Package ‘SetMethods’

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**Description**


**Details**

- **Package:** SetMethods
- **Type:** Package
- **Version:** 4.0
- **Date:** 2023-03-29
- **License:** GPL-2

The package contains functions to perform set-theoretic multi-method research, theory evaluation, QCA for clustered data, Enhanced Standard Analyses, indirect calibration, calculate parameters of fit and produce XY plots and QCA Radar Charts, perform robustness tests, etc.. Furthermore, it contains all the data used in the Schneider and Wagemann (2012) and Oana, Schneider, and Thomann (2021) books.

**Author(s)**

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**References**

ambig.cases

Function for identifying cases with 0.5 fuzzy-set values.

Description
A function that identifies cases with 0.5 fuzzy-set values.

Usage
ambig.cases(data)

Arguments
data
A dataframe, a subset of a dataframe, or a vector (i.e. single column in a
dataframe). If the function is provided with the dataframe it will return the
name of the cases with 0.5 values together with their location in the dataframe.
If the function is provided with a vector (i.e. a single column), it will return
the position of the case having a 0.5 in that vector. The function should be
used for calibrated data and will give an error if the data contains uncalibrated
scores. However, if you have both calibrated and uncalibrated data in the same
dataframe, it is possible to use the function only for the calibrated subset of that
data.

Author(s)
Ioana-Elena Oana

Examples
# Import your data. For example:
data(SCHF)

# Get cases with 0.5 in the entire dataframe:
ambig.cases(SCHF)
# Get cases with 0.5 in the column "EMP" in the dataframe:
ambig.cases(SCHF$EMP)

# Get cases with 0.5 in the 7th column of the dataframe:
ambig.cases(SCH[,7])

Description
The BCMV data frame has 18 rows and 5 variables

Usage
data(BCMV)

Format
A data frame with 18 observations on the following 5 variables.

**GNP** a numeric vector. Condition, Gross National Product/Capita (ca. 1930). 0 if below 500$, 1 if between 550 and 850$, 2 above 850$.

**URB** a numeric vector. Condition, urbanization (population in towns with 20000 and more inhabitants); 0 if below 50 per cent; 1 if above.

**LIT** a numeric vector. Condition, literacy: 0 if below 75 per cent; 1 if above.

**INDUS** a numeric vector. Condition, Industrial Labour Force (incl. mining); 0 if below 30 per cent of active population; 1 if above.

**DEMOC** a numeric vector. Condition, stability of a democracy: 0 if not stable; 1 if stable.

Details
The data are used by Berg-Schlosser and Cronqvist (2005) to demonstrate mvQCA. The original data are from Lipset (1963). Data are multi-value.

References


Examples

data(BCMV)

class

Diagnostic tool for clustered data.

Description

Function returns pooled, within, and between consistencies for the relationship between two sets, for an object of class "qca", and for a Boolean expression.

Usage

cluster(data=NULL, results, outcome,
unit_id, cluster_id, sol = 1,
necessity = FALSE, wicons = FALSE)

Arguments

data A data frame in the long format containing both a column with the unit names and a column with the cluster names. Column names should be in capital letters.

results An object of class "qca". For performing cluster diagnostics of the sufficient solution for the negated outcome one must only use the minimize() result from the sufficiency analysis of the negated outcome. The argument results can also be a vector, a character string, or a boolean expression of the form e.g. "A*B + ~B*C".

outcome A character string with the name of the outcome in capital letters. When performing cluster diagnostics of the sufficient solution for the negated outcome one must only use the minimize() result from the sufficiency analysis of the negated outcome in the argument results. When performing cluster diagnostics for boolean expressions or vectors the negated outcome can be used by inserting a tilde in the outcome name in the argument outcome. The outcome can also be a vector.

unit_id A character string with the name of the vector containing the units (e.g. countries).

cluster_id A character string with the name of the vector containing the clustering units (e.g. years).

sol A vector where the first number indicates the number of the conservative or parsimonious solution according to the order in the "qca" object. For more complicated structures of model ambiguity, the intermediate solution can also be specified by using a character string of the form "c1p3i2" where c = conservative solution, p = parsimonious solution and i = intermediate solution.
necessity Logical. Perform the diagnostic for the relationship of necessity?
wicons Logical. Should within consistencies and coverages be printed?

Author(s)
Ioana-Elena Oana

References

See Also
minimize

Examples

# Import your clustered data in the long format.
# For example:

data(SCHLF)

# Get the intermediate solution:

sol_yi <- minimize(SCHLF, outcome = "EXPORT",
conditions = c("EMP","BARGAIN","UNI","OCCUP","STOCK","MA"),
incl.cut = .9,
include = "?",
details = TRUE, show.cases = TRUE, dir.exp = c(0,0,0,0,0,0))

# Get pooled, within, and between consistencies for the intermediate solution:

cluster(SCHLF, sol_yi, "EXPORT", unit_id = "COUNTRY",
cluster_id = "YEAR", sol = 1)

# or:

cluster(SCHLF, sol_yi, "EXPORT", unit_id = "COUNTRY",
cluster_id = "YEAR", sol = "c1p1i1")

# Get pooled, within, and between consistencies for EMP as necessary for EXPORT:

cluster(SCHLF, results="EMP", outcome="EXPORT", unit_id = "COUNTRY",
cluster_id = "YEAR", necessity=TRUE)

# or:

cluster(results=SCHLF$EMP, outcome=SCHLF$EXPORT, unit_id = SCHLF$COUNTRY,
cluster_id = SCHLF$YEAR, necessity=TRUE)
# Get pooled, within, and between consistencies for ~EMP as necessary for EXPORT:

cluster(SCHLF, results=~"EMP", outcome="EXPORT", unit_id = "COUNTRY",
       cluster_id = "YEAR", necessity=TRUE)

# or:

cluster(results=1-SCHLF$EMP, outcome=SCHLF$EXPORT, unit_id = SCHLF$COUNTRY,
       cluster_id = SCHLF$YEAR, necessity=TRUE)

# Get pooled, within, and between consistencies for EMP*~MA*STOCK as sufficient for EXPORT:

cluster(SCHLF, "EMP*~MA*STOCK", "EXPORT", unit_id = "COUNTRY",
       cluster_id = "YEAR")

# Get pooled, within, and between consistencies for EMP*MA + ~STOCK as sufficient for ~EXPORT:

cluster(SCHLF, "EMP*MA + ~STOCK", "~EXPORT", unit_id = "COUNTRY",
       cluster_id = "YEAR")

---

cluster.plot

Function for plotting pooled, between, and within consistencies for a cluster diagnostics.

Description

Function for plotting pooled, between, and within consistencies for a cluster diagnostics. For a sufficient solution, the function returns plots for the entire solution and each sufficient term.

Usage

cluster.plot(cluster.res, 
             labs = TRUE, 
             size = 5, 
             angle = 0, 
             wicons = FALSE, 
             wiconslabels = FALSE, 
             wiconssize = 5, 
             wiconangle = 90)

Arguments

cluster.res An object of class "cluster.res". This is the result of a cluster diagnostics obtained with the cluster() function.

labs Logical. Should labels for the clusters be printed?

size Label font size for the clusters.

angle Label rotation for the clusters.

wicons Logical. Should within consistency plots be returned?
wiconslabs   Logical. Should labels for the units be printed?

wiconssize   Label font size for the units.

wiconsangle   Label rotation for the units.

Author(s)

Ioana-Elena Oana

References


Examples

# Load the data:
data(PAYF)

# Create a sufficient solution using minimize:
PS <- minimize(data = PAYF,
    outcome = "HL",
    conditions = c("HE","GG","AH","HI","HW"),
    incl.cut = 0.9,
    n.cut = 2,
    include = "?",
    details = TRUE,
    show.cases = TRUE)

PS

# Perform cluster diagnostics:

CB <- cluster(data = PAYF,
    results = PS,
    outcome = "HL",
    unit_id = "COUNTRY",
    cluster_id = "REGION",
    necessity=FALSE,
    wicons = FALSE)

CB

# Plot pooled, between, and within consistencies:

cluster.plot(cluster.res = CB,
    labs = TRUE,
    size = 8,
    angle = 6,
    wicons = TRUE)
Description

The EMMF data frame has 19 rows and 8 sets

Usage

data(EMMF)

Format

A data frame with 19 observations on the following 8 sets.

country a factor with levels Australia Austria Belgium Canada Denmark Finland France Germany Ireland Italy Netherlands NewZealand Norway Portugal Spain Sweden Switzerland UK USA
s  a numeric vector. Condition, state-society relationships.
c  a numeric vector. Condition, non-market coordination.
l  a numeric vector. Condition, strength of the labour movement.
r  a numeric vector. Condition, religious denomination.
v  a numeric vector. Condition, institutional veto points.
jsr a numeric vector. Outcome, job-secturity regulations.

