

# Package: SafeVote (via r-universe)

September 11, 2024

**Type** Package

**Title** Election Vote Counting with Safety Features

**Version** 1.0.0

**Date** 2023-01-18

**Description** Fork of 'vote\_2.3-2', Raftery et al. (2021)  
<[DOI:10.32614/RJ-2021-086](https://doi.org/10.32614/RJ-2021-086)>, with additional support for  
stochastic experimentation.

**Depends** R (>= 3.5.0)

**Imports** formattable, knitr, fields, grDevices, graphics, utils,  
ggplot2, data.table, stringr, forcats, dplyr

**Encoding** UTF-8

**License** GPL (>= 2)

**Language** EN-GB

**NeedsCompilation** no

**RoxygenNote** 7.2.3

**Roxygen** list(markdown = TRUE)

**LazyData** true

**URL** <https://cthombor.github.io/SafeVote/>

**Suggests** testthat (>= 3.0.0), vote, STV

**Config/testthat/edition** 3

**Repository** <https://cthombor.r-universe.dev>

**RemoteUrl** <https://github.com/cthombor/safevote>

**RemoteRef** HEAD

**RemoteSha** fab14efa569ecc239b5493153344d7321cc5ee19

## Contents

.print.summary.SafeVote	3
.summary.SafeVote	4
a3_hil	5
a4_hil	5
a53_hil	6
approval	7
as.SafeRankExpt	7
assemble.args.for.check.score	8
assemble.args.for.check.stv	8
backwards.tiebreak	9
check.nseats	9
check.ranking	10
check.votes	10
check.votes.approval	11
check.votes.condorcet	11
check.votes.plurality	12
check.votes.score	12
check.votes.stv	13
check.votes.tworound.runoff	13
combineRankings	14
completeRankingTable	14
condorcet	15
correct.ranking	16
dublin_west	17
election.info	17
extractMargins	18
extractRank	18
food_election	19
forwards.tiebreak	19
image.SafeVote.condorcet	20
image.SafeVote.stv	20
ims_approval	21
ims_election	21
ims_plurality	22
ims_score	22
ims_stv	23
invalid.votes	23
is.SafeRankExpt	24
is.valid.vote	24
loserMargin	25
new_SafeRankExpt	25
ordered.preferences	26
ordered.tiebreak	27
plot.SafeRankExpt	27
plot.SafeVote.stv	29
plurality	29

<code>prepare.votes</code>	30
<code>print.summary.SafeRankExpt</code>	30
<code>print.summary.SafeVote.approval</code>	31
<code>print.summary.SafeVote.condorcet</code>	31
<code>print.summary.SafeVote.plurality</code>	32
<code>print.summary.SafeVote.score</code>	32
<code>print.summary.SafeVote.stv</code>	33
<code>rbind.SafeRankExpt</code>	33
<code>readHil</code>	34
<code>remove.candidate</code>	34
<code>score</code>	35
<code>solveTiebreak</code>	35
<code>stv</code>	36
<code>summary.SafeRankExpt</code>	39
<code>summary.SafeVote.approval</code>	39
<code>summary.SafeVote.condorcet</code>	40
<code>summary.SafeVote.plurality</code>	40
<code>summary.SafeVote.score</code>	41
<code>summary.SafeVote.stv</code>	41
<code>sumOfVotes</code>	42
<code>testAdditions</code>	42
<code>testDeletions</code>	43
<code>testFraction</code>	45
<code>translate.ties</code>	46
<code>uk_labour_2010</code>	46
<code>view</code>	47
<code>view.SafeVote.approval</code>	47
<code>view.SafeVote.condorcet</code>	48
<code>view.SafeVote.plurality</code>	48
<code>view.SafeVote.score</code>	49
<code>view.SafeVote.stv</code>	49
<code>winnerMargin</code>	50
<code>yale_ballots</code>	50

**Index** **51**

---

`.print.summary.SafeVote`  
*.print method for summary object*

---

**Description**

`.print` method for summary object

**Usage**

`.print.summary.SafeVote(x, ...)`

**Arguments**

`x, ...`            undocumented

**Value**

undocumented

---

`.summary.SafeVote`        *summarises vote-totals for subsequent printing*

---

**Description**

summarises vote-totals for subsequent printing

**Usage**

```
.summary.SafeVote(object, larger.wins = TRUE, reorder = TRUE)
```

**Arguments**

`object`            vector of total votes per candidate

`larger.wins`        TRUE if candidates are "voted in" rather than voted-out

`reorder`            TRUE if output data.frame columns should be in rank-order

**Value**

a data.frame with three columns and `nc+1` rows, where `nc` is the number of candidates. The first column contains candidate names and a final entry named "Sum". The second column contains vote totals. The third column is a vector of chars which indicate whether the candidate has been elected. The data.frame has four named attributes carrying election parameters.

TODO: refactor into a modern dialect of R, perhaps by defining a constructor for an `election_info` S3 object with a `summary` method and a `print` method

---

a3\_hil

*Tideman a3\_hil*

---

**Description**

This data is one of 87 sets of ballots from the Tideman data collection, as curated by The Center for Range Voting.

This set of ballots was collected in 1987 by Nicolaus Tideman, with support from NSF grant SES86-18328. "The data are records of ballots from elections of British organizations (mostly trade unions using PR-STV or IRV voting) in which the voters ranked the candidates. The data were gathered under a stipulation that the organizations involved would remain anonymous."

The ballots were encoded in David Hill's format, and have been converted to the preference-vector format of this package. The archival file A4.HIL at [rangevoting.org](http://rangevoting.org) contains eight blank ballot papers (1, 616, 619, 620, 685, 686, 687, 688) which we have retained. This set may be counted by `stv(a3_hil, nseats=attr(a3_hil, "nseats"))`.

**Usage**

```
data(a3_hil)
```

**Format**

A data frame with attribute "nseats" = 7, consisting of 989 observations and 15 candidates.

---

a4\_hil

*Tideman a4\_hil*

---

**Description**

This data is one of 87 sets of ballots from the Tideman data collection, as curated by The Center for Range Voting. The ballots were archived in David Hill's format, and have been converted to the preference-vector format of this package.

This set of ballots was collected in 1987 by Nicolaus Tideman, with support from NSF grant SES86-18328. "The data are records of ballots from elections of British organizations (mostly trade unions using PR-STV or IRV voting) in which the voters ranked the candidates. The data were gathered under a stipulation that the organizations involved would remain anonymous."

**Usage**

```
data(a4_hil)
```

**Format**

A data frame with attribute "nseats" = 2, consisting of 43 observations and 14 candidates.

---

a53\_hil

*Tideman a53\_hil*

---

### Description

This data is one of 87 sets of ballots from the Tideman data collection, as curated by The Center for Range Voting.

This set of ballots was collected in 1988 by Nicolaus Tideman, with support from NSF grant SES86-18328. "The data are records of ballots from elections of British organizations (mostly trade unions using PR-STV or IRV voting) in which the voters ranked the candidates. The data were gathered under a stipulation that the organizations involved would remain anonymous."

The ballots were encoded in David Hill's format, and have been converted to the preference-vector format of this package. Candidates have been renamed to letters of the alphabet, for ease of comparison with Table 3 of Tideman (2000). Note: the DOI for this article is 10.1023/A:1005082925477, with an embedded colon which isn't handled by the usual DOI-to-URL conversions.

