Working Papers in Statistics
No 2015:1

Department of Statistics
School of Economics and Management
Lund University

Are there house effects in Swedish polls? A compositional approach

JAKOB BERGMAN, LUND UNIVERSITY

Are there house effects in Swedish polls? A compositional approach

Jakob Bergman
Department of Statistics, Lund University

Abstract
We investigate if we can find evidence of house effects in Swedish political opinion polls from 2006 to 2014. In order to respect the inherent restriction of the simplex sample space, we apply compositional data analysis and Aitchison geometry. We use compositional locally weighted regression (*C*-loess) to estimate the share of voters for each party at given dates, a poll of polls. The estimated shares are compared to the poll(s) for that date using simplicial distances and compositional deviations (inverse perturbation). We can conclude that neither the mean simplicial distance nor the mean compositional deviation are equal for all polling organisations, also when controlling for different sample sizes and limiting the sample to only the last two years.

Keywords
House effects; Compositional data analysis; Simplicial distance; Aitchison geometry; Polls, Sweden; Poll of polls

Introduction
The 349 seats of the Swedish parliament (Riksdagen) are allocated according to a system of party-list proportional representation. The parliament has a four percent election threshold, which has led to there since September 2010 being eight parties with seats in the parliament. Outside parliament there are a couple of parties with a potential to gain seats in future elections and a large amount of smaller parties. In the latest election in September 2014, votes were cast for more than 800 existing or non-existing parties including six votes for the Zlatan-party (apparently named after the football player Zlatan Ibrahimović) and two votes for Mickey Mouse (Swedish Election Authority, 2014). Political opinion polls in Sweden thus usually report shares for the eight parties in the parliament and “other parties”[1]. Polls are published regularly by eight polling organisations, each performing approximately 10 polls each year with an increased number during election years. In addition to these polls Statistics Sweden polls the opinion twice a year (the Party Preference Survey, PSU). Primarily two surveying methods are being used: telephone interviews and internet interviews. A number of different sampling methods are being used. Statistics Sweden draws random samples of voters whereas the other polling houses draw random samples of telephone numbers (random digit dialling) when doing telephone interviews. The members of the web panels used for internet interviews are recruited either from a random sample of the national registers (a closed panel) or utilising some sort of convenient sampling (an open self-recruiting panel), or some combination of the two; this of course leading to a panel that can be more or less representative of the electorate. The sampling from the panels in turn can be done with a varying degree of stratification. The sample sizes used vary from approximately 1000 to 7500 and with different response rates. On top of this different weighting and post-stratification of the results are utilised, and there might perhaps also be some calibration of the results (Clinton and Rogers, 2013).

[1] The “Other parties” typically receive around one percent of the votes.

House effects

These different methodological choices lead to the question if the different polling organisations have the same precision and accuracy. Or if some polling organisations consistently tend to over- or underestimate the voter share? This is usually referred to as ”house effects” or ”house bias” (Smith, 1978, Fisher et al., 2011); in this paper we will refer to them as house effects. Researchers have investigated house effects from a number of different perspectives: some have wanted to prove them (e.g. Jackman, 2005), others have wanted to quantify them (e.g. Smith, 1982) and some have wanted to correct for their effect (e.g. Fisher et al., 2011). Regardless of the purpose, any attempt to estimate a house effect needs to compare the results of the organisation’s polls with each party’s actual share of the voters. Unfortunately, the share of the voters is only known on the election day[2]. Hence, the share of the voters must be modelled in some way.

Smith (1978, 1982), instead of modelling the population proportion, does pairwise comparisons of the results of surveys under the assumption of no change in the population proportion, using significant test results to indicate house effects. It should be noted that the studies are not about voter shares but attitudes on various political and economic issues.

Erikson and Wlezien (1999) use regression analysis with dummy variables for the different polling organisations to correct the estimate for any house effects, without explicitly quantifying the house effects.

Jackman (2005) uses a state-space model to model the share of an Australian party, assuming a normal distribution for the voter share, where an additive house effect is included in the model of the mean voter share. Fisher et al. (2011) use a similar model, but model three British parties independently. Thorburn and Tongur (2012) use a Wiener process with a house effect to model Swedish logit transformed party block shares.

At this point we should perhaps consider the sample space of a poll.

