A Work Project, presented as part of the requirements for the Award of a Master's degree in Economics from the Nova School of Business and Economics.

SHOULD PORTUGAL CONSIDER CHANGING ITS PRESIDENTIAL ELECTION VOTING SYSTEM?

JOSÉ CARDOSO LEITÃO BARATA DE OLIVEIRA - 50933

A Project carried out under the supervision of

Professor Paulo Côrte-Real

14-12-2022

Abstract: In this paper, we will study if Portugal should consider changing its Presidential election voting system from Plurality Runoff to Instant Runoff Voting or Approval Voting. We produce a systematic state-of-the-art review of Instant Runoff Voting and Approval Voting, from an axiomatic perspective by using a specific set of voting criteria, and by reviewing the literature on the theoretical and practical benefits and challenges. After identifying the main features of each system, we present a brief discussion on how these voting systems might apply to the Portuguese context, including a small simulation using data from the 1986 Presidential Election.

Keywords: Voting Criteria, Plurality Runoff, Instant Runoff Voting, Approval Voting,

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209)

1. Introduction

Voting is a fundamental component of a functioning Democracy, as it is the way we consolidate the enormous number of different preferences present in society into a definitive decision. Voting systems, also called election systems, are the set of rules that a community adopts to determine how voting takes place, and exactly how the final decision is chosen.

The question of "What is the best voting system?" has been studied for decades, and scholars have not reached a consensual answer, as it is clear that no system is perfect. As Levin and Nalebuff (1995) said, choosing between systems is always a "choice between flawed systems ", due to the different strengths and weaknesses that arise from their properties.

Therefore, the change from one voting system to another is a very difficult decision that cannot be done lightly. Decision-makers must analyze the systems and thoroughly discuss the theoretical benefits and challenges of each one, as well as the practical consequences of implementation.

Portugal established democracy with its 25th of April 1976 constitution, and its first presidential election was held on the 28th of June 1976. The voting system was a procedure known as Plurality Runoff (PR), which is still the voting procedure used to this day. In general, there is no conversation within the national administration, or even the media, about whether this remains the optimal Presidential voting system for Portugal, or if it should possibly change.

As such, in this paper I propose to open the conversation: "Should Portugal consider changing its Presidential voting system?". I chose to focus on two systems (in addition to the one currently in use, Plurality Runoff): Instant Runoff Voting (IRV) and Approval

Voting (AV). Both systems are able to more precisely express voters' preferences, (Richie 2004 and Brams and Herschbach 2001), than Plurality Runoff, which is a very interesting property, and actually represent a gradient of voter expressiveness, with PR being the least expressive, IRV the most, and AV the intermediate. In addition, Instant Runoff Voting is the most used form of Ranked-Choice Voting in national elections worldwide and has very similar properties to Plurality Runoff. Approval Voting is not used in any national election, but its peculiarity and dissimilarity with the other systems, as well as its simplicity, made it a candidate in this study.

There are two main contributions of this study: first, we conduct a systematic state-of-the-art review of Instant Runoff Voting and Approval Voting, in both an axiomatic perspective, by use of a specific set of voting criteria, and in a more pragmatic way, by reviewing the literature on the theoretical and practical benefits and challenges; and second, we present a brief discussion on how these voting systems apply to Portugal's context, to open the discussion of whether a change should be considered.

This document will follow the ensuing structure: in Section 2 I will first describe the different systems in analysis and exemplify how they can reach different outcomes; in Section 3, I will report and exemplify how the systems perform against a set of voting criteria selected from the literature; in Section 4 I will discuss the different advantages and disadvantages that these systems have been reported to create or enable in society; in Section 5 I will combine all the knowledge gathered about the different voting systems and contextualize it to Portugal's specific case, including a small simulation using the results of the Presidential elections of 1986; finally, in Section 6, I will present the main conclusions of the study.

2. Characterization of Plurality Runoff, Instant Runoff Voting, and Approval Voting

The current voting system used in Portugal's Presidential election chooses the candidate that receives more than 50% of the valid votes with a possibility of a runoff if that does not happen. This system is known in the literature as Plurality Runoff (PR) or the Two Round System.

Instant Runoff Voting (IRV) is a single-winner type of ranked-choice voting, which means that the voters, rather than choosing one option in the ballot, will rank the options based on their preference. The system differs from country to country, with some requiring at very least 6 ranks, while others require none. While I have decided to use the term Instant Runoff Voting, it is also called Ranked Choice Voting, Alternative Vote, Preferential Voting, or Hare's System.

