelorsDegree	-0.1919016	0.1572748	-0.5060531	0.1144480
educationHighSchool	0.4775150	0.1514626	0.1835533	0.7738158
educationLessthanBachelorsDegree	0.3316144	0.1392986	0.0550034	0.6147528
educationLessthanHighSchool	0.9139391	0.1853574	0.5312120	1.2857836
genderMale	0.5025381	0.0828363	0.3320982	0.6670346
cps19_provinceBritishColumbia	-0.0997836	0.1732440	-0.4309069	0.2448686
cps19_provinceManitoba	-0.5823733	0.2748476	-1.1518317	-0.0652046
cps19_provinceNewBrunswick	0.4133926	0.2544445	-0.0916066	0.8972029
cps19_provinceNewfoundlandandLabrador	-0.8313490	0.4753747	-1.8368295	0.0205935
cps19_provinceNovaScotia	0.0915975	0.2784922	-0.4743689	0.6037893
cps19_provinceOntario	0.0418755	0.1296095	-0.2106380	0.3034338
cps19_provincePrinceEdwardIsland	-775.3570356	913.4555741	-3348.8897907	-17.3196160
cps19_provinceQuebec	-0.0714404	0.1469905	-0.3585431	0.2210749
cps19_provinceSaskatchewan	0.0682458	0.2339670	-0.4274922	0.4903630

Table 5: Bloc Québécois

	Estimate	Est.Error	Q2.5	Q97.5
Intercept	-1.038324e+12	2.670877e+12	-1.022114e+13	-19168948
age_range25to34	-5.032119e+10	1.818933e+11	-6.368713e+11	203162888264
age_range35to44	7.347707e+10	2.928461e+11	-1.585483e+11	1168630833974
age_range45to54	1.542361e+11	4.061579e+11	-3.153596e+10	1440557369232
age_range55to64	3.116779e+11	1.013004e+12	-9.598270e+10	4512168884706
age_range65to74	5.077892e+09	1.031550e+11	-2.103846e+11	312312700783
age_range75andabove	8.176087e+10	3.829217e+11	-5.045995e+11	1319986393247
educationBachelorsDegree	1.138501e+11	5.849339e+11	-4.271511e+11	1875387553285
educationHighSchool	-4.906861e+10	8.965398e+11	-2.961992e+12	2005364262677
educationLessthanBachelorsDegree	9.560820e+10	3.463121e+11	-1.009880e+11	1440865599279
educationLessthanHighSchool	-9.058093e+10	2.871317e+11	-1.081141e+12	78718789399
educationNDA	2.366275e+11	6.354279e+11	-2.790559e+10	2352766184061
genderMale	1.571084e+10	8.182149e+10	-1.006190e+11	255682316581
cps19_provinceBritishColumbia	-4.471431e+11	1.271619e+12	-4.805890e+12	117947445633
cps19_provinceManitoba	3.236580e+10	1.543898e+11	-1.048890e+11	538635047712
cps19_provinceNewBrunswick	1.851496e+11	4.983267e+11	-3.796412e+10	2005986997491
cps19_provinceNewfoundlandandLabrador	5.883792e+10	1.563337e+11	-4.053799e+10	548735857530
cps19_provinceNovaScotia	-5.613120e+10	1.615682e+11	-6.206346e+11	17892257593
cps19_provinceOntario	-5.674378e+10	2.185329e+11	-8.347288e+11	234193918018
cps19_provincePrinceEdwardIsland	-8.866443e+09	9.936208e+10	-2.865623e+11	133880711554
cps19_provinceQuebec	-1.645664e+11	5.103750e+11	-1.892789e+12	202313718077
cps19_provinceSaskatchewan	2.347830e+10	1.599551e+11	-1.753978e+11	513251179545