Details

Data are used by Emmenegger (2011) to analyze job-security regulations in Western democracies. The data are fuzzy-sets.

References


Examples

data(EMMF)
esa

Function that performs the Enhanced Standard Analysis.

Description

Function that performs the Enhanced Standard Analysis.

Usage

esa(oldtt, nec_cond, untenable_LR, contrad_rows)

Arguments

oldtt A truthTable object.

nec_cond A vector of character strings containing the necessary conditions. Conditions should be capitalized and negated conditions should be inserted with a "~". Unions of conditions are performed with a "+". Using this argument, logical remainder rows that contradict the statement of necessity will not be used in the analysis (i.e. OUT will be set to 0 in the truth table).

untenable_LR A Boolean expression containing the untenable logical remainders. Conditions should be capitalized and negated conditions should be inserted with a "~". Intersections of conditions are performed with a "*". Using this argument, logical remainder rows containing the particular intersection specified will not be used in the analysis (i.e. OUT will be set to 0 in the truth table).

contrad_rows A vector containing the names of the rows that are contradictory. Using this argument, all rows with the names specified (both logical remainders and rows containing empirical information) will not be used in the analysis (i.e. OUT will be set to 0 in the truth table).

Value

It returns a new truth table in which all truth table rows are set to outcome value 0 that would otherwise present untenable assumptions.

Author(s)

Ioana-Elena Oana

References


See Also

minimize
Examples

# Import your data. For example:

data(SCHF)

# Get the truth table for the presence of the outcome:

TT_y <- truthTable(SCHF, outcome = "EXPORT",
                   conditions = c("EMP","BARGAIN","UNI","OCCUP","STOCK","MA"),
                   incl.cut = .9,
                   complete = TRUE,
                   PRI = TRUE,
                   sort.by = c("out", "incl", "n"))

# Exclude condition STOCK + MA and condition EMP as necessary for EXPORT
# Exclude all remainder rows containing the combination BARGAIN*~OCCUP
# Exclude the rows "19", "14", "46", "51" as contradictory:

newtt <- esa(oldtt = TT_y, nec_cond = c("STOCK+MA", "EMP"),
             untenable_LR = "BARGAIN*~OCCUP", contrad_rows = c("19", "14", "46", "51"))

# The truth table newly created can afterwards be used in further analyses

FakeCS  Fake crisp-set data

Description

The FakeCS data frame has 30 rows and 5 sets

Usage

data(FakeCS)

Format

A data frame with 30 observations on the following 5 sets.

y  a numeric vector. Outcome with 2 categories (crisp-set).

j  a numeric vector. Condition with 2 categories (crisp-set).

z  a numeric vector. Condition with 2 categories (crisp-set).

w  a numeric vector. Condition with 2 categories (crisp-set).

k  a numeric vector. Condition with 2 categories (crisp-set).

Details

The data frame has only exercise purposes to let the user learn how to perform crisp-set QCA in R.
FakeMV

References


Examples

data(FakeCS)

FakeMV

Description

mvQCA data frame has 25 rows and 4 sets.

Usage

data(FakeMV)

Format

A data frame with 25 observations on the following 4 sets.

Y a numeric vector. Outcome with 2 categories (crisp).
A a numeric vector. Condition with 2 categories (crisp).
B a numeric vector. Condition with 3 categories (multi-value).
C a numeric vector. Condition with 3 categories (multi-value).

Details

The data frame has only exercise purpuses to let the user learn how to perform mvQCA in R.

References


Examples

data(FakeMV)
FSR

*Freitag and Schlicht (2009)*

**Description**

The FSR data frame has 16 rows and 8 sets.

**Usage**

data(FSR)

**Format**

A data frame with 16 observations on the following 8 sets.

- `coop_comp_schools` a numeric vector. Condition, percentage of Pupils Enrolled in Cooperative Comprehensive Schools.
- `full_day_schools` a numeric vector. Condition, percentage of Pupils Enrolled in All-Day Schools.
- `child_care` a numeric vector. Condition, ratio of Number of Child Care Facilities to Total Population between 0 and 6 Years (percent).
- `pre_schools` a numeric vector. Condition, ratio of pupils Enrolled in Pre-School to Total 6-Year-Old Population (per cent).
- `early_tracking` a numeric vector. Condition, onset of Tracking, Legal Regulation.
- `outcome` a numeric vector. Outcome, high Degree of Social Inequality Cases in Education.
- `indep_hauptschule` a numeric vector. Condition, autonomy of the Hauptschule.

**Details**

Data are used by Freitag and Schlicht (2009) to analyze social inequality in education. The data are raw scores.

**References**


**Examples**

data(FSR)
**Description**

indirectCalibration is a function for the indirect calibration procedure as described by Ragin (2008). It uses a binomial or a beta regression for transforming raw scores into calibrated scores. In our opinion, using a fractional polynomial may not be appropriate to this case. In fact, we do not deal with proportions. This function requires the package `betareg`.

**Usage**

```r
indirectCalibration(x, x_cal, binom = TRUE)
```

**Arguments**

- `x` vector of raw scores.
- `x_cal` vector of theoretically calibrated scores.
- `binom` logical. If indirect calibration has to be performed using binomial regression or beta regression. The default is `TRUE`, which means that binomial regression is used.

**Value**

It returns a vector of indirectly calibrated values.

**Author(s)**

Mario Quaranta

**References**


**Examples**

```r
# Generate fake data
set.seed(4)
x <- runif(20, 0, 1)

# Find quantiles
quant <- quantile(x, c(.2, .4, .5, .6, .8))

# Theoretical calibration
```
x_cal <- NA
x_cal[x <= quant[1]] <- 0
x_cal[x > quant[1] & x <= quant[2]] <- .2
x_cal[x > quant[2] & x <= quant[3]] <- .4
x_cal[x > quant[3] & x <= quant[4]] <- .6
x_cal[x > quant[4] & x <= quant[5]] <- .8
x_cal[x > quant[5]] <- 1
x_cal

# Indirect calibration (binomial)
a <- indirectCalibration(x, x_cal, binom = TRUE)

# Indirect calibration (beta regression)
b <- indirectCalibration(x, x_cal, binom = FALSE)

# Correlation
cor(a, b)

# Plot
plot(x, a); points(x, b, col = "red")

---

**intersectExp**

*Intersects two boolean expressions.*

---

**Description**

Function that intersects two boolean expressions.

**Usage**

```
intersectExp(expression1, expression2)
```

**Arguments**

- **expression1**
  A boolean expression. Conditions should be capitalized and negated conditions should be inserted with a "~". Unions of conditions are performed with a "+", while intersections are performed with a "*".

- **expression2**
  A boolean expression. Conditions should be capitalized and negated conditions should be inserted with a "~". Unions of conditions are performed with a "+", while intersections are performed with a "*".

**Value**

It returns the boolean expression representing the intersection of the two inputed expressions.

**Author(s)**

Ioana-Elena Oana
JOBF

**Examples**

```r
intersectExp("~EMP*MA", "MA+-STOCK*OCCUP")
intersectExp("~A*B + C+-D","A*B+-D")
```

---

**Description**

Fake fuzzy-set job motivation data used for Chapter 3 of the Oana et al. (forthcoming) book.

**Usage**

```r
data(JOBF)
```

**Format**

A data frame with 17 observations on the following 3 variables.

- **HS** Condition: High salary
- **FS** Condition: Flexible schedule
- **LS** Condition: Lenient supervisor
- **LJS** Condition: Low job security
- **PP** Condition: High promotion potential
- **HM** Outcome: High motivation
- **FSorLS** Condition:

**References**


**Examples**

```r
data(JOBF)
```
Description

The KAF data frame has 13 rows and 5 sets

Usage

data(KAF)

Format

A data frame with 13 observations on the following 5 sets.

supranat  a numeric vector. Government support for supranational CFSP.
identmass  a numeric vector. European identity of the general public.
conform  a numeric vector. Policy conformity.
region  a numeric vector. Regional governance.
capab  a numeric vector. Material capabilities.

Details

Data are used by Koenig-Archibugi (2004) to analyze government preferences for institutional change in EU foreign and security policy. Data are fuzzy-sets.

References


Examples

data(KAF)
Description

The LIPC data frame has 18 rows and 6 sets.

Usage

data(LIPC)

Format

A data frame with 18 observations on the following 6 sets.

DEVELOPED a numeric vector. Condition, economically developed country.
URBAN a numeric vector. Condition, urbanized countries.
LITERATE a numeric vector. Condition, countries with high literacy rate.
INDUSTRIAL a numeric vector. Condition, industrialized countries.
GOVSTAB a numeric vector. Condition, politically stable countries.
SURVIVED a numeric vector. Outcome, survival of democracy during the inter-war period.