The first step in determining the victor in IRF is to count every voter's first preferences and check if any candidates have more than 50% of the total votes. If it happens, that candidate is declared the victor; if not, a second round is needed. In the second round, the candidate with the lowest number of first preferences is removed, and the votes that placed that candidate first are distributed through the other candidates, based on the second preferences. This process happens repeatedly until a majority by one of the candidates is achieved. The system also possesses tie-breaking rules to ensure its proper functioning.

Approval Voting (AV) is a single-winner voting system mainly developed by Steven J. Brams and Peter C. Fishburn in 1978, in which you can choose to vote for any number of candidates; and, differently from IRV, you do not rank them. With AV the voters have $2^m - 1$ options, where m is the number of candidates in the election: different possibilities

{(1, 0,...,0), (1,1, 0,…,0),…, (1,1,…,1,0), (0,0,…,0,0)}. Approving all candidates is not counted as a possibility due to being effectively useless. Each of the candidates chosen in the ballot will receive one vote with the winner being the candidate with the greatest number of approvals (votes).

To exemplify how each of the voting procedures works and how they can lead to different outcomes, Table 1 illustrates the preference profiles of 100 voters and the results of a fictitious election. Each column represents the ranking of a specific preference profile, and the letters in parenthesis would be the approved options for AV. Also, we are assuming in PR that preferences do not change between rounds.

Table 1. Preference profiles and the result of a fictitious election.

Preferences\Votes	42	26	15	17
1st	(A)	(B)	(C)	(D)
2nd	B	(C)	(D)	C
3rd	C	(D)	B	B
4th	D	A	A	A

In Approval Voting, it is straightforward to observe that the option with the highest number of approval votes is D, which would be the winner.

In Plurality Runoff, since no candidate has more than 50% from the start, a runoff would happen between A and B, the candidates with the highest number of votes. In the runoff, the voters of options C and D would now vote for option B, which would make this option the winner.

For Instant Runoff Voting, 3 rounds would be needed to find the winner, which are represented in Table 2.

Table 2. IRV vote distribution

Options \ Votes Per Round	First	Second	Third
A	42	42	42
B	26	26	-
C	17	32	58
D	15	-	-

In the first round, since no option has more than 50% of the votes, Option D is eliminated and its votes are distributed to the second preference, option C. In the second round, once again there is still no majority, and so the option with less first rank votes has its votes distributed, 26 votes go to option C from option B (since D has already been eliminated). Finally, we can observe that option C has obtained more than 50% of first-rank votes and is therefore the winner.

This example illustrates the importance of the voting system choice, as it shows that each of the voting procedures can lead to extremely different results and winners.

3. Comparison using voting criteria

One of the ways of evaluating voting systems is the application of objective criteria, in the form of mathematical modeling techniques, which have received a considerable amount of research (Gehrlein and Lepelley, 2011). As such, a multitude of criteria have been developed to make sure that voting systems are fair and reasonable.

It is important to note again that no system is perfect, and no system will be able to fulfill all criteria (especially considering some of them are mutually exclusive). Ideally, decision-makers should decide which criteria are most important to the voters, and for the

specific case they are evaluating, and choose a voting system that fulfills the majority of those criteria. This is, of course, an extremely complex decision.

In this work, I decided to utilize the criteria which are said to be the most common, in Nurmi (2002): The Condorcet Winner (A); The Condorcet Loser (B); Majority Winner (C), Monotonicity (D), Pareto (E), Consistency (F); and Independent Irrelevant Alternatives (G). All the information about the criteria, and whether the voting systems fulfill them were obtained from Felsenthal and Nurmi (2018) and Nurmi (1987).

In the next subsections, I will first explain the different criteria, and whether PR, IRV, and AV fulfill them, and at the end, produce a small discussion about the systems. The examples shown in the next subsections presume that the voters vote sincerely based on their preferences and that in PR, runoff preferences do not change. We also presume that the number of initially approved options in preferences profiles does not change even if the preferences are altered.

3.1 Condorcet Winner Criterion (A)

The Condorcet Winner Criterion is fulfilled if the voting procedure chosen winner and the Condorcet Winner are always the same. The Condorcet Winner is a very old concept with the first instance of its proposal being by Ramon Llull in the 13th century and it states that the option that wins in pairwise majority clashes is the Condorcet Winner. It is a very interesting criterion, and its use is understandable because humanity's concept of victory and loss is often thought of it in this way.