Table 6: NDP

	Estimate	Est.Error	Q2.5	Q97.5
Intercept	-1.2279630	0.0887813	-1.4001961	-1.0537419
age_range25to34	-0.2667307	0.0592818	-0.3822286	-0.1492729
age_range35to44	-0.5668044	0.0624218	-0.6880442	-0.4447436
age_range45to54	-0.8267789	0.0637899	-0.9516070	-0.7032153
age_range55to64	-1.1450082	0.0649862	-1.2721539	-1.0180818
age_range65to74	-1.2785806	0.0721386	-1.4210369	-1.1391036
age_range75andabove	-1.5741540	0.1324631	-1.8456152	-1.3255745
educationBachelorsDegree	-0.0425799	0.0609603	-0.1613862	0.0810738
educationHighSchool	0.0722434	0.0670088	-0.0610525	0.2028304
educationLessthanBachelorsDegree	0.1130208	0.0572105	0.0008978	0.2261337
educationLessthanHighSchool	0.2093916	0.0885206	0.0372485	0.3777114
educationNDA	0.0662407	0.4203446	-0.8015082	0.8676409
genderMale	-0.4427896	0.0373439	-0.5166485	-0.3685531
cps19_provinceBritishColumbia	0.7585561	0.0725013	0.6162480	0.9030085
cps19_provinceManitoba	0.5457649	0.0954172	0.3612077	0.7332911
cps19_provinceNewBrunswick	-0.3513142	0.1618987	-0.6753729	-0.0467300
cps19_provinceNewfoundlandandLabrador	0.7815464	0.1346491	0.5141939	1.0371542
cps19_provinceNovaScotia	0.3933711	0.1190247	0.1618207	0.6207649
cps19_provinceOntario	0.5390533	0.0614231	0.4214102	0.6627601
cps19_provincePrinceEdwardIsland	-0.1261671	0.3222062	-0.7924620	0.4624305
cps19_provinceQuebec	-0.0177528	0.0714620	-0.1575653	0.1233244
cps19_provinceSaskatchewan	0.8239390	0.0971141	0.6354362	1.0111918

The standout issue at first is the Bloc Québécois model, in that the coefficients are all quite small. We'll touch on this more in the discussion section, but this is not necessarily completely unusable. As for the rest of the parties, the error can be a little high for a few coefficients, but overall the models are viable enough for the purposes of our analysis.

Post-Stratification Results

In order to apply the post-stratification, we used the predict function in R using the previous models on the GSS data. Each model generated a likelihood that a particular respondent supported, and ideally would have voted for, the respective party. Subsequently, we assigned the supported party of choice for each respondent by choosing the party with the maximum likelihood based on their characteristics (age, gender, education, and province).

