Package 'StablePopulation'

July 25, 2025

Title Calculates Alpha for a Stable Population

Version 1.0.3

Date 2025-07-24

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Description Provides tools to calculate the alpha parameter of the Weibull distribution, given beta and the age-specific fertility of a species, so that the population remains stable and stationary. Methods are inspired by ``Survival profiles from linear models versus Weibull models: Estimating stable
and stationary population structures for Pleistocene large mammals" (Martín-González et al. 2019)
<doi:10.1016/j.jasrep.2019.03.031>.

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Encoding UTF-8

RoxygenNote 7.3.2

Depends R (>= 3.5.0)

Imports readxl, openxlsx, stats

NeedsCompilation no

Repository CRAN

Date/Publication 2025-07-25 16:30:09 UTC

Contents

`alpha_objective` *Objective Function for* `uniroot`*: Finds the Difference Between Births and 1*

Description

This function calculates the difference between the number of births, as calculated with the given values of `alpha`, `beta`, and `fertility_rates`, and the target value of 1.

Usage

```
alpha_objective(alpha, beta, fertility_rates)
```

Arguments

`alpha`	A numeric value representing the alpha parameter.
`beta`	A numeric value representing the beta parameter.
`fertility_rates`	A numeric vector containing the fertility rates.

Details

Typically used as the objective function in root-finding algorithms such as uniroot, to determine the value of alpha that results in exactly one birth.

This function depends on calculate_population, which must be available in your package namespace.

Value

A numeric value giving the difference between the number of births (as calculated) and 1.

See Also

`uniroot`

Examples

```
# Basic usage
alpha_objective(0.5, 1.2, c(0.2, 0.3, 0.5, 0.4))

# Example with uniroot:
fertility_rates <- c(0.2, 0.3, 0.5, 0.4)
beta <- 1.2
res <- uniroot(
  alpha_objective,
  interval = c(0.000001, 100),
  beta = beta,
```

```
  fertility_rates = fertility_rates
)
res$root
```

`calculate_population` *Calculates the population for each age group*

Description

This function calculates the population for each age group and the number of births.

Usage

```
calculate_population(alpha, beta, fertility_rates)
```

Arguments

`alpha`	A numeric value representing the scale parameter (α) of the Weibull distribution. Note: In this context, alpha controls the horizontal scaling of the survival curve.
`beta`	A numeric value representing the shape parameter (β) of the Weibull distribution. Note: Beta controls the shape of the survival curve (e.g., aging or failure rate).
`fertility_rates`	A vector of fertility rates for each age group.

Value

A list with the following elements:

population A numeric vector giving the population size for each age group.

births A numeric value giving the total number of births.

Examples

```
calculate_population(0.5, 1.2, c(0.2, 0.3, 0.5, 0.4))
```

find_alphas *Function to find the value of alpha*

Description

This function finds the value of alpha using the `uniroot` method for a given beta and a vector of fertility rates. If the function values at the interval ends do not have opposite signs, it returns the closest value to 0.

Usage

```
find_alphas(beta, fertility_rates, tol = 1e-22)
```

Arguments

`beta`	A numeric value representing the beta parameter of Weibull distribution.
`fertility_rates`	A numeric vector containing the fertility rates.
`tol`	A numeric value representing the tolerance for the `uniroot` method. Default is `1e-22`.

Value

A numeric value giving the estimated value of alpha, either found by `uniroot` or selected as the endpoint closest to zero if the root is not bracketed.

Examples

```
find_alphas(1.2, c(0.2, 0.3, 0.5, 0.4))
```

run_analysis *Run Analysis on Excel Data and Export Results*

Description

This function reads fertility rate data and Beta value from an Excel file, processes it, and exports the results to a new Excel file for the species, including population matrices and calculated alpha/beta values.

Usage

```
run_analysis()
```

Details

The function relies on functions from the **readxl** and **openxlsx** packages to handle Excel files.

The following external functions are used:

- excel_sheets: List all sheet names in an Excel file.
- read_excel: Read data from an Excel file.
- createWorkbook: Create a new Excel workbook.
- addWorksheet: Add a worksheet to a workbook.
- writeData: Write data to a worksheet.
- saveWorkbook: Save the workbook to a file.

Please refer to the documentation of those packages for more details.

Value

No return value. Called for side effects (reading data, writing Excel files, and printing messages).

See Also

`excel_sheets`, `read_excel`, `createWorkbook`, `addWorksheet`, `writeData`, `saveWorkbook`

`weibull_survival` *Weibull function for the survival rate*

Description

This function calculates the survival rate to reach a specific age using the Weibull function.

Usage

```
weibull_survival(alpha, beta, age)
```

Arguments

`alpha`	A numeric value representing the scale parameter of the Weibull distribution.
`beta`	A numeric value representing the shape parameter of the Weibull distribution.
`age`	A numeric value representing the age.

Value

A numeric value giving the survival rate (probability) for reaching the given age.

Examples

```
weibull_survival(1.5, 0.8, 10)
```

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