Compositions and the simplex

The number of votes a party receives and the share of votes a party receives have different sample spaces. The sample space of the number of votes is the non-negative integers $\mathbb{N}$, whereas the sample space of the share of votes is the real numbers between 0 and 1. However, when polling, the respondents are not (at least not in Sweden) asked ‘Would you vote for party A if it were election today?’, but ‘Which party would you vote for if it were election today?’. Hence, if the polling organisation accounts for D parties (including ‘other parties’), the outcome is a vector $\boldsymbol{X}$ with D components or parts between 0 and 1 summing to 1. This is mathematically referred to as a *composition*. The sample space of a composition with D parts is the simplex $\mathbb{S}^D$. Obviously, and contrary to the absolute number of votes, the parts of a composition are always correlated; if one party increases its share, at least one other party must decrease. This is in fact a special case of spurious correlation (Pearson, 1897).

[2] If even then – only 86 % of the voters cast a vote in the last Swedish election with an all-time high voter turnout of 91.8 % in 1976. (Ohlsson, P. T. (2014). *Svensk politik*, Lund: Historiska media.) Hence, the opinions of 10–15 % of the voters are unknown.

Geometrically the simplex could be treated as a subspace of the real space and the standard Euclidian geometry utilised. However, it has been shown that often it makes more sense to use the so called *Aitchison geometry* (Aitchison, 1986, Pawlowsky-Glahn and Egozcue, 2001). Aitchison geometry implies that distances between compositions are measured using *simplicial distance* also known as Aitchison distance (Aitchison, 1983, Aitchison, 1986, 193, Aitchison, 1992, Pawlowsky-Glahn and Egozcue, 2002). The simplicial distance between two compositions $\boldsymbol{x} = (x_1, \dots, x_D)$ and $\boldsymbol{y} = (y_1, \dots, y_D)$ may be calculated as

$$d_S(\boldsymbol{x}, \boldsymbol{y}) = \sqrt{\sum_{i=1}^{D} \left(\log \frac{x_i}{g(\boldsymbol{x})} - \log \frac{y_i}{g(\boldsymbol{y})}\right)}, \tag{1}$$

where $g(\boldsymbol{x})$ is the geometric mean of the parts of $\boldsymbol{x}$, i.e. $(x_1 x_2 \cdots x_D)^{1/D}$, and analogously for $\boldsymbol{y}$. Within the Aitchison geometry, addition and multiplication is replaced by *perturbation* $\oplus$ (Aitchison, 1982)

$$\boldsymbol{x} \oplus \boldsymbol{y} = \mathcal{C}(x_1 y_1, \dots, x_D y_D) \tag{2}$$

and the *power function* $\odot$ (Aitchison, 1986, 120)

$$a \odot \boldsymbol{x} = \mathcal{C}(x_1^a, \dots, x_D^a), \tag{3}$$

respectively. Hence, subtraction is replaced by *inverse perturbation* $\ominus$ (Aitchison, 1986, 43) defined as

$$\boldsymbol{x} \ominus \boldsymbol{y} = \mathcal{C}(x_1/y_1, \dots, x_D/y_D). \tag{4}$$

In all three operations

$$\mathcal{C}(x_1, \dots, x_D) = \left(\frac{x_1}{x_1 + \cdots + x_D}, \dots, \frac{x_D}{x_1 + \cdots + x_D}\right) \tag{5}$$

is the *closure operation.* One may note that a result of this is that the analogue of 0 in the simplex is the composition

$$\boldsymbol{x} \ominus \boldsymbol{x} = 0 \odot \boldsymbol{x} = \mathcal{C}(1, \dots, 1) = \left(\frac{1}{D}, \dots, \frac{1}{D}\right). \tag{6}$$

Combining perturbation and power function, it follows that the compositional analogue of the arithmetic mean in the real space is

$$\frac{1}{n} \odot (\boldsymbol{x_1} \oplus \cdots \oplus \boldsymbol{x_n}) = \mathcal{C}\left((x_{11} \cdots x_{n1})^{\frac{1}{n}}, \dots, (x_{1D} \cdots x_{nD})^{\frac{1}{n}}\right), \tag{7}$$

i.e. the composition of the part wise geometric means.

