

Package ‘aLBI’

September 27, 2026

Type Package

Title Estimating Length-Based Indicators for Fish Stock Assessment

Version 0.2.0

Description Provides tools for estimating length-based indicators (LBIs) from length-frequency data to assess fish stock status and evaluate growth and recruitment overfishing in data-limited fisheries. Implements the sustainability indicators of Froese (2004) <[doi:10.1111/j.1467-2979.2004.00144.x](https://doi.org/10.1111/j.1467-2979.2004.00144.x)>, empirical biological reference points from Froese and Binohlan (2000) <[doi:10.1111/j.1095-8649.2000.tb00870.x](https://doi.org/10.1111/j.1095-8649.2000.tb00870.x)>, and the decision framework of Cope and Punt (2009) <[doi:10.1577/C08-025.1](https://doi.org/10.1577/C08-025.1)>. Incorporates a three-tier Monte Carlo and bootstrap uncertainty propagation framework for sustainability indicators, optimum bin size calculations following Wang et al. (2020) <[doi:10.1016/j.fishres.2019.105474](https://doi.org/10.1016/j.fishres.2019.105474)>, multi-month length-frequency harmonization, and length-weight relationship fitting. Methodology is detailed in Ali et al. (2025) <[doi:10.1016/j.fishres.2025.107467](https://doi.org/10.1016/j.fishres.2025.107467)>.

Depends R (>= 4.0.0)

Imports ggplot2, graphics, grDevices, openxlsx, stats, utils

Suggests dplyr, knitr, readxl, rmarkdown, testthat

License GPL-3

Encoding UTF-8

LazyData true

URL <https://github.com/Ataher76/aLBI>

BugReports <https://github.com/Ataher76/aLBI/issues>

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CPdata	<i>CPdata: Example dataset for aLBI package</i>
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Description

This dataset contains description of CPdata.

Usage

data(CPdata)

Format

- A data frame with 11 columns:
- A Probability values
 - B Probability values
 - C Probability values
 - D Probability values
 - E Probability values
 - F Probability values
 - G Probability values
 - H Probability values
 - I Probability values
 - J Probability values
 - Tx Target column compared with LM_ratio to pick probability values

Source

A decision table described by Cope and Punt (2009)

Examples

```
data(CPdata, package = "aLBI")
head(CPdata)
```

ExData

*ExData: Example raw length dataset for aLBI package***Description**

This dataset contains description of ExData.

Usage

```
data(ExData)
```

Format

A data frame with 1 column:

Length Sampled length data (cm)

Source

Data collected for fish stock assessment studies

Examples

```
data(ExData, package = "aLBI")
head(ExData)
```

FishPar

*Length-Based Indicators with Three-Tier Uncertainty Propagation***Description**

Estimates Froese (2004) length-based sustainability indicators via a two-stage simulation and a novel three-tier uncertainty decomposition:

1. **Monte Carlo** for length parameters (Lmax, Linf, Lmat, Lopt) based on Froese & Binohlan (2000) allometric regressions.
2. **Three-tier uncertainty propagation** to Pmat, Popt, Pmega:
 - Tier 1: Parameter uncertainty only (MC parameters, observed catch).
 - Tier 2: Data-sampling uncertainty only (fixed parameters, bootstrap catch).
 - Tier 3: Total/joint uncertainty (MC parameters + bootstrap catch simultaneously), the novel contribution.

Plots are rendered in the active graphics device. When `save_output = TRUE`, all PDFs and an Excel workbook are written to `getwd()`. The Excel workbook contains a dedicated `FishSS_Inputs` sheet with all values required by `FishSS()`.

Usage

```
FishPar(
  data,
  resample = 1000,
  progress = FALSE,
  Linf = NULL,
  Linf_sd = 0.5,
  Lmat = NULL,
  Lmat_sd = 0.5,
  save_output = FALSE
)
```

Arguments

<code>data</code>	Data frame – two columns: Length and Frequency.
<code>resample</code>	Monte Carlo / bootstrap iterations (default 1000).
<code>progress</code>	Logical; display a text progress bar (default FALSE).
<code>Linf</code>	Optional asymptotic length; overrides <code>Lmax</code> / 0.95.
<code>Linf_sd</code>	Gaussian noise SD for <code>Linf</code> samples (default 0.5).
<code>Lmat</code>	Optional length at first maturity; overrides regression.
<code>Lmat_sd</code>	Gaussian noise SD for <code>Lmat</code> samples (default 0.5).
<code>save_output</code>	Logical; write all PDFs and Excel to disk (default FALSE). Set TRUE to persist outputs to <code>getwd()</code> .

Value

Invisibly, a named list:

estimated_length_par MC mean $\pm$ 95% CI for length parameters.
froese_par_mc Tier 1 – parameter-uncertainty CIs for `Pmat`, `Popt`, `Pmega`.
froese_par_bootstrap Tier 2 – data-sampling CIs.
froese_par_joint Tier 3 – total/joint CIs (novel).
froese_ind_vs_target Observed vs. Froese (2004) targets.
LM_ratio `Lmat` / `Lopt`.
Pobj `Pmat` + `Popt` + `Pmega` (0-300 scale; Cope & Punt 2009).
Total_ind Total observed individuals.

