Mathematician’s Contribution to Election Method Design

Election methods consist of a set of rules that must be followed for a vote to be valid, including the form of the ballot (how votes are cast) as well as the process used to determine the final result of an election. The specific election method used can have a significant effect in the election’s final result, especially if there are more than 2 options for voters to choose, making the study of election method design very important.1 This report offers a brief overview of the history of voting theory, some of the contributions mathematicians have made to the field as well as explain some of the mathematical challenges involved in designing election methods.

The Early History of Voting Theory

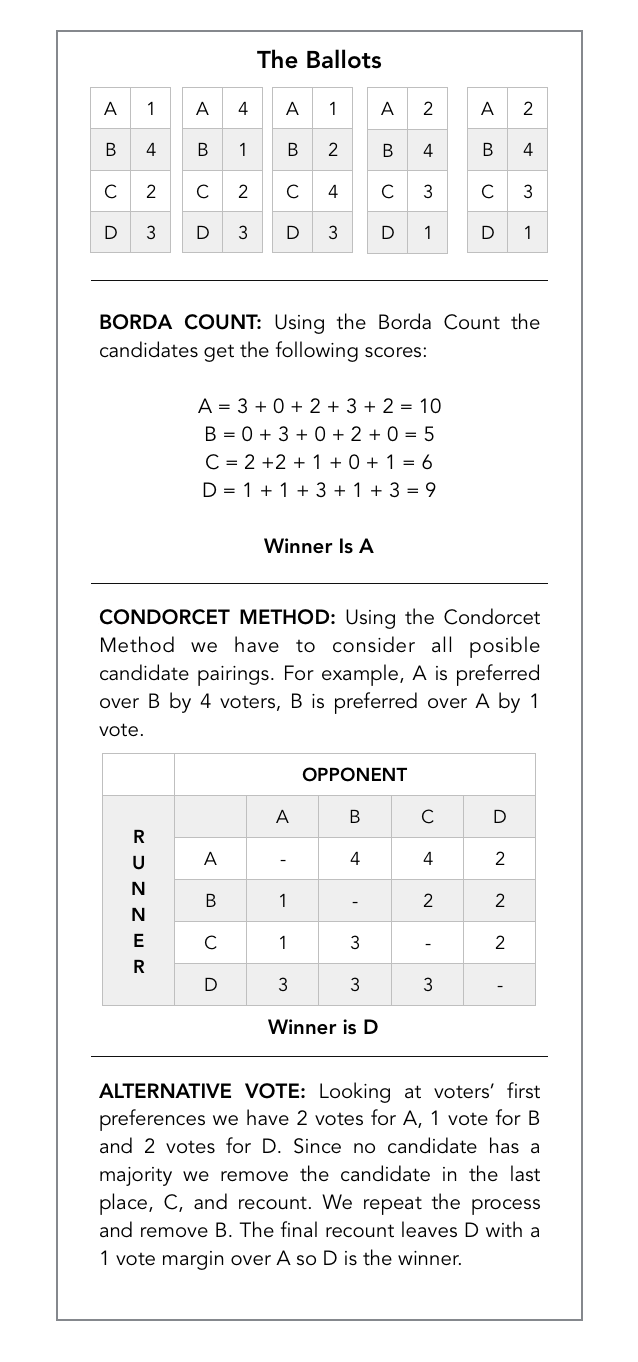
Voting and elections have played a significant role in society for centuries, but academics didn’t start studying them until much later. Voting has been a part of democracy since the 6th century, when Athenian democracy was introduced. However, election method design, the main focus of voting theory, wasn’t an object of academic study until the 18th century.2 Jean-Charles the Borda and Marquis de Condorcet are usually credited as the founders of voting theory for their contributions developing the Borda count, the Condorcet method and the Condorcet paradox.3

Later in the 18th century the topic of apportionment (also sometimes known as proportional representation), the process by which seats in a legislature (e.g. parliament) are allocated, began to be studied because the United States Constitution mandated that seats in the House of Representatives had to be allocated proportional to the population in each state but didn’t specify how.4 Various methods were proposed, and later, some of the methods discovered in the United States were rediscovered in Europe in the 19th century including Jefferson’s method/d’Hondt method, Webster’s method/Sainte-Laguë method, and Hamilton’s method/Hare largest remainder method.4 The single transferable vote, another apportionment method, was developed by Carl Andræ in Denmark in 18555 and Thomas Hare in England in 1857.6

In the late 19th century the focus went back to single winner methods. Around 1870 William Robert Ware propose applying single transferable vote to single winner elections, which became what is now known as the alternative vote.7 Shortly after mathematicians started revisiting Condorcet’s and Borda’s ideas and inventing new Condorcet methods, for example, Edward Nanson combined the alternative vote and the Borda count and produced a new Condorcet method called Nanson’s method.8 Charles Dodgson introduced the use of matrices to analyse Condorcet elections and proposed another Condorcet method known as Dodgson’s method.9 Ranked voting methods started gaining support and being used in government elections. The alternative vote was first adopted in Australia in 1893 and continues to be used to date.10

Some Election Methods in Action

The Borda count, the Condorcet method and the alternative vote are all single winner election methods in which voters rank options in order of preference.11 When using the Borda count the outcome is determined by giving each option a number of points corresponding to the number of candidates ranked lower; when using the Condorcet method the outcome is determined by counting how many votes rank one candidate over the other for each possible pairing of candidates; when using the alternative votes the outcome is determined by counting the votes for each voter’s top choice, declaring a winner if a candidate has more than half of the voters or removing the candidate in last place and recounting until a candidate has a majority.11

The Borda count is currently used for some political elections in Slovenia12, Kiribati13 and Nauru14; the Condorcet method is used in elections in various organizations including Music Television (MTV) 15, Ubuntu16, and Wikipedia17; the alternative vote is used for some political elections in Australia18, Canada19, the Czech Republic20, India21, Ireland22, New Zealand23, Papua New Guinea24, the United Kingdom25 and the United States26, 27. These 3 methods will be illustrated in the diagram below.

A Few Results Relating to Designing and Selecting Election Methods

As seen above, the election method chosen can affect who is the winner, which raises the question of how to decide which election method to use. Mathematical criteria can be defined, and voting methods can hence be assessed based on whether or not they fit the criteria. However, the criteria might not be relevant in practice. An alternative approach is to define a set of ideal properties and then see how close different voting methods come to having said ideal properties over a large sample of simulated elections. In this case, the results are practically relevant but the result might be biased based on how the elections are simulated. In this section I’ll go over a few theorems and results relating to this topic.

The Condorcet paradox states that when there are 3 or more alternatives, the collective preferences can be cyclic even if the preferences of individual voters aren’t, e.g. if the voters’ ranked preferences are ABC, BCA, CAB respectively then A is preferred over B which is preferred over C which is preferred over A.28 One important implication of this paradox is that in a two stage voting process the winner might depend on how the 2 stages are structured.11 If the winner of A versus B then faces C then A would defeat B and then lose to C. But if instead the winner of B versus C faces A then B would defeat C and then lose to A.

Arrow’s theorem states that when there are 3 or more alternatives no ranked order voting system can convert the individuals’ ranked preferences into a community-wide ranking while also meeting the following criteria:

* Unrestricted domain: all voters’ preferences are allowed.
* Non-dictatorship: a single voter’s preference can’t determine the result of the election
* Pareto efficiency: we can’t pick a winner that would better fit an individual’s preferences without it being a worse fit for other individual’s preferences.
* Independence of irrelevant alternatives: if candidate A is preferred over candidate B, introducing a third option C mustn’t make B preferred over A.29

A related result is the Gibbard-Satterthwaite theorem which states that if there are 3 or more options in a single-winner election one of the following must be true regardless of the specific election method used:

* Dictatorship (as explained above).
* There is a candidate who can never win.
* The method is susceptible to tactical voting, i.e. a voter supporting a candidate other than their preference to prevent their least favourite candidate from winning.30, 31

Conclusion

Mathematicians have made a lot of valuable contributions to voting theory. Some of the contributions were listed here, like the Borda count and the Condorcet method, but this is by no means a comprehensive account. Mathematician’s contributions to voting theory aren’t limited to direct contributions to the field either, for example, number theory and cryptography have recently started playing a role in the field. However, a lot of work remains to be done to better determine which election methods can best represent voters’ opinions and how to avoid bias or result manipulation deriving from the election method design.

The Major Voting Systems in use around the World

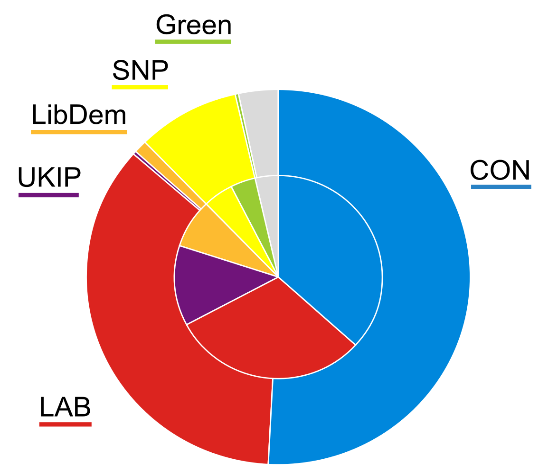
There is a plethora of electoral systems in use to elect Parliaments around the world. We will explore the most popular electoral systems in this report and briefly comment on the fairness of these systems.

