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Salahaddin University-Erbil

On Some Mathematical Applications In Politics Science

Research Project

Submitted to the department of (Mathematic) in partial fulfillment of the requirements for the degree of BSc. in (forth)

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Certification of the Supervisors

I certify that this report was prepared under my supervision at the Department of Mathematics / College of Education / Salahaddin University-Erbil in partial fulfillment of the requirements for the degree of Bachelor of philosophy of Science in Mathematics.

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Date: 4 / 4 / 2024

In view of the available recommendations, I forward this report for debate by the examining committee.

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Abstract

Mathematics is used in many fields of life and plays a very important role in other science branches such as chemistry, physics, and sports. In this work, we are study mathematical applications in politics science. First, we study the saint_lague method and how to use it. Then we study weighted voting. Furthermore, we study voting theory and discuss some type of voting and the role of mathematics on it. In all applications we solve many examples that illustrate the applications.

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Introduction

Political scientists employ mathematics and statistics to forecast the behavior of a group of people. They must monitor the social, political, and financial consequences of a community's beliefs and behaviors. Political scientists examine the population through a variety of mathematical applications, including computer technology, database management, statistics, and economics. Mathematics reveals hidden patterns that help us understand the world around us. Now much more than arithmetic and geometry, mathematics today is a diverse discipline that deals with data, measurements, and observations from science; with inference, deduction, and proof; and with mathematical models of natural phenomena, of human behavior, and of social systems.

Mathematics especially statistics plays a key role in political science especially in voting theory. In this work we study math in political science especially in voting theory. This work consists of three chapters and is organized as follows. In chapter one we are talking about the Santlio voting system, which is used in many countries. In chapter two we are talking about weighted voting, which refers to voting rules. At the last chapter, we study voting theory and discuss some type of voting and the role of mathematics on it. In all applications we solve many examples that illustrate the applications.

CHAPTER ONE

The Saint-Lague Method

1.1 The Saint-Lague Method

The webster method, also known as the Sainte-Lague technique, is a highest averages apportionment method used to distribute seats among parties in a party-list proportional representation system or among federal states in a parliament.

Senator Daniel Webster, an American statesman, initially detailed the procedure in 1832. The act of June 25, 1842, ch 46, 5 Stat. 491, established the procedure for the proportional allocation of members in the US Congress, was implemented in 1842. The French mathematician André Sainte-Lague independently developed the same technique in 1910. It appears that webster was not well-known in French and European literature until the end of world war II. The double name has this explanation. (Webster, D. 1832)

1.2 Motivation

A party with 30% of the vote would obtain 30% of the seats in a proportional electoral system, which aims to allocate seats according to each political party's share of the vote. The distribution of seats can only be done in whole, therefore exact proportionality is not achievable. There are various techniques for allocating seats based on votes, one of which is the Sainte-Lague system. different allocation techniques reveal varying degrees of political fragmentation, apportionment paradoxes, and proportionality. The Sainte-Lague approach is a statistical technique that reduces the average deviation of the seats-to-votes ratio. It also demonstrates the best proportionality behavior and more equal seats-to-votes ratio for parties of varying sizes.

1.3 Description

After all the votes have been tallied, successive quotients are calculated for each party. The formula for the quotient is quotient=v/2s+1 where v is the total number of votes that party received, and s is the number of seats that have been allocated so far to that party, initially 0 for all parties. Which ever party has the highest quotient gets the next seat allocated, and their quotient is recalculated. The process is repeated until all seats have been allocated. The below chart is an easy way to perform the calculation:

Some nations, like Sweden, Norway, and Nepal, alter the quotient formula for parties with no seats (s = 0) in an effort to lessen political fragmentation. These nations switched from utilizing V to V/1.4 for the quotient; however, Sweden has been using V/1.2 since the general elections of 2018.In other words, the improved technique uses (1.4, 3, 5, 7,…) instead of (1, 3, 5, 7,…) as the sequence of divisors. Parties finding themselves with only one seat will find it more difficult than with the original Sainte-Lague's system. These tiny parties are not allotted seats under the amended procedure; instead, the seats are allocated to a larger party. Norway uses a two-tier proportionality to further modify this method. The number of members that must be returned from each of Norway's 19 constituencies, or former counties, is determined by the county's area and population. A county's population is worth one point, while its area is worth 1.8 points per km^. In addition, the national distribution of votes determines the allocation of one seat from each constituency.

