

Package ‘phsmethods’

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Title Standard Methods for Use in Public Health Scotland

Version 1.2.0

Description A collection of methods for commonly undertaken analytical tasks, primarily developed for Public Health Scotland (PHS) analysts, but the package is also generally useful to others working in the healthcare space, particularly since it has functions for working with Community Health Index (CHI) numbers. The package can help to make data manipulation and analysis more efficient and reproducible.

License GPL (>= 2)

URL <https://github.com/Public-Health-Scotland/phsmethods>,
<https://public-health-scotland.github.io/phsmethods/>

BugReports <https://github.com/Public-Health-Scotland/phsmethods/issues>

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age_calculate	<i>Calculate age between two dates</i>
---------------	--

Description

This function calculates the age between two dates using functions in lubridate. It calculates age in either years or months.

Usage

```
age_calculate(  
  start,  
  end = if (lubridate::is.Date(start)) Sys.Date() else Sys.time(),  
  units = c("years", "months"),
```

```
    round_down = TRUE
  )
```

Arguments

start	A start date (e.g. date of birth) which must be supplied with Date or POSIXct or POSIXlt class. <code>base::as.Date()</code> , <code>lubridate::dmy()</code> and <code>as.POSIXct()</code> are examples of functions which can be used to store dates as an appropriate class.
end	An end date which must be supplied with Date or POSIXct or POSIXlt class. Default is <code>Sys.Date()</code> or <code>Sys.time()</code> depending on the class of start.
units	Type of units to be used. years and months are accepted. Default is years.
round_down	Should returned ages be rounded down to the nearest whole number. Default is TRUE.

Value

A numeric vector representing the ages in the given units.

Examples

```
library(lubridate)
birth_date <- lubridate::ymd("2020-02-29")
end_date <- lubridate::ymd("2022-02-21")
age_calculate(birth_date, end_date)
age_calculate(birth_date, end_date, units = "months")

# If the start day is leap day (February 29th), age increases on 1st March
# every year.
leap1 <- lubridate::ymd("2020-02-29")
leap2 <- lubridate::ymd("2022-02-28")
leap3 <- lubridate::ymd("2022-03-01")

age_calculate(leap1, leap2)
age_calculate(leap1, leap3)
```

age_from_chi

Extract age from the CHI number

Description

`age_from_chi` takes a CHI number or a vector of CHI numbers and returns the age as implied by the CHI number(s). If the Date of Birth (DoB) is ambiguous it will return NA. It uses `dob_from_chi()`.

Usage

```
age_from_chi(
  chi_number,
  ref_date = NULL,
  min_age = 0L,
  max_age = NULL,
  chi_check = TRUE,
  check_mod11 = TRUE,
  check_mod10 = TRUE
)
```

Arguments

chi_number	a CHI number or a vector of CHI numbers with character class.
ref_date	calculate the age at this date, default is to use Sys.Date() i.e. today.
min_age, max_age	optional min and/or max dates that the DoB could take as the century needs to be guessed. Must be either length 1 for a 'fixed' age or the same length as chi_number for an age per CHI number. min_age can be age based on common sense in the dataset, whilst max_age can be age when an event happens such as the age at discharge.
chi_check	logical, optionally skip checking the CHI for validity which will be faster but should only be used if you have previously checked the CHI(s), the default (TRUE) will to check the CHI numbers.
check_mod11, check_mod10	Logical values (TRUE or FALSE, default is TRUE). By default, a CHI that passes either the modulo 10 or the modulo 11 check will be considered valid. Historically, CHIs only used modulo 11 for their check digit; however, starting in August 2026, some CHIs will only pass if they meet the modulo 10 criteria. Implementation of Mod 10 CHI numbers is scheduled for August 2026. From this date, CHI numbers are valid if they pass either a Mod 11 check or a Mod 10 check.

Value

an integer vector of ages in years truncated to the nearest year. It will be the same length as chi_number.

