

# Package ‘powerindexR’

February 8, 2024

**Type** Package

**Title** Measuring the Power in Voting Systems

**Version** 1.5

**Date** 2024-02-08

**Depends** R(>= 3.0.0)

**Description** This R package allows the determination of some distributions of the voters' power when passing laws in weighted voting situations.

**License** GPL-2

**LazyLoad** yes

**Repository** CRAN

**NeedsCompilation** no

**RoxygenNote** 7.0.2

**Author** Livino M. Armijos-Toro [aut, cre],  
Jose M. Alonso-Meijide [aut],  
Manuel A. Mosquera [aut],  
Alejandro Saavedra-Nieves [aut]

**Maintainer** Livino M. Armijos-Toro <livinoa@gmail.com>

**Date/Publication** 2024-02-08 18:10:02 UTC

## R topics documented:

powerindexR-package	2
MWC	3
pi.banzhaf	4
pi.colomermartinez	5
pi.johnston	6
pi.johnstoncolomermartinez	7
pi.shapley	8
powerindex	9
QMWC	10

<b>Index</b>	<b>12</b>
--------------	-----------

---

powerindexR-package    *Measuring the Power in Voting Systems*

---

## Description

This R package allows the determination of some distributions of the voters' power when passing laws in weighted voting situations.

## Details

The DESCRIPTION file:

```
Package:           powerindexR
Type:              Package
Title:             Measuring the Power in Voting Systems
Version:           1.5
Date:              2024-02-08
Authors@R:         c(person("Livino M.", "Armijos-Toro", role = c("aut","cre"), email="livinoa@gmail.com"), person("Jose M. Alonso-Meijide", "Alonso-Meijide", role = c("aut","cre"), email="jalonso@mat.ucm.es"))
Depends:           R(>= 3.0.0)
Description:       This R package allows the determination of some distributions of the voters' power when passing laws in weighted voting situations.
License:           GPL-2
LazyLoad:          yes
Packaged:          CRAN
Repository:        CRAN
NeedsCompilation: no
RoxygenNote:       7.0.2
Author:            Livino M. Armijos-Toro [aut, cre], Jose M. Alonso-Meijide [aut], Manuel A. Mosquera [aut], Alejandro M. Colomer [aut]
Maintainer:        Livino M. Armijos-Toro <livinoa@gmail.com>
```

Index of help topics:

```
MWC                Obtain the minimal winning coalitions
QMWC               Obtain the quasi-minimal winning coalitions
pi.banzhaf         Power based on the Banzhaf index.
pi.colomermartinez Power based on the Colomer-Martinez index.
pi.johnston        Power based on the Johnston index.
pi.johnstoncolomermartinez
                    Power based on the Jonhston-Colomer-Martinez
                    index.
pi.shapley         Power based on the Shapley-Shubik index.
powerindex         Obtain several measures of power
powerindexR-package Measuring the Power in Voting Systems
```

This R package allows the determination of some distributions of the voters' power when passing laws in weighted voting situations.

**Author(s)**

Livino M. Armijos-Toro, Jose M. Alonso-Mejjide, Manuel A. Mosquera, Alejandro Saavedra-Nieves.

**References**

- Alonso-Mejjide, J. M., & Bowles, C. (2005). Generating functions for coalitional power indices: An application to the IMF. *Annals of Operations Research*, 137, 21-44. <<https://doi.org/10.1007/s10479-005-2242-y>>.
- Brams, S. J., & Affuso, P. J. (1976). Power and size: A new paradox. *Theory and Decision*, 7(1-2), 29-56. <<https://doi.org/10.1007/BF00141101>>.
- Colomer, J. M., & Martinez, F. (1995). The paradox of coalition trading. *Journal of Theoretical Politics*, 7(1), 41-63. <<https://doi.org/10.1177/0951692895007001003>>.
- Johnston, R. J. (1978). On the measurement of power: Some reactions to Laver. *Environment and Planning A*, 10(8), 907-914. <<https://doi.org/10.1068/a100907>>.
- Lucas, W. F. (1983). Measuring power in weighted voting systems (pp. 183-238). Springer New York. <[https://doi.org/10.1007/978-1-4612-5430-0\\_9](https://doi.org/10.1007/978-1-4612-5430-0_9)>

---

MWC

---

*Obtain the minimal winning coalitions*


---

**Description**

This function determines the minimal winning coalitions in a weighted majority game.