As noted in this table, it is a very close race between candidates D, F, and B in the final rounds of a Meek count of a53\_hil.

Tideman's implementation of Meek's method excludes B (on 59.02 votes), then elects D in the final round (on 88.33 votes) with a margin of 0.95 votes ahead of F (on 87.38 votes).

In v1.0, `stv(a53.hil, quota.hare=TRUE)` excludes F (on 56.418 votes), then elects D in the final round (on 79.705 votes) with a winning margin of 0.747 votes ahead of B (on 78.958 votes). The result of the election is the same but the vote counts and winning margins differ significantly; so we conclude that `stv(quota.hare=TRUE)` in SafeVote v1.0 is *not* a reliable proxy for Tideman's implementation of Meek's algorithm.

Future researchers may wish to adjust the quota calculation of `vote.stv()` so that it is no longer biased upward by a "fuzz" of 0.001, to see if this change significantly reduces the discrepancies with Tideman's implementation of Meek.

It would be unreasonable to expect an exact replication of results from two different implementations of an STV method. We leave it to future researchers to develop a formal specification, so that it would be possible to verify the correctness of an implementation. We also leave it to future researchers to develop a set of test cases with appropriate levels of tolerance for the vagaries of floating-point roundoff in optimised (or even unoptimised!) compilations of the same code on different computing systems. We suggest that a53\_hil be included in any such test set.

We note in passing that B.A. Wichmann, in "Checking two STV programs", Voting Matters 11, 2000, discussed the cross-validation exercise he conducted between the ERBS implementation of its voting rules and the Church of England's implementation of its voting rules. In both cases, he discovered ambiguities in the specification as well as defects in the implementation.

### Usage

```
data(a53_hil)
```

### Format

A data frame with attribute "nseats" = 4, consisting of 460 observations and 10 candidates.

---

approval	<i>Count votes using the approval method</i>
----------	----------------------------------------------

---

**Description**

See <https://arxiv.org/abs/2102.05801>

**Usage**

```
approval(votes, nseats = 1, fsep = "\t", quiet = FALSE, ...)
```

**Arguments**

votes, nseats, fsep, quiet, ...  
undocumented

**Value**

undocumented

---

as.SafeRankExpt	<i>as.SafeRankExpt()</i>
-----------------	--------------------------

---

**Description**

as.SafeRankExpt()

**Usage**

```
as.SafeRankExpt(df)
```

**Arguments**

df                    data.frame object

**Value**

a SafeRankExpt object, or stop() if df fails some sanity checks

---

assemble.args.for.check.score  
*undocumented internal method*

---

**Description**

undocumented internal method

**Usage**

assemble.args.for.check.score(x, max.score = NULL, ...)

**Arguments**

x, max.score, ...  
undocumented

**Value**

undocumented

---

assemble.args.for.check.stv  
*undocumented internal method*

---

**Description**

undocumented internal method

**Usage**

assemble.args.for.check.stv(x, equal.ranking = FALSE, ...)

**Arguments**

x, equal.ranking, ...  
undocumented

**Value**

undocumented



---

backwards.tiebreak      *Undocumented internal method*

---

**Description**

Undocumented internal method

**Usage**

```
backwards.tiebreak(prefs, icans, elim = TRUE)
```

**Arguments**

prefs	undocumented
icans	undocumented
elim	undocumented

---

check.nseats      *parameter-checking method for nseats (internal)*

---

**Description**

parameter-checking method for nseats (internal)

**Usage**

```
check.nseats(
  nseats = NULL,
  ncandidates,
  default = 1,
  mcan = NULL,
  complete.ranking = FALSE
)
```

**Arguments**

nseats	initially-specified number of seats to be filled in an election
ncandidates	the number of candidates standing for election
default	the return value of this function when nseats=NULL
mcan	a deprecated name for nseats
complete.ranking	when TRUE, the return value is in 1..ncandidates When FALSE, the return value is in 1..ncandidates-1 (for backwards compatibility)

**Value**

a valid non-NULL value for the number of seats to be filled

---

check.ranking	<i>check the validity of a partial ranking</i>
---------------	------------------------------------------------

---

**Description**

check the validity of a partial ranking

**Usage**

```
check.ranking(r)
```

**Arguments**

r                    a numeric vector

**Value**

a partial ranking of the elements of r, using `ties.method="min"`

---

check.votes	<i>undocumented internal method</i>
-------------	-------------------------------------

---

**Description**

undocumented internal method

**Usage**

```
check.votes(x, ..., quiet = FALSE)
```

**Arguments**

x, quiet, ...        undocumented

**Value**

undocumented

---

`check.votes.approval` *undocumented internal method*

---

**Description**

undocumented internal method

**Usage**

`check.votes.approval(record, ...)`

**Arguments**

`record, ...`      undocumented

**Value**

undocumented

---

`check.votes.condorcet` *undocumented internal method*

---

**Description**

undocumented internal method

**Usage**

`check.votes.condorcet(record, ...)`

**Arguments**

`record, ...`      undocumented

**Value**

undocumented

---

check.votes.plurality *undocumented internal method*

---

### Description

undocumented internal method

### Usage

check.votes.plurality(record, ...)

### Arguments

record, ...      undocumented

### Value

undocumented

---

check.votes.score      *undocumented internal method*

---

### Description

undocumented internal method

### Usage

check.votes.score(record, max.score, ...)

### Arguments

record, max.score, ...  
                                          undocumented

### Value

undocumented

---

check.votes.stv      *undocumented internal method*

---

**Description**

undocumented internal method

**Usage**

check.votes.stv(record, equal.ranking = FALSE, ...)

**Arguments**

record, equal.ranking, ...  
undocumented

**Value**

undocumented

---

check.votes.tworound.runoff  
*undocumented internal method*

---

**Description**

undocumented internal method

**Usage**

check.votes.tworound.runoff(record, ...)

**Arguments**

record, ...      undocumented

**Value**

undocumented

---

combineRankings	<i>the least upper bound on a pair of rankings</i>
-----------------	----------------------------------------------------

---

**Description**

the least upper bound on a pair of rankings

**Usage**

```
combineRankings(r1, r2)
```

**Arguments**

r1, r2            numeric vectors

**Value**

the most complete (but possibly partial) ranking which is consistent with both r1 and r2. Uses ties.method="min"

**Examples**

```
combineRankings( c(3,1,2), c(2,1,3) )
```

---

completeRankingTable	<i>internal method to analyse the partial results of an stv() ballot count, to discover a complete ranking of all candidates. The ranking may depend on the value of nseats, because this affects how votes are transferred.</i>
----------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

---

**Description**

internal method to analyse the partial results of an stv() ballot count, to discover a complete ranking of all candidates. The ranking may depend on the value of nseats, because this affects how votes are transferred.

**Usage**

```
completeRankingTable(object, quiet, verbose)
```

**Arguments**

object            partial results  
 quiet            TRUE to suppress console output  
 verbose          TRUE to produce diagnostic output

**Value**

data.frame with columns TotalRank, Margin, Candidate, Elected, SafeRank

---

condorcet	<i>Count votes using the Condorcet voting method.</i>
-----------	-------------------------------------------------------

---

**Description**

The Condorcet method elects the candidate who wins a majority of the ranked vote in every head to head election against each of the other candidates. A Condorcet winner is a candidate who beats all other candidates in pairwise comparisons. Analogously, a Condorcet loser is a candidate who loses against all other candidates. Neither Condorcet winner nor loser might exist.