* First past the post (FPTP)
* Party list proportional representation (PR)
* Two-round run-off
* Additional-member system (AMS)
* Alternative Vote (AV)

First Past the Post

First past the post is one of the most popular voting systems around the world, especially within countries formerly part of the British Empire32. It is used in the UK, USA, India, Canada, and a variety of other countries32. FPTP demands that the nation is divided into constituencies. Each constituency returns one member to Parliament. Hence, there are only as many members taking seats in Parliament as there are constituencies in the country.

On polling day, the electorate is given a list of candidates standing for election in their constituency. An individual may only choose one candidate to vote for. After polling stations close, the votes are subsequently counted and the candidate with the most votes wins and is sent to Parliament. Therefore, all other candidates lose and are not sent to Parliament; this leads to some dubbing this system “winner takes all”33.



*Pie chart34 showing the results from the UK 2015 Westminster elections. Inner circle shows popular vote. Outer circle shows seats won*

The popular vote for a party is defined as the total number of votes won by all the candidates who stood for the same party. Since losers are given nothing, nor is there a minimum vote the winner must achieve, this can lead to Parliaments where one party may have a majority of seats but a minority of the popular vote. This happens because the party that won the election, fielded candidates who defeated all alternative candidates in a majority of constituencies in the country. Thus, proportionality is traded for local accountability.

Party List Proportional Representation

Party list PR is popular in the European Mainland, Latin America, and sub-Saharan Africa35. Unlike FPTP, the country does not need to be divided into constituencies. However, constituencies do exist in some countries such as Spain36. Political parties are required to produce ranked lists of candidates that they would like to sit in Parliament.

On polling day, the electorate is then given the right to choose their favourite list of candidates and may vote for one respectively. There are several different ways to count votes, here we will look at a commonly used method which is the d'Hondt method37. First, the total votes are tallied and divided by the number of seats won by the party (either in the constituency or the entire nation) plus one to acquire a number for the quota for each party. Obviously, at the beginning of the counting process every party has zero seats.

Under the d'Hondt counting system, the party which has the largest quota has its 1st member of the list granted a seat in Parliament and they are duly elected. Then the quota for that party is adjusted thereafter and the party with the largest quota is sought after again. This process is repeated, so ensuring a level of proportionality of seats won to votes cast for those parties. It also ensures that the leadership of all the parties are entrenched in Parliament since the leadership put themselves at the top of the list38. Here local accountability is exchanged for proportionality.

Two-Round Run-Off

Two-round run-off systems are very similar to first past the post. The President of the 5th French Republic is elected this way. Like FPTP, the country is divided into constituencies and each constituency elects one MP from a list of candidates standing there. The election is split into two polling days usually a week apart.

On the 1st polling day, voters vote for their favourite candidate. If no-one receives more than 50% of the total vote in the first round39, then the two most popular candidates are selected to stand for election again in the 2nd round. All candidates who win over 10% may stand in the 2nd round40. The winner of the 2nd round is then returned to Parliament, with the loser of the 2nd round facing the same fate as those who didn’t make it to the 2nd round. A major consequence of two-round is establishment parties collaborating with each other in the 2nd round to cut down minor parties. They do this by standing down and letting a less disagreeable opponent win41.

Additional-Member System

Additional-Member systems are a mixture of first past the post and party lists. The most well-known Parliaments which are elected using AMS are the Scottish Parliament and the German Bundestag. The nation is divided into constituencies and each of these constituencies belong to one region each e.g. all the Glasgow constituencies belong to the Glasgow region. Each constituency returns one member to the Parliament, just as it would do under FPTP. In addition to those MPs, more are elected from a top-up list which operates under the d’Hondt system.

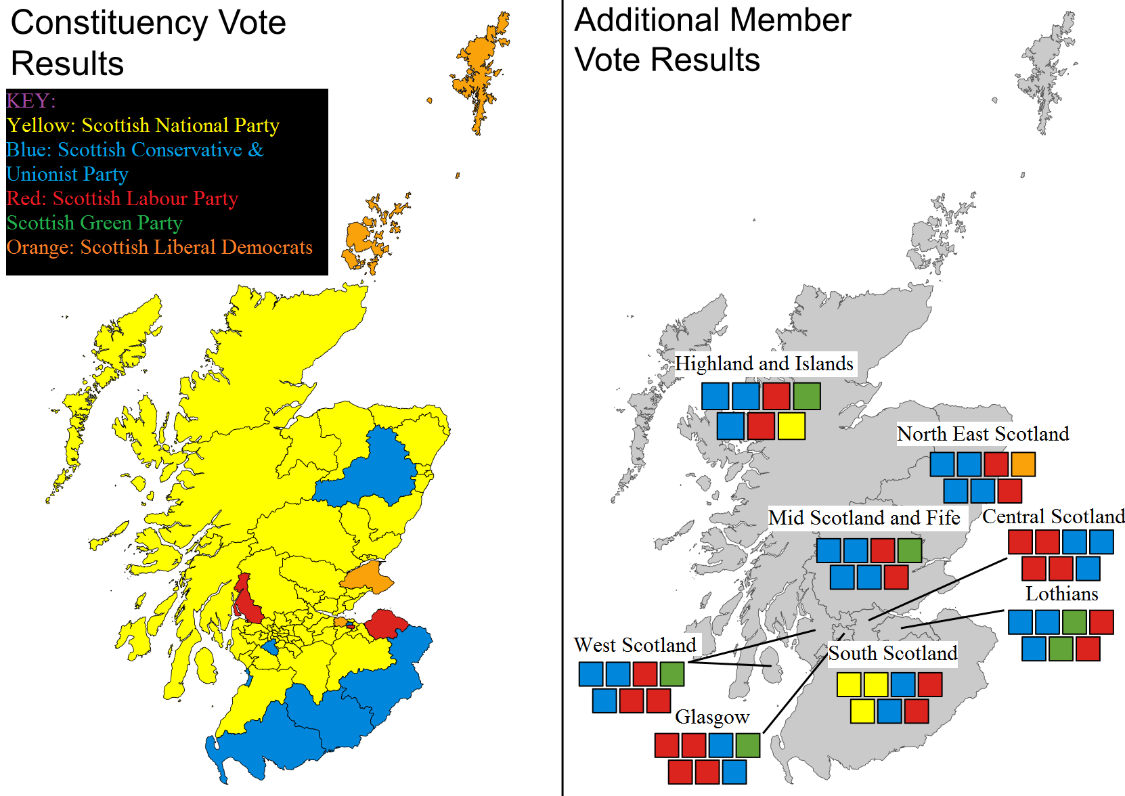


Figure 1 Scottish Parliamentary election results for 2016 with constituency results on the left and regional list results on the right.42

On polling day, individuals from the electorate are provided two ballots each. One for their constituency and one for their region. They then choose their favourite candidate to represent their constituency and then their favourite party list for the region. Constituency seats are allocated using FPTP. The distribution of regional seats operates under the d’Hondt system. Constituency seats won in that region as well as regional seats are used to find the quota. Therefore, there are two classes of politicians: one which was directly elected by a locality and another which was elected from a list for a region.43

Alternative Vote

AV is used to elect the Australian House of Representatives.44 AV is like first past the post insofar as the country is divided into constituencies and each constituency elects one MP from a list of candidates.

On polling day, voters are then able to rank candidates in numerical order with lower numbers indicating higher preference. Voters are free to rank as many as they please. The votes are then tallied and if no candidates win over 50% of the 1st preference votes, then the candidate with the fewest votes is eliminated. That candidate’s votes are redistributed per their 2nd preferences. This process repeats (using 3rd, 4th, etc. preference votes) until a candidate breaches the 50% threshold, therefore winning a seat in Parliament. This system was devised to stop the ‘spoiler effect’ found in FPTP elections.45

From the wide variety of electoral systems in use around the world, not only is democracy widespread but the people want different things from their electoral systems. FPTP offers direct accountability of politicians but party list PR gives proportionality of seats won to votes cast. Whilst others try to create a compromise between proportionality and local accountability. So, we can conclude that fairness in elections implies different things to different electorates and nations.

Different forms or proportional representation

What is Proportional Representation?

Proportional Representation is a general term for different election processes which all attempt to fix the problems of majoritarian voting systems, to ensure that the distribution of power in a system is as equal as possible to the voting preferences of the population. The goal is to make every vote count as much as another, regardless of whether the vote was for a popular candidate or party. It is a system which chooses fairness over political stability, as it nearly always results in coalitions.

Before getting into the different types of Proportional Representation, it is important to highlight the main issues it attempts to resolve:

First Past the Post (FPTP) elections: This is the most basic form of majoritarian voting systems. In FPTP, the candidate or party with the most votes wins 100% of the election. While this may not seem unreasonable, if one considers a scenario where three parties are competing against each other and two of them receive 30% of votes each while the last party receives 40%, the last party will win the entire election and the 60% of the population that voted for other parties will not be represented at all. This encourages the population to vote tactically, rather than for the party they like the most.