Example 1.1:

In this example, 230,000 voters decide the disposition of 8 seats among 4 parties. Since 8 seats are to be allocated, each party's total votes are divided by 1, then by 3, and 5 (and then, if necessary, by 7, 9, 11, 13, and so on by using the formula above) every time the number of votes is the biggest for the current round of calculation.

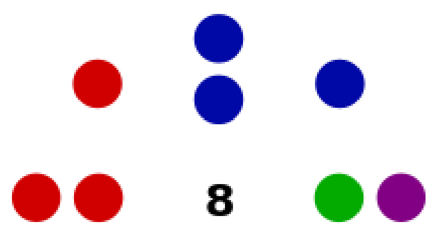
For comparison, the "True proportion" column shows the exact fractional numbers of seats due, calculated in proportion to the number of votes received. (For example, 100,000/230,000 × 8 = 3.48.)

round ***(1 seat per round)***	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Seats won** **(bold)**
Party A quotient seats after round	**100,000** **0+1**	33,333 1	**33,333** **1+1**	20,000 2	20,000 2	**20,000** **2+1**	14,286 3	**3**
Party B quotient seats after round	80,000 0	**80,000** **0+1**	26,667 1	26,667 1	**26,667** **1+1**	16,000 2	**16,000** **2+1**	**3**
Party C quotient seats after round	30,000 0	30,000 0	30,000 0	**30,000** **0+1**	10,000 1	10,000 1	10,000 1	**1**
Party D quotient seats after round	20,000 0	20,000 0	20,000 0	20,000 0	20,000 0	**20,000** **0+1**	6,667 1	**1**

Denominator	/1	/3	/5	Seats won (*)	True proportion
Party A	**100,000***	**33,333***	**20,000***	**3**	3.5
Party B	**80,000***	**26,667***	**16,000***	**3**	2.8
Party C	**30,000***	10,000	6,000	**1**	1.0
Party D	**20,000***	6,667	4,000	**1**	0.7
Total				**8**	**8**

Party-list PR — Sainte-Lague method

Party	**Popular vote**	**Number of seats**	**Seats %**
Party A	43.5%	3	37.5%
Party B	34.8%	3	37.5%
Party C	13.0%	1	12.5%
Party D	8.7%	1	12.5%
TOTAL	*100%*	*8*	*100%*



The 8 highest entries (in the current round of calculation) are marked by asterisk: from 100,000 down to 16,000; for each, the corresponding party gets a seat. The below chart is an easy way to perform the calculation: In comparison, the D'Hondt method would allocate four seats to party A and no seats to party D, reflecting the D'Hondt method's overrepresentation of larger parties.

1.4 History

In 1832, Webster presented the United States Congress with a plan for the proportional distribution of seats. The procedure was implemented in 1842 (Act of June 25, 1842, section 46, 5 Stat. 491). After that, the Hamilton method took its place, and the Webster method was reinstated in 1911. Given that the Sainte-Lague technique is based on party votes and the Webster method is used to allocate seats based on state populations, the two approaches should be seen as having the same outcome. Although Webster developed his approach for legislative apportionment—which distributes legislative seats to areas according to their population share rather than for elections which distributes legislative seats to parties according to their vote share the computations in the method remain the same.

1.5 Usage by country

Currently, Bosnia and Herzegovina, Ecuador, Indonesia, Iraq, Kosovo, Latvia, Nepal, New Zealand, Norway, and Sweden utilize the Webster/Sainte-Lague technique. The Bundestag, the state legislatures of Baden-Württemberg, Bavaria, Bremen, Hamburg, North Rhine-Westphalia, Rhineland-Palatinate, and Schleswig-Holstein, and the federal government use it ,The Saint—Lague method is used in several Swiss cantons for the distribution of votes among electoral districts and for the biproportional allocation of seats. Bolivia in 1993, Poland in 2001, and the Palestinian Legislative Council in 2006 all employed the

Webster/Sainte-Lague technique. From 2003 to 2013, the United Kingdom Electoral Commission employed this procedure to allot British seats in the European Parliament to the member states of the United Kingdom as well as the English regions. The United Kingdom Conservative-Liberal Democrat coalition government in 2011 proposed the method to the Irish Green Party as a reform for use in Dáil Éirean elections. The method was also used to determine the distribution of seats in elections to the House of Lords, the nation’s upper house of parliament.