Hence, we want a model to be appropriate for compositional data. Instead of assuming a parametric model for the voter shares, we use a locally weighted regression (loess) (Cleveland, 1979). Loess has been used by Erikson and Wlezien (1999) to model voter shares, but only for one proportion. We utilise a loess model for compositional data ($\mathcal{C}$-loess) suggested by Bergman and Holmquist (2014) which allows us to model all parties simultaneously. Electoral data have been analysed within a compositional framework by Katz and King (1999) and their methods further developed by Honaker et al. (2002), but we believe this is the first analysis of survey data, apart from the example in Bergman and Holmquist (2014).

Swedish polls

Data consist of all published Swedish polls that present shares for the Sweden-Democrats (SD) up to the beginning of September 2014[3]. The data have been compiled by Novus Group International AB and are publicly available at

[3] The Sweden-Democrats were included in “Other parties” until 2006. The first reported share is in September 2006, though some polling organisations do not report the party separately until the summer of 2007.

Table 1. Number of polls per year and polling organisation. The small number of polls during 2006 in the data is due to the fact that several polling organisations did not start to report the Sweden-Democrats separately until 2007. 2010 and 2014 were election years and hence there were an increased number of polls.

Year	Demo-skop	Ipsos[4]	Novus	SCB[5]	Sentio	Sifo	Skop	United Minds	You-Gov	Total
2006	0	6	1	1	0	5	2	0	0	15
2007	5	12	8	0	4	11	6	0	0	46
2008	12	12	10	2	2	11	10	0	0	59
2009	12	11	11	2	3	11	10	9	0	69
2010	12	17	18	2	9	16	16	24	0	114
2011	13	11	11	2	10	11	9	14	11	92
2012	10	11	11	2	10	11	8	11	11	85
2013	11	11	12	2	12	11	6	12	12	89
2014	9	9	10	1	8	11	4	11	8	71
Total	84	100	92	14	58	98	71	81	42	640

http://www.novus.se/vaeljaropinionen/samtliga-svenska-vaeljarbarometrar.aspx. Each poll has been assigned a date equalling the mid-date of the reported polling period. In a few cases the polling period has not been reported and in these cases a mid-date has been imputed based on the published date and the average difference between mid-date and publishing date for that polling organisation. Approximately 20 polls have had dates imputed. In five cases neither publishing date nor polling period has been reported, and these polls have consequently been dropped from the data set. In total 640 polls from nine polling organisations are included, see Table 1 for details.

Estimating the house effects

Using *C*-loess we estimate the parties' shares for each date with at least one poll. The results are shown in Figure 1. The bandwidth parameter of the *C*-loess is chosen to give rather smooth curves. In this case we use the 40 temporal closest observations, weighing each observation inversely proportional to its temporal distance. In a few instances when there are very large movements during a very short time span, the smoothing is not able to capture all of the movements. This is the case e.g. during the social democratic (S) party's crisis in late 2011. However, overall we believe that the chosen level of smoothing gives a reasonable picture of the changes in political opinion.

For every date with an estimate we calculate the simplicial distance (1) between the observed poll $\boldsymbol{y}_i$ and the *C*-loess estimate $\hat{\boldsymbol{y}}_i$ as $d_i = d_S(\boldsymbol{y}_i, \hat{\boldsymbol{y}}_i)$. The arithmetic means of the distances $\bar{d}$ are given in Table 2 for each polling organisation. One may note that the largest mean distance is more than 60 % larger than the smallest. Using analysis of variance, we conclude that there is a significant difference mean distance between the various polling organisations ($p < 0.0001$). (In order to achieve more normally distributed residuals, the logarithms of the distances were used in the test.)

We also calculate the compositional deviations between the observed poll $\boldsymbol{y}_i$ and the *C*-loess estimate $\hat{\boldsymbol{y}}_i$ as $\boldsymbol{d}_i = \hat{\boldsymbol{y}}_i \ominus \boldsymbol{y}_i$ using (4). For every poll we thus get a compositional deviation (or difference) from the estimated composition. This deviation may be thought of as how much the poll needs to be reweighted in order to equal the estimated composition. Since the neutral composition equals

[4] The name was changed from Temo to Synovate to Ipsos during the period.
[5] Statistics Sweden is abbreviated SCB.