**Usage**

```
condorcet(
  votes,
  runoff = FALSE,
  nseats = 1,
  safety = 1,
  fsep = "\t",
  quiet = FALSE,
  ...
)
```

**Arguments**

votes	A <a href="#">matrix</a> or <a href="#">data.frame</a> containing the votes. Rows correspond to the votes, columns correspond to the candidates. If votes is a character string, it is interpreted as a file name from which the votes are to be read. See <a href="#">below</a> .
runoff	Logical. If <a href="#">TRUE</a> and no Condorcet winner exists, the election goes into a runoff, see <a href="#">below</a> .
nseats	the number of seats to be filled in this election
safety	Parameter for a clustering heuristic on a total ranking of the candidates. Conjecture: the default of 1.0 ensures a separation of one s.d. between clusters, when votes are i.u.d. permutations on the candidates.
fsep	If votes is a file name, this argument gives the column separator in the file.
quiet	If <a href="#">TRUE</a> no output is printed.
...	Undocumented intent (preserved from legacy code)

## Details

If the runoff argument is set to TRUE and no Condorcet winner exists, two or more candidates with the most pairwise wins are selected and the method is applied to such subset. If more than two candidates are in such run-off, the selection is performed repeatedly, until either a winner is selected or no more selection is possible.

The input data votes is structured the same way as for the `stv` method: Row  $i$  contains the preferences of voter  $i$  numbered 1; 2; : : : ;  $r$ ; 0; 0; 0; 0, in some order, while equal preferences are allowed. The columns correspond to the candidates. The `dimnames` of the columns are the names of the candidates; if these are not supplied then the candidates are lettered A, B, C, . . . . If the dataset contains missing values (NA), they are replaced by zeros.

If a ballot has equally-ranked candidates, its rankings are tested for validity: for each preference  $i$  which does not have any duplicate, there are exactly  $i - 1$  preferences  $j$  with  $0 < j < i$ . If any ballot  $x$  fails this validity test, it is automatically corrected (aka "converted") into a valid ballot using `x <- rank(x, ties.method = "min")`, and a warning is issued.

This method also computes a Borda ranking of all candidates, using tournament-style scoring. This ranking is "fuzzed" into a `safeRank`, with approximately 1 s.d. of fuzz when `safety=1.0` and voter preferences are i.u.d. A warning is thrown if a `safeRank` violates the (extended) Condorcet principle: that Candidate  $i$  is more highly ranked than Candidate  $j$  only if a majority of voters agree with this.

## Value

Object of class `SafeVote.condorcet`

## Examples

```
{
data(food_election)
condorcet(food_election)
}
```

---

correct.ranking	<i>Amend ballots with equal or incomplete preferences</i>
-----------------	-----------------------------------------------------------

---

## Description

The `correct.ranking` function returns a modified set of ballots. Its argument `partial` determines if ballots are partially set to 0 (TRUE), or if it is a complete re-ranking, as allowed when `equal.ranking = TRUE`. It can be used by calling it explicitly. It is called by `stv` if `equal.ranking = TRUE` or `invalid.partial = TRUE`. It is also called from within the `condorcet` function with the default value (FALSE) for `partial`, i.e. interpreting any 0 as a last= preference.

## Usage

```
correct.ranking(votes, partial = FALSE, quiet = FALSE)
```



**Arguments**

votes	original contents of ballot box
partial	if FALSE (default), each ballot is interpreted, if possible, as a complete (but not necessarily total) ranking of the candidates. If TRUE, a ballot will contain a 0 on unranked candidates.
quiet	suppress diagnostics

**Value**

corrected ballots

---

dublin_west	<i>Dublin West</i>
-------------	--------------------

---

**Description**

Dataset containing ranked votes for the Dublin West constituency in 2002, Ireland.

**Usage**

```
data(dublin_west)
```

**Format**

A data frame with 29988 observations and 9 candidates. Each record corresponds to one ballot with candidates being ranked between 1 and 9 with zeros allowed.

**See Also**

[Wikipedia](#)

---

election.info	<i>prints the basic results of an election</i>
---------------	------------------------------------------------

---

**Description**

prints the basic results of an election

**Usage**

```
election.info(x)
```

**Arguments**

x	basic election results, as named attributes of an R structure or object
---	-------------------------------------------------------------------------

**Value**

data.frame : an invisible copy of the printed results

TODO: refactor into a modern dialect of R, e.g. defining a constructor for an election\_info S3 object with a print method

---

extractMargins	<i>extract margins from the results of a ballot count</i>
----------------	-----------------------------------------------------------

---

**Description**

extract margins from the results of a ballot count

**Usage**

```
extractMargins(marginNames, crRanks, cr)
```

**Arguments**

marginNames      list of colnames of the margins in our SafeRank result

crRanks            ranks of candidates, not necessarily total

cr                 structure returned by a ballot-counting method

Margins are adjusted for tied candidates, such that candidates within a tie group have margins indicative of their relative strengths. Extremely small margins are indicative of floating-point roundoff errors.

**Value**

named list of margins

---

extractRank	<i>Extract a ranking vector by name from the results of a ballot count</i>
-------------	----------------------------------------------------------------------------

---

**Description**

Extract a ranking vector by name from the results of a ballot count

**Usage**

```
extractRank(rankMethod, cr)
```

**Arguments**

rankMethod        "safeRank", "elected", or "rank"

cr                 structure returned by a ballot-counting method

**Value**

a numeric ranking vector, in order of colnames(cr\$data)

---

food_election	<i>Food Election</i>
---------------	----------------------

---

**Description**

Sample data for testing SafeVote

**Usage**

```
data(food_election)
```

**Format**

A data frame with 20 observations and 5 candidates (Oranges, Pears, Chocolate, Strawberries, Sweets). Each record corresponds to one ballot with ranking for each of the candidates.

---

forwards.tiebreak	<i>Undocumented internal method</i>
-------------------	-------------------------------------

---

**Description**

Undocumented internal method

**Usage**

```
forwards.tiebreak(prefs, icans, elim = TRUE)
```

**Arguments**

prefs	undocumented
icans	undocumented
elim	undocumented

---

```
image.SafeVote.condorcet
```

*The image function visualizes the joint distribution of two preferences (if all.pref=FALSE) given xpref and ypref, as well as the marginal distribution of all preferences (if all.pref=TRUE). The joint distribution can be shown as proportions (if proportion=TRUE) or raw vote counts (if proportion=FALSE).*

---

### Description

The image function visualizes the joint distribution of two preferences (if all.pref=FALSE) given xpref and ypref, as well as the marginal distribution of all preferences (if all.pref=TRUE). The joint distribution can be shown as proportions (if proportion=TRUE) or raw vote counts (if proportion=FALSE).

### Usage

```
## S3 method for class 'SafeVote.condorcet'
image(x, ...)
```

### Arguments

x	object of type SafeVote.condorcet
...	See arguments for <a href="#">image.SafeVote.stv</a> , especially xpref, ypref, all.pref and proportion.