Details

Data used by Ragin (2009) to illustrates the variants of QCA. Originally by Lipset (1959). Data are crisp-sets.

References


Examples

data(LIPC)
Description

The LIPF data frame has 18 rows and 6 sets

Usage

data(LIPF)

Format

A data frame with 18 observations on the following 6 sets.

SURVIVED a numeric vector. Outcome, survival of democracy during the inter-war period.
DEVELOPED a numeric vector. Condition, economically developed countries.
URBAN a numeric vector. Condition, urbanized countries.
LITERATE a numeric vector. Condition, countries with high literacy rate.
INDUSTRIAL a numeric vector. Condition, industrialized countries.
STABLE a numeric vector. Condition, politically stable countries.

Details

Data used by Ragin (2009) to illustrates the variants of QCA. Originally by Lipset (1959). Data are fuzzy-sets.

References


Examples

data(LIPF)
Description

The LIPR data frame has 18 rows and 6 variables

Usage

data(LIPR)

Format

A data frame with 18 observations on the following 6 variables.

SURVIVED a numeric vector. Outcome, survival of democracy during the inter-war period.
DEVELOPED a numeric vector. Condition, level of economic development.
URBAN a numeric vector. Condition, level of urbanization.
LITERATE a numeric vector. Condition, level of literacy.
INDUSTRIAL a numeric vector. Condition, level of industrialization.
UNSTABLE a numeric vector. Condition, politically stable countries.

Details

Data used by Ragin (2009) to illustrates the variants of QCA. Originally by Lipset (1959). Data are raw-scores.

References


Examples

data(LIPR)
**LR.intersect**

*Function for identifying contradictory simplifying assumptions or easy counterfactuals.*

### Description

A function for identifying contradictory simplifying assumptions or easy counterfactuals by intersecting the SAs or ECs of two solutions.

### Usage

```r
LR.intersect(results1, results2, sol1 = 1, sol2 = 1)
```

### Arguments

- **results1**
  - An object of class "qca". It can be a parsimonious or an intermediate solution for an outcome or its negation obtained via `minimize()`.

- **results2**
  - An object of class "qca". It can be a parsimonious or an intermediate solution for an outcome or its negation obtained via `minimize()`.

- **sol1**
  - A vector where the first number indicates the number of the conservative or parsimonious solution according to the order in the "qca" object. For more complicated structures of model ambiguity, the intermediate solution can also be specified by using a character string of the form "c1p3i2" where c = conservative solution, p = parsimonious solution and i = intermediate solution.

- **sol2**
  - A vector where the first number indicates the number of the conservative or parsimonious solution according to the order in the "qca" object. For more complicated structures of model ambiguity, the intermediate solution can also be specified by using a character string of the form "c1p3i2" where c = conservative solution, p = parsimonious solution and i = intermediate solution.

### Author(s)

Ioana-Elena Oana

### See Also

`minimize`

### Examples

```r
# Import your data. For example:
data(SCHF)

# Get the parsimonious solution:
sol_yp <- minimize(SCHF, outcome = "EXPORT",)
```
negateExp

negateExp(expression)

Arguments

expression A boolean expression. Conditions should be capitalized and negated conditions should be inserted with a "~". Unions of conditions are performed with a "+", while intersections are performed with a "*".

Value

It returns a negated boolean expression.

Author(s)

Ioana-Elena Oana

Examples

negateExp("~EMP*MA")
negateExp("~A*B + C*D")
Description

The PAYF data frame has 131 rows and 9 sets. The data is calibrated into fuzzy sets.

Usage

data(PAYF)

Format

A data frame with 131 observations on the following 9 sets.

COUNTRY Country
REGION Region the country belongs to.
HE Condition: healthy education system
GG Condition: good governance
AH Condition: affluent health system
HI Condition: high income inequality
HW Condition: high wealth
HL Outcome: high life expectancy
LL Negated Outcome: low life expectancy

References


Examples

data(PAYF)
Description

The PAYR data frame has 131 rows and 9 variables. The data is raw, uncalibrated.

Usage

data(PAYR)

Format

A data frame with 131 observations on the following 9 sets.

COUNTRY  Country
REGION   Region the country belongs to.
LIFEX    Life expectancy, raw data.
EDUC     Education, raw data.
GOV      Governance, raw data.
HEAL     Health system, raw data.
INCEQ    Income inequality, raw data.
WEAL     Wealth, raw data.

References


Examples

data(PAYR)
Description

The PENF data frame has 45 rows and 5 sets

Usage

    data(PENF)

Format

    A data frame with 45 observations on the following 5 sets.

    K  a numeric vector. Outcome, constitutional control.
    C  a numeric vector. Condition, consensus democracy.
    P  a numeric vector. Condition, presidentialism.
    N  a numeric vector. Condition, new democracy.
    R  a numeric vector. Condition, rigid constitution.

Details

    Data used by Pennings (2009) to explain constitutional control. Data are fuzzy-sets.

References

    Pennings, P. (2009) "Beyond Dichotomous Explanations: Explaining Constitutional control of
    University Press: Cambridge.

Examples

    data(PENF)
pimdata  

Function to extract prime implicants table from object of class "qca"

Description

A function that displays each case's set membership scores in each sufficient term, the solution formula, and the outcome from an object of class "qca".

Usage

pimdata(results, outcome, sol = 1, ...)

Arguments

results  

An object of class "qca". For performing pimdata of the sufficient solution for the negated outcome one must only use the minimize() result from the sufficiency analysis of the negated outcome.

outcome  

A character string with the name of the outcome in capital letters. When performing pimdata of the sufficient solution for the negated outcome one must only use the minimize() result from the sufficiency analysis of the negated outcome in the argument results. Changing the name in the argument outcome or using a tilde is not necessary.

sol  

A vector where the first number indicates the number of the conservative or parsimonious solution according to the order in the "qca" object. For more complicated structures of model ambiguity, the intermediate solution can also be specified by using a character string of the form "c1p3i2" where c = conservative solution, p = parsimonious solution and i = intermediate solution.

...

Deprecated arguments (neg.out, use.tilde)

Value

A table with set memberships.

solution_formula  

The solution formula.

out  

Membership in the outcome.

Author(s)

Ioana-Elena Oana and Juraj Medzhorsky

See Also

minimize pimplot
Examples

# Import your data. For example:

data(SCHF)

# Get the parsimonious solution:

sol_yp <- minimize(SCHF, outcome = "EXPORT",
                    conditions = c("EMP","BARGAIN","UNI","OCCUP","STOCK","MA"),
                    incl.cut = .9,
                    include = "?",
                    details = TRUE, show.cases = TRUE)

# Get the intermediate solution:

sol_yi <- minimize(SCHF, outcome = "EXPORT",
                    conditions = c("EMP","BARGAIN","UNI","OCCUP","STOCK","MA"),
                    incl.cut = .9,
                    include = "?",
                    details = TRUE, show.cases = TRUE, dir.exp = c(0,0,0,0,0,0))

# Get the prime implicants table for the parsimonious solution:

pimdata(results = sol_yp, outcome = "EXPORT")

# Get the prime implicants table for the first intermediate solution:

pimdata(results = sol_yi, outcome = "EXPORT", sol = 1)

description

A function that displays XY plots for each sufficient term and the solution formula plotted against the outcome from an object of class "qca" (obtained by using the minimize function in package QCA). The function can also plot truth table rows against the outcome. Additionally, the function can plot results obtained from necessity analyses using an object of class "sS" (obtained by using the superSubset function in package QCA).