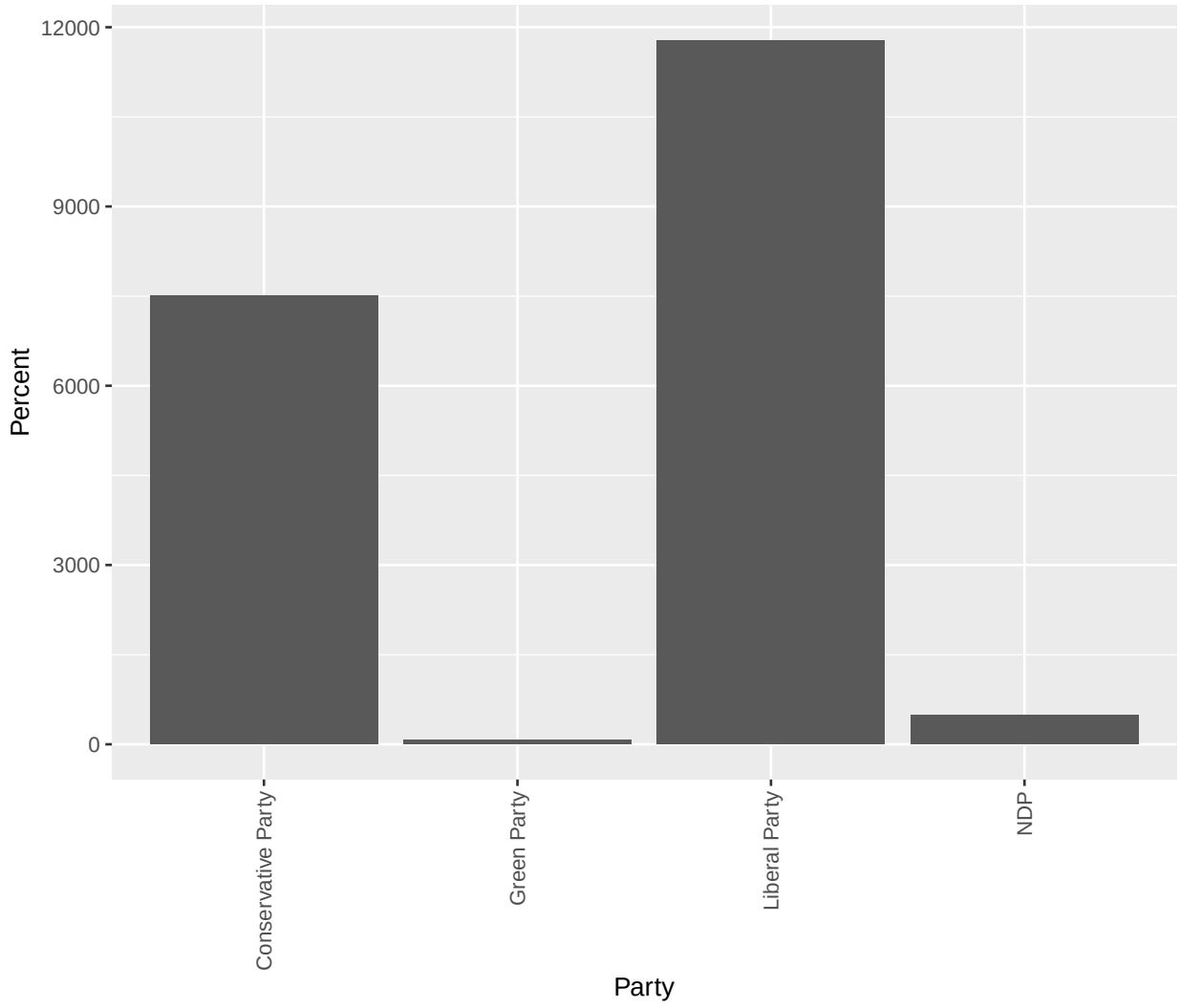

Figure 6: Modeled Distribution of Party Choice of GSS Respondents.

