

# Trees of Electoral District in Indonesian Legislative Election

Empirical Case of Assortments in 2004 General Election

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## **Abstract**

The short paper presents interesting discussions related to specific Indonesian legislative election system. We build algorithmic steps in computational geometry that employ the basic patterns that emerged from the legal decisions of Indonesian General Election Commission about the election district. Some interesting facts are observed and tried to be analyzed and concerning them to the democratization processes in the country. The further implementation of the model can be utilized as a tool to see the patterns of optimizations for the beneficial of particular parties, to evaluate the election results, and to see the relatedness of the legally-decided configurations of election district in Indonesia.

**Keywords:** general election, election district, voting geometry.

## 1. Intro

Indonesia is learning to be democratic. This can be seen from many changes in cultural aspects in the political realm of the people. One aspect that easy to see the democracy is the practical aspects of the general elections with which citizens can give their votes on preferred leaders and representatives that would bring the whole nations in the incoming service year under the constitution.

Some statistical aspects of Indonesian democratic features have been discussed previously in Situngkir & Surya (2004). This work brings the macro-properties of the resulting legislative election 2004 to the observation and also has been confirmed in some other countries. The present paper delivers a more micro-view of the legislative elections by zooming the electoral processes in an administrative district/area. In the meso-level of legislative election (2004), one of important and sometimes crucial issues to be discussed are about the electoral district<sup>1</sup>. However, the configuration of the electoral districts, can yield distinct results in the elections practically and some hypotheses regarding to this would be the theme of our discussions in the rest of the paper.

## 2. Electoral District in Indonesia's Election

Countries have historical background of its own, governmental systems, and various population densities including the distinctive ethnic groups. This, we suppose, becomes the source of the variations of electoral systems across countries in the world. IIDEA (2005) divides electoral system into 4 different types. Every main class can also be distinguished into some sub-classes. We may refer it to table 1. For instance, the legislative election in United States uses the First Past The Post System while Japan use the Parallel System. In advance, apparently the electoral system not only varied across nations but also have dynamics respect to the political changes within countries.

**Table 1**  
Classification of general electoral systems (IIDEA, 2005)

<b>Plurality/Majority</b>	<b>Mixed</b>	<b>Proportional Representation</b>	<b>Other</b>
<ul style="list-style-type: none"><li>• <i>First Past The Post.</i></li><li>• <i>The Two-Round System.</i></li><li>• <i>The Alternative Vote.</i><ul style="list-style-type: none"><li>• <i>Block Vote.</i></li></ul></li><li>• <i>Party Block Vote.</i></li></ul>	<ul style="list-style-type: none"><li>• <i>Parallel Systems.</i></li><li>• <i>Mixed Member Proportional.</i></li></ul>	<ul style="list-style-type: none"><li>• <i>List Proportional Representation.</i><ul style="list-style-type: none"><li>• <i>Single Transferable Vote.</i></li></ul></li></ul>	<ul style="list-style-type: none"><li>• <i>The Single Non-Transferable Vote.</i></li><li>• <i>The Limited Vote</i><ul style="list-style-type: none"><li>• <i>Borda Count.</i></li></ul></li></ul>

As a specific case, Indonesia's electoral system is interesting to be observed. Indonesia has the fourth largest populations on earth after China, India, and the United States. More interestingly, the population is made by more than 100 ethnic groups spreading in islands of thousand existing ones, yet more than half of the population lives in a single island, Java. This fact bestows a sophisticated challenge to

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<sup>1</sup> We refer "electoral district" as English translation of Indonesian "Daerah Pemilihan".

the endeavors of establishing the stable yet effective political development in Indonesia.

Since the downfall of the New Order Regime in 1998, the first democratic general election was held after more than 30 years of dictatorship regime. At that time, the implemented electoral system was called proportional system with district characteristics. This is however a unique system. The existing 27 provinces is viewed as electoral districts (Indonesian General Elections Act, 1999). The electoral chairs are distributed proportionally with the regards to the populations on each district. There are about 4 to 83 electoral chairs on each province. In the system, the political parties made the list of candidates and voters choose the preferred political parties in a closed-list of legislators' candidates. The number of chairs won by a party was calculated by using the proportional representation principles (PR) and the calculation of the chairs is conducted by using the largest remainder method and the Hare quota.