### Value

image object, with side-effect in RStudio Plots pane

---

```
image.SafeVote.stv    visualisation of joint and marginal distributions in STV preferences
```

---

### Description

visualisation of joint and marginal distributions in STV preferences

### Usage

```
## S3 method for class 'SafeVote.stv'
image(x, xpref = 2, ypref = 1, all.pref = FALSE, proportion = TRUE, ...)
```

**Arguments**

x	STV results to be visualised
xpref, ypref	candidates shown in a joint distribution plot
all.pref	plot the joint distribution of two preferences (if all.pref=FALSE) or the marginal distribution of all preferences (if all.pref=TRUE).
proportion	The joint distribution can be shown either as proportions (if proportion=TRUE) or raw vote counts (if proportion=FALSE).
...	args passed to fields::image.plot()

**Value**

image object, with side-effect in RStudio Plots pane

---

ims_approval	<i>IMS Approval</i>
--------------	---------------------

---

**Description**

Modified version of `ims_election`, for use in approval voting.

**Usage**

```
data(ims_approval)
```

**Format**

A data frame with 620 observations and 10 candidates (names were made up). Each record corresponds to one ballot, with 0 indicating disapproval of a candidate and 1 indicating approval.

---

ims_election	<i>IMS Election</i>
--------------	---------------------

---

**Description**

Datasets containing anonymized votes for a past Council election of the Institute of Mathematical Statistics (IMS). The dataset `ims_election` is the original dataset used with single transferable vote, where candidate names have been changed.

**Usage**

```
data(ims_election)
```

**Format**

A data frame with 620 observations and 10 candidates (names were made up). Each record corresponds to one ballot. The IMS Council voting is done using the STV method, and thus the `ims_election` dataset contains ballots with candidates being ranked between 1 and 10 with zeros allowed.

---

<code>ims_plurality</code>	<i>IMS Plurality</i>
----------------------------	----------------------

---

**Description**

Modified version of `ims_election`, for use in plurality voting.

**Usage**

```
data(ims_plurality)
```

**Format**

A data frame with 620 observations and 10 candidates (names were made up). Each record corresponds to one ballot, with 1 against the voter's most-preferred candidate and 0 against all other candidates.

---

<code>ims_score</code>	<i>IMS Score</i>
------------------------	------------------

---

**Description**

Modified version of `ims_election`, for use in score voting.

**Usage**

```
data(ims_score)
```

**Format**

A data frame with 620 observations and 10 candidates (names were made up). Each record corresponds to one ballot, with higher values indicating the more-preferred candidates.

---

 ims\_stv

*IMS STV*


---

**Description**

Copy of `ims_election`, included for backwards compatibility.

**Usage**

```
data(ims_election)
```

**Format**

A data frame with 620 observations and 10 candidates (names were made up). Each record corresponds to one ballot. The IMS Council voting is done using the STV method, and thus the `ims_election` dataset contains ballots with candidates being ranked between 1 and 10 with zeros allowed.

---

 invalid.votes

*Extracts the invalid.votes member (if any) from the result of a count*


---

**Description**

This method was added Jan 2022 – it was named in a warning message but had apparently either never been implemented, or had been "lost" through versioning.

**Usage**

```
invalid.votes(x)
```

**Arguments**

x value returned by `stv`, `condorcet`, `approval`, `plurality`, or `score`

**Value**

matrix with one column per candidate and one row per invalid ballot

---

is.SafeRankExpt	<i>is.SafeRankExpt()</i>
-----------------	--------------------------

---

**Description**

is.SafeRankExpt()

**Usage**

is.SafeRankExpt(x)

**Arguments**

x                    object of unknown class

**Value**

TRUE if x is a valid SafeRankExpt object

---

is.valid.vote	<i>undocumented internal method</i>
---------------	-------------------------------------

---

**Description**

undocumented internal method

**Usage**

is.valid.vote(x, method, ...)

**Arguments**

x, method, ...      undocumented

**Value**

undocumented



---

loserMargin	<i>Find a loser and their margin of victory</i>
-------------	-------------------------------------------------

---

**Description**

Find a loser and their margin of victory

**Usage**

```
loserMargin(votes)
```

**Arguments**

votes	cleaned ballots
-------	-----------------

**Value**

length-2 vector: the index of a losing candidate, and their margin of loss (0 if a tie, NA if no winners)

---

new_SafeRankExpt	<i>Constructor for the results of a SafeRank experiment</i>
------------------	-------------------------------------------------------------

---

**Description**

Constructor for the results of a SafeRank experiment

**Usage**

```
new_SafeRankExpt(  
  rankNames = list(),  
  marginNames = list(),  
  countMethod = character(0),  
  rankMethod = character(0),  
  datasetName = character(0),  
  experimentalMethod = character(0),  
  countArgs = list(),  
  nseats = integer(0),  
  otherFactors = list(),  
  unitFactors = list()  
)
```

**Arguments**

rankNames	colnames for per-candidate ranks
marginNames	colnames for per-candidate margins
countMethod	secondary factor: counting method e.g. "stv"
rankMethod	secondary factor: ranking method e.g. "elected"
datasetName	secondary factor: name of the dataset of ballots
experimentalMethod	secondary factor: name of the method which simulated these elections e.g. "test-Fraction"
countArgs	secondary factor: args passed to countMethod
nseats	secondary factor: number of seats to be filled
otherFactors	other secondary factors, e.g. parameters to experimentalMethod
unitFactors	per-unit factors derived from PRNG of the experimental harness, e.g. describing the ballots randomly deleted during testDeletions

**Value**

object of class SafeRankExpt

---

ordered.preferences     *Undocumented internal method*

---

**Description**

Undocumented internal method

**Usage**

ordered.preferences(vmat)

**Arguments**

vmat                    undocumented

---

ordered.tiebreak	<i>Undocumented internal method</i>
------------------	-------------------------------------

---

**Description**

Undocumented internal method

**Usage**

```
ordered.tiebreak(vmat, seed = NULL)
```

**Arguments**

vmat	undocumented
seed	undocumented

---

plot.SafeRankExpt	<i>plot() method for the result of an experiment with varying numbers of ballots</i>
-------------------	--------------------------------------------------------------------------------------

---

**Description**

The "adjusted rank" of a candidate is their ranking  $r$  plus their scaled "winning margin". The scaled margin is  $e^{-cx/\sqrt{n}}$ , where  $x$  is the adjusted margin (i.e. the number of votes by which this candidate is ahead of the next-weaker candidate, adjusted for the number of ballots  $n$  and the number of seats  $s$ ), and  $c > 0$  is the margin-scaling parameter `cMargin`.

**Usage**

```
## S3 method for class 'SafeRankExpt'
plot(
  x,
  facetWrap = FALSE,
  nResults = NA,
  anBallots = 0,
  cMargin = 1,
  xlab = "Ballots",
  ylab = "Adjusted Rank",
  title = NULL,
  subtitle = "(default)",
  line = TRUE,
  boxPlot = FALSE,
  boxPlotCutInterval = 10,
  pointSize = 1,
  ...
)
```

**Arguments**

<code>x</code>	object containing experimental results
<code>facetWrap</code>	TRUE provides per-candidate scatterplots
<code>nResults</code>	number of candidates whose results are plotted (omitting the least-favoured candidates first)
<code>anBallots, cMargin</code>	parameters in the rank-adjustment formula
<code>xlab, ylab</code>	axis labels
<code>title</code>	overall title for the plot. Default: NULL
<code>subtitle</code>	subtitle for the plot. Default: value of <code>nSeats</code> and any non-zero rank-adjustment parameters
<code>line</code>	TRUE will connect points with lines, and will disable jitter
<code>boxPlot</code>	TRUE for a boxplot, rather than the default xy-scatter
<code>boxPlotCutInterval</code>	parameter of boxplot, default 10
<code>pointSize</code>	diameter of points
<code>...</code>	params for generic plot()

**Details**

The default value of `cMargin=1.0` draws visual attention to candidates with a very small winning margin, as their adjusted rank is very near to  $r + 1$ . Candidates with anything more than a small winning margin have only a small rank adjustment, due to the exponential scaling.