References

Froese, R. (2004). Keep it simple: three indicators to deal with overfishing. *Fish and Fisheries*, 5, 86-91.

Froese, R. & Binohlan, C. (2000). Empirical relationships to estimate asymptotic length, length at first maturity and length at maximum yield per recruit in fishes. *J. Fish Biol.*, 56, 758-773.

Silverman, B.W. (1986). *Density Estimation for Statistics and Data Analysis*. Chapman & Hall, London.

Efron, B. & Tibshirani, R.J. (1993). *An Introduction to the Bootstrap*. Chapman & Hall, New York.

Description

Assesses stock status against target and limit spawning biomass reference points (0.40 SB0 and 0.25 SB0) and classifies catch selectivity patterns using the decision framework of Cope & Punt (2009).

Usage

```
FishSS(data, LM_ratio, Pmat, Popt, Pmega)
```

Arguments

<code>data</code>	Data frame containing the Cope & Punt (2009) look-up table with columns: Tx, A, B, C, D, E, F, G, H, I, J.
<code>LM_ratio</code>	Numeric; length at maturity ratio (L_{mat} / L_{opt}).
<code>Pmat</code>	Numeric; percentage of mature fish in catch (0-100).
<code>Popt</code>	Numeric; percentage of optimally sized fish in catch (0-100).
<code>Pmega</code>	Numeric; percentage of mega-spawners in catch (0-100).

Value

A named list containing:

Pobj Composite indicator sum ($P_{mat} + P_{opt} + P_{mega}$; 0-300 scale).

Px_trigger Name of trigger indicator used ("Pmat" or "Popt").

Px_value Calculated value of the trigger indicator.

StockStatus Named vector with probabilities: `p_below_target` ($P(\text{biomass} < 0.40 \text{ SB}_0)$) and `p_below_limit` ($P(\text{biomass} < 0.25 \text{ SB}_0)$).

Selectivity Character description of the catch selectivity pattern.

References

Cope, J. M., & Punt, A. E. (2009). Length-based reference points for data-limited situations: Applications and restrictions. *Marine and Coastal Fisheries*, 1(1), 169-186.

Ali, A., Sarker, M. R., & Alam, M. S. (2025). Development of a simple R package (aLBI) for the estimation of stock status from the length frequency data. *Fisheries Research*, 288, 107467.

Examples

```
utils::data("CPdata", package = "aLBI", envir = environment())
if (exists("CPdata")) {
  FishSS(CPdata, LM_ratio = 0.95, Pmat = 56.5, Popt = 38.4, Pmega = 36.4)
}
```

FreqTM

*Generate Frequency Distribution Table Across Months***Description**

Creates a standardized frequency distribution table for fish length data across multiple months using a consistent length-class lattice. The bin width is determined by either user input or Wang's empirical formula applied across the full dataset. Columns for month and length are dynamically detected. Months are converted to sequential date headers in 'dd.mm.yy' format.

Usage

```
FreqTM(
  data,
  bin_width = NULL,
  Lmax = NULL,
  save_output = FALSE,
  output_file = "FreqTM_Output.xlsx",
  date_config = list(day = 1, year = 2025)
)
```

Arguments

<code>data</code>	A data frame containing columns for months and lengths.
<code>bin_width</code>	Numeric; class interval width (cm). If NULL (default), calculated using Wang's formula.
<code>Lmax</code>	Numeric; maximum observed length. If NULL, the observed maximum in data is used.
<code>save_output</code>	Logical; write the output table to an Excel workbook (default FALSE).
<code>output_file</code>	Character; name of the output Excel file when <code>save_output = TRUE</code> . Defaults to "FreqTM_Output.xlsx".
<code>date_config</code>	A list with numeric elements <code>day</code> (default 1) and <code>year</code> (default 2025) for formatting date headers.

Value

A data frame where the first column is Length (upper class boundaries) and subsequent columns contain catch frequencies for each sampling date formatted as 'dd.mm.yy'.

References

Wang, K., Zhang, C., Xu, B., Xue, Y., & Ren, Y. (2020). Selecting optimal bin size to account for growth variability in Electronic Length Frequency ANalysis (ELEFAN). *Fisheries Research*, 225, 105474.

Examples

```
set.seed(123)
sample_data <- data.frame(
  SamplingMonth = rep(c("Aug", "Sep", "Oct"), each = 50),
  TotalLength = runif(150, min = 8.5, max = 22.4)
)

# Run in-memory (CRAN compliant)
res <- FreqTM(data = sample_data, bin_width = 2)
head(res)
```

FrequencyTable

*Generate a Frequency Distribution Table for Fish Length Data***Description**

Creates a standardized length-frequency distribution table from individual fish length measurements. The bin width is determined by either user specification or Wang's empirical formula. Class intervals are represented by their upper boundaries for direct compatibility with `FishPar()`.