The Spoiler Effect: This is an effect which even other majoritarian systems, such as the Alternative Vote, seek to mitigate. New parties entering a FPTP election help their biggest opponents, and damage the success of similarly motivated parties due to votes being split between them. Consider a FPTP election where the “Blue” Party will win 40% of the vote and the “Orange” party is predicted to win 60%. If a third party, the “Pink” party, with similar ideas to “Orange” decides to enter the election, the “Orange” party’s votes will now be split between both themselves and the new “Pink” party. If they each then win 30% of the vote, the “Blue” party’s 40% will win the entire election, even if it’s the party that the majority of the population liked the least. This discourages any political diversity and means that FPTP voting will always trend toward a Two-Party System.

Gerrymandering: This is a practice that can be abused by a party already in power to maximise their chances of being re-elected. It is done by manipulating the boundaries of constituencies so that their voters make up the minimum majority in each constituency.

The Different Forms of Proportional Representation:

*Single Transferable Vote (STV):*

Although not too common, the Single Transferable Vote system focuses on giving each constituency multiple representatives proportional to the votes in that constituency. It is used in Ireland’s Presidential election, as well as smaller elections in many other countries.

It works as follows:

Each constituency will want to elect a number of representatives relative to its size. A candidate will need 100%/n of the vote, where “n” is the number of representatives, to be elected.

Several candidates will run for election. Multiple candidates from the same party can run alongside each other.

The population votes for the candidates, ordering them in terms of preference, much like the Alternative Vote.

If any candidates meet the voting quota, they are elected. Any votes that take them above this quota are redistributed to the second choice candidate.

If the redistribution of excess votes takes another candidate above the quota, they are elected. If not, the candidate with the fewest votes is eliminated, and their votes are redistributed to their second choice candidates. This step is repeated until the number of representatives needed is met.

This is an effective type of Proportional Representation, as it encourages the population to vote for the candidate they like most, even if they are worried they might not win. This is because if they are eliminated from the election, the vote goes to the second-best candidate, rather than going totally to waste, as in FPTP. It also gives a chance for smaller parties to be represented if they are the second choice for many other candidates. Because this system’s tries to make each person’s vote as valuable as possible, Gerrymandering is mitigated to a large extent. The greatest strength of STV is that you vote for direct representatives of your constituency, rather than for a party in general. It is however not as representative as Party-list Proportional Representation.

*Party-List Proportional Representation*

Party-list Proportional Representation is different from STV in that a population will vote for a party in a larger district rather than a candidate in a constituency. This is interesting, as it means that parties are integral part of the voting system, and any individual candidate is treated as a party too.

Each district has a certain number of seats and each party will receive a number of seats proportional to the percentage of the vote they won in the district.

There are two main types of Party-list PR: Open-list PR and Closed-list PR. In Open-list, voters can decide which candidates they would like see take seats in the district. This is used in many European countries such as Sweden, Finland and the Netherlands. In Closed-list, voters do not get the choice, the candidates are decided within the party. This is used in Russia, South Africa, and other countries.

The advantage of Party-list PR is that it is the most fair, proportional system. Small parties and minorities are encouraged. Everyone is represented relative to the size of the vote. Because of this, there is near to no incentive to Gerrymander. It will however nearly always result in a coalition government, as it becomes incredibly difficult to achieve a majority with this system.

*Semi-Proportional representation*

There are also a couple of systems which marry concepts from majoritarian and proportional elections. Most notable of these is Mixed Member proportional representation (MMP), where each constituency will elect one candidate using the FPTP model, but then an equal amount of candidates are elected to fit the proportional split in parties. If one were to consider five constituencies where three parties, the Green party, the Yellow party, and the Brown party were competing, and in each constituency, there was 20% support for Green, 35% support for Yellow and 45% support for Brown, the Brown party would win all five FPTP candidate elections. However, now the number of seats is doubled to ten, and the largest party is given a seat until they are over-represented. So here, Yellow would be given four seats, and Green would be given one, so that even if they did not win the FPTP elections, they are still proportionally represented overall.

Conclusion

There are many ways to assemble a proportional election, but the goals of preventing minority rule, giving a fair voice to all people, and the mitigation of Gerrymandering are the same with them all. Their strength is however also their greatest weakness, as they nearly always result in coalitions.

The advantages and disadvantages of the ‘First Past the Post’ voting system

‘First Past the Post’ is a voting system that involves the electorate casting one vote each for a single candidate in their local constituency; the winner is the candidate who collects the most votes, and this candidate gains a seat in parliament.

One of the defining features of this system is that candidates who do not win in a constituency gain no representation in parliament, regardless of how much support they accrued in the area. This is the underlying cause of most of the disadvantages of the system, but it also solves many of the problems that are faced by other electoral systems in place around the world.

Firstly, the system is very effective at producing majority governments – coalitions are rare. With only one seat in parliament available per constituency, election results in constituencies are much more decisive, which –in turn- causes the overall results of the general election to be much more decisive. This can be considered an advantage, since (in the UK) “conflicting ideologies” in a coalition “can make a government fractious whilst also weakening government”.53

On the other hand, the ‘winner gets the seat’ system causes the geographical location of a parties supporters to become very important in winning elections. A party will win many more seats if all of its supporters are concentrated in an area, rather than spread out over the whole of the UK. Taking the 2015 election as an example, the Scottish National Party was able to win 56 seats despite only having 4.7% of the overall vote share, whereas UKIP won only one seat with 12.6% of the overall vote share.54 This was entirely due to the effect described, with the supporters of the Scottish National Party concentrated in Scotland (where the party won all but three seats55) and the supporters of UKIP spread over the whole of the UK. The concentration of SNP voters compared to UKIP voters is visualised in the maps below (*figure 1* and *figure 2*), where the more opaque the colour, the higher the percentage of supporters in that constituency.

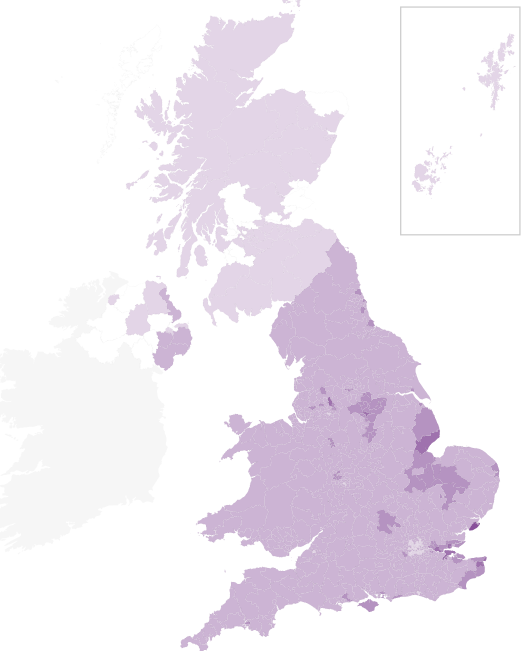


Figure 1 Map showing the spread of UKIP votes55

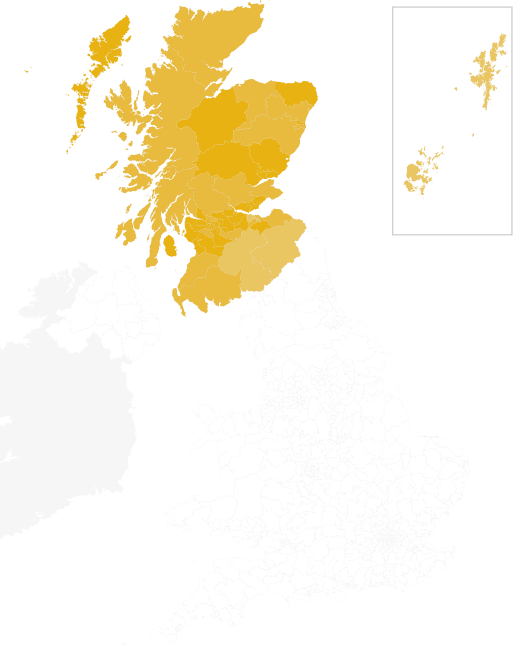


Figure 2 Map showing the spread of SNP votes55

Marginal seats are also an occurrence when using a single-winner voting system. Marginal seats are seats for which the leading party has a very small lead over the other popular parties in the associated constituency. Most commonly, these seats are two way marginal, where two parties are in close competition to win. Such seats are an issue because the winning party will have often gained fewer than half of the votes, meaning that most voters in the constituency would prefer for a different candidate to be in power. In some cases, two way marginal seats can develop further into three way marginal seats, which significantly worsens the problem as supporters of the winning party will be considerably outnumbered by the combined supporters of the other two major parties.

Strongly linked to the problem of marginal seats is the issue of tactical voting. This may occur when an elector’s preferred candidate appears to be unable to win the seat, and so voting for their favourite would seem be a waste of the elector’s vote (this particularly occurs in marginal seats). As such, the elector will often choose to vote in such a way as to keep their least preferred candidate out of power.

An example for marginal seats and tactical voting is the constituency of ‘Hampstead and Kilburn’ in London. This was a marginal seat in the 2015 election with Labour winning 44.4% of the votes and the Conservative party winning 42.3% of the votes56. In this case, supporters of other parties such as UKIP may have chosen to vote tactically for either Labour or the Conservatives - it would have been clear from opinion polls that their own preference would not win.