A scaling linear in  $s/n$  is applied to margins when `anBallots>0`. Such a linear scaling may be a helpful way to visualise the winning margins in STV elections because the margin of victory for an elected candidate is typically not much larger than the quota of  $n/(s + 1)$  (Droop) or  $n/s$  (Hare). The linear scaling factor is  $as/n$ , where  $a$  is the value of `anBallots`,  $s$  is the number of seats, and  $n$  is the number of ballots. For plotting on the (inverted) adjusted rank scale, the linearly-scaled margin is added to the candidate's rank. Note that the linearly-scaled margins are zero when  $a = 0$ , and thus have no effect on the adjusted rank. You might want to increase the value of `anBallots`, starting from 1.0, until the winning candidate's adjusted rank is 1.0 when all ballots are counted, then confirm that the adjusted ranks of other candidates are still congruent with their ranking (i.e. that the rank-adjustment is less than 1 in all cases except perhaps on an initial transient with small numbers of ballots).

When both `anBallots` and `cMargins` are non-zero, the ranks are adjusted with both exponentially-scaled margins and linearly-scaled margins. The resulting plot would be difficult to interpret in a valid way.

Todo: Accept a list of `SafeVoteExpt` objects.

Todo: Multiple counts with the same number of ballots could be summarised with a box-and-whisker graphic, rather than a set of jittered points.

Todo: Consider developing a linear scaling that is appropriate for plotting stochastic experimental data derived from Condorcet elections.

**Value**

graphics object, with side-effect in RStudio Plots pane

---

plot.SafeVote.stv      *plot() method for the result of an stv() ballot-count*

---

**Description**

The plot function shows the evolution of the total score for each candidate as well as the quota.

**Usage**

```
## S3 method for class 'SafeVote.stv'
plot(x, xlab = "Count", ylab = "Preferences", point.size = 2, ...)
```

**Arguments**

x	stv results
xlab, ylab	axis labels
point.size	diameter of elected/eliminated points
...	params for generic plot()

**Value**

graphics object, with side-effect in RStudio's Plots pane

---

plurality      *Count votes using the plurality method*

---

**Description**

See <https://arxiv.org/abs/2102.05801>

**Usage**

```
plurality(votes, nseats = 1, fsep = "\t", quiet = FALSE, ...)
```

**Arguments**

votes, nseats, fsep, quiet, ...	
	undocumented

**Value**

undocumented

---

```
prepare.votes          Coerce input 'data' into a matrix
```

---

**Description**

Coerce input 'data' into a matrix

**Usage**

```
prepare.votes(data, fsep = "\n")
```

**Arguments**

data                   possibly a .csv file, possibly an R object  
 fsep                   separation character for .csv e.g. tab or comma

**Value**

a matrix with one row per ballot, one column per candidate, with named rows and columns

---

```
print.summary.SafeRankExpt  

   Print method for summary.SafeRankExpt
```

---

**Description**

Print method for summary.SafeRankExpt

**Usage**

```
## S3 method for class 'summary.SafeRankExpt'  

print(x, ...)
```

**Arguments**

x                       experimental results  
 ...                     args for generic print()

**Value**

invisible(x), with side-effects to console

---

```
print.summary.SafeVote.approval
    print method for summary object
```

---

### **Description**

print method for summary object

### **Usage**

```
## S3 method for class 'summary.SafeVote.approval'
print(x, ...)
```

### **Arguments**

x, ...            undocumented

### **Value**

undocumented

---

```
print.summary.SafeVote.condorcet
    print method for summary.SafeVote.condorcet
```

---

### **Description**

print method for summary.SafeVote.condorcet

### **Usage**

```
## S3 method for class 'summary.SafeVote.condorcet'
print(x, ...)
```

### **Arguments**

x                    object of type summary.SafeVote.condorcet  
...                  parameters passed to generic [print](#)

### **Value**

textual description of x

---

```
print.summary.SafeVote.plurality
    print method for summary of plurality object
```

---

**Description**

print method for summary of plurality object

**Usage**

```
## S3 method for class 'summary.SafeVote.plurality'
print(x, ...)
```

**Arguments**

x, ...           undocumented

**Value**

undocumented

---

```
print.summary.SafeVote.score
    print method for summary.score object
```

---

**Description**

print method for summary.score object

**Usage**

```
## S3 method for class 'summary.SafeVote.score'
print(x, ...)
```

**Arguments**

x, ...           undocumented

**Value**

undocumented



---

```
print.summary.SafeVote.stv
    print() method for a summary() of a SafeVote result
```

---

**Description**

print() method for a summary() of a SafeVote result

**Usage**

```
## S3 method for class 'summary.SafeVote.stv'
print(x, ...)
```

**Arguments**

x	election results
...	args to be passed to kable()

**Value**

no return value, called for side-effect of printing to console

---

```
rbind.SafeRankExpt    add a row to a SafeRankExpt object
```

---

**Description**

add a row to a SafeRankExpt object

**Usage**

```
## S3 method for class 'SafeRankExpt'
rbind(object, row)
```

**Arguments**

object	prior results of experimentation
row	new observations

**Value**

SafeRankExpt object with an additional row

---

readHil	<i>read a set of ballots in .HIL format</i>
---------	---------------------------------------------

---

### Description

[rangevoting.org/TidemanData.html](http://rangevoting.org/TidemanData.html): The data are in a format developed by David Hill. The first line contains the number of candidates and the number to be elected. (Many but not all elections were multi-winner.) In subsequent lines that represent ballot papers, the first number is always 1. (The format was designed for a counting program that treats the first number as the number of instances of the ordering of the candidates on the line.) Next on these lines is a sequence of numbers representing a voter's reported ranking: The number of the candidate ranked first, the number of the candidate ranked second, and so on. The end of the reported ranking is signaled by a zero. A zero at the beginning of the ranking is a signal that the list of ballot papers has ended. Next come the names of the candidates, each in parentheses, as required by the counting program, and finally the name of the election.

### Usage

```
readHil(film, quiet = FALSE)
```

### Arguments

film	name of a file in .HIL format
quiet	suppress diagnostic output

### Value

a matrix with one row per ballot, one column per candidate, with named rows and columns, and with attributes "nseats" and "ename"

---

remove.candidate	<i>Remove a candidate, amending ballot papers as required</i>
------------------	---------------------------------------------------------------

---

### Description

Remove a candidate, amending ballot papers as required

### Usage

```
remove.candidate(votes, can, quiet = TRUE)
```

### Arguments

votes	ballot box
can	candidate to be removed
quiet	suppress diagnostics

**Value**

amended ballot box

---

score	<i>Count votes using the score (or range) method.</i>
-------	-------------------------------------------------------

---

**Description**

See <https://arxiv.org/abs/2102.05801>

**Usage**

```
score(
  votes,
  nseats = 1,
  max.score = NULL,
  larger.wins = TRUE,
  fsep = "\t",
  quiet = FALSE,
  ...
)
```

**Arguments**

votes, nseats, max.score, larger.wins, fsep, quiet, ...  
undocumented

**Value**

undocumented

---

solveTiebreak	<i>Undocumented internal method, renamed from 'solve.tiebreak' to avoid confusion with generic solve()</i>
---------------	------------------------------------------------------------------------------------------------------------

---

**Description**

Undocumented internal method, renamed from 'solve.tiebreak' to avoid confusion with generic solve()

**Usage**

```
solveTiebreak(method, prefs, icans, ordered.ranking = NULL, elim = TRUE)
```

**Arguments**

method	undocumented
prefs	undocumented
icans	undocumented
ordered.ranking	undocumented
elim	undocumented

**Value**

undocumented

---

 stv

---

*Count preferential ballots using an STV method*


---

**Description**

The votes parameter is as described in [condorcet\(\)](#) with the following additional semantics.