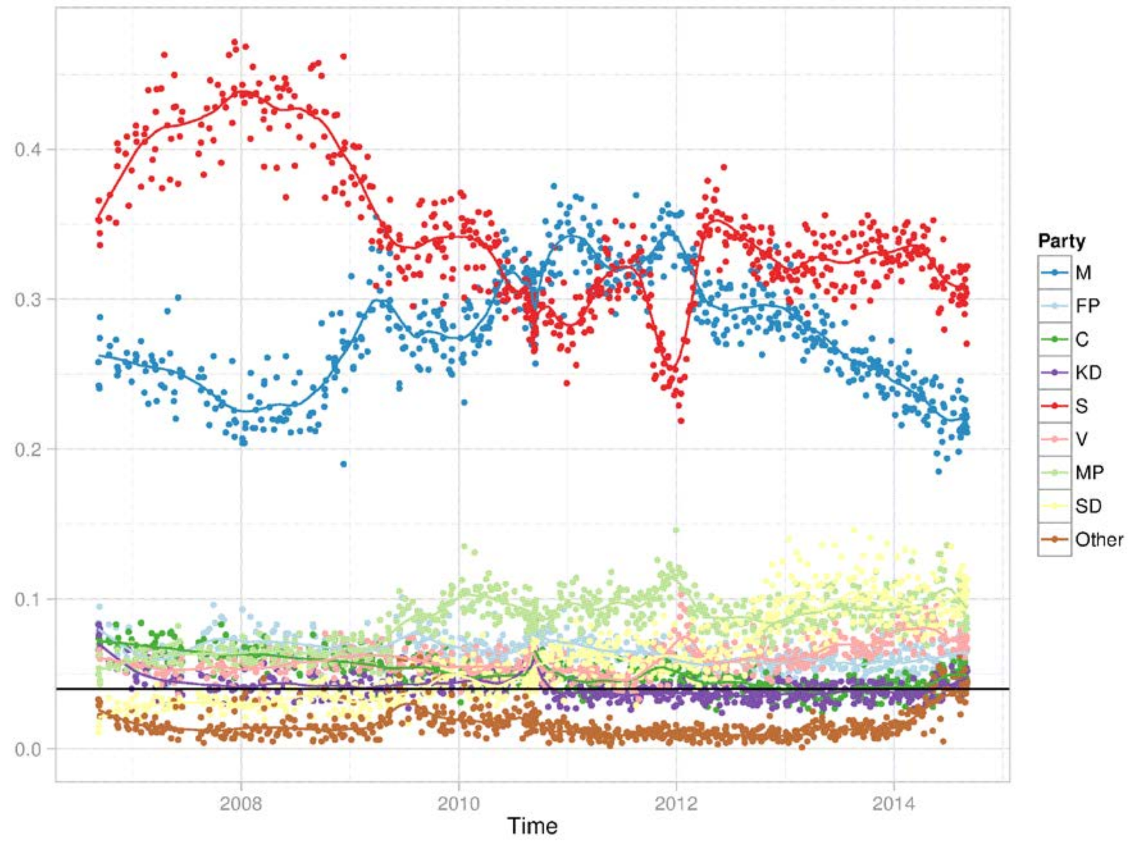

Figure 1. Polls from September 2006 until September 2014 with estimated shares (lines). The black solid line indicates the four per cent election threshold to the Swedish parliament.

Table 2. The mean distances from the *C*-loess estimate for the different polling organisations.

Polling organisation	$\bar{d}$
Novus	0.0224
Sifo	0.0244
Ipsos	0.0263
YouGov	0.0266
SCB	0.0272
Demoskop	0.0313
Skop	0.0323
United Minds	0.0325
Sentio Research	0.0364

(1/9, …, 1/9), a value greater than 1/9 for a party indicates that the party has been given a greater share in that poll compared to the estimated value. A value less than 1/9 analogously indicates that the party has been given a smaller share compared to the estimate.

The mean deviation (7) for each polling organisation is shown in Figure 2. Since we are averaging the deviations over several years for each polling organisation we get an estimate of how the organisation's measurement tend to be compared to the estimate based on all organisations. If an organisation is performing the same way as the estimate, the mean deviation should equal (1/9, …, 1/9), cf. (6). As can be seen in the figure, some organisations are quite close to this whereas others seem to be further away.

