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Election Decision Making by Using Special Voting Methods

Özel Oylama Yöntemleri ile Seçim Kararı Verme

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ABSTRACT

This paper explains special voting methods designed to support making right decision for an election into any group. These frequently used voting methods are Kemeny-Young, minimax, Tideman, Schulze, Bucklin and Coombs method. They have different process to elect a winner. In this research, there is an example about an chairman election in a political party's youth branch. So, all voters use their votes for four candidates and rank them, preferences for 4 candidates (A, B, C, D) are clear. These voting methods determine the winner and ranking by using these data with their own techniques. At the end of the research, there exists no difference between the winners of voting methods, however their ranking of candidates are changable.

Keywords: Voting methods, group decision making, election decision

ÖZET

Bu çalışma herhangi bir grup içerisinde yapılacak bir seçim esnasında doğru karar verilebilmesi için gerçekleştirilen özel oylama yöntemlerini açıklamaktadır. Kemeny-Young, minimax, Tideman, Schulze, Bucklin ve Coombs yöntemleri sıklıkla kullanılan oylama yöntemlerdendir. Bu yöntemler kazananı belirleme konusunda farklı süreçlere sahiplerdir. Bu çalışmada da, politik bir partinin gençlik kollarında gerçekleştirilen başkan seçimi örnek olarak verilmiştir. 4 adayın (A, B, C, D) olduğu bu seçimde oylayıcıların tercihleri bellidir. Bahsedilen oylama yöntemleri kendilerine ait özel teknikleri ile elde edilmiş olan tercih verilerini kullanarak kazananı ve bu dört adayın sıralamasını ortaya koymuşlardır. Çalışmanın sonunda kullanılan oylama yöntemlerinin belirlemiş olduğu kazananlar arasında fark olmadığı, ancak adayların sıralamalarının değiştiği belirlenmiştir.

Anahtar Kelimeler: Oylama yöntemleri, grup kararı verme, seçim kararı

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1. Introduction

Voting systems have been used as an important point of democracy since the 6th century BC, when democracy was introduced by the Athenian democracy. Voting is a common way to find solution for disagreement during decision making process, also it helps to elect and determine the winners in any contests, so it can be called as a problem solver system. One of the earliest recorded elections in Athens was a plurality vote. Most elections in the early history of democracy were held using plurality voting or some variant. Plurality voting still saves its place in voting systems.

A voting system includes many rules for valid voting, and how votes can be counted and aggregated to reach the outcome. This outcome can be a single winner, or can contain multiple winners. However, the outcome of voting is a product of the collective decision made by group. The voting procedure plays an important role as the outcome of voting. Because its determinants guide the decision making groups about balloting. For instance, every voter can vote for one candidate and the winner is determined as the recipient of the largest number of votes. This system is known as the plurality voting method.

Plurality voting use several extensions in many single-winner elections. Runoff elimination method is a form of ranked choice voting in which voters rank the candidates in order of preference instead of selecting a single candidate. If no candidate receives more than half of the votes, there has to be a runoff election between two candidates. The winner of the head to head runoff always wins the election.

In addition to this, there are several voting methods that are based on such pairwise comparisons of decision alternatives. They differ in how the winner is determined once the pairwise votes have been taken. Most of these methods correspond with election of candidate that beats all other competitor in pairwise votes. The results often give a right to be a candidate. Also, one of the most important voting system concept is condorcet method that always elect the condorcet winner who is the candidate can be found by conducting a series of pairwise comparisons.

Within the framework of all concepts about voting system, the aim of this paper is to explain popular six voting methods for decision making in a group according to their special voting rules. Voting is the best way for group decisions, that's why decision makers must learn various voting methods such as Kemeny-Young, minimax, Tideman, Schulze, Bucklin and Coombs method.

2. Kemeny-Young Method

John Kemeny developed this method in 1959 as an extension of the majority principle. This voting method uses preferential ballots, pairwise comparison counts, and sequence scores to identify the most popular choice, and so on (http://www.search.com/reference/Kemeny-Young_method). In this method, a voter is allowed to rank more than one choice at the same preference level. Sum up, it consists of the linear orders that are closest, on average, to the rankings of the profile according to the symmetric difference distance δ (Lamboray, 2007). Kemeny-Young calculations

are usually done in two steps. The first step is to create a matrix or table that counts pairwise voter preferences. The second step is to test all possible order-of-preference sequences, calculate a sequence score for each sequence, and compare the scores. For example, there are 4 candidates for being a chairman of political party's youth branch.