According to Nurmi (1987) and Felsenthal and Nurmi (2018), PR, IRV, and AV all fail this criterion.

This can be observed in **Image 1** (from the appendices). The Condorcet Winner in this example would be option C and the winner in IRV and the PR would be option A. From

Image 2 (from the appendices) the Condorcet winner would be option B however in AV if the voters approved the option between the parentheses option A would be the elected one.

Therefore, since we observe that these systems can elect candidates that are not Condorcet Winners, they do not fulfill this criterion.

Table 3. Condorcet Efficiency - adapted from Merril (1984)

	Number of candidates				
Voting System	3	4	5	7	10
Approval	76.0	69.8	67.1	63.7	61.3
Instant Runoff Voting	96.2	92.7	89.1	84.8.	77.9
Runoff	96.2	90.1	83.6	73.5	61.3

Notwithstanding, the simulation of elections done by Merril (1984), Table 3, has shown that the Condorcet Efficiency, the percentage of elections where the voting system chooses the Condorcet Winner, can still be very different. We observe in Table 3 that the IRV is the system with the best overall performance and even with an increased number of candidates, keeps the efficiency at a relatively high value.

3.2 Condorcet Loser Criterion (B)

The Condorcet Loser Criterion is fulfilled if the voting procedure chosen winner and the Condorcet Loser can never match. The Condorcet Loser is the candidate that loses in pairwise majority clashes with the other options, the opposite of the Condorcet Winner.

According to Nurmi (1987) and Felsenthal and Nurmi (2018), PR and IRV satisfy this criterion while AV does not.

The PR procedure satisfies this criterion, as it will never elect the Condorcet loser. If a runoff happens the Condorcet loser will never win and if no runoff happens it implies that

a candidate obtained more than 50% votes in the first round, which once again cannot be the Condorcet Loser.

The IRV will also exclude the Condorcet Loser thus never electing one. The IRV searches for an option that the majority of voters prefer; the option that loses in pairwise contests, the Condorcet Loser, will always be eliminated.

The AV can choose the Condorcet Loser, as such, fails this criterion. In **Image 3** (from appendices) we can deduce that the Condorcet Loser would be Option A and by looking at the different preference profiles and approved options of the voters, the ones with parentheses, this voting procedure would also choose Option A.

3.3 Majority Winner (C)

The Majority Winner Criterion is fulfilled if the option that has more than 50% of first ranks is always the winner.

According to Nurmi (1987) and Felsenthal and Nurmi (2018), PR and IRV fulfill this criterion while AV does not.PR and IRV both pass because both systems have rules that inherently fulfill this criterion. The winner in both these systems must have more than 50% of the first ranks, PR goes to runoff to make sure this happens, and IRV distributes the preferences until it happens.

AV fails this criterion. In **Image 4** (from appendices), if the first preference profile voters approve the top 2 options and the 2nd and 3rd Preference Profile approve only the top option, the Approval voting winner will be B, even though A is the Majority Winner.

It should be mentioned that the axioms discussed up to this criterion have been based on the notion of majority and as such systems that seek a majority, like PR and IRV, will tend to satisfy them.

3.4 Monotonicity Criterion (D)

The Monotonicity, or non-negative responsiveness, holds if an increase in support of a winning candidate by one or more individuals, maintaining all other preferences profiles constant, never turns that candidate into a loser.

Nurmi (1987) states "The monotonicity criterion is undoubtedly one of the basic criteria of democratic group decision making. The idea of counting votes in an effort to determine group preferences assumes that the more support an alternative has, the better chances it has to be chosen as the socially most preferred alternative." The possibility of a system in which a candidate might end up losing when becoming more preferred is a very serious flaw in what is supposedly a democratic voting system.

According to Nurmi (1987) and Felsenthal and Nurmi (2018), IRV and PR both fail this criterion while AV fulfills it.

IRV and PR both fail this criterion. We observe in **Image 1** (from appendices), that using PR and IRV the winner with those preference profiles would be option A. However, if 5 of 14 voters of the 3rd Preference Profile, increase their support of option A, becoming their most preferred option, the winner will then be option C. The increase in support produced a negative effect for option A, proving that IRV and PR are not monotonic.

The Non-Monotonicity of IRV is one of the biggest flaws appointed to IRV due to its importance in a democratic choice, but initially, proponents of this system argued that despite being possible the probability of it practically happening would be very low.

