Package ‘multimorbidity’

August 20, 2021

Title Harmonizing Various Comorbidity, Multimorbidity, and Frailty Measures

Version 0.5.0

Description Identifying comorbidities, frailty, and multimorbidity in claims and administrative data is often a duplicative process. The functions contained in this package are meant to first prepare the data to a format acceptable by all other packages, then provide a uniform and simple approach to generate comorbidity and multimorbidity metrics based on these claims data. The package is ever evolving to include new metrics, and is always looking for new measures to include. The citations used in this package include the following publications:

- Anne Elixhauser, Claudia Steiner, D. Robert Harris, Rosanna M. Coffey (1998) <doi:10.1097/00005650-199801000-00004>,
- Richard A. Deyo, Daniel C. Cherkin, Marcia A. Ciol (1992) <doi:10.1016/0895-4356(92)90133-8>,
- Hude Quan, Vijaya Sundararajan, Patricia Hallon, et al. (2005) <doi:10.1097/01.mlr.0000182534.19832.83>,
- Melissa Y Wei, David Ratz, Kenneth J Mukamal (2020) <doi:10.1111/jgs.16310>,

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Encoding UTF-8

LazyData true

RoxygenNote 7.1.1

Imports tidyverse, dplyr, lubridate, magrittr, stringr, rlang, tidyselect, tidyyr, devtools, sqldf, stats

URL https://github.com/WYATTBENSKEN/multimorbidity

BugReports https://github.com/WYATTBENSKEN/multimorbidity/issues
R topics documented:

- cfi
- cfi_dx10lookup
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**cfi**

Claims-based Frailty Index (CFI)

**Description**

*cfi* returns a summary dataset containing the deficit-accumulation frailty index for each patient.

**Usage**

```r
 cfi(
   dat = NULL,
   id = NULL,
   dx = "dx",
   version = 19,
   version_var = NULL,
   hcpcs = "yes"
)
```
Arguments

dat
dataset which has been properly prepared using ’prepare_data()’
id
variable of the unique patient identifier
dx
the column with the diagnoses and procedures (defaults to ’dx’)
version
which version(s) of ICD your data contain (ICD-9 only: 9, ICD-10 only: 10, Both: 19)
version_var
variable which denotes if the diagnoses on that row are ICD-9 (9) or ICD-10 (10)
hcpcs
whether or not HCPCS variables are included (”yes” or ”no”, where ”yes” is the default)

Details

This function uses data which has been properly prepared to calculate the claims-based frailty index (CFI) developed by Kim et al. for each patient. As this algorithm was never developed to require two diagnosis codes, and is weighted, we have excluded that feature from this function. See full package documentation for additional details. This function is based largely on the code available via the Harvard Dataverse.

Value

dataframe with one row per patient, and a column for their patient id and a column with their frailty index.

Examples

cfi(dat = prepared_data, id = patient_id, dx = dx, version = 19, version_var = version)

cfi_dx10lookup

CFI ICD-10 Lookup.

Description

A lookup dataset for CFI ICD-10.

Usage

data(cfi_dx10lookup)

Format

An object of class data.frame with 44807 rows and 2 columns.

Source

This was created by Kim et al.
Description
A lookup dataset for CFI ICD-9.

Usage
data(cfi_dx9lookup)

Format
An object of class data.frame with 107 rows and 3 columns.

Source
This was created by Kim et al.

Description
A lookup dataset for CFI Procedure Codes.

Usage
data(cfi_pxlookup)

Format
An object of class data.frame with 90 rows and 3 columns.

Source
This was created by Kim et al.
**cfi_weightlookup**

*CFI Procedure Codes Lookup.*

**Description**

A lookup dataset for CFI weights.

**Usage**

```r
data(cfi_weightlookup)
```

**Format**

An object of class `data.frame` with 93 rows and 2 columns.

**Source**

This was created by Kim et al.

---

**charlson**

*Charlson Comorbidities*

**Description**

`charlson` returns a summary dataset containing the Charlson comorbidities for each patient.

