Package 'lactater'

September 8, 2022

Title Tools for Analyzing Lactate Thresholds

Version 0.1.1

Description Set of tools for analyzing lactate thresholds from a step incremental test to exhaustion. Easily analyze
the methods Log-log, Onset of Blood Lactate Accumulation (OBLA), Baseline plus (Bsln+), Dmax, Lactate Turning Point (LTP),
and Lactate / Intensity ratio (LTratio) in cycling, running, or swimming.
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Suggests bsplus, covr, datapasta, glue, knitr, miniUI, rhandsontable, rmarkdown, shiny, shinyjs, shinyWidgets, spelling, testthat (>= 3.0.0)

Imports magrittr, broom, dplyr, ggplot2, ggtext, patchwork, lubridate, minpack.lm, pracma, rlang, segmented, stringr, tidyr, forcats

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R topics documented:

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demo_data   *Demo data*

Description

A dataset containing the lactate and heart rate data collected from a step-incremental test as an example

Usage

    demo_data

Format

A data frame with 8 rows and 5 variables:

step the number of the step, starting at zero for the baseline.

length the length of each step.

intensity the intensity performed on each step (in this case in watts).

lactate the blood lactate concentration.

heart_rate the heart rate associated with that step.

lactate_threshold	*Lactate threshold*

Description

This is a general function that applies several lactate threshold methods at the same time.

Usage

```
lactate_threshold(
  .data,
  intensity_column,
  lactate_column,
  heart_rate_column,
  method = c("Log-log", "OBLA", "Bsln+", "Dmax", "LTP", "LTratio"),
  fit = c("3rd degree polynomial", "4th degree polynomial", "B-spline"),
  include_baseline = FALSE,
  sport = c("cycling", "running", "swimming"),
  loglog_restrainer = 1,
  plot = TRUE
)
```

Arguments

`.data`	The raw data.
`intensity_column`	
	The name of the intensity column.
`lactate_column`	The name of the lactate column.
`heart_rate_column`	
	The name of the heart rate column, if applicable.
`method`	The lactate threshold method to calculate. It can be one or many of the following: `Log-log`, `OBLA`, `Bsln+`, `Dmax`, `LTP`, `LTratio`. See `Details` for more information. Default to `c("Log-log", "OBLA", "Bsln+", "Dmax", "LTP", "LTratio")`.
`fit`	The fit you would like to use for finding the lactate values associated to each one of the lactate thresholds. Please, note that a few lactate thresholds have default methods for this and cannot be changed. Options are `3rd degree polynomial`, `4th degree polynomial`, or `B-spline`. See `Details`.
`include_baseline`	
	A boolean to indicate whether to include the baseline value in the fit.
`sport`	The sport at which the incremental test was performed. One of `cycling`, `running`, or `swimming`.
`loglog_restrainer`	
	A scalar from 0 to 1 indicating the percentage of the data that you would like to restrain for fitting the Log-Log method. For example, 1 means no restriction (fits using the whole data), and `0.5` means that only the first 50% of the data will be used. Default to `1`.

plot   A boolean to indicate whether to generate a plot from each one of the methods.
                        Default to TRUE.

Details

Log-log:

The lactate response (i.e., log of lactate vs intensity) is divided into two segments. A segmented regression is then performed such that the lactate curve would present one breaking point. The exercise intensity at which the breaking point occurs is then considered as Log-log (Beaver et al., 1985). Caution: this method might require a double-check via a visual inspection, depending in some cases.

OBLA:

The Onset of Blood Lactate Accumulation (OBLA) is the exercise intensity at fixed lactate of 2.0, 2.5, 3.0, 3.5, and 4.0 mmol/L (Heck et al., 1985, Kindermann et al., 1979; Skinner & Mclellan, 1980). The lactate curve is usually fitted using a 3rd order polynomial regression curve, but the user can define another method (4th degree polynomial or B-spline).