Usage

pimplot(data = NULL,
        results, outcome,
        incl.tt=NULL,
Arguments

data

For analyses of sufficiency, providing a dataframe is not necessary. For analyses of necessity on objects of class "sS", you need to provide a dataframe with the name of the outcome and of the conditions in capital letters.

results

An object of class "qca" when necessity is FALSE. An object of class "sS" when necessity is TRUE. For performing pimplot of the sufficient solution for the negated outcome one must use the minimize() result from the sufficiency analysis of the negated outcome.

outcome

A character string with the name of the outcome in capital letters. When performing pimplot of the sufficient solution for the negated outcome one must only use the minimize() result from the sufficiency analysis of the negated outcome in the argument results. Changing the name in the argument outcome or using a tilde is not necessary, but recommended.

incl.tt

A numerical vector of length 1 specifying the row consistency threshold above which it should plot truth table rows. By default it is NULL and the function will produce plots using "qca" or "sS" objects. If a numerical value is specified, then it automatically only plots truth table rows above that consistency value. N.B. This argument cannot be used simultaneously with the ttrows argument.

ttrows

A vector of character strings specifying the names of the truth table rows to be printed. By default this vector is empty and the function will produce plots using "qca" or "sS" objects. If a value is specified, then it automatically only plots those particular truth table rows. N.B. This argument cannot be used simultaneously with the incl.tt argument.

necessity

logical. It indicates if the output should be for the results of sufficiency or necessity analyses. By default, FALSE, the function works with an object of class "qca" obtained from the minimize function in package QCA. When it set to TRUE the function returns plots for an object of class "sS" obtained from the superSubset function in package QCA.

sol

A vector where the first number indicates the number of the conservative or parsimonious solution according to the order in the "qca" object. For more complicated structures of model ambiguity, the intermediate solution can also be specified by using a character string of the form "c1p3i2" where c = conservative solution, p = parsimonious solution and i = intermediate solution.
all_labels Logical. Print ALL case labels?
markers Logical. Print deviant consistency cases with different markers?
labcol Color of the labels.
jitter Logical. Should labels not overlap?
font Font of the labels. Accepts "sans", "serif", and "mono" fonts.
fontface Fontface of the labels. Accepts "plain", "bold", "italic", "bold.italic".
fontsize Fontsize of the labels.
crisp Logical. Should the function return a two-by-two table for crisp sets?
consH Logical. Should Haesebrouck’s consistency be printed?
... Other non essential arguments.

Value

XY plots.

Author(s)

Ioana-Elena Oana

References


See Also

minimize pimdata

Examples

# Import your data. For example:
data(SCHF)

# Get the parsimonious solution:

sol_yp <- minimize(SCHF, outcome = "EXPORT",
                    conditions = c("EMP","BARGAIN","UNI","OCCUP","STOCK","MA"),
                    incl.cut = .9,
                    include = "?",
                    details = TRUE, show.cases = TRUE)

# Plot the prime implicants of the parsimonious solution:
pimplot(data = SCHF, results = sol_yp, outcome = "EXPORT")
property.cube

# Function producing a 3D scatter plot.

Description

A function for visualizing 3D property spaces as a 3D scatter plot using the scatterplot3d package.

Usage

property.cube(data, labs = FALSE,
               main = "3D Property Space",
               xlab=NULL,
               ylab=NULL,
               zlab=NULL,
               highlight.3d=TRUE,
               dot.cex=0.5,
               dot.col="black",
               dot.srt=15,
               dot.pos=3,
               dot.offset = 1)
property.cube

Arguments

data
   A dataframe with 3 conditions.
labs
   Logical. Should the case names be printed? If set to TRUE, it will automatically print the rownames of the dataframe given.
main
   an overall title for the plot. The default is "3D Property Space"

xlab
   a title for the x-axis. The default is the name of the first column in the dataframe.
ylab
   a title for the y-axis. The default is the name of the third column in the dataframe.
zlab
   a title for the z-axis. The default is the name of the second column in the dataframe.
highlight.3d
   Logical. Should dots be colored differently according to their position in the property space?
dot.cex
   size of the case labels
dot.col
   color of the case labels
dot.srt
   rotation of the case labels
dot.pos
   position of the case labels (1-below, 2-left, 3-above, 4-right)
dot.offset
   distance of text label from the dot

Value

It returns an enhanced 3d scatter plot using the scatterplot3d package.

Author(s)

Ioana-Elena Oana

Examples

# Load the Schneider data:
data(SCHF)

# Create a property space for conditions "EMP","BARGAIN", and outcome "EXPORT":
property.cube(SCHF[,c("EMP","BARGAIN","EXPORT")])

# Create a property space for conditions 1,2, and 3 in the data together with case labels:
property.cube(SCHF[,1:3], labs=TRUE)
QCAfit

Function calculating the parameters of fit

Description

QCAfit is a function calculating parameters of fit useful in QCA and fsQCA that are consistency, coverage, PRI, Haesebrouck’s consistency, RoN and PRODUCT. It works with both single and multiple conditions.

Usage

QCAfit(x, y, cond.lab = NULL, necessity = TRUE, neg.out = FALSE, product = FALSE, sol=1, ttrows= c(), consH = FALSE)

Arguments

x: A vector containing the values of a condition, a matrix with more than one conditions, or an object of class "qca" when necessity is FALSE and when outcome is specifyied as a character string.

y: A vector containing the values of the output or a character string when y is of class "qca".

cond.lab: When inserting a dataframe or a matrix with more than one condition and column names, the function automatically prints the names of the conditions tested. When inputing a vector, hence a single condition (i.e. a single column in a dataframe, the name of the condition tested should be inserted in this option.)

necessity: logical. It indicates if the output should be for sufficient or necessary condition(s). By default, FALSE, the function returns a table of parameters of fit for sufficient condition(s) (Consistency, Coverage, PRI, Haesebrouck’s Consistency, and optionally Product). When it set to TRUE the function returns a table of parameters of fit for necessary condition(s) (Consistency, Coverage, Relevance of Necessity).

neg.out: logical. It indicates if the parameters of fit should be computed for the positive or the negative outcome. By default, FALSE, the function returns parameters of fit for the positive outcome.

product: logical. It indicates whether the parameter of fit PRODUCT should be shown. This stands for the product between the consistency sufficiency parameter and the PRI parameter.

sol: A vector where the first number indicates the number of the conservative or parsimonious solution according to the order in the "qca" object. For more complicated structures of model ambiguity, the intermediate solution can also be specified by using a character string of the form "c1p3i2" where c = conservative solution, p = parsimonious solution and i = intermediate solution.

ttrows: A vector specifying the names of the truth table rows for which the function reports parameters of fit. For using this option y must be a "qca" object.

consH: Logical. Print also the Haesebrouck’s consistency among the parameters of fit?
Value

It returns a matrix containing the parameters of fit for each condition.

Author(s)

Mario Quaranta and Ioana-Elena Oana

References


See Also

minimize

Examples

# Generate fake data
set.seed(1234)

a <- runif(100, 0, 1)
b <- runif(100, 0, 1)
c <- runif(100, 0, 1)
y <- runif(100, 0, 1)

# Only one condition, for necessity
QCAfit(a, y, cond.lab = "A")

# With three conditions and their negation, for necessity
QCAfit(cbind(a, b, c), y)

# Only one condition, for sufficiency
QCAfit(a, y, cond.lab = "A", necessity = FALSE)

# With three conditions, their negation and negated output, for necessity
QCAfit(cbind(a, b, c), y, neg.out = TRUE)

# Load the Schneider data:
data(SCHF)

# Get parameters of fit for condition EMP as necessary for outcome EXPORT:
QCAfit(SCHF$EMP, SCHF$EXPORT, cond.lab = "EMP")

# Get parameters of fit for condition ~EMP as necessary for outcome ~EXPORT:
QCAfit(1-SCHF$EMP, SCHF$EXPORT, neg.out=TRUE, cond.lab = "-EMP")

# Get parameters of fit for all conditions and their negation as necessary for outcome EXPORT:
QCAfit(SCHF[,1:6], SCHF$EXPORT)

# Obtain the parsimonious solution for outcome "EXPORT":
sol_yp <- minimize(SCHF, outcome = "EXPORT",
                   conditions = c("EMP","BARGAIN","UNI","OCCUP","STOCK", "MA"),
                   incl.cut = .9,
                   include = "?",
                   details = TRUE, show.cases = TRUE)

# Get parameters of fit for the parsimonious solution:
QCAfit(x = sol_yp, y = "EXPORT", necessity = FALSE)

# Get parameters of fit for truth table rows 2, 8, and 10:
QCAfit(x = sol_yp, y = "EXPORT", ttrows=c("2","8","10"), necessity = FALSE)

---

**QCAradar**

**Function for displaying a radar chart.**

**Description**

Function displays a radar chart for an object of class "qca" or for a boolean expression.

**Usage**

QCAradar(results, outcome= NULL, fit= FALSE, sol = 1)

**Arguments**

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>results</td>
<td>An object of class &quot;qca&quot;. For performing radar charts of the sufficient solution for the negated outcome one must only use the minimize() result from the sufficiency analysis of the negated outcome. The argument results can also be a boolean expression of the form e.g. &quot;A<em>B + ~B</em>C&quot;.</td>
</tr>
<tr>
<td>outcome</td>
<td>A character string with the name of the outcome in capital letters when results is of type ‘qca’. When performing radar charts of the sufficient solution for the negated outcome one must only use the minimize() result from the sufficiency analysis of the negated outcome in the argument results. Changing the name in the argument outcome or using a tilde is not necessary.</td>
</tr>
<tr>
<td>fit</td>
<td>Logical. Print parameters of fit when results is of type 'qca'</td>
</tr>
</tbody>
</table>
sol
A vector where the first number indicates the number of the conservative or parsimonious solution according to the order in the "qca" object. For more complicated structures of model ambiguity, the intermediate solution can also be specified by using a character string of the form "c1p3i2" where c = conservative solution, p = parsimonious solution and i = intermediate solution.