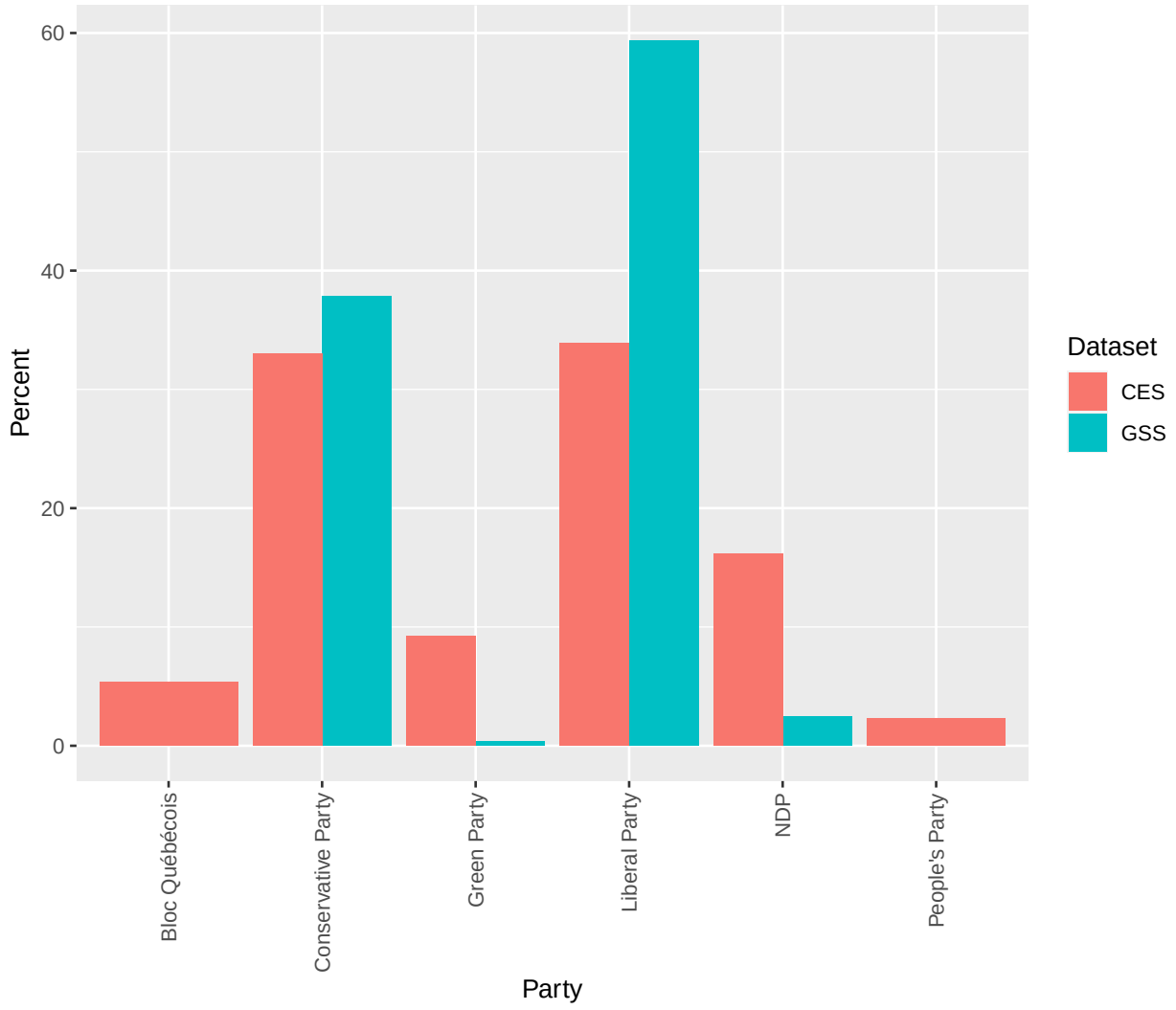

Figure 7: Modeled Distribution of Party Choice of respondents.

The key point of note is that with the post-stratification there's a much heavier support for the liberal and conservative parties, and much fewer for everyone else, including no support at all in the case of the People's Party and Bloc Québécois.

Discussion

Acknowledging the elephant in the room, it is abnormal that there is no support for either the People's Party or Bloc Québécois. After all, there were those respondents who supported them in the CES data. This is also not a surprise for Bloc Québécois given the details of their model. Does this mean these models were flawed? While it is possible the model isn't as optimal as it could be under ideal circumstances, the results it displays can be explained fairly easily. There are not a lot of people who support either of those parties, especially in regards to the rest. As such, there wasn't a lot of data to pull from. In addition, the GSS is a smaller dataset, so it makes sense that there would be fewer supporters for these parties. However, a potentially more accurate interpretation of these results is that in our current population, supporters of these two parties are overrepresented in the CES dataset. That's not to say there are indeed no supporters out there, but seeing as how they had no supporters after applying the post-stratification, it's definitely

plausible.

Before we explore how the results impact the bigger picture, it seems prudent to first explain the limitations of the analysis conducted. It's hard to ignore the fact that we ignored many respondents given the fact that they didn't have answers to certain questions, didn't live in one of the 10 provinces, or were not cisgender. There were not enough people excluded to make the models created unusable, but it's certainly a downside when the main purpose of this report was to highlight how the results of the election could have been if EVERYONE's vote had counted, which includes those respondents who were not taken into account during the analysis. There's also the fact that since there wasn't as much data for the two parties who had no supporters after the post-stratification, the models generated for them, and likely the NDP and Green Party as well to some extent, may not have been as accurate. That said, we don't believe these models are without merit and can despite all this help us in our discussion.

Given the models are less than optimal, we will use the results less from a specific number by number basis, but in a more general sense. Shown below are the actual election results ((“Federal Election 2019 Live Results,” n.d.)), in terms of the number of votes each party received.