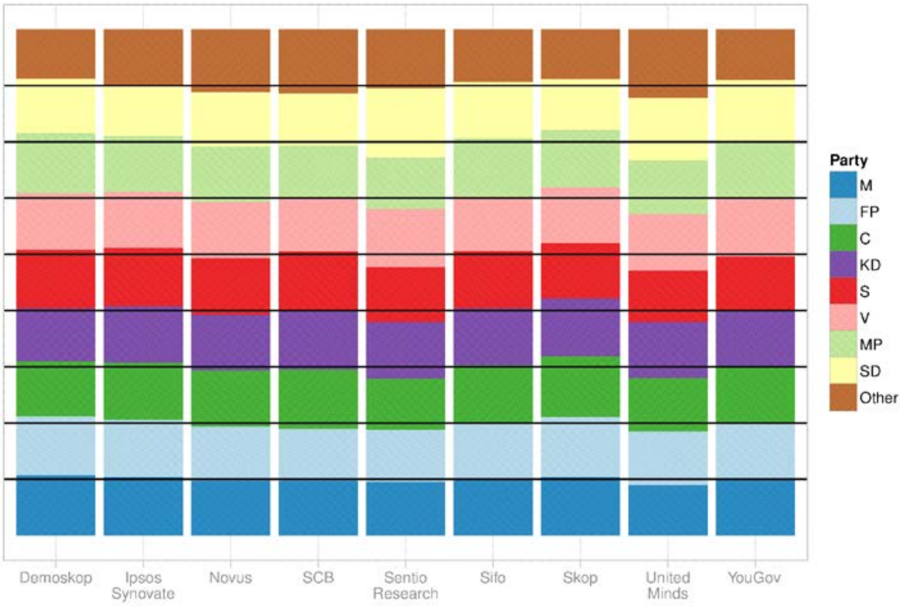

Figure 2. The mean compositional deviation from the *C*-loess estimate for each polling organisation. The equivalence of 0, the composition (1/9, ..., 1/9), is shown in the figure as solid horizontal lines.

Since the deviations $\boldsymbol{d}_i$ are compositions, most standard statistical techniques are not immediately applicable. We thus transform the deviations using the isometric log-ratio (ILR) transformation (Egozcue et al., 2003), yielding vectors in the real space $\mathbb{R}^{D-1}$. Using multivariate analysis of variance and Wilk's test, we conclude that the nine organisations do not have the same mean vectors ($p < 0.0001$).

Limitations

The methodology of a polling organisation of course changes over time, hopefully improving their estimates. It might thus be argued that it is not really fair to look at the average deviations over eight years. The average deviations for each organisation and year are therefore shown in Figure 3. (Statistics Sweden is not included as they only publish two polls per year.) In the figure we see that the deviations differ quite drastically from to year to year, for some of the organisations. We have therefor also redone the MANOVA but limited to the periods 2011-2014 and 2013-2014, respectively. The previous result, however, is not changed. There is still a significant difference between the polling organisations.

Since sample size varies greatly between polling organisations, but to a lesser extent within an organisation, we have redone the tests controlling for sample size by including the sample size as a covariate. We have also redone the test controlling for sample size but only using the polls during 2011-2014 and 2013-2014, respectively. In neither case, the conclusion of a significant difference between the polling organisations is changed.

One might also be concerned comparing organisations contributing with different number of polls; an organisation with many polls will of course have a greater influence of the estimated share of voters than an organisation with few polls. In this study the contributed number of polls varies from 14 to 100, as may be seen in Table 1. However, looking at Table 2 we see that the organisations with the fewest polls, Statistics Sweden and YouGov, fare quite well compared to organisations with more polls.

