Package: ggpmisc (via r-universe)

September 26, 2024

Type Package

Title Miscellaneous Extensions to 'ggplot2'

Version 0.6.0

Date 2024-06-26

Maintainer Pedro J. Aphalo <pedro.aphalo@helsinki.fi>

Description Extensions to 'ggplot2' respecting the grammar of graphics paradigm. Statistics: locate and tag peaks and valleys; label plot with the equation of a fitted polynomial or other types of models; labels with P-value, R^2 or adjusted R^2 or information criteria for fitted models; label with ANOVA table for fitted models; label with summary for fitted models. Model fit classes for which suitable methods are provided by package 'broom' and 'broom.mixed' are supported. Scales and stats to build volcano and quadrant plots based on outcomes, fold changes, p-values and false discovery rates.

License GPL (>= 2)

LazyLoad TRUE

ByteCompile TRUE

Depends R (>= 4.0.0), ggpp (>= 0.5.8)

Imports grid, stats, ggplot2 (>= 3.5.0), scales (>= 1.3.0), rlang (>= 1.1.3), generics (>= 0.1.3), MASS (>= 7.3-60.0.1), confintr (>= 1.0.2), polynom (>= 1.4-1), quantreg (>= 5.97), lmodel2 (>= 1.7-3), splus2R (>= 1.3-5), multcomp (>= 1.4-25), multcompView (>= 0.1-10), tibble (>= 3.2.1), plyr (>= 1.8.9), dplyr (>= 1.1.4), lubridate (>= 1.9.3)

Suggests knitr (>= 1.45), rmarkdown (>= 2.25), ggrepel (>= 0.9.5), broom (>= 1.0.3), broom.mixed (>= 0.2.9.5), nlme (>= 3.1-160), gginnards (>= 0.1.0-1), ggtext (>= 0.1.2), testthat, vdiffr

URL https://docs.r4photobiology.info/ggpmisc/, https://github.com/aphalo/ggpmisc

BugReports https://github.com/aphalo/ggpmisc/issues

Contents

Index

---

ggpmisc-package *ggpmisc: Miscellaneous Extensions to 'ggplot2'*

Description

Extensions to 'ggplot2' respecting the grammar of graphics paradigm. Statistics: locate and tag peaks and valleys; label plot with the equation of a fitted polynomial or other types of models; labels with P-value, R^2 or adjusted R^2 or information criteria for fitted models; label with ANOVA table for fitted models; label with summary for fitted models. Model fit classes for which suitable methods are provided by package 'broom' and 'broom.mixed' are supported. Scales and stats to build volcano and quadrant plots based on outcomes, fold changes, p-values and false discovery rates.

Details

The new facilities for cleanly defining new stats and geoms added to 'ggplot2' in version 2.0.0 and the support for nested data frames and lists and new syntax for mapping computed values to aesthetics added to 'ggplot2' in version 3.0.0 are used in this package's code, as well as some features added in more recent updates including 3.5.0. This means that current 'ggpmisc' versions require recent versions of ggplot2.

Extensions provided:

- Function for conversion of time series data into tibbles that can be plotted with ggplot.

- `ggplot()` method for time series data.

- Stats for locating and tagging "peaks" and "valleys" (local or global maxima and minima).

- Stat for generating labels from model fit objects, including formatted equations. By default labels are R's plotmath expressions but LaTeX, markdown and plain text formatted labels are optionaly assembled.

- Stats for extracting information from a any model fit supported by package 'broom' and using it to generate various annotations and data labels.

- Stat for computing and generating labels for the results from multiple comparisons, including adjusted *P*-values.

The stats for peaks and valleys are coded so as to work correctly both with numeric and POSIXct variables mapped to the x aesthetic. Special handling was needed as text labels are generated from the data.

Note

The signatures of stat_peaks() and stat_valleys() from 'ggpmisc' are identical to those of stat_peaks and stat_valleys from package 'ggspectra' but the variables returned are a subset as special handling of values related to light spectra is missing. Furthermore the stat_peaks() and stat_valleys() from package 'ggpmisc' work correctly when date or datetime values are mapped to the *x* statistic, while those from package 'ggspectra' do not generate correct labels in this case.

Author(s)

Maintainer: Pedro J. Aphalo <pedro.aphalo@helsinki.fi> (ORCID)

Other contributors:

- Kamil Slowikowski (ORCID) [contributor]
- Samer Mouksassi <samermouksassi@gmail.com> (ORCID) [contributor]

References

Package suite 'r4photobiology' web site at https://www.r4photobiology.info/
Package 'ggplot2' documentation at https://ggplot2.tidyverse.org/
Package 'ggplot2' source code at https://github.com/tidyverse/ggplot2

See Also

Useful links:

- https://docs.r4photobiology.info/ggpmisc/
- https://github.com/aphalo/ggpmisc
- Report bugs at https://github.com/aphalo/ggpmisc/issues

Examples

```
library(tibble)

ggplot(lynx, as.numeric = FALSE) + geom_line() +
stat_peaks(colour = "red") +
  stat_peaks(geom = "text", colour = "red", angle = 66,
             hjust = -0.1, x.label.fmt = "%Y") +
  ylim(NA, 8000)

formula <- y ~ poly(x, 2, raw = TRUE)
ggplot(cars, aes(speed, dist)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(use_label("eq", "R2", "P"),
               formula = formula,
               parse = TRUE) +
  labs(x = expression("Speed, "*x~("mph")),
       y = expression("Stopping distance, "*y~("ft")))

formula <- y ~ x
```

```
ggplot(PlantGrowth, aes(group, weight)) +
  stat_summary(fun.data = "mean_se") +
  stat_fit_tb(method = "lm",
              method.args = list(formula = formula),
              tb.type = "fit.anova",
              tb.vars = c(Term = "term", "df", "M.S." = "meansq",
                          "italic(F)" = "statistic",
                          "italic(p)" = "p.value"),
              tb.params = c("Group" = 1, "Error" = 2),
              table.theme = ttheme_gtbw(parse = TRUE)) +
  labs(x = "Group", y = "Dry weight of plants") +
  theme_classic()
```

---

check_poly_formula   *Validate model formula as a polynomial*

Description

Analyse a model formula to determine if it describes a polynomial with terms in order of increasing powers, and fulfils the expectations of the algorithm used to generate the equation-label.

Usage

```
check_poly_formula(
  formula,
  x.name = "x",
  warning.text = "'formula' not an increasing polynomial: 'eq.label' is NA!"
)
```

Arguments

formula	A model formula in x.name.
x.name	character The name of the explanatory variable in the formula.
warning.text	character string.

Details

This validation check could fail to validate some valid formulas as it is difficult to test, or even list all possible variations of valid formulas. Consequently, this function triggers a warning in case of failure, not an error. Furthermore, the statistics only fail to build the correct equation label, but in most cases other output is still usable with models that are not strictly polynomials.

Model formulas with and without an intercept term are accepted as valid, as +0, -1 and +1 are accepted. If a single power term is included, it is taken as a transformation and any power is accepted. If two or more terms are powers, they are expected in increasing order with no missing intermediate terms. If poly() is used in the model formula, a single term is expected.

This function checks that all power terms defined using ^ are protected with "as is" `I()`, as otherwise they are not powers but instead part of the formula specification. It also checks that an argument is passed to parameter `raw` of function `poly()` if present.

If the warning text is `NULL` or `character(0)` no warning is issued. The caller always receives a length-1 logical as return value.

Value

A logical, TRUE if the formula describes an increasing polynomial, and FALSE otherwise. As a side-effect a warning is triggered when validation fails.

Examples

```
check_poly_formula(y ~ 1)
check_poly_formula(y ~ x)
check_poly_formula(y ~ x^3)
check_poly_formula(y ~ x + 0)
check_poly_formula(y ~ x - 1)
check_poly_formula(y ~ x + 1)
check_poly_formula(y ~ x + I(x^2))
check_poly_formula(y ~ 1 + x + I(x^2))
check_poly_formula(y ~ I(x^2) + x)
check_poly_formula(y ~ x + I(x^2) + I(x^3))
check_poly_formula(y ~ I(x) + I(x^2) + I(x^3))
check_poly_formula(y ~ I(x^2) + I(x^3))
check_poly_formula(y ~ I(x^2) + I(x^4))
check_poly_formula(y ~ x + I(x^3) + I(x^2))

check_poly_formula(y ~ poly(x, 2, raw = TRUE)) # use for label
check_poly_formula(y ~ poly(x, 2)) # orthogonal polynomial
```

---

  coef.lmodel2   *Extract Model Coefficients*

Description

`coef` is a generic function which extracts model coefficients from objects returned by modeling functions. `coefficients` is an alias for it.

Usage

```
## S3 method for class 'lmodel2'
coef(object, method = "MA", ...)
```

Arguments

object	a fitted model object.
method	character One of the methods available in `object`.
...	ignored by this method.

Details

Function lmodel2() from package 'lmodel2' returns a fitted model object of class "lmodel2" which differs from that returned by lm(). Here we implement a coef() method for objects of this class. It differs from de generic method and that for lm objects in having an additional formal parameter method that must be used to select estimates based on which of the methods supported by lmodel2() are to be extracted. The returned object is identical in its structure to that returned by coef.lm().

Value

A named numeric vector of length two.

See Also

[lmodel2](#)

| coefs2poly_eq | *Format a polynomial as an equation* |

Description

Uses a vector of coefficients from a model fit of a polynomial to build the fitted model equation with embedded coefficient estimates.

Usage

```
coefs2poly_eq(
  coefs,
  coef.digits = 3L,
  coef.keep.zeros = TRUE,
  decreasing = getOption("ggpmisc.decreasing.poly.eq", FALSE),
  eq.x.rhs = "x",
  lhs = "y~`=`~",
  output.type = "expression",
  decimal.mark = "."
)
```

Arguments

coefs	numeric Terms always sorted by increasing powers.
coef.digits	integer
coef.keep.zeros	
	logical This flag refers to trailing zeros.
decreasing	logical It specifies the order of the terms in the returned character string; in increasing (default) or decreasing powers.
eq.x.rhs	character

`lhs`	character
`output.type`	character One of "expression", "latex", "tex", "text", "tikz", "markdown".
`decimal.mark`	character

Value

A `character` string.

Note

Terms with zero-valued coefficients are dropped from the polynomial.

Examples

```
coefs2poly_eq(c(1, 2, 0, 4, 5, 2e-5))
coefs2poly_eq(c(1, 2, 0, 4, 5, 2e-5), output.type = "latex")
coefs2poly_eq(0:2)
coefs2poly_eq(0:2, decreasing = TRUE)
coefs2poly_eq(c(1, 2, 0, 4, 5), coef.keep.zeros = TRUE)
coefs2poly_eq(c(1, 2, 0, 4, 5), coef.keep.zeros = FALSE)
```

---

confint.lmodel2	*Confidence Intervals for Model Parameters*

Description

Computes confidence intervals for one or more parameters in a fitted model. This a method for objects inheriting from class "lmodel2".

Usage

```
## S3 method for class 'lmodel2'
confint(object, parm, level = 0.95, method = "MA", ...)
```

Arguments

`object`	a fitted model object.
`parm`	a specification of which parameters are to be given confidence intervals, either a vector of numbers or a vector of names. If missing, all parameters are considered.
`level`	the confidence level required. Currently only 0.95 accepted.
`method`	character One of the methods available in `object`.
`...`	ignored by this method.

Details

Function `lmodel2()` from package 'lmodel2' returns a fitted model object of class `"lmodel2"` which differs from that returned by `lm()`. Here we implement a `confint()` method for objects of this class. It differs from the generic method and that for lm objects in having an additional formal parameter `method` that must be used to select estimates based on which of the methods supported by `lmodel2()` are to be extracted. The returned object is identical in its structure to that returned by `confint.lm()`.

Value

A data frame with two rows and three columns.

See Also

lmodel2

---

find_peaks   *Find local maxima or global maximum (peaks)*

Description

This method finds peaks (local maxima) in a vector, using a user selectable span and size threshold relative to the tallest peak (global maximum).

Usage

```
find_peaks(x, ignore_threshold = 0, span = 3, strict = FALSE, na.rm = FALSE)
```

Arguments

x   numeric vector.

ignore_threshold

numeric value between 0.0 and 1.0 indicating the size threshold below which peaks will be ignored, or a negative value >= -1, to ignore peaks above a threshold. These values are relative to the range of x.

span   a peak is defined as an element in a sequence which is greater than all other elements within a window of width span centered at that element. The default value is 3, meaning that a peak is bigger than both of its neighbors. span = NULL extends the span to the whole length of x.

strict   logical flag: if TRUE, an element must be strictly greater than all other values in its window to be considered a peak. Default: TRUE.

na.rm   logical indicating whether NA values should be stripped before searching for peaks.

Details

This function is a wrapper built onto function [peaks](#) from **splus2R** and handles non-finite (including NA) values differently than peaks, instead of giving an error when na.rm = FALSE and x contains NA values, NA values are replaced with the smallest finite value in x. span = NULL is treated as a special case and returns max(x).

Value

A vector of logical values. Values that are TRUE correspond to local peaks in vector x and can be used to extract the rows corresponding to peaks from a data frame.

Note

The default for parameter strict is FALSE in functions peaks() and find_peaks(), as in stat_peaks() and in stat_valleys(), while the default in [peaks](#) is strict = TRUE.

See Also

[peaks](#)

Examples

```
# lynx is a time.series object
lynx_num.df <-
  try_tibble(lynx,
             col.names = c("year", "lynx"),
             as.numeric = TRUE) # years -> as numeric

which(find_peaks(lynx_num.df$lynx, span = 31))
lynx_num.df[find_peaks(lynx_num.df$lynx, span = 15), ]
lynx_num.df[find_peaks(lynx_num.df$lynx, span = NULL), ]
lynx_num.df[find_peaks(lynx_num.df$lynx,
                       span = 31,
                       ignore_threshold = 0.75), ]

lynx_datetime.df <-
   try_tibble(lynx,
              col.names = c("year", "lynx")) # years -> POSIXct

which(find_peaks(lynx_datetime.df$lynx, span = 31))
lynx_datetime.df[find_peaks(lynx_datetime.df$lynx, span = 31), ]
lynx_datetime.df[find_peaks(lynx_datetime.df$lynx,
                            span = 31,
                            ignore_threshold = 0.75), ]
```

keep_tidy   *Tidy, glance or augment an object keeping a trace of its origin*

Description

Methods implemented in package 'broom' to tidy, glance and augment the output from model fits return a consistently organized tibble with generic column names. Although this simplifies later steps in the data analysis and reporting, it drops key information needed for interpretation. keep_tidy() makes it possible to retain fields from the model fit object passed as argument to parameter x in the attribute ″fm″. The class of x is always stored, and by default also fields ″call″, ″terms″, ″formula″, ″fixed″ and ″random″ if available.

Usage

```
keep_tidy(x, ..., to.keep = c("call", "terms", "formula", "fixed", "random"))

keep_glance(x, ..., to.keep = c("call", "terms", "formula", "fixed", "random"))

keep_augment(
  x,
  ...,
  to.keep = c("call", "terms", "formula", "fixed", "random")
)
```

Arguments

x	An object for which tidy(), glance and/or augment method is available.
...	Other named arguments passed along to tidy(), glance or augment.
to.keep	character vector of field names in x to copy to attribute ″fm″ of the tibble returned by tidy(), glance or augment.

Details

Functions keep_tidy(), keep_glance or keep_augment are simple wrappers of the generic methods which make it possible to add to the returned values an attribute named ″fm″ preserving user selected fields and class of the model fit object. Fields names in to.keep missing in x are silently ignored.

Examples

```
# these examples can only be run if package 'broom' is available

if (requireNamespace("broom", quietly = TRUE)) {

  library(broom)

  mod <- lm(mpg ~ wt + qsec, data = mtcars)
```

```
attr(keep_tidy(mod), "fm")[["class"]]
attr(keep_glance(mod), "fm")[["class"]]
attr(keep_augment(mod), "fm")[["class"]]

attr(keep_tidy(summary(mod)), "fm")[["class"]]

library(MASS)
rmod <- rlm(mpg ~ wt + qsec, data = mtcars)
attr(keep_tidy(rmod), "fm")[["class"]]

}
```

Moved   *Moved to package 'gginnards'*

Description

Some stats, geoms and the plot layer manipulation functions have been moved from package 'ggp-
misc' to a separate new package called 'gginnards'.

Details

To continue using any of these functions and methods, simply run at the R prompt or add to your
script library(gginnards), after installing package 'gginnards'.

See Also

[gginnards-package](), [geom_null](), [stat_debug_group](), [stat_debug_panel](), [geom_debug]() and [delete_layers]().

---

outcome2factor   *Convert numeric ternary outcomes into a factor*

Description

Convert numeric ternary outcomes into a factor

Usage

```
outcome2factor(x, n.levels = 3L)

threshold2factor(x, n.levels = 3L, threshold = 0)
```

Arguments

x	a numeric vector of -1, 0, and +1 values, indicating down-regulation, uncertain response or up-regulation, or a numeric vector that can be converted into such values using a pair of thresholds.
n.levels	numeric Number of levels to create, either 3 or 2.
threshold	numeric vector Range enclosing the values to be considered uncertain.

Details

These functions convert the numerically encoded values into a factor with the three levels "down", "uncertain" and "up", or into a factor with two levels de and uncertain as expected by default by scales scale_colour_outcome, scale_fill_outcome and scale_shape_outcome. When n.levels = 2 both -1 and +1 are merged to the same level of the factor with label "de".

Note

These are convenience functions that only save some typing. The same result can be achieved by a direct call to factor and comparisons. These functions aim at making it easier to draw volcano and quadrant plots.

See Also

Other Functions for quadrant and volcano plots: FC_format(), scale_colour_outcome(), scale_shape_outcome(), scale_y_Pvalue(), xy_outcomes2factor()

Other scales for omics data: scale_colour_logFC(), scale_shape_outcome(), scale_x_logFC(), xy_outcomes2factor()

Examples

```
outcome2factor(c(-1, 1, 0, 1))
outcome2factor(c(-1, 1, 0, 1), n.levels = 2L)

threshold2factor(c(-0.1, -2, 0, +5))
threshold2factor(c(-0.1, -2, 0, +5), n.levels = 2L)
threshold2factor(c(-0.1, -2, 0, +5), threshold = c(-1, 1))
```

---

plain_label	*Format numbers as character labels*

Description

These functions format numeric values as character labels including the symbol for statistical parameter estimates suitable for adding to plots. The labels can be formatted as strings to be parsed as plotmath expressions, or encoded using LaTeX or Markdown.

