Apportionment in the Indian Context

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Links: Github Repository Link , Link to the Visualisations

ABSTRACT

This project is about the Apportionment Problem in the Indian Context. We aim to study the Apportionment Problem by creating visualisations of seat distribution in India over the years. We also aim to study how different Apportionment procedures work on the Indian numbers and which apportionment procedures benefit/harm different subgroups(based on gender, religion, rural/urban).

CONTENTS

1 INTRODUCTION

In a representative democracy citizens exert their influence via elected representatives. Representation will be fair if the citizens have the same influence(more or less) that is, each representative stands for the same number of seats. We cannot establish equal population districts as they have to fit in existing administrative structures of the country for practical purposes. This general problem of allocating seats between regions/states in a "fair" way is called the apportionment problem.

An apportionment problem involves a group of states with given population say, $p_1, p_2 \dots p_n$, a whole number of a seats to be distributed among them. An apportionment allots a whole number of seats a_i to each state i, the sum, $\sum_i a_i = a$. The quota (q_i) of a state is the fraction the state's population represents of the total population, multiplied by the total number of seats. $q_i = \frac{p_i}{p} \times a$ where $p = p_1 + p_2 + p_3 + ... + p_n$.

There are some common Apportionment methods defined in the Apportionment literature. One of them is the Hamilton Method. Hamilton's Method allocates each state its lower quota and then allocates the remaining seats one at a time to the state with the largest residue $r_i = q_i - \lfloor q_i \rfloor$. Jefferson's Method takes a desired number of seats a, finds a divisor D such that $\sum_i \lfloor \frac{p_i}{D} \rfloor = a$, where $q_i' = \frac{p_i}{D}$ is the modified quota. Each state is allocated $\lfloor q_i' \rfloor$ number of seats. In Adams's method of allocation, a divisor D is found such that $\sum_i \lceil \frac{p_i}{D} \rceil = a$ and each state is allocated $\lceil q_i' \rceil$ number of seats. Similarly we have some other methods such as Webster's method or Huntington Hill method etc.

Now, what does fair mean? The most natural way to look at it is through proportional representation. The procedure for allocation of Lok Sabha seats is clearly laid down in Article 81(2) of the Constitution says:-

- There shall be allotted to each State a number of seats in the House of the People in such manner that the ratio between that number and the population of the State is, so far as practical
- Each State shall be divided into territorial constituencies in such manner that the ratio between the population of each constituency and the number of seats allotted to it is, so far as practicable, the same throughout the State

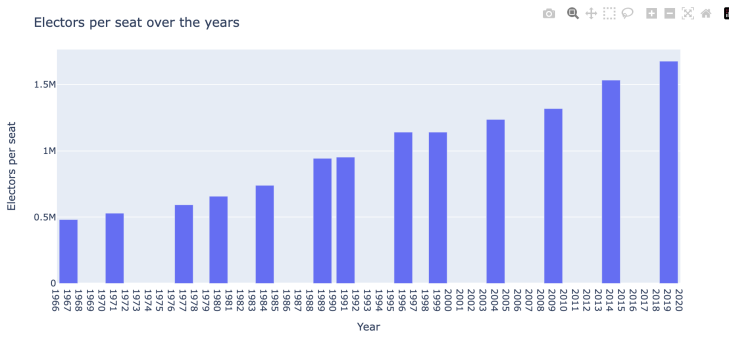
But it is not universal, most countries have representative territories based on geographical regions. The basis is the people of same geographical regions share common cultural/geographical interests. The Boundary Commissions in England are expected not to "forget the old principle that the function of MPs is to represent the local communities... and the Representation of the People Act does not permit variations in the population of constituencies more often than is necessary and not to cut across local government boundaries except where this is unavoidable. Besides there are multiple ways of defining fairness such as population monotonicity, house monotonicity etc.

2 APPORTIONMENT IN INDIA

Apportionment in India is called Delimitation process. It is done by the body called Delimitation Commission. Unlike some western countries it is not based on proportional representation and rather territorial groupings of people. It is not done regularly. In the past it has been done in the years 1952,1963, 1973 and 2002. The Delimitation commission does not reveal it's methodology of apportioning seats so we do not know the "formula"/method. There has been a freeze in the delimitation procedure since 1976 due to rapidly changing population profile. As opposed to US or other European countries, there is very limited literature available about delimitation process in Indian setting.

Table 1. Delimitation post independence.