A further effect of the lack of representation for voters who do not support the winning candidate, is that voters may be divided if two or more candidates with similar goals run- an occurrence known as ‘split votes’. If this takes place, it can lead to opposition with fewer supporters completely controlling the constituency. The impact of this is most obvious in areas such as Northern Ireland where there is a strong divide between two groups with conflicting ideals. In this case, these groups are the unionists and the nationalists; they are extremely opposed to candidates from the respective opposite groups.

By investigating the results for the constituency of ‘Fermanagh and South Tyrone’ in the 2015 general election, it can be seen that the seat was won by the unionist candidate Tom Elliot, despite him only having 46.4% of the votes, compared to a total 50.8% between the two largest nationalist parties. The reason for this was that –despite outnumbering the unionists- these nationalist voters were split with Michelle Gildernew winning 45.4% of the total votes and John Coyle winning the remaining 5.4%.57 So, as a consequence of the ‘First Past the Post’ voting system, a constituency that is mostly populated by nationalists is entirely represented in parliament by a unionist.

One advantage to the system is that voters have a strong link to their local MPs, since electors vote for candidates and not for a party. Due to these strong links, voters can be in support of an MP who they believe is good for their area, instead of a particular political party. This was highlighted in 2014 in the constituency of Clacton, when the MP Douglas Carswell defected from the Conservative party to UKIP and resigned his seat. This trigged a by-election but Douglas Carswell was able to win the seat once more (now for UKIP); he had an enormous majority of supporters despite switching parties.58

Another anomaly that occurs when using the ‘First Past the Post’ system is that parties can be almost guaranteed to win a certain number of seats in parliament. These seats are known as ‘safe seats’, where an overwhelming majority of supporters of a particular party exist in the associated constituency. In these constituencies, those who do not support the major party in the area will usually have no effect on the overall vote.

In immediate contrast to this however, are situations in which constituencies that are considered as ‘safe seats’ for certain parties are overthrown by other parties. For example, the victories of the Scottish National Party in Scotland in the 2015 election, where they won 56 of the 59 seats55, a large number of which were considered ‘safe seats’ for the Labour party.

To conclude, it is obvious that the ‘First Past the Post’ voting system has many weaknesses. Despite this, it is very effective at getting results and changing the voting system to a more proportional one would complicate the process, greatly weaken the link between MPs and their constituencies and make coalition governments much more common. It is therefore my belief that the system should remain the way it is – changing the system would present much more of a challenge than continuing to use the current ‘First Past the Post’ system.

The Accuracy of Opinion Polling

In modern society, opinion polls are widely used to measure public opinion, with questions being asked such as “do you favour a ban on smoking in public places?”. An opinion poll is an evaluation of public opinion on certain matters through questioning a representative group of people. Generally, these are carried out when various organisations want a political subject answered, in particular in the UK they are used when attempting to predict who will be elected in the next general election. Opinion polling can be a powerful yet dangerous tool, as it can misrepresent a certain party’s popularity. In this report, I will be discussing the reliability of opinion polling, comparing it to electoral results and using statistical analysis to come to a sound conclusion.

How Is Opinion Polling Conducted?

There are many ways in which opinion polling is carried out, the main ones being online polling, telephone polling, and door-knock polling.

One of the leading polling organisations YouGov conducts its opinion polls online. The organisation has gathered a panel of over 360,000 people. When a political question needs to be answered they fill the sample quota from this panel, these people are then asked to fill out an online.59

Another large organisation that conducts opinion polling in the UK is Ipsos MORI. This organisation uses telephone polling to evaluate public opinion. They use random-digit dialling so the panel is completely random, they assort the panel into weighted demographics in order to fulfil the sample quota.59

The most accurate way of polling is the use of “door- knock polls”. This is where individuals hired by polling organisations go from house to house and fill out surveys regarding political issues. This is the ideal way of gaining polling data as it reaches the broadest demographic, it also gains the most reliable data as people are more likely to share their true opinion when the survey is carried out in person. However, it is impractical and costly. It requires a lot of finance as well as manpower to reach the required sample quota, a significant amount more than online and telephone polling.

Online Polling

The use of online polling is extremely convenient; people can fill out polling surveys on the go, on their smart phone. The costs implicated with online polling are also extremely low, including costs for creating and maintaining a website. The cost per person reached appears to be even lower with an almost limitless reach of people to question. However, those questioned will in most cases be of a younger generation. The elderly may find it difficult to navigate their way through a computer in order to fill out a survey, hence this may skew the results of a poll as not all opinions will be recorded.60 In order to resolve this, organizations put “weights” onto certain demographics. This is where demographic results are increased or decreased appropriately to gain a fair and accurate representation of the population.

In the 2015 general election, the polling organizations such as YouGov put weights onto different age categories, however these weights were not correct and they did not successfully represent the opinion of different demographics. The younger generations were over-represented skewing the polling results in favour of the Labour party. This was due to the voter samples containing a higher proportion of Labour supporters than in the general election.61 Whereas the older generations were under-represented due to the incorrect weighting. This led to a lower show in support for the Conservative party, as opinion polls underestimated the number of older typically-Conservative voters in the country.62 This had the overall effect of making the 2015 online opinion polling results very inaccurate, it gave the impression that both Labour and the Conservatives were neck and neck, whereas in fact the Conservative party had a much stronger showing in the country than was predicted in the polls. This is shown in the figure below.

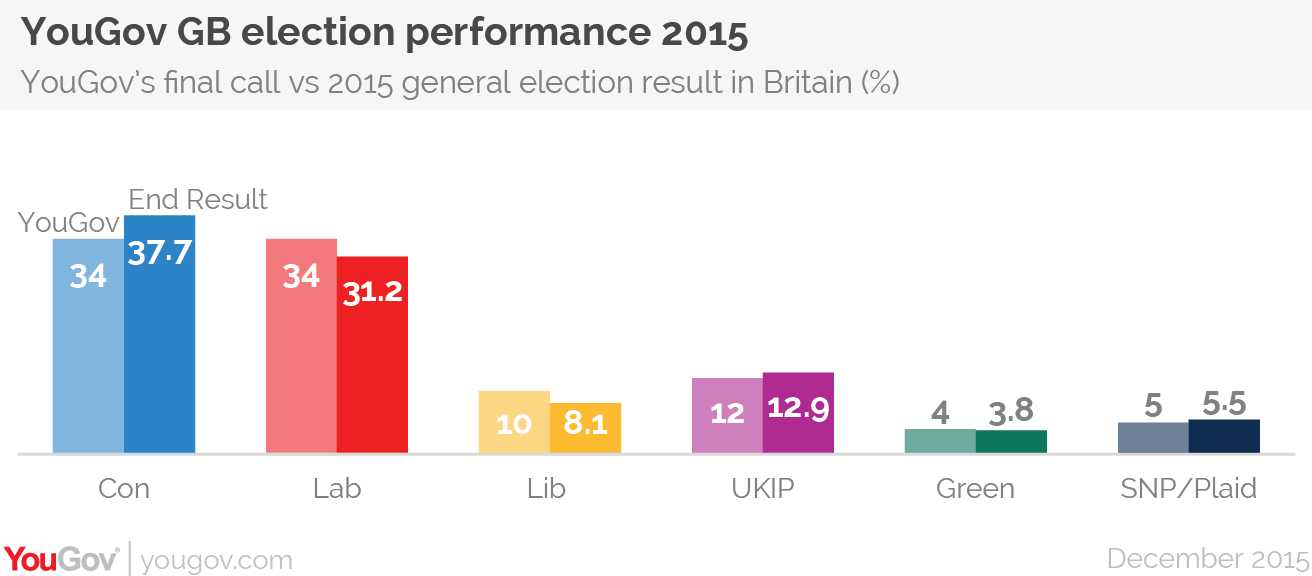
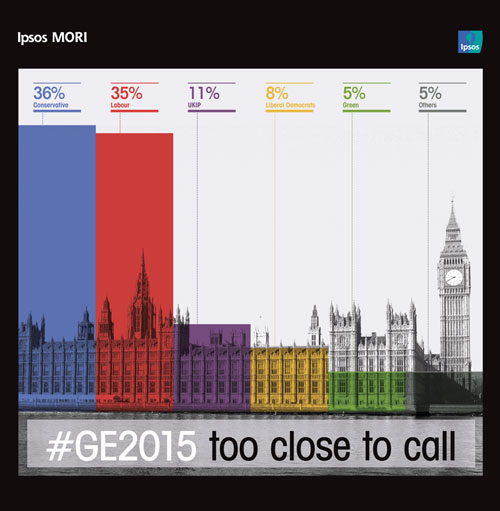
Telephone Polling

