Package ‘mutualinf’

October 28, 2021

Type Package
Title Computation and Decomposition of the Mutual Information Index
Version 1.1.2
Description The Mutual Information Index (M) introduced to social science literature by Theil and Finizza (1971) <doi:10.1080/0022250X.1971.9989795> is a multigroup segregation measure that is highly decomposable and that according to Frankel and Volij (2011) <doi:10.1016/j.jet.2010.10.008> and Mora and Ruiz-Castillo (2011) <doi:10.1111/j.1467-9531.2011.01237.x> satisfies the Strong Unit Decomposability and Strong Group Decomposability properties. This package allows computing and decomposing the total index value into its "between" and "within" terms. These last terms can also be decomposed into their contributions, either by group or unit characteristics. The factors that produce each "within" term can also be displayed at the user's request. The results can be computed considering a variable or sets of variables that define separate clusters.
License GPL-3
Imports data.table, parallel, runner, stats
Encoding UTF-8
LazyData true
URL https://github.com/RafaelFuentealbaC/mutualinf
BugReports https://github.com/RafaelFuentealbaC/mutualinf/issues
Depends R (>= 2.10)
RoxygenNote 7.1.1
Collate 'Data_Source.R' 'get_general_contribution.R'
  'get_proportion.R' 'get_internal_data.R' 'M_within.R'
  'mutual.R' 'get_contribution.R' 'M_value.R' 'M.R' 'globals.R'
  'prepare_data.R'
NeedsCompilation no
Author Rafael Fuentealba-Chaura [aut, cre], Ricardo Mora [aut], Julio Rojas-Mora [aut],
mutualinf-package

An R package to compute and decompose the Mutual Information Index (M).

Description

The Mutual Information Index (M) introduced to the social sciences by Theil and Finizza (1971). The M index is a multigroup segregation measure that is highly decomposable, satisfying both the Strong Unit Decomposability (SUD) and the Strong Group Decomposability (SGD) properties (Frankel and Volij, 2011; Mora and Ruiz-Castillo, 2011).

The package allows for:

- The computation of the M index, either overall or over subsamples defined by the user.
- The decomposition of the M index into a "between" and a "within" term.
- The identification of the "exclusive contributions" of segregation sources defined either by group or unit characteristics.
- The computation of all the elements that conform the "within" term in the decomposition.
- Fast computation employing more than one CPU core in Mac, Linux, Unix, and BSD systems. This option uses the data.table and parallel libraries (which Windows does not permit to run with more than one CPU core).

Author(s)

Rafael Fuentealba-Chaura <rfuentealba@inf.uct.cl>
Ricardo Mora <ricmora@eco.uc3m.es>
Julio Rojas-Mora <jrojas@inf.uct.cl>
References


DF_Seg_Chile

Segregation data in southern Chile

Description

The data set included in this package was built using two data sets. The first one is the student enrollment reported by the Ministry of Education (MINEDUC, [https://datosabiertos.mineduc.cl/](https://datosabiertos.mineduc.cl/)) for students of primary education (first eight years of formal education) who attended establishments officially recognized by the State. The second one is the Quality and Context of Education Questionnaire for Parents and Guardians, and the Student Questionnaire, both applied by the Education Quality Agency ([https://www.agenciaeducacion.cl/](https://www.agenciaeducacion.cl/)) to all students in grades 4 and 8 of primary education. Both sources are limited to the period 2016-2018. Contains information related to students and educational system characteristics in southern Chile (Biobío, La Araucanía and Los Ríos regions).

Usage

DF_Seg_Chile

Format

A data frame with 191495 observations and 11 variables:

- **year** Student enrollment year. From 2016 to 2018.
- **school** School ID (RBD, Rol de Base de Datos).
- **district** Administrative district where the school is located.
**DT_Seg_Chile**

- **csep** Preferential Scholar Subsidy Category (from the Spanish Categoría de Sub-vención Escolar Preferencial). Students belong to either the non-subsidized, the partially-subsidized, or the subsidized group according to the Act 20.248 of Preferential Scholar Subsidy (SEP).
- **ethnicity** Self-reported Mapuche ethnicity. Students belong to Mapuche ethnicity or not.
- **rural** School with multiage classrooms. The school is located in an urban zone or not.
- **region** Administrative region where the school is located. Schools can belong either Biobío region, La Araucania region or Los Ríos region.
- **sch_type** Whether the school is public, charter, or private.
- **gender** Student gender code. Students can either be female or male.
- **grade** Student grade. Students can either belong to the 4th (4) or 8th (8) grade of basic school.
- **nobs** Number of students in a cell or combination of variables.