Usage

```
plain_label(
  value,
  value.name,
  digits = 3,
  fixed = FALSE,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)

italic_label(
  value,
  value.name,
  digits = 3,
  fixed = FALSE,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)

bold_label(
  value,
  value.name,
  digits = 3,
  fixed = FALSE,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)

p_value_label(
  value,
  small.p = getOption("ggpmisc.small.p", default = FALSE),
  subscript = "",
  superscript = "",
  digits = 4,
  fixed = NULL,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)

f_value_label(
  value,
  df1 = NULL,
  df2 = NULL,
  digits = 4,
  fixed = FALSE,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)
```

```
t_value_label(
  value,
  df = NULL,
  digits = 4,
  fixed = FALSE,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)

z_value_label(
  value,
  digits = 4,
  fixed = FALSE,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)

S_value_label(
  value,
  digits = 4,
  fixed = FALSE,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)

mean_value_label(
  value,
  digits = 4,
  fixed = FALSE,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)

var_value_label(
  value,
  digits = 4,
  fixed = FALSE,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)

sd_value_label(
  value,
  digits = 4,
  fixed = FALSE,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
```

```
)

se_value_label(
  value,
  digits = 4,
  fixed = FALSE,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)

r_label(
  value,
  method = "pearson",
  small.r = getOption("ggpmisc.small.r", default = FALSE),
  digits = 3,
  fixed = TRUE,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)

rr_label(
  value,
  small.r = getOption("ggpmisc.small.r", default = FALSE),
  digits = 3,
  fixed = TRUE,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)

adj_rr_label(
  value,
  small.r = getOption("ggpmisc.small.r", default = FALSE),
  digits = 3,
  fixed = TRUE,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)

rr_ci_label(
  value,
  conf.level,
  range.brackets = c("[", "]"),
  range.sep = NULL,
  digits = 2,
  fixed = TRUE,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)
```

```
r_ci_label(
  value,
  conf.level,
  small.r = getOption("ggpmisc.small.r", default = FALSE),
  range.brackets = c("[", "]"),
  range.sep = NULL,
  digits = 2,
  fixed = TRUE,
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)
```

Arguments

`value`	numeric The value of the estimate.
`value.name`	character The symbol used to represent the value, or its name.
`digits`	integer Number of digits to which numeric values are formatetd.
`fixed`	logical Interpret `digits` as indicating a number of digits after the decimal mark or as the number of significant digits.
`output.type`	character One of "expression", "latex", "tex", "text", "tikz", "markdown".
`decimal.mark`	character Defaults to the value of R option `"OutDec"`.
`small.p, small.r`	logical If TRUE use lower case (p and r, r^2) instead of upper case (P and R, R^2),
`subscript, superscript`	character Text for a subscript and superscript to *P* symbol.
`df, df1, df2`	numeric The degrees of freedom of the estimate.
`method`	character The method used to estimate correlation, which selects the symbol used for the value.
`conf.level`	numeric critical *P*-value expressed as fraction in [0..1].
`range.brackets, range.sep`	character Strings used to format a range.

Value

A character string with formatting, encoded to be parsed as an R plotmath expression, as plain text, as markdown or to be used with $LaTeX$ within **math mode**.

See Also

[sprintf_dm](#)

Examples

```
plain_label(value = 123, value.name = "n", output.type = "expression")
plain_label(value = 123, value.name = "n", output.type = "markdown")
plain_label(value = 123, value.name = "n", output.type = "latex")
italic_label(value = 123, value.name = "n", output.type = "expression")
italic_label(value = 123, value.name = "n", output.type = "markdown")
italic_label(value = 123, value.name = "n", output.type = "latex")
bold_label(value = 123, value.name = "n", output.type = "expression")
bold_label(value = 123, value.name = "n", output.type = "markdown")
bold_label(value = 123, value.name = "n", output.type = "latex")

p_value_label(value = 0.345, digits = 2, output.type = "expression")
p_value_label(value = 0.345, digits = Inf, output.type = "expression")
p_value_label(value = 0.345, digits = 6, output.type = "expression")
p_value_label(value = 0.345, output.type = "markdown")
p_value_label(value = 0.345, output.type = "latex")
p_value_label(value = 0.345, subscript = "Holm")
p_value_label(value = 1e-25, digits = Inf, output.type = "expression")

f_value_label(value = 123.4567, digits = 2, output.type = "expression")
f_value_label(value = 123.4567, digits = Inf, output.type = "expression")
f_value_label(value = 123.4567, digits = 6, output.type = "expression")
f_value_label(value = 123.4567, output.type = "markdown")
f_value_label(value = 123.4567, output.type = "latex")
f_value_label(value = 123.4567, df1 = 3, df2 = 123,
              digits = 2, output.type = "expression")
f_value_label(value = 123.4567, df1 = 3, df2 = 123,
              digits = 2, output.type = "latex")

t_value_label(value = 123.4567, digits = 2, output.type = "expression")
t_value_label(value = 123.4567, digits = Inf, output.type = "expression")
t_value_label(value = 123.4567, digits = 6, output.type = "expression")
t_value_label(value = 123.4567, output.type = "markdown")
t_value_label(value = 123.4567, output.type = "latex")
t_value_label(value = 123.4567, df = 12,
              digits = 2, output.type = "expression")
t_value_label(value = 123.4567, df = 123,
              digits = 2, output.type = "latex")

r_label(value = 0.95, digits = 2, output.type = "expression")
r_label(value = -0.95, digits = 2, output.type = "expression")
r_label(value = 0.0001, digits = 2, output.type = "expression")
r_label(value = -0.0001, digits = 2, output.type = "expression")
r_label(value = 0.1234567890, digits = Inf, output.type = "expression")
r_label(value = 0.95, digits = 2, method = "pearson")
r_label(value = 0.95, digits = 2, method = "kendall")
r_label(value = 0.95, digits = 2, method = "spearman")

rr_label(value = 0.95, digits = 2, output.type = "expression")
rr_label(value = 0.0001, digits = 2, output.type = "expression")
rr_label(value = 1e-17, digits = Inf, output.type = "expression")
```

```
adj_rr_label(value = 0.95, digits = 2, output.type = "expression")
adj_rr_label(value = 0.0001, digits = 2, output.type = "expression")

rr_ci_label(value = c(0.3, 0.4), conf.level = 0.95)
rr_ci_label(value = c(0.3, 0.4), conf.level = 0.95, output.type = "text")
rr_ci_label(value = c(0.3, 0.4), conf.level = 0.95, range.sep = ",")

r_ci_label(value = c(-0.3, 0.4), conf.level = 0.95)
r_ci_label(value = c(-0.3, 0.4), conf.level = 0.95, output.type = "text")
r_ci_label(value = c(-0.3, 0.4), conf.level = 0.95, range.sep = ",")
r_ci_label(value = c(-1.0, 0.4), conf.level = 0.95, range.sep = ",")
```

---

poly2character   *Convert a polynomial into character string*

Description

Differs from `polynom::as.character.polynomial()` in that trailing zeros are preserved.

Usage

```
poly2character(
  x,
  decreasing = getOption("ggpmisc.decreasing.poly.eq", FALSE),
  digits = 3,
  keep.zeros = TRUE
)
```

Arguments

x	a `polynomial` object.
decreasing	logical It specifies the order of the terms; in increasing (default) or decreasing powers.
digits	integer Giving the number of significant digits to use for printing.
keep.zeros	logical It indicates if zeros are to be retained in the formatted coefficients.

Value

A `character` string.

Note

This is an edit of the code in package 'polynom' so that trailing zeros are retained during the conversion. It is not defined using a different name so as not to interfere with the original.

Examples

```
poly2character(1:3)
poly2character(1:3, decreasing = TRUE)
```

---

predict.lmodel2	*Model Predictions*

Description

predict is a generic function for predictions from the results of various model fitting functions.
predict.lmodel2 is the method for model fit objects of class ″lmodel2″.

Usage

```
## S3 method for class 'lmodel2'
predict(
  object,
  method = ″MA″,
  newdata = NULL,
  interval = c(″none″, ″confidence″),
  level = 0.95,
  ...
)
```

Arguments

object	a fitted model object.
method	character One of the methods available in object.
newdata	An optional data frame in which to look for variables with which to predict. If omitted, the fitted values are used.
interval	Type of interval calculation.
level	the confidence level required. Currently only 0.95 accepted.
...	ignored by this method.

Details

Function lmodel2() from package 'lmodel2' returns a fitted model object of class ″lmodel2″ which differs from that returned by lm(). Here we implement a predict() method for objects of this class. It differs from the generic method and that for lm objects in having an additional formal parameter method that must be used to select which of the methods supported by lmodel2() are to be used in the prediction. The returned object is similar in its structure to that returned by predict.lm() but lacking names or rownames.

Value

If `interval` = `"none"` a numeric vector is returned, while if `interval` = `"confidence"` a data frame with columns `fit`, `lwr` and `upr` is returned.

See Also

lmodel2

`scale_colour_logFC`   *Colour and fill scales for log fold change data*

Description

Continuous scales for `colour` and `fill` aesthetics with defaults suitable for values expressed as log2 fold change in `data` and fold-change in tick labels. Supports tick labels and data expressed in any combination of fold-change, log2 fold-change and log10 fold-change. Supports addition of units to legend title passed as argument to the `name` formal parameter.

Usage

```
scale_colour_logFC(
  name = "Abundance of y%unit",
  breaks = NULL,
  labels = NULL,
  limits = symmetric_limits,
  oob = scales::squish,
  expand = expansion(mult = 0.05, add = 0),
  log.base.labels = FALSE,
  log.base.data = 2L,
  midpoint = NULL,
  low.colour = "dodgerblue2",
  mid.colour = "grey50",
  high.colour = "red",
  na.colour = "black",
  aesthetics = "colour",
  ...
)

scale_color_logFC(
  name = "Abundance of y%unit",
  breaks = NULL,
  labels = NULL,
  limits = symmetric_limits,
  oob = scales::squish,
  expand = expansion(mult = 0.05, add = 0),
  log.base.labels = FALSE,
  log.base.data = 2L,
```

```
    midpoint = NULL,
    low.colour = "dodgerblue2",
    mid.colour = "grey50",
    high.colour = "red",
    na.colour = "black",
    aesthetics = "colour",
    ...
)

scale_fill_logFC(
    name = "Abundance of y%unit",
    breaks = NULL,
    labels = NULL,
    limits = symmetric_limits,
    oob = scales::squish,
    expand = expansion(mult = 0.05, add = 0),
    log.base.labels = FALSE,
    log.base.data = 2L,
    midpoint = 1,
    low.colour = "dodgerblue2",
    mid.colour = "grey50",
    high.colour = "red",
    na.colour = "black",
    aesthetics = "fill",
    ...
)
```

Arguments

name	The name of the scale without units, used for the legend title.
breaks	The positions of ticks or a function to generate them. Default varies depending on argument passed to `log.base.labels`. if supplied as a numeric vector they should be given using the data as passed to parameter `data`.
labels	The tick labels or a function to generate them from the tick positions. The default is function that uses the arguments passed to `log.base.data` and `log.base.labels` to generate suitable labels.
limits	limits One of: NULL to use the default scale range from ggplot2. A numeric vector of length two providing limits of the scale, using NA to refer to the existing minimum or maximum. A function that accepts the existing (automatic) limits and returns new limits. The default is function `symmetric_limits()` which keep 1 at the middle of the axis..
oob	Function that handles limits outside of the scale limits (out of bounds). The default squishes out-of-bounds values to the boundary.
expand	Vector of range expansion constants used to add some padding around the data, to ensure that they are placed some distance away from the axes. The default is to expand the scale by 15% on each end for log-fold-data, so as to leave space for counts annotations.

log.base.labels, log.base.data

        integer or logical Base of logarithms used to express fold-change values in tick labels and in `data`. Use `FALSE` for no logarithm transformation.

midpoint   numeric Value at the middle of the colour gradient, defaults to FC = 1, assuming data is expressed as logarithm.

low.colour, mid.colour, high.colour, na.colour

        character Colour definitions to use for the gradient extremes and middle.

aesthetics   Character string or vector of character strings listing the name(s) of the aesthetic(s) that this scale works with. This can be useful, for example, to apply colour settings to the colour and fill aesthetics at the same time, via aesthetics = c("colour", "fill").

...   other named arguments passed to `scale_y_continuous`.

Details

These scales only alter default arguments of `scale_colour_gradient2()` and `scale_fill_gradient2()`. Please, see documentation for [scale_continuous](#) for details. The name argument supports the use of `"%unit"` at the end of the string to automatically add a units string, otherwise user-supplied values for names, breaks, and labels work as usual. Tick labels in the legend are built based on the transformation already applied to the data (log2 by default) and a possibly different log transformation (default is fold-change with no transformation). The default for handling out of bounds values is to "squish" them to the extreme of the scale, which is different from the default used in 'ggplot2'.

See Also

Other scales for omics data: [outcome2factor](#)(), [scale_shape_outcome](#)(), [scale_x_logFC](#)(), [xy_outcomes2factor](#)()

Examples

```
set.seed(12346)
my.df <- data.frame(x = rnorm(50, sd = 4), y = rnorm(50, sd = 4))
# we assume that both x and y values are expressed as log2 fold change

ggplot(my.df, aes(x, y, colour = y)) +
  geom_point(shape = "circle", size = 2.5) +
  scale_x_logFC() +
  scale_y_logFC() +
  scale_colour_logFC()

ggplot(my.df, aes(x, y, fill = y)) +
  geom_point(shape = "circle filled", colour = "black", size = 2.5) +
  scale_x_logFC() +
  scale_y_logFC() +
  scale_fill_logFC()

my.labels <-
  scales::trans_format(function(x) {log10(2^x)}, scales::math_format())
ggplot(my.df, aes(x, y, colour = y)) +
  geom_point() +
```

```
    scale_x_logFC(labels = my.labels) +
    scale_y_logFC(labels = my.labels) +
    scale_colour_logFC(labels = my.labels)

ggplot(my.df, aes(x, y, colour = y)) +
  geom_point() +
  scale_x_logFC(log.base.labels = 2) +
  scale_y_logFC(log.base.labels = 2) +
  scale_colour_logFC(log.base.labels = 2)

ggplot(my.df, aes(x, y, colour = y)) +
  geom_point() +
  scale_x_logFC(log.base.labels = 10) +
  scale_y_logFC(log.base.labels = 10) +
  scale_colour_logFC(log.base.labels = 10)

ggplot(my.df, aes(x, y, colour = y)) +
  geom_point() +
  scale_x_logFC(log.base.labels = 10) +
  scale_y_logFC(log.base.labels = 10) +
  scale_colour_logFC(log.base.labels = 10,
                     labels = FC_format(log.base.labels = 10,
                                        log.base.data = 2L,
                                        fmt = "% .*g"))

# override default arguments.
ggplot(my.df, aes(x, y, colour = y)) +
  geom_point() +
  scale_x_logFC() +
  scale_y_logFC() +
  scale_colour_logFC(name = "Change",
                     labels = function(x) {paste(2^x, "fold")})
```

---

scale_colour_outcome   *Colour and fill scales for ternary outcomes*

Description

Manual scales for colour and fill aesthetics with defaults suitable for the three way outcome from some statistical tests.

Usage

```
scale_colour_outcome(
  ...,
  name = "Outcome",
  ns.colour = "grey80",
  up.colour = "red",
  down.colour = "dodgerblue2",
```

```
    de.colour = "goldenrod",
    na.colour = "black",
    values = "outcome:updown",
    drop = TRUE,
    aesthetics = "colour"
)

scale_color_outcome(
    ...,
    name = "Outcome",
    ns.colour = "grey80",
    up.colour = "red",
    down.colour = "dodgerblue2",
    de.colour = "goldenrod",
    na.colour = "black",
    values = "outcome:updown",
    drop = TRUE,
    aesthetics = "colour"
)

scale_fill_outcome(
    ...,
    name = "Outcome",
    ns.colour = "grey80",
    up.colour = "red",
    down.colour = "dodgerblue2",
    de.colour = "goldenrod",
    na.colour = "black",
    values = "outcome:both",
    drop = TRUE,
    aesthetics = "fill"
)
```

Arguments

`...`	other named arguments passed to `scale_colour_manual`.
`name`	The name of the scale, used for the axis-label.
`ns.colour, down.colour, up.colour, de.colour`	
	The colour definitions to use for each of the three possible outcomes.
`na.colour`	colour definition used for NA.
`values`	a set of aesthetic values to map data values to. The values will be matched in order (usually alphabetical) with the limits of the scale, or with breaks if provided. If this is a named vector, then the values will be matched based on the names instead. Data values that don't match will be given na.value. In addition the special values `"outcome:updown"`, `"outcome:de"` and `"outcome:both"` set predefined values, with `"outcome:both"` as default.
`drop`	logical Should unused factor levels be omitted from the scale? The default,

TRUE, uses the levels that appear in the data; FALSE uses all the levels in the
factor.

aesthetics   Character string or vector of character strings listing the name(s) of the aes-
                    thetic(s) that this scale works with. This can be useful, for example, to apply
                    colour settings to the colour and fill aesthetics at the same time, via aesthetics =
                    c("colour", "fill").

Details

These scales only alter the `breaks`, `values`, and `na.value` default arguments of `scale_colour_manual()`
and `scale_fill_manual()`. Please, see documentation for [scale_manual](#) for details.

Note

In 'ggplot2' (3.3.4, 3.3.5, 3.3.6) `scale_colour_manual()` and `scale_fill_manual()` do not obey
drop, most likely due to a bug as this worked in version 3.3.3 and earlier. This results in spureous
levels in the plot legend when using versions 3.3.4, 3.3.5, 3.3.6 of 'ggplot2'.

See Also

Other Functions for quadrant and volcano plots: [FC_format](#)(), [outcome2factor](#)(), [scale_shape_outcome](#)(),
[scale_y_Pvalue](#)(), [xy_outcomes2factor](#)()

Examples

```
set.seed(12346)
outcome <- sample(c(-1, 0, +1), 50, replace = TRUE)
my.df <- data.frame(x = rnorm(50),
                    y = rnorm(50),
                    outcome2 = outcome2factor(outcome, n.levels = 2),
                    outcome3 = outcome2factor(outcome))

ggplot(my.df, aes(x, y, colour = outcome3)) +
  geom_point() +
  scale_colour_outcome() +
  theme_bw()

ggplot(my.df, aes(x, y, colour = outcome2)) +
  geom_point() +
  scale_colour_outcome() +
  theme_bw()

ggplot(my.df, aes(x, y, fill = outcome3)) +
  geom_point(shape = 21) +
  scale_fill_outcome() +
  theme_bw()
```

scale_shape_outcome   *Shape scale for ternary outcomes*

Description

Manual scales for colour and fill aesthetics with defaults suitable for the three way outcome from some statistical tests.

Usage

```
scale_shape_outcome(
  ...,
  name = "Outcome",
  ns.shape = "circle filled",
  up.shape = "triangle filled",
  down.shape = "triangle down filled",
  de.shape = "square filled",
  na.shape = "cross"
)
```

Arguments

`...`	other named arguments passed to `scale_manual`.
`name`	The name of the scale, used for the axis-label.
`ns.shape, down.shape, up.shape, de.shape`	
	The shapes to use for each of the three possible outcomes.
`na.shape`	Shape used for NA.

Details

These scales only alter the `values`, and `na.value` default arguments of `scale_shape_manual()`. Please, see documentation for [scale_manual](#) for details.