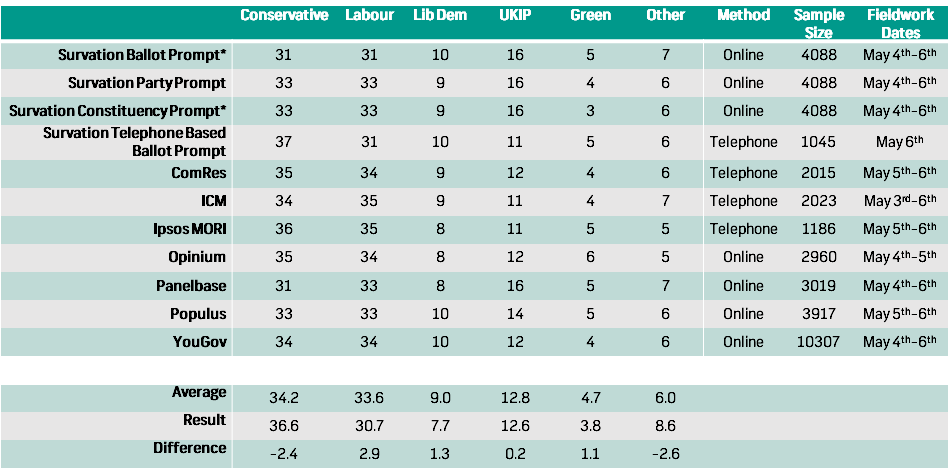
Figure 1: YouGov Election Performance 2015 61

The use of telephone polling is extremely convenient. In modern society, most people carry a mobile phone around with them wherever they go. This means that a large number of participants respond to polling organisations within 10 minutes of being contacted. Furthermore, participants will respond to questions in their natural state, not having much time to question themselves about their answers. This results in true opinions being recorded with no outside influence. Mobile phones also reach a broad demographic, with even those in the older generations using them. This means that a broad demographic can be reached by polling organisations resulting in more reliable and accurate data.63,64

Telephone polling organisations have higher costs than that of online polling organisations. They have to hire a lot of people to call up voters, as a result of this, sample quotas are usually relatively small, meaning weights have to be assigned to demographics in order to gain reliable data. Ipsos MORI predicted that the General Election would be a close call between Labour and Conservative party, though in actual fact the Conservative party won by 7%. This gives the impression that telephone polling is no more reliable than online polling as results gained there were similarly wrong

*Figure 2: Ipsos-Mori Polling Results 65*

Final Call Predictions for the 2015 Election by Multiple Polling Organisations



*Table 1: Final Call predictions.59*

As you can see from the data above, there was a significant difference in the opinion polls and the actual general election results with an overestimate of 2.9% for the Labour party and an underestimate of -2.4% for the Conservative party on average.

Comparison of Online and Telephone Polling Accuracy in the 2015 General Election

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Conservative | Labour | Lib Dem | UKIP | Green | Other |
| Telephone polling | 35.50% | 33.75% | 9.00% | 11.25% | 4.5% | 6% |
| Online polling | 32.86% | 33.00% | 9.14% | 14.57% | 4.57% | 6.14% |
| Result | 36.60% | 30.70% | 7.70% | 12.60% | 3.80% | 8.60% |
| Difference (Telephone Polling) | -1.10% | 3.05% | 1.30% | -1.35% | 0.70% | -2.60% |
| Difference (Online Polling) | -3.74% | 2.30% | 1.44% | 1.97% | 0.77% | -2.46% |

*Table 2: Comparison Between Online and Telephone Polling Accuracy.59*

As you can see from the data that I calculated, online polling appeared to experience a larger percentage error than that of telephone polling, with the exception of the “Labour” and “Other” column results. This implies that during the 2015 election, telephone polling was more accurate than online polling, despite the use of larger sample sizes from online polling organisations such as YouGov. This is borne from the inaccurate weighting used by YouGov when calculating opinion poll results.

Undecided Voters

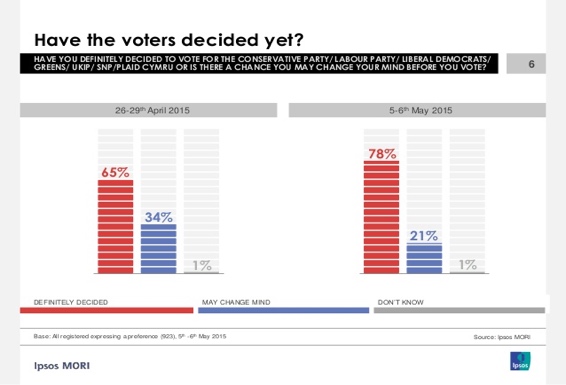
As you can see from the data above collected by Ipsos MORI, of the sample of 1186 people questioned 22% were still not certain who they were going to vote for as of the 6th of May 2015 (one day before the General Election). This means a significant amount of the sample was deemed to be unreliable, hence voting intention figures were only based on 862 adults. This is small sample size cannot be considered representative of

Figure 3 ‘Have the Voters Decided Yet?’.61

the UK electorate.

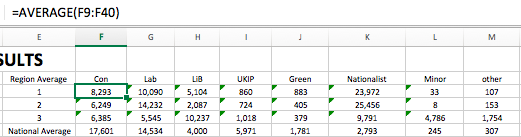
Conclusion

In conclusion, I believe that the opinion polling results of 2015 were inaccurate. They gave off the impression that the election was much closer than what was actually the case. This was a result of the combination of the incorrect demographic weights as well as the small sample sizes used in particular by telephone-polls. Furthermore, the significant number of undecided voters made predictions much more difficult to ascertain. In order to make opinion polling more accurate, adjustments of voter samples are needed to better reflect the UK’s voters. Additionally, a substantial increase in sample size for telephone polls are needed in order to improve accuracy of data gathered. Whilst opinion polling may never be 100% accurate, they are still necessary to view a rough snapshot of where the mood of the country is.

General Election Excel Analysis Findings

The datasets given contained the final results for the 2010 and 2015 General Elections, it contained 649 constituencies within 20 regions and outlined the results per party.

Within the Excel analysis, we selected three regions and analysed the results found. We evaluated each region’s average result and compared them to the national results. The regions chosen were regions 1,2 and 3.



|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **2015** |  |  |  |  |  |  |  |  |  |
| Total Electorate | Region Average | Con | Lab | LiB | UKIP | Green | Nationalist | Minor | other |
| 46428805 | 1 | 8293 | 10090 | 5104 | 860 | 883 | 23972 | 33 | 107 |
|  | 2 | 6249 | 14232 | 2087 | 724 | 405 | 25456 | 8 | 153 |
|  | 3 | 6385 | 5545 | 10237 | 1018 | 379 | 9791 | 4786 | 1754 |
|  | National Average | 17601 | 14534 | 4000 | 5971 | 1781 | 2793 | 245 | 307 |

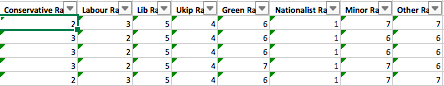
|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **2010** |  |  |  |  |  |  |  |  |  |
| Total Electorate | Region Average | Con | Lab | LiB | UKIP | Green | Nationalist | Minor | other |
| 45601060 | 1 | 7604 | 14360 | 9947 | 379 | 342 | 9044 | 44 | 342 |
|  | 2 | 6281 | 21334 | 5451 | 189 | 218 | 7481 | 55 | 467 |
|  | 3 | 5687 | 6165 | 9345 | 0 | 197 | 9552 | 5310 | 1181 |
|  | National Average | 16660 | 13412 | 10776 | 1415 | 438 | 1275 | 490 | 1208 |

As you can see from the graphs made, there was a significant shift in­ voters in regions 1 and 2. It can be seen that the votes shifted from the Labour Party and Liberal Democrats to the Nationalist party from 2010 to 2015. Within region 3, average votes per party experienced very little change, with the liberal democrats leading in both years with the nationalist party close behind.

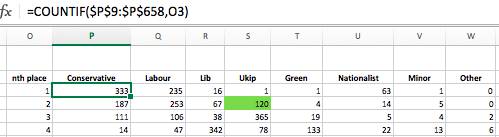
Despite this significant change in votes from regions 1 and 2 regions, the National Average votes for the Nationalist party was still considerably low. Implying that regions 1 and 2 had little influence over the general election.

Next our group analysed the frequency of nth places (n=1,2,3,4) for all parties in the 2015 election.

/Users/Cameron/Desktop/Screen Shot 2017-05-12 at 18.22.02.pngWe did this by finding the nth places of each party in each constituency by using the “Rank” function.



Then we used the “Countif” function to count the frequency of nth places for the selectedparty.



As you can see, the conservative party came first in a considerable number of constituencies. This reflects on the fact that they won the 2015 election.

The highlighted cell is the amount of times UKIP came second to other parties in 2015.