However, simulations of IRV elections done by Ornstein, J.T., Norman, R.Z. (2014), and Miller, N.R. (2017) have found the opposite. The authors discovered that in a three-way

competitive election the probability of non-monotonicity is a valid concern, as it does not happen rarely.

AV does fulfill this criterion. An increase in support can only improve or maintain the same result. If there is an increase in support of one option such that the option is now approved instead of another, the result improves. If there is an increase in support but it is not enough for approval or the option is already approved, the winner will not change.

3.5 Pareto (E)

The Pareto criterion also known as the Weak Pareto Condition, states that if every voter strictly prefers option A to Option B, then option B cannot be the winner.

According to Nurmi (1987) and Felsenthal and Nurmi (2018), IRV and PR satisfy this criterion while AV does not.

In PR, if Option A is the first preference by more than 50% of the voters, Option B can never be the winner. If option A is the first preference of less than 50% of voters, if it is not chosen for the runoff, neither will option B be, because A will still have more first preferences. Finally, if both options go to a runoff, option A will win once again because it is preferred by all the voters to option B.

In IRV, option B is less preferred that Option A and cannot be the winner because it will always be eliminated before A. And, if they are the last ones, Option A will win because it is the most preferred.

In AV, with the Preference Profiles of Voters shown in **Image 5** (from appendices), we observe that all voter prefers A to B. If the first voting profile chose the top 2 options and the second voting profile chose only the top option then the winners would be A and B,

therefore proving that this system can indeed declare a winner an option that is completely dominated by another one.

3.6 Consistency (F)

The Consistency criterion states that if in various subsets of voters the same candidate or the same group of candidates win, then that candidate or group must also be the winner for the combined voter set of all those subsets.

According to Nurmi (1987), IRV and PR do not satisfy this criterion while AV does.

IRV is not consistent. In **Image 6** (from appendices) we can observe that despite x being the winner for both subsets of voters, globally the winner is y.

PR is not consistent. In **Image 7** (from appendices) we also see that, for the first subset of voters, the winners are x and y; and for the second, x is the winner; however, y wins for the global set of voters.

AV is consistent, because if in both subsets the option with the most approvals is the same then when you combine the subsets that option will still be the one with the highest approval.

3.7 Independence of irrelevant alternatives (G)

Independence of irrelevant alternatives (IIA) states that if candidate A is the winner in an election over candidate B and a new candidate C is proposed, then the final winner must not become option B. The case when this criterion fails is called also the spoiler effect since the introduction of Candidate C spoiled the win for Candidate A.

According to Felsenthal and Nurmi (2018), IRV and PR both fail a criterion named Subset Choice Condition while AV is fulfilled, and in this definition of Independence of Irrelevant Alternatives both criteria coincide and therefore the same conclusions apply.

IRV and PR both fail this Criterion. We observe in **Table 7** (from appendices) that the addition of option C to those preference profiles created a situation in which option B, which had initially more than 50% of the votes and as such won in both Voting Procedures, stops being the winner in favor of option A. Option C spoiled the Victory for Option B.

AV fulfills this criterion because the introduction of option C does not change the approval votes for A and B. After all, in this system, you can vote for how many options you desire.

3.8 Discussion

Table 3 presents the summary of the fulfillment of criteria by the three voting systems, Plurality Runoff, Instant Runoff Voting, and Approval Voting.

Table 4. Overall criteria fulfillment

	A	B	C	D	E	F	G
Plurality Runoff	-	**X**	**X**	-	**X**	-	-
Instant Runoff Voting	-	**X**	**X**	-	**X**	-	-
Approval Voting	-	-	-	**X**	-	**X**	**X**

To conclude, IRV fulfills the same set of criteria as PR and even performs better in choosing the Condorcet Winner. If one were to pick just objectively through the criteria, this might be reason enough to choose IRV over PR.

On the other hand, AV fulfills a completely different set of criteria, including some interesting ones like the Monotonicity (D) and the IIA (G) which eliminates the spoiler

effect. A change to AV from PR would mean that the logic behind the desired criteria had changed drastically from a majority-based logic to a monotonicity-based logic

Voting criteria are a useful and interesting way to characterize and evaluate voting systems. However, it is a game of equilibrium, and one must decide which criteria are most important for a specific situation and for the voters, to make a sound and grounded decision.