See Also

Other Functions for quadrant and volcano plots: [FC_format](#)(), [outcome2factor](#)(), [scale_colour_outcome](#)(), [scale_y_Pvalue](#)(), [xy_outcomes2factor](#)()

Other scales for omics data: [outcome2factor](#)(), [scale_colour_logFC](#)(), [scale_x_logFC](#)(), [xy_outcomes2factor](#)()

Examples

```
set.seed(12346)
outcome <- sample(c(-1, 0, +1), 50, replace = TRUE)
my.df <- data.frame(x = rnorm(50),
                    y = rnorm(50),
                    outcome2 = outcome2factor(outcome, n.levels = 2),
```

```
                  outcome3 = outcome2factor(outcome))

ggplot(my.df, aes(x, y, shape = outcome3)) +
  geom_point() +
  scale_shape_outcome() +
  theme_bw()

ggplot(my.df, aes(x, y, shape = outcome3)) +
  geom_point() +
  scale_shape_outcome(guide = FALSE) +
  theme_bw()

ggplot(my.df, aes(x, y, shape = outcome2)) +
  geom_point(size = 2) +
  scale_shape_outcome() +
  theme_bw()

ggplot(my.df, aes(x, y, shape = outcome3, fill = outcome2)) +
  geom_point() +
  scale_shape_outcome() +
  scale_fill_outcome() +
  theme_bw()

ggplot(my.df, aes(x, y, shape = outcome3, fill = outcome2)) +
  geom_point() +
  scale_shape_outcome(name = "direction") +
  scale_fill_outcome(name = "significance") +
  theme_bw()
```

---

scale_x_logFC   *Position scales for log fold change data*

Description

Continuous scales for x and y aesthetics with defaults suitable for values expressed as log2 fold
change in `data` and fold-change in tick labels. Supports tick labels and data expressed in any
combination of fold-change, log2 fold-change and log10 fold-change. Supports addition of units to
axis labels passed as argument to the `name` formal parameter.

Usage

```
scale_x_logFC(
  name = "Abundance of x%unit",
  breaks = NULL,
  labels = NULL,
  limits = symmetric_limits,
  oob = scales::squish,
  expand = expansion(mult = 0.05, add = 0),
```

```
    log.base.labels = FALSE,
    log.base.data = 2L,
    ...
)

scale_y_logFC(
  name = "Abundance of y%unit",
  breaks = NULL,
  labels = NULL,
  limits = symmetric_limits,
  oob = scales::squish,
  expand = expansion(mult = 0.05, add = 0),
  log.base.labels = FALSE,
  log.base.data = 2L,
  ...
)
```

Arguments

name	The name of the scale without units, used for the axis-label.
breaks	The positions of ticks or a function to generate them. Default varies depending on argument passed to `log.base.labels`. if supplied as a numeric vector they should be given using the data as passed to parameter `data`.
labels	The tick labels or a function to generate them from the tick positions. The default is function that uses the arguments passed to `log.base.data` and `log.base.labels` to generate suitable labels.
limits	limits One of: NULL to use the default scale range from ggplot2. A numeric vector of length two providing limits of the scale, using NA to refer to the existing minimum or maximum. A function that accepts the existing (automatic) limits and returns new limits. The default is function `symmetric_limits()` which keep 1 at the middle of the axis..
oob	Function that handles limits outside of the scale limits (out of bounds). The default squishes out-of-bounds values to the boundary.
expand	Vector of range expansion constants used to add some padding around the data, to ensure that they are placed some distance away from the axes. The default is to expand the scale by 15% on each end for log-fold-data, so as to leave space for counts annotations.
log.base.labels, log.base.data	
	integer or logical Base of logarithms used to express fold-change values in tick labels and in `data`. Use `FALSE` for no logarithm transformation.
...	other named arguments passed to `scale_y_continuous`.

Details

These scales only alter default arguments of `scale_x_continuous()` and `scale_y_continuous()`. Please, see documentation for [scale_continuous](#) for details. The name argument supports the use of "%unit" at the end of the string to automatically add a units string, otherwise user-supplied

values for names, breaks, and labels work as usual. Tick labels are built based on the transformation already applied to the data (log2 by default) and a possibly different log transformation (default is fold-change with no transformation). The default for handling out of bounds values is to "squish" them to the extreme of the scale, which is different from the default used in 'ggplot2'.

See Also

Other scales for omics data: outcome2factor(), scale_colour_logFC(), scale_shape_outcome(), xy_outcomes2factor()

Examples

```
set.seed(12346)
my.df <- data.frame(x = rnorm(50, sd = 4), y = rnorm(50, sd = 4))
# we assume that both x and y values are expressed as log2 fold change

ggplot(my.df, aes(x, y)) +
  geom_point() +
  scale_x_logFC() +
  scale_y_logFC()

ggplot(my.df, aes(x, y)) +
  geom_point() +
  scale_x_logFC(labels = scales::trans_format(function(x) {log10(2^x)},
                           scales::math_format())) +
  scale_y_logFC(labels = scales::trans_format(function(x) {log10(2^x)},
                           scales::math_format()))

ggplot(my.df, aes(x, y)) +
  geom_point() +
  scale_x_logFC(log.base.labels = 2) +
  scale_y_logFC(log.base.labels = 2)

ggplot(my.df, aes(x, y)) +
  geom_point() +
  scale_x_logFC("A concentration%unit", log.base.labels = 10) +
  scale_y_logFC("B concentration%unit", log.base.labels = 10)

ggplot(my.df, aes(x, y)) +
  geom_point() +
  scale_x_logFC("A concentration%unit", breaks = NULL) +
  scale_y_logFC("B concentration%unit", breaks = NULL)

# taking into account that data are expressed as log2 FC.
ggplot(my.df, aes(x, y)) +
  geom_point() +
  scale_x_logFC("A concentration%unit", breaks = log2(c(1/100, 1, 100))) +
  scale_y_logFC("B concentration%unit", breaks = log2(c(1/100, 1, 100)))

ggplot(my.df, aes(x, y)) +
  geom_point() +
  scale_x_logFC(labels = scales::trans_format(function(x) {log10(2^x)},
```

```
                              scales::math_format())) +
    scale_y_logFC(labels = scales::trans_format(function(x) {log10(2^x)},
                              scales::math_format())) 

# override "special" default arguments.
ggplot(my.df, aes(x, y)) +
  geom_point() +
  scale_x_logFC("A concentration",
                breaks = waiver(),
                labels = waiver()) +
  scale_y_logFC("B concentration",
                breaks = waiver(),
                labels = waiver())

ggplot(my.df, aes(x, y)) +
  geom_point() +
  scale_x_logFC() +
  scale_y_logFC() +
  geom_quadrant_lines() +
  stat_quadrant_counts(size = 3.5)
```

---

scale_y_Pvalue   *Convenience scale for P-values*

Description

Scales for y aesthetic mapped to P-values as used in volcano plots with transcriptomics and metabolomics data.

Usage

```
scale_y_Pvalue(
  ...,
  name = expression(italic(P) - plain(value)),
  transform = NULL,
  breaks = NULL,
  labels = NULL,
  limits = c(1, 1e-20),
  oob = NULL,
  expand = NULL
)

scale_y_FDR(
  ...,
  name = "False discovery rate",
  transform = NULL,
  breaks = NULL,
  labels = NULL,
```

```
  limits = c(1, 1e-10),
  oob = NULL,
  expand = NULL
)

scale_x_Pvalue(
  ...,
  name = expression(italic(P) - plain(value)),
  transform = NULL,
  breaks = NULL,
  labels = NULL,
  limits = c(1, 1e-20),
  oob = NULL,
  expand = NULL
)

scale_x_FDR(
  ...,
  name = "False discovery rate",
  transform = NULL,
  breaks = NULL,
  labels = NULL,
  limits = c(1, 1e-10),
  oob = NULL,
  expand = NULL
)
```

Arguments

`...`	other named arguments passed to `scale_y_continuous`.
`name`	The name of the scale without units, used for the axis-label.
`transform`	Either the name of a transformation object, or the object itself. Use NULL for the default.
`breaks`	The positions of ticks or a function to generate them. Default varies depending on argument passed to `log.base.labels`.
`labels`	The tick labels or a function to generate them from the tick positions. The default is function that uses the arguments passed to `log.base.data` and `log.base.labels` to generate suitable labels.
`limits`	Use one of: NULL to use the default scale range, a numeric vector of length two providing limits of the scale; NA to refer to the existing minimum or maximum; a function that accepts the existing (automatic) limits and returns new limits.
`oob`	Function that handles limits outside of the scale limits (out of bounds). The default squishes out-of-bounds values to the boundary.
`expand`	Vector of range expansion constants used to add some padding around the data, to ensure that they are placed some distance away from the axes. The default is to expand the scale by 15% on each end for log-fold-data, so as to leave space for counts annotations.

Details

These scales only alter default arguments of scale_x_continuous() and scale_y_continuous(). Please, see documentation for scale_continuous for details.

See Also

Other Functions for quadrant and volcano plots: FC_format(), outcome2factor(), scale_colour_outcome(), scale_shape_outcome(), xy_outcomes2factor()

Examples

```
set.seed(12346)
my.df <- data.frame(x = rnorm(50, sd = 4),
                    y = 10^-runif(50, min = 0, max = 20))

ggplot(my.df, aes(x, y)) +
  geom_point() +
  scale_x_logFC() +
  scale_y_Pvalue()

ggplot(my.df, aes(x, y)) +
  geom_point() +
  scale_x_logFC() +
  scale_y_FDR(limits = c(NA, 1e-20))
```

---

sprintf_dm   *Format numeric values as strings*

Description

Using sprintf flexibly format numbers as character strings encoded for parsing into R expressions or using LaTeX or markdown notation.

Usage

```
sprintf_dm(fmt, ..., decimal.mark = getOption("OutDec", default = "."))

value2char(
  value,
  digits = Inf,
  format = "g",
  output.type = "expression",
  decimal.mark = getOption("OutDec", default = ".")
)
```

Arguments

`fmt`	character as in `sprintf()`.
`...`	as in `sprintf()`.
`decimal.mark`	character If NULL or NA no substitution is attempted and the value returned by `sprintf()` is returned as is.
`value`	numeric The value of the estimate.
`digits`	integer Number of digits to which numeric values are formatted.
`format`	character One of "e", "f" or "g" for exponential, fixed, or significant digits formatting.
`output.type`	character One of "expression", "latex", "tex", "text", "tikz", "markdown".

Details

These functions are used to format the character strings returned, which can be used as labels in plots. Encoding used for the formatting is selected by the argument passed to `output.type`, thus, supporting different R graphic devices.

See Also

sprintf

Examples

```
sprintf_dm("%2.3f", 2.34)
sprintf_dm("%2.3f", 2.34, decimal.mark = ",")


value2char(2.34)
value2char(2.34, digits = 3, format = "g")
value2char(2.34, digits = 3, format = "f")
value2char(2.34, output.type = "text")
value2char(2.34, output.type = "text", format = "f")
value2char(2.34, output.type = "text", format = "g")
```

---

stat_correlation   *Annotate plot with correlation test*

Description

`stat_correlation()` applies `stats::cor.test()` respecting grouping with `method = "pearson"` default but alternatively using "kendall" or "spearman" methods. It generates labels for correlation coefficients and p-value, coefficient of determination (R^2) for method "pearson" and number of observations.

Usage

```
stat_correlation(
  mapping = NULL,
  data = NULL,
  geom = "text_npc",
  position = "identity",
  ...,
  method = "pearson",
  n.min = 2L,
  alternative = "two.sided",
  exact = NULL,
  r.conf.level = ifelse(method == "pearson", 0.95, NA),
  continuity = FALSE,
  small.r = getOption("ggpmisc.small.r", default = FALSE),
  small.p = getOption("ggpmisc.small.p", default = FALSE),
  coef.keep.zeros = TRUE,
  r.digits = 2,
  t.digits = 3,
  p.digits = 3,
  CI.brackets = c("[", "]"),
  label.x = "left",
  label.y = "top",
  hstep = 0,
  vstep = NULL,
  output.type = NULL,
  boot.R = ifelse(method == "pearson", 0, 999),
  na.rm = FALSE,
  parse = NULL,
  show.legend = FALSE,
  inherit.aes = TRUE
)
```

Arguments

mapping	The aesthetic mapping, usually constructed with aes. Only needs to be set at the layer level if you are overriding the plot defaults.
data	A layer specific dataset, only needed if you want to override the plot defaults.
geom	The geometric object to use display the data
position	The position adjustment to use for overlapping points on this layer
...	other arguments passed on to layer. This can include aesthetics whose values you want to set, not map. See layer for more details.
method	character One of "pearson", "kendall" or "spearman".
n.min	integer Minimum number of distinct values in the variables for fitting to the attempted.
alternative	character One of "two.sided", "less" or "greater".

exact	logical Whether an exact p-value should be computed. Used for Kendall's tau and Spearman's rho.
r.conf.level	numeric Confidence level for the returned confidence interval. If set to NA computation of CI is skipped.
continuity	logical If TRUE , a continuity correction is used for Kendall's tau and Spearman's rho when not computed exactly.
small.r, small.p	
	logical Flags to switch use of lower case r and p for coefficient of correlation (only for method = "pearson") and p-value.
coef.keep.zeros	
	logical Keep or drop trailing zeros when formatting the correlation coefficients and t-value, z-value or S-value (see note below).
r.digits, t.digits, p.digits	
	integer Number of digits after the decimal point to use for R, r.squared, tau or rho and P-value in labels. If Inf, use exponential notation with three decimal places.
CI.brackets	character vector of length 2. The opening and closing brackets used for the CI label.
label.x, label.y	
	numeric with range 0..1 "normalized parent coordinates" (npc units) or character if using geom_text_npc() or geom_label_npc(). If using geom_text() or geom_label() numeric in native data units. If too short they will be recycled.
hstep, vstep	numeric in npc units, the horizontal and vertical displacement step-size used between labels for different groups.
output.type	character One of "expression", "LaTeX", "text", "markdown" or "numeric".
boot.R	interger The number of bootstrap resamples. Set to zero for no bootstrap estimates for the CI.
na.rm	a logical indicating whether NA values should be stripped before the computation proceeds.
parse	logical Passed to the geom. If TRUE, the labels will be parsed into expressions and displayed as described in ?plotmath. Default is TRUE if output.type = "expression" and FALSE otherwise.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes.
inherit.aes	If FALSE, overrides the default aesthetics, rather than combining with them. This is most useful for helper functions that define both data and aesthetics and shouldn't inherit behaviour from the default plot specification, e.g. borders.

Details

This statistic can be used to annotate a plot with the correlation coefficient and the outcome of its test of significance. It supports Pearson, Kendall and Spearman methods to compute correlation. This statistic generates labels as R expressions by default but LaTeX (use TikZ device), markdown (use package 'ggtext') and plain text are also supported, as well as numeric values for user-generated text labels. The character labels include the symbol describing the quantity together with the numeric

value. For the confidence interval (CI) the default is to follow the APA recommendation of using square brackets.

The value of `parse` is set automatically based on `output-type`, but if you assemble labels that need parsing from `numeric` output, the default needs to be overridden. By default the value of `output.type` is guessed from the name of the geometry.

A ggplot statistic receives as `data` a data frame that is not the one passed as argument by the user, but instead a data frame with the variables mapped to aesthetics. `cor.test()` is always applied to the variables mapped to the x and y aesthetics, so the scales used for x and y should both be continuous scales rather than discrete.

Aesthetics

`stat_correaltion()` requires x and y. In addition, the aesthetics understood by the geom ("text" is the default) are understood and grouping respected.

Computed variables

If output.type is "numeric" the returned tibble contains the columns listed below with variations depending on the `method`. If the model fit function used does not return a value, the variable is set to `NA_real_`.

x,npcx x position

y,npcy y position

r, and cor, tau or rho numeric values for correlation coefficient estimates

t.value and its df, z.value or S.value numeric values for statistic estimates

p.value, n numeric values.

r.conf.level numeric value, as fraction of one.

r.confint.low Confidence interval limit for `r`.

r.confint.high Confidence interval limit for `r`.

grp.label Set according to mapping in `aes`.

method.label Set according `method` used.

method, test character values

If output.type different from "numeric" the returned tibble contains in addition to the columns listed above those listed below. If the numeric value is missing the label is set to `character(0L)`.

r.label, and cor.label, tau.label or rho.label Correlation coefficient as a character string.

t.value.label, z.value.label or S.value.label t-value and degrees of freedom, z-value or S-value as a character string.

p.value.label P-value for test against zero, as a character string.

r.confint.label, and cor.conint.label, tau.confint.label or rho.confint.label Confidence interval for `r` (only with method = "pearson").

n.label Number of observations used in the fit, as a character string.

grp.label Set according to mapping in `aes`, as a character string.

To explore the computed values returned for a given input we suggest the use of [geom_debug](#) as shown in the last examples below.

Note

Currently `coef.keep.zeros` is ignored, with trailing zeros always retained in the labels but not
protected from being dropped by R when character strings are parsed into expressions.

See Also

[cor.test](#) for details on the computations.

Examples

```
# generate artificial data
set.seed(4321)
x <- (1:100) / 10
y <- x + rnorm(length(x))
my.data <- data.frame(x = x,
                      y = y,
                      y.desc = - y,
                      group = c("A", "B"))

# by default only R is displayed
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_correlation()

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_correlation(small.r = TRUE)

ggplot(my.data, aes(x, y.desc)) +
  geom_point() +
  stat_correlation(label.x = "right")

# non-default methods
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_correlation(method = "kendall")

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_correlation(method = "spearman")

# use_label() can map a user selected label
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_correlation(use_label("R2"))

# use_label() can assemble and map a combined label
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_correlation(use_label("R", "P", "n", "method"))

ggplot(my.data, aes(x, y)) +
```

```
  geom_point() +
  stat_correlation(use_label("R", "R.CI"))

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_correlation(use_label("R", "R.CI"),
                   r.conf.level = 0.95)

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_correlation(use_label("R", "R.CI"),
                   method = "kendall",
                   r.conf.level = 0.95)

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_correlation(use_label("R", "R.CI"),
                   method = "spearman",
                   r.conf.level = 0.95)

# manually assemble and map a specific label using paste() and aes()
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_correlation(aes(label = paste(after_stat(r.label),
                                     after_stat(p.value.label),
                                     after_stat(n.label),
                                     sep = "*\", \"*")))

# manually format and map a specific label using sprintf() and aes()
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_correlation(aes(label = sprintf("%s*\" with \"*%s*\" for \"*%s",
                                       after_stat(r.label),
                                       after_stat(p.value.label),
                                       after_stat(t.value.label))))

# Inspecting the returned data using geom_debug()
# This provides a quick way of finding out the names of the variables that
# are available for mapping to aesthetics with after_stat().

gginnards.installed <- requireNamespace("gginnards", quietly = TRUE)

if (gginnards.installed)
  library(gginnards)

# the whole of computed data
if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_correlation(geom = "debug")

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
```

```
      geom_point() +
      stat_correlation(geom = "debug", method = "pearson")

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_correlation(geom = "debug", method = "kendall")

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_correlation(geom = "debug", method = "spearman")

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_correlation(geom = "debug", output.type = "numeric")

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_correlation(geom = "debug", output.type = "markdown")

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_correlation(geom = "debug", output.type = "LaTeX")
```

---

stat_fit_augment   *Augment data with fitted values and statistics*

Description

stat_fit_augment fits a model and returns a "tidy" version of the model's data with prediction added, using 'augmnent()' methods from packages 'broom', 'broom.mixed', or other sources. The prediction can be added to the plot as a curve.

