

Package ‘soiltestcorr’

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Title Soil Test Correlation and Calibration

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Description A compilation of functions designed to assist users on the correlation analysis of crop yield and soil test values. Functions to estimate crop response patterns to soil nutrient availability and critical soil test values using various approaches such as: 1) the modified arc-sine-log calibration curve (Correndo et al. (2017) <[doi:10.1071/CP16444](https://doi.org/10.1071/CP16444)>); 2) the graphical Cate-Nelson quadrants analysis (Cate & Nelson (1965)), 3) the statistical Cate-Nelson quadrants analysis (Cate & Nelson (1971) <[doi:10.2136/sssaj1971.03615995003500040048x](https://doi.org/10.2136/sssaj1971.03615995003500040048x)>), 4) the linear-plateau regression (Anderson & Nelson (1975) <[doi:10.2307/2529422](https://doi.org/10.2307/2529422)>), 5) the quadratic-plateau regression (Bullock & Bullock (1994) <[doi:10.2134/agronj1994.00021962008600010033x](https://doi.org/10.2134/agronj1994.00021962008600010033x)>), and 6) the Mitscherlich-type exponential regression (Melsted & Peck (1977) <[doi:10.2134/asaspecpub29.c1](https://doi.org/10.2134/asaspecpub29.c1)>). The package development stemmed from ongoing work with the Fertilizer Recommendation Support Tool (FRST) and Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification (SIIL) projects.

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URL <https://adriancorrendo.github.io/soiltestcorr/>,
<https://soiltestfrst.org/>,
<https://www.siildigitalagconsortium.com/>

BugReports <https://github.com/adriancorrendo/soiltestcorr/issues>

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cate_nelson_1965	<i>Cate & Nelson quadrants analysis (graphical)</i>
------------------	---

Description

This function runs the quadrants analysis suggested by Cate and Nelson (1965)

Usage

```
cate_nelson_1965(data = NULL, stv, ry, target, tidy = TRUE, plot = FALSE)

boot_cn_1965(data, ry, stv, target = 90, n = 5, ...)
```

Arguments

data	argument to call a data.frame or data.table containing the data
stv	argument to call the vector or column containing the soil test value (stv) data
ry	argument to call the vector or column containing the relative yield (ry) data
target	argument to specify the ry target (numeric) to estimate the critical stv for
tidy	logical operator (TRUE/FALSE) to decide the type of return. TRUE returns a tibble, FALSE returns a list. Default: TRUE.

plot	logical operator (TRUE/FALSE) to decide the type of return. TRUE returns a ggplot, FALSE returns either a list (tidy == FALSE) or a tibble (tidy == TRUE).
n	sample size for the bootstrapping Default: 500
...	when running bootstrapped samples, the ... (open arguments) allows to add grouping variable/s (factor or character) Default: NULL

Details

See [online-documentation](#) for additional details.

Value

returns an object of type ggplot if plot = TRUE.

returns an object of class data.frame if tidy = TRUE,

returns an object of class list if tidy = FALSE.

boot_cn_1965: bootstrapping function

Note

This code was adapted from Mangiafico, S. S. (2013). Cate-Nelson Analysis for Bivariate Data Using R-project. *The Journal of Extension*, 51(5), Article 33. <https://tigerprints.clemson.edu/joe/vol51/iss5/33/>

References

Cate & Nelson (1965). A rapid method for correlation of soil test analysis with plant response data. *North Carolina Agric. Exp. Stn., International soil Testing Series I. No. 1.*

See Also

[eval_tidy](#), [defusing-advanced lm](#), [anova ggplot](#), [aes](#), [geom_point](#), [labs](#), [geom_abline](#), [annotate](#), [theme](#)

Examples

```
# Example 1 dataset
dat <- data.frame("ry" = c(65,80,85,88,90,94,93,96,97,95,98,100,99,99,100),
                  "stv" = c(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15))

# Run
fit_example_cn_1965 <- cate_nelson_1965(data = dat,
ry = ry, stv = stv, target = 90, tidy=FALSE, plot=FALSE)

fit_example_cn_1965
```

cate_nelson_1971

Cate & Nelson quadrants analysis (statistical)

Description

This function runs the quadrants analysis suggested by Cate and Nelson (1971)