CHAPTER TWO

Weighted Voting

Sometimes anonymity is a necessary need for a voting procedure, while other times it isn't. Even if egalitarianism frequently seems right, there are situations in which it looks either Or unjust. For instance, in business elections, shareholders usually cast their votes. Tions with as many votes as possible, not just one vote for each shareholder. As the shares that each shareholder owns. It appears that the guiding idea is that A shareholder has the right to get double the amount they invested in a corporation. Nearly twice as much influence and authority over choices made at That business. This chapter explores the possibility of weighted voting Actually succeeds in sharing power among voters in the Expected manner. It will become evident that a voter's power in the election is not always directly correlated with the amount of votes they receive. We must define "voting power" in order to make this explanation clear. (Robinson, E. A. Jr., & Ullman, D. H. 2010).

2.1 General Weighted Systems

Many systems weight some members' votes more heavily than others. Probably the Most familiar is a shareholders' vote where each voter receives one vote for each Share owned; we brought this up in Chap. 7, in our discussion of cumulative voting.. While some political systems allocate equal numbers of votes to each component, Others give more votes to larger states or nations. For example, in the Council of Ministers of the European Union, each nation has one representative, but the number Of votes depends on the size of the country: Germany, the United Kingdom and France have 29 votes each, Romania has 14, while Ireland has 7 and Malta has Only 3. In order for a proposition to pass, it must receive 74 % of the votes, and at Least 50 % of the countries must vote in favor. Many County Boards of Electors in The United States, particularly in New York State, have one member from each city but those from larger cities have more votes. In a weighted voting system for n participants, suppose the numbers of votes Available to the participants (or weights) are w1, w2,…,wn and the number of votes Required to pass a motion (the quota) is q. We shall say the system is of type [q : w1, w2,…,wn]. For example, the system used by the committee we discussed in the preceding sec-Tion was [3 : 2, 1, 1, 1]. (Wallis 2014)

2.2 Dictator

A player will be a dictator if their weight is equal to or reater than the quota. The dictator can also block any Proposal from passing; the other players cannot reach Quota without the dictator. [20: 21, 6, 3].

2.3 Veto Power

A player has veto power if their support is necessary for the Quota to be reached. It is possible for more than one Player to have veto power, or for no player to have veto power

A. [30: 19, 15, 11]

Player 1 has veto power.

B. [11: 9,8, 8]

No player has veto power.

2.4 Dummy

A player is a dummy if their vote is never essential for a Group to reach quota.

A. [16: 12, 10, 2]

Player 3 is a dummy player.

Example 2.1:

Consider the weighted voting system [18: 8, 8, 8, 2].

A. How many players are there?

There are 4 players.

B. What is the total number (weight) of votes?

The total votes is 26.

C. What is the quota?

The quota is 18.

D. Identify and dictators.

There are no dictators.

E. Identify any players with veto power.

No players have veto power.

F. Identify any dummy players.

There are no dummy players.

Example 2.2:

Consider the weighted voting system [16: 18, 5,3, 3, 1].

A. How many players are there?

There are 5 players.

B. What is the total number (weight) of votes?

The total votes is 30.

C. What is the quota?

The quota is 16.

D. Identify and dictator

Player 1 is a dictator.

E. Identify any players with veto power.

Player 1 has veto power.

F. Identify any dummy players.

Players 2, 3, 4, and 5 are dummy players.

2.5 The Banzhaf Power

It's common to assume that everyone in a group will vote in the same way, but this isn't always the case. For instance, in the US House of Representatives, it is generally expected that all Republicans will vote for bills that support their party's goals and against those that do the opposite. However, on occasion, a tiny minority of members will abstain from voting. A coalition is a collection of people who all intend to either support or oppose a move. A coalition that supports the motion in issue and has enough votes to ensure that it passes with the support of all coalition members is considered successful. Give it a vote. One that opposes the motion is referred to as a "blocking coalition." And has sufficient votes to win.(Wallis 2014).

