Title  Athlete Maturation and Biobanding

Description  Identifying maturation stages across young athletes is paramount for talent identification. Furthermore, the concept of biobanding, or grouping of athletes based on their biological development, instead of their chronological age, has been widely researched. The goal of this package is to help professionals working in the field of strength & conditioning and talent ID obtain common maturation metrics and as well as to quickly visualize this information via several plotting options. For the methods behind the computed maturation metrics implemented in this package refer to Khamis, H. J., & Roche, A. F. (1994) <https://pubmed.ncbi.nlm.nih.gov/7936860/>, Mirwald, R.L et al., (2002) <https://pubmed.ncbi.nlm.nih.gov/11932580/> and Cumming, Sean P. et al., (2017) <doi:10.1519/SSC.0000000000000281>.

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URL  https://github.com/josedv82/matuR

BugReports  https://github.com/josedv82/matuR/issues

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Author  Jose Fernandez [aut, cre]

Maintainer  Jose Fernandez <jose.fernandezdv@gmail.com>

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Data from growth charts

Description

Data from growth charts

Usage

curves

Format

Data frame with 14 variables and 436 observations:

Gender  A character string. Refers to Male or Female.
Agemos  Age in months
Power   Power in the Box-Cox transformation
Median  Median
CV      Generalized Coefficient of Variation
P3      Data under percentile 3
P5      Data under percentile 5
P10     Data under percentile 10
P25     Data under percentile 25
P50     Data under percentile 50
P75     Data under percentile 75
P90     Data under percentile 90
P95     Data under percentile 95
P97     Data under percentile 97
Details

A data frame containing information for growth charts from the National Center from Health and Statistics. Visit https://www.cdc.gov/growthcharts/percentile_data_files.htm for more details.

Description

A sample dataset for demonstration purposes.

Usage
data_sample

data_sample

Format

Data frame with 13 variables and 20 observations:

**Athlete** A character string. Name of the subjects.
Date of Birth A date object referring to the DOB for each athlete.
Testing Date A date object referring to the date of testing of each athlete.
**Gender** A character string. Refers to Male or Female.
**Weight1 (KG)** A number. Weight in kgs. Measurement 1.
**Weight2 (KG)** A number. Weight in kgs. Measurement 2.
**Height1 (CM)** A number. Height in cms. Measurement 1.
**Height2 (CM)** A number. Height in cms. Measurement 2.
**Sitting Height1 (CM)** A number. Length of the trunk in cms for a seated measurement. Measurement 1.
**Sitting Height2 (CM)** A number. Length of the trunk in cms for a seated measurement. Measurement 2.
**Bench Height2 (CM)** A number. If the sitting height is done using a chair or a bench, indicate its length, otherwise use 0.
**Mothers Height (CM)** A number. The standing height of the athlete’s mother in cms.
**Fathers Height (CM)** A number. The standing height of the athlete’s father in cms.

Details

A data frame containing unreal sample data for demonstration purposes only. It also serves as an example for a template of how user collected data should look. Use this dataset to learn about the functions on this package.
Maturation and Biobanding Metrics

Description
This function returns a dataframe with computed maturation metrics in cms calculated from the raw data imported by the user. See references for further details about the methodology behind each metric. For the same table in Inches see `maturation_in()`

Usage
`maturation_cm(data)`

Arguments
- `data` A data frame. See `data_sample` for formatting reference.

Value
A data frame with the following columns:
- **Athlete** A character string. The name of the athlete
- **Gender** A character string. The gender of the athlete
- **Testing Date** A date. The data collection date for each athlete
- **Birth Year** The year of birth for every athlete
- **Quarter** The yearly quarter in which athletes were born
- **Height (CM)** The height in cms for each athlete at the time of testing
- **Estimated Adult Height (CM)** The estimated adult height in cms of the athlete using the Khamis-Roche method. See references for further details.
- **% Adult Height** Their current height expressed as %, compared to their predicted adult height
- **Remaining Growth (CM)** The difference between their predicted adult height and current height, in cms
- **Maturity Offset (years)** Difference between their current age and their estimated age at PHV, expressed in years.
- **Age @ PHV** The estimated age of the player at the time of Peak Height Velocity. Calculated using the Mirwald equation. See references for further details.
- **Maturity Category** Categories for bio-banding based on the work from Cumming et al, 2017. See references for further details.

References
Examples

maturation_cm(data_sample)

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Description

This function returns a dataframe with computed maturation metrics in inches calculated from the raw data imported by the user. See references for further details about the methodology behind each metric. For the same table in centimeters use maturation_cm().

Usage

maturation_in(data)

Arguments

data A data frame. See data_sample for formatting reference.