Examples

```
age_from_chi("0101336489")

library(tibble)
library(dplyr)
data <- tibble(chi = c(
  "0101336489",
  "0101405073",
  "0101625707"
```

```

), dis_date = as.Date(c(
  "1950-01-01",
  "2000-01-01",
  "2020-01-01"
)))

data %>%
  mutate(chi_age = age_from_chi(chi))

data %>%
  mutate(chi_age = age_from_chi(chi, min_age = 18, max_age = 65))

data %>%
  mutate(chi_age = age_from_chi(chi,
    ref_date = dis_date
  ))

```

area_lookup	<i>Codes and names of Scottish geographical and administrative areas.</i>
-------------	---

Description

A dataset containing Scotland's geography codes and associated area names. It is used within [match_area\(\)](#).

Usage

```
area_lookup
```

Format

A [tibble::tibble\(\)](#) with 2 variables and over 17,000 rows:

geo_code Standard geography code - 9 characters

area_name Name of the area the code represents

Details

geo_code contains geography codes pertaining to Health Boards, Council Areas, Health and Social Care Partnerships, Intermediate Zones, Data Zones (2001 and 2011), Electoral Wards, Scottish Parliamentary Constituencies, UK Parliamentary Constituencies, Travel to work areas, National Parks, Community Health Partnerships, Localities (S19), Settlements (S20) and Scotland.

Source: Scotland's official statistics

See Also

The script used to create the area_lookup dataset on [GitHub](#).

`as_percent`*Percentages*

Description

`percent` is a lightweight S3 class allowing for pretty printing of proportions as percentages. It aims to remove the need for creating character vectors of percentages.

Usage

```
as_percent(x, digits = 2)
```

```
NA_percent_
```

Arguments

<code>x</code>	[numeric] vector of proportions.
<code>digits</code>	[numeric(1)] - The number of digits that will be used for formatting. This is by default 2 and is applied whenever <code>format()</code> , <code>as.character()</code> and <code>print()</code> are called. This can also be controlled directly via <code>format()</code> .

Details

Rounding:

The rounding for percent vectors differs to that of base R rounding, namely in that halves are rounded up instead of rounded to even. This means that `round(x)` will round the percent vector `x` using halves-up rounding (like in the `janitor` package).

Formatting:

By default all percentages are formatted to 2 decimal places which can be overwritten using `format()` or using `round()` if your required digits are less than 2. It's worth noting that the `digits` argument in `format.percent` uses decimal rounding instead of the usual significant digit rounding that `format.default()` uses.

Value

An object of class `percent`.

Examples

```
# Convert proportions to percentages
as_percent(seq(0, 1, 0.1))

# You can use round() as usual
p <- as_percent(15.56 / 100)
round(p)
round(p, digits = 1)
```

```

p2 <- as_percent(0.0005)
signif(p2, 2)
floor(p2)
ceiling(p2)

# We can do basic math operations as usual

# Order of operations doesn't matter
10 * as_percent(c(0, 0.5, 2))
as_percent(c(0, 0.5, 2)) * 10

as_percent(0.1) + as_percent(0.2)

# Formatting options
format(as_percent(2.674 / 100), digits = 2, symbol = " (%)")
# Prints nicely in data frames (and tibbles)
library(dplyr)
starwars %>%
  count(eye_color) %>%
  mutate(perc = as_percent(n / sum(n))) %>%
  arrange(desc(perc)) %>% # We can do numeric sorting with percent vectors
  mutate(perc_rounded = round(perc))

```

chi_check

Check the validity of a CHI number

Description

chi_check takes a CHI number or a vector of CHI numbers with character class. It returns feedback on the validity of the entered CHI number and, if found to be invalid, provides an explanation as to why.