Table 2.1. The preferences of voters

40% of voters	**24% of voters**	**19% of voters**	**17% of voters**
1. A	1. **B**	1. **C**	1. **D**
2. B	2. C	2. D	2. C
3. C	3. D	3. B	3. B
4. D	4. A	4. A	4. A

Table 2.2. Pairwise Comparision Matrix

	A	**B**	**C**	**D**
A	-	40%	40%	40%
B	60%	-	64%	64%
C	60%	36%	-	83%
D	60%	36%	17%	-

The Kemeny-Young method arranges the pairwise comparison counts in the following table **.**

Table 2.3. Pairwise comparison for Kemeny-Young Method

All possible pairs of choice names	**Number of votes with indicated preference**		
	Prefer X over Y	**Equal preference**	**Prefer Y over X**
X = A Y = B	40%	0	60%
X = A Y = C	40%	0	60%
X = A Y = D	40%	0	60%
X = B Y = C	64%	0	36%
X = B Y = D	64%	0	36%
X = C Y = D	83%	0	17%

Table 2.4. The sequence score for the sequence for all possible ranks

First choice	Second choice	Third choice	Fourth choice	Sequence score
A	B	C	D	331
A	B	D	C	265
A	C	B	D	303
A	C	D	B	275
A	D	B	C	237
A	D	C	B	209
B	A	C	D	351
B	A	D	C	285
B	C	A	D	371
B	**C**	**D**	**A**	**391**
B	D	A	C	305
B	D	C	A	325
C	A	B	D	323
C	A	D	B	295
C	B	A	D	343
C	B	D	A	363
C	D	A	B	315
C	D	B	A	335
D	A	B	C	257
D	A	C	B	229
D	B	A	C	277
D	B	C	A	297
D	C	A	B	249
D	C	B	A	269

After calculating sequence score, we determine the highest score and this highest score's rank gives us the winner. Preference order follows these names. The first choice is B and second one is C, D is the third one and A is the last. Kemeny- Young method provides only preference.

3. Minimax Method

It is also known as Simpson- Kramer min-max rule. It stands for large majorities over small majorities. Each alternative is given a score equal to the greatest margin of victory by which that alternative loses a pairwise contest. A score of 0 is given if no losses exist

for the candidate. The alternative with the lowest score wins. A condorcet winner will always be a min-max winner. When there is a cycle, we can think of the min-max winner as being the least objectionable candidate (Levin and Nalebuff, 1995).

Table 3.1. Pairwise comparison matrix for Kemeny-Young Method

	A	**B**	**C**	**D**
A	0	40%	40%	40%
B	**60%**	0	**64%**	**64%**
C	**60%**	36%	0	**83%**
D	**60%**	36%	17%	0

Candidate B defeats all others with a large margin . As a result, the others candidates rank by their performance against B. According to Min-Max rule, B is the winner and then, A comes, then C and D.

Table 3.2. Minimax Method's Result

	A	**B**	**C**	**D**
Votes	60	36	64	64

4. Tideman's Method

Tideman's method, also known as "Ranked Pairs Method", is a method for conducting elections. It is developed by Nicolaus Tideman in 1987. In this method, each voter firstly ranks the options, and then the method constructs a complete ranking of the options based on the decisions of the voters. Ranked Pairs gives the ranking of the options that always reflects the majority preference between any two options, except in order to reflect majority preferences with greater margins (http://condorcet.org/rp/intro.shtml).

Table 4.1. The preferences of voters

40% of voters	**24% of voters**	**19% of voters**	**17% of voters**
A	**B**	**C**	**D**
B	C	D	C
C	D	B	B
D	A	A	A

Table 4.2. Pairwise Election Result

		X			
		A	B	C	D
Y	A	0	40% (Y) **60%** (X)	40%(Y) **60%**(X)	40% (Y) **60%** (X)
	B	**60%**(Y) 40% (X)	0	**64%** (Y) 36% (X)	**64%** (Y) 36% (X)
	C	**60% (**Y) 40% (X)	36%(Y) **64%**(X)	0	**83%** (Y) 17% (X)
	D	**60%**(Y) 40% (X)	36%(Y) **64%**(X)	17% (Y) **83%** (X)	0
Pairwise Elect. Result (won-lost-tie)		**(0-3-0)**	**(3-0-0)**	**(2-1-0)**	**(1-2-0)**
Votes against in worst pairwise defeat		**60%**	**No**	**64%**	**83%**

Table 4.3. Winners according to Pairs

Pairs	**Winner**
A (40%) vs. B (60%)	**A (60%)**
A (40%) vs. C (60%)	**C (60%)**
A (40%) vs. D (60%)	**D (60%)**
B(64%) vs. C (36%)	**B (64%)**
B (64%) vs D (36%)	**B (64%)**
C (83%) vs. D (17%)	**C (83%)**

Candidate C has the largest majority over candidate D. However candidate B is prefered to candidate D and C. So we can say that C and D are losers against B.

