Package 'pedbp'

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Title Pediatric Blood Pressure

Version 1.0.0

Description Data and utilities for estimating pediatric blood pressure percentiles by sex, age, and optionally height (stature). Blood pressure percentiles for children under one year of age come from Gemelli et.al. (1990) <doi:10.1007/BF02171556>. Estimates of blood pressure percentiles for children at least one year of age are informed by data from the National Heart, Lung, and Blood Institute (NHLBI) and the Centers for Disease Control and Prevention (CDC) <doi:10.1542/peds.2009-2107C> or from Lo et.al. (2013) <doi:10.1542/peds.2012-1292>. The flowchart for selecting the informing data source comes from Martin et.al. (2022) <doi:10.1542/hpeds.2021-005998>.

Depends R (>= 3.5.0)

License GPL-2

Encoding UTF-8

URL https://github.com/dewittpe/pedbp/

Language en-us

LazyData true

Imports ggplot2, scales

Suggests covr, data.table, DT, gridExtra, knitr, rmarkdown, shiny, shinydashboard

VignetteBuilder knitr

RoxygenNote 7.2.0

NeedsCompilation no

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R topics documented:

`bpdata` *Data Sets Informing Blood Pressure Percentile Estimates*

Description

A collection of data sets from multiple sources used to inform blood pressure percentiles for pediatrics patients by sex, age, and height (if known).

Usage

```
lo2013

gemelli1990

nhlbi_bp_norms

bp_parameters
```

Format

An object of class `data.frame` with 30 rows and 6 columns.

An object of class `data.frame` with 8 rows and 6 columns.

An object of class `data.frame` with 952 rows and 6 columns.

An object of class `data.frame` with 276 rows and 8 columns.

Details

Data sets are named to reflect the source.

For all the data sets provided units are uniform:

age: Patient age; months

height: length/height/stature; cm

weight: kilograms

male: integer value; 1 = male, 0 = female

sbp: systolic blood pressure; mmHg

dbp: diastolic blood pressure; mmHg

Columns with a name such as sbp is a point observations. Summary statistics are appended to the variable as needed, e.g., sbp_mean and sbp_sd for the reported mean and standard deviation of systolic blood pressure.

CDC ages represent whole month but reported at the half month. That is, age = 12.5 is short-hand for 12 <= age < 13. The exception is birth; age = 0 is birth and not a range.

bp_parameters has the estimated mean and standard deviations for estimating percentiles using a Gaussian distribution for a given sex, age (in months), and height (if known/applicable).

References

Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents. "Expert panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents: summary report." Pediatrics 128.Supplement_5 (2011): S213-S256.

Gemelli, M., Manganaro, R., Mami, C., & De Luca, F. (1990). Longitudinal study of blood pressure during the 1st year of life. European journal of pediatrics, 149(5), 318-320.

Lo, Joan C., et.al. "Prehypertension and hypertension in community-based pediatric practice." Pediatrics 131.2 (2013): e415-e424.

See Also

```
vignette("bp-distributions", package = "pedbp")
```

---

bp_cdf *Plot the CDF for Blood Pressure*

Description

Plot the CDF for blood pressure given age, sex, and height.

Usage

```
bp_cdf(
  age,
  male,
  height = NA,
  height_percentile = 0.5,
  sbp = NA,
  dbp = NA,
  ...
)
```

Arguments

age	numeric age, in months
male	integer value, 1 = male, 0 = female, indicating sex of the patient
height	numeric, in centimeters, can be missing. This is the length for patients under three years of age
height_percentile	default height percentile to use if height is missing.
sbp, dbp	observed values to plot on the CDF
...	not currently used

Value

a ggplot2 graphic showing the CDF for diastolic and systolic blood pressures with vertical and horizontal lines highlight the percentile for the given inputs.

Examples

```
bp_cdf(age = 96, male = 1, sbp = 103, dbp = 55)
```

---

bp_distribution *Estimate Pediatric Blood Pressure Distribution*

Description

Percentile and quantile functions for pediatric blood pressure.

Usage

```
p_bp(q_sbp, q_dbp, age, male, height = NA, height_percentile = 0.5, ...)

q_bp(p_sbp, p_dbp, age, male, height = NA, height_percentile = 0.5, ...)
```

Arguments

q_sbp	a vector of systolic blood pressures
q_dbp	a vector of diastolic blood pressures
age	numeric age, in months
male	integer value, 1 = male, 0 = female
height	numeric, in centimeters, can be missing.
height_percentile	default height percentile to use if height is missing.
...	not currently used
p_sbp	a vector of systolic blood percentiles
p_dbp	a vector of diastolic blood percentiles

Value

a pedbp_bp object. This is a list of two numeric vectors: sbp_percentile (systolic blood pressure) and dbp_percentile (diastolic blood pressure). Additionally, the bp_params attribute provides details on the data source and parameters used in the percentile estimates.

See Also

vignette("bp-distriution", package = "pedbp")

Examples

```
x <- p_bp( q_sbp = 100, q_dbp = 60, age = 8, male = 0)
x
str(x)

x <- p_bp(q_sbp = c(NA, 82), q_dbp = c(60, 72), age = 9.2, male = 0)
x
str(x)

x <- p_bp(q_sbp = c(NA, 82), q_dbp = c(60, 72), age = 29.2, male = 0, height = 82.8)
x
str(x)

x <- q_bp(p_sbp = 0.78, p_dbp = 0.65, age = 8, male = 0)
x
str(x)

################################################################################
# Working with multiple patients records
d <- read.csv(system.file("example_data", "for_batch.csv", package = "pedbp"))
d

bp_percentiles <-
  p_bp(
      q_sbp = d$sbp..mmHg.
    , q_dbp = d$dbp..mmHg.
    , age   = d$age_months
    , male  = d$male
    )
bp_percentiles

q_bp(
    p_sbp = bp_percentiles$sbp_percentile
  , p_dbp = bp_percentiles$dbp_percentile
  , age   = d$age_months
  , male  = d$male
  )
```

est_norm *Estimate Normal Distribution Given Set of Quantile Values*

Description

With at least two quantile values find the mean and standard deviation of a normal distribution to match up with empirical values provided.