Usage

```
chi_check(chi_number, check_mod11 = TRUE, check_mod10 = TRUE)
```

Arguments

chi_number a CHI number or a vector of CHI numbers with character class.

check_mod11, check_mod10

Logical values (TRUE or FALSE, default is TRUE). By default, a CHI that passes either the modulo 10 or the modulo 11 check will be considered valid. Historically, CHIs only used modulo 11 for their check digit; however, starting in August 2026, some CHIs will only pass if they meet the modulo 10 criteria. Implementation of Mod 10 CHI numbers is scheduled for August 2026. From this date, CHI numbers are valid if they pass either a Mod 11 check or a Mod 10 check.

Details

The Community Health Index (CHI) is a register of all patients in NHS Scotland. A CHI number is a unique, ten-digit identifier assigned to each patient on the index.

The first six digits of a CHI number are a patient's date of birth in DD/MM/YY format.

The ninth digit of a CHI number identifies a patient's sex: odd for male, even for female. The tenth digit is a check digit, denoted checksum.

While a CHI number is made up exclusively of numeric digits, it cannot be stored with numeric class in R. This is because leading zeros in numeric values are silently dropped, a practice not exclusive to R. For this reason, `chi_check` accepts input values of character class only. A leading zero can be added to a nine-digit CHI number using `chi_pad()`.

`chi_check` assesses whether an entered CHI number is valid by checking whether the answer to each of the following criteria is Yes:

- Does it contain no non-numeric characters?
- Is it ten digits in length?
- Do the first six digits denote a valid date?
- Is the checksum digit correct?

Value

`chi_check` returns a character string. Depending on the validity of the entered CHI number, it will return one of the following:

- Valid CHI
- Invalid character(s) present
- Too many characters
- Too few characters
- Invalid date
- Invalid checksum
- Missing (NA)
- Missing (Blank)

Examples

```
chi_check("0101011237")
chi_check(c("0101201234", "3201201234"))

library(dplyr)
df <- tibble(chi = c(
  "3213201234",
  "123456789",
  "12345678900",
  "010120123?",
  NA
))
df %>%
  mutate(validity = chi_check(chi))
```

chi_pad	<i>Add a leading zero to nine-digit CHI numbers</i>
---------	---

Description

chi_pad takes a nine-digit CHI number with character class and prefixes it with a zero. Any values provided which are not a string comprised of nine numeric digits remain unchanged.

Usage

```
chi_pad(chi_number)
```

Arguments

chi_number a CHI number or a vector of CHI numbers with character class.

Details

The Community Health Index (CHI) is a register of all patients in NHS Scotland. A CHI number is a unique, ten-digit identifier assigned to each patient on the index.

The first six digits of a CHI number are a patient's date of birth in DD/MM/YY format. The first digit of a CHI number must, therefore, be 3 or less. Depending on the source, CHI numbers are sometimes missing a leading zero.

While a CHI number is made up exclusively of numeric digits, it cannot be stored with numeric class in R. This is because leading zeros in numeric values are silently dropped, a practice not exclusive to R. For this reason, chi_pad accepts input values of character class only, and returns values of the same class. It does not assess the validity of a CHI number - please see [chi_check\(\)](#) for that.

Value

The original character vector with CHI numbers padded if applicable.

Examples

```
chi_pad(c("101011237", "101201234"))
```

create_age_groups	<i>Create age groups</i>
-------------------	--------------------------

Description

create_age_groups() takes a numeric vector and assigns each age to the appropriate age group.

Usage

```
create_age_groups(
  x,
  from = lifecycle::deprecated(),
  to = lifecycle::deprecated(),
  by = lifecycle::deprecated(),
  as_factor = FALSE,
  breaks = seq(0, 90, 5)
)
```

Arguments

x	a vector of numeric values
from, to, by	[Deprecated] Use breaks instead.
as_factor	The default behaviour is to return a character vector. Use TRUE to return a factor vector instead.
breaks	a numeric vector of cut points defining the age groups. The default is seq(0, 90, 5), which corresponds to the European Standard Population age groups.