**Usage**

```r
charlson(
  dat = NULL,
  id = NULL,
  dx = "dx",
  version = 19,
  version_var = NULL,
  outpatient_two = "no"
)
```

**Arguments**

- `dat` dataset which has been properly prepared using `prepare_data()`
- `id` variable of the unique patient identifier
- `dx` the column with the diagnoses (defaults to `"dx"`)  
- `version` which version(s) of ICD your data contain (ICD-9 only: 9, ICD-10 only: 10, Both: 19)
version_var variable which denotes if the diagnoses on that row are ICD-9 (9) or ICD-10 (10)

outpatient_two whether or not it should be required for there to be two outpatient claims for a diagnosis for a patient to be positively coded with that diagnosis.

Details
This function uses data which has been properly prepared to identify and flag the Charlson comorbidities. See full package documentation for additional details.

Value
dataframe with one row per patient, and a column for their patient id, a column with each Charlson comorbidity, and a column with their Charlson score

Examples
charlson(dat = prepared_data, id = patient_id, dx = dx, version = 19, version_var = version, outpatient_two = "yes")

comorbidity_window
Limit our comorbidities / multimorbidity measures to a specific time window:

Description
comorbidity_window returns a dataset of claims which fall within a specific timeframe.

Usage
comorbidity_window(
  dat = NULL,
  id_dat = NULL,
  id = NULL,
  id_date = NULL,
  claims_date = NULL,
  time_pre = Inf,
  time_post = Inf
)

Arguments
dat dataset
id_dat dataset with our other identifying variables, this should be 1 row per person
id ID variable which will be used to match and merge
elixhauser

id_date  name of the date of interest from the identification dataset, for example a date of diagnosis
claims_date  name for the variable in the claims data (dat) which is the date of the claim
time_pre  number to limit how many days, pre diagnosis, should be included. Default will be infinity (all claims)
time_post  similar to time_pre, but this will be after the date of interest

Details
This function takes prepared data, using the 'prepare_data' function, along with an identification dataset to limit the claims of interest to a specific time window.

Value
dataframe with which has limited the claims to a specific window

Examples
comorbidity_window(id_dat = id, dat = prepared_data, id = patient_id, id_date = date_of_interest9, claims_date = claim_date, time_pre = 60)

elixhauser  Elixhauser Comorbidities

Description
elixhauser returns a summary dataset containing the Elixhauser comorbidities for each patient.

Usage
elixhauser(
    dat = NULL,
    id = NULL,
    dx = "dx",
    version = 19,
    version_var = NULL,
    outpatient_two = "no"
)

Arguments
dat  dataset which has been properly prepared using 'prepare_data()'
id  variable of the unique patient identifier
dx  the column with the diagnoses (defaults to 'dx')
version which version(s) of ICD your data contain (ICD-9 only: 9, ICD-10 only: 10, Both: 19)
version_var variable which denotes if the diagnoses on that row are ICD-9 (9) or ICD-10 (10)
outpatient_two whether or not it should be required for there to be two outpatient claims for a diagnosis for a patient to be positively coded with that diagnosis.

Details

This function uses data which has been properly prepared to identify and flag the Elixhauser comorbidities. See full package documentation for additional details.

Value
dataframe with one row per patient, and a column for their patient id, a column with each Elixhauser comorbidity, and a column with their Elixhauser index for readmission and death

Examples
elixhauser(dat = prepared_data, id = patient_id, dx = dx, version = 19, version_var = version, outpatient_two = "yes")

i9_i10_comb  Example diagnosis data.

Description

A dataset with fake patient data for 5 patients, with both inpatient and outpatient data, as well as HCPCS codes, and ICD9 and ICD10.

Usage
data(i9_i10_comb)

Format

A data frame with 58 rows and 11 variables:

patient_id patient_id
sex patient’s sex (male or female)
date_of_serv the date of service for the fake claim
visit_type inpatient (ip) or outpatient(ot)
dx1 first diagnosis
dx2 second diagnosis
id

dx3  third diagnosis
dx4  fourth diagnosis
dx5  fifth diagnosis
hcpcs  HCPCS code
icd_version  Which version of ICD the row is. 9 = ICD-9, 0 = ICD-10

Source

This was created by the package author.

<table>
<thead>
<tr>
<th>id</th>
<th>Example ID data.</th>
</tr>
</thead>
</table>

Description

A dataset with fake patient data, to match the diagnoses, that includes a date of interest to demonstrate how we can attach these dates and then subset the data to a specific time window around the date of interest.