**Usage**

```
stv(
  votes,
  nseats = NULL,
  eps = 0.001,
  equal.ranking = FALSE,
  fsep = "\t",
  ties = c("f", "b"),
  quota.hare = FALSE,
  constant.quota = FALSE,
  win.by.elim = TRUE,
  group.nseats = NULL,
  group.members = NULL,
  complete.ranking = FALSE,
  invalid.partial = FALSE,
  verbose = FALSE,
  seed = NULL,
  quiet = FALSE,
  digits = 3,
  backwards.compatible = FALSE,
  safety = 1,
  ...
)
```

**Arguments**

<code>votes</code>	an array with one column per candidate and one row per ballot, as described in <a href="#">condorcet()</a>
<code>nseats</code>	the number of seats to be filled in this election
<code>eps</code>	fuzz-factor when comparing fractional votes. The default of 0.001 is preserved from the legacy code, injecting substantial validity hazards into the codebase. We have not attempted to mitigate any of these hazards in <code>SafeVote v1.0.0</code> . We prefer instead to retain backwards-compatibility with the legacy code in <code>vote_2.3-2</code> in the knowledge that, even if these hazards were adequately addressed, the resulting code is unlikely to be reliable at replicating the results of any other implementation of any of the many variants of "STV" counting methods. Please see the description of the <code>a53_hi1</code> dataset in this package for some preliminary findings on the magnitude of the vote-count-variances which may be injected by differing implementations of broadly-similar "STV" counting methods.
<code>equal.ranking</code>	if TRUE, equal preferences are allowed.
<code>fsep</code>	column-separator for output
<code>ties</code>	vector of tie-breaking methods: 'f' for forward, 'b' for backward
<code>quota.hare</code>	TRUE if Hare quota, FALSE if Droop quota (default)
<code>constant.quota</code>	TRUE if quota is held constant. Over-rides <code>quota.hare</code> . Default is FALSE
<code>win.by.elim</code>	TRUE (default) if the quota is waived when there are no more candidates than vacant seats. Note: there is no lower limit when the quota is waived, so a candidate may be elected on zero votes.
<code>group.nseats</code>	number of seats reserved to members of a group
<code>group.members</code>	vector of members of the group with reserved seats
<code>complete.ranking</code>	is TRUE by default. This parameter is retained solely for backwards compatibility with <code>vote::stv()</code> . It has no effect on elections in which <code>nseats</code> is explicitly specified in the call to <code>stv()</code> .
<code>invalid.partial</code>	TRUE if ballots which do not specify a complete ranking of candidates are informal (aka "invalid") <i>i.e.</i> ignored (with a warning). Default is FALSE.
<code>verbose</code>	TRUE for diagnostic output
<code>seed</code>	integer seed for tie-breaking. Warning: if non-NULL, the PRNG for R is reseeded prior to <i>every</i> random tie-break among the possibly-elected candidates. We have preserved this functionality in this branch to allow regression against the legacy codebase of <code>vote::stv()</code> . In <code>stv()</code> the default value for <code>seed</code> is NULL rather than the legacy value of 1234, to mitigate the validity hazard of PRNG reseeds during a stochastic experiment.
<code>quiet</code>	TRUE to suppress console output
<code>digits</code>	number of significant digits in the output table
<code>backwards.compatible</code>	TRUE to regress against <code>vote2_3.2</code> by disabling <code>\$margins</code> , <code>\$fuzz</code> , <code>\$rankingTable</code> , <code>\$safeRank</code>

safety	number of standard deviations on vote-counts, when producing a safeRank by clustering near-ties in a complete ranking
...	undocumented intent (preserved from legacy code)

## Details

By default the preferences are not allowed to contain duplicates per ballot. However, if the argument `equal_ranking` is set to `TRUE`, ballots are allowed to have the same ranking for multiple candidates. The desired format is such that for each preference  $i$  that does not have any duplicate, there must be exactly  $i - 1$  preferences  $j$  with  $0 < j < i$ . For example, valid ordered preferences are `1; 1; 3; 4; . . .`, or `1; 2; 3; 3; 3; 6; . . .`, but NOT `1; 1; 2; 3; . . .`, or NOT `1; 2; 3; 3; 3; 5; 6; . . .`. If the data contain such invalid votes, they are automatically corrected and a warning is issued by calling the `correct_ranking` function.

If equal ranking is not allowed (`equal_ranking = FALSE`), the argument `invalid_partial` can be used to make ballots containing duplicates or gaps partially valid. If it is `TRUE`, a ballot is considered valid up to a preference that is in normal case not allowed. For example, ballots `1; 2; 3; 4; 4; 6` or `1; 2; 3; 5; 6; 7` would be both converted into `1; 2; 3; 0; 0; 0`, because the ballots contain valid ranking only up to the third preference.

By default, ties in the STV algorithm are resolved using the forwards tie-breaking method, see Newland and Briton (Section 5.2.5). Argument `ties` can be set to "b" in order to use the backwards tie-breaking method, see O'Neill (2004). In addition, both methods are complemented by the following "ordered" method: Prior to the STV election candidates are ordered by the number of first preferences. Equal ranks are resolved by moving to the number of second preferences, then third and so on. Remaining ties are broken by random draws. Such complete ordering is used to break any tie that cannot be resolved by the forwards or backwards method. If there is at least one tie during the processing, the output contains a row indicating in which count a tie-break happened (see the `ties` element in the Value section for an explanation of the symbols).

The ordered tiebreaking described above can be analysed from outside of the `stv` function by using the `ordered_tiebreak` function for viewing the a-priori ordering (the highest number is the best and lowest is the worst). Such ranking is produced by comparing candidates along the columns of the matrix returned by `ordered_preferences`.

## Value

object of class `vote.stv`. Note: the winning margins in this object are valid for the elected candidates and their (total) ranking, but must be adjusted within tiegroups to be valid for the candidates' (possibly partial) safeRank.