Details

The breaks vector defines the cut points for the age groups. The final age group will capture all ages equal to or greater than the last value in breaks, labelled as last+. If the cut points are not evenly spaced, the labels will reflect the actual width of each group.

Value

A character vector, where each element is the age group for the corresponding element in x. If as_factor = TRUE, a factor vector is returned instead.

Examples

```
age <- c(54, 7, 77, 1, 26, 101)

create_age_groups(age)
create_age_groups(age, breaks = seq(0, 80, 10))

# Non-uniform age groups
create_age_groups(age, breaks = c(0, 18, 45, 65, 90))
```

```
# Final group may start below the last break
create_age_groups(age, breaks = seq(0, 65, 10))

# To get the output as a factor:
create_age_groups(age, as_factor = TRUE)
```

dob_from_chi

Extract Date of Birth (DoB) from the CHI number

Description

`dob_from_chi` takes a CHI number or a vector of CHI numbers and returns the Date of Birth (DoB) as implied by the CHI number(s). If the DoB is ambiguous it will return NA.

Usage

```
dob_from_chi(
  chi_number,
  min_date = NULL,
  max_date = NULL,
  chi_check = TRUE,
  check_mod11 = TRUE,
  check_mod10 = TRUE
)
```

Arguments

<code>chi_number</code>	a CHI number or a vector of CHI numbers with character class.
<code>min_date, max_date</code>	optional min and/or max dates that the DoB could take as the century needs to be guessed. Must be either length 1 for a 'fixed' date or the same length as <code>chi_number</code> for a date per CHI number. <code>min_date</code> can be date based on common sense in the dataset, whilst <code>max_date</code> can be date when an event happens such as discharge date.
<code>chi_check</code>	logical, optionally skip checking the CHI for validity which will be faster but should only be used if you have previously checked the CHI(s). The default (TRUE) will check the CHI numbers.
<code>check_mod11, check_mod10</code>	Logical values (TRUE or FALSE, default is TRUE). By default, a CHI that passes either the modulo 10 or the modulo 11 check will be considered valid. Historically, CHIs only used modulo 11 for their check digit; however, starting in August 2026, some CHIs will only pass if they meet the modulo 10 criteria. Implementation of Mod 10 CHI numbers is scheduled for August 2026. From this date, CHI numbers are valid if they pass either a Mod 11 check or a Mod 10 check.

Value

a date vector of DoB. It will be the same length as chi_number.

Examples

```
dob_from_chi("0101336489")

library(tibble)
library(dplyr)
data <- tibble(chi = c(
  "0101336489",
  "0101405073",
  "0101625707"
), adm_date = as.Date(c(
  "1950-01-01",
  "2000-01-01",
  "2020-01-01"
)))

data %>%
  mutate(chi_dob = dob_from_chi(chi))

data %>%
  mutate(chi_dob = dob_from_chi(chi,
    min_date = as.Date("1930-01-01"),
    max_date = adm_date
  ))
```

extract_fin_year

Extract the formatted financial year from a date

Description

extract_fin_year takes a date and extracts the correct financial year in the PHS specified format from it.

Usage

```
extract_fin_year(date)
```

Arguments

date	A date which must be supplied with Date, POSIXct, POSIXlt or POSIXt class. <code>base::as.Date()</code> , <code>lubridate::dmy()</code> and <code>as.POSIXct()</code> are examples of functions which can be used to store dates as an appropriate class.
------	---

Details

The PHS accepted format for financial year is YYYY/YY e.g. 2017/18.

Value

A character vector of financial years in the form '2017/18'.

Examples

```
x <- lubridate::dmy(c(21012017, 04042017, 17112017))
extract_fin_year(x)
```

format_postcode	<i>Format a postcode</i>
-----------------	--------------------------

Description

format_postcode takes a character string or vector of character strings. It extracts the input values which adhere to the standard UK postcode format (with or without spaces), assigns the appropriate amount of spacing to them (for both pc7 and pc8 formats) and ensures all letters are capitalised.