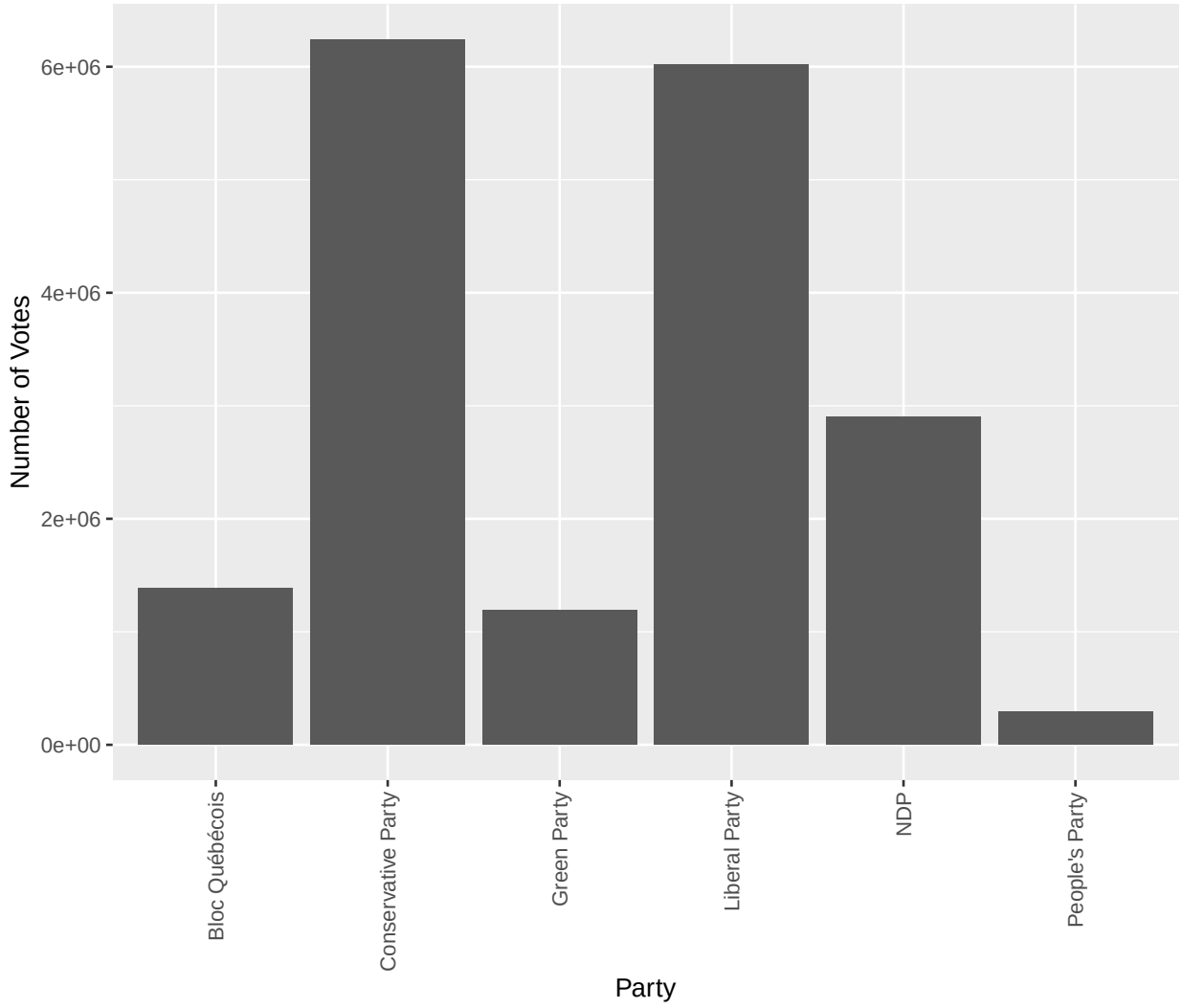

Figure 8: Results of the 2019 Canadian Federal Election

The major conclusion from our results are that the Conservative Party would have a much smaller percentage

of votes than is seen above, mainly replaced by the growth of the Liberal Party. Given our uncertainty with the other parties, let's say they remain in somewhat similar standing, perhaps slightly less, the decrease in which would support again the growth of the Liberal Party. That's somewhat of a big deal. There would be a new party with the majority of votes. However, in terms of seats (positions awarded to the winner of the majority of votes in each riding), which is really what matters when it comes to policy, the liberal party already had the majority. That faces us with the question once again: Would the results have changed if everyone had voted? We would say yes. Even though they already had more seats than any other party, the increase in votes may have given the Liberal Party enough seats to attain a "majority", which would give them more power than they have at the moment. Furthermore, we would find that the Conservative Party is overrepresented, and would lose power had everyone voted. While this may not seem to be a big shift, every little bit count when it comes to policy, especially when impacting a whole country of people. Thus, highlighted here are not just the hypothetical results of an imaginary situation, but also a message for those who did not vote, specifically those people who support the Liberal Party – Your vote matters, and it's your duty as an eligible voter to make your voice heard, or else those with views in the minority will have a greater impact on the country than the majority.