4. Benefits and challenges of IRV and AV over PR

This section will explore the literature about the benefits and challenges of IRV and AV over PR: both the theoretical benefits/challenges that have been argued, as well as actual data from instances of real-world implementation. A significant portion of the benefits/challenges that scholars have proposed are similar in both IRV and AV. However, due to the significantly higher implementation of IRV, most of the literature regarding practical applications and results is focused on this system.

Supporters of IRV and AV believe that these systems address some challenges and shortcomings of the traditional runoff system. Firstly, obviously, these types of systems allow voters to express their preferences more precisely, (Richie 2004 and Brams and Herschbach 2001), since they are not constrained by having to vote for one single candidate. This is true for both systems, although IRV allows for an extra layer of precision, through the ranking of the options.

The cost of these systems is also lower, since only one election is required to choose the winner, which saves money on the election procedures and campaigning, a benefit for both the taxpayers and the candidates. A related benefit was argued by Richie (2003) who claims that runoff elections increase opportunities for campaign donors to influence candidates, which can lead to dishonesty and corruption.

A commonly mentioned advantage of both IRV and AV is their ability to combat the spoiler problem (Richie 2004, Langan 2005). As mentioned in the previous section, this effect is correlated with the criterium of **Independence of irrelevant alternatives**. While IRV fails this criterium (as does PR), and as such, the winner can be influenced by spoiler candidates, supporters affirm that this system partially solves cases where the spoiler candidate has minor support. Although this might be true, IRV still suffers from the spoiler effect. On the other hand, if voters are sincere, AV does not suffer from this effect, as it fulfills the IIA criterium.

The reduction of the spoiler effect in IRV and AV leads to a decrease in the incentive for strategic, or tactical, voting: voting insincerely to prevent the win of an undesirable candidate. Although it is impossible to fully prevent voters from performing strategic voting, these systems make it harder and more complex than under PR. This is an advantage of these systems because as Chamberlin et al. (1984) states, if manipulating the voting outcomes is easy, candidates could find ways to organize voter behavior to achieve a specific goal, and the election cannot be trusted to be a true reflection of the people's preferences.

In PR systems strategic voting is easier, as voters only need to estimate the first preferences of other voters. In IRV, strategic voting takes advantage of its non-monotonicity property, although its properties and characteristics make it so that any strategy to manipulate the results must be complex as one needs to estimate both order of finish and the magnitudes of the vote totals (Chamberlin et al. 1984). Similarly, in AV strategies for manipulations are possible, but difficult to use effectively (Carter 1990).

Supporters of both IRV and AV assert that these systems increase civility between candidates and reduce negative campaigning (Donovan 2016, Brams and Herschbach 2001). In PR, a candidate does not have much reason not to attack other candidates, while

in IRV and AV there is an incentive to keep positive, in order to attract (or not completely repel) voters who are primarily interested in other candidates, as they can also support them. In Donovan (2016), the author tested this hypothesis by surveying voters from campaigns held under plurality and preferential voting in the US in 2013 and found that voters in preferential voting cities perceived campaigns as less negative, in which the candidates had fewer criticisms of each other, and reported a higher level of satisfaction with the conduct of campaigns. Kropf (2021) utilized text analysis software to examine candidate tweets and newspaper articles in Ranked Choice Voting (RCV) and plurality cities and found that the newspaper articles in the RCV cities showed more positive content, and that candidate tweets showed that they seemed to be more likely to engage with each other.

Advocates of IRV and AV assert that these systems could lead to higher voter turnout and participation in politics, due to the possibility of increased support for minority candidates, being able to fully express their preferences, reduction in the spoiler effect, and less negative campaigning (Richie 2004, Langan 2005, Brams and Fishburn 1983). However, in practice, this claim is not consensual, and differs highly from situation to situation, and according to the characteristics in study (including race and age). McDaniel (2016) found that the introduction of IRV in San Francisco's mayoral elections was associated with a decline in turnout in Black and White voters, while Asian and Latino participation increased, probably due to viable Asian and Latino candidates on the ballot. Juelich and Coll (2021) studied data from seven Ranked Choice Voting Cities, and fourteen plurality cities and found no statistical differences between them for the general public. However, they reported that a higher turnout in younger voters was more likely in RCV cities.