Author(s)
Ioana-Elena Oana

References

See Also
minimize

Examples

# Import data.
# For example:
data(SCHF)

# Get the intermediate solution:
sol_yi <- minimize(SCHF, outcome = "EXPORT",
                   conditions = c("EMP","BARGAIN","UNI","OCCUP","STOCK","MA"),
                   incl.cut = .9,
                   include = "?",
                   details = TRUE, show.cases = TRUE, dir.exp = c(0,0,0,0,0,0))

# Display radar chart for the intermediate solution:
QCAradar(results = sol_yi, outcome = "EXPORT", fit=TRUE, sol = 1)

# Show a radar chart for the following boolean expression "A + ~B*Z*~C"
QCAradar(results = "A + ~B*Z*~C")

---

rob.calibrange
Function for identifying the calibration threshold ranges for a condition within which the Boolean formula for the solution does not change.
rob.calibrange

Description

Function for identifying the calibration threshold ranges for a condition within which the Boolean formula for the solution does not change. The function gradually increases and, then, decreases each of the three (0, 0.5, 1) calibration thresholds of a condition by the value specified in the step argument and checks whether the solution formula changes. The function performs this iteration for the number of times specified in the max.runs argument. If the solution formula does not change given the number of runs specified, it will return an NA, meaning that it could not find a limit to the range.

Usage

rob.calibrange(raw.data,
calib.data,
test.cond.raw,
test.cond.calib,
test.thresholds,
type = "fuzzy",
step = 1,
max.runs = 20,
outcome,
conditions,
incl.cut = 1,
n.cut = 1,
include = "",
...)

Arguments

raw.data  A data frame containing the raw data used to test the calibration thresholds for the chosen condition.
calib.data  A data frame containing the calibrated data for the sufficient solution.
test.cond.raw  A character string specifying the name of the condition in the RAW dataset for which to test the calibration ranges.
test.cond.calib  A character string specifying the name of the condition in the CALIBRATED dataset for which to test the calibration ranges.
test.thresholds  The initial qualitative anchors used for calibrating the chosen condition.
type  The calibration type, "fuzzy" is the default, but it can also be changed to "crisp".
step  The value to be gradually added and subtracted from the threshold tested.
max.runs  The maximum number of times the step value gets gradually added and subtracted.
outcome  A character string with the name of the outcome in capital letters. For the negated outcome a tilde "~" should be used. This had the same usage as the outcome argument in the minimize function.
conditions A vector of character strings containing the names of the conditions. This had
the same usage as the conditions argument in the minimize function.

incl.cut The raw consistency threshold for the truth table rows.

n.cut The frequency threshold for the truth table rows.

include A vector of other output values (for example "?" for logical remainders) to in-
clude in the minimization. This had the same usage as the include argument in
the minimize function.

... Other options that the minimize function in the QCA package accepts. Check
them out using ?minimize.

Author(s)

Ioana-Elena Oana

References

Oana, Ioana-Elena, and Carsten Q. Schneider. 2020. Robustness tests in QCA: A fit-oriented and

Oana, Ioana-Elena, Carsten Q. Schneider, and Eva Thomann (forthcoming). Qualitative Compara-

Examples

# Load the calibrated data:
data(LIPF)

# Load the raw data:
data(LIPR)

# Get calibration ranges for condition DEVELOPED:

rob.calibrange(
  raw.data = LIPR,
  calib.data = LIPF,
  test.cond.raw = "DEVELOPED",
  test.cond.calib = "DEVELOPED",
  test.thresholds = c(400, 550, 900),
  step = 500,
  max.runs = 2,
  outcome = "SURVIVED",
  conditions = c("URBAN", "LITERATE", "INDUSTRIAL", "STABLE"),
  incl.cut = 0.8,
  n.cut = 1,
  include = "?")
rob.cases

Function for identifying cases in the intersections between an initial solution and test solutions.

Description

Function for identifying cases between the various intersections between an initial solution and test solutions. The function also returns case ratio parameters.

Usage

rob.cases(test_sol,
           initial_sol,
           outcome)

Arguments

test_sol  The different alternative solutions created with minimize() and placed in a list using list().
initial_sol  The initial solution created with minimize().
outcome  A character string containing the name of the outcome.

Author(s)

Ioana-Elena Oana

References


Examples

```r
## Not run:
# Load the data:
data(PAYF)

# Store the name of the conditions in one vector:
conds <- c("HE", "GG", "AH", "HI", "HW")

# Create several solutions:

# The initial solution
IS <- minimize(data = PAYF,
                outcome = "HL",
                conditions = conds,
```
incl.cut = 0.87,
n.cut = 2,
include = "?",
details = TRUE,
show.cases = TRUE)

# altering consistency
TS1 <- minimize(data = PAYF,
  outcome = "HL",
  conditions = conds,
  incl.cut = 0.7,
  n.cut = 2,
  include = "?",
  details = TRUE, show.cases = TRUE)

# altering n.cut
TS2 <- minimize(data = PAYF,
  outcome = "HL",
  conditions = conds,
  incl.cut = 0.87,
  n.cut = 1,
  include = "?",
  details = TRUE, show.cases = TRUE)

# Create the test set in a list:
TS <- list(TS1, TS2)

# Looking at cases against the test set:
rob.cases(test_sol = TS,
  initial_sol = IS,
  outcome = "HL")

## End(Not run)

---

**rob.corefit**

*Function returning parameters of fit for the robust core of different alternative sufficient solutions.*

**Description**

Function returning parameters of fit for the robust core between an initial solution and various alternative test solutions.

**Usage**

```
rob.corefit(test_sol, initial_sol, outcome)
```
Arguments

test_sol  The different alternative solutions created with minimize() and placed in a list using list().
initial_sol  The initial solution created with minimize().
outcome  A character string containing the name of the outcome.

Author(s)

Ioana-Elena Oana

References


Examples

# Load the data:
data(PAYF)

# Store the name of the conditions in one vector:
conds <- c("HE", "GG", "AH", "HI", "HW")

# Create several solutions:

# The initial solution
IS <- minimize(data = PAYF,
    outcome = "HL",
    conditions = conds,
    incl.cut = 0.87,
    n.cut = 2,
    include = "?",
    details = TRUE,
    show.cases = TRUE)

# altering consistency
TS1 <- minimize(data = PAYF,
    outcome = "HL",
    conditions = conds,
    incl.cut = 0.7,
    n.cut = 2,
    include = "?",
    details = TRUE, show.cases = TRUE)

# altering n.cut
TS2 <- minimize(data = PAYF,
    outcome = "HL",
    conditions = conds,
incl.cut = 0.87,
n.cut = 1,
include = "?",
details = TRUE, show.cases = TRUE)

# Create the test set in a list:
TS <- list(TS1, TS2)

# Calculate robustness parameters, i.e. the ratio of the parameters
# of fit for the core vis-a-vis for the initial solution:

CF <- rob.corefit(test_sol = TS,
     initial_sol = IS,
     outcome = "HL")

CF

---

rob.fit  

*Function returning robustness parameters of fit.*

---

**Description**

Function returning robustness parameters of fit of the intersections between an initial sufficient solution and various alternative test solutions.

**Usage**

```r
rob.fit(test_sol, initial_sol, outcome)
```

**Arguments**

- `test_sol`: The different alternative solutions created with `minimize()` and placed in a list using `list()`.
- `initial_sol`: The initial solution created with `minimize()`.
- `outcome`: A character string containing the name of the outcome.

**Author(s)**

Ioana-Elena Oana

**References**


Examples

# Load the data:
data(PAYF)

# Store the name of the conditions in one vector:
conds <- c("HE","GG","AH","HI","HW")

# Create several solutions:

# The initial solution
IS <- minimize(data = PAYF,
               outcome = "HL",
               conditions = conds,
               incl.cut = 0.87,
               n.cut = 2,
               include = "?",
               details = TRUE,
               show.cases = TRUE)

# altering consistency
TS1 <- minimize(data = PAYF,
                 outcome = "HL",
                 conditions = conds,
                 incl.cut = 0.7,
                 n.cut = 2,
                 include = "?",
                 details = TRUE, show.cases = TRUE)

# altering n.cut
TS2 <- minimize(data = PAYF,
                 outcome = "HL",
                 conditions = conds,
                 incl.cut = 0.87,
                 n.cut = 1,
                 include = "?",
                 details = TRUE, show.cases = TRUE)

# Create the test set in a list:
TS <- list(TS1, TS2)

# Calculate robustness parameters, i.e. the ratio of the parameters
# of fit for the core vis-a-vis for the initial solution:
RF <- rob.fit(test_sol = TS,
              initial_sol = IS,
              outcome = "HL")
RF

---

**rob.inclrange**

*Function for identifying the raw consistency threshold range within which the Boolean formula for the solution does not change.*
Description

Function for identifying the raw consistency threshold range for a truth table within which the Boolean formula for the solution does not change. The function gradually increases and, then, decreases an initial selected threshold by the value specified in the step argument and checks whether the solution formula changes for finding the lower and upper ranges for the raw consistency threshold. The function performs this iteration for the number of times specified in the max.runs argument. If the solution formula does not change given the number of runs specified, it will return an NA, meaning that it could not find a limit to the range.