Example 2.3: Find the Banzhaf power index for the voting system
[16: 12, 6, 4, 2]

Coalitions:

{P1, P2}	Total Weight:	12+6=18
{P1, P3}	Total Weight:	12+4=16
{P1, P4}	Total Weight:	12+2=14
{P2, P3}	Total Weight:	6+4=10
{P2, P4}	Total Weight:	6+2=8
{P3, P4}	Total Weight:	4+2=6

CHAPTER THREE

VOTING THEORY

Obtaining group consensus is often required while making decisions. This occurs when a corporation choose which design to make, when a group of friends choose which movie to see, and when a democratic nation chooses its leaders. While most people agree on the fundamentals of voting, there are differences in the ways that votes are cast and winners are decided. If you're with friends, you can choose a movie by casting votes for all the films you'd want to see. The movie with the most votes wins. An organization may remove designs that aren't popular and then re-vote on the ones left. A nation may search for the candidate who received the most votes. The primary objective in selecting a winner is always to fairly represent the choices of the participants. (Lippman, D. 2012)

3.1 Plurality

Diversity. Nominee A would win with 36 first-place votes if the party decided to elect its candidate by a simple plurality, despite the fact that A was rated dead last by all other delegates and received less than one-third of the vote overall.

Example 3.1:

In our election from above, we had the preference table:

	1	3	3	3
1st choice	A	A	O	H
2nd choice	O	H	H	A
3rd choice	H	O	A	O

For the plurality method, we only care about the first choice options. Totaling them up:

Anaheim: 4 votes

Orlando: 3 votes

Hawaii:3 votes

3.2 What's wrong with plurality?

The election above may seem totally clean, but there is a problem lurking that arises whenever there are three or more choices. Looking back at our preference table, how would our members vote if they only had two choices? Anaheim vs Orlando: 7 out of the 10 would prefer Anaheim.

	1	3	3	3
1^{st} choice	A	A	O	H
2^{nd} choice	O	H	H	A
3^{rd} choice	H	O	A	O

Anaheim vs Hawaii: 6 out of 10 would prefer Hawaii

	1	3	3	3
1^{st} choice	A	A	O	H
2^{nd} choice	O	H	H	A
3^{rd} choice	H	O	A	O

This seems wrong, doesn't it? Despite Hawaii being preferred by six out of ten votes, Anaheim has just won the election! It doesn't seem fair at all. Condorcet observed how this may occur, therefore we named our first fairness criterion in his honor. Statements that seem reasonable in a fair election make up the fairness criteria.

3.3 Condorcet criterion

Hawaii is the Condorcet Winner in the aforementioned situation. (Verify if Hawaii is preferable to Orlando for yourself).

Example 3.2: Consider a city council election in a district that is 60% democratic voters and 40% republican voters. Even though city council is technically a nonpartisan office, people generally know the affiliations of the candidates. In this election there are three Candidates: Don and Key, both democrats, and Elle, a republican. A preference schedule for the votes looks as follows:

	342	214	298
1st choice	Elle	Don	Key
2nd choice	Don	Key	Don
3rd choice	Key	Elle	Elle

We can see a total of 342+214+298=854 voters participated in this election.

Computing percentage of first place votes:

Don:214/854=25.1%

Key:298/854 = 34.9%

Elle:342/854 = 40.0%

So in this election, the democratic voters split their vote over the two democratic candidates, allowing the republican candidate Elle to win under the plurality method with 40% of the vote. Analyzing this election closer, we see that it violates the Condorcet Criterion. Analyzing the one-to-one comparisons:

Elle vs Don: 342 prefer Elle; 512 prefer Don

Elle vs Key: 342 prefer Elle; 512 prefer Key

Don vs Key: 556 prefer Don; 298 prefer Key

So even though Don had the smallest number of first-place votes in the .election, he is the Condorcet Winner, being preferred in every one-to-one comparison with the other candidat

3.4 Borda Count

Another voting technique is called Borda Count, after Jean-Charles de Borda, who created the procedure in 1770. Candidates receive points according to their ranking in this method: 1 point is awarded for the last choice, 2 points for the next-to-last choice, and so on. Every vote has a point value, which is added up, and the winner is the contender with the highest total. (Hodge, J.K. & Klima,R.E. 2018).