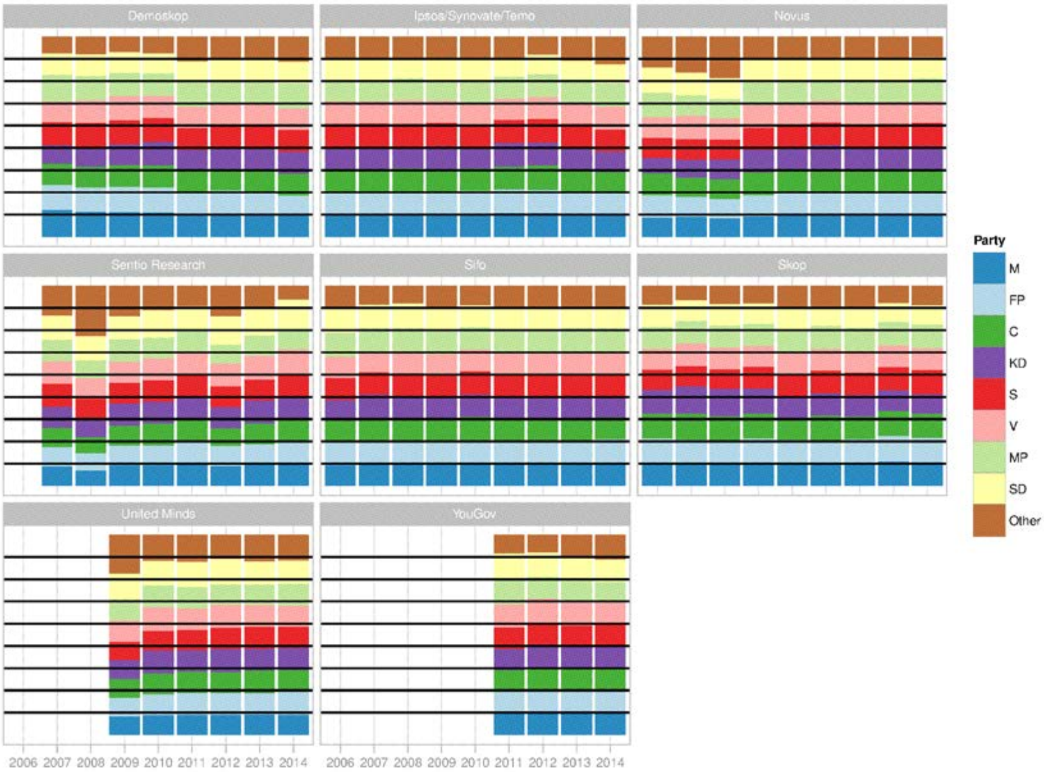

Figure 3. Mean compositional deviations from the *C*-loess estimate for each polling organisation and year. (Statistics Sweden is excluded since they only publish two polls per year.) The solid horizontal lines indicate the neutral composition (1/9, …, 1/9).

Finally, we want to stress the fact that the deviations should not be interpreted in absolute terms but in relative. The reason for this is that the *C*-loess estimate is an unbiased estimate of the party shares in the electorate only if all the polls are unbiased. Since there evidently are differences between the polling organisations, this is probably not the case. Hence, the deviations should be viewed as deviations from a common mean rather than the electorate mean. We argue that nevertheless, the differences are of such a magnitude that the conclusion will sustain if the *C*-loess estimate were replaced by the electorate party shares.

Conclusions

This paper has investigated if house effects are present in Swedish polls. We believe that this is the first study looking for evidence of house effects in Swedish polls. The study has used (almost) all published polls from 2006 to 2014, in total eight years of polling and 640 polls from nine polling organisations. In order to be able to compare the polls of the various organisations we have estimated a common estimate. As Sweden has a multiparty system with usually nine reported parties, we have used a loess estimate developed for compositional data (*C*-loess) which respects the inherent restrictions of the sample space of such data. The choice of using a non-parametric estimate is done in order not to have to impose any distributional assumptions.

We have used two measures, the univariate simplicial distance d_i and the multivariate compositional deviation $\boldsymbol{d}_i$, to investigate the presence of house effects. One may note that the two measures are related as $d_i = \|\boldsymbol{d}_i\|_S$, where $\|\cdot\|_S$ is the simplicial norm (Billheimer et al., 2001). Whereas the deviations provide information on which parties are being given too large shares and which parties are being given too small shares, the distance only provide information on how close to the common estimate the poll is. The distance measure may thus be view as summarising measure of the deviation. Both measures are developed for compositional data and thus respecting the restrictions of the sample space.