Usage

```
est_norm(q, p, weights = rep(1, length(p)), ...)
```

Arguments

q	quantile values.
p	probabilities corresponding to the q quantiles.
weights	relative weight of each quantile. The higher the weight the better the approximated distribution will be at fitting that quantile.
...	passed to optim.

Details

For X ~ N(mu, sigma), Pr[X <= q] = p

Given the set of quantiles and probabilities, est_norm uses optim to find the preferable mean and standard deviation of a normal distribution to fit the provided quantiles.

Use the weight argument to emphasize which, if any, of the provided quantiles needs to be approximated closer than others. By default all the quantiles are weighted equally.

Value

a pedbp_est_norm object. This is a list with elements:

- para named numeric vector with the mean and standard deviation for a Gaussian distribution
- qpa numeric matrix with two columns built from the input values of q and p
- weightsthe weights used
- callThe call made
- optimresult from calling optim

Examples

```
# Example 1
q <- c(-1.92, 0.1, 1.89) * 1.8 + 3.14
p <- c(0.025, 0.50, 0.975)

x <- est_norm(q, p)
```

```
str(x)
x

plot(x)

# Example 2 -- build with quantiles that are easy to see unlikely to be from
# a Normal distribuiton
q <- c(-1.92, 0.05, 0.1, 1.89) * 1.8 + 3.14
p <- c(0.025, 0.40, 0.50, 0.975)

# with equal weights
x <- est_norm(q, p)
x
plot(x)

# weight to ignore one of the middle value and make sure to hit the other
x <- est_norm(q, p, weights = c(1, 2, 0, 1))
x
plot(x)

# equal weight the middle, more than the tails
x <- est_norm(q, p, weights = c(1, 2, 2, 1))
x
plot(x)
```

`pediatric_vital_sign_distributions` *Pediatric Vital Sign Distributions*

Description

Based on the data provided by the CDC, provide the distribution function, quantile function, and a z-score function for one of eight vital signs by another vital sign, e.g., weight for age. Values are based on an LMS approach.

Usage

```
p_bmi_for_age(q, age, male)

q_bmi_for_age(p, age, male)

z_bmi_for_age(q, age, male)

p_head_circ_for_age(q, age, male)

q_head_circ_for_age(p, age, male)

z_head_circ_for_age(q, age, male)
```

```
p_length_for_age_inf(q, age, male)

q_length_for_age_inf(p, age, male)

z_length_for_age_inf(q, age, male)

p_stature_for_age(q, age, male)

q_stature_for_age(p, age, male)

z_stature_for_age(q, age, male)

p_weight_for_age_inf(q, age, male)

q_weight_for_age_inf(p, age, male)

z_weight_for_age_inf(q, age, male)

p_weight_for_age(q, age, male)

q_weight_for_age(p, age, male)

z_weight_for_age(q, age, male)

p_weight_for_length_inf(q, length, male)

q_weight_for_length_inf(p, length, male)

z_weight_for_length_inf(q, length, male)

p_weight_for_stature(q, height, male)

q_weight_for_stature(p, height, male)

z_weight_for_stature(q, height, male)
```

Arguments

q	a vector of quantities
age	numeric age, in months
male	integer value, 1 = male, 0 = female
p	a vector of probabilities
length	length, in cm, of the patient (age under 3 years)
height	height, in cm, of the patient (age 2 - 20 years)

Value

The p_ method return values from the estimated distribution function. q_ methods return values from the estimated quantile function. z_ methods return standard scores, equivalent to qnorm.

References

https://www.cdc.gov/growthcharts/percentile_data_files.htm

Examples

```
################################################################################
# BMI for Age

# A BMI of 18.2 for a 18.1 year old female is in the
p_bmi_for_age(q = 18.2, age = 18.1 * 12, male = 0)
# percentile.

# The z-score is the same as qnorm(p)
qnorm(p_bmi_for_age(q = 18.2, age = 18.1 * 12, male = 0))
z_bmi_for_age(q = 18.2, age = 18.1 * 12, male = 0)

# The 70th percentile of BMI for 15.4 year old males is
q_bmi_for_age(p = 0.70, age = 15.4 * 12, male = 1)

################################################################################
# Stature/Lenght/Height for Age

# length_for_age_inf is for Infants are from 0 to 3 years (36 months)
# stature_for_age    is for pediatrics from 2 years (24 months) to 20 years
#                    (240 months)
# The overlap between these functions will produce slightly different values
# the kids between 24 and 36 months of age.
p_length_for_age_inf(87, age = 28, male = 0)
p_stature_for_age(87, age = 28, male = 0)
p_length_for_age_inf(q = 87, age = 28,  male = 0)

################################################################################
# Multiple patients, the age and male, length, height arguments can also be
# vectors
p_length_for_age_inf(q = 87, age = 28,  male = 0)
p_length_for_age_inf(q = 90, age = 30,  male = 1)
p_length_for_age_inf(q = c(87,90), age = c(28, 30),  male = c(0,1))
```

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