## Examples

```
data(food_election)
stv(food_election, safety = 0.0)
stv(food_election, nseats = 2)
```

---

summary.SafeRankExpt    *summary method for SafeRankExpt*

---

**Description**

summary method for SafeRankExpt

**Usage**

```
## S3 method for class 'SafeRankExpt'  
summary(object, ...)
```

**Arguments**

object	experimental results to be summarised
...	args for generic summary()

**Value**

summary.SafeRankExpt object

---

summary.SafeVote.approval  
*summary method for approval results*

---

**Description**

summary method for approval results

**Usage**

```
## S3 method for class 'SafeVote.approval'  
summary(object, ...)
```

**Arguments**

object, ...	undocumented
-------------	--------------

**Value**

undocumented

---

summary.SafeVote.condorcet

*Summary method for condorcet() results*

---

### Description

Summary method for condorcet() results

### Usage

```
## S3 method for class 'SafeVote.condorcet'  
summary(object, ...)
```

### Arguments

object	of type SafeVote.condorcet
...	undocumented, currently unused

### Value

[data.frame](#) object

---

summary.SafeVote.plurality

*summary method for plurality object*

---

### Description

summary method for plurality object

### Usage

```
## S3 method for class 'SafeVote.plurality'  
summary(object, ...)
```

### Arguments

object, ...	undocumented
-------------	--------------

### Value

descriptive dataframe



---

summary.SafeVote.score  
*summary method for score object*

---

### Description

summary method for score object

### Usage

```
## S3 method for class 'SafeVote.score'  
summary(object, ...)
```

### Arguments

object, ...      undocumented

### Value

undocumented

---

summary.SafeVote.stv    *summary() method for a SafeVote result*

---

### Description

summary() method for a SafeVote result

### Usage

```
## S3 method for class 'SafeVote.stv'  
summary(object, ..., digits = 3)
```

### Arguments

object            undocumented, legacy code  
...                undocumented  
digits            undocumented

### Value

data.frame summarising object, for use by print method

---

sumOfVotes	<i>internal method, computes column-sums</i>
------------	----------------------------------------------

---

**Description**

Renamed from 'sum.votes' to avoid confusion with the generic sum()

**Usage**

```
sumOfVotes(votes)
```

**Arguments**

votes                ballots are rows, candidates are columns

**Value**

vector of votes for each candidate

---

testAdditions	<i>Test the sensitivity of a result to tactical voting.</i>
---------------	-------------------------------------------------------------

---

**Description**

Ballots are added until a specified number of simulated elections (arep) have been held. If a favoured candidate is specified, then the ballot-box is stuffed with ballots awarding first-preference to this candidate. Alternatively, a tacticalBallot may be specified. If both favoured and tacticalBallot are NULL, then a random candidate is selected as the favoured one.

**Usage**

```
testAdditions(
  votes,
  ainc = 1,
  arep = NULL,
  favoured = NULL,
  tacticalBallot = NULL,
  rankMethod = "safeRank",
  countMethod = "stv",
  countArgs = list(),
  exptName = NULL,
  equiet = FALSE,
  everbose = FALSE
)
```

**Arguments**

votes	A set of ballots, as in <a href="#">vote_2.3.2</a>
ainc	Number of ballots to be added in each step
arep	Maximum number of ballot-stuffed elections to run
favoured	Name of the candidate being "plumped". If NULL, a random candidate is selected from among the candidates not initially top-ranked. All other candidates are fully-ranked at random, with an identical ballot paper being stuffed multiple times. An integer value for favoured is interpreted as an index into the candidate names.
tacticalBallot	A ballot paper i.e. a vector of length <code>ncol(ballots)</code> . If this argument is non-NULL, it takes precedence over favoured when the ballot box is being stuffed.
rankMethod	"safeRank" (default), "elected", or "rank". "rank" is a total ranking of the candidates, with ties broken at random. "elected" assigns rank=1 to elected candidates, rank=2 for eliminated candidates.
countMethod	countMethod "stv" (default) or "condorcet"
countArgs	List of args to be passed to countMethod (in addition to votes)
exptName	stem-name of experimental units e.g. "E". If NULL, then a 3-character string of capital letters is chosen at random.
equiet	TRUE to suppress all experimental output
everbose	TRUE to produce diagnostic output from the experiment

**Value**

A matrix of experimental results, of dimension  $n$  by  $2m + 1$ , where  $n$  is the number of elections and  $m$  is the number of candidates. The first column is named "nBallots". Other columns indicate the ranking of the eponymous candidate, and their margin over the next-lower-ranked candidate.

**Examples**

```
data(food_election)
testAdditions(food_election, arep = 2, favoured = "Strawberries",
  countArgs = list(safety = 0))
```

---

testDeletions	<i>Assess the safety of a preliminary result for an election</i>
---------------	------------------------------------------------------------------

---

**Description**

Ballots are deleted at random from the ballot-box, with election results computed once per `dinc` ballot-deletions. The experiment terminates after a specified number of ballots have been deleted, or a specified number of ballot-counts have occurred. Note: these ballot-counts are correlated. Use [testFraction\(\)](#) to experiment with independently-drawn samples from the ballot-box.

**Usage**

```
testDeletions(
  votes,
  countMethod = "stv",
  countArgs = list(),
  dstart = NULL,
  dinc = NULL,
  dlimit = NULL,
  drep = NULL,
  rankMethod = "safeRank",
  exptName = NULL,
  equiet = FALSE,
  everbose = FALSE
)
```

**Arguments**

votes	A set of ballots, as in <a href="#">vote_2.3.2</a>
countMethod	"stv" (default) or "condorcet"
countArgs	List of args to be passed to countMethod (in addition to votes)
dstart	Number of ballots in the first ballot-count (selected at random from votes, without replacement)
dinc	Number of ballots to be deleted in subsequent steps
dlimit	Maximum number of ballots to delete (in addition to dstart)
drep	Maximum number of elections (required if dinc=0)
rankMethod	"safeRank" (default), "elected", or "rank". "rank" is a total ranking of the candidates, with ties broken at random. "elected" assigns rank=1 to elected candidates, rank=2 for eliminated candidates.
exptName	stem-name of experimental units <i>e.g.</i> "E". If NULL, then a 3-character string of capital letters is chosen at random.
equiet	TRUE to suppress all experimental output
everbose	TRUE to produce diagnostic output from the experiment

**Value**

[SafeRankExpt](#) object, describing this experiment and its results

**Examples**

```
data(food_election)
testDeletions(food_election)
testDeletions(food_election, countMethod="stv",
  countArgs=list(complete.ranking=TRUE))
```

---

testFraction	<i>Bootstrapping experiment, with fractional counts of a ballot box.</i>
--------------	--------------------------------------------------------------------------

---

### Description

Starting from some number (`astart`) of randomly-selected ballots, an increasingly-large collection of randomly-selected ballots are counted. The ballots are chosen independently without replacement for each experimental unit; if you want to count decreasingly-sized portions of a single sample of ballots, use `testDeletions()`.

### Usage

```
testFraction(
  votes = NULL,
  astart = NULL,
  ainc = NULL,
  arep = NULL,
  trep = NULL,
  rankMethod = "safeRank",
  countMethod = "stv",
  countArgs = list(),
  exptName = NULL,
  equiet = FALSE,
  everbose = FALSE
)
```

### Arguments

<code>votes</code>	A numeric matrix: one row per ballot, one column per candidate
<code>astart</code>	Starting number of ballots (min 2)
<code>ainc</code>	Number of ballots to be added in each step. Must be non-negative.
<code>arep</code>	Number of repetitions of the test on each step. Required to be non-NULL if <code>ainc=0</code> && <code>is.null(trep)</code> .
<code>trep</code>	Limit on the total number of simulated elections. Required to be non-NULL if <code>ainc=0</code> && <code>is.null(arep)</code> .
<code>rankMethod</code>	"safeRank" (default), "elected", or "rank". "rank" is a total ranking of the candidates, with ties broken at random. "elected" assigns rank=1 to elected candidates, rank=2 for eliminated candidates.
<code>countMethod</code>	countMethod "stv" (default) or "condorcet"
<code>countArgs</code>	List of args to be passed to countMethod (in addition to votes)
<code>exptName</code>	stem-name of experimental units <i>e.g.</i> "E". If NULL, then a 3-character string of capital letters is chosen at random.
<code>equiet</code>	TRUE to suppress all experimental output
<code>everbose</code>	TRUE to produce diagnostic output from the experiment

**Value**

a `SafeRankExpt` object of experimental results.