Table 4.4. Lock results of Tideman's method

Lock		
C	>	D
B	>	C
B	>	D
B	>	A
C	>	A
D	>	A

Table 4.5. Pairs and Winner after Lock results

Pairs	Winner
C (83%) vs. D (17%)	C (83%)
B (64%) vs. C (36%)	**B (64%)**
B (64%) vs D (36%)	**B (64%)**
A (40%) vs. B (60%)	**B (60%)**
A (40%) vs. C (60%)	C (60%)
A (40%) vs. D (60%)	D (60%)

The pairs have to lock in order. Candidate B is the winner. There is no cycles that are created by any of the pairs. That's why, all of them are "lock in". Every "lock in" would add another arrow to the graph showing the relationship between the candidates.

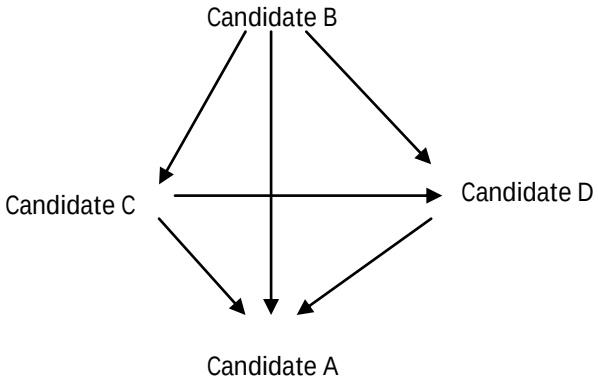

Figure 4.1. Graphics of "lock in" order

According to Tideman, the main motivation for the Ranked Pairs Rule has been its independence with respect to clones. A clone means a subset of alternatives such that no alternative not belonging to the clone is ranked in between the alternatives of the clone in the initial profile. The winner of the Ranked Pairs Rule is independent of the addition

or the removal of clones for almost every profile, and complete independence can be achieved by adopting a particular tie-breaking mechanism (Lamboray, 2009) .

In the Lamboray's paper, he uses another perspective to understand the Ranked Pairs Rule. He concentrates on the set of output rankings instead of working in a choice-theoretic framework. These rankings obtained by the Ranked Pairs Rule are all so-called prudent orders. A prudent order is a linear order such that the weakest pairwise majority margin of the preferences it contains is maximal. In this article, there are many standard conditions that are explained by using ranking rules.

5. Schulze Method

The Schulze method is a voting system developed in 1997 by Markus Schulze that selects a single winner using votes that express preferences. The method can also be used to create a sorted list of winners. The Schulze method is also known as Schwartz Sequential Dropping (SSD), Cloneproof Schwartz Sequential Dropping (CSSD), Beatpath Method, Beatpath Winner, Path Voting, and Path Winner (http://en.allexperts.com/e/s/sc/schulze_method.htm) .

According to Johnson (2005), Schulze Method relies on the mathematical fact that this procedure meets many of the criteria against which voting procedures are judged. If there is a condorcet winner, this method selects it as the winner. The Schulze method satisfies many of the other most important priorities, including undifferentiatedness, monotonicity, independence of clones (cloneproofness) .

In this method, the voters first of all submit the rankings of as many candidates as they wish, and the ones they do not rank are assumed to be interchangeable and less desirable than the ones they do rank.

Schulze method uses two mathematical equivalent descriptions of the for choosing the winner in a competitive election. These methods employ the idea of transitive defeat. Transitive defeat (chains) creates a chain of comparision. For example, x **P** y, w **P** z. The chains can be quite long, and to save space we might as well write x **P** w **P** z **P** y to mean that x transitively defeats y with w and z in the middle of the chain. The strength of a chain from x to y is measured by Schulze Method whose aim is to determine an alternative with the strongest chains through which it can defeat all other alternatives.

Johnson's paper (2005) says that first we collect up all the alternatives that are not disqualified, then we have a set of potential winners. If we are lucky enough to have only one candidate left, then it is the beatpath winner. If we have several left then a tie breaking procedure is needed. So, the most important point in this method is to narrow the alternatives down to this set of unbeaten candidates, and the tie breaking procedure is something of an afterthought. In the example, this method will be more understandable.

Table 5.1. Pairwise result of Schulze Method

		X			
		A	B	C	D
Y	A	0	40% (Y) **60%** (X)	40%(Y) **60%**(X)	40% (Y) **60%** (X)
	B	**60%**(Y) 40% (X)	0	**64%** (Y) 36% (X)	**64%** (Y) 36% (X)
	C	**60% (**Y) 40% (X)	36%(Y) **64%**(X)	0	**83%** (Y) 17% (X)
	D	**60%**(Y) 40% (X)	36%(Y) **64%**(X)	17% (Y) **83%** (X)	0
Pairwise Elect. Result (won-lost-tie)		**(0-3-0)**	**(3-0-0)**	**(2-1-0)**	**(1-2-0)**
Votes against in worst pairwise defeat		**60%**	**No**	**64%**	**83%**