Usage

```
stat_fit_augment(
  mapping = NULL,
  data = NULL,
  geom = "smooth",
  method = "lm",
  method.args = list(formula = y ~ x),
  n.min = 2L,
  augment.args = list(),
  level = 0.95,
```

```
    y.out = ".fitted",
    position = "identity",
    na.rm = FALSE,
    show.legend = FALSE,
    inherit.aes = TRUE,
    ...
)
```

Arguments

`mapping`	The aesthetic mapping, usually constructed with [aes](). Only needs to be set at the layer level if you are overriding the plot defaults.
`data`	A layer specific dataset - only needed if you want to override the plot defaults.
`geom`	The geometric object to use display the data
`method`	character or function.
`method.args, augment.args`	
	list of arguments to pass to `method` and to to `broom::augment`.
`n.min`	integer Minimum number of distinct values in the explanatory variable (on the rhs of formula) for fitting to the attempted.
`level`	numeric Level of confidence interval to use (0.95 by default)
`y.out`	character (or numeric) index to column to return as `y`.
`position`	The position adjustment to use for overlapping points on this layer
`na.rm`	logical indicating whether NA values should be stripped before the computation proceeds.
`show.legend`	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes.
`inherit.aes`	If FALSE, overrides the default aesthetics, rather than combining with them. This is most useful for helper functions that define both data and aesthetics and shouldn't inherit behaviour from the default plot specification, e.g. [borders]().
`...`	other arguments passed on to [layer](). This can include aesthetics whose values you want to set, not map. See [layer]() for more details.

Details

stat_fit_augment together with [stat_fit_glance]() and [stat_fit_tidy](), based on package 'broom' can be used with a broad range of model fitting functions as supported at any given time by 'broom'. In contrast to [stat_poly_eq]() which can generate text or expression labels automatically, for these functions the mapping of aesthetic label needs to be explicitly supplied in the call, and labels built on the fly.

A ggplot statistic receives as data a data frame that is not the one passed as argument by the user, but instead a data frame with the variables mapped to aesthetics. In other words, it respects the grammar of graphics and consequently within arguments passed through method.args names of aesthetics like x and y should be used instead of the original variable names, while data is automatically passed the data frame. This helps ensure that the model is fitted to the same data as plotted in other layers.

Warning!

Not all 'glance()' methods are defined in package 'broom'. 'glance()' specializations for mixed models fits of classes 'lme', 'nlme', 'lme4', and many others are defined in package 'broom.mixed'.

Handling of grouping

`stat_fit_augment` applies the function given by `method` separately to each group of observations; in ggplot2 factors mapped to aesthetics generate a separate group for each level. Because of this, `stat_fit_augment` is not useful for annotating plots with results from `t.test()` or ANOVA or ANCOVA. In such cases use instead `stat_fit_tb()` which applies the model fitting per panel.

Computed variables

The output of `augment()` is returned as is, except for y which is set based on `y.out` and `y.observed` which preserves the y returned by the `generics::augment` methods. This renaming is needed so that the geom works as expected.

To explore the values returned by this statistic, which vary depending on the model fitting function and model formula we suggest the use of [geom_debug](). An example is shown below.

Note

The statistic `stat_fit_augment` can be used only with `methods` that accept formulas under any formal parameter name and a `data` argument. Use `ggplot2::stat_smooth()` instead of `stat_fit_augment` in production code if the additional features are not needed.

Although arguments passed to parameter `augment.args` will be passed to [generics::augment()] whether they are silently ignored or obeyed depends on each specialization of [augment()], so do carefully read the documentation for the version of [augment()] corresponding to the 'method' used to fit the model.

See Also

[broom]() and `broom.mixed` for details on how the tidying of the result of model fits is done.

Other ggplot statistics for model fits: [stat_fit_deviations](), [stat_fit_glance](), [stat_fit_residuals](), [stat_fit_tb](), [stat_fit_tidy]()

Examples

```
# Package 'broom' needs to be installed to run these examples.
# We check availability before running them to avoid errors.

if (requireNamespace("broom", quietly = TRUE)) {
  broom.installed <- TRUE
  library(broom)
  library(quantreg)

# Inspecting the returned data using geom_debug()
  if (requireNamespace("gginnards", quietly = TRUE)) {
    library(gginnards)
```

```
# Regression by panel, inspecting data
   ggplot(mtcars, aes(x = disp, y = mpg)) +
     geom_point(aes(colour = factor(cyl))) +
     stat_fit_augment(method = "lm",
                      method.args = list(formula = y ~ x),
                      geom = "debug",
                      summary.fun = colnames)
 }
}

# Regression by panel example
if (broom.installed)
  ggplot(mtcars, aes(x = disp, y = mpg)) +
    geom_point(aes(colour = factor(cyl))) +
    stat_fit_augment(method = "lm",
                     method.args = list(formula = y ~ x))

# Residuals from regression by panel example
if (broom.installed)
  ggplot(mtcars, aes(x = disp, y = mpg)) +
    geom_hline(yintercept = 0, linetype = "dotted") +
    stat_fit_augment(geom = "point",
                     method = "lm",
                     method.args = list(formula = y ~ x),
                     y.out = ".resid")

# Regression by group example
if (broom.installed)
  ggplot(mtcars, aes(x = disp, y = mpg, colour = factor(cyl))) +
    geom_point() +
    stat_fit_augment(method = "lm",
                     method.args = list(formula = y ~ x))

# Residuals from regression by group example
if (broom.installed)
  ggplot(mtcars, aes(x = disp, y = mpg, colour = factor(cyl))) +
    geom_hline(yintercept = 0, linetype = "dotted") +
    stat_fit_augment(geom = "point",
                     method.args = list(formula = y ~ x),
                     y.out = ".resid")

# Weighted regression example
if (broom.installed)
  ggplot(mtcars, aes(x = disp, y = mpg, weight = cyl)) +
    geom_point(aes(colour = factor(cyl))) +
    stat_fit_augment(method = "lm",
                     method.args = list(formula = y ~ x,
                                        weights = quote(weight)))

# Residuals from weighted regression example
if (broom.installed)
  ggplot(mtcars, aes(x = disp, y = mpg, weight = cyl)) +
    geom_hline(yintercept = 0, linetype = "dotted") +
```

```
    stat_fit_augment(geom = "point",
                     method.args = list(formula = y ~ x,
                                        weights = quote(weight)),
                     y.out = ".resid")

# Quantile regression
if (broom.installed)
  ggplot(mtcars, aes(x = disp, y = mpg)) +
    geom_point() +
    stat_fit_augment(method = "rq")
```

---

stat_fit_deviations   *Residuals from model fit as segments*

Description

stat_fit_deviations fits a linear model and returns fitted values and residuals ready to be plotted as segments.

Usage

```
stat_fit_deviations(
  mapping = NULL,
  data = NULL,
  geom = "segment",
  method = "lm",
  method.args = list(),
  n.min = 2L,
  formula = NULL,
  position = "identity",
  na.rm = FALSE,
  orientation = NA,
  show.legend = FALSE,
  inherit.aes = TRUE,
  ...
)

stat_fit_fitted(
  mapping = NULL,
  data = NULL,
  geom = "point",
  method = "lm",
  method.args = list(),
  n.min = 2L,
  formula = NULL,
  position = "identity",
```

```
    na.rm = FALSE,
    orientation = NA,
    show.legend = FALSE,
    inherit.aes = TRUE,
    ...
)
```

Arguments

mapping	The aesthetic mapping, usually constructed with [aes](). Only needs to be set at the layer level if you are overriding the plot defaults.
data	A layer specific dataset - only needed if you want to override the plot defaults.
geom	The geometric object to use display the data
method	function or character If character, "lm", "rlm", "lqs", "rq" and the name of a function to be matched, possibly followed by the fit function's method argument separated by a colon (e.g. "rq:br"). Functions implementing methods must accept arguments to parameters formula, data, weights and method. A fitted() method must exist for the returned model fit object class.
method.args	named list with additional arguments.
n.min	integer Minimum number of distinct values in the explanatory variable (on the rhs of formula) for fitting to the attempted.
formula	a "formula" object. Using aesthetic names instead of original variable names.
position	The position adjustment to use for overlapping points on this layer
na.rm	a logical indicating whether NA values should be stripped before the computation proceeds.
orientation	character Either "x" or "y" controlling the default for formula.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes.
inherit.aes	If FALSE, overrides the default aesthetics, rather than combining with them. This is most useful for helper functions that define both data and aesthetics and should not inherit behaviour from the default plot specification, e.g. [borders]().
...	other arguments passed on to [layer](). This can include aesthetics whose values you want to set, not map. See [layer]() for more details.

Details

This stat can be used to automatically highlight residuals as segments in a plot of a fitted model equation. This stat only generates the residuals, the predicted values need to be separately added to the plot, so to make sure that the same model formula is used in all steps it is best to save the formula as an object and supply this object as argument to the different statistics.

A ggplot statistic receives as data a data frame that is not the one passed as argument by the user, but instead a data frame with the variables mapped to aesthetics. In other words, it respects the grammar of graphics and consequently within the model formula names of aesthetics like x and y should be used instead of the original variable names. This helps ensure that the model is fitted to the same data as plotted in other layers.

Computed variables

Data frame with same nrow as data as subset for each group containing five numeric variables.

x x coordinates of observations

x.fitted x coordinates of fitted values

y y coordinates of observations

y.fitted y coordinates of fitted values

To explore the values returned by this statistic we suggest the use of geom_debug. An example is shown below, where one can also see in addition to the computed values the default mapping of the fitted values to aesthetics xend and yend.

Note

In the case of method = "rq" quantiles are fixed at tau = 0.5 unless method.args has length > 0. Parameter orientation is redundant as it only affects the default for formula but is included for consistency with ggplot2.

See Also

Other ggplot statistics for model fits: stat_fit_augment(), stat_fit_glance(), stat_fit_residuals(), stat_fit_tb(), stat_fit_tidy()

Examples

```
# generate artificial data
library(MASS)

set.seed(4321)
x <- 1:100
y <- (x + x^2 + x^3) + rnorm(length(x), mean = 0, sd = mean(x^3) / 4)
my.data <- data.frame(x, y)

# plot residuals from linear model
ggplot(my.data, aes(x, y)) +
  geom_smooth(method = "lm", formula = y ~ x) +
  stat_fit_deviations(method = "lm", formula = y ~ x, colour = "red") +
  geom_point()

# plot residuals from linear model with y as explanatory variable
ggplot(my.data, aes(x, y)) +
  geom_smooth(method = "lm", formula = y ~ x, orientation = "y") +
  stat_fit_deviations(method = "lm", formula = x ~ y, colour = "red") +
  geom_point()

# as above using orientation
ggplot(my.data, aes(x, y)) +
  geom_smooth(method = "lm", orientation = "y") +
  stat_fit_deviations(orientation = "y", colour = "red") +
  geom_point()
```

```
# both regressions and their deviations
ggplot(my.data, aes(x, y)) +
  geom_smooth(method = "lm") +
  stat_fit_deviations(colour = "blue") +
  geom_smooth(method = "lm", orientation = "y", colour = "red") +
  stat_fit_deviations(orientation = "y", colour = "red") +
  geom_point()

# give a name to a formula
my.formula <- y ~ poly(x, 3, raw = TRUE)

# plot linear regression
ggplot(my.data, aes(x, y)) +
  geom_smooth(method = "lm", formula = my.formula) +
  stat_fit_deviations(formula = my.formula, colour = "red") +
  geom_point()

ggplot(my.data, aes(x, y)) +
  geom_smooth(method = "lm", formula = my.formula) +
  stat_fit_deviations(formula = my.formula, method = stats::lm, colour = "red") +
  geom_point()

# plot robust regression
ggplot(my.data, aes(x, y)) +
  stat_smooth(method = "rlm", formula = my.formula) +
  stat_fit_deviations(formula = my.formula, method = "rlm", colour = "red") +
  geom_point()

# plot robust regression with weights indicated by colour
my.data.outlier <- my.data
my.data.outlier[6, "y"] <- my.data.outlier[6, "y"] * 10
ggplot(my.data.outlier, aes(x, y)) +
  stat_smooth(method = MASS::rlm, formula = my.formula) +
  stat_fit_deviations(formula = my.formula, method = "rlm",
                      mapping = aes(colour = after_stat(weights)),
                      show.legend = TRUE) +
  scale_color_gradient(low = "red", high = "blue", limits = c(0, 1),
                       guide = "colourbar") +
  geom_point()

# plot quantile regression (= median regression)
ggplot(my.data, aes(x, y)) +
  stat_quantile(formula = my.formula, quantiles = 0.5) +
  stat_fit_deviations(formula = my.formula, method = "rq", colour = "red") +
  geom_point()

# plot quantile regression (= "quartile" regression)
ggplot(my.data, aes(x, y)) +
  stat_quantile(formula = my.formula, quantiles = 0.75) +
  stat_fit_deviations(formula = my.formula, colour = "red",
                      method = "rq", method.args = list(tau = 0.75)) +
  geom_point()
```

```
# inspecting the returned data with geom_debug()
gginnards.installed <- requireNamespace("gginnards", quietly = TRUE)

if (gginnards.installed)
  library(gginnards)

# plot, using geom_debug() to explore the after_stat data
if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_smooth(method = "lm", formula = my.formula) +
    stat_fit_deviations(formula = my.formula, geom = "debug") +
    geom_point()

if (gginnards.installed)
  ggplot(my.data.outlier, aes(x, y)) +
    stat_smooth(method = MASS::rlm, formula = my.formula) +
    stat_fit_deviations(formula = my.formula, method = "rlm", geom = "debug") +
    geom_point()
```

---

stat_fit_glance   *One row summary data frame for a fitted model*

Description

stat_fit_glance fits a model and returns a "tidy" version of the model's fit, using 'glance()
methods from packages 'broom', 'broom.mixed', or other sources.

Usage

```
stat_fit_glance(
  mapping = NULL,
  data = NULL,
  geom = "text_npc",
  method = "lm",
  method.args = list(formula = y ~ x),
  n.min = 2L,
  glance.args = list(),
  label.x = "left",
  label.y = "top",
  hstep = 0,
  vstep = 0.075,
  position = "identity",
  na.rm = FALSE,
  show.legend = FALSE,
  inherit.aes = TRUE,
  ...
)
```

Arguments

mapping	The aesthetic mapping, usually constructed with [aes](). Only needs to be set at the layer level if you are overriding the plot defaults.
data	A layer specific data set - only needed if you want to override the plot defaults.
geom	The geometric object to use display the data
method	character or function.

method.args, glance.args

list of arguments to pass to method and to [generics::glance()], respectively.

n.min	integer Minimum number of distinct values in the explanatory variable (on the rhs of formula) for fitting to the attempted.

label.x, label.y

numeric with range 0..1 "normalized parent coordinates" (npc units) or character if using geom_text_npc() or geom_label_npc(). If using geom_text() or geom_label() numeric in native data units. If too short they will be recycled.

hstep, vstep	numeric in npc units, the horizontal and vertical step used between labels for different groups.
position	The position adjustment to use for overlapping points on this layer
na.rm	a logical indicating whether NA values should be stripped before the computation proceeds.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes.
inherit.aes	If FALSE, overrides the default aesthetics, rather than combining with them. This is most useful for helper functions that define both data and aesthetics and shouldn't inherit behaviour from the default plot specification, e.g. [borders]().
...	other arguments passed on to [layer](). This can include aesthetics whose values you want to set, not map. See [layer]() for more details.

Details

stat_fit_glance together with [stat_fit_tidy]() and [stat_fit_augment](), based on package 'broom' can be used with a broad range of model fitting functions as supported at any given time by package 'broom'. In contrast to [stat_poly_eq]() which can generate text or expression labels automatically, for these functions the mapping of aesthetic label needs to be explicitly supplied in the call, and labels built on the fly.

A ggplot statistic receives as data a data frame that is not the one passed as argument by the user, but instead a data frame with the variables mapped to aesthetics. In other words, it respects the grammar of graphics and consequently within arguments passed through method.args names of aesthetics like x and y should be used instead of the original variable names, while data is automatically passed the data frame. This helps ensure that the model is fitted to the same data as plotted in other layers.

Value

The output of the glance() methods is returned almost as is in the data object, as a data frame. The names of the columns in the returned data are consistent with those returned by method glance()

from package 'broom', that will frequently differ from the name of values returned by the print methods corresponding to the fit or test function used. To explore the values returned by this statistic including the name of variables/columns, which vary depending on the model fitting function and model formula we suggest the use of geom_debug. An example is shown below.

Warning!

Not all 'glance()' methods are defined in package 'broom'. 'glance()' specializations for mixed models fits of classes 'lme', 'nlme', 'lme4', and many others are defined in package 'broom.mixed'.

Handling of grouping

stat_fit_glance applies the function given by method separately to each group of observations, and factors mapped to aesthetics, including x and y, create a separate group for each factor level. Because of this, stat_fit_glance is not useful for annotating plots with results from t.test(), ANOVA or ANCOVA. In such cases use the stat_fit_tb() statistic which applies the model fitting per panel.

Model formula required

The current implementation works only with methods that accept a formula as argument and which have a data parameter through which a data frame can be passed. For example, lm() should be used with the formula interface, as the evaluation of x and y needs to be delayed until the internal data object of the ggplot is available. With some methods like stats::cor.test() the data embedded in the "ggplot" object cannot be automatically passed as argument for the data parameter of the test or model fit function. Please, for annotations based on stats::cor.test() use stat_correlation().

Note

Although arguments passed to parameter glance.args will be passed to [generics::glance()] whether they are silently ignored or obeyed depends on each specialization of [glance()], so do carefully read the documentation for the version of [glance()] corresponding to the 'method' used to fit the model.

See Also

broom and broom.mixed for details on how the tidying of the result of model fits is done.