**Usage**

MWC(quota, weights)

**Arguments**

quota	Numerical value that represents the majority in a given voting.
weights	Numerical vector of dimension $n$ that indicates the weights of $n$ agents in a given voting.

**Value**

Number of Minimal Winning Coalitions	Total amount of Minimal Winning Coalitions.
Minimal Winning Coalitions	Each row indicates a binary representation of each Minimal Winning Coalition.

**Author(s)**

Livino M. Armijos-Toro, Jose M. Alonso-Mejjide, Manuel A. Mosquera, Alejandro Saavedra-Nieves.

**Examples**

```
weights<-c(137,85,71,32,9,8,5,2,1)
quota<-176
MWC(quota,weights)
```

---

pi.banzhaf

*Power based on the Banzhaf index.*


---

**Description**

This function determines the distribution of the power based on the Banzhaf index and the Banzhaf-Owen value.

**Usage**

```
pi.banzhaf(quota, weights, partition = NULL, normalized = FALSE, swing = FALSE)
```

**Arguments**

quota	Numerical value that represents the majority in a given voting.
weights	Numerical vector of dimension $n$ that indicates the weights of $n$ agents in a given voting.
partition	Numerical vector that indicates the partition of voters. Each component indicates the element of the partition to which such voter belongs. If it is not NULL, it provides the distribution of the power based on the Banzhaf-Owen value.
normalized	Logical option to obtain the normalized Banzhaf values.
swing	Logical option to obtain the number of swings of each voter.

**Value**

Banzhaf value	The Banzhaf value, if partition=NULL.
Banzhaf-Owen value	The Banzhaf-Owen value, if partition!=NULL.

**Author(s)**

Livino M. Armijos-Toro, Jose M. Alonso-Mejjide, Manuel A. Mosquera, Alejandro Saavedra-Nieves.

**References**

Alonso-Mejjide, J. M., & Bowles, C. (2005). Generating functions for coalitional power indices: An application to the IMF. *Annals of Operations Research*, 137, 21-44.

Brams, S. J., & Affuso, P. J. (1976). Power and size: A new paradox. *Theory and Decision*, 7(1-2), 29-56.

**Examples**

```
# Example Banzhaf value
weights<-c(137,85,71,32,9,8,5,2,1)
quota<-176
pi.banzhaf(quota,weights)
pi.banzhaf(quota,weights,normalized=TRUE)

# Example Banzhaf-Owen value
quota<-30
weights<-c(28, 16, 5, 4, 3, 3)
# Partition={{1},{2,4,6},{3,5}}
pi.banzhaf(quota,weights,partition=c(1,2,3,2,3,2))
```

---

pi.colomermartinez      *Power based on the Colomer-Martinez index.*

---

**Description**

This function determines the distribution of the power based on the Colomer-Martinez index.

**Usage**

```
pi.colomermartinez(quota, weights, minimal = FALSE)
```

**Arguments**

quota	Numerical value that represents the majority in a given voting.
weights	Numerical vector of dimension $n$ that indicates the weights of $n$ agents in a given voting.
minimal	Logical option to obtain the Minimal Winning Coalitions.

**Value**

Colomer-Martinez	The Colomer-Martinez index.
Number of Minimal Winning Coalitions	Total amount of Minimal Winning Coalitions.
Minimal Winning Coalitions	Each row indicates a binary representation of each Minimal Winning Coalition.

**Author(s)**

Livino M. Armijos-Toro, Jose M. Alonso-Mejjide, Manuel A. Mosquera, Alejandro Saavedra-Nieves.

**References**

Colomer, J. M., & Martinez, F. (1995). The paradox of coalition trading. *Journal of Theoretical Politics*, 7(1), 41-63.