Usage

```
cate_nelson_1971(data = NULL, stv, ry, tidy = TRUE, plot = FALSE)
```

```
boot_cn_1971(data, ry, stv, n = 5, ...)
```

Arguments

data	argument to call a data.frame or data.table containing the data
stv	argument to call the vector or column containing the soil test value (stv) data
ry	argument to call the vector or column containing the relative yield (ry) data
tidy	logical operator (TRUE/FALSE) to decide the type of return. TRUE returns a data.frame, FALSE returns a list. Default: TRUE.
plot	logical operator (TRUE/FALSE) to decide the type of return. TRUE returns a ggplot, FALSE returns either a list (tidy == FALSE) or a data.frame (tidy == TRUE).
n	sample size for the bootstrapping Default: 500
...	when running bootstrapped samples, the ... (open arguments) allows to add grouping variable/s (factor or character) Default: NULL

Details

See [online-documentation](#) for additional details.

Value

returns an object of type ggplot if plot = TRUE.
 returns an object of class data.frame if tidy = TRUE,
 returns an object of class list if tidy = FALSE.
 boot_cn_1971: bootstrapping function

Note

This code was adapted from Mangiafico, S. S. (2013). Cate-Nelson Analysis for Bivariate Data Using R-project. *The Journal of Extension*, 51(5), Article 33. <https://tigerprints.clemson.edu/joe/vol51/iss5/33/>

References

Cate & Nelson (1971). A simple statistical procedure for partitioning soil test correlation data into two classes. *Soil Sci. Soc. Am. Proc.* 35:658-660. doi:10.2136/sssaj1971.03615995003500040048x

See Also

[eval_tidy](#), [defusing-advanced lm](#), [anova ggplot](#), [aes](#), [geom_point](#), [labs](#), [geom_abline](#), [annotate](#), [theme](#)

Examples

```
# Example 1 dataset
dat <- data.frame("ry" = c(65,80,85,88,90,94,93,96,97,95,98,100,99,99,100),
                  "stv" = c(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15))

# Run
fit_example_cn_1971 <- cate_nelson_1971(data = dat,
ry = ry, stv = stv, tidy=FALSE, plot=FALSE)

fit_example_cn_1971
```

data_test

Dataset 1

Description

Example dataset containing hypothetical pairs of soil test value (STV) and relative yield (RY).

Usage

data_test

Format

this data frame has 137 rows and the following 2 columns:

STV soil test value

RY relative yield, %

Source

doi:10.7910/DVN/NABA57

```
freitas1966
```

```
Dataset 2
```

Description

Example dataset containing real data reported by Cate & Nelson (1971) from Freitas et al. (1966). Soil test potassium values (STK) and relative yield as percentage (RY).

Usage

```
freitas1966
```

Format

this data frame has 24 rows and the following 2 columns:

RY relative yield, %

STK soil test potassium, ppm

Source

Freitas et al. (1966) cited and used by Cate & Nelson (1971). Soil Sci. Soc. Am. Proc. 35:658-659

```
linear_plateau
```

```
Linear-plateau response function
```

Description

This function helps to fit a linear-plateau model in order to estimate critical soil test values (CSTV) above which yield response becomes flat.

Usage

```
SS_LP(x, a, b, xs)
```

```
linear_plateau(
  data = NULL,
  stv,
  ry,
  target = NULL,
  tidy = TRUE,
  plot = FALSE,
  resid = FALSE
)
```

```
boot_linear_plateau(data, stv, ry, n = 1000, target = NULL, ...)
```

Arguments

x	selfstart arg. for explanatory variable in SSlinp Default: NULL
a	selfstart arg. for intercept Default: NULL
b	selfstart arg. for slope Default: NULL
xs	selfstart arg. for break/join point in SSlinp Default: NULL
data	Optional argument to call and object of type data.frame or data.table containing the soil test value (STV) and relative yield (RY) data, Default: NULL
stv	name of the vector containing soil test values (-) of type numeric.
ry	name of the vector containing relative yield values (%) of type numeric.
target	numeric value of relative yield target (e.g. 90 for 90%) to estimate the CSTV. The target needs to be < plateau, otherwise, target = plateau.
tidy	logical operator (TRUE/FALSE) to decide the type of return. TRUE returns a tidy data frame or tibble (default), FALSE returns a list.
plot	logical operator (TRUE/FALSE) to plot the linear-plateau model, Default: FALSE
resid	logical operator (TRUE/FALSE) to plot residuals analysis, Default: FALSE
n	sample size for the bootstrapping Default: 500
...	when running bootstrapped samples, the ... (open arguments) allows to add grouping variable/s (factor or character) Default: NULL

Details

See [online-documentation](#) for additional details.