After 1999, some critics were sounded to the existing electoral system. Some academics and mass media viewed that the principle of List PR in the 1999 general elections must be responsible for the gap between the elected legislators with their constituents. Thus, some alternatives were proposed and one of them is the single-member district (SMD). Nonetheless, this idea is rejected for it potentially may fail to reflect the diversity of Indonesia.



**Figure 1.**  
Electoral districts used in legislative general election 2004 in East Java Province (KPU, 2004).

Eventually, the widely agreed election system for the parliament is the same arrangement of List PR but with open-lists<sup>2</sup>. The calculation for the chairs was still conducted with the largest remainder method and Hare quota (Indonesian Legislative Elections, 2003). Furthermore, in order to accommodate the demand for senators' representativeness with their constituents, the multi member district system was applied.

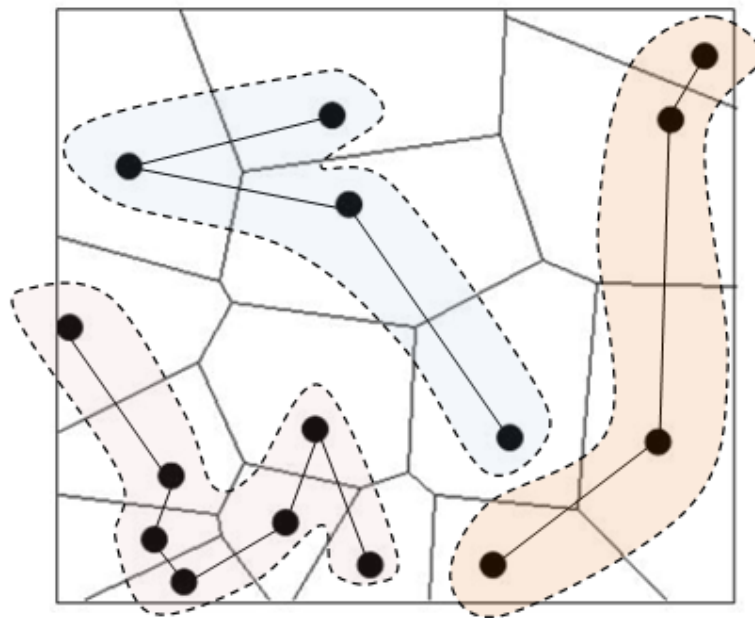
<sup>2</sup> The presidential election used the Two-Round System while the election of the Regional Representatives' Council used the Single Non-Transferable Voting System.



1. There are no administrative district below the province (i.e.: municipalities) partitioned into some electoral districts.
2. An electoral district is always coalesced by neighboring administrative district.

### 3. Model: Electoral Localized Trees are Assorted

The patterns depicted in latest part of the previous section, somehow, would have left questions to any political analysts about the possible variations and configurations of the electoral districts, especially those which are in the provinces with largest population. Obviously there are particular configurations of electoral districts that could possibly made certain parties to gain more chairs in the house while other configurations could also made them loosing votes as residue for they cannot fulfill enough quota for a chair. In the other cases, different numbers of chairs representing an electoral district could also give different result of the gaining in the tally.



**Figure 3**

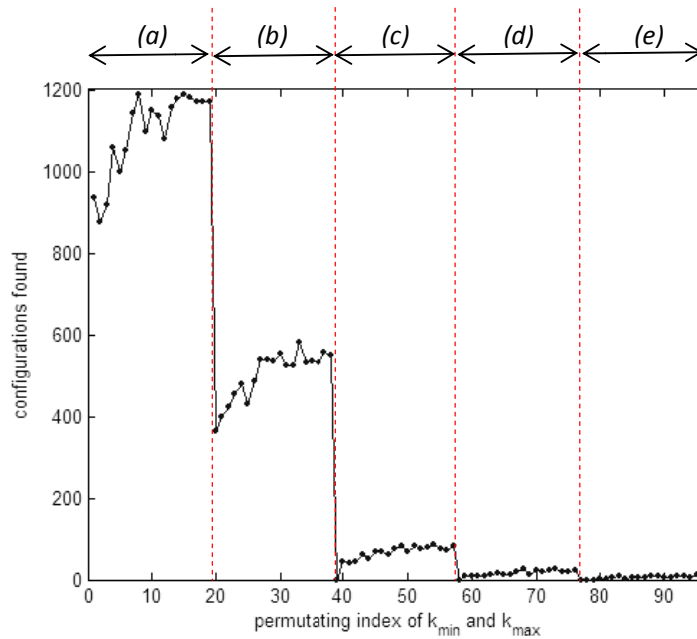
The exemplification of the electoral district as the tree of municipalities with the two constraints depicted in the Election Act (1999) regarding  $D^i$ . Here we use the Voronoi Diagram (cf. Haklay, 2004) representing the boundaries between municipalities and sized regarding to the size of the respective population.