Other ggplot statistics for model fits: stat_fit_augment(), stat_fit_deviations(), stat_fit_residuals(), stat_fit_tb(), stat_fit_tidy()

Examples

```
# package 'broom' needs to be installed to run these examples

if (requireNamespace("broom", quietly = TRUE)) {
  broom.installed <- TRUE
  library(broom)
  library(quantreg)

# Inspecting the returned data using geom_debug()
```

```
     if (requireNamespace("gginnards", quietly = TRUE)) {
       library(gginnards)

       ggplot(mtcars, aes(x = disp, y = mpg)) +
         stat_smooth(method = "lm") +
         geom_point(aes(colour = factor(cyl))) +
         stat_fit_glance(method = "lm",
                         method.args = list(formula = y ~ x),
                         geom = "debug")
     }
   }

   if (broom.installed)
   # Regression by panel example
     ggplot(mtcars, aes(x = disp, y = mpg)) +
       stat_smooth(method = "lm", formula = y ~ x) +
       geom_point(aes(colour = factor(cyl))) +
       stat_fit_glance(method = "lm",
                       label.y = "bottom",
                       method.args = list(formula = y ~ x),
                   mapping = aes(label = sprintf('italic(r)^2~"="~%.3f~~italic(P)~"="~%.2g',
                                      after_stat(r.squared), after_stat(p.value))),
                       parse = TRUE)

   # Regression by group example
   if (broom.installed)
     ggplot(mtcars, aes(x = disp, y = mpg, colour = factor(cyl))) +
       stat_smooth(method = "lm") +
       geom_point() +
       stat_fit_glance(method = "lm",
                       label.y = "bottom",
                       method.args = list(formula = y ~ x),
                       mapping = aes(label = sprintf('r^2~"="~%.3f~~italic(P)~"="~%.2g',
                                      after_stat(r.squared), after_stat(p.value))),
                       parse = TRUE)

   # Weighted regression example
   if (broom.installed)
     ggplot(mtcars, aes(x = disp, y = mpg, weight = cyl)) +
       stat_smooth(method = "lm") +
       geom_point(aes(colour = factor(cyl))) +
       stat_fit_glance(method = "lm",
                       label.y = "bottom",
                       method.args = list(formula = y ~ x, weights = quote(weight)),
                       mapping = aes(label = sprintf('r^2~"="~%.3f~~italic(P)~"="~%.2g',
                                      after_stat(r.squared), after_stat(p.value))),
                       parse = TRUE)

   # correlation test
   if (broom.installed)
     ggplot(mtcars, aes(x = disp, y = mpg)) +
       geom_point() +
       stat_fit_glance(method = "cor.test",
```

```
                            label.y = "bottom",
                            method.args = list(formula = ~ x + y),
                    mapping = aes(label = sprintf('r[Pearson]~"="~%.3f~~italic(P)~"="~%.2g',
                                        after_stat(estimate), after_stat(p.value))),
                            parse = TRUE)

if (broom.installed)
  ggplot(mtcars, aes(x = disp, y = mpg)) +
    geom_point() +
    stat_fit_glance(method = "cor.test",
                    label.y = "bottom",
                method.args = list(formula = ~ x + y, method = "spearman", exact = FALSE),
                mapping = aes(label = sprintf('r[Spearman]~"="~%.3f~~italic(P)~"="~%.2g',
                                        after_stat(estimate), after_stat(p.value))),
                            parse = TRUE)

# Quantile regression by group example
if (broom.installed)
  ggplot(mtcars, aes(x = disp, y = mpg)) +
    stat_smooth(method = "lm") +
    geom_point() +
    stat_fit_glance(method = "rq",
                    label.y = "bottom",
                    method.args = list(formula = y ~ x),
                    mapping = aes(label = sprintf('AIC = %.3g, BIC = %.3g',
                                        after_stat(AIC), after_stat(BIC))))
```

---

stat_fit_residuals   *Residuals from a model fit*

Description

stat_fit_residuals fits a linear model and returns residuals ready to be plotted as points.

Usage

```
stat_fit_residuals(
  mapping = NULL,
  data = NULL,
  geom = "point",
  method = "lm",
  method.args = list(),
  n.min = 2L,
  formula = NULL,
  resid.type = NULL,
  weighted = FALSE,
  position = "identity",
  na.rm = FALSE,
```

```
    orientation = NA,
    show.legend = FALSE,
    inherit.aes = TRUE,
    ...
)
```

Arguments

mapping	The aesthetic mapping, usually constructed with [aes](#). Only needs to be set at the layer level if you are overriding the plot defaults.
data	A layer specific dataset - only needed if you want to override the plot defaults.
geom	The geometric object to use display the data
method	function or character If character, "lm", "rlm", "rq" and the name of a function to be matched, possibly followed by the fit function's `method` argument separated by a colon (e.g. `"rq:br"`). Functions implementing methods must accept arguments to parameters `formula`, `data`, `weights` and `method`. A `residuals()` method must exist for the returned model fit object class.
method.args	named list with additional arguments.
n.min	integer Minimum number of distinct values in the explanatory variable (on the rhs of formula) for fitting to the attempted.
formula	a "formula" object. Using aesthetic names instead of original variable names.
resid.type	character passed to `residuals()` as argument for `type` (defaults to `"working"` except if `weighted = TRUE` when it is forced to `"deviance"`).
weighted	logical If true weighted residuals will be returned.
position	The position adjustment to use for overlapping points on this layer
na.rm	a logical indicating whether NA values should be stripped before the computation proceeds.
orientation	character Either "x" or "y" controlling the default for `formula`.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes.
inherit.aes	If FALSE, overrides the default aesthetics, rather than combining with them. This is most useful for helper functions that define both data and aesthetics and should not inherit behaviour from the default plot specification, e.g. [borders](#).
...	other arguments passed on to [layer](#). This can include aesthetics whose values you want to set, not map. See [layer](#) for more details.

Details

This stat can be used to automatically plot residuals as points in a plot. At the moment it supports only linear models fitted with function `lm()` or `rlm()`. It applies to the fitted model object methods [residuals](#) or [weighted.residuals](#) depending on the argument passed to parameter `weighted`.

A ggplot statistic receives as data a data frame that is not the one passed as argument by the user, but instead a data frame with the variables mapped to aesthetics. In other words, it respects the grammar of graphics and consequently within the model `formula` names of aesthetics like x and y should be used instead of the original variable names, while data is automatically passed the data frame. This helps ensure that the model is fitted to the same data as plotted in other layers.

Computed variables

Data frame with same value of nrow as data as subset for each group containing five numeric variables.

x x coordinates of observations or x residuals from fitted values,

y y coordinates of observations or y residuals from fitted values,

x.resid residuals from fitted values,

y.resid residuals from fitted values,

weights the weights passed as input to lm or those computed by rlm

.

For `orientation = "x"`, the default, `stat(y.resid)` is copied to variable y, while for `orientation = "y"` `stat(x.resid)` is copied to variable x.

Note

How weights are applied to residuals depends on the method used to fit the model. For ordinary least squares (OLS), weights are applied to the squares of the residuals, so the weighted residuals are obtained by multiplying the "deviance" residuals by the square root of the weights. When residuals are penalized differently to fit a model, the weighted residuals need to be computed accordingly. Say if we use the absolute value of the residuals instead of the squared values, weighted residuals are obtained by multiplying the residuals by the weights.

See Also

Other ggplot statistics for model fits: `stat_fit_augment()`, `stat_fit_deviations()`, `stat_fit_glance()`, `stat_fit_tb()`, `stat_fit_tidy()`

Examples

```
# generate artificial data
set.seed(4321)
x <- 1:100
y <- (x + x^2 + x^3) + rnorm(length(x), mean = 0, sd = mean(x^3) / 4)
my.data <- data.frame(x, y)

# plot residuals from linear model
ggplot(my.data, aes(x, y)) +
  geom_hline(yintercept = 0, linetype = "dashed") +
  stat_fit_residuals(formula = y ~ x)

ggplot(my.data, aes(x, y)) +
  geom_hline(yintercept = 0, linetype = "dashed") +
  stat_fit_residuals(formula = y ~ x, weighted = TRUE)

# plot residuals from linear model with y as explanatory variable
ggplot(my.data, aes(x, y)) +
  geom_vline(xintercept = 0, linetype = "dashed") +
  stat_fit_residuals(formula = x ~ y) +
```

```
  coord_flip()

# give a name to a formula
my.formula <- y ~ poly(x, 3, raw = TRUE)

# plot residuals from linear model
ggplot(my.data, aes(x, y)) +
  geom_hline(yintercept = 0, linetype = "dashed") +
  stat_fit_residuals(formula = my.formula) +
  coord_flip()

ggplot(my.data, aes(x, y)) +
  geom_hline(yintercept = 0, linetype = "dashed") +
  stat_fit_residuals(formula = my.formula, resid.type = "response")

# plot residuals from robust regression
ggplot(my.data, aes(x, y)) +
  geom_hline(yintercept = 0, linetype = "dashed") +
  stat_fit_residuals(formula = my.formula, method = "rlm")

# plot residuals with weights indicated by colour
my.data.outlier <- my.data
my.data.outlier[6, "y"] <- my.data.outlier[6, "y"] * 10
ggplot(my.data.outlier, aes(x, y)) +
  stat_fit_residuals(formula = my.formula, method = "rlm",
                     mapping = aes(colour = after_stat(weights)),
                     show.legend = TRUE) +
  scale_color_gradient(low = "red", high = "blue", limits = c(0, 1),
                       guide = "colourbar")

# plot weighted residuals with weights indicated by colour
ggplot(my.data.outlier) +
  stat_fit_residuals(formula = my.formula, method = "rlm",
                     mapping = aes(x = x,
                                   y = stage(start = y, after_stat = y * weights),
                                   colour = after_stat(weights)),
                     show.legend = TRUE) +
  scale_color_gradient(low = "red", high = "blue", limits = c(0, 1),
                       guide = "colourbar")

# plot residuals from quantile regression (median)
ggplot(my.data, aes(x, y)) +
  geom_hline(yintercept = 0, linetype = "dashed") +
  stat_fit_residuals(formula = my.formula, method = "rq")

# plot residuals from quantile regression (upper quartile)
ggplot(my.data, aes(x, y)) +
  geom_hline(yintercept = 0, linetype = "dashed") +
  stat_fit_residuals(formula = my.formula, method = "rq",
  method.args = list(tau = 0.75))

# inspecting the returned data
gginnards.installed <- requireNamespace("gginnards", quietly = TRUE)
```

```
if (gginnards.installed)
  library(gginnards)

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    stat_fit_residuals(formula = my.formula, resid.type = "working",
                       geom = "debug")

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    stat_fit_residuals(formula = my.formula, method = "rlm",
                       geom = "debug")
```

---

stat_fit_tb   *Model-fit summary or ANOVA*

Description

stat_fit_tb fits a model and returns a "tidy" version of the model's summary or ANOVA table,
using 'tidy() methods from packages 'broom', 'broom.mixed', or other 'broom' extensions. The
annotation is added to the plots in tabular form.

Usage

```
stat_fit_tb(
  mapping = NULL,
  data = NULL,
  geom = "table_npc",
  method = "lm",
  method.args = list(formula = y ~ x),
  n.min = 2L,
  tidy.args = list(),
  tb.type = "fit.summary",
  tb.vars = NULL,
  tb.params = NULL,
  digits = 3,
  p.digits = digits,
  label.x = "center",
  label.y = "top",
  position = "identity",
  table.theme = NULL,
  table.rownames = FALSE,
  table.colnames = TRUE,
  table.hjust = 1,
  parse = FALSE,
  na.rm = FALSE,
```

```
    show.legend = FALSE,
    inherit.aes = TRUE,
    ...
)
```

Arguments

mapping	The aesthetic mapping, usually constructed with [aes](#). Only needs to be set at the layer level if you are overriding the plot defaults.
data	A layer specific dataset, only needed if you want to override the plot defaults.
geom	The geometric object to use display the data
method	character.
method.args, tidy.args	
	lists of arguments to pass to method and to tidy().
n.min	integer Minimum number of distinct values in the explanatory variable (on the rhs of formula) for fitting to the attempted.
tb.type	character One of "fit.summary", "fit.anova" or "fit.coefs".
tb.vars, tb.params	
	character or numeric vectors, optionally named, used to select and/or rename the columns or the parameters in the table returned.
digits	integer indicating the number of significant digits to be used for all numeric values in the table.
p.digits	integer indicating the number of decimal places to round p-values to, with those rounded to zero displayed as the next larger possible value preceded by "<". If p.digits is outside the range 1..22 no rounding takes place.
label.x, label.y	
	numeric Coordinates in data units or with range 0..1, expressed in "normalized parent coordinates" or as character strings depending on the geometry used. If too short they will be recycled. They set the x and y coordinates at the after_stat stage.
position	The position adjustment to use for overlapping points on this layer
table.theme	NULL, list or function A 'gridExtra' ttheme definition, or a constructor for a ttheme or NULL for default.
table.rownames, table.colnames	
	logical flag to enable or disabling printing of row names and column names.
table.hjust	numeric Horizontal justification for the core and column headings of the table.
parse	If TRUE, the labels will be parsed into expressions and displayed as described in ?plotmath.
na.rm	a logical indicating whether NA values should be stripped before the computation proceeds.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes.
inherit.aes	If FALSE, overrides the default aesthetics, rather than combining with them. This is most useful for helper functions that define both data and aesthetics and shouldn't inherit behaviour from the default plot specification, e.g. [borders](#).

... other arguments passed on to [layer](). This can include aesthetics whose values you want to set, not map. See [layer]() for more details.

Details

`stat_fit_tb()` Applies a model fitting function per panel, using the grouping factors from aesthetic mappings in the fitted model. This is suitable, for example for analysis of variance used to test for differences among groups.

The argument to `method` can be any fit method for which a suitable `tidy()` method is available, including non-linear regression. Fit methods retain their default arguments unless overridden.

A ggplot statistic receives as data a data frame that is not the one passed as argument by the user, but instead a data frame with the variables mapped to aesthetics. In other words, it respects the grammar of graphics and consequently within arguments passed through `method.args` names of aesthetics like x and y should be used instead of the original variable names. The plot's default `data` is used by default, which helps ensure that the model is fitted to the same data as plotted in other layers.

Value

A tibble with columns named `fm.tb` (a tibble returned by `tidy()` with possibly renamed and subset columns and rows, within a list), `fm.tb.type` (copy of argument passed to `tb.type`), `fm.class` (the class of the fitted model object), `fm.method` (the fit function's name), `fm.call` (the call if available), `x` and `y`.

To explore the values returned by this statistic, which vary depending on the model fitting function and model formula we suggest the use of [geom_debug]().

Computed variables

The output of `tidy()` is returned as a single "cell" in a tibble (i.e., a tibble nested within a tibble). The returned `data` object contains a single tibble, containing the result from a single model fit to all data in a panel. If grouping is present, it is ignored in the sense of returning a single table, but the grouping aesthetic can be a term in the fitted model.

See Also

[broom](), broom.mixed, and [tidy]() for details on how the tidying of the result of model fits is done. See [geom_table]() for details on how inset tables respond to mapped aesthetics and table themes. For details on predefined table themes see [ttheme_gtdefault]().

Other ggplot statistics for model fits: [stat_fit_augment](), [stat_fit_deviations](), [stat_fit_glance](), [stat_fit_residuals](), [stat_fit_tidy]()

Examples

```
# Package 'broom' needs to be installed to run these examples.
# We check availability before running them to avoid errors.
broom.installed <- requireNamespace("broom", quietly = TRUE)

if (broom.installed)
  library(broom)
```

```
# data for examples
  x <- c(44.4, 45.9, 41.9, 53.3, 44.7, 44.1, 50.7, 45.2, 60.1)
  covariate <- sqrt(x) + rnorm(9)
  group <- factor(c(rep("A", 4), rep("B", 5)))
  my.df <- data.frame(x, group, covariate)

gginnards.installed  <- requireNamespace("gginnards", quietly = TRUE)

if (gginnards.installed)
  library(gginnards)

## covariate is a numeric or continuous variable
# Linear regression fit summary, all defaults
if (broom.installed)
  ggplot(my.df, aes(covariate, x)) +
    geom_point() +
    stat_fit_tb() +
    expand_limits(y = 70)

# we can use geom_debug() and str() to inspect the returned value
# and discover the variables that can be mapped to aesthetics with
# after_stat()
if (broom.installed && gginnards.installed)
  ggplot(my.df, aes(covariate, x)) +
    geom_point() +
    stat_fit_tb(geom = "debug", summary.fun = str) +
    expand_limits(y = 70)

# Linear regression fit summary, with default formatting
if (broom.installed)
  ggplot(my.df, aes(covariate, x)) +
    geom_point() +
    stat_fit_tb(tb.type = "fit.summary") +
    expand_limits(y = 70)

# Linear regression fit summary, with manual table formatting
if (broom.installed)
  ggplot(my.df, aes(covariate, x)) +
    geom_point() +
    stat_fit_tb(digits = 2,
                p.digits = 4,
                tb.params = c("intercept" = 1, "covariate" = 2),
                tb.vars = c(Term = 1, Estimate = 2,
                            "italic(s)" = 3, "italic(t)" = 4,
                            "italic(P)" = 5),
                parse = TRUE) +
    expand_limits(y = 70)

# Linear regression ANOVA table, with default formatting
if (broom.installed)
  ggplot(my.df, aes(covariate, x)) +
    geom_point() +
```

```
      stat_fit_tb(tb.type = "fit.anova") +
      expand_limits(y = 70)

# Linear regression ANOVA table, with manual table formatting
if (broom.installed)
  ggplot(my.df, aes(covariate, x)) +
    geom_point() +
    stat_fit_tb(tb.type = "fit.anova",
                tb.params = c("Covariate" = 1, 2),
                tb.vars = c(Effect = 1, d.f. = 2,
                            "M.S." = 4, "italic(F)" = 5,
                            "italic(P)" = 6),
                parse = TRUE) +
    expand_limits(y = 67)

# Linear regression fit coeficients, with default formatting
if (broom.installed)
  ggplot(my.df, aes(covariate, x)) +
    geom_point() +
    stat_fit_tb(tb.type = "fit.coefs") +
    expand_limits(y = 67)

# Linear regression fit coeficients, with manual table formatting
if (broom.installed)
  ggplot(my.df, aes(covariate, x)) +
    geom_point() +
    stat_fit_tb(tb.type = "fit.coefs",
                tb.params = c(a = 1, b = 2),
                tb.vars = c(Term = 1, Estimate = 2)) +
    expand_limits(y = 67)

## x is also a numeric or continuous variable
# Polynomial regression, with default formatting
if (broom.installed)
  ggplot(my.df, aes(covariate, x)) +
    geom_point() +
    stat_fit_tb(method.args = list(formula = y ~ poly(x, 2))) +
    expand_limits(y = 70)

# Polynomial regression, with manual table formatting
if (broom.installed)
  ggplot(my.df, aes(covariate, x)) +
    geom_point() +
    stat_fit_tb(method.args = list(formula = y ~ poly(x, 2)),
                tb.params = c("x^0" = 1, "x^1" = 2, "x^2" = 3),
                tb.vars = c("Term" = 1, "Estimate" = 2, "S.E." = 3,
                            "italic(t)" = 4, "italic(P)" = 5),
                parse = TRUE) +
    expand_limits(y = 70)

## group is a factor or discrete variable
# ANOVA summary, with default formatting
if (broom.installed)
```

```
    ggplot(my.df, aes(group, x)) +
      geom_point() +
      stat_fit_tb() +
      expand_limits(y = 70)

# ANOVA table, with default formatting
if (broom.installed)
  ggplot(my.df, aes(group, x)) +
    geom_point() +
    stat_fit_tb(tb.type = "fit.anova") +
    expand_limits(y = 70)

# ANOVA table, with manual table formatting
if (broom.installed)
  ggplot(my.df, aes(group, x)) +
    geom_point() +
    stat_fit_tb(tb.type = "fit.anova",
                tb.vars = c(Effect = "term", "df", "italic(F)" = "statistic",
                            "italic(P)" = "p.value"),
                tb.params = c(Group = 1, Error = 2),
                parse = TRUE)

# ANOVA table, with manual table formatting
# using column names with partial matching
if (broom.installed)
  ggplot(my.df, aes(group, x)) +
    geom_point() +
    stat_fit_tb(tb.type = "fit.anova",
                tb.vars = c(Effect = "term", "df", "italic(F)" = "stat",
                            "italic(P)" = "p"),
                tb.params = c(Group = "x", Error = "Resid"),
                parse = TRUE)

# ANOVA summary, with default formatting
if (broom.installed)
  ggplot(my.df, aes(group, x)) +
    geom_point() +
    stat_fit_tb() +
    expand_limits(y = 70)

## covariate is a numeric variable and group is a factor
# ANCOVA (covariate not plotted) ANOVA table, with default formatting
if (broom.installed)
  ggplot(my.df, aes(group, x, z = covariate)) +
    geom_point() +
    stat_fit_tb(tb.type = "fit.anova",
                method.args = list(formula = y ~ x + z))

# ANCOVA (covariate not plotted) ANOVA table, with manual table formatting
if (broom.installed)
  ggplot(my.df, aes(group, x, z = covariate)) +
    geom_point() +
    stat_fit_tb(tb.type = "fit.anova",
```

```
                method.args = list(formula = y ~ x + z),
                tb.vars = c(Effect = 1, d.f. = 2,
                            "M.S." = 4, "italic(F)" = 5,
                            "italic(P)" = 6),
                tb.params = c(Group = 1,
                              Covariate = 2,
                              Error = 3),
                parse = TRUE)

## group is a factor or discrete variable
# t-test, minimal output, with manual table formatting
if (broom.installed)
  ggplot(my.df, aes(group, x)) +
    geom_point() +
    stat_fit_tb(method = "t.test",
                tb.vars = c("italic(t)" = "statistic", "italic(P)" = "p.value"),
                parse = TRUE)

# t-test, more detailed output, with manual table formatting
if (broom.installed)
  ggplot(my.df, aes(group, x)) +
    geom_point() +
    stat_fit_tb(method = "t.test",
                tb.vars = c("\"Delta \"*italic(x)" = "estimate",
                            "CI low" = "conf.low", "CI high" = "conf.high",
                            "italic(t)" = "statistic", "italic(P)" = "p.value"),
                parse = TRUE) +
    expand_limits(y = 67)

# t-test (equal variances assumed), minimal output, with manual table formatting
if (broom.installed)
  ggplot(my.df, aes(group, x)) +
    geom_point() +
    stat_fit_tb(method = "t.test",
                method.args = list(formula = y ~ x, var.equal = TRUE),
                tb.vars = c("italic(t)" = "statistic", "italic(P)" = "p.value"),
                parse = TRUE)

## covariate is a numeric or continuous variable
# Linear regression using a table theme and non-default position
if (broom.installed)
  ggplot(my.df, aes(covariate, x)) +
    geom_point() +
    stat_fit_tb(table.theme = ttheme_gtlight,
                npcx = "left", npcy = "bottom") +
    expand_limits(y = 35)
```

---

stat_fit_tidy   *One row data frame with fitted parameter estimates*

Description

stat_fit_tidy fits a model and returns a "tidy" version of the model's summary, using 'tidy()' methods from packages 'broom', 'broom.mixed', or other sources. To add the summary in tabular form use [stat_fit_tb](#) instead of this statistic. When using stat_fit_tidy() you will most likely want to change the default mapping for label.