Year	*Details*	*Census*	*Seats*
1952	First delimitation exercise post-independence.	1951	494
1963	First delimitation exercise after the reorganisation of states in 1956. Only single-seat constituencies	1961	522
1973	Increase in Lok Sabha seats from 522 to 543.	1971	543
2002	No changes in Lok Sabha seats or their apportionment between the various states	2001	543

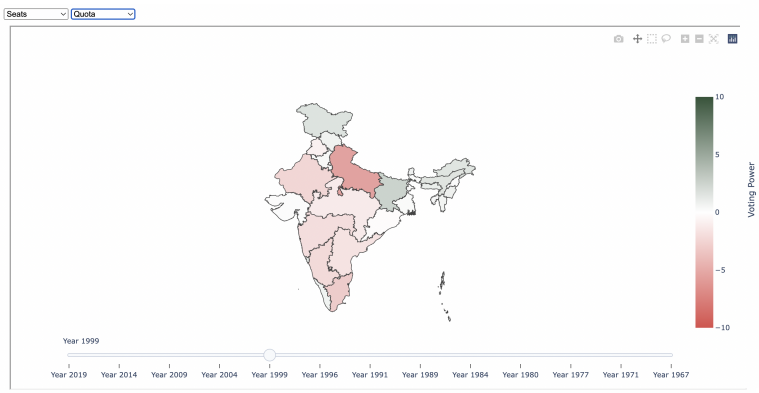


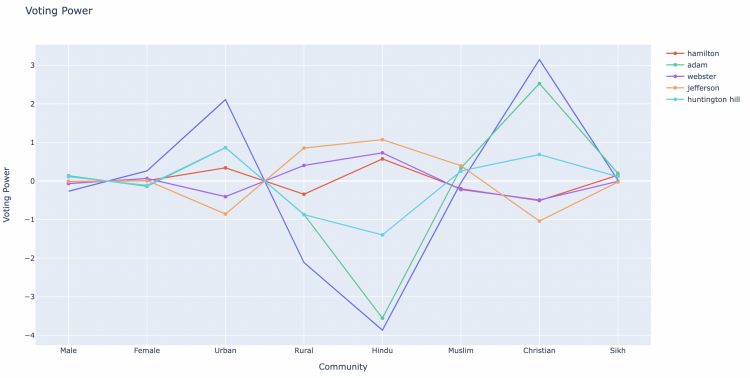
3 MY WORK

To understand the procedure better, I have created a visual tool (Link). The link to Comparison between different Apportionments is the main visualisation tool. There is a map of India and the slider below shows all the election years. From the two drop downs two options can be selected, corresponding to the kind of allocations we wish to compare. We can also compare a single seat allocation with the respective quotas by selecting the Quota in the second drop down. Seats corresponds to the actual number of seats given to each state by the Delimitaion Commission. Green color corresponds to a state deserving more number of seats through the first method with respect to the second method. Similarly, red represents less number of seats.

The Category wise Difference represents the difference between the number of number of seats reserved for the SC/ST community and their deserving quotas based on the population. Green and Red have the same meaning.

Please note that all the population data used is actually the number of electors, these figures were published by the Election Commission of India during each election year. I have used Plotly Library in Python and also Apportionpy to create the visualisations.The source code can be seen on Github(Link)





4 SOME CONCLUSIONS

Using the visualisation, we can answer some questions we started out with. If we were to use Adam's method which is known to favour small states, UP will gain 4 seats and the number is 6 for Huntington Hill Method and 7 for other methods. This is also reflected in the fact that UP is highly underrepresented according to it's Quota. In general, northern states will gain some seats and southern states will end up losing seats. This can be explained by the fact that Delimitation has been put on freeze since 1976 and the populations of Northern states have increased more since then.

For the current number of seats these methods match exactly with only 2-4 states. In general also, the Delimitation Process by India could not resemble any process so far studied. Also in terms of quota most states are either highly under represented or over represented But also, if we compare the number of SC/ST seats over time with their quotas we can see that the chart is mostly white meaning that the seat the category wise seat allocations have been more or less fair over the number of years.

This tool can also be used to study various Apportionment procedures over the years in the Indian context. For example, if we go from 2009 to 2014 in the Hamilton Method vs Seats, we can see that Hamilton method allots Assam 13 seats and 12 seats. During this time the number of seats have remained same while the population increased and this led to Assam loosing out one seat. This is a clear example of population paradox. Similarly from 1999 to 2004 adding new states Uttarakhand, Jharkhand and Chattisgarh, leads to Karnataka losing 2 seats according to the Hamilton method.

To study the effect of specific procedures on various population subgroups, we define a $'VotingPower'$ of a subgroup c in a state s as,

$$VotingPower = \frac{p_{c,s}}{p_s} \times a_s \tag{1}$$

where $p_{c,s}$ is the population of that subgroup in the state s. The total voting power of that sub group is the sum of it's voting power over all states, $\sum_s \frac{p_{c,s}}{p_s} \times a_s$. This is the influence each subgroup exerts in the Parliament. We compare it with $\frac{p_c}{p} \times a$ which is the amount of influence the community should exert theoretically. A positive difference would mean that the subgroup is benefited by the apportionment procedure and a negative value means that it is harmed. These voting power values have been plotted for the above discussed Apportionment methods. The plot an be accessed from the third link. (Please note that this plot has been created according to the 2011 census data and only for that particular year.)

According to the seats allocated by Delimitation Commission, women are slightly over represented. Urban population is over represented while rural population is under-represented. Hindus are very under-represented. Jefferson's and Webster's method favour the rural population while other methods favour urban population. Hamilton method is the one closest to 0 favouring/harming the least, since it the method closest to Quota Allocation. Similarly, we can see out how different methods favour different subgroups.

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2. Plotly
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