Next, we found the top ten “winnable” seats for UKIP from other parties in the next election based on the 2015 results. The results were as follows:

|  |  |
| --- | --- |
| **Ukip's Top Ten Most "Winnable" Seats from Other Parties In 2015** | **Difference in votes from the winning party** |
| Thanet South | 2,812 |
| Hartlepool | 3,024 |
| Boston and Skegness | 4,336 |
| Dagengam and Rainham | 4,980 |
| Stone-on-Trent Central | 5,179 |
| Heywood and Middleton | 5,299 |
| Rochester and Strood | 7,133 |
| Rother Valley | 7,297 |
| Basildon South and East Thurrock | 7,691 |
| West Bromwich West | 7,742 |

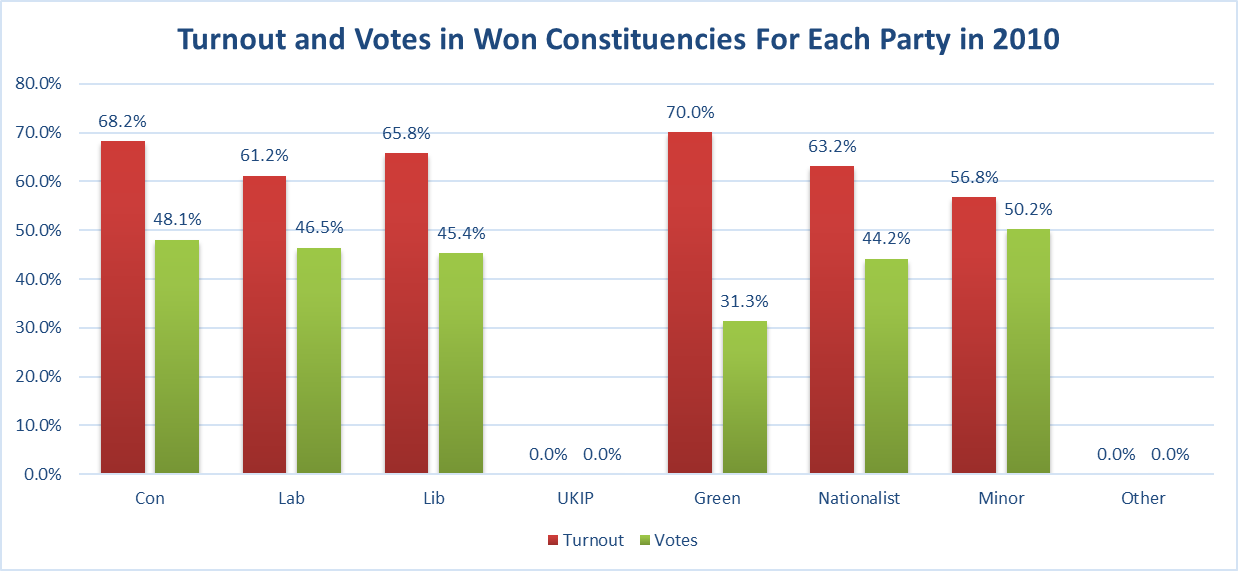
This was achieved by filtering the results to find all of those of which UKIP came second. Then, we found the constituencies that had the lowest difference in votes from 1st and 2nd through simply subtracting the second-place result from the first-place result. Then we used conditional formatting to find the 10 lowest values from those results.

Voter Turnout by Constituency

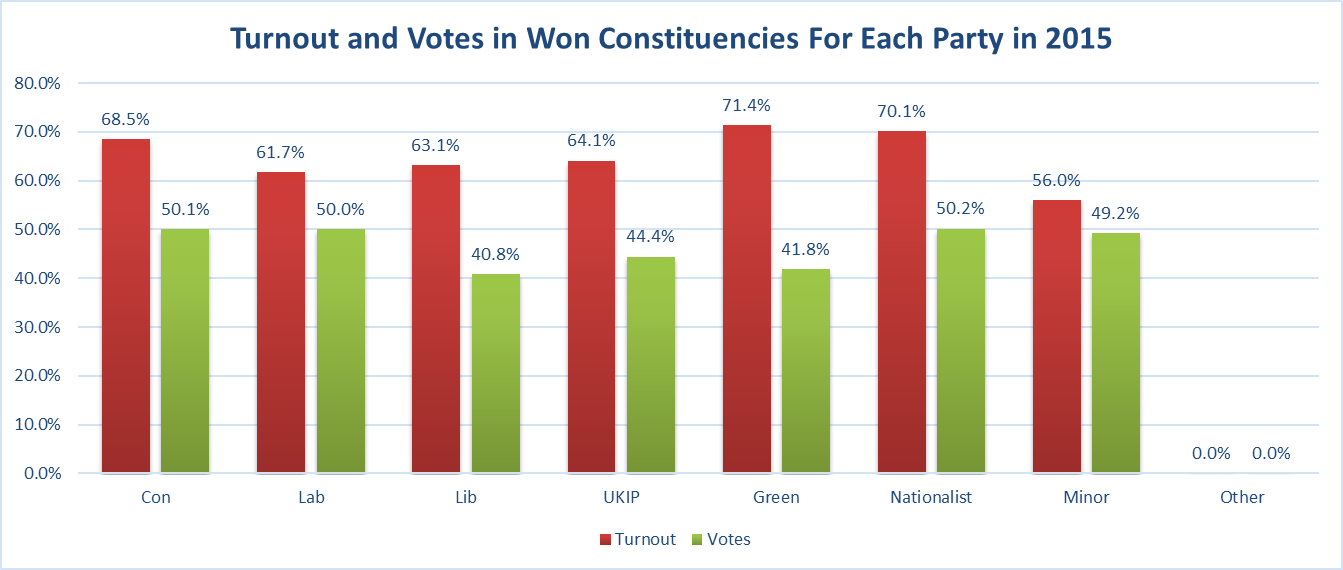
Average turnout overall was 65.0% in 2010 and 66.1% in 2015.

We can see from the following graphs that constituencies won by the Conservative and Green parties have the highest turnouts overall, with 68.2% and 70.0% respectively. The constituencies with the lowest turnouts appear to favour minor parties over the larger ones, however Labour held constituencies too have a low turnout rate.

We also observe that a change in turnout rate correlates with a change of leading party vote. All parties that won constituencies which increased in turnout also increased their lead over their opponents, while a decrease in turnouts made for a weaker victory.



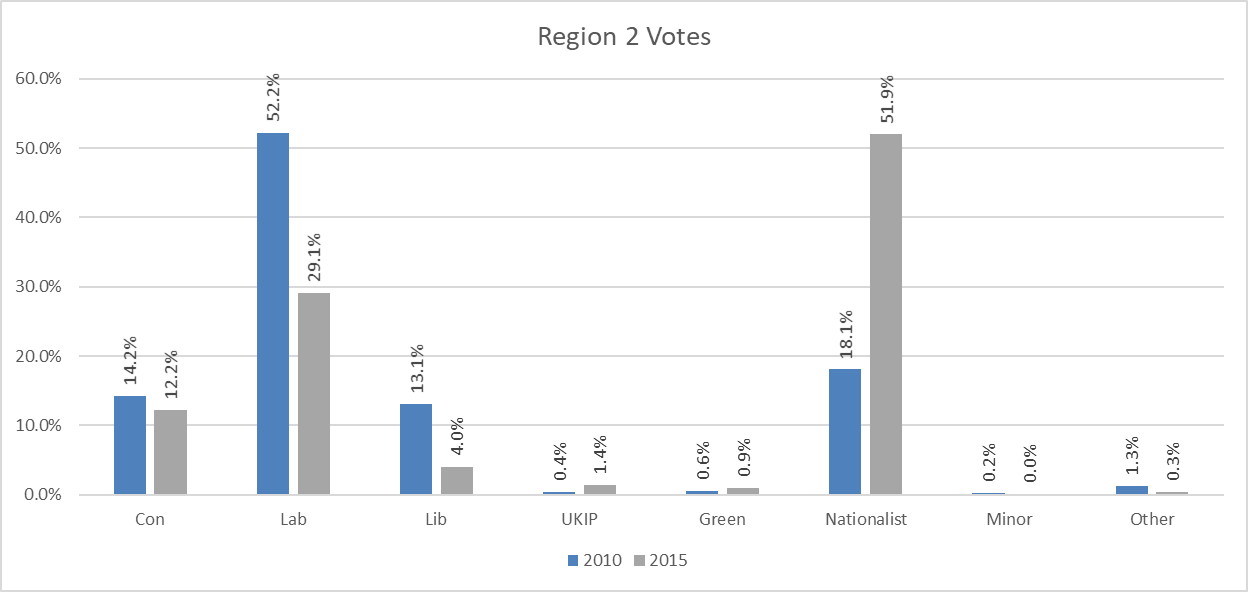






Swings

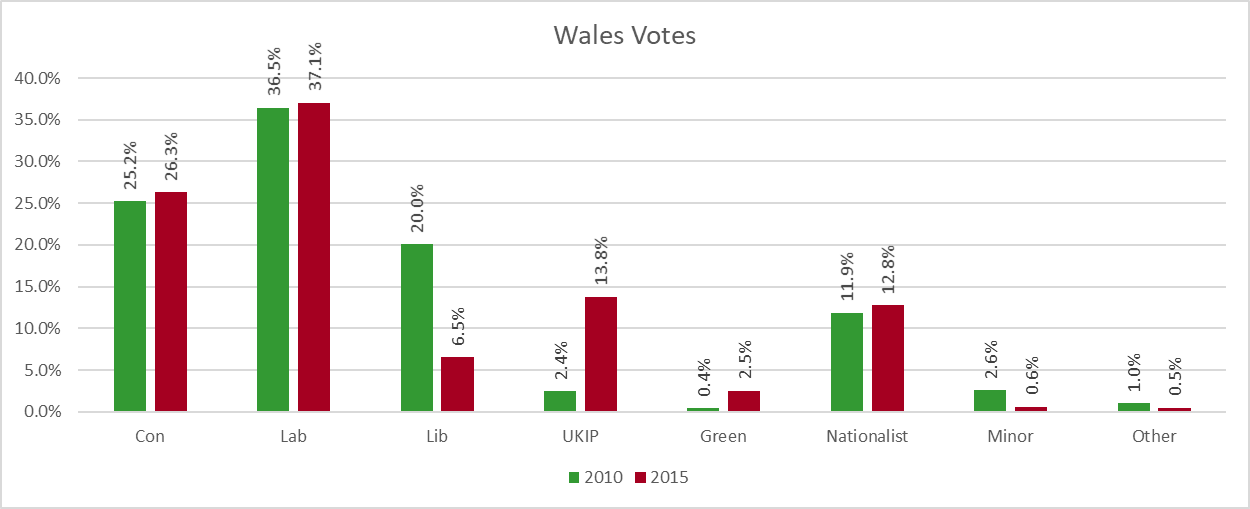
*Region 2*





In region 2 we can observe the large shift in support in favour of the Nationalist party, which gained over three times more votes in 2015 than it won in the 2010 election. These votes appear to have come from ex-Labour and ex-Liberal-Democrats, as these parties appear to have suffered the most from this shift, with the Liberal Democrats losing more than half their support. The Conservative party did lose votes, but their overall support seems to have remained largely unaffected.