Usage

```
stat_fit_tidy(
  mapping = NULL,
  data = NULL,
  geom = "text_npc",
  method = "lm",
  method.args = list(formula = y ~ x),
  n.min = 2L,
  tidy.args = list(),
  label.x = "left",
  label.y = "top",
  hstep = 0,
  vstep = NULL,
  sanitize.names = FALSE,
  position = "identity",
  na.rm = FALSE,
  show.legend = FALSE,
  inherit.aes = TRUE,
  ...
)
```

Arguments

mapping	The aesthetic mapping, usually constructed with [aes](#). Only needs to be set at the layer level if you are overriding the plot defaults.
data	A layer specific dataset - only needed if you want to override the plot defaults.
geom	The geometric object to use display the data
method	character or function.
method.args, tidy.args	
	list of arguments to pass to method, and to [generics::tidy], respectively.
n.min	integer Minimum number of distinct values in the explanatory variable (on the rhs of formula) for fitting to the attempted.
label.x, label.y	
	numeric with range 0..1 or character. Coordinates to be used for positioning the output, expressed in "normalized parent coordinates" or character string. If too short they will be recycled.
hstep, vstep	numeric in npc units, the horizontal and vertical step used between labels for different groups.
sanitize.names	logical If true sanitize column names in the returned data with R's make.names() function.

position	The position adjustment to use for overlapping points on this layer
na.rm	a logical indicating whether NA values should be stripped before the computation proceeds.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes.
inherit.aes	If FALSE, overrides the default aesthetics, rather than combining with them. This is most useful for helper functions that define both data and aesthetics and shouldn't inherit behaviour from the default plot specification, e.g. borders.
...	other arguments passed on to layer. This can include aesthetics whose values you want to set, not map. See layer for more details.

Details

stat_fit_tidy together with stat_fit_glance and stat_fit_augment, based on package 'broom' can be used with a broad range of model fitting functions as supported at any given time by 'broom'. In contrast to stat_poly_eq which can generate text or expression labels automatically, for these functions the mapping of aesthetic label needs to be explicitly supplied in the call, and labels built on the fly.

A ggplot statistic receives as data a data frame that is not the one passed as argument by the user, but instead a data frame with the variables mapped to aesthetics. In other words, it respects the grammar of graphics and consequently within arguments passed through method.args names of aesthetics like x and y should be used instead of the original variable names, while data is automatically passed the data frame. This helps ensure that the model is fitted to the same data as plotted in other layers.

Value

The output of tidy() is returned after reshaping it into a single row. Grouping is respected, and the model fitted separately to each group of data. The returned data object has one row for each group within a panel. To use the intercept, note that output of tidy() is renamed from (Intercept) to Intercept. Otherwise, the names of the columns in the returned data are based on those returned by the tidy() method for the model fit class returned by the fit function. These will frequently differ from the name of values returned by the print methods corresponding to the fit or test function used. To explore the values returned by this statistic including the name of variables/columns, which vary depending on the model fitting function and model formula, we suggest the use of geom_debug. An example is shown below. Names of columns as returned by default are not always syntactically valid R names making it necessary to use back ticks to access them. Syntactically valid names are guaranteed if sanitize.names = TRUE is added to the call.

To explore the values returned by this statistic, which vary depending on the model fitting function and model formula we suggest the use of geom_debug. An example is shown below.

Warning!

Not all 'glance()' methods are defined in package 'broom'. 'glance()' specializations for mixed models fits of classes 'lme', 'nlme', 'lme4', and many others are defined in package 'broom.mixed'.

Handling of grouping

`stat_fit_tidy` applies the function given by `method` separately to each group of observations; in ggplot2 factors mapped to aesthetics generate a separate group for each level. Because of this, `stat_fit_tidy` is not useful for annotating plots with results from `t.test()` or ANOVA or ANCOVA. In such cases use instead `stat_fit_tb()` which applies the model fitting per panel.

Note

The statistic `stat_fit_tidy` can be used only with `methods` that accept formulas under any formal parameter name and a `data` argument. Use `ggplot2::stat_smooth()` instead of `stat_fit_augment` in production code if the additional features are not needed.

Although arguments passed to parameter `tidy.args` will be passed to [generics::tidy()] whether they are silently ignored or obeyed depends on each specialization of [tidy()], so do carefully read the documentation for the version of [tidy()] corresponding to the 'method' used to fit the model. You will also need to manually install the package, such as 'broom', where the tidier you intend to use are defined.

See Also

[broom](#) and `broom.mixed` for details on how the tidying of the result of model fits is done.

Other ggplot statistics for model fits: [stat_fit_augment()](#), [stat_fit_deviations()](#), [stat_fit_glance()](#), [stat_fit_residuals()](#), [stat_fit_tb()](#)

Examples

```
# Package 'broom' needs to be installed to run these examples.
# We check availability before running them to avoid errors.

if (requireNamespace("broom", quietly = TRUE)) {
  broom.installed <- TRUE
  library(broom)
  library(quantreg)

# Inspecting the returned data using geom_debug()
  if (requireNamespace("gginnards", quietly = TRUE)) {
    library(gginnards)

# This provides a quick way of finding out the names of the variables that
# are available for mapping to aesthetics. This is specially important for
# this stat as these names depend on the specific tidy() method used, which
# depends on the method used, such as lm(), used to fit the model.

# Regression by panel, default column names
  ggplot(mtcars, aes(x = disp, y = mpg)) +
    stat_smooth(method = "lm", formula = y ~ x + I(x^2)) +
    geom_point(aes(colour = factor(cyl))) +
    stat_fit_tidy(method = "lm",
                  method.args = list(formula = y ~ x + I(x^2)),
                  geom = "debug")
```

```
# Regression by panel, sanitized column names
  ggplot(mtcars, aes(x = disp, y = mpg)) +
    stat_smooth(method = "lm", formula = y ~ x + I(x^2)) +
    geom_point(aes(colour = factor(cyl))) +
    stat_fit_tidy(method = "lm",
                  method.args = list(formula = y ~ x + I(x^2)),
                  geom = "debug", sanitize.names = TRUE)
  }
}

# Regression by panel example
if (broom.installed)
  ggplot(mtcars, aes(x = disp, y = mpg)) +
    stat_smooth(method = "lm", formula = y ~ x) +
    geom_point(aes(colour = factor(cyl))) +
    stat_fit_tidy(method = "lm",
                  label.x = "right",
                  method.args = list(formula = y ~ x),
                  mapping = aes(label = sprintf("Slope = %.3g\np-value = %.3g",
                                                after_stat(x_estimate),
                                                after_stat(x_p.value))))

# Regression by group example
if (broom.installed)
  ggplot(mtcars, aes(x = disp, y = mpg, colour = factor(cyl))) +
    stat_smooth(method = "lm", formula = y ~ x) +
    geom_point() +
    stat_fit_tidy(method = "lm",
                  label.x = "right",
                  method.args = list(formula = y ~ x),
                  mapping = aes(label = sprintf("Slope = %.3g, p-value = %.3g",
                                                after_stat(x_estimate),
                                                after_stat(x_p.value))))

# Weighted regression example
if (broom.installed)
  ggplot(mtcars, aes(x = disp, y = mpg, weight = cyl)) +
    stat_smooth(method = "lm", formula = y ~ x) +
    geom_point(aes(colour = factor(cyl))) +
    stat_fit_tidy(method = "lm",
                  label.x = "right",
                  method.args = list(formula = y ~ x, weights = quote(weight)),
                  mapping = aes(label = sprintf("Slope = %.3g\np-value = %.3g",
                                                after_stat(x_estimate),
                                                after_stat(x_p.value))))

# Quantile regression
if (broom.installed)
  ggplot(mtcars, aes(x = disp, y = mpg)) +
    stat_smooth(method = "lm", formula = y ~ x) +
    geom_point() +
    stat_fit_tidy(method = "rq",
                  label.y = "bottom",
```

```
                        method.args = list(formula = y ~ x),
                        tidy.args = list(se.type = "nid"),
                        mapping = aes(label = sprintf("Slope = %.3g\np-value = %.3g",
                                                      after_stat(x_estimate),
                                                      after_stat(x_p.value))))
```

---

stat_ma_eq   *Equation, p-value, R^2 of major axis regression*

Description

stat_ma_eq fits model II regressions. From the fitted model it generates several labels including
the equation, p-value, coefficient of determination (R^2), and number of observations.

Usage

```
stat_ma_eq(
  mapping = NULL,
  data = NULL,
  geom = "text_npc",
  position = "identity",
  ...,
  formula = NULL,
  method = "lmodel2:MA",
  method.args = list(),
  n.min = 2L,
  range.y = NULL,
  range.x = NULL,
  nperm = 99,
  eq.with.lhs = TRUE,
  eq.x.rhs = NULL,
  small.r = getOption("ggpmisc.small.r", default = FALSE),
  small.p = getOption("ggpmisc.small.p", default = FALSE),
  coef.digits = 3,
  coef.keep.zeros = TRUE,
  decreasing = getOption("ggpmisc.decreasing.poly.eq", FALSE),
  rr.digits = 2,
  theta.digits = 2,
  p.digits = max(1, ceiling(log10(nperm))),
  label.x = "left",
  label.y = "top",
  hstep = 0,
  vstep = NULL,
  output.type = NULL,
  na.rm = FALSE,
  orientation = NA,
```

```
    parse = NULL,
    show.legend = FALSE,
    inherit.aes = TRUE
)
```

Arguments

mapping	The aesthetic mapping, usually constructed with [aes](#). Only needs to be set at the layer level if you are overriding the plot defaults.
data	A layer specific dataset, only needed if you want to override the plot defaults.
geom	The geometric object to use display the data
position	The position adjustment to use for overlapping points on this layer
...	other arguments passed on to [layer](#). This can include aesthetics whose values you want to set, not map. See [layer](#) for more details.
formula	a formula object. Using aesthetic names x and y instead of original variable names. Either y ~ x or x ~ y.
method	function or character If character, "MA", "SMA" , "RMA" or "OLS", alternatively "lmodel2" or the name of a model fit function are accepted, possibly followed by the fit function's method argument separated by a colon (e.g. "lmodel2:MA"). If a function different to lmodel2(), it must accept arguments named formula, data, range.y, range.x and nperm and return a model fit object of class lmodel2.
method.args	named list with additional arguments.
n.min	integer Minimum number of distinct values in the explanatory variable (on the rhs of formula) for fitting to the attempted.
range.y, range.x	
	character Pass "relative" or "interval" if method "RMA" is to be computed.
nperm	integer Number of permutation used to estimate significance.
eq.with.lhs	If character the string is pasted to the front of the equation label before parsing or a logical (see note).
eq.x.rhs	character this string will be used as replacement for "x" in the model equation when generating the label before parsing it.
small.r, small.p	
	logical Flags to switch use of lower case r and p for coefficient of determination and p-value.
coef.digits	integer Number of significant digits to use for the fitted coefficients.
coef.keep.zeros	
	logical Keep or drop trailing zeros when formatting the fitted coefficients and F-value.
decreasing	logical It specifies the order of the terms in the returned character string; in increasing (default) or decreasing powers.
rr.digits, theta.digits, p.digits	
	integer Number of digits after the decimal point to use for R^2, theta and P-value in labels. If Inf, use exponential notation with three decimal places.

label.x, label.y

> numeric with range 0..1 "normalized parent coordinates" (npc units) or charac-
> ter if using geom_text_npc() or geom_label_npc(). If using geom_text() or
> geom_label() numeric in native data units. If too short they will be recycled.

hstep, vstep numeric in npc units, the horizontal and vertical step used between labels for
different groups.

output.type character One of "expression", "LaTeX", "text", "markdown" or "numeric".

na.rm a logical indicating whether NA values should be stripped before the computa-
tion proceeds.

orientation character Either "x" or "y" controlling the default for formula.

parse logical Passed to the geom. If TRUE, the labels will be parsed into expressions
and displayed as described in ?plotmath. Default is TRUE if output.type =
"expression" and FALSE otherwise.

show.legend logical. Should this layer be included in the legends? NA, the default, includes if
any aesthetics are mapped. FALSE never includes, and TRUE always includes.

inherit.aes If FALSE, overrides the default aesthetics, rather than combining with them.
This is most useful for helper functions that define both data and aesthetics and
shouldn't inherit behaviour from the default plot specification, e.g. borders.

Details

This stat can be used to automatically annotate a plot with R^2, P-value, n and/or the fitted model
equation. It supports linear major axis (MA), standard major axis (SMA) and ranged major axis
(RMA) regression by means of function lmodel2. Formulas describing a straight line and including
an intercept are the only ones currently supported. Please see the documentation, including the
vignette of package 'lmodel2' for details. The parameters in stat_ma_eq() follow the same naming
as in function lmodel2().

It is important to keep in mind that although the fitted line does not depend on whether the x or y
appears on the rhs of the model formula, the numeric estimates for the parameters do depend on
this.

A ggplot statistic receives as data a data frame that is not the one passed as argument by the
user, but instead a data frame with the variables mapped to aesthetics. stat_ma_eq() mimics how
stat_smooth() works, except that Model II regressions can be fitted. Similarly to stat_smooth()
the model is fitted separately to data from each group, so the variables mapped to x and y should
both be continuous rather than discrete as well as the corresponding scales.

The minimum number of observations with distinct values can be set through parameter n.min. The
default n.min = 2L is the smallest possible value. However, model fits with very few observations
are of little interest and using a larger number for n.min than the default is usually wise.

Value

A data frame, with a single row and columns as described under **Computed variables**. In cases
when the number of observations is less than n.min a data frame with no rows or columns is returned
rendered as an empty/invisible plot layer.

User-defined methods

User-defined functions can be passed as argument to `method`. The requirements are 1) that the signature is similar to that of function `lmodel2()` and 2) that the value returned by the function is an object as returned by `lmodel2()` or an atomic NA value. Thus, user-defined methods can implement conditional skipping of labelling.

Aesthetics

`stat_ma_eq` understands x and y, to be referenced in the `formula` while the `weight` aesthetic is ignored. Both x and y must be mapped to `numeric` variables. In addition, the aesthetics understood by the geom (`"text"` is the default) are understood and grouping respected.

Transformation of x *or* y *within the model formula is not supported by* `stat_ma_eq()`. *In this case, transformations should not be applied in the model formula, but instead in the mapping of the variables within* aes *or in the scales.*

Computed variables

If `output.type` is different from `"numeric"` the returned tibble contains columns listed below. If the fitted model does not contain a given value, the label is set to `character(0L)`.

x,npcx x position

y,npcy y position

eq.label equation for the fitted polynomial as a character string to be parsed

rr.label R^2 of the fitted model as a character string to be parsed

p.value.label P-value if available, depends on `method`.

theta.label Angle in degrees between the two OLS lines for lines estimated from y ~ x and x ~ y linear model (`lm`) fits.

n.label Number of observations used in the fit.

grp.label Set according to mapping in `aes`.

method.label Set according `method` used.

r.squared, theta, p.value, n numeric values, from the model fit object

If output.type is `"numeric"` the returned tibble contains columns listed below. If the model fit function used does not return a value, the variable is set to `NA_real_`.

x,npcx x position

y,npcy y position

coef.ls list containing the "coefficients" matrix from the summary of the fit object

r.squared, theta, p.value, n numeric values, from the model fit object

grp.label Set according to mapping in `aes`.

b_0.constant TRUE is polynomial is forced through the origin

b_i One or two columns with the coefficient estimates

To explore the computed values returned for a given input we suggest the use of [geom_debug](#) as shown in the last examples below.

Note

For backward compatibility a logical is accepted as argument for eq.with.lhs. If TRUE, the default is used, either "x" or "y", depending on the argument passed to formula. However, "x" or "y" can be substituted by providing a suitable replacement character string through eq.x.rhs. Parameter orientation is redundant as it only affects the default for formula but is included for consistency with ggplot2::stat_smooth().

Methods in lmodel2 are all computed always except for RMA that requires a numeric argument to at least one of range.y or range.x. The results for specific methods are extracted a posteriori from the model fit object. When a function is passed as argument to method, the method can be passed in a list to method.args as member method. More easily, the name of the function can be passed as a character string together with the lmodel2-supported method.

R option OutDec is obeyed based on its value at the time the plot is rendered, i.e., displayed or printed. Set options(OutDec = ",") for languages like Spanish or French.