Table 5.2. Pairwise Winner of Schulze Method

Pairs	**Winner**
C (83%) vs. D (17%)	**C (83%)**
B (64%) vs. C (36%)	**B (64%)**
B (64%) vs D (36%)	**B (64%)**
A (40%) vs. B (60%)	**B (60%)**
A (40%) vs. C (60%)	**C (60%)**
A (40%) vs. D (60%)	**D (60%)**

And then we try to find list of candidates and their matchup wins or defeats. Candidate B has 3 wins 0 defeat. Candidate C has 2 wins 1 defeat. Candidate D has 1 win 2 defeats. Candidate A has 0 win and 3 defeats. According to these result, B is the winner.

6. Bucklin Method

Bucklin method is a voting system that can be used for single-member and multi-member districts. It is developed by James W. Bucklin. It is a ranked ballot system. If any candidate has a majority of first choice votes alone, then that candidate is elected. Otherwise, if any candidate has a majority of first and second choice votes, that candidate is elected. Otherwise, if any candidate has a majority of first and second and third choice votes, they are elected. And so on. If two candidates achieve a majority at

the same stage of the count, then the candidate with the larger total at that stage is elected (http://fc.antioch.edu/~james_green-armytage/vm/survey.htm#beatpath).

According to Smith (2006), Bucklin resembles approval voting and plurality voting in some ways. candidates. Bucklin also suffers from many of the same vote splitting problems as does plain plurality: lack of clone immunity, failure to always elect condorcetwinners and capability of electing condorcet losers .

Table 6.1. The preferences of voters

40 votes	**24 votes**	**19 votes**	**17 votes**
A	**B**	**C**	**D**
B	C	D	C
C	D	B	B
D	A	A	A

Table 6.2. The first round of Voting

A	**B**	**C**	**D**
40 votes	24 votes	19 votes	17 votes

No one has the majority votes in the first rank. In the second round, we use the second choices to find majority votes. For example, candidate A's votes transfer to Candidate B. Candidate B's votes trasfer to candidate C. After that, we calculate the new votes and find majority votes.

Table 6.3. The second round of Voting

A	B	C	D
40 votes	**64 votes**	**60 votes**	36 votes

According to Bucklin method, Candidate B is the winner because of its majority of votes.

7. Coombs Rule

Coombs method is an another voting method which is developed by Clyde Coombs to use for single winner election. Where Instant Runoff Voting eliminates the candidate with the fewest first choice votes, Coombs method eliminates the candidate with the most last choice votes.[1][*] Otherwise, the two methods are the same (http://fc.antioch.edu/~james_green-armytage/vm/survey.htm#_ftnref9) .

This method starts with no alternatives eliminated. If one candidate has a majority of first-place votes, it is the winner. Otherwise, we have to find the total votes for each alternative of how many ballots it is the lowest ranked non-eliminated alternative. Eliminate the alternative with the highest score and repeat the process until an alternative has a majority in first-place votes among non-eliminated candidates. This is an example how Coombs rule works.

Table 7.1. The preferences of voters

40 votes	**24 votes**	**19 votes**	**17 votes**
A	**B**	**C**	**D**
B	C	D	C
C	D	B	B
D	A	A	A

Table 7.2. First and Second Round of voting

	First Round		**Second Round**
	First rank	Last rank	First rank
A	40	60	0
B	24	0	**84**
C	19	0	19
D	17	40	17

Candidate A is eliminated in the first round because it has the most last place votes. And its votes transfer to candidate B because of its own ranking. And candidate B is the winner according to Coombs rule.

In Grofman and Feld's article (2004), they try to compare two voting rules under the assumption that is about to evaluate them in the politically realistic situations where voters have single-peaked preferences over alternatives. After evaluating, they find that approval voting method is always as likely or more likely to select the condorcet winner than plurality with taking into consideration four factors such as avoidance of condorcet losers, choice of condorcet winners, resistance to manipulability with strategic voting and simplicity that are choices while selecting candidates. Addition to this, they say that Coombs rule will always select the Condorcet winner regardless of the number of alternatives.

8. Conclusion

Several voting methods can be used to decide the winner of candidates in a group. Many researchers worked to improve the voting methods to find the best method to elect the right candidate as a winner. Kemeny-Young, minimax, Tideman, Schulze, Bucklin and Coombs methods are special voting methods for group decision making. Although their techniques are different from each other, they have the same winner according to the result of this example. This winner is determined as a candidate B. In addition to this, although Kemeny-Young method and minimax method have different ranking of candidate, their winner is candidate B.

Finally, special voting methods are very useful to determine the winner in a group. Voting system is always better than one person decision system in the group. That's why, researchers are still interested in finding new voting methods to make the best decision in a group.

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