

Is Democracy Mathematical?

A celebration of the UK Parliament and Psephology

Essential Information: Please Read

This question may seem like an odd one. Democracy originated in Ancient Athens and the word itself lies in the combination of the Greek terms **demos** (meaning the people, or 'the mob') and **kratos** (power). Therefore democracy describes any government in which the people are involved, either directly or indirectly.

The UK is a representative democracy in which voters select someone to represent them indirectly at Parliament in Westminster. MPs are elected to represent seats which are named after geographical areas based on population size. There are 650 MPs in the House of Commons, all of whom are chosen by an electoral system known as **First Past the Post (FPTP)**. The name of this system comes from horse racing where it is possible for a horse to be declared the winner of a race by a narrow 'photo finish' margin such as if the tip of their nose crossed the line first.

FPTP is known as a 'simple plurality' system because it is possible to be elected an MP in the UK General election by 1 vote, this is all that is needed. It is not a requirement that a winner receives an absolute majority.

The party that wins the most seats in the election is then invited to form the government. It is not necessary for a UK government to have won the most votes across the country. Indeed the last time a government had over 50% of the popular vote was 1935. The example below should help illustrate how FPTP works in the UK

Seat: North East Fife: General Election: 2017

Candidate	Party	Votes	Percentage share of the vote
Stephen Gethins	SNP	13,743	32.861%
Elizabeth Riches	Liberal Democrats	13,741	32.856%
Tony Miklinski	Conservative	10,088	24.1%
Rosalind Garton	Labour	4,026	9.6%
Rodney McCune	Independent Sovereign Democratic Britain	224	0.5%

Stephen Gethins was elected as the MP for North East Fife with a majority of 2 votes. The majority of voters in the election voted **against** him.

This reflects the fact that FPTP dates from a time before the UK was a full democracy and only a small fraction of the population was allowed to vote. The system also favours larger parties who can afford to run in every seat across the country (£500 x 649) as those who vote for smaller parties split the vote to allow one of either Conservative, Labour or the SNP in Scotland to take the plurality and win the seat.

The problem: many people feel that their votes are not democratically respected as many seats are 'safe' for one of the larger parties.

Example: Liverpool Walton - a Labour seat since 1964, won in 2019 by Dan Carden MP with 84.7% of the vote (a majority of 30,520). Conservative supporters living in the seat are unlikely to see a non Labour MP in their lifetimes as they would need 30,521 more votes than their previous total to defeat Carden.

Can this be fixed?

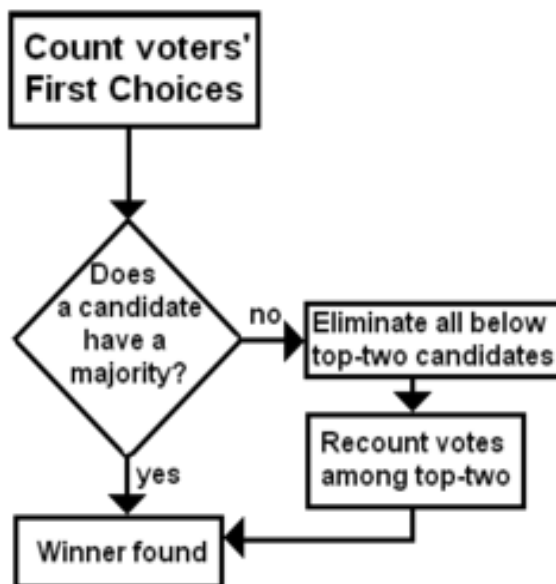
In theory yes, as there are alternative systems.

Type of system	What does the winner need
Majoritarian	An absolute majority of 50% +1
Proportional	A set percentage of the vote
Hybrid (mixed)	A mixture of absolute and proportional

Majoritarian systems: SV (Supplementary Vote)

How do they work?

1. A winner must have over 50% of the vote. Each voter is given 2 votes and they are asked to rank 2 candidates numbers 1 and 2 in order of preference.
2. The votes are counted, if someone has over 50% then they are declared the winner.
3. If no one has the 50%+1, then the lowest ranked candidates are eliminated and second preference votes are added to the first. This process continues until a candidate has 50% + 1 and is therefore elected.



Where are these systems used?

In London, to elect the mayor. Currently this is Sadiq Khan (Labour) who last won in May 2021 with 55.2% of the vote. He needed the second vote as he only had 40% after the first round.

Question: Is this method mathematically more democratic?

Proportional Systems: PL (Party List) and STV (Single Transferable Vote)

How do they work?