Usage

```
format_postcode(x, format = c("pc7", "pc8"), quiet = FALSE)
```

Arguments

x	A character string or vector of character strings. Input values which adhere to the standard UK postcode format may be upper or lower case and will be formatted regardless of existing spacing. Any input values which do not adhere to the standard UK postcode format will generate an NA and a warning message - see Value section for more information.
format	A character string denoting the desired output format. Valid options are pc7 and pc8. The default is pc7. See Value section for more information on the string length of output values.
quiet	(optional) If quiet is TRUE all messages and warnings will be suppressed. This is useful in a production context and when you are sure of the data or you are specifically using this function to remove invalid postcodes. This will also make the function a bit quicker as fewer checks are performed.

Details

The standard UK postcode format (without spaces) is:

- 1 or 2 letters, followed by
- 1 number, followed by
- 1 optional letter or number, followed by
- 1 number, followed by
- 2 letters

UK government regulations mandate which letters and numbers can be used in specific sections of a postcode. However, these regulations are liable to change over time. For this reason, `format_postcode` does not validate whether a given postcode actually exists, or whether specific numbers and letters are being used in the appropriate places. It only assesses whether the given input is consistent with the above format and, if so, assigns the appropriate amount of spacing and capitalises any lower case letters.

Value

When `format` is set equal to `pc7`, `format_postcode` returns a character string of length 7. 5 character postcodes have two spaces after the 2nd character; 6 character postcodes have 1 space after the 3rd character; and 7 character postcodes have no spaces.

When `format` is set equal to `pc8`, `format_postcode` returns a character string with maximum length 8. All postcodes, whether 5, 6 or 7 characters, have one space before the last 3 characters.

Any input values which do not adhere to the standard UK postcode format will generate an NA output value and a warning message. A warning is generated rather than an error so as not to let one erroneously recorded postcode in a large input vector prevent the remaining entries from being appropriately formatted.

Any input values which do adhere to the standard UK postcode format but contain lower case letters will generate a warning message explaining that these letters will be capitalised.

Examples

```
format_postcode("G26QE")
format_postcode(c("KA89NB", "PA152TY"), format = "pc8")

library(dplyr)
df <- tibble(postcode = c("G429BA", "G207AL", "DD37JY", "DG98BS"))
df %>%
  mutate(postcode = format_postcode(postcode))
```

match_area

Translate geography codes into area names

Description

`match_area` takes a geography code or vector of geography codes. It matches the input to the corresponding value in the `area_lookup()` dataset and returns the corresponding area name.

Usage

```
match_area(x)
```

Arguments

`x` A geography code or vector of geography codes.

Details

`match_area` relies predominantly on the standard 9 digit geography codes. The only exceptions are:

- RA2701: No Fixed Abode
- RA2702: Rest of UK (Outside Scotland)
- RA2703: Outside the UK
- RA2704: Unknown Residency

`match_area` caters for both current and previous versions of geography codes (e.g 2014 and 2019 Health Boards).

It can account for geography codes pertaining to Health Boards, Council Areas, Health and Social Care Partnerships, Intermediate Zones, Data Zones (2001 and 2011), Electoral Wards, Scottish Parliamentary Constituencies, UK Parliamentary Constituencies, Travel to work areas, National Parks, Community Health Partnerships, Localities (S19), Settlements (S20) and Scotland.

`match_area` returns a non-NA value only when an exact match is present between the input value and the corresponding variable in the `area_lookup()` dataset. These exact matches are sensitive to both case and spacing. It is advised to inspect `area_lookup()` in the case of unexpected results, as these may be explained by subtle differences in transcription between the input value and the corresponding value in the lookup dataset.

Value

Each geography code within Scotland is unique, and consequently `match_area` returns a single area name for each input value. Any input value without a corresponding value in the `area_lookup()` dataset will return an NA output value.