Value

returns an object of type ggplot if plot = TRUE.

returns a residuals plot if resid = TRUE.

returns an object of class data.frame if tidy = TRUE,

returns an object of class list if tidy = FALSE.

SS_LP: selfStart function to pass into the linear_plateau fit

linear_plateau: function

boot_linear_plateau: bootstrapping function

Note

For extended reference, we recommend to visit: <https://gradcylinder.org/post/linear-plateau/> by Austin Pearce. Self-start function code adapted from nlraa package by F. Miguez <https://github.com/femiguez/nlraa>

References

Anderson, R. L., and Nelson, L. A. (1975). A Family of Models Involving Intersecting Straight Lines and Concomitant Experimental Designs Useful in Evaluating Response to Fertilizer Nutrients. *Biometrics*, 31(2), 303–318. doi:10.2307/2529422

See Also

[eval_tidy](#), [defusing-advanced](#), [nlsLM](#), [SSlinp](#), [AIC](#), [lm](#), [optim](#), [coef](#), [predict](#), [AICc](#), [model-quality](#), [nlsResiduals](#), [bind](#), [ggplot](#), [aes](#), [geom_rug](#), [geom_point](#), [geom_abline](#), [geom_path](#), [annotate](#), [labs](#), [theme](#), [annotate](#)

Examples

```
# Example dataset
dat <- data.frame("ry" = c(65,80,85,88,90,94,93,96,97,95,98,100,99,99,100),
                  "stv" = c(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15))

# Run
fit_example_lp <- linear_plateau(data = dat,
ry = ry, stv = stv, resid = TRUE, plot = FALSE)
fit_example_lp
```

mitscherlich

*Mitscherlich response function***Description**

This function helps to fit a Mitscherlich-style exponential response model for relative yield (ry) as a function of soil test values (stv).

Usage

```
mits_formula_1(x, a, b, c)
```

```
mits_formula_2(x, b, c)
```

```
mits_formula_3(x, c)
```

```
mitscherlich(
  data = NULL,
  stv,
  ry,
  type = 1,
  target = 95,
  tidy = TRUE,
  plot = FALSE,
  resid = FALSE
)
```

```
boot_mitscherlich(data, stv, ry, type = 1, n = 999, target = 95, ...)
```

Arguments

<code>x</code>	selfstart vector. for model fit Default: NULL
<code>a</code>	selfstart arg. for asymptote parameter, Default: NULL
<code>b</code>	selfstart arg. for b parameter ($b = -X_intercept$) Default: NULL
<code>c</code>	selfstart arg. for curvature parameter Default: NULL
<code>data</code>	Optional argument to call and object of type <code>data.frame</code> or <code>data.table</code> containing the <code>stv</code> and <code>ry</code> data, Default: NULL
<code>stv</code>	name of the vector containing soil test values (-) of type <code>numeric</code> .
<code>ry</code>	name of the vector containing relative yield values (%) of type <code>numeric</code> .
<code>type</code>	string or number that indicates the type of Mitscherlich model to fit. Default: 1. For model with 'no restrictions' use <code>type = 1</code> , <code>type = "no restriction"</code> , or <code>type = "free"</code> ; For model with 'asymptote = 100' use <code>type = 2</code> , <code>type = "asymptote 100"</code> , or <code>type = "100"</code> ; For model with 'asymptote = 100 and <code>xintercept = 0</code> ' <code>type = 3</code> , <code>type = "asymptote 100 from 0"</code> , or <code>type = "fixed"</code> .
<code>target</code>	numeric value of relative yield target (e.g. 90 for 90%) to estimate the CSTV. Default: NULL
<code>tidy</code>	logical operator (TRUE/FALSE) to decide the type of return. TRUE returns a tidy data frame or tibble (default), FALSE returns a list.
<code>plot</code>	logical operator (TRUE/FALSE) to plot the Mitscherlich model, Default: FALSE
<code>resid</code>	logical operator (TRUE/FALSE) to plot residuals analysis, Default: FALSE
<code>n</code>	sample size for the bootstrapping Default: 500
<code>...</code>	when running bootstrapped samples, the <code>...</code> (open arguments) allows to add grouping variable/s (factor or character) Default: NULL

Details

See [online-documentation](#) for additional details.