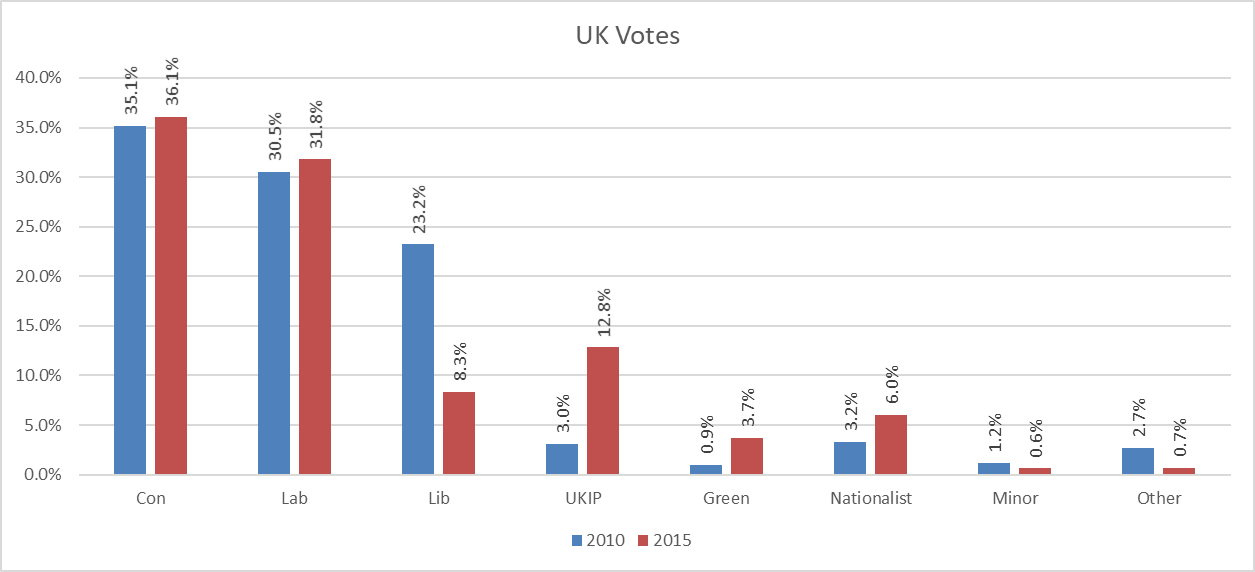
*Wales*





In Wales we observe a large swing from the Liberal-Democratic Party to the UK Independence Party. The Conservative and Labour parties have similar votes in each election, slightly higher in 2015. While their overall votes remain much lower than those of the leading parties, it is worth noting that the Green Party received six times as many votes in 2015 than it did in 2010.

*UK*

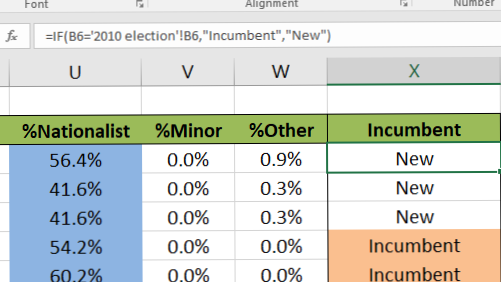




The overall changes in the UK as a whole are very similar to those in Wales, with the Liberal-Democratic party losing a large portion of their votes and UKIP taking their position as the third largest British party. No significant shifts in either the Conservative or Labour parties, which both seem to slightly strengthen their positions. Support of the Nationalist Party has doubled, which can be related back to the large swing of votes in Scotland.

Incumbent Effect

Using the IF and COUNTIF functions, we can show and find the number of recurring winners in the 2015 election.



Untitled



In 2015, 453 of the 650 constituencies (69.7%) were won by winners in 2010, with only 197 won by new candidates (30.3%). This supports the idea of there being an “Incumbent Effect” as a current MP has a much higher likelihood of being re-elected. While a previous winner does appear to be significantly more likely to win, they do not seem to gain a huge number of votes for the following election, although there is still an increase. These candidates won an average of 50.5% of votes in their constituencies in 2015, compared to 47.1% in 2010 (increase of 7.2%).

Further Analysis

*Average votes between countries within the UK*



As you can see from the data, all three regions had different winning parties. Region 1 in Scotland had a significant win by the Nationalist Party. Region 3 in Northern Ireland had a narrow win by the Lib Dems. Region 12 in Wales had a convincing win by the Labour Party. Region 20 in England had a substantial win by the Conservative Party. Region 20 had a similar result to the National Average, suggesting that this region and those around it had a large influence over the final result.

As you can see from the pie charts above, The national average vote distribution experienced little change for the conservative (+1%) and labour (+2%) parties. However, the Lib Dem party experienced a significant fall in average votes (-16%), whereas UKIP experienced a significant increase in average votes (+12%).

As you can see from the pie charts above, there was a massive shift in voters from the Labour Party in 2010 to the Scottish National Party in 2015. This resulted in the SNP going from 21% in 2010 to 49% in 2015. This change occurred due to the massive support of the Scottish People for the SNP’s policies and promises.

As you can see from the pie charts above, there was very little change in average votes per party within region 3 (Northern Ireland). The largest change in votes came from UKIP, which experienced a change from 0% in 2010 to 3% in 2015.

As you can see from the pie charts above, Region 12 (Wales) mainly experienced changes in average votes in the Lib Dems, which experienced a fall in average votes from 20% to 6%, and UKIP which experienced and increase in voted from 3% to 14%.

As you can see from the pie chart above, Region 20 (England) experienced average vote changes again in the Lib Dems and UKIP. The Lib Dems experienced a change from 24% in 2010 to 8% in 2015. UKIP experienced a changed of average voted from 4% in 2010 to 17% in 2015.

Though it looks like those who voted Lib Dem switched to UKIP, this was not the case. In actual fact, unhappy voters from the Conservative party switched to UKIP and then voters that voted for the Lib Dems in 2010 voted conservative in 2015.

General Election MATLAB Analysis

Outputs

1. *For the 2015 election:* 
   1. According to the data, how many people are there in the UK eligible to vote and how many voted in the 2015 election? Calculate this as a percentage and then calculate the average percentage turnout across all constituencies.
   2. Produce a 6 by 1 array showing the number of seats held by the 6 main parties in parliament as a result of the 2015 election. Hint: start by producing a matrix where each row has all 0s except for a single 1 in the column corresponding to the winning party.
   3. Produce a pie chart to show the proportions of total votes gained by each of the6 main parties. Comment on how this compares with the number of seats gained.
   4. Perform the same analysis for the 2010 election and display the 2010 and 2015 results in a comparative manner. Find a suitable way to show graphically the difference between parties share of the votes and share of parliamentary seats in 2010 and 2015.
2. By running the script ‘Question\_1a.m’, the following output is given**:**

According to the data, at the time of the 2015 election there were 46428805 people eligible to vote in the UK.

According to the data, 30697854 people voted in the 2015 UK election.

The overall percentage turnout for the whole UK was therefore 6.611812e+01 percent.

The average of the percentage turnouts in every constituency was 6.605318e+01 percent.

1. By running the script ‘Question\_1b.m’, the following output is given:

The 6 by 1 array for seats held by the six main parties is:

ArrayOfSixMainParties =

333

235

16

1

1

63

Therefore: CON won 333 seats; LAB won 235 seats; LIB won 16 seats; UKIP won 1 seats; Green won 1 seats and Nationalists won 63 seats.

1. Running the script ‘Question\_1c.m’ produces the following pie charts:

Note that the UKIP slice in the pie chart showing the spread of seats has been exploded to make the labels legible, without adjusting the order (and therefore colour) of the slices.

In these two pie charts, the consequences of using a ‘First Past The Post’ voting system can be seen: the representation for the Green Party and for UKIP was much smaller than the number of votes received, and the opposite is true for the Conservative and nationalist parties.