Examples

```
match_area("S20000010")

library(dplyr)
df <- tibble(code = c("S02000656", "S02001042", "S08000020", "S12000013"))
df %>% mutate(name = match_area(code))
```

qtr

Assign a date to a quarter

Description

The `qtr` functions take a date input and calculate the relevant quarter-related value from it. They all return the year as part of this value.

- `qtr` returns the current quarter
- `qtr_end` returns the last month in the quarter
- `qtr_next` returns the next quarter
- `qtr_prev` returns the previous quarter

Usage

```

qtr(date, format = c("long", "short"))

qtr_end(date, format = c("long", "short"))

qtr_next(date, format = c("long", "short"))

qtr_prev(date, format = c("long", "short"))

```

Arguments

date	A date which must be supplied with Date or POSIXct
format	A character string specifying the format the quarter should be displayed in. Valid options are long (January to March 2018) and short (Jan-Mar 2018). The default is long.

Details

Quarters are defined as:

- January to March (Jan-Mar)
- April to June (Apr-Jun)
- July to September (Jul-Sep)
- October to December (Oct-Dec)

Value

A character vector of financial quarters in the specified format.

Examples

```

x <- lubridate::dmy(c(26032012, 04052012, 23092012))
qtr(x)
qtr_end(x, format = "short")
qtr_next(x)
qtr_prev(x, format = "short")

```

sex_from_chi

Extract sex from the CHI number

Description

sex_from_chi takes a CHI number or a vector of CHI numbers and returns the sex as implied by the CHI number(s). The default return type is an integer but this can be modified.

Usage

```
sex_from_chi(  
  chi_number,  
  male_value = 1L,  
  female_value = 2L,  
  as_factor = FALSE,  
  chi_check = TRUE,  
  check_mod11 = TRUE,  
  check_mod10 = TRUE  
)
```

Arguments

chi_number a CHI number or a vector of CHI numbers with character class.

male_value, female_value optionally supply custom values for Male and Female. Note that that these must be of the same class.

as_factor logical, optionally return as a factor with labels 'Male' and 'Female'. Note that this will override any custom values supplied with **male_value** or **female_value**.

chi_check logical, optionally skip checking the CHI for validity which will be faster but should only be used if you have previously checked the CHI(s).

check_mod11, check_mod10 Logical values (TRUE or FALSE, default is TRUE). By default, a CHI that passes either the modulo 10 or the modulo 11 check will be considered valid. Historically, CHIs only used modulo 11 for their check digit; however, starting in August 2026, some CHIs will only pass if they meet the modulo 10 criteria. Implementation of Mod 10 CHI numbers is scheduled for August 2026. From this date, CHI numbers are valid if they pass either a Mod 11 check or a Mod 10 check.

Details

The Community Health Index (CHI) is a register of all patients in NHS Scotland. A CHI number is a unique, ten-digit identifier assigned to each patient on the index.

The ninth digit of a CHI number identifies a patient's sex: odd for men, even for women.

The default behaviour for `sex_from_chi` is to first check the CHI number is valid using `check_chi` and then to return 1 for male and 2 for female.

There are options to return custom values e.g. 'M' and 'F' or to return a factor which will have labels 'Male' and 'Female')

Value

a vector with the same class as **male_value** and **female_value**, (integer by default) unless **as_factor** is TRUE in which case a factor will be returned.

Examples

```
sex_from_chi("0101011237")
sex_from_chi(c("0101011237", "0101336489", NA))
sex_from_chi(
  c("0101011237", "0101336489", NA),
  male_value = "M",
  female_value = "F"
)
sex_from_chi(c("0101011237", "0101336489", NA), as_factor = TRUE)

library(dplyr)
df <- tibble(chi = c("0101011237", "0101336489", NA))
df %>% mutate(chi_sex = sex_from_chi(chi))
```

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