Our model would first transform the geographical map as shown in figure 1 into the nodes and edges where edges represent the neighbors surrounding the corresponding municipalities denoted by vertex. Hence, the edge  $e_{ij}$  shows that in the geographical map, both vertex  $i$  and  $j$  are neighbors each other. Thus, the connectivity of the vertexes is becoming our references to draw the tessellations of

the votes. To build the electoral tessellations, the constraints we used are the number of the legislative chairs pursued by the political parties. As it has been noted before, according to the election rule stated by the law, the number of the legislative chairs for  $i$ -th electoral district must fulfill the inequality,

$$k_{\min} \leq D^i \leq k_{\max} \quad (1)$$

Henceforth, when the general election commission stated the electoral district in the term of municipalities, two or more municipalities may be joined to fulfill the inequality while in the other hand, a province that may comprised by more than five municipalities can only be regarded as a single electoral district. As we have discussed in the previous section, there are two patterns showing the way the election commission configure the electoral district. Moreover, the second pattern stating that an electoral district tends to be made up by neighboring municipalities presents the problem of tessellations.



**Figure 4**

The configurations found with  $k_{\min} = 1$  (a),  $k_{\min} = 2$  (b),  $k_{\min} = 3$  (c),  $k_{\min} = 4$  (d),  $k_{\min} = 5$  (e), while  $k_{\max}$  varies from 7 to 25.

Is there any configurations giving more beneficial for particular political parties? Furthermore, when the commission stated the exact value of  $k_{\min}$  and  $k_{\max}$ , are there any values that beneficial to or worsen the ballots of certain parties? If this problem of belongs to political parties to be solved, the problem becomes a problem of optimization of the existing tessellations; but since this is the problem of the national commission, then it has become a political discourse. To analyze this specific problem we build a model that would see how various numbers and

distinctive configurations of the electoral districts giving impact to the legislative chairs gained by political parties.

As shown in figure 2, the data structure of an electoral district has direct boundaries with one another can be viewed as graph or a tree-like mathematical structure. Here, be it a graph or a data structure are equivalent since the tree-like data structure contains not only a set of elements but also connections between elements, giving a tree-like graph.

From the first pattern in the 2004 general election, we build an algorithm to have one single electoral district as the tree of municipalities as represented by the vertex and to which geographical boundaries exist as edges. This is similar to the updating rule of Cayley tree (*cf.* Bergeron, *et. al.*, 1998: 284). Thus, we would have possibly several trees acting as electoral districts ruled by the assumptions of the value of  $D^i$  and the graph of municipalities' geographical boundaries as shown in figure 2. A test of our algorithm is applied to the Voronoi Diagram (constructed with the similar two-patterns) as shown in figure 3. The algorithm we used can be summarized as follows:

```
1 randomized(municipalities(1:N));
2 while (flag_municipalities(i=0)) do
3     j=random_number(municipalities(1:N));
4     k==neighbor(j);
5     let Cj==electoral_chairs(j);
6     let Ck==electoral_chairs(k);
7     while (sum(Cj, Ck)<K_max) do
8         while (sum(Cj, Ck)<K_min) do
9             flag(municipalities(j));
10            flag(municipalities(k));
11            if random_number([0,1])<0.5
12                k==neighbor(j);
13                D(x)=Cj+Ck;
14                Cj=D(x);
15                return;
16            else
17                next x;
18        end;
19    end;
20 end;
```

From the algorithm above, apparently that not all of the running processes would eventually come up with complete series of electoral districts. There would always be a running processes from the randomized initial point of municipality that in the end returning a tree with  $D^i < k_{\min}$ . In this case, the whole algorithm would be restarted.