1. Running the script ‘Question\_1c.m’ produces the following pie charts:

There is the issue of overlapping section labels on these pie charts, which will be resolved for the presentation by redrawing the graphs using excel, using the data from these MATLAB functions. This will also allow us to change the colours of the section of the pie chart to match the parties represented by each section.

Additionally, running the script “Question\_1a\_Modified\_for\_2010.m” produces the following results:

According to the data, at the time of the 2010 election there were 45601060 people eligible to vote in the UK.

According to the data, 29687737 people voted in the 2010 UK election.

The overall percentage turnout for the whole UK was therefore 6.510317e+01 percent.

The average of the percentage turnouts in every constituency was 6.501744e+01 percent.

2. The year is now 2020. Assume that there is no change in the electorate or candidates and that the following occur in each constituency, in each case the changes are by comparison with 2015:

1. Assume that the Conservative share of the vote goes up by 3 percentage points, Labour down by 10 percentage points, Libdem down by 5 percentage points and UKIP up by 12 percentage points.
2. Incumbents experience an increase of x% in the number of their votes in each constituency as a result of non-voters now voting. What is the smallest value of x that results in incumbents obtaining an additional seat?
3. Assume that where UKIP are second to the Conservatives they gain 5 percentage points of share of vote and Conservatives lose 5% and where UKIP are second to Labour they gain 7% and Labour lose 7%. Calculate the overall number of seats for each party with the combined effect of these assumptions.

Running the script “Question\_2.m” (Which internally runs the script “Question\_2b.m”), the following pie charts are produced:

Also, the following console output is produced: The minimum gain for one Incumbent to hold their constituency is 0.090000 percent

Once again, the pie chart on the left shows the issue of overlapping pie chart section labels, which will be resolved in the same way as before – by redrawing the pie charts on excel using the data produced by the MATLAB functions.

Part 2b is included in the running of the code, but has little effect on the overall outcome because it causes one seat that would be taken over by UKIP after the effects of part ‘a’ to be held by the Labour incumbent. This means it is then a seat in which UKIP are second to Labour by a very small amount, and so with the 7% swing from Labour to UKIP in all constituencies where UKIP is second to Labour in part c, the seat falls to UKIP once more. Therefore, the only change that results from part b is an increase of 0.09% to the votes of all incumbents as a result of non-voters voting. However, this is not enough to gain them any additional seats.

*Further Study*

The Outputs of the further study section will be explored in the “Written Analysis” Section, as we chose not to complete the suggested ideas for further study, to instead investigate our own ideas (such as the upcoming 2017 snap

Report

In section one of the MATLAB analysis, we were asked to calculate the total electorate and the total number of people who voted for both the 2010 and 2015 elections.

We found that there overall percentage turnout for the 2015 election was 66.12%, which is very similar to the average percentage turnout across all constituencies – which was 66.05%. In 2010, the overall percentage turnout was 65.10% and the average across all constituencies was 65.02%.

Turnout in the United Kingdom is comparably low when compared to other Western democracies. For instance, in the Netherlands and Sweden turnout regularly exceeds 70% of the electorate. This may be attributed to the electoral system in use in both those countries which is party list proportional representation. As explained earlier in the report party list PR allows a vote to have greater strength in deciding who their lawmakers are as seats won are proportional to votes cast for parties. On the other hand, changing the electoral system from FPTP to PR in the UK may not improve turnout – in some Western countries such as Portugal the Czech Republic turnout is lower than it is in the UK even though both of those countries have PR.

It is not therefore possible to conclude that FPTP lowers turnout or PR increases turnout, but it is still fair to say that a voter in Britain may be persuaded to abstain from the voting process if they feel that their vote will not make a difference.

We also noted that the UK general election results from both 2010 and 2015 were not proportional, in that the percentage of seats won by both the Conservative and Labour parties exceeded their percentage of vote share. In 2010 the Liberal Democrats won 24% of the vote but won 10% of the seats according to our model. This is in fact skewed because the data for the Democratic Unionist Party which only stands candidates in Northern Ireland is also included within the Liberal Democrats data. In reality, the Liberal Democrats won fewer than 10% of the seats in the 2010 general election.

In 2015 the results were even less proportional. The surge in UKIP support failed to materialise in seat wins as their support was too thinly spread, unlike the SNP’s support which was smaller nationally than UKIP, but concentrated more densely in part of the country: Scotland.

The following question asked us to model the results of the next general election altering some inputs for party vote share. In Q2a) we saw that if we increased the Conservatives by 3% and UKIP by 12%, with Labour and the Liberal Democrats losing 10% and 5% respectively, the Conservatives gain more seats than UKIP do despite the much smaller increase in vote share. This shows that the Conservatives are a closer 2nd in more constituencies than UKIP are. The Excel analysis showed that UKIP are 2nd in 120 constituencies, but in most of these constituencies they are far behind such as the seats in Doncaster, Sheffield, and Barnsley. This further reinforces the point that UKIP’s votes are spread across the country too thinly. In order for them to win seats they must work hard to concentrate their vote in areas where they are strong.

The next question galvanises the points made earlier. If there were a 5% CON-UKIP swing and a 7% LAB-UKIP swing in seats where UKIP are 2nd to both of those parties respectively, UKIP would win just 4 extra seats.

However if one combined both Q2a) and Q2c) UKIP would win several more seats, returning dozens of MPs to Parliament. However here again the Conservatives would increase their majority, and Labour would have more seats than UKIP despite having a smaller overall vote share.

*Further Analysis*

We asked ourselves 4 questions.

1. If there were an Empty Chair party which automatically collected abstentions, how would they fare in a general election using the 2015 results?
2. How many non-voters would Labour need to win in order to win a majority in the House of Commons, keeping other party’s vote share the same?
3. What integer percentage of Conservative voters need to switch to Labour in order for Jeremy Corbyn to lead a majority government?
4. What would the results be for the 2017 general election using the best and worst opinion polls for the Conservatives?

For Q1) all that was required was to add a new column to the matrix of votes cast in each constituency and treat it as a political party competing with the others. The Empties would have won 34% of the votes cast and 346 seats at the general election, winning 194 from Labour and 123 from the Conservatives. Labour would be reduced to a rump of just 41 seats if the Empty Chair party existed – and the Tories would have 69% of the remaining seats in the House of Commons. This further compounds the results obtained in the Excel analysis which showed that Labour won constituencies with considerably lower turnout than the Conservatives did. This shows that there is a greater sense of voter apathy in Labour towns than there is in a Conservative town. This may be down to factors that correlate with Labour voters such as lower socioeconomic status and finding it difficult to travel to a polling station or students who move between addresses regularly.

Alternatively, the reason Labour areas have higher abstentions is because there is less of a debate about Labour’s right to govern in Labour-held areas. So non-Labour supporters are unable to articulate their opposition to Labour in Labour towns to the same extent as non-Conservative supporters in Tory areas. It is evident with the rise of the Scottish Nationalists and UKIP that core Labour voters in their heartlands are losing loyalty to the party, and with enough momentum like the SNP had, Labour could be thrown out of their bases in England and Wales. The Empty Chair party may seem a tad farcical, but it ought to worry Labour that there is a battalion of non-voters lying dormant in their heartlands.

In Q2) we used a script called TurnoutGain and experimented until Labour won more than or equal to 325 seats. The exact percentage of non-voters needed to switch to Labour was 33% and this gave Labour 325 seats. This amounts to winning 5.4 million non-voters. In practice this is a working majority of 8 because of Sinn Féin’s abstention from the Westminster Parliament. As a caveat to that, the majority is doubtlessly exaggerated because the Social Democratic Labour party, an Irish nationalist party in Northern Ireland, is included within Labour’s data for the purposes of the analysis.

Answering Q3) is crucial as it will provide an answer as to what Labour’s strategy should be for the next general election and whether tacking to the right is worthwhile. If Labour were to target Conservative voters and lose none of their existing voters, then just 2.7 million Conservative voters would need to change their minds to provide Labour with a majority in Parliament. This represents 24% of existing Conservative voters.

Q2) and Q3) show that is far more efficient for Labour to win Conservative voters than to win non-voters in order to achieve a Labour victory and propel Corbyn and McDonnell into Downing Street. This is because if a Conservative switches to Labour, not only does Labour’s vote share increase but the Conservative vote share decreases too. Winning a non-voter to Labour does not change the Conservative vote share however. It is therefore twice as powerful to convince a Conservative voter to vote Labour as it is to convince a non-voter to vote Labour.

For the final question, we ultimately tried to predict the outcome of the general election on the 8th of June which elects the United Kingdom’s 57th Parliament. The opinion polls were described as worst and best with respect to the Conservatives’ point of view. The worst opinion poll gave the Conservatives a 9% lead over Labour. This represents a 1% LAB-CON swing from the 2015 general election. The results computed from MATLAB showed that the Conservatives would stand to win over a dozen seats directly from Labour and increase their majority from 12 to 50 in the Commons.

If the best opinion poll were borne out by reality then the Conservatives would improve their result to better than anything they have had in living memory with a majority of 194. Just 151 Labour bottoms would sit on the green benches. Such a mega majority for the Conservatives could potentially cause ructions for the Tories as a large group of them may want to break off from the main Conservative party group and could form an Opposition which was larger than the Labour party, thereby becoming the Official Opposition.

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