Bsln+:

In the baseline plus method (Bsln+), the exercise intensity at which lactate increases to 0.5, 1.0, and 1.5 mmol/L above baseline (resting) values is considered (Berg et al., 1990; Zoladz et al., 1995). The lactate curve is usually fitted using a 3rd order polynomial regression curve, but the user can define another method (4th degree polynomial or B-spline).

Dmax:

Dmax:

The exercise intensity that yields the maximum perpendicular distance to the straight line between the first and the last data point (Cheng et al., 1992). The lactate curve is fitted using a 3rd order polynomial regression curve, and it can't be changed.

Modified Dmax (ModDmax):

The exercise intensity that yields the maximum perpendicular distance to the straight line between data point preceding the first rise in lactate greater than 0.4 mmol/L and the last data point (Bishop et al., 1998). The lactate curve is fitted using a 3rd order polynomial regression curve, and it can't be changed.

Exponential Dmax (Exp-Dmax):

The exercise intensity on the exponential plus-constant regression lactate curve that yields the maximum perpendicular distance to the straight line between the first and the last data point (Hughson et al., 1987). The lactate curve is fitted using an exponential curve, and it can't be changed.

Log-log modified Dmax (Log-Poly-ModDmax):

The exercise intensity that yields the maximum perpendicular distance to the straight line between Log-log and the last data point in the 3rd order polynomial regression curve (Jamnick et al., 2018). The lactate curve is fitted using a 3rd order polynomial regression curve, and it can't be changed.

Log-log exponential Dmax (Log-Exp-ModDmax):

The exercise intensity that yields the maximum perpendicular distance to the straight line between Log-log and the last data point in the exponential curve (Jamnick et al., 2018). The lactate curve is fitted using an exponential curve, and it can't be changed.

LTP:

Lactate Turning Point 1 (LTP1) and Lactate Turning Point 2 (LTP2):
the lactate response is divided into three segments. A segmented regression is performed such that the lactate curve yields two breaking points. The first breaking point, representing the first rise in lactate above resting levels, is considered as LTP1. The second breaking point, representing an accelerated lactate accumulation, is then considered as LTP2 (Hofmann & Tschakert, 2017; Hofmann et al., 1997; Pokan et al., 1997). Caution: this method might require a double-check via a visual inspection, depending in some cases.

LTratio:

The lactate response (i.e., ratio of lactate / exercise intensity vs exercise intensity) is interpolated using a B-spline regression curve. LTratio is then defined as the lowest value of the lactate / exercise intensity ratio, which attempts to describe the onset of the lactate increase (Dickhuth et al., 1999).

Value

a tibble with the following columns:

`method_category`
the category of the lactate threshold method.

`method`   the method used to estimate the lactate threshold

`fitting`   the fitting method used to predict the lactate curve

`intensity`   the intensity associated with the estimated lactate threshold

`lactate`   the lactate concentration associated with the estimated lactate threshold

`heart_rate`   the heart rate associated with the estimated lactate threshold

`plot`   the plot produced to display the lactate threshold

References

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Dickhuth H-H, Yin L, Niess A, et al. Ventilatory, Lactate-Derived and Catecholamine Thresholds During Incremental Treadmill Running: Relationship and Reproducibility. International Journal of Sports Medicine. 1999;20(02):122–7.

Examples

```
## Not run:
lactate_threshold(
  .data = demo_data,
  intensity_column = "intensity",
  lactate_column = "lactate",
  heart_rate_column = "heart_rate",
  fit = "3rd degree polynomial",
  include_baseline = TRUE,
  sport = "cycling",
  loglog_restrainer = 1,
  plot = TRUE
)

## End(Not run)
```

| plot_methods | *Combine lactate threshold methods into one plot* |

Description

Combine lactate threshold methods into one plot

Usage

```
plot_methods(plots, ...)
```

Arguments

plots	The `ggplot2` objects to be combined.
...	Additional arguments passed onto `patchwork::wrap_plots()`.

Value

a `patchwork` object

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run_data_input   *Data input widget*

Description

Widget to help with data input.

Usage

```
run_data_input(width = 1200, height = 900)
```

Arguments

width	The width, in pixels.
height	The height, in pixels.

Value

The code to reproduce the manual data input.

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