**Examples**

```
weights<-c(137,85,71,32,9,8,5,2,1)
quota<-176
pi.colomermartinez(176,weights,minimal=TRUE)
```

---

pi.johnston

*Power based on the Johnston index.*


---

**Description**

This function determines the distribution of the power based on the Johnston index.

**Usage**

```
pi.johnston(quota, weights, quasiminimal = FALSE)
```

**Arguments**

quota	Numerical value that represents the majority in a given voting.
weights	Numerical vector of dimension $n$ that indicates the weights of $n$ agents in a given voting.
quasiminimal	Logical option to obtain the Quasi-Minimal Winning Coalitions.

**Value**

Johnston	The Jonhston index.
Number of Quasi-Minimal Winning Coalitions	Total amount of Quasi-Minimal Winning Coalitions.
Quasi-Minimal Winning Coalitions	Each row indicates a binary representation of each Quasi-Minimal Winning Coalition.

**Author(s)**

Livino M. Armijos-Toro, Jose M. Alonso-Mejjide, Manuel A. Mosquera, Alejandro Saavedra-Nieves.

**References**

Johnston, R. J. (1978). On the measurement of power: Some reactions to Laver. *Environment and Planning A*, 10(8), 907-914.

**Examples**

```
weights<-c(137,85,71,32,9,8,5,2,1)
quota<-176
pi.johnston(176,weights,quasiminimal=TRUE)
```

---

`pi.johnstoncolomermartinez`*Power based on the Jonhston-Colomer-Martinez index.*

---

**Description**

This function determines the distribution of the power based on the Jonhston-Colomer-Martinez index.

**Usage**

```
pi.johnstoncolomermartinez(quota, weights)
```

**Arguments**

quota	Numerical value that represents the majority in a given voting.
weights	Numerical vector of dimension $n$ that indicates the weights of $n$ agents in a given voting.

**Value**

Jonhston-Colomer-Martinez  
The Jonhston-Colomer-Martinez index.

**Author(s)**

Livino M. Armijos-Toro, Jose M. Alonso-Mejjide, Manuel A. Mosquera, Alejandro Saavedra-Nieves.

**References**

Colomer, J. M., & Martinez, F. (1995). The paradox of coalition trading. *Journal of Theoretical Politics*, 7(1), 41-63.

Johnston, R. J. (1978). On the measurement of power: Some reactions to Laver. *Environment and Planning A*, 10(8), 907-914.

**Examples**

```
weights<-c(137,85,71,32,9,8,5,2,1)
quota<-176
pi.johnstoncolomermartinez(176,weights)
```

---

 pi.shapley

*Power based on the Shapley-Shubik index.*


---

### Description

This function determines the distribution of the power based on the Shapley-Shubik index and the Owen value.

### Usage

```
pi.shapley(quota, weights, partition = NULL)
```

### Arguments

quota	Numerical value that represents the majority in a given voting.
weights	Numerical vector of dimension $n$ that indicates the weights of $n$ agents in a given voting.
partition	Numerical vector that indicates the partition of voters. Each component indicates the element of the partition to which such voter belongs. If it is not NULL, it provides the distribution of the power based on the Owen value.

### Value

Shapley value	The Shapley value, if partition=NULL.
Owen value	The Owen value, if partition!=NULL.

### Author(s)

Livino M. Armijos-Toro, Jose M. Alonso-Mejjide, Manuel A. Mosquera, Alejandro Saavedra-Nieves.

### References

Alonso-Mejjide, J. M., & Bowles, C. (2005). Generating functions for coalitional power indices: An application to the IMF. *Annals of Operations Research*, 137, 21-44.

Lucas, W. F. (1983). Measuring power in weighted voting systems (pp. 183-238). Springer New York.

### Examples

```
# Example Shapley value
weights<-c(137,85,71,32,9,8,5,2,1)
quota<-176
pi.shapley(quota,weights)

# Example Owen value
quota<-30
```



```
weights<-c(28, 16, 5, 4, 3, 3)
# Partition={{1},{2,4,6},{3,5}}
pi.shapley(quota,weights,partition=c(1,2,3,2,3,2))
```

---

powerindex                      *Obtain several measures of power*

---

### Description

This general function allows the determination of several distributions of the power under different approaches in a weighted voting situation.