Value

returns an object of type `ggplot` if `plot = TRUE`.

returns a residuals plot if `resid = TRUE`.

returns an object of class `data.frame` if `tidy = TRUE`,

returns an object of class `list` if `tidy = FALSE`.

Mitscherlich type 1 formula

Mitscherlich type 2 formula

Mitscherlich type 3 formula

`mitscherlich`: function

`boot_mitscherlich`: bootstrapping function

Note

For extended reference, we recommend to visit: <https://github.com/austinwpearce/SoilTestCocaCola> by Austin Pearce.

References

Melsted, S.W. and Peck, T.R. (1977). The Mitscherlich-Bray Growth Function. *In Soil Testing (eds T. Peck, J. Cope and D. Whitney)*. doi:10.2134/asaspecpub29.c1

See Also

[eval_tidy](#), [defusing-advanced-nlsLM](#), [AIC](#), [lm](#), [optim](#), [coef](#), [predict](#), [AICc](#), [model-quality](#), [nlsResiduals](#), [bind](#), [ggplot](#), [aes](#), [geom_rug](#), [geom_point](#), [geom_abline](#), [geom_path](#), [annotate](#), [labs](#), [theme](#)

Examples

```
# Example dataset
dat <- data.frame("ry" = c(65,80,85,88,90,94,93,96,97,95,98,100,99,99,100),
                  "stv" = c(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15))

# Run
fit_example_mits <- mitscherlich(data = dat, type = 1,
                                ry = ry, stv = stv, resid = TRUE, plot = FALSE)

fit_example_mits
```

mod_alcc

Modified Arcsine-Log Calibration Curve

Description

This function runs the modified arcsine-log calibration curve to estimate critical soil test values (CSTV) following Correndo et al. (2017)

Usage

```
mod_alcc(
  data = NULL,
  ry,
  stv,
  target,
  confidence = 0.95,
  tidy = TRUE,
  plot = FALSE
)

logLik_alcc(object, ...)

boot_mod_alcc(data, ry, stv, n = 500, target = 90, confidence = 0.95, ...)
```

Arguments

data	Optional argument to call and object of type data.frame or data.table containing the stv and ry data, Default: NULL
ry	name of the vector containing relative yield values (%) of type numeric.
stv	name of the vector containing soil test values of type numeric.
target	numeric value of relative yield target (e.g. 90 for 90%) to estimate the CSTV.
confidence	numeric value of confidence level (e.g. 0.95 for significance = 0.05)
tidy	logical operator (TRUE/FALSE) to decide the type of return. TRUE returns a tidy data frame or tibble (default), FALSE returns a list.
plot	logical operator (TRUE/FALSE) to decide the type of return. TRUE returns a ggplot, FALSE returns either a list (tidy == FALSE) or a data.frame (tidy == TRUE).
object	the "object" is the output data frame from approx with resid column
...	when running bootstrapped samples, the ... (open arguments) allows to add grouping variable/s (factor or character) Default: NULL
n	sample size for the bootstrapping Default: 500

Details

See [online-documentation](#) for additional details.

Value

returns an object of type ggplot if plot = TRUE.
 returns an object of class data.frame if tidy = TRUE,
 returns an object of class list if tidy = FALSE.
 logLik_alcc: AIC on original scale function
 boot_mod_alcc: bootstrapping function

Note

For extended reference, we recommend to visit [doi:10.7910/DVN/NABA57](https://doi.org/10.7910/DVN/NABA57) and <https://github.com/adriancorrendo/modified-ALCC> by Adrian Correndo.