A noteworthy benefit of IRV, which is not shared by AV, is the increased likelihood that the winning candidate will have majority support, since it fulfills the Majority Winner Criterion, as mentioned in the previous section. However, it is important to note that IRV only ensures that the winner will have the majority of all valid votes, not all votes. Burnett and Kogan (2015) assessed four ranked-choice elections and found that, in all cases, the winner receives less than a majority of the total votes cast. This is mostly due to a problem referred to as "Ballot exhaustion". Ballot exhaustion occurs when all the candidates marked on it are no longer in the contest, after being eliminated during the counting process. This problem may be exacerbated in situations where the number of candidates each voter can rank is limited. Tomlinson et al. (2022) analyzed data from 168 real-world elections and found that changes in ballot length frequently produce different winners.

One of the biggest criticisms of IRV is that it can be too complicated for voters to understand (Langan 2005) and that asking people to rank multiple candidates, as opposed to picking one, makes the choice more difficult. Burnett and Kogan (2015) affirm that research should be done to examine whether the increased cognitive costs of ranking candidates, have a negative impact on underprivileged and minority voters. In comparison, AV is much easier to explain and understand.

5. The case of Portugal's Presidential Election

Portugal has been in a Democracy since 1976 and has elected its President using Plurality Runoff ever since then. The Portuguese President is mainly a representative role, although the Presidency also includes the power to sign and veto laws, appoint the Prime Minister, and dissolve the Parliament.

System distrust, low political engagement and interest, and the existence of candidates who are expected to win without question, have made turnout levels decrease to an all-

time low of 60.8% in the presidential election of 2021[1], with younger voters being the ones with the lowest turnout. This is not only a Portugal problem, as levels of participation in elections have decreased in multiple European democracies (Cancela and Vicente 2019).

Deciding whether Portugal should fully switch from PR to IRV or AV is an extremely challenging task, one that should not be done lightly, but be thoroughly thought out and studied. Notwithstanding, I do believe Portugal should consider this possibility, and here, I present my recommendations based on the literature review.

Starting with AV, this system fulfills completely different criteria than PR as we saw previously, with the monotonicity and IIA being very notable ones. If Portugal decided that fulfillment of these criteria was crucial, AV would be an option to consider. Notwithstanding, this system is still relatively recent, from the 1970s, and it has not had enough practical applications, especially in national elections; and the complete study of its practical advantages and disadvantages is incomplete. One significant advantage of this system over IRV is that it is much simpler to explain, and more closely resembles PR. In the case of a change, this could be a defining factor, since Portugal has an aged population, 23% of the population in 2021 is above 65 years[2], and a low average number of schooling years, 9.6 years in 2021[3], if we are to assume that these sections of the population usually struggle with change and more complex systems.

As for IRV, one of its strongest points is that it is able to capture voter preferences in a more complete way, which is an appealing property. In reality, the main downside of this

[1] https://www.pordata.pt/portugal/taxa+de+abstencao+nas+eleicoes+para+a+presidencia+da+republica+total++residentes+em+portugal+e+residentes+no+estrangeiro-2207, visited on 08/12/2022

[2] https://data.worldbank.org/indicator/SP.POP.65UP.TO.ZS?end=2021&locations=PT&start=1960&view=chart, visited on 12/12/2022

[3] https://hdr.undp.org/data-center/human-development-index#/indicies/HDI, visited on 12/12/2022

system (when comparing to PR) is that people could be confused by its rules. Of course, this is a possibility, but with enough information, it is highly probable that people will comprehend it correctly. Although reports on the effect of IRV on turnout are conflicting, Portugal has a serious problem with election turnout, and should try to come up with solutions. It is possible IRV could increase turnout participation, due to voters being more engaged, and could be beneficial in calling young voters to the polls, as younger voters are usually bigger fans of reforms.

Something to consider is that Portugal has not had a runoff since 1986 which means that every candidate since that date has won with more than 50% of the votes. This shows us that if IRV had been used, the winners would not have changed, presuming sincere preferences. The same conclusion may not hold for AV. It also shows us that the cost-saving argument for IRV has not been relevant in Portugal, although of course this could change. Furthermore, one must be aware that a significant amount of money would have to be spent on materials to educate and explain the new systems to the population.

Finally, it is worth pointing out that to change the election system in Portugal, a constitutional change would be needed, which would require 66% of the MP of the Assembleia da República to approve it, and usually can only be done 5 years after the last change, unless a more significant majority of members agree. This would be, undoubtedly, a big challenge in its implementation.

Even though neither Instant Runoff Voting nor Approval Voting are perfect systems (again, all systems have different flaws), they are extremely viable options that deserve more research in the context of Portugal. It is true that there is a lack of outcry for change and no heavy criticism of the currently used system however, I believe that this is more due to unawareness, rather than contentedness with the current system. The lack of evidence concerning Approval Voting applications might lead to a recommendation of

Instant Runoff Voting, due to its vast implementations and reported benefits, and the similarities it shares with PR, if the focus on majority-based axioms is to be maintained.