Usage

rob.inclrange(data,
   step = 0.1,
   max.runs = 20,
   outcome,
   conditions,
   incl.cut = 1,
   n.cut = 1,
   include = "",
   ...)

Arguments

data A data frame containing the calibrated data for the sufficient solution.
step The value to be gradually added and subtracted from the threshold tested.
max.runs The maximum number of times the step value gets gradually added and subtracted.
outcome A character string with the name of the outcome in capital letters. For the negated outcome a tilde "~" should be used. This had the same usage as the outcome argument in the minimize function.
conditions A vector of character strings containing the names of the conditions. This had the same usage as the conditions argument in the minimize function.
incl.cut The raw consistency threshold for the truth table rows.
n.cut The frequency threshold for the truth table rows.
include A vector of other output values (for example "?" for logical remainders) to include in the minimization. This had the same usage as the include argument in the minimize function.
... Other options that the minimize function in the QCA package accepts. Check them out using ?minimize.

Author(s)

Ioana-Elena Oana
rob.ncutrange

References


Examples

# Load the calibrated data:
data(PAYF)

# Check raw consistency ranges:

rob.inclrange(  
data = PAYF,  
    step = 0.01,  
    max.runs = 10,  
    outcome = "HL",  
    conditions = c("HE","GG","AH","HI","HW"),  
    incl.cut = 0.87,  
    n.cut = 2,  
    include = "?"  
)

---

rob.ncutrange Function for identifying the frequency threshold range within which the Boolean formula for the solution does not change.

Description

Function for identifying the frequency threshold range for a truth table within which the Boolean formula for the solution does not change. The function gradually increases and, then, decreases an initial selected threshold by the value specified in the step argument and checks whether the solution formula changes for finding the lower and upper ranges for the frequency threshold. The function performs this iteration for the number of times specified in the max.runs argument. If the solution formula does not change given the number of runs specified, it will return an NA, meaning that it could not find a limit to the range.

Usage

rob.ncutrange(data,  
    step = 1,  
    max.runs = 20,  
    outcome,  
    conditions,  
    incl.cut = 1,  
    n.cut = 1,  
    include = "?",  
    ...)

Arguments

data  A data frame containing the calibrated data for the sufficient solution.
step  The value to be gradually added and subtracted from the threshold tested.
max.runs  The maximum number of times the step value gets gradually added and subtracted.
outcome  A character string with the name of the outcome in capital letters. For the negated outcome a tilde "~" should be used. This had the same usage as the outcome argument in the minimize function.
conditions  A vector of character strings containing the names of the conditions. This had the same usage as the conditions argument in the minimize function.
incl.cut  The raw consistency threshold for the truth table rows.
n.cut  The frequency threshold for the truth table rows.
include  A vector of other output values (for example "?" for logical remainders) to include in the minimization. This had the same usage as the include argument in the minimize function.
...
Other options that the minimize function in the QCA package accepts. Check them out using ?minimize.

Author(s)

Ioana-Elena Oana

References


Examples

# Load the calibrated data:
data(PAYF)

# Check frequency ranges:
rob.ncutrange(
data = PAYF,
step = 1,
max.runs = 10,
outcome = "HL",
conditions = c("HE","GG","AH","HI","HW"),
incl.cut = 0.87,
n.cut = 2,
include = "?"
)
rob.singletest

Function returning robustness parameters for each single test solution in TS.

Description

Function returning robustness parameters for each single test solution in TS. The function returns the set-coincidence and RC_Rank between each alternative solution and the initial solution.

Usage

rob.singletest(test_sol, initial_sol, outcome)

Arguments

- test_sol: The different alternative solutions created with minimize() and placed in a list using list().
- initial_sol: The initial solution created with minimize().
- outcome: A character string containing the name of the outcome.

Author(s)

Ioana-Elena Oana

References


Examples

# Load the data:
data(PAYF)

# Store the name of the conditions in one vector:
conds <- c("HE", "GG", "AH", "HI", "HW")

# Create several solutions:
IS <- minimize(data = PAYF, outcome = "HL", conditions = conds, incl.cut = 0.87,
# altering consistency
TS1 <- minimize(data = PAYF,
outcome = "HL",
conditions = conds,
incl.cut = 0.7,
n.cut = 2,
include = "?",
details = TRUE, show.cases = TRUE)

# altering n.cut
TS2 <- minimize(data = PAYF,
outcome = "HL",
conditions = conds,
incl.cut = 0.87,
n.cut = 1,
include = "?",
details = TRUE, show.cases = TRUE)

# Create the test set in a list:
TS <- list(TS1, TS2)

# Calculate robustness parameters, i.e. the ratio of the parameters
# of fit for the core vis-a-vis for the initial solution:
RST <- rob.singletest(test_sol = TS,
initial_sol = IS,
outcome = "HL")

RST

---

rob.xyplot: Function for plotting an initial solution against the test set.

### Description

Function for plotting an initial solution against the test set.

### Usage

```r
rob.xyplot(test_sol, initial_sol, outcome, all_labels = FALSE, jitter = TRUE, fontsize = 3, labs = TRUE, area_lab = TRUE)
```
Arguments

test_sol  The different alternative solutions created with minimize() and placed in a list using list().
initial_sol  The initial solution created with minimize().
outcome  A character string containing the name of the outcome.
all_labels  Logical. Should all the case labels be printed? If FALSE, only shaky and possible cases are printed.
jitter  Logical. Should case labels be jitter so as not to overlap?
fontsize  The size of the font for case labels.
labs  Logical. Should case labels be printed?
area_lab  Logical. Should labels for each area with regard to minTS/maxTS be printed?

Author(s)

Ioana-Elena Oana

References


Examples

# Load the data:
data(PAYF)

# Store the name of the conditions in one vector:
conds <- c("HE", "GG", "AH", "HI", "HW")

# Create several solutions:

# The initial solution
IS <- minimize(data = PAYF,
outcome = "HL",
conditions = conds,
incl.cut = 0.87,
n.cut = 2,
include = "?",
details = TRUE,
show.cases = TRUE)

# altering consistency
TS1 <- minimize(data = PAYF,
outcome = "HL",
conditions = conds,
incl.cut = 0.7,
n.cut = 2,
include = "?",
details = TRUE, show.cases = TRUE)

#altering n.cut
TS2 <- minimize(data = PAYF,
outcome = "HL",
conditions = conds,
incl.cut = 0.87,
n.cut = 1,
include = "?",
details = TRUE, show.cases = TRUE)

# Create the test set in a list:
TS <- list(TS1, TS2)

# Plotting the initial solution against the test set:
rob.xyplot(test_sol = TS,
initial_sol = IS,
outcome = "HL",
fontsize = 2.5,
jitter=TRUE)

---

**Description**

The SAMF data frame has 61 rows and 4 sets

**Usage**

data(SAMF)

**Format**

A data frame with 61 observations on the following 4 sets.

Y a numeric vector. Outcome, trade liberalization.
G a numeric vector. Condition, lack of weak growth.
H a numeric vector. Condition, lack of hyper-inflation
HorG a numeric vector. Condition, H or G.

**Details**

Data are used by Samford (2010) to analyze rapid trade liberalization in Latin America. Data are fuzzy-sets.
References


Examples

data(SAMF)

Description

The SC data frame has 130 rows and 4 sets

Usage

data(SC)

Format

A data frame with 130 observations on the following 4 sets.

A a numeric vector. Condition, crisp-set.
B a numeric vector. Condition, crisp-set.
C a numeric vector. Condition, crisp-set.

Details

The authors of the data are Carsten Schnieder and Claudius Wagemann. The data are used in the on-line appendix of "Set-Theoretic Methods for the Social Sciences" to practice the truth table algorithm. Data are crisp-sets.