See Also

The major axis regression model is fitted with function lmodel2, please consult its documentation. Statistic stat_ma_eq() can return different ready formatted labels depending on the argument passed to output.type. If ordinary least squares polynomial regression is desired, then stat_poly_eq. If quantile-fitted polynomial regression is desired, stat_quant_eq should be used. For other types of models such as non-linear models, statistics stat_fit_glance and stat_fit_tidy should be used and the code for construction of character strings from numeric values and their mapping to aesthetic label explicitly supplied in the call.

Other ggplot statistics for major axis regression: stat_ma_line()

Examples

```
# generate artificial data
set.seed(98723)
my.data <- data.frame(x = rnorm(100) + (0:99) / 10 - 5,
                      y = rnorm(100) + (0:99) / 10 - 5,
                      group = c("A", "B"))

# using defaults (major axis regression)
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line() +
  stat_ma_eq()

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line() +
  stat_ma_eq(mapping = use_label("eq"))

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line() +
  stat_ma_eq(mapping = use_label("eq"), decreasing = TRUE)
```

```
# use_label() can assemble and map a combined label
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line(method = "MA") +
  stat_ma_eq(mapping = use_label("eq", "R2", "P"))

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line(method = "MA") +
  stat_ma_eq(mapping = use_label("R2", "P", "theta", "method"))

# using ranged major axis regression
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line(method = "RMA",
               range.y = "interval",
               range.x = "interval") +
  stat_ma_eq(mapping = use_label("eq", "R2", "P"),
             method = "RMA",
             range.y = "interval",
             range.x = "interval")

# No permutation-based test
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line(method = "MA") +
  stat_ma_eq(mapping = use_label("eq", "R2"),
             method = "MA",
             nperm = 0)

# explicit formula "x explained by y"
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line(formula = x ~ y) +
  stat_ma_eq(formula = x ~ y,
             mapping = use_label("eq", "R2", "P"))

# modifying both variables within aes()
ggplot(my.data, aes(log(x + 10), log(y + 10))) +
  geom_point() +
  stat_poly_line() +
  stat_poly_eq(mapping = use_label("eq"),
               eq.x.rhs = "~~log(x+10)",
               eq.with.lhs = "log(y+10)~~`=`~~")

# grouping
ggplot(my.data, aes(x, y, color = group)) +
  geom_point() +
  stat_ma_line() +
  stat_ma_eq()

# labelling equations
ggplot(my.data,
```

```
        aes(x, y,  shape = group, linetype = group, grp.label = group)) +
  geom_point() +
  stat_ma_line(color = "black") +
  stat_ma_eq(mapping = use_label("grp", "eq", "R2")) +
  theme_classic()

# Inspecting the returned data using geom_debug()
# This provides a quick way of finding out the names of the variables that
# are available for mapping to aesthetics with after_stat().

 gginnards.installed <- requireNamespace("gginnards", quietly = TRUE)

if (gginnards.installed)
  library(gginnards)

# default is output.type = "expression"
if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_ma_eq(geom = "debug")

## Not run:
if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_ma_eq(mapping = aes(label = after_stat(eq.label)),
               geom = "debug",
               output.type = "markdown")

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_ma_eq(geom = "debug", output.type = "text")

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_ma_eq(geom = "debug", output.type = "numeric")

## End(Not run)
```

---

stat_ma_line	*Predicted line from major axis linear fit*

Description

Predicted values and a confidence band are computed and, by default, plotted. stat_ma_line()
behaves similarly to stat_smooth except for fitting the model with lmodel2::lmodel2() with
"MA" as default for method.

Usage

```
stat_ma_line(
  mapping = NULL,
  data = NULL,
  geom = "smooth",
  position = "identity",
  ...,
  method = "lmodel2:MA",
  method.args = list(),
  n.min = 2L,
  formula = NULL,
  range.y = NULL,
  range.x = NULL,
  se = TRUE,
  fm.values = FALSE,
  n = 80,
  nperm = 99,
  fullrange = FALSE,
  level = 0.95,
  na.rm = FALSE,
  orientation = NA,
  show.legend = NA,
  inherit.aes = TRUE
)
```

Arguments

mapping	The aesthetic mapping, usually constructed with [aes](#). Only needs to be set at the layer level if you are overriding the plot defaults.
data	A layer specific dataset, only needed if you want to override the plot defaults.
geom	The geometric object to use display the data
position	The position adjustment to use for overlapping points on this layer
...	other arguments passed on to [layer](#). This can include aesthetics whose values you want to set, not map. See [layer](#) for more details.
method	function or character If character, "MA", "SMA" , "RMA" or "OLS", alternatively "lmodel2" or the name of a model fit function are accepted, possibly followed by the fit function's method argument separated by a colon (e.g. "lmodel2:MA"). If a function different to lmodel2(), it must accept arguments named formula, data, range.y, range.x and nperm and return a model fit object of class lmodel2.
method.args	named list with additional arguments.
n.min	integer Minimum number of distinct values in the explanatory variable (on the rhs of formula) for fitting to the attempted.
formula	a formula object. Using aesthetic names x and y instead of original variable names.

`range.y, range.x`	
	character Pass "relative" or "interval" if method "RMA" is to be computed.
`se`	logical Return confidence interval around smooth? ('TRUE' by default, see 'level' to control.)
`fm.values`	logical Add R2, p-value and n as columns to returned data? ('FALSE' by default.)
`n`	Number of points at which to evaluate smoother.
`nperm`	integer Number of permutation used to estimate significance.
`fullrange`	Should the fit span the full range of the plot, or just the data?
`level`	Level of confidence interval to use (only 0.95 currently).
`na.rm`	a logical indicating whether NA values should be stripped before the computation proceeds.
`orientation`	character Either "x" or "y" controlling the default for `formula`.
`show.legend`	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes.
`inherit.aes`	If FALSE, overrides the default aesthetics, rather than combining with them. This is most useful for helper functions that define both data and aesthetics and shouldn't inherit behaviour from the default plot specification, e.g. [borders](#).

Details

This statistic fits major axis ("MA") and other model II regressions with function [lmodel2](#). Model II regression is called for when both x and y are subject to random variation and the intention is not to predict y from x by means of the model but rather to study the relationship between two independent variables. A frequent case in biology are allometric relationships among body parts.

As the fitted line is the same whether x or y is on the rhs of the model equation, `orientation` even if accepted does not have an effect on the fitted line. In contrast, [geom_smooth](#) treats each axis differently and can thus have two orientations. The orientation is easy to deduce from the argument passed to `formula`. Thus, `stat_ma_line()` will by default guess which orientation the layer should have. If no argument is passed to `formula`, the orientation can be specified directly passing an argument to the `orientation` parameter, which can be either "x" or "y". The value gives the axis that is on the rhs of the model equation, "x" being the default orientation. Package 'ggpmisc' does not define new geometries matching the new statistics as they are not needed and conceptually transformations of `data` are expressed as statistics.

The minimum number of observations with distinct values can be set through parameter `n.min`. The default `n.min = 2L` is the smallest possible value. However, model fits with very few observations are of little interest and using a larger number for `n.min` than the default is wise.

Value

The value returned by the statistic is a data frame, that will have n rows of predicted values and their confidence limits. Optionally it will also include additional values related to the model fit.

Computed variables

'stat_ma_line()' provides the following variables, some of which depend on the orientation:

y *or* x predicted value

ymin *or* xmin lower pointwise confidence interval around the mean

ymax *or* xmax upper pointwise confidence interval around the mean

se standard error

If fm.values = TRUE is passed then columns based on the summary of the model fit are added, with the same value in each row within a group. This is wasteful and disabled by default, but provides a simple and robust approach to achieve effects like colouring or hiding of the model fit line based on P-values, r-squared or the number of observations.

Aesthetics

stat_ma_line understands x and y, to be referenced in the formula. Both must be mapped to numeric variables. In addition, the aesthetics understood by the geom ("geom_smooth" is the default) are understood and grouping respected.

See Also

Other ggplot statistics for major axis regression: stat_ma_eq()

Examples

```
# generate artificial data
set.seed(98723)
my.data <- data.frame(x = rnorm(100) + (0:99) / 10 - 5,
                      y = rnorm(100) + (0:99) / 10 - 5,
                      group = c("A", "B"))

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line()

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line(method = "MA")

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line(method = "SMA")

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line(method = "RMA",
               range.y = "interval", range.x = "interval")

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line(method = "OLS")
```

```
# plot line to the ends of range of data (the default)
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line(fullrange = FALSE) +
  expand_limits(x = c(-10, 10), y = c(-10, 10))

# plot line to the limits of the scales
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line(fullrange = TRUE) +
  expand_limits(x = c(-10, 10), y = c(-10, 10))

# plot line to the limits of the scales
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line(orientation = "y", fullrange = TRUE) +
  expand_limits(x = c(-10, 10), y = c(-10, 10))

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line(formula = x ~ y)

# Smooths are automatically fit to each group (defined by categorical
# aesthetics or the group aesthetic) and for each facet.

ggplot(my.data, aes(x, y, colour = group)) +
  geom_point() +
  stat_ma_line()

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_ma_line() +
  facet_wrap(~group)

# Inspecting the returned data using geom_debug()
gginnards.installed <- requireNamespace("gginnards", quietly = TRUE)

if (gginnards.installed)
  library(gginnards)

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    stat_ma_line(geom = "debug")

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    stat_ma_line(geom = "debug", fm.values = TRUE)
```

---

stat_multcomp   *Labels for pairwise multiple comparisons*

Description

stat_multcomp fits a linear model by default with stats::lm() but alternatively using other model fit functions. The model is passed to function glht() from package 'multcomp' to fit Tukey, Dunnet or other **pairwise** contrasts and generates labels based on adjusted *P*-values.

Usage

```
stat_multcomp(
  mapping = NULL,
  data = NULL,
  geom = NULL,
  position = "identity",
  ...,
  formula = NULL,
  method = "lm",
  method.args = list(),
  contrasts = "Tukey",
  p.adjust.method = NULL,
  small.p = getOption("ggpmisc.small.p", default = FALSE),
  adj.method.tag = 4,
  p.digits = 3,
  label.type = "bars",
  fm.cutoff.p.value = 1,
  mc.cutoff.p.value = 1,
  mc.critical.p.value = 0.05,
  label.y = NULL,
  vstep = NULL,
  output.type = NULL,
  na.rm = FALSE,
  orientation = "x",
  parse = NULL,
  show.legend = FALSE,
  inherit.aes = TRUE
)
```

Arguments

mapping	The aesthetic mapping, usually constructed with [aes](#). Only needs to be set at the layer level if you are overriding the plot defaults.
data	A layer specific dataset, only needed if you want to override the plot defaults.
geom	The geometric object to use to display the data.
position	The position adjustment to use for overlapping points on this layer.
...	other arguments passed on to [layer](#). This can include aesthetics whose values you want to set, not map. See [layer](#) for more details.
formula	a formula object. Using aesthetic names x and y instead of original variable names.

method	function or character If character, "lm" (or its equivalent "aov"), "rlm" or the name of a model fit function are accepted, possibly followed by the fit function's `method` argument separated by a colon (e.g. `"rlm:M"`). If a function different to `lm()`, it must accept as a minimum a model formula through its first parameter, and have formal parameters named `data`, `weights`, and `method`, and return a model fit object accepted by function `glht()`.
method.args	named list with additional arguments.
contrasts	character vector of length one or a numeric matrix. If character, one of "Tukey" or "Dunnet". If a matrix, one column per level of the factor mapped to x and one row per **pairwise** contrast.
p.adjust.method	
	character As the argument for parameter `type` of function `adjusted()` passed as argument to parameter `test` of [`summary.glht`](#). Accepted values are "single-step", "Shaffer", "Westfall", "free", "holm", "hochberg", "hommel", "bonferroni", "BH", "BY", "fdr", "none".
small.p	logical If true, use of lower case *p* instead of capital *P* as the symbol for *P*-value in labels.
adj.method.tag	numeric, character or function If `numeric`, the length in characters of the abbreviation of the method used to adjust *p*-values. A value of zero, adds no label and a negative value uses as starting point for the abbreviation the word "adjusted". If `character` its value is used as subscript. If a `function`, the value used is the value returned by the function when passed p.adjust.method as its only argument.
p.digits	integer Number of digits after the decimal point to use for R^2 and *P*-value in labels.
label.type	character One of "bars", "letters" or "LETTERS", selects how the results of the multiple comparisons are displayed. Only "bars" can be used together with `contrasts = "Dunnet"`.
fm.cutoff.p.value	
	numeric [0..1] The *P*-value for the main effect of factor x in the ANOVA test for the fitted model above which no pairwise comparisons are computed or labels generated. Be aware that recent literature tends to recommend to consider which testing approach is relevant to the problem at hand instead of requiring the significance of the main effect before applying multiple comparisons' tests. The default value is 1, imposing no restrictions.
mc.cutoff.p.value	
	numeric [0..1] The *P*-value for the individual contrasts above which no labelled bars are generated. Default is 1, labelling all pairwise contrasts tested.
mc.critical.p.value	
	numeric The critical *P*-value used for tests when encoded as letters.
label.y	numeric vector Values in native data units or if character, one of "top" or "bottom". Recycled if too short and truncated if too long.
vstep	numeric in npc units, the vertical displacement step-size used between labels for different contrasts when `label.type = "bars"`.
output.type	character One of "expression", "LaTeX", "text", "markdown" or "numeric".

na.rm	a logical indicating whether NA values should be stripped before the computation proceeds.
orientation	character Either "x" or "y" controlling the default for formula. **Support for** orientation **is not yet implemented but is planned.**
parse	logical Passed to the geom. If TRUE, the labels will be parsed into expressions and displayed as described in ?plotmath. Default is TRUE if output.type = "expression" and FALSE otherwise.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes.
inherit.aes	If FALSE, overrides the default aesthetics, rather than combining with them.

Details

This statistic can be used to automatically annotate a plot with *P*-values for **pairwise** multiple comparison tests, based on Tukey contrasts (all pairwise), Dunnet contrasts (other levels against the first one) or a subset of all possible pairwise contrasts. See Meier (2022, Chapter 3) for an accessible explanation of multiple comparisons and contrasts with package 'multcomp', of which stat_multcomp() is mostly a wrapper.

The explanatory variable mapped to the *x* aesthetic must be a factor as this creates the required grouping. Currently, contrasts that involve more than two levels of a factor, such as the average of two treatment levels against a control level are not supported, mainly because they require a new geometry that I need to design, implement and add to package 'ggpp'.

Two ways of displaying the outcomes are implemented, and are selected by '"bars"', '"letters"' or '"LETTERS"' as argument to parameter 'label.type'. '"letters"' and '"LETTERS"' can be used only with Tukey contrasts, as otherwise the encoding is ambiguous. As too many bars clutter a plot, the maximum number of factor levels supported for '"bars"' together with Tukey contrasts is five, while together with Dunnet contrasts or contrasts defined by a numeric matrix, no limit is imposed.

stat_multcomp() by default generates character labels ready to be parsed as R expressions but LaTeX (use TikZ device), markdown (use package 'ggtext') and plain text are also supported, as well as numeric values for user-generated text labels. The value of parse is set automatically based on output.type, but if you assemble labels that need parsing from numeric output, the default needs to be overridden. This statistic only generates annotation labels and segments connecting the compared factor levels, or letter labels that discriminate significantly different groups.

Value

A data frame with one row per comparison for label.type = "bars", or a data frame with one row per factor x level for label.type = "letters" and for label.type = "LETTERS". Variables (= columns) as described under **Computed variables**.

Aesthetics

stat_multcomp() understands x and y, to be referenced in the formula and weight passed as argument to parameter weights. A factor must be mapped to x and numeric variables to y, and, if used, to weight. In addition, the aesthetics understood by the geom ("label_pairwise" is the default for label.type = "bars", "text" is the default for label.type = "letters" and for label.type = "LETTERS") are understood and grouping respected.

Computed variables

If `output.type = "numeric"` and `label.type = "bars"` the returned tibble contains columns listed below. In all cases if the model fit function used does not return a value, the label is set to `character(0L)` and the numeric value to NA.

x,x.left.tip,x.right.tip x position, numeric.

y y position, numeric.

coefficients Delta estimate from pairwise contrasts, numeric.

contrasts Contrasts as two levels' ordinal "numbers" separated by a dash, character.

tstat *t*-statistic estimates for the pairwise contrasts, numeric.

p.value *P*-value for the pairwise contrasts.

fm.method Set according `method` used.

fm.class Most derived class of the fitted model object.

fm.formula Formula extracted from the fitted model object if available, or the formula argument.

fm.formula.chr Formula extracted from the fitted model object if available, or the formula argument, formatted as character.

mc.adjusted The method used to adjust the *P*-values.

mc.contrast The type of contrast used for multiple comparisons.

n The total number of observations or rows in data.

default.label text label, always included, but possibly NA.

If output.type is not `"numeric"` the returned data frame includes in addition the following labels:

stars.label *P*-value for the pairwise contrasts encoded as "starts", character.

p.value.label *P*-value for the pairwise contrasts, character.

delta.label The coefficient or estimate for the difference between compared pairs of levels.

t.value.label *t*-statistic estimates for the pairwise contrasts, character.

If `label.type = "letters"` or `label.type = "LETTERS"` the returned tibble contains columns listed below.

x,x.left.tip,x.right.tip x position, numeric.

y y position, numeric.

critical.p.value *P*-value used in pairwise tests, numeric.

fm.method Set according `method` used.

fm.class Most derived class of the fitted model object.

fm.formula Formula extracted from the fitted model object if available, or the formula argument.

fm.formula.chr Formula extracted from the fitted model object if available, or the formula argument, formatted as character.

mc.adjusted The method used to adjust the *P*-values.

mc.contrast The type of contrast used for multiple comparisons.

n The total number of observations or rows in data.

default.label text label, always included, but possibly NA.

If output.type is not `"numeric"` the returned data frame includes in addition the following labels:

letters.label Letters that distinguish levels based on significance from multiple comparisons test.

Alternatives

stat_signif() in package 'ggsignif' is an earlier and independent implementation of pairwise tests.

Note

R option OutDec is obeyed based on its value at the time the plot is rendered, i.e., displayed or printed. Set options(OutDec = ",") for languages like Spanish or French.

References

Meier, Lukas (2022) *ANOVA and Mixed Models: A Short Introduction Using R*. Chapter 3 Contrasts and Multiple Testing. The R Series. Boca Raton: Chapman and Hall/CRC. ISBN: 9780367704209, doi:10.1201/9781003146216.

See Also

This statistic uses the implementation of Tests of General Linear Hypotheses in function glht. See summary.glht and p.adjust for the supported and tests and the references therein for the theory behind them.