Based on our findings we conclude that there are house effects in Swedish polls, and that some polling organisations are probably better of estimating the party shares in the electorate than others. As our common estimate is most likely biased, we refrain from analysing which polling organisations are superior. The house effects remain also after controlling for different sample sizes and different length of time periods. It remains as future research to find unbiased estimates of the electorate party shares, and using these to quantify the house effects. Such quantified house effects might then be used to correct or weight the polls of different polling organisations when combining them in e.g. a poll of polls. An alternative approach that we are considering is using some state-space model but simultaneously model all parties using e.g. the logistic normal distribution (Aitchison and Shen, 1980) or the additive logistic Student t distribution (Katz and King, 1999).

References

Aitchison, J. (1982). The statistical analysis of compositional data. *Journal of the Royal Statistical Society. Series B,* 44, 139-177.

Aitchison, J. (1983). Principal component analysis of compositional data. *Biometrika*, 70, 57-65.

Aitchison, J. (1986). *The statistical analysis of compositional data*, London: Chapman and Hall.

Aitchison, J. (1992). On criteria for measures of compositional difference. *Mathematical Geology,* 24, 365-379.

Aitchison, J. & Shen, S. M. (1980). Logistic-normal distributions: Some properties and uses. *Biometrika,* 67, 261-272.

Bergman, J. & Holmquist, B. (2014). Poll of polls: A compositional loess model. *Scandinavian Journal of Statistics. Theory and Applications,* 41, 301-310.

Billheimer, D., Guttorp, P. & Fagan, W. F. (2001). Statistical interpretation of species composition. *Journal of the American Statistical Association,* 96, 1205-1214.

Cleveland, W. S. (1979). Robust locally weighted regression and smoothing scatterplots. *Journal of the American Statistical Association,* 74, 829-837.

Clinton, J. D. & Rogers, S. (2013). Robo-polls: Taking cues from traditional sources? *PS – Political Science and Politics,* 46, 333-337.

Egozcue, J. J., Pawlowsky-Glahn, V., Mateu-Figueras, G. & Barceló-Vidal, C. (2003). Isometric logratio transformations for compositional data analysis. *Mathematical Geology,* 35, 279-300.

Erikson, R. S. & Wlezien, C. (1999). Presidential polls as a time series: The case of 1996. *Public Opinion Quarterly,* 63, 163-177.

Fisher, S. D., Ford, R., Jennings, W., Pickup, M. & Wlezien, C. (2011). From polls to votes to seats: Forecasting the 2010 british general election. *Electoral Studies,* 30, 250-257.

Honaker, J., Katz, J. N. & King, G. (2002). A fast, easy, and efficient estimator for multiparty electoral data. *Political Analysis,* 10, 84-100.

Jackman, S. (2005). Pooling the polls over an election campaign. *Australian Journal of Political Science,* 40, 499-517.

Katz, J. N. & King, G. (1999). A statistical model for multiparty electoral data. *American Political Science Review,* 95, 49-69.

Ohlsson, P. T. (2014). *Svensk politik,* Lund: Historiska media.

Pawlowsky-Glahn, V. & Egozcue, J. J. (2001). Geometric approach to statistical analysis on the simplex. *Stochastic Environmental Research and Risk Assessment,* 15, 384-398.
Pawlowsky-Glahn, V. & Egozcue, J. J. (2002). Blu estimators and compositional data. *Mathematical Geology,* 34, 259-274.
Pearson, K. (1897). Mathematical contributions to the theory of evolution.—on a form of spurious correlation which may arise when indices are used in the measurement of organs. *Proceedings of the Royal Society of London,* LX, 489-498.
Smith, T. W. (1978). In search of house effects: A comparison of responses to various quesitons by different survey organizations. *Public Opinion Quarterly,* 42, 443-463.
Smith, T. W. (1982). House effects and the reproducibility of survey measurements: A comparison of the 1980 gss and the 1980 american national election study. *Public Opinion Quarterly,* 46, 54-68.
Swedish Election Authority, V. 2014. *Val till riksdagen – röster* [Online]. Available: http://www.val.se/val/val2014/slutresultat/R/rike/index.html [Accessed 21 October 2014.
Thorburn, D. & Tongur, C. (2012). Combination of sample surveys or projections of political opinions. *Workshop of Baltic-Nordic-Ukrainian Network on Survey Statistics,* 2012. University of Latvia, Central Statistical Bureau of Latvia, Riga, 191-197.