Value

A data frame with the following columns:

- **Athlete** A character string. The name of the athlete
- **Gender** A character string. The gender of the athlete
- **Testing Date** A date. The data collection date for each athlete
- **Birth Year** The year of birth for every athlete
- **Quarter** The yearly quarter in which athletes were born
- **Height (IN)** The height in inches for each athlete at the time of testing
- **Estimated Adult Height (IN)** The estimated adult height in inches of the athlete using the Khamis-Roche method. See references for further details.
- **% Adult Height** Their current height expressed as %, compared to their predicted adult height
- **Remaining Growth (IN)** The difference between their predicted adult height and current height, in inches
- **Maturity Offset (years)** Difference between their current age and their estimated age at PHV, expressed in years.
- **Age @ PHV** The estimated age of the player at the time of Peak Height Velocity. Calculated using the Mirwald equation. See references for further details.
- **Maturity Category** Categories for bio-banding based on the work from Cumming et al, 2017. See references for further details.
References

Examples
maturation_cm(data_sample)

plot_growth_female

Description
This function returns a ggplot object showing the current and predicted height vs normal growth charts for American population.

Usage
plot_growth_female(data, athlete)

Arguments
data A data frame. The object containing the raw data we wish to analyze.
athlete A character string with the name of the athlete we wish to plot.

Details
Data for growth charts was obtained from the National Center for Health Statistics.
Please visit https://www.cdc.gov/growthcharts/percentile_data_files.htm to learn more about this information.
Be aware, players from different populations to the one used on these growth charts may not be well represented.
For males, use documentation for plot_growth_male()

Value
A plot (ggplot)

Examples
plot_growth_female(data_sample, "Athlete 18")
plot_growth_male

Description

This function returns a ggplot object showing the current and predicted height vs normal growth charts for the American population.

Usage

plot_growth_male(data, athlete)

Arguments

data A data frame. The object containing the raw data we wish to analyze.
athlete A character string with the name of the athlete we wish to plot.

Details

Data for growth charts was obtained from the National Center for Health Statistics.

Please visit https://www.cdc.gov/growthcharts/percentile_data_files.htm to learn more about this information.

Be aware, players from different populations to the one used on these growth charts may not be well represented.

For females, use documentation for plot_growth_female()

Value

A plot (ggplot)

Examples

plot_growth_male(data_sample, "Athlete 08")
plot_maturity_offset  

**Maturity Offset Plot**

**Description**
This function returns a lollipop ggplot object showing the offset in years from current age to estimated age at PHV for each athlete in the dataset.

**Usage**

```r
plot_maturity_offset(data)
```

**Arguments**

- `data`  
  A data frame. The object containing the raw data we wish to analyze.

**Details**
Refer to references cited on this package for further details on how these metrics are calculated.

**Value**
A lollipop plot (ggplot)

**Examples**

```r
plot_maturity_offset(data_sample)
```

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plot_predicted_height_cm

**Predicted Height Plot (cm)**

**Description**
This function returns a ggplot object showing the predicted adult height for each athlete in the dataset. For the same plot in inches use `plot_predicted_height_in()`

**Usage**

```r
plot_predicted_height_cm(data)
```

**Arguments**

- `data`  
  A data frame. The object containing the raw data we wish to analyze.
plot_predicted_height_in

Value
A plot (ggplot)

Examples
plot_predicted_height_cm(data_sample)

plot_predicted_height_in

Description
This function returns a ggplot object showing the predicted adult height in inches for each athlete in the dataset. For the same plot in centimeters use plot_predicted_height_cm()

Usage
plot_predicted_height_in(data)

Arguments

data A data frame. The object containing the raw data we wish to analize.

Value
A plot (ggplot)

Examples
plot_predicted_height_in(data_sample)

plot_puberty_stages

% Adult Height vs Maturity Offset in Years

Description
This function returns a scatterplot showing the % of adult height vs the maturity offset (in years).

Usage
plot_puberty_stages(data)
Arguments
  data  A data frame. The object containing the raw data we wish to analyze.

Value
  A plot (ggplot)

Examples
  plot_puberty_stages(data_sample)

plot_time_phv  Time to PHV Dumbell Plot

Description
  This function returns a dumbell plot showing the difference (in years) between current age and estimated age at PHV for each athlete in the dataset.

Usage
  plot_time_phv(data)

Arguments
  data  A data frame. The object containing the raw data we wish to analyze.

Details
  Athletes are ordered by the difference between current and estimated age at PHV, as shown on the right of the plot, from highest to lowest.
  Check the references cited on this package for further details on how these metrics are calculated.

Value
  A dumbell plot (ggplot)

Examples
  plot_time_phv(data_sample)
**Description**

Khamis-Roche model estimates tables

**Usage**

`table`

**Format**

Data frame with 13 variables and 20 observations:

- **Age** Age group in years. Rounded every 6 months.
- **B1** Model intercept for males.
- **M-Height** Height (inches), for males.
- **M-Weight** Weight (lbs) for males.
- M-Midparent Stature  Average stature across mother & father for each age group, for males.
- **B2** Model intercept for females.
- **F-Height** Height (inches), for females.
- **F-Weight** Weight (lbs) for males.
- F-Midparent Stature  Average stature across mother & father for each age group, for females.

**Details**

A data frame containing model estimates and predictions by age from the Khamis-Roche method.

For further details visit [https://pediatrics.aappublications.org/content/94/4/504.short](https://pediatrics.aappublications.org/content/94/4/504.short)
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