Example 3.3: A group of mathematicians are getting together for a conference. The members are coming from four cities: Seattle, Tacoma, Puyallup, and Olympia. Their approximate relationship on a map is shown to the right. The votes for where to hold the conference were:

	51	25	10	14
1st choice	Seattle	Tacoma	Puyallup	Olympia
2nd choice	Tacoma	Puyallup	Tacoma	Tacoma
3rd choice	Olympia	Olympia	Olympia	Puyallup
4th choice	Puyallup	Seattle	Seattle	Seattle

In each of the 51 ballots ranking Seattle first, Puyallup will be given 1 point, Olympia 2 points, Tacoma 3 points, and Seattle 4 points. Multiplying the points per vote times the number of votes allows us to calculate points awarded:

	51	25	10	14
1st choice 4 points	Seattle 204	Tacoma 100	Puyallup 40	Olympia 56
2nd choice 3 points	Tacoma 153	Puyallup 75	Tacoma 30	Tacoma 42

3rd choice 2 points	Olympia 102	Olympia 50	Olympia 20	Puyallup 28
4th choice 1 point	Puyallup 51	Seattle 25	Seattle 10	Seattle 14

Adding up the points:

Seattle: 204+25+10+14 = 253 points

Tacoma: 153+100+30+42 = 325 points

Puyallup: 51+75+40+28 = 194 points

Olympia: 102+50+20+56 = 228 points

Under the Borda Count method, Tacoma is the winner of this election.

3.5 What's Wrong with Borda Count?

You might have already noticed one potential flaw of the Borda Count from the previous example. In that example, Seattle had a majority of first-choice votes, yet lost the election! This seems odd, and prompts our next fairness criterion:

This example under the Borda Count violates the Majority Criterion. Notice also that this automatically means that the Condorcet Criterion will also be violated, as Seattle would have been preferred by 51% of voters in any head-to-head comparison Borda count is sometimes described as a consensus-based voting system, since it can sometimes choose a more broadly acceptable option over the one with majority support. In the example above, Tacoma is probably the best compromise location. Because of this consensus behavior, Borda Count (or some variation) is commonly used in awarding sports awards. It is used to determine the Most Valuable Player in baseball, to rank teams in NCAA sports, and to award the Heisman trophy. (Hodge, J.K. & Klima, R.E. 2018)

3.6 Copeland's Method (Pairwise Comparisons)

So far none of our voting methods have satisfied the Condorcet Criterion. The Copeland Method specifically attempts to satisfy the Condorcet Criterion by looking at pairwise (one- to-one) comparisons. In this method, each pair of candidates is compared, using all preferences to determine which of the two is more preferred. The more preferred candidate is awarded 1 point. If there is a tie, each candidate is awarded ½ point. After all pairwise comparisons are made, the candidate with the most points, and hence the most pairwise wins, is declared the winner. (Robinson, E. A. Jr., & Ullman, D. H. 2010)

Example 3.4: Consider our vacation group example from the beginning of the chapter.

	1	3	3	3
1st choice	A	A	O	H
2nd choice	O	H	H	A
3rd choice	H	O	A	O

Comparing Anaheim to Orlando, the 1 voter in the first column clearly prefers Anaheim, as do the 3 voters in the second column. The 3 voters in the third column clearly prefer Orlando. The 3 voters in the last column prefer Hawaii as their first choice, but if they had to choose between Anaheim and Orlando, they'd choose Anaheim, their second choice overall. So, altogether 1+3+3=7 voters prefer Anaheim over Orlando, and 3 prefer Orlando over Anaheim. So, comparing Anaheim vs Orlando: 7 votes to 3 votes: Anaheim gets 1 point

Anaheim vs Hawaii: 4 votes to 6 votes: Hawaii gets 1 point

Hawaii vs Orlando:6 votes to 4 votes: Hawaii gets 1 point

Hawaii is the winner under Copeland's Method, having earned the most points. Notice this is process is consistent with our determination of a Condorcet Winner.

3.7 What's Wrong with Copeland's Method

As already noted, Copeland's Method does satisfy the Condorcet Criterion. It also satisfies the Majority Criterion and the Monotonicity Criterion. So is this the perfect method? Well, no.

Example 3.5: A committee is trying to award a scholarship to one of four students, Anna (A), Brian (B), Carlos (C), and Dimitry (D). The votes are shown below:

	5	5	6	4
1st choice	D	A	C	B
2nd choice	A	C	B	D
3rd choice	C	B	D	A
4th choice	B	D	A	C

Making the comparisons:

A vs B: 10 votes to 10 votes A gets ½ point, B gets ½ point

A vs C: 14 votes to 6 votes: A gets 1 point

A vs D: 5 votes to 15 votes: D gets 1 point

B vs C: 4 votes to 16 votes: C gets 1 point

B vs D: 15 votes to 5 votes: B gets 1 point

C vs D: 11 votes to 9 votes: C gets 1 point

Totaling:

A has 1 ½ points

B has 1 ½ points

C has 2 points

D has 1 point

So Carlos is awarded the scholarship. However, the committee then discovers that Dimitry was not eligible for the scholarship (he failed his last math class). Even though this seems like it shouldn't affect the outcome, the committee decides to recount the vote, removing Dimitry from consideration:

	5	5	6	4
1st choice	A	A	C	B
2nd choice	C	C	B	A
3rd choice	B	B	A	C

A vs B: 10 votes to 10 votes A gets ½ point, B gets ½ point

A vs C: 14 votes to 6 votes A gets 1 point

B vs C: 4 votes to 16 votes C gets 1 point

Totaling:

A has 1 ½ points

B has ½ point

C has 1 point

Suddenly Anna is the winner! This leads us to another fairness criterion.

The Independence of Irrelevant Alternatives (IIA) Criterion: If a non-winning choice is removed from the ballot, it should not change the winner of the election Equivalently, if choice A is preferred over choice B, introducing or removing a choice C should not make B preferred over A. In this election, the IIA Criterion was violated. This anecdote illustrating the IIA issue is attributed to Sidney Morgen besser: After finishing dinner, Sidney Morgen besser decides to order dessert. The waitress tells him he has two choices: apple pie and blueberry pie. Sidney orders the apple pie. After a few minutes the waitress returns and says that they also have cherry pie at which point Morgen besser says “In that case I’ll have the blueberry pie.” Another disadvantage of Copeland’s Method is that it is fairly easy for the election to end in a tie. There are a number of alternative methods based on satisfying the Condorcet Criterion that use more sophisticated methods for determining the winner when there is not a Condorcet Candidate

3.8 Approval Voting

Up until now, we’ve been considering voting methods that require ranking of candidates on a preference ballot. There is another method of voting that can be more appropriate in some decision making scenarios. With Approval Voting, the ballot asks you to mark all choices that you find acceptable. The results are tallied, and the option with the most approval is the winner.

Example 3.6: A group of friends is trying to decide upon a movie to watch. Three choices are provided, and each person is asked to mark with an “X” which movies they are willing to watch. The results are:

	Bob	Ann	Marv	Alice	Eve	Omar	Lupe	Dave	Tish	Jim
Titanic		X	X			X		X		X
Scream	X		X	X		X	X		X	
The Matrix	X	X	X	X	X		X			X

Totaling the results, we find Titanic received 5 approvals, Scream received 6 approvals. The Matrix received 7 approvals. In this vote, the Matrix would be the winner.

3.9 What's Wrong with Approval Voting?

Approval voting can very easily violate the Majority Criterion. Consider the voting schedule:

	80	15	5
1st choice	A	B	C
2nd choice	B	C	B
3rd choice	C	A	A

Clearly A is the majority winner. Now suppose that this election was held using Approval Voting, and every voter marked approval of their top two candidate

A would receive approval from 80 voters

B would receive approval from 100 voters

C would receive approval from 20 voters

B would be the winner. Some argue that Approval Voting tends to vote the least disliked choice, rather than the most liked candidate.

Additionally, Approval Voting is susceptible to strategic insincere voting, in which a voter does not vote their true preference to try to increase the chances of their choice winning. For example, in the movie example above, suppose Bob and Alice would much rather watch Scream. They remove The Matrix from their approval list, resulting in a different result.

	Bob	Ann	Marv	Alice	Eve	Omar	Lupe	Dave	Tish	Jim
Titanic		X	X			X		X		X
Scream	X		X	X		X	X		X	
The Matrix		X	X		X		X			X

Totaling the results, we find Titanic received 5 approvals, Scream received 6 approvals, and The Matrix received 5 approvals. By voting insincerely, Bob and Alice were able to sway the result in favor of their preference.

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پوختە

لە م کارەدا ئێمە لێکۆلینەوە لە بەکارهێنانی بیرکاری لە زانستی سیاسەتدا دەکەین. سەرەتا لێکۆلینەوە لە سیستەمی سانت لیگۆو چۆنیەتی بەکارهێنانی دەکەین. پاشان باس لە دەنگدانی سەخت دەکەین لەگەڵ
هەندێک لە جۆرەکانی. لە کۆتاییدا ئێمە باس لە تیۆری دەنگدان وجۆر وبەشەکانی دەکەین هەروها هێنانەوەی نموونە بۆ هەر جۆرێکی