References


Schneider, C. Q., Wagemann, C., Quaranta, M. (2012) How To... Use Software for Set-Theoretic Analysis. Online Appendix to "Set-Theoretic Methods for the Social Sciences". Available at www.cambridge.org/schneider-wagemann

Examples

data(SC)
Description
The SCHF data frame has 76 observations and 7 sets.

Usage
data(SCHF)

Format
A data frame with 76 observations on the following 7 sets.

EMP a numeric vector. Condition, employment protection.
BARGAIN a numeric vector. Condition, collective bargaining.
UNI a numeric vector. Condition, university training.
OCCUP a numeric vector. Condition, occupational training.
STOCK a numeric vector. Condition, stock market size.
MA a numeric vector. Condition, mergers and acquisitions.
EXPORT a numeric vector. Outcome, export performance in high-tech industries.

Details
Data used by Schneider et. al. (2010) to explain capitalist variety and export performance in high-tech industries. Data are fuzzy-sets.

References

Examples
data(SCHF)
**Description**

The SCHLF data frame has 76 observations and 9 variables.

**Usage**

```r
data(SCHLF)
```

**Format**

A data frame with 76 observations on the following 9 variables.

- **EMP** a numeric vector. Condition, employment protection.
- **BARGAIN** a numeric vector. Condition, collective bargaining.
- **UNI** a numeric vector. Condition, university training.
- **OCCUP** a numeric vector. Condition, occupational training.
- **STOCK** a numeric vector. Condition, stock market size.
- **MA** a numeric vector. Condition, mergers and acquisitions.
- **EXPORT** a numeric vector. Outcome, export performance in high-tech industries.
- **COUNTRY** a string vector. Name of the country in which the observation was made.
- **YEAR** a numeric vector. Year in which the observation was made.

**Details**

Data used by Schneider et. al. (2010) to explain capitalist variety and export performance in high-tech industries. Data is saved in the long format and the first 7 variables are fuzzy-sets.

**References**


**Examples**

```r
data(SCHLF)
```
Description

The SDC data frame has 98 rows and 4 sets

Usage

data(SDC)

Format

A data frame with 98 observations on the following 4 sets.

A  a numeric vector. Condition, crisp-set.
B  a numeric vector. Condition, crisp-set.
C  a numeric vector. Condition, crisp-set.
Y  a numeric vector. Outcome, crisp-set.

Details

The authors of the data are Carsten Schnieder and Claudius Wagemann. The data are used in the on-line appendix of "Set-Theoretic Methods for the Social Sciences" to show the disappearance of a necessary condition. Data are crisp-sets.

References


Schneider, C. Q., Wagemann, C., Quaranta, M. (2012) How To... Use Software for Set-Theoretic Analysis. Online Appendix to "Set-Theoretic Methods for the Social Sciences". Available at www.cambridge.org/schneider-wagemann

Examples

data(SDC)
skew.check

Function for checking how skewed sets are.

Description

A function that identifies how skewed sets are by returning the number and percentage of cases with higher than 0.5 fuzzy-set values. The function can also return histograms of the calibrated sets.

Usage

skew.check(data, hist = FALSE, main = NULL)

Arguments

data | A datafarme, a subset of a dataframe, or a vector (i.e. single column in a dataframe). The function should be used for calibrated data and will give an error if the data contains uncalibrated scores. However, if you have both calibrated and uncalibrated data in the same dataframe, it is possible to use the function only for the calibrated subset of that data.

hist | Logical. Should the function also return histograms of the sets?

main | Title for the plot. When provided with a dataframe, the function automatically assigns the column name to the plot.

Author(s)

Ioana-Elena Oana

Examples

# Import your data. For example:
data(SCHF)

# Check skewness for the entire dataframe:
skew.check(SCHF)

# Check skewness for the column "EMP" in the dataframe:
skew.check(SCHF$EMP)

# Check skewness for the 5th column of the dataframe:
skew.check(SCHF[,5])
Function for performing set-theoretic multi-method research.

Description
A function that selects best available cases for single case studies and best pairs of matching cases for comparative case studies.

Usage

```r
smmr(results, outcome, sol = 1, match = NULL,
     cases = NULL, max_pairs = 5, term = 1, nec.cond =NULL, necessity = FALSE, ...)
```

Arguments

- **results**
  - An object of class "qca".
- **outcome**
  - A character string with the name of the outcome. If the negated outcome is analyzed, one can also write for example outcome = "~Y", however this is unnecessary as the values in the outcome will be taken from the appropriate minimized solution.
- **sol**
  - A vector where the first number indicates the number of the conservative or parsimonious solution according to the order in the "qca" object. For more complicated structures of model ambiguity, the intermediate solution can also be specified by using a character string of the form "c1p3i2" where c = conservative solution, p = parsimonious solution and i = intermediate solution.
- **match**
  - Logical. Should comparative SMMR be used?
- **cases**
  - A numerical vector indicating the type of cases to be returned. For single case studies for SUFFICIENCY:
    1 = typical cases,
    2 = typical cases for each focal conjunct in a sufficient term,
    3 = deviant consistency,
    4 = deviant coverage,
    5 = individually irrelevant,
    6 = all of the above;
  For comparative case studies for SUFFICIENCY:
    1 = Typical-Typical for each focal conjunct in a sufficient term,
    2 = Typical-IIR for each focal conjunct in a sufficient term,
    3 = Typical-Dev.Cons.,
    4 = Dev.Cov.-IIR;
    5 = Typical-Typical for each term;
    6 = Typical-IIR for each term;
    7 = all of the above;
  For single case studies for NECESSITY:
    1 = typical cases,
    2 = deviant consistency,
    3 = deviant relevance,
4 = all of the above;
For comparative case studies for NECESSITY:
1 = Typical-Deviant Relevance,
2 = Typical-Deviant Consistency,
3 = Typical-IIR,
4 = Typical-Typical,
5 = all of the above;
max_pairs  Maximum number of pairs to extract.
term  A numeric vector where the first number indicates the number of the term according to the order in the "qca" object.
nec.cond  A character vector specifying the necessity results obtained. This could be of the form "A", "A+B", or "A*B", making sure no spaces are left between the name of the conditions and the Boolean operator. Notice that nec.cond can also be specified for sufficiency results in single SMMR typical cases for each focal conjunct in a sufficient term, and for comparative SMMR in typical-typical and typical-iir comparisons for each focal conjunct. Note that in the later case only expressions of the forms "A" or "A+B" are accepted. If dealing with a necessary condition of the form "A*B", each of the individual conditions should be entered separately when performing analyses of sufficiency.
necessity  Logical. Should SMMR results for necessity be shown?

Author(s)
Ioana-Elena Oana

References

See Also
minimize

Examples
# Import your data. For example:
data(SCHF)

## SUFFICIENCY SMMR examples:
# Get the parsimonious solution:
sol_yp <- minimize(SCHF, outcome = "EXPORT",
conditions = c("EMP","BARGAIN","UNI","OCCUP","STOCK", "MA"),
incl.cut = .9,
include = "?",

...
stargazerSol

Function for exporting a sufficient solution from minimize in latex, html, or text format.

Description
Function for exporting a sufficient solution from minimize in latex, html, or text format.

Usage
stargazerSol(results, outcome, sol = 1, show.cases = FALSE,
type = "latex",
    title = "",
    out = NULL,
    digits = 3)

Arguments

results  An object of class "qca": a sufficient solution obtained with the minimize function.
outcome   A character string with the name of the outcome in capital letters. When performing pimplot of the sufficient solution for the negated outcome one must only use the minimize() result from the sufficiency analysis of the negated outcome in the argument results. Changing the name in the argument outcome or using a tilde is not necessary, but recommended.
sol   A vector where the first number indicates the number of the conservative or parsimonious solution according to the order in the "qca" object. For more complicated structures of model ambiguity, the intermediate solution can also be specified by using a character string of the form "c1p3i2" where c = conservative solution, p = parsimonious solution and i = intermediate solution.
show.cases Logical. Should the names of cases be printed?
type     character string that specifies what type of output the command should produce. The possible values are "latex" (default), "html", "text".
title    title for the table.
out      name of the file to be saved containing the extension (e.g. "mysol.tex", "mysol.txt")
digits   To how many digits should the parameters of fit be rounded up.

Author(s)

Ioana-Elena Oana

References


Examples

# Import your data. For example:

data(SCHF)

# Get the parsimonious solution:

sol_yp <- minimize(SCHF, outcome = "EXPORT",
                    conditions = c("EMP","BARGAIN","UNI","OCCUP","STOCK", "MA"),
                    incl.cut = .9,
                    include = "?",
                    show.cases = TRUE,
                    type = "latex",
                    title = "",
                    out = NULL,
                    digits = 3)
stargazerTT

Function for exporting a sufficient solution from minimize in latex, html, or text format.