Usage

data(id)

Format

A data frame with 5 rows and 3 variables:

patient_id  patient_id
date_of_interest10  the date of interest, if you were to use only ICD-10 data
date_of_interest9  The date of interest, if you were to use only ICD-9 data

Source

This was created by the package author.
**mwi**  
*Multimorbidity Weighted Index (MWI)*

**Description**

cfi returns a summary dataset containing the multimorbidity weighted index for each patient.

**Usage**

```r
mwi(dat = NULL, id = NULL, dx = "dx", version = 19, version_var = NULL)
```

**Arguments**

- `dat`: dataset which has been properly prepared using 'prepare_data()'
- `id`: variable of the unique patient identifier
- `dx`: the column with the diagnoses and procedures (defaults to 'dx')
- `version`: which version(s) of ICD your data contain (ICD-9 only: 9, ICD-10 only: 10, Both: 19)
- `version_var`: variable which denotes if the diagnoses on that row are ICD-9 (9) or ICD-10 (10)

**Details**

This function uses data which has been properly prepared to calculate the multimorbidity weighted index developed by Wei et al. As this algorithm was never developed to require two diagnosis codes, and is weighted, we have excluded that feature from this function. See full package documentation for additional details.

**Examples**

```r
mwi(dat = prepared_data, id = patient_id, dx = dx, version = 9, version_var = version)
```

**nicholsonfortin**  
*Nicholson and Fortin Conditions*

**Description**

elixhauser returns a summary dataset containing the Nicholson and Fortin Conditions for each patient.
Usage

nicholsonfortin(
  dat = NULL,
  id = NULL,
  dx = "dx",
  version = 19,
  version_var = NULL,
  outpatient_two = "no"
)

Arguments

dat  dataset which has been properly prepared using 'prepare_data()'
id  variable of the unique patient identifier
dx  the column with the diagnoses (defaults to ‘dx’)
version  which version(s) of ICD your data contain (ICD-9 only: 9, ICD-10 only: 10, Both: 19)
version_var  variable which denotes if the diagnoses on that row are ICD-9 (9) or ICD-10 (10)
outpatient_two  whether or not it should be required for there to be two outpatient claims for a diagnosis for a patient to be positively coded with that diagnosis.

Details

This function uses data which has been properly prepared to identify and flag the Nicholson and Fortin conditions. See full package documentation for additional details.

Value

dataframe with one row per patient, and a column for their patient id, a column with each Nicholson/Fortin comorbidity

Examples

nicholsonfortin(dat = prepared_data, id = patient_id, dx = dx, version = 19, version_var = version, outpatient_two = "yes")
**prepare_data**

---

**prepared_data**  
*Prepared dataset*

**Description**

A dataset which has been prepared using the `prepare_data` function in this package.

**Usage**

```r
data(prepared_data)
```

**Format**

An object of class `tbl_df` (inherits from `tbl_data.frame`) with 242 rows and 5 columns.

**Source**

Built using the packages in this code.

---

**prepare_data**  
*Prepare our claims data for analysis*

**Description**

`prepare_data` returns a dataset which has been transformed and prepared for subsequent functions in this package.

**Usage**

```r
prepare_data(
  dat = NULL,
  style = "long",
  id = NULL,
  prefix_dx = "dx",
  hcpcs = "no",
  prefix_hcpcs,
  version_var,
  type_name,
  date
)
```
prepare_data

Arguments

dat dataset
style long, the default, is one diagnosis column per row whereas wide is multiple diagnosis columns
id unique patient identifier variable name
prefix_dx the variable prefix for the diagnosis columns (defaults to "dx"), in quotes
hcpcs whether or not HCPCS variables are included ("yes" or "no", where "no" is the default)
prefix_hcpcs if HCPCS are included, the variable prefix in quotes
version_var variable which denotes if the diagnoses on that row are ICD-9 (9) or ICD-10 (10)
type_name variable to denote if the claim is inpatient (ip) or outpatient (ot)
date variable with the date of the claim

Details

This function takes our raw claims data, in a number of different forms, and prepares it in a way which allows the other functions in this package to easily work with it. It is recommended to run this package on all data regardless of setup.

Value
dataframe with multiple rows per patient, which has re-structured their claims

Examples

prepare_data(dat = i9_i10_comb, id = patient_id, style = "wide",
prefix_dx = "dx", hcpcs = "yes", prefix_hcpcs = "hcpcs",
version_var = icd_version, type_name = visit_type, date = date_of_serv)
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