References

Correndo et al. (2017). A modification of the arcsine–log calibration curve for analysing soil test value–relative yield relationships. *Crop and Pasture Science*, 68(3), 297-304. [doi:10.1071/CP16444](https://doi.org/10.1071/CP16444)

See Also

[eval_tidy](#), [defusing-advanced TDist](#), [cor](#), [cor.test](#), [sd](#), [approx](#), [bind](#), [filter](#), [nest](#), [ggplot](#), [aes](#), [geom_point](#), [scale_manu](#), [annotate](#)

Examples

```
# Example 1 dataset
dat <- data.frame("ry" = c(65,80,85,88,90,94,93,96,97,95,98,100,99,99,100),
                  "stv" = c(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15))

# Run
fit_example <- mod_alcc(data = dat, ry = ry, stv = stv, target=90, confidence = 0.95)
fit_example
```

quadratic_plateau	<i>Quadratic-plateau response function</i>
-------------------	--

Description

This function helps to fit a quadratic-plateau response model and to estimate a critical soil test values (CSTV) above which yield response becomes flat.

Usage

```
SS_QP(x, a, b, xs)
```

```
quadratic_plateau(
  data = NULL,
  stv,
  ry,
  target = NULL,
  tidy = TRUE,
  plot = FALSE,
  resid = FALSE
)
```

```
boot_quadratic_plateau(data, stv, ry, n = 1000, target = NULL, ...)
```

Arguments

x	selfstart arg. for explanatory variable in SSquadp3xs Default: NULL
a	selfstart arg. for intercept Default: NULL
b	selfstart arg. for slope Default: NULL
xs	selfstart arg. for break/join point in SSquadp3xs Default: NULL
data	Optional argument to call and object of type data.frame or data.table containing the stv and ry data, Default: NULL
stv	name of the vector containing soil test values (-) of type numeric.
ry	name of the vector containing relative yield values (%) of type numeric.
target	numeric value of relative yield target (e.g. 90 for 90%) to estimate the CSTV. The target needs to be < plateau, otherwise, target = plateau.

<code>tidy</code>	logical operator (TRUE/FALSE) to decide the type of return. TRUE returns a tidy data frame or tibble (default), FALSE returns a list.
<code>plot</code>	logical operator (TRUE/FALSE) to plot the quadratic-plateau model, Default: FALSE
<code>resid</code>	logical operator (TRUE/FALSE) to plot residuals analysis, Default: FALSE
<code>n</code>	sample size for the bootstrapping Default: 500
<code>...</code>	when running bootstrapped samples, the ... (open arguments) allows to add grouping variable/s (factor or character) Default: NULL

Details

See [online-documentation](#) for additional details.

Value

returns an object of type `ggplot` if `plot = TRUE`.

returns a residuals plot if `resid = TRUE`.

returns an object of class `data.frame` if `tidy = TRUE`,

returns an object of class `list` if `tidy = FALSE`.

`SS_QP`: selfStart function to pass into the `quadratic_plateau` fit

`quadratic_plateau`: function

`boot_quadratic_plateau`: bootstrapping function

Note

For extended reference, we recommend to visit <https://gradcylinder.org/post/quad-plateau/> by Austin Pearce. Self-start function code adapted from `nlraa` package by F. Miguez <https://github.com/femiguez/nlraa>

References

Bullock, D.G. and Bullock, D.S. (1994) Quadratic and Quadratic-Plus-Plateau Models for Predicting Optimal Nitrogen Rate of Corn: A Comparison. *Agron. J.*, 86: 191-195. doi:10.2134/agronj1994.00021962008600010033x

See Also

[eval_tidy](#), [defusing-advanced nlsLM](#), [SSlinp](#), [AIC](#), [lm](#), [optim](#), [coef](#), [predict](#), [AICc](#), [model-quality](#), [nlsResiduals](#), [bind](#), [ggplot](#), [aes](#), [geom_rug](#), [geom_point](#), [geom_abline](#), [geom_path](#), [annotate](#), [labs](#), [theme](#), [annotate](#)

Examples

```
# Example dataset
df <- data.frame("ry" = c(65,80,85,88,90,94,93,96,97,95,98,100,99,99,100),
                 "stv" = c(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15))

# Run
fit_example_qp <- quadratic_plateau(data = df,
  stv = stv, ry = ry, resid = TRUE, plot = FALSE)
fit_example_qp
```

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