**Source**

Ministry of Education (MINEDUC): [https://datosabiertos.mineduc.cl/](https://datosabiertos.mineduc.cl/)
Education Quality Agency: [https://www.agenciaeducacion.cl/](https://www.agenciaeducacion.cl/)

---

**DT_Seg_Chile**

**Segregation data in southern Chile**

**Description**

The data set included in this package was build using two data sets. The first one is the student enrollment reported by the Ministry of Education (MINEDUC, [https://datosabiertos.mineduc.cl/](https://datosabiertos.mineduc.cl/)) for students of primary education (first eight years of formal education) who attended establishments officially recognized by the State. The second one is the Quality and Context of Education Questionnaire for Parents and Guardians, and the Student Questionnaire, both applied by the Education Quality Agency ([https://www.agenciaeducacion.cl/](https://www.agenciaeducacion.cl/)) to all students in grades 4 and 8 of primary education. Both sources are limited to the period 2016-2018. Contains information related to students and educational system characteristics in southern Chile (Biobío, La Araucania and Los Ríos regions).

**Usage**

DT_Seg_Chile

**Format**

A data table with 55960 observations and 11 variables:

- **year** Student enrollment year. From 2016 to 2018.
- **school** School ID (RBD, Rol de Base de Datos).
- **district** Administrative district where the school is located.
DT_test

preferential scholar subsidy category (from the Spanish: Categoría de Sub-vención Escolar Preferencial). Students belong to either the non-subsidized, the partially-subsidized, or the subsidized group according to the Act 20.248 of Preferential Scholar Subsidy (SEP).

ethnicity self-reported Mapuche ethnicity. Students belong to Mapuche ethnicity or not.

rural school with multiage classrooms. The school is located in a urban zone or not.

region administrative region where the school is located. Schools can belong either Biobio region, La Araucania region or Los Rios region.

sch_type whether the school is public, charter, or private.

gender student gender code. Students can either be female or male.

grade student grade. Students can either belong to the 4th (4) or 8th (8) grade of basic school.

nobs number of students in a cell or combination of variables.

Source


Education Quality Agency: https://www.agenciaeducacion.cl/

Description

The data set included in this package was build using two data sets. The first one is the student enrollment reported by the Ministry of Education (MINEDUC, https://datosabiertos.mineduc.cl/) for students of primary education (first eight years of formal education) who attended establishments officially recognized by the State. The second one is the Quality and Context of Education Questionnaire for Parents and Guardians, and the Student Questionnaire, both applied by the Education Quality Agency (https://www.agenciaeducacion.cl/) to all students in grades 4 and 8 of primary education. Both sources are limited to 2018. Contains information related to students and educational system characteristics in southern Chile (Biobio, La Araucania and Los Rios regions).

Usage

DT_test

Format

A data frame with 6703 observations and 5 variables, only for testing purposes:

school School ID (RBD, Rol de Base de Datos).

csep Preferential Scholar Subsidy Category (from the Spanish: Categoría de Sub-vención Escolar Preferencial). Students belong to either the non-subsidized, the partially-subsidized, or the subsidized group according to the Act 20.248 of Preferential Scholar Subsidy (SEP).

ethnicity Self-reported Mapuche ethnicity. Students belong to Mapuche ethnicity or not.

region Administrative region where the school is located. Schools can belong either Biobio region, La Araucania region or Los Rios region.

fw Number of students in a cell or combination of variables.
mutual

Computes and decomposes the Mutual Information index

Description

Computes and decomposes the Mutual Information index into "between" and "within" terms. The "within" terms can also be decomposed into "exclusive contributions" of segregation sources defined either by group or unit characteristics. The mathematical components required to compute each "within" term can also be displayed at the user’s request. The results can be computed over subsamples defined by the user.

Usage

mutual(
  data,
  group,
  unit,
  within = NULL,
  by = NULL,
  contribution.from = NULL,
  components = FALSE,
  cores = NULL
)

Arguments

data An object from the "data.table" and "mutual.data" classes.
group A categorical variable name or vector of categorical variables names contained in data, or also, a column number or vector of column numbers of data. Defines the first dimension over which segregation is computed.
unit A categorical variable name or vector of categorical variables names contained in data, or also, a column number or vector of column numbers of data. Defines the second dimension over which segregation is computed.
within A categorical variable name or vector of categorical variables names contained in data, or also, a column number or vector of column numbers of data. Defines the partitions to compute the between and within decompositions. By default is NULL.
by A categorical variable name or vector of categorical variables names contained in data, or also, a column number or vector of column numbers of data. Defines the subsamples over which indexes are computed. By default is NULL.
contribution.from