Usage

```
FrequencyTable(
  data,
  bin_width = NULL,
  Lmax = NULL,
  save_output = FALSE,
  output_file = "FrequencyTable_Output.xlsx"
)
```

Arguments

<code>data</code>	A numeric vector or data frame containing fish length measurements. If a data frame is provided, the first numeric column is used.
<code>bin_width</code>	Numeric; class interval width (cm). If NULL (default), calculated using Wang's formula.
<code>Lmax</code>	Numeric; maximum observed length. If NULL, the observed maximum in data is used.
<code>save_output</code>	Logical; write the output tables to an Excel workbook (default FALSE).
<code>output_file</code>	Character; name of the output Excel file when <code>save_output = TRUE</code> . Defaults to "FrequencyTable_Output.xlsx".

Value

A list containing two data frames:

lfqTable Complete frequency table with class intervals (Length_Range) and observed counts (Frequency).

lfreq Condensed two-column table with upper class boundaries (Length) and observed counts (Frequency), ready for FishPar().

References

Wang, K., Zhang, C., Xu, B., Xue, Y., & Ren, Y. (2020). Selecting optimal bin size to account for growth variability in Electronic Length Frequency ANalysis (ELEFAN). *Fisheries Research*, 225, 105474.

Examples

```
set.seed(123)
fish_lengths <- runif(200, min = 5, max = 70)

# Run in-memory (CRAN compliant)
res <- FrequencyTable(data = fish_lengths)
head(res$lfreq)

# Custom bin width
res_custom <- FrequencyTable(data = fish_lengths, bin_width = 5)
head(res_custom$lfreq)
```

lenfreq01	<i>lenfreq01: Example dataset for aLBI package</i>
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Description

This dataset contains description of lenfreq01.

Usage

```
data(lenfreq01)
```

Format

A data frame with 2 columns:

Frequency Observed individuals in each length class

Length Upper value of each length class (cm)

Source

Data collected for fish stock assessment studies

Examples

```
data(lenfreq01, package = "aLBI")
head(lenfreq01)
```

lenfreq02

*lenfreq02: Example dataset for aLBI package***Description**

This dataset contains description of lenfreq02.

Usage

```
data(lenfreq02)
```

Format

A data frame with 2 columns:

Frequency Observed individuals in each length class

LengthClass Upper value of each length class (cm)

Source

Data collected for fish stock assessment studies

Examples

```
data(lenfreq02, package = "aLBI")
head(lenfreq02)
```

lenfreqM

*lenfreqM: Example length-weight dataset for aLBI package***Description**

This dataset contains length data of multiple months

Usage

```
data(lenfreqM)
```

Format

A data frame with 2 columns: First one is month and second one is length

Months Name of the Sampling Months

Length Measured lengths of the sampled fish

Source

Data collected for fish stock assessment studies

Examples

```
data(lenfreqM, package = "aLBI")  
head(lenfreqM)
```

LWdata

LWdata: Example length-weight dataset for aLBI package

Description

This dataset contains length and weight measurements for fish.

Usage

```
data(LWdata)
```

Format

A data frame with 2 columns:

Length Length of sampled fish (cm)

Weight Weight of sampled fish (g)

Source

Data collected for fish stock assessment studies

Examples

```
data(LWdata, package = "aLBI")  
head(LWdata)
```

LWR

Plot and Model Length-Weight Relationships with Optional Log Transformation

Description

Visualizes and models the relationship between fish length and body weight (or any two continuous allometric variables) using linear regression. Supports both natural scale and log-log linearised models ($W = a * L^b$). Produces a publication-ready ggplot2 figure with regression diagnostics, confidence intervals, and parameter estimates.

Usage

```
LWR(
  data,
  log_transform = TRUE,
  point_col = "black",
  line_col = "red",
  shade_col = "red",
  point_size = 2,
  line_size = 1,
  alpha = 0.2,
  main = "Length-Weight Relationship",
  xlab = NULL,
  ylab = NULL,
  save_output = FALSE
)
```

Arguments

data	A data frame containing at least two numeric columns: length (first column) and weight (second column).
log_transform	Logical; apply log-log transformation (default TRUE).
point_col	Color of data points (default "black").
line_col	Color of fitted regression line (default "red").
shade_col	Color of confidence interval ribbon (default "red").
point_size	Numeric; size of data points (default 2).
line_size	Numeric; thickness of regression line (default 1).
alpha	Numeric; transparency of CI ribbon (default 0.2).
main	Character; plot title (default "Length-Weight Relationship").
xlab	Character; optional custom x-axis label.
ylab	Character; optional custom y-axis label.
save_output	Logical; save plot PDF and summary text file to disk (default FALSE).

Value

A list containing:

model The fitted `lm` model object.

intercept The estimated intercept (back-transformed a if `log_transform = TRUE`).

slope The estimated allometric slope b .

r_squared Coefficient of determination (R^2).

correlation_r Pearson correlation coefficient (r).

p_value P-value for the slope parameter.

plot The `ggplot2` object for further customization.

Examples

```
utils::data("LWdata", package = "aLBI", envir = environment())
if (exists("LWdata")) {
  res <- LWR(LWdata, log_transform = TRUE, save_output = FALSE)
  print(res$plot)
}
```

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