References

Code supporting this analysis can be found at https://github.com/ZakirChaudry/PS5

Alexander, Rohan. 2020. Statistics Department, University of Toronto.

Beaupré, Pascale. 2020. "General Social Survey - Cycle 31 : Families - User Guide." *Statistics Canada*. Authority of the Minister responsible for Statistics Canada. https://sda-artsci-utoronto-ca.myaccess.library.utoronto.ca/sdaweb/dli2/gss/gss31/gss31/more_doc/GSS31_User_Guide.pdf.

Bürkner, Paul-Christian. 2018. "Advanced Bayesian Multilevel Modeling with the R Package brms." *The R Journal* 10 (1): 395–411. https://doi.org/10.32614/RJ-2018-017.

Canada, Statistics. 2017. "General Social Survey - Cycle 31 : Families."

———. 2019. "General Social Survey: An Overview, 2019." *Statistics Canada*. The Government of Canada. https://www150.statcan.gc.ca/n1/pub/89f0115x/89f0115x2019001-eng.htm.

———. 2020. "Sex at Birth and Gender: Technical Report on Changes for the 2021 Census." *Statistics Canada*. Government of Canada, Statistics Canada. https://www12.statcan.gc.ca/census-recensement/2021/ref/98-20-0002/982000022020002-eng.cfm.

"Canadian Election Drew Nearly 66." 2019. *CBCnews*. CBC/Radio Canada. https://www.cbc.ca/news/canada/voter-turnout-2019-1.5330207.

"Federal Election 2019 Live Results." n.d. *CBCnews*. CBC/Radio Canada. https://newsinteractives.cbc.ca/elections/federal/2019/results/.

Government of Canada, Statistics Canada. 2020. "Population Estimates, Quarterly." *Population Estimates, Quarterly*. Government of Canada, Statistics Canada. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710000901.

Macrotrends. 2020. "Canada Birth Rate 1950-2020." *MacroTrends*. https://www.macrotrends.net/countries/CAN/canada/birth-rate.

R Core Team. 2020. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.

Stephenson, Laura B, Allison Harell, Daniel Rubenson, and Peter John Loewen. 2020. "2019 Canadian Election Study - Online Survey." Harvard Dataverse. https://doi.org/10.7910/DVN/DUS88V.

"Welcome to the 2019 Canadian Election Study." n.d. *Canadian Election Study*. Canadian Election Study. http://www.ces-eec.ca/.

Wickham, Hadley. 2016. *Ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York. https://ggplot2.tidyverse.org.

Wickham, Hadley, Mara Averick, Jennifer Bryan, Winston Chang, Lucy D'Agostino McGowan, Romain François, Garrett Grolemund, et al. 2019. "Welcome to the tidyverse." *Journal of Open Source Software* 4 (43): 1686. https://doi.org/10.21105/joss.01686.

Wickham, Hadley, Romain François, Lionel Henry, and Kirill Müller. 2020. *Dplyr: A Grammar of Data Manipulation*. https://CRAN.R-project.org/package=dplyr.

Wickham, Hadley, and Evan Miller. 2020. *Haven: Import and Export 'Spss', 'Stata' and 'Sas' Files*. https://CRAN.R-project.org/package=haven.

Xie, Yihui. 2020. *Bookdown: Authoring Books and Technical Documents with R Markdown*. https://github.com/rstudio/bookdown.

Xie, Yihui, Christophe Dervieux, and Emily Riederer. 2020. *R Markdown Cookbook*. Boca Raton, Florida: Chapman; Hall/CRC. https://bookdown.org/yihui/rmarkdown-cookbook.