### Usage

```
powerindex(quota, weights, index = c("S", "B", "J", "CM", "JCM"),
partition = NULL, quasiminimal = FALSE, minimal = FALSE, normalized = FALSE,
swing = FALSE)
```

### Arguments

quota	Numerical value that represents the majority in a given voting.
weights	Numerical vector of dimension $n$ that indicates the weights of $n$ agents in a given voting.
index	Character that indicates the used approach. S and B denote the Shapley-Shubik index and the Banzhaf index, and the Owen index and the Banzhaf-Owen index if partition exist. J is used for obtaining the Jonhston index, CM determines the Colomer-Martinez index and JCM is used for obtaining the Jonhston-Colomer-Martinez index.
partition	Numerical vector that indicates the partition of voters. Each component indicates the element of the partition to which such voter belongs.
quasiminimal	Logical option to obtain the Quasi-Minimal Winning Coalitions.
minimal	Logical option to obtain the Minimal Winning Coalitions.
normalized	Logical option to obtain the normalized Banzhaf values.
swing	Logical option to obtain the number of swings of each voter.

### Value

See the values of the respective functions.

### Author(s)

Livino M. Armijos-Toro, Jose M. Alonso-Mejide, Manuel A. Mosquera, Alejandro Saavedra-Nieves.

## References

- Alonso-Mejjide, J. M., & Bowles, C. (2005). Generating functions for coalitional power indices: An application to the IMF. *Annals of Operations Research*, 137, 21-44.
- Brams, S. J., & Affuso, P. J. (1976). Power and size: A new paradox. *Theory and Decision*, 7(1-2), 29-56.
- Colomer, J. M., & Martinez, F. (1995). The paradox of coalition trading. *Journal of Theoretical Politics*, 7(1), 41-63.
- Johnston, R. J. (1978). On the measurement of power: Some reactions to Laver. *Environment and Planning A*, 10(8), 907-914.
- Lucas, W. F. (1983). Measuring power in weighted voting systems (pp. 183-238). Springer New York.

## Examples

```
weights<-c(137,85,71,32,9,8,5,2,1)
quota<-176
powerindex(quota,weights,index="S")
powerindex(quota,weights,index="B",swing=TRUE)
powerindex(quota,weights,index="B",partition=c(1,1,2,2,3,3,4,4,4),swing=TRUE)
powerindex(quota,weights,index="J",quasiminimal=TRUE)
```

---

QMWC

*Obtain the quasi-minimal winning coalitions*

---

## Description

This function determines the quasi-minimal winning coalitions in a weighted majority game.

## Usage

```
QMWC(quota, weights)
```

## Arguments

quota	Numerical value that represents the majority in a given voting.
weights	Numerical vector of dimension $n$ that indicates the weights of $n$ agents in a given voting.

## Value

Number of Quasi-Minimal Winning Coalitions  
 Total amount of Quasi-Minimal Winning Coalitions.

Quasi-Minimal Winning Coalitions  
 Each row indicates a binary representation of each Quasi-Minimal Winning Coalition.

**Author(s)**

Livino M. Armijos-Toro, Jose M. Alonso-Mejjide, Manuel A. Mosquera, Alejandro Saavedra-Nieves.

**Examples**

```
weights<-c(137,85,71,32,9,8,5,2,1)
quota<-176
QMWC(quota,weights)
```

# Index

## \* **powerindex**

powerindexR-package, [2](#)

MWC, [3](#)

pi.banzhaf, [4](#)

pi.colomermartinez, [5](#)

pi.johnston, [6](#)

pi.johnstoncolomermartinez, [7](#)

pi.shapley, [8](#)

powerindex, [9](#)

powerindexR (powerindexR-package), [2](#)

powerindexR-package, [2](#)

QMWC, [10](#)