**Examples**

```
data(food_election)
testFraction(food_election, countMethod="condorcet",
             countArgs=list(safety=0.5, complete.ranking=TRUE))
testFraction(dublin_west, astart=20, ainc=10, arep=2, trep=3,
             countMethod="stv", rankMethod="elected", equiet=FALSE)
```

---

<code>translate.ties</code>	<i>Undocumented internal method from original code</i>
-----------------------------	--------------------------------------------------------

---

**Description**

Undocumented internal method from original code

**Usage**

```
translate.ties(ties, method)
```

**Arguments**

<code>ties</code>	undocumented
<code>method</code>	'f' for forward, 'b' for backward

**Value**

undocumented

---

<code>uk_labour_2010</code>	<i>UK Labour Party Leader 2010</i>
-----------------------------	------------------------------------

---

**Description**

These are the ballots cast by Labour MPs and MEPs in an election of their party's leader in 2010, as published by the Manchester Guardian. The names of the electors have been suppressed in this file, but are available at [rangevoting.org](http://rangevoting.org), along with extensive commentary on the election.

**Usage**

```
data(uk_labour_2010)
```

**Format**

A data frame with 266 observations and 5 candidates.

---

view	<i>generic view() for classes defined in this package</i>
------	-----------------------------------------------------------

---

**Description**

generic view() for classes defined in this package

**Usage**

```
view(object, ...)
```

**Arguments**

object	election object to be viewed
...	additional parameters, passed to formattable::formattable()

**Value**

html-formatted object, with side-effect in RStudio's Viewer pane

---

view.SafeVote.approval	<i>view method for approval object</i>
------------------------	----------------------------------------

---

**Description**

view method for approval object

**Usage**

```
## S3 method for class 'SafeVote.approval'  
view(object, ...)
```

**Arguments**

object, ...	undocumented
-------------	--------------

**Value**

undocumented

view.SafeVote.condorcet

*view method for SafeVote.condorcet*

---

### Description

view method for SafeVote.condorcet

### Usage

```
## S3 method for class 'SafeVote.condorcet'  
view(object, ...)
```

### Arguments

object            of type SafeVote.condorcet  
...                see [view.SafeVote.approval](#)

### Value

view object

---

view.SafeVote.plurality

*view method for plurality object*

---

### Description

view method for plurality object

### Usage

```
## S3 method for class 'SafeVote.plurality'  
view(object, ...)
```

### Arguments

object, ...        undocumented

### Value

undocumented



---

view.SafeVote.score    *view method for score object*

---

**Description**

view method for score object

**Usage**

```
## S3 method for class 'SafeVote.score'  
view(object, ...)
```

**Arguments**

object, ...    undocumented

**Value**

undocumented

---

view.SafeVote.stv    *view method for the result of an stv() ballot-count*

---

**Description**

view method for the result of an stv() ballot-count

**Usage**

```
## S3 method for class 'SafeVote.stv'  
view(object, ...)
```

**Arguments**

object            object to be viewed  
...                additional parameters, passed to formattable::formattable()

**Value**

html-formatted object

---

winnerMargin	<i>Find a winner and their margin of victory</i>
--------------	--------------------------------------------------

---

**Description**

Find a winner and their margin of victory

**Usage**

```
winnerMargin(votes)
```

**Arguments**

votes            cleaned ballots

**Value**

length-2 vector: the index of a winning candidate, and their margin of victory (0 if a tie, NA if no losers)

---

yale_ballots	<i>Yale Faculty Senate 2016</i>
--------------	---------------------------------

---

**Description**

This data follows the structure of a 2016 Yale Faculty Senate election, with candidate names anonymised and permuted. Imported to SafeVote from [STV v1.0.2](#), after applying the `STV::cleanBallots` method to remove the ten empty rows.

**Usage**

```
data(yale_ballots)
```

**Format**

A data frame with 479 observations and 44 candidates.

# Index

- \* **datasets**
  - a3\_hil, 5
  - a4\_hil, 5
  - a53\_hil, 6
  - dublin\_west, 17
  - food\_election, 19
  - ims\_approval, 21
  - ims\_election, 21
  - ims\_plurality, 22
  - ims\_score, 22
  - ims\_stv, 23
  - uk\_labour\_2010, 46
  - yale\_ballots, 50
- .print.summary.SafeVote, 3
- .summary.SafeVote, 4
- a3\_hil, 5
- a4\_hil, 5
- a53\_hil, 6
- approval, 7
- as.SafeRankExpt, 7
- assemble.args.for.check.score, 8
- assemble.args.for.check.stv, 8
- backwards.tiebreak, 9
- check.nseats, 9
- check.ranking, 10
- check.votes, 10
- check.votes.approval, 11
- check.votes.condorcet, 11
- check.votes.plurality, 12
- check.votes.score, 12
- check.votes.stv, 13
- check.votes.tworound.runoff, 13
- combineRankings, 14
- completeRankingTable, 14
- condorcet, 15
- condorcet(), 36, 37
- correct.ranking, 16
- data.frame, 15, 40
- dimnames, 16
- dublin\_west, 17
- election.info, 17
- extractMargins, 18
- extractRank, 18
- food\_election, 19
- forwards.tiebreak, 19
- image.SafeVote.condorcet, 20
- image.SafeVote.stv, 20, 20
- ims\_approval, 21
- ims\_election, 21
- ims\_plurality, 22
- ims\_score, 22
- ims\_stv, 23
- invalid.votes, 23
- is.SafeRankExpt, 24
- is.valid.vote, 24
- loserMargin, 25
- matrix, 15
- NA, 16
- new.SafeRankExpt, 25
- ordered.preferences, 26
- ordered.tiebreak, 27
- plot.SafeRankExpt, 27
- plot.SafeVote.stv, 29
- plurality, 29
- prepare.votes, 30
- print, 31
- print.summary.SafeRankExpt, 30
- print.summary.SafeVote.approval, 31
- print.summary.SafeVote.condorcet, 31
- print.summary.SafeVote.plurality, 32

print.summary.SafeVote.score, 32  
print.summary.SafeVote.stv, 33

rbind.SafeRankExpt, 33  
readHil, 34  
remove.candidate, 34

score, 35  
solveTiebreak, 35  
stv, 16, 36  
stv(), 37  
summary.SafeRankExpt, 39  
summary.SafeVote.approval, 39  
summary.SafeVote.condorcet, 40  
summary.SafeVote.plurality, 40  
summary.SafeVote.score, 41  
summary.SafeVote.stv, 41  
sumOfVotes, 42

testAdditions, 42  
testDeletions, 43  
testDeletions(), 45  
testFraction, 45  
translate.ties, 46  
TRUE, 15

uk\_labour\_2010, 46

view, 47  
view.SafeVote.approval, 47, 48  
view.SafeVote.condorcet, 48  
view.SafeVote.plurality, 48  
view.SafeVote.score, 49  
view.SafeVote.stv, 49  
vote::stv(), 37

winnerMargin, 50

yale\_ballots, 50