5.1 Simulation

A simulation of both IRV and AV was made for the 1986 Presidential election, the only one in Portugal's history where a runoff happened. The candidates were Diogo Freitas do Amaral (supported by CDS-PP and PSD), Mário Soares (supported by PS), Francisco Salgado Zenha (supported by PCP and PRD), and Maria de Lourdes Pintasilgo (supported by UDP). Freitas do Amaral was the only candidate supported by right-leaning parties while the 3 others were candidates supported by left-leaning parties.

Freitas do Amaral easily won in the first round, while not having a majority. This triggered a runoff between him and Mário Soares, which Mário Soares incredibly won due to the supporters of Salgado Zenha and Maria de Lourdes Pintasilgo voting for him in the runoff due to the more similar ideologies (all 3 were supported by left-leaning parties).

Table 5 represents the results of this election, as well as the preference profiles and approved options in AV, represented in parenthesis. It is important to note that no hard data exists about the preference profiles of voters, as well as the approved options. As such, we had to make assumptions about the preference profiles; their votes were extracted from the actual votes the first candidate received.

Table 5. Results and preference profiles of the 1986 Presidential election - simulation

	2,629,597	1,443,683	1,185,867	418,961
1	(Freitas do Amaral)	(Mário Soares)	(Salgado Zenha)	(ML Pintasilgo)
2	Mário Soares	Salgado Zenha	(Mário Soares)	(Salgado Zenha)
3	Salgado Zenha	ML Pintasilgo	(ML Pintasilgo)	(Mário Soares)

Observing Table 5, we can see that for Approval Voting, the winner would have been Mário Soares with Freitas do Amaral having 2nd place. This exemplifies this system's tendency to choose not-so-polarizing options: Mário Soares won because while he wasn't approved in the biggest preference profile, the other 3 preferences profile he was approved for had enough votes to win against Freitas do Amaral who was only approved by one.

The condition that guaranteed the victory for Mário Soares by approval was that Salgado Zenha's supporters approved him. If that had not happened Freitas do Amaral would have won by a very large margin.

As for Instant Runoff Voting, Table 6 presents its vote distributions. With the preference profiles from Table 5, it is interesting to note that the IRV winner would have been Salgado Zenha, mainly because the Maria de Lourdes Pintasilgo supporters preferred him over Mário Soares, which made him have more first preference votes and avoid getting eliminated in the second round. Mário Soares would have won using IRV if Maria de Lourdes Pintasilgo supporters had preferred him to Salgado Zenha.

Even If we assumed that Freitas do Amaral's, and Salgado Zenha's supporters had different preference profiles for the 2nd and 3rd preference the result would not have

changed in any way. Because they were the two candidates to reach the last round and therefore their votes were not distributed to their 2nd and 3rd preference.

In the case of Mario Soares's supporters if we keep the assumption that voter who prefer candidates supported by left-leaning parties will always prefer other candidates supported by left-leaning parties over Freitas do Amaral then a change in the 2nd and 3rd preference profile of Mário Soares will not change the Salgado Zenha's win.

This simulation was created to show with a real-life case how much impact a voting procedure can have in the running of a democracy. If Portugal had implemented IRV at the time, we might have had Salgado Zenha as a President, while if AV had been implemented, Mário Soares would have won with no historically famous runoff happening, but he would still have needed at the very least the approval of Salgado Zenha's supporters.

Table 6. IRV's vote distribution for the 1986 Presidential election – simulation

Options\Votes Per Round	First	Second	Third
Diogo Freitas do Amaral	2,629,597	2,629,597	2,629,597
Mário Soares	1,443,683	1,443,683	-
Francisco Salgado Zenha	1,185,867	1,604,828	3,048,511
Maria de Lourdes Pintasilgo	418,961	-	-

6. Conclusion

Voting systems are an incredibly important part of Democracy and can greatly influence the outcome of elections. Portugal implemented its Democracy in 1976 and has used the Plurality Runoff system ever since for the Presidential election. In this work, we propose

starting a discussion about whether Portugal should consider a change in its voting system, particularly to Instant Runoff Voting, or Approval Voting.