#### 4. Discussions and Practical Impacts

Now we are ready for a simulation in order to find any interesting patterns comes up with the legislative electoral system used in 2004 for the administrative districts in East Java, one of the biggest and denser populations in the country. We do the simulations by varying the number of  $k_{\min}$  and  $k_{\max}$  and also the possible configurations within. Figure 4 shows how many possible configurations may be found in different  $k_{\min}$  and  $k_{\max}$ . Obviously, the bigger the gap between  $k_{\min}$  and  $k_{\max}$  the more possible configurations found while the effects to each party could be distinctive. Furthermore, bigger size of an electoral district means that the more little residue of the votes. In contrast, smaller size of an electoral district means that the cumulative lost residue of votes will be more likely. However, smaller size of an electoral district shows that the representation of the constituents and the candidates shall be better. This is because a candidate would have concentrated more in smaller administrative area and thus, minimizes the distance with the voters.

In the perspective of the political parties whose motives are to gaining as much as possible of legislative chairs without taking care on how many votes and how popular the parties or even the candidates in it. The candidates have been given certain rank from the party of which lower rank/number of a candidate the more likely she enters the parliament. Apparently, we can see that the legislative electoral system has turned out into a system that potentially yielding distinction between popular votes and the electoral votes. A clearer view in this issue is presented in figure 5.

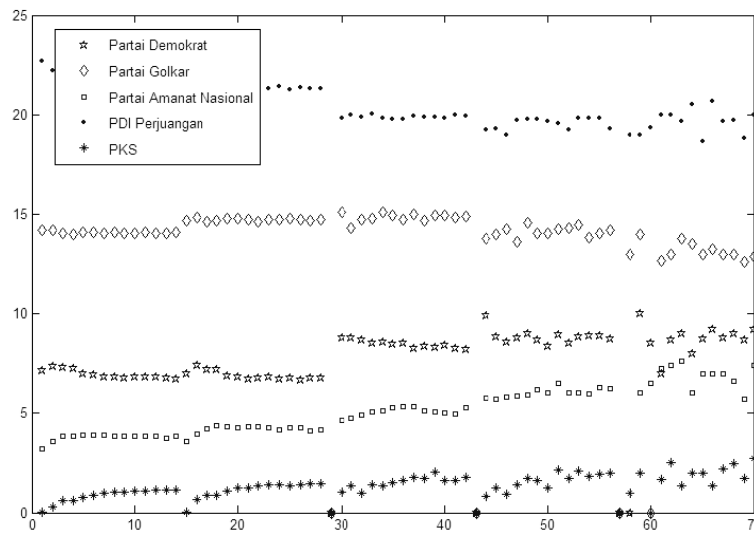
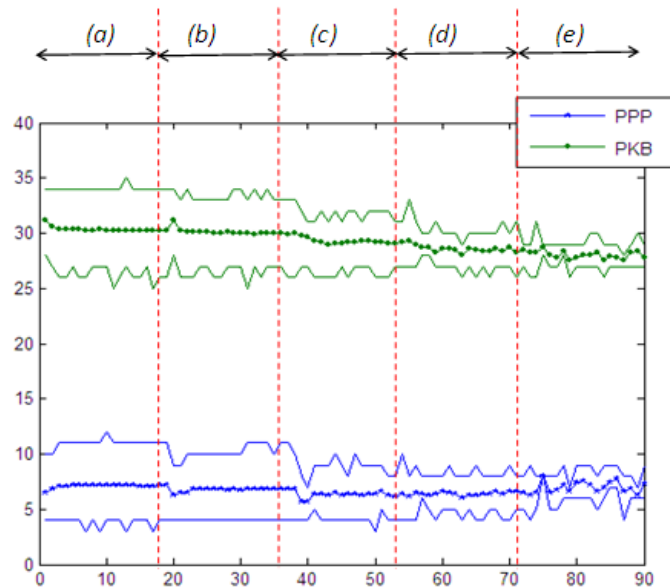


Figure 5

The average of simulated gained chairs of five political parties based on the data (legislative election 2004) on each different possible size and configuration of electoral districts.