1. In most PR systems, parties submit a list of candidates with their preferences at the top of that list. The voter picks a party but does not get to choose which person on the list is elected.
2. The votes are counted, parties are allocated seats based on a required threshold of the vote (i.e.) 10%. The more votes a party receives the more members from its list will be elected.
3. A government will be formed by the party that wins the most seats overall although it is more likely to be a coalition government consisting of 2 or 3 parties who gained the most seats in combination. This will ensure that most parties could have a chance of playing a role in government.
4. In some countries that use **STV** the seats are allocated using the **D'Hondt method** - each voter has as many votes as there seats (i.e.) 6 in one region. A party must achieve what is referred to as the Droop Quota to receive seats.

This is calculated as follows:

$$\frac{\text{Number of votes polled}}{\text{Number of seats}} + 1 = \text{Quota needed per seat}$$

Where are these systems used?

There are a number of types of proportional systems. In Israel, the Knesset is elected using PR and the threshold for election is 2.3%, this is a lower requirement than a number of countries.

Northern Ireland uses the D'Hondt method and the Single Transferable Vote system

Question: Are these methods mathematically more democratic?

Hybrid (Mixed) Systems: AMS (Additional Member System)

How do they work?

1. Voters have 2 votes. The parliament or assembly is organised into 2 types of seats - the first are elected using First Past The Post - the rest are allocated to parties using the Party List system of PR. These PR seats are known as 'Top Up'.
2. After the FPTP votes are counted, the smaller parties are given the preference of the top up seats to ensure a broader representation in the parliament or assembly. It should be noted that if all of the voters chose the main parties across all voting categories, the top ups would still be awarded to the main parties.
3. This system can produce a majority government but is more likely to result in a coalition of more than one party as the PR seats will balance the power across a few smaller parties.

Where is this system used?

In Scotland, Wales and the London Assembly. The last elections produced a coalition government in Scotland for the SNP (Scottish National Party) and the Greens. In Wales, the Labour Party got the most seats but could not outvote every other party so work in combination with the Welsh national party Plaid Cymru (PC).

Question: Is this method mathematically more democratic?

Psephology (from the Greek for Pebbles, used to vote in the first democratic elections) is the study of election data. Often, psephologists use data to predict outcomes in elections. First Past the Post can be easier in this regard as 'safe seats' are common. They use voter turnout data and 'swing percentages' (how many voters switched between parties) to calculate how governments can be formed. It is the scientific study of elections.

Your task will involve you considering psephology. This is a field that requires both knowledge and application of mathematical reasoning.

Electoral systems and democracy

Consider the following requirements of what an electoral system should ideally consist of:

- An electoral system should involve the people choosing their government
- An electoral system should ensure that minority voices are heard and therefore avoid 'tyranny of the majority'.
- An electoral system should ensure that a tiny minority interest should not be able to wield disproportionate power and therefore avoid 'tyranny of the minority'.
- An electoral system must be clear to understand to ensure participation

Extra information

In 2011 the UK government held a referendum (a one off vote) to replace the First Past the Post system for General elections. The voters in this referendum rejected the proposed system, known as AV+.

Research the referendum - have a look at how AV+ is different to FPTP? What was the turnout of this vote? Did voters reject a more democratic system?

Your task

To produce a report based on the 2019 UK General Election with the following title:

Is it possible to determine the most democratic electoral system for the UK using mathematical reasoning?

How should I approach this task?

1. Ensure you have read and understood how FPTP and alternative systems work, how does a government win the election in each case?
2. Research the 2019 UK General Election victory for Boris Johnson and the Conservatives. Find out the following:
 - *Total eligible electorate of the UK (those entitled to vote)*
 - *The election turnout (the percentage of those who could vote that did)*
 - *The vote share of each of the parties that participated.*
3. Work out how democratic the 2019 was? If the total electorate had voted (this never happens) and the parties share of the vote was the same, how many votes would each party have received?
4. Applying the mathematical reasoning of the alternative systems - which of the alternative systems is the most democratic for the UK going forward into the 2024 General Election? In order to calculate this, you could use both the eligible electorate figure and the actual turnout from 2019.

Note: *For this task, you could apply these systems to the whole country or split it into regions, the method of this is up to you, consider looking at European Parliament elections prior to the UK leaving the EU for examples of this.*

Please show your reasoning throughout and any psephological methods you can apply to your report. The format and final presentation of the report is entirely up to you.

Enjoy the task,

Gavin Sheffield

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