Description

Function for exporting a sufficient solution from minimize in latex, html, or text format.

Usage

stargazerTT(truthtable,
    show.cases = FALSE,
    type = "latex",
    title = "",
    out = NULL,
    digits = 3)

Arguments

  truthTable A truth table obtained with the truthTable function.
  show.cases Logical. Should the names of cases be printed?
  type character string that specifies what type of output the command should produce. The possible values are "latex" (default), "html", "text".
  title title for the table.
  out name of the file to be saved containing the extension (e.g. "mysol.tex", "mysol.txt")
  digits To how many digits should the parameters of fit be rounded up.

Author(s)

Ioana-Elena Oana

References

Examples

# Import your data. For example:
data(SCHF)

# Get the truth table:
mytt <- truthTable(SCHF, outcome = "EXPORT",
                 conditions = c("EMP","BARGAIN","UNI","OCCUP","STOCK","MA"),
                 incl.cut = .9, complete = TRUE)

# Export as latex:
stargazerTT(mytt)

# Export as text:
stargazerTT(mytt, type = "text")

STUF
Fake fuzzy-set student data.

Description
Fake fuzzy-set football practice data used for Chapter 4 of the Oana et al. (forthcoming) book.

Usage
data(STUF)

Format
A data frame with 17 observations on the following 3 variables. Conditions for arriving in time for football practice.
A Condition: Live close by
B Condition: Arrive by bike
C Condition: Come from punctual familie
D Condition: Are seasoned players
E Condition: Goalkeepers
Y Outcome: Arrive on time for football practice

References

Examples
data(STUF)
theory.evaluation

**STUR**  
*Fake raw, student data.*

**Description**
Fake raw, student data used for Chapter 2 of the Oana et al. (forthcoming) book.

**Usage**

data(STUR)

**Format**
A data frame with 17 observations on the following 3 variables.

- **MARK**  Cond.: student mark
- **PARTICIPATION**  Cond.: quality and correctness of the student’s comments in class,
- **PEERS**  Cond.: extent to which the student engages with and helps peers during interactive in-class teaching exercises

**References**

**Examples**

data(STUR)

---

**theory.evaluation**  
*Performs theory evaluation.*

**Description**
Function that returns membership of cases in the intersections between theory and the empirical solution in the form of a data frame, the names of cases in the intersections between theory and the empirical solution, and the parameters of fit for these intersections.

**Usage**

thory.evaluation(theory, empirics, outcome, sol = 1, print.fit=FALSE, print.data=FALSE, consH = FALSE, ...)


Arguments

theory A character string specifying the theory. Unions of conditions are performed with a "+", while intersections are performed with a "*". Conditions should be capitalized and negated conditions should be inserted with a "~".

empirics An object of class 'qca'. When performing analyses for the negated outcome, just use the results from the `minimize()` function for the negation of the outcome.

outcome A character string with the name of the outcome. When performing analyses of the sufficient solution for the negated outcome one must only use the `minimize()` result from the sufficiency analysis of the negated outcome in the argument empirics. Changing the name in the argument outcome or using a tilde is not necessary.

sol A vector where the first number indicates the number of the conservative or parsimonious solution according to the order in the "qca" object. For more complicated structures of model ambiguity, the intermediate solution can also be specified by using a character string of the form "c1p3i2" where c = conservative solution, p = parsimonious solution and i = intermediate solution.

print.data Logical. Print also the membership of cases in all the intersections between theory and empirics?

print.fit Logical. Print also the parameters of fit for the intersections between theory and empirics?

consH Logical. Print also the Haesebrouck’s consistency among the parameters of fit?

... Deprecated arguments (use.tilde).

Author(s)

Ioana-Elena Oana

References


See Also

minimize

Examples

## Not run:
# Import your data. For example:

data(SCHF)

# Get the intermediate solution:
sol_yi <- minimize(SCHF, outcome = "EXPORT",
                   conditions = c("EMP","BARGAIN","UNI","OCCUP","STOCK","MA"),
                   incl.cut = .9,
                   include = "?",
                   details = TRUE, show.cases = TRUE, dir.exp = c(0,0,0,0,0,0))

# Specify the theory. Let's assume the theory says that the
# absence of EMP and the presence of MA is sufficient for EXPORT:

t<="~EMP*MA"

# Perform theory evaluation (get only the names of the cases and the Boolean intersections):

TH <- theory.evaluation(theory = t, empirics = sol_yi, outcome = "EXPORT", sol = 1,
                        print.data=FALSE, print.fit=FALSE)

TH

# Get only the case names:

TH$cases

# Or only the parameters of fit:

TH$fit

## End(Not run)

Description

The THOF data frame has 76 rows and 7 sets. The study analyses how European Union (EU) member
states adapt EU directives to domestic contexts during transposition and asks how and why fully
compliant countries 'customize' EU directives.

Usage

data(THOF)

Format

A data frame with 76 observations on the following 7 sets.

RESP Cond.: Responsive regulatory mode
SAL Cond.: Salient issue
VISC

RES  Cond.: Domestic resistance
VPO  Cond.: Many veto points
VPL  Cond.: Many veto players
COERC Cond.: Coercive interventionist style
CUSTOM Outcome: Extensive customization

Details

Data used by Thomann (2015) to explain customization. Data are fuzzy-sets.

References


Examples

data(THOF)

data(VISC)

Description

The VISC data frame has 25 rows and 4 sets

Usage

data(VISC)

Format

A data frame with 25 observations on the following 4 sets.

P  a numeric vector. Condition, weak political positions, with parties in government expecting losses at the next election.
S  a numeric vector. Condition, deteriorating economic situation.
R  a numeric vector. Condition, government dominated by parties from the right of the political spectrum.
U  a numeric vector. Outcome, unpopular reform.

Details

Data are used by Vis (2009) to analyze the pursuit of unpopular reforms by governments. Data are crisp-sets.
References

Examples
data(VISC)

### Description
The VISF data frame has 25 rows and 4 sets

### Usage
data(VISF)

### Format
A data frame with 25 observations on the following 4 sets.
- **p**: a numeric vector. Condition, weak political positions, with parties in government expecting losses at the next election.
- **s**: a numeric vector. Condition, deteriorating economic situation.
- **r**: a numeric vector. Condition, government dominated by parties from the right of the political spectrum.
- **u**: a numeric vector. Outcome, unpopular reform.

### Details
Data are used by Vis (2009) to analyze the pursuit of unpopular reforms by governments. Data are fuzzy-sets.

### References

### Examples
data(VISF)
**xy.plot**

*Function producing enhanced XY plots*

**Description**

xy.plot produces XY plots and provides values for consistency, Haesebrouck's consistency, coverage, RoN, PRI. Several graphic parameters can be decided by the user.

**Usage**

```r
xy.plot(x, y, data,
    labcol = "black",
    main = "XY plot",
    ylab = "Outcome",
    xlab = "Condition",
    necessity = FALSE,
    jitter = FALSE,
    font = "sans",
    fontface = "italic",
    fontsize = 3,
    labs = rownames(data),
    crisp = FALSE,
    shape = 19,
    consH = FALSE,
    ...)
```

**Arguments**

- **x**: vector containing the condition.
- **y**: vector containing the outcome.
- **data**: The dataset used.
- **labcol**: color of the dots.
- **main**: an overall title for the plot. The default is "XY plot". See ?title.
- **ylab**: a title for the y-axis. The default is "Outcome". See ?title.
- **xlab**: a title for the x-axis. The default is "Condition". See ?title.
- **necessity**: logical. Indicates if the parameters of fit are calculated for a sufficient or necessary condition. The default is FALSE, therefore it calculates the parameters of fit for sufficiency. To get the parameters of fit for necessary conditions set necessity as TRUE.
- **jitter**: Logical. Should labels be jitter to not overlap?
- **font**: Font of the labels. Accepts "sans", "serif", and "mono" fonts.
- **fontface**: Fontface of the labels. Accepts "plain", "bold", "italic", "bold.italic".
- **fontsize**: Fontsize of the labels.
labs the vector of case labels. The default is the rownames of the dataset.
crisp Logical. Should a two-by-two table for crisp sets be returned?
shape The shape for the markers.
consH Logical. Should Haesebrouck’s consistency be printed?
... Other internal arguments. Do not specify!

Value

It returns an enhanced XY plot.

Author(s)

Mario Quaranta and Ioana-Elena Oana.

References


Examples

# Load the Schneider data:

data(SCHF)

# Plot of condition EMP as necessary for outcome EXPORT with case labels
# and names for the plot and axes:

xy.plot("EMP", "EXPORT", data=SCHF, necessity = TRUE,
         main = "EMP as necessary for EXPORT", ylab = "EXPORT", xlab = "EMP")
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