The Partai Golkar<sup>3</sup> and the PDI-Perjuangan<sup>4</sup> are the winning two parties in almost all regions of Indonesia in the election of 2004. As we can see in any configurations and sizes of electoral district, both parties performed very well relative to other parties. However, as we scrutinize the simulation result in figure 5, apparently for both parties big sizes (shown in more right-sided in the figure) of electoral districts are not really beneficial for the gaining legislative chairs. This is relative to the three presented parties (Partai Demokrat<sup>5</sup>, Partai Amanat Nasional<sup>6</sup>, and Partai Keadilan Sejahtera<sup>7</sup>). These three parties perform well to gaining the legislative chairs as the sizes of the electoral district become larger. This however, makes sense; since the latter three are relatively small parties and their constituencies are not uniformly distributed in the population on all administrative districts. Thus, as the electoral district was made smaller, more of their votes would be a residue and cannot be regarded as legislative chairs.



**Figure 6.**

The averaged simulated votes of PPP and PKB along with the maximum and minimum values on each series of possible configurations.

We believe that this is the tricky part of the electoral system that is used in Indonesia. A relatively smaller political parties would have craved for smaller parties by sounding the issue of the closeness of candidates to their constituencies, while

<sup>3</sup> Partai Golkar or Golkar Party is the reformed Golongan Karya.

<sup>4</sup> Partai Demokrasi Indonesia-Perjuangan, the Indonesia Democratic for Struggle Party led by Megawati Sukarnoputri.

<sup>5</sup> Democratic Party, a party established by the elected president, President Susilo Bambang Yudhoyono.

<sup>6</sup> PAN, National Mandate Party.

<sup>7</sup> PKS, Prosperous Justice Party

big parties would have become easier gaining legislative chair as bigger electoral district used. As we see in figure 5, there at the similar size of electoral districts, in few configurations (indexed at 43th and 59th), the political party PAN is performing better relative to their performance compared also with other parties. Here, our hypothesis is visually seen that some methods can also be developed in the future to compute better gaining votes in Indonesian general election for specific political parties based on their historical performance.

Other interesting features can also be seen from our observation as shown in figure 6. PKB<sup>8</sup> is the winner in our focus province and there is similar voter's profile brought by both parties. In this figure, we do not only observe the average numbers of legislative chairs but also see the spreading of them in the variable of the maximum and minimum legislative chairs the political parties gained. From figure 6, as we see the struggles of the two Islamic parties, in all of the possible sizes of electoral districts PKB hold the winning theme, but interestingly, in some cases, PPP<sup>9</sup> as the smaller party have possibilities to steal some votes as the sizes of the districts are made smaller: some configurations can even almost double the gain of legislative chairs.

Thus, the uncertainty of legislative election is bigger as the sizes of the electoral districts are smaller, this is shown by the interesting fact that:

- Smaller parties can steal votes since the smaller the size of the district, the more they can save the votes that on average can be regarded just as residue.
- Smaller sizes of the electoral districts, bigger the possible configurations of the districts and it has been showed that several of the combinations can significantly be beneficial for the gained legislative chair.

## 5. Concluding Remarks

We have built algorithm to check some hypothetical propositions regarding the issues on legislative electoral districts. We formalize algorithmically the two patterns of the electoral districts' configurations, namely the fact that electoral districts are always configured within provinces (and or lower administrative districts) and another fact that electoral districts are always coalesced by neighboring administrative districts.

From those basic assumptions and some interpretations of the election law along with processing the 2004 results and the population data in Eastern Java, we have observed some interesting features from the legislative election 2004. From the simulation we showed that there exist some configurations of electoral districts significantly beneficial to some political parties. Larger parties would prefer larger sized electoral districts so that they can beat the smaller parties whose total votes would always be able to be undermined. However, the democratization processes demand the close relationship between the representatives and the constituents that in one way can be reflected by smaller sized electoral districts. The latter would

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<sup>8</sup> Partai Kebangkitan Bangsa, The National Awakening Party, led by the well known Islamic leader, Abdurrahman Wahid.

<sup>9</sup> Partai Persatuan Pembangunan, The United Development Party.

be beneficial very much to smaller parties since it opened their ways and access to gain legislative chairs.

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