A variable of character type that can be 'group_vars' or 'unit_vars', or also, a
categorical variable name or vector of categorical variables names contained in
the group parameter or unit parameter, or also, a column number or vector of
column numbers in the group parameter or the unit parameter. Defines the
segregation sources whose exclusive contributions to the "within" terms and the
overall index are computed. By default is NULL.

components

A boolean value. If TRUE and the within option is not NULL and the by option is
NULL, then it returns a list where the first element is a data.table that contains
a summary of the index total value and its decompositions, while the second
element is a data.table with more detailed information of the decomposition
of the "within" term (the mathematical components required to compute the
within terms). If the within and by options are not NULL, then the function
returns a list of lists where each first element is a data.table that contains
the summary of the index total value and decompositions in a given subsample,
while each second element is a data.table with more detailed information of
the decomposition of the within term displayed in each first element in the same
subsample. By default is FALSE.

cores

A positive integer. Defines the amount of CPU cores to use in parallelization
tasks. If NULL, then the computation is carried out in only one core. This op-
tion is available to Mac, Linux, Unix, and BSD systems but is not available to
Windows systems. By default is NULL.

Details

Mixing group variables with unit variables in contribution.from will produce an error.

Value

A data.table if the components option is FALSE; a list if the components option is TRUE, the
within option is not NULL and the by option is NULL; or a list of lists if the components option is
TRUE, and both within and by options are not NULL.

References


de Economía.


0022250X.1971.9989795.
Examples

# To compute the overall measure of school segregation by socioeconomic and ethnic status.
mutual(data = DT_test, group = c("csep", "ethnicity"), unit = "school")

# Computation of the exclusive effect of specific segregation sources on the overall measure, e.g.,
# socioeconomic and ethnic contributions, and the contribution that cannot be attributed to any of
# them (the "interaction" term).
mutual(data = DT_test, group = c("csep", "ethnicity"), unit = "school", by = "region",
       contribution.from = "group_vars")

# For more information on the package, refer to the manual and the README file.

prepare_data

Prepares the data to be used by the mutual function

Description

Receives the data that is later used in the mutual function. Generates a data.table with the entry
variables.

Usage

prepare_data(data, vars, fw = NULL, col.order = NULL)

Arguments

data A tabular format object (data.frame, data.table, tibble). The data expected
      is microdata or frequency weight data for each combination of variables. The
      variables must be of "factor" class.

vars A vector of variable names or vector of columns numbers contained in data.
      Also can be used "all_vars" to select all variables contained in data.

fw Variable name or column number contained in data that contains frequency
       weight for each combination of variables of the dataset. If this variable exists
       then the function will change its original name to fw. If this variable does not
       exist or is NULL, then the function will compute the frequency weight given the
       combination of variables of vars and will create a new variable called fw. By
       default is NULL.

col.order A variable name or vector of variables names contained in vars, or a column
           number or vector of column numbers contained in vars. Selects the columns to
           sort the dataset. By default is NULL.

Value

Returns a data.table of class "data.table" "data.frame" "mutual.data".
## Examples

```r
## Not run:
# Using some variable names in 'data' with explicit 'fw'.
my_data <- prepare_data(data = DF_Seg_Chile, vars = c("csep", "ethnicity", "school", "district"),
fw = "nobs")

# Using some column numbers in 'data' and explicit 'fw' as another column number.
my_data <- prepare_data(data = DF_Seg_Chile, vars = c(4, 5, 2, 3), fw = 11)

# Using all variables of 'data' with explicit 'fw'.
my_data <- prepare_data(data = DF_Seg_Chile, vars = "all_vars", fw = "nobs")

# Using some variable names in 'data' and 'fw' does not exist (in this case, the new 'fw' will
# be equal to 1 for all variable combinations as 'data' already has a frequency weights variable)
my_data <- prepare_data(data = DF_Seg_Chile, vars = c("csep", "ethnicity", "school", "district"))

# Using the 'col.order' option to sort data according to the 'csep' column.
my_data <- prepare_data(data = DF_Seg_Chile, vars = c("csep", "ethnicity", "school", "district"),
fw = "nobs", col.order = "csep")

# The class of the resulting object in all cases must be "data.table", "data.frame" and
# "mutual.data".
class(my_data)

## End(Not run)
```
Index

* datasets
  DF_Seg_Chile, 3
  DT_Seg_Chile, 4
  DT_test, 5
* package
  mutualinf-package, 2

DF_Seg_Chile, 3
DT_Seg_Chile, 4
DT_test, 5

mutual, 6
mutualinf-package, 2

prepare_data, 8