In order to achieve the goal of this dissertation, we perform a systematic review of the state of the art regarding Instant Runoff Voting and Approval Voting, including an axiomatic analysis with a focus on a specific set of voting criteria, and also by reviewing the literature on their theoretical and practical benefits and challenges in comparison with Plurality Runoff. Following this review, we start a discussion on how these voting systems might apply to Portugal and how they would work in this specific context.

As previously mentioned, the decision to change voting systems is an extremely challenging one. Bearing in mind that there are no perfect systems, there must be compromises. It is clear that IR satisfies similar axioms to PR (based on notions of respecting majority opinions), whereas AV satisfies a different set of axioms (based on notions of monotonicity and independence of irrelevant alternatives).

In addition, even if there is extensive research on these voting systems, one will never fully comprehend the effects of the change until it is implemented because the differences in the population's attitude and response can be so varied. Also, although AV is an interesting system, its practical applications are still scarce and although some of the implications can be safely deduced from the applications of IRV, due to some of their similarities, this might not provide enough assurance for the elected officials, or to the voters themselves. It might therefore be more prudent at this point to opt for IRV since it is closer to the current system and might therefore limit the learning costs, even though that would still require a change in the Constitution.

All in all, even though the main question of this work, "Should Portugal consider changing its Presidential election voting system?", was supposed to be a way to introduce

the topic and open the conversation, more than to provide a definite answer, we suggest that Portugal should indeed consider different types of voting systems, and expose voters to this debate, exploring the advantages and disadvantages of each system and allowing them to reach a collective decision on the most appropriate system.

7. References

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8. Appendices

Image 1- Example of Preference Profiles to showcase failure of Condorcet Winner Criterion and lack of Monotonicity in IRV and PR

(retrieved from Felsenthal and Nurmi (2018))

No. of voters	Preference orderings
7	$a \succ b \succ c$
9	$a \succ c \succ b$
14	$b \succ c \succ a$
13	$c \succ a \succ b$

Image 2 – Example of Preference Profiles to showcase the failure of Condorcet Winner criterion in AV

(retrieved from Felsenthal and Nurmi (2018))

No. of voters	Preference orderings
18	$(a) \succ b \succ c$
6	$(b \succ c) \succ a$
8	$(b \succ a) \succ c$
2	$(c \succ a) \succ b$
15	$(c) \succ b \succ a$

Image 3 – Example of Preference Profiles to showcase failure of Condorcet Loser criterion in AV

(retrieved from Felsenthal and Nurmi (2018))

No. of voters	Preference orderings
6	$(a) \succ b \succ c$
4	$(b) \succ c \succ a$
1	$(c \succ a) \succ b$
4	$(c) \succ b \succ a$

Image 4 - Example of Preference Profiles to showcase the failure of the Majority Winner Criterion in AV

(retrieved from Nurmi (1987))

Example 5.14. $|N| = 5$, $X = \{a,b,c\}$

3 voters	1 voter	1 voter
a	b	c
b	c	b
c	a	a

Image 5 – Example of Preference Profiles to showcase the failure of the Pareto Criterion in AV

(retrieved from Felsenthal and Nurmi (2018))

No. of voters	Preference orderings
2	$a \succ b \succ c$
1	$c \succ a \succ b$

Image 6 – Example of Preference Profiles to showcase the failure of the Consistency criterion in IRV

(retrieved from Nurmi, Hannu (1987))

Example 8.3. $X = \{x,y,z,w\}$
$N_1 = \{1, \ldots, 12\}$
$N_2 = \{13, \ldots, 21\}$

N_1's preference profile R:

voters 1-4	voters 5-7	voters 8-12
x	y	z
y	x	y
w	w	w
z	z	x

N_2's preference profile R':

voters 13-15	voters 16-20	voter 21
y	x	w
w	w	y
z	z	z
x	y	x

Image 7 – Example of Preference Profiles to Showcase the failure of the Consistency criterion in PR

(retrieved from Nurmi (1987))

Example 8.2. $X = \{x,y,z\}$
$N_1 = \{1, \ldots, 6\}$
$N_2 = \{7, \ldots, 11\}$

N_1's preference profile R:

voter 1	voters 2 and 3	voters 4-6
z	x	y
x	y	z
y	z	x

N_2's preference profile R':

voter 7	voters 8 and 9	voters 10 and 11
y	z	x
x	y	y
z	x	z

Table 7 – Example of Preference Profiles to showcase failure of IIA in PR and IRV

Preferences\Votes	3	2	3
1st	A	B	C
2nd	B	A	B
3rd	C	C	A