Examples

```
p1 <- ggplot(mpg, aes(factor(cyl), hwy)) +
  geom_boxplot(width = 0.33)

## labeleld bars

p1 +
  stat_multcomp()

p1 +
  stat_multcomp(adj.method.tag = 0)

# test against a control, with first level being the control
# change order of factor levels in data to set the control group
p1 +
  stat_multcomp(contrasts = "Dunnet")

# arbitrary pairwise contrasts, in arbitrary order
p1 +
  stat_multcomp(contrasts = rbind(c(0, 0, -1, 1),
                                  c(0, -1, 1, 0),
                                  c(-1, 1, 0, 0)))

# different methods to adjust the contrasts
p1 +
  stat_multcomp(p.adjust.method = "bonferroni")

p1 +
  stat_multcomp(p.adjust.method = "holm")
```

```
p1 +
  stat_multcomp(p.adjust.method = "fdr")

# no correction, useful only for comparison
p1 +
  stat_multcomp(p.adjust.method = "none")

# sometimes we need to expand the plotting area
p1 +
  stat_multcomp(geom = "text_pairwise") +
  scale_y_continuous(expand = expansion(mult = c(0.05, 0.10)))

# position of contrasts' bars (based on scale limits)
p1 +
  stat_multcomp(label.y = "bottom")

p1 +
  stat_multcomp(label.y = 11)

# use different labels: difference and P-value from hypothesis tests
p1 +
  stat_multcomp(use_label("Delta", "P"),
                size = 2.75)

# control smallest P-value displayed and number of digits
p1 +
  stat_multcomp(p.digits = 4)

# label only significant differences
# but test and correct for all pairwise contrasts!
p1 +
  stat_multcomp(mc.cutoff.p.value = 0.01)

## letters as labels for test results

p1 +
  stat_multcomp(label.type = "letters")

# use capital letters
p1 +
  stat_multcomp(label.type = "LETTERS")

# location
p1 +
  stat_multcomp(label.type = "letters",
                label.y = "top")

p1 +
  stat_multcomp(label.type = "letters",
                label.y = 0)

# stricter critical p-value than default used for test
```

```
p1 +
  stat_multcomp(label.type = "letters",
                mc.critical.p.value = 0.01)

# Inspecting the returned data using geom_debug()
# This provides a quick way of finding out the names of the variables that
# are available for mapping to aesthetics with after_stat().

gginnards.installed <- requireNamespace("gginnards", quietly = TRUE)

if (gginnards.installed)
  library(gginnards)

if (gginnards.installed)
p1 +
  stat_multcomp(label.type = "bars",
                geom = "debug")

if (gginnards.installed)
p1 +
  stat_multcomp(label.type = "letters",
                geom = "debug")

if (gginnards.installed)
p1 +
  stat_multcomp(label.type = "bars",
                output.type = "numeric",
                geom = "debug")
```

---

stat_peaks   *Local maxima (peaks) or minima (valleys)*

Description

`stat_peaks` finds at which x positions local y maxima are located and `stat_valleys` finds at which x positions local y minima are located. Both stats return a subset of `data` with rows matching for peaks or valleys with formatted character labels added. The formatting is determined by a format string compatible with `sprintf()` or `strftime()`.

Usage

```
stat_peaks(
  mapping = NULL,
  data = NULL,
  geom = "point",
  span = 5,
  ignore_threshold = 0,
  strict = FALSE,
```

```
    label.fmt = NULL,
    x.label.fmt = NULL,
    y.label.fmt = NULL,
    orientation = "x",
    position = "identity",
    na.rm = FALSE,
    show.legend = FALSE,
    inherit.aes = TRUE,
    ...
)

stat_valleys(
    mapping = NULL,
    data = NULL,
    geom = "point",
    span = 5,
    ignore_threshold = 0,
    strict = FALSE,
    label.fmt = NULL,
    x.label.fmt = NULL,
    y.label.fmt = NULL,
    orientation = "x",
    position = "identity",
    na.rm = FALSE,
    show.legend = FALSE,
    inherit.aes = TRUE,
    ...
)
```

Arguments

mapping	The aesthetic mapping, usually constructed with [aes](). Only needs to be set at the layer level if you are overriding the plot defaults.
data	A layer specific dataset - only needed if you want to override the plot defaults.
geom	The geometric object to use display the data.
span	a peak is defined as an element in a sequence which is greater than all other elements within a window of width span centered at that element. The default value is 5, meaning that a peak is bigger than two consecutive neighbors on each side. A NULL value for span is taken as a span covering the whole of the data range.
ignore_threshold	
	numeric value between 0.0 and 1.0 indicating the size threshold below which peaks will be ignored.
strict	logical flag: if TRUE, an element must be strictly greater than all other values in its window to be considered a peak. Default: FALSE.
label.fmt	character string giving a format definition for converting values into character strings by means of function [sprintf]() or [strptime](), its use is deprecated.

x.label.fmt	character string giving a format definition for converting x-values into character strings by means of function [sprintf](#) or [strftime](#). The default argument varies depending on the scale in use.
y.label.fmt	character string giving a format definition for converting y-values into character strings by means of function [sprintf](#).
orientation	character Either "x" or "y".
position	The position adjustment to use for overlapping points on this layer.
na.rm	a logical value indicating whether NA values should be stripped before the computation proceeds.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes.
inherit.aes	If FALSE, overrides the default aesthetics, rather than combining with them. This is most useful for helper functions that define both data and aesthetics and shouldn't inherit behaviour from the default plot specification, e.g. [borders](#).
...	other arguments passed on to [layer](#). This can include aesthetics whose values you want to set, not map. See [layer](#) for more details.

Details

These stats use geom_point by default as it is the geom most likely to work well in almost any situation without need of tweaking. The default aesthetics set by these stats allow their direct use with geom_text, geom_label, geom_line, geom_rug, geom_hline and geom_vline. The formatting of the labels returned can be controlled by the user.

The default for parameter strict is TRUE in functions splus2R::peaks() and find_peaks(), while the default is FALSE in stat_peaks() and in stat_valleys().

Returned and computed variables

x x-value at the peak (or valley) as numeric

y y-value at the peak (or valley) as numeric

x.label x-value at the peak (or valley) as character

y.label y-value at the peak (or valley) as character

Warning!

The current version of these statistics do not support passing nudge_x or nurge_y named parameters to the geometry. Use 'position' and one of the position functions such as [position_nudge_keep](#) instead.

Note

These statistics check the scale of the x aesthetic and if it is Date or Datetime they correctly generate the labels by transforming the numeric x values to Date or POSIXct objects, respectively. In which case the x.label.fmt must follow the syntax supported by strftime() rather than by sprintf(). Overlap of labels with points can avoided by use of one of the nudge positions, possibly together with geometry [geom_text_s](#) from package [ggpp](#), or with [geom_text_repel](#) or [geom_label_repel](#)

from package [ggrepel](). To discard overlapping labels use check_overlap = TRUE as argument to geom_text or geom_text_s. By default the labels are character values suitable to be plotted as is, but with a suitable format passed as argument to label.fmt labels suitable for parsing by the geoms (e.g. into expressions containing Greek letters, super- or subscripts, maths symbols or maths constructs) can be also easily obtained.

Examples

```
# lynx is a time.series object
lynx_num.df <-
  try_tibble(lynx,
             col.names = c("year", "lynx"),
             as.numeric = TRUE) # years -> as numeric

ggplot(lynx_num.df, aes(year, lynx)) +
  geom_line() +
  stat_peaks(colour = "red") +
  stat_valleys(colour = "blue")

ggplot(lynx_num.df, aes(lynx, year)) +
  geom_line(orientation = "y") +
  stat_peaks(colour = "red", orientation = "y") +
  stat_valleys(colour = "blue", orientation = "y")

ggplot(lynx_num.df, aes(year, lynx)) +
  geom_line() +
  stat_peaks(colour = "red") +
  stat_peaks(colour = "red", geom = "rug")

ggplot(lynx_num.df, aes(year, lynx)) +
  geom_line() +
  stat_peaks(colour = "red") +
  stat_peaks(colour = "red", geom = "text", hjust = -0.1, angle = 33)

ggplot(lynx_num.df, aes(lynx, year)) +
  geom_line(orientation = "y") +
  stat_peaks(colour = "red", orientation = "y") +
  stat_peaks(colour = "red", orientation = "y",
             geom = "text", hjust = -0.1)

lynx_datetime.df <-
   try_tibble(lynx,
              col.names = c("year", "lynx")) # years -> POSIXct

ggplot(lynx_datetime.df, aes(year, lynx)) +
  geom_line() +
  stat_peaks(colour = "red") +
  stat_valleys(colour = "blue")

ggplot(lynx_datetime.df, aes(year, lynx)) +
  geom_line() +
  stat_peaks(colour = "red") +
```

```
    stat_peaks(colour = "red",
               geom = "text",
               hjust = -0.1,
               x.label.fmt = "%Y",
               angle = 33)

ggplot(lynx_datetime.df, aes(year, lynx)) +
  geom_line() +
  stat_peaks(colour = "red") +
  stat_peaks(colour = "red",
             geom = "text_s",
             position = position_nudge_keep(x = 0, y = 200),
             hjust = -0.1,
             x.label.fmt = "%Y",
             angle = 90) +
  expand_limits(y = 8000)

ggplot(lynx_datetime.df, aes(year, lynx)) +
  geom_line() +
  stat_peaks(colour = "red",
             geom = "text_s",
             position = position_nudge_to(y = 7600),
             arrow = arrow(length = grid::unit(1.5, "mm")),
             point.padding = 0.7,
             x.label.fmt = "%Y",
             angle = 90) +
  expand_limits(y = 9000)
```

---

stat_poly_eq   *Equation, p-value, $R\char94 2$, AIC and BIC of fitted polynomial*

Description

stat_poly_eq fits a polynomial, by default with stats::lm(), but alternatively using robust regression. Using the fitted model it generates several labels including the fitted model equation, p-value, F-value, coefficient of determination (R^2), 'AIC', 'BIC', and number of observations.

Usage

```
stat_poly_eq(
  mapping = NULL,
  data = NULL,
  geom = "text_npc",
  position = "identity",
  ...,
  formula = NULL,
  method = "lm",
  method.args = list(),
```

```
    n.min = 2L,
    eq.with.lhs = TRUE,
    eq.x.rhs = NULL,
    small.r = getOption("ggpmisc.small.r", default = FALSE),
    small.p = getOption("ggpmisc.small.p", default = FALSE),
    CI.brackets = c("[", "]"),
    rsquared.conf.level = 0.95,
    coef.digits = 3,
    coef.keep.zeros = TRUE,
    decreasing = getOption("ggpmisc.decreasing.poly.eq", FALSE),
    rr.digits = 2,
    f.digits = 3,
    p.digits = 3,
    label.x = "left",
    label.y = "top",
    hstep = 0,
    vstep = NULL,
    output.type = NULL,
    na.rm = FALSE,
    orientation = NA,
    parse = NULL,
    show.legend = FALSE,
    inherit.aes = TRUE
)
```

Arguments

mapping	The aesthetic mapping, usually constructed with [aes](). Only needs to be set at the layer level if you are overriding the plot defaults.
data	A layer specific dataset, only needed if you want to override the plot defaults.
geom	The geometric object to use display the data
position	The position adjustment to use for overlapping points on this layer
...	other arguments passed on to [layer](). This can include aesthetics whose values you want to set, not map. See [layer]() for more details.
formula	a formula object. Using aesthetic names x and y instead of original variable names.
method	function or character If character, "lm", "rlm" or the name of a model fit function are accepted, possibly followed by the fit function's method argument separated by a colon (e.g. "rlm:M"). If a function different to lm(), it must accept as a minimum a model formula through its first parameter, and have formal parameters named data, weights, and method, and return a model fit object of class lm.
method.args	named list with additional arguments.
n.min	integer Minimum number of distinct values in the explanatory variable (on the rhs of formula) for fitting to the attempted.
eq.with.lhs	If character the string is pasted to the front of the equation label before parsing or a logical (see note).

eq.x.rhs   character this string will be used as replacement for "x" in the model equation
                  when generating the label before parsing it.

small.r, small.p

                  logical Flags to switch use of lower case r and p for coefficient of determination
                  and p-value.

CI.brackets   character vector of length 2. The opening and closing brackets used for the CI
                  label.

rsquared.conf.level

                  numeric Confidence level for the returned confidence interval. Set to NA to skip
                  CI computation.

coef.digits, f.digits

                  integer Number of significant digits to use for the fitted coefficients and F-value.

coef.keep.zeros

                  logical Keep or drop trailing zeros when formatting the fitted coefficients and
                  F-value.

decreasing   logical It specifies the order of the terms in the returned character string; in
                  increasing (default) or decreasing powers.

rr.digits, p.digits

                  integer Number of digits after the decimal point to use for R^2 and P-value in
                  labels. If Inf, use exponential notation with three decimal places.

label.x, label.y

                  numeric with range 0..1 "normalized parent coordinates" (npc units) or charac-
                  ter if using geom_text_npc() or geom_label_npc(). If using geom_text() or
                  geom_label() numeric in native data units. If too short they will be recycled.

hstep, vstep   numeric in npc units, the horizontal and vertical step used between labels for
                  different groups.

output.type   character One of "expression", "LaTeX", "text", "markdown" or "numeric".

na.rm   a logical indicating whether NA values should be stripped before the computa-
                  tion proceeds.

orientation   character Either "x" or "y" controlling the default for formula.

parse   logical Passed to the geom. If TRUE, the labels will be parsed into expressions
                  and displayed as described in ?plotmath. Default is TRUE if output.type =
                  "expression" and FALSE otherwise.

show.legend   logical. Should this layer be included in the legends? NA, the default, includes if
                  any aesthetics are mapped. FALSE never includes, and TRUE always includes.

inherit.aes   If FALSE, overrides the default aesthetics, rather than combining with them.
                  This is most useful for helper functions that define both data and aesthetics and
                  shouldn't inherit behaviour from the default plot specification, e.g. borders.

Details

This statistic can be used to automatically annotate a plot with R^2, adjusted R^2 or the fitted model
equation. It supports linear regression and polynomial fits, and robust regression fitted with func-
tions lm, or rlm, respectively.

While strings for R^2, adjusted R^2, F, and P annotations are returned for all valid linear models, A character string for the fitted model is returned only for polynomials (see below), in which case the equation can still be assembled by the user. In addition, a label for the confidence interval of R^2, based on values computed with function `ci_rsquared` from package 'confintr' is also returned.

The model formula should be defined based on the names of aesthetics x and y, not the names of the variables in the data. Before fitting the model, data are split based on groupings created by any other mappings present in a plot panel: *fitting is done separately for each group in each plot panel*.

Model formulas can use poly() or be defined algebraically including the intercept indicated by +1, -1, +0 or implicit. If defined using poly() the argument raw = TRUE must be passed. The model formula is checked, and if not recognized as a polynomial with no missing terms and terms ordered by increasing powers, no equation label is generated. Thus, as the value returned for eq.label can be NA, the default aesthetic mapping to *label* is R^2.

By default, the character strings are generated as suitable for parsing into R's plotmath expressions. However, LaTeX (use TikZ device), markdown (use package 'ggtext') and plain text are also supported, as well as returning numeric values for user-generated text labels. The argument of parse is set automatically based on output-type, but if you assemble labels that need parsing from numeric output, the default needs to be overridden.

This statistic only generates annotation labels, the predicted values/line need to be added to the plot as a separate layer using `stat_poly_line` (or `stat_smooth`). Using the same formula in stat_poly_line() and in stat_poly_eq() in most cases ensures that the plotted curve and equation are consistent. Thus, unless the default formula is not overriden, it is best to save the model formula as an object and supply this named object as argument to the two statistics.

A ggplot statistic receives as data a data frame that is not the one passed as argument by the user, but instead a data frame with the variables mapped to aesthetics. stat_poly_eq() mimics how stat_smooth() works.

With method "lm", singularity results in terms being dropped with a message if more numerous than can be fitted with a singular (exact) fit. In this case or if the model results in a perfect fit due to a low number of observations, estimates for various parameters are NaN or NA. When this is the case the corresponding labels are set to character(0L) and thus not visible in the plot.

With methods other than "lm", the model fit functions simply fail in case of singularity, e.g., singular fits are not implemented in "rlm".

In both cases the minimum number of observations with distinct values in the explanatory variable can be set through parameter n.min. The default n.min = 2L is the smallest suitable for method "lm" but too small for method "rlm" for which n.min = 3L is needed. Anyway, model fits with very few observations are of little interest and using larger values of n.min than the default is usually wise.

Value

A data frame, with a single row and columns as described under **Computed variables**. In cases when the number of observations is less than n.min a data frame with no rows or columns is returned, and rendered as an empty/invisible plot layer.

User-defined methods

User-defined functions can be passed as argument to method. The requirements are 1) that the signature is similar to that of function lm() (with parameters formula, data, weights and any other

arguments passed by name through `method.args`) and 2) that the value returned by the function is an object of class `"lm"` or an atomic NA value.

The `formula` used to build the equation label is extracted from the returned `"lm"` object and can safely differ from the argument passed to parameter `formula` in the call to `stat_poly_eq()`. Thus, user-defined methods can implement both model selection or conditional skipping of labelling.

Aesthetics

`stat_poly_eq()` understands x and y, to be referenced in the `formula` and `weight` passed as argument to parameter `weights`. All three must be mapped to `numeric` variables. In addition, the aesthetics understood by the geom (`"text"` is the default) are understood and grouping respected.

If the model formula includes a transformation of x, a matching argument should be passed to parameter `eq.x.rhs` as its default value `"x"` will not reflect the applied transformation. In plots, transformation should never be applied to the left hand side of the model formula, but instead in the mapping of the variable within `aes`, as otherwise plotted observations and fitted curve will not match. In this case it may be necessary to also pass a matching argument to parameter `eq.with.lhs`.

Computed variables

If output.type different from `"numeric"` the returned tibble contains columns listed below. If the model fit function used does not return a value, the label is set to `character(0L)`.

x,npcx x position

y,npcy y position

eq.label equation for the fitted polynomial as a character string to be parsed or NA

rr.label R^2 of the fitted model as a character string to be parsed

adj.rr.label Adjusted R^2 of the fitted model as a character string to be parsed

rr.confint.label Confidence interval for R^2 of the fitted model as a character string to be parsed

f.value.label F value and degrees of freedom for the fitted model as a whole.

p.value.label P-value for the F-value above.

AIC.label AIC for the fitted model.

BIC.label BIC for the fitted model.

n.label Number of observations used in the fit.

grp.label Set according to mapping in `aes`.

method.label Set according `method` used.

r.squared, adj.r.squared, p.value, n numeric values, from the model fit object

If output.type is `"numeric"` the returned tibble contains columns listed below. If the model fit function used does not return a value, the variable is set to `NA_real_`.

x,npcx x position

y,npcy y position

coef.ls list containing the "coefficients" matrix from the summary of the fit object

r.squared, rr.confint.level, rr.confint.low, rr.confint.high, adj.r.squared, f.value, f.df1, f.df2, p.value, AIC, BIC, n numeric values, from the model fit object

grp.label Set according to mapping in `aes`.

b_0.constant TRUE is polynomial is forced through the origin

b_i One or columns with the coefficient estimates

To explore the computed values returned for a given input we suggest the use of geom_debug as shown in the last examples below.

Alternatives

`stat_regline_equation()` in package 'ggpubr' is a renamed but almost unchanged copy of `stat_poly_eq()` taken from an old version of this package (without acknowledgement of source and authorship). `stat_regline_equation()` lacks important functionality and contains bugs that have been fixed in `stat_poly_eq()`.

Note

For backward compatibility a logical is accepted as argument for `eq.with.lhs`. If `TRUE`, the default is used, either `"x"` or `"y"`, depending on the argument passed to `formula`. However, `"x"` or `"y"` can be substituted by providing a suitable replacement character string through `eq.x.rhs`. Parameter `orientation` is redundant as it only affects the default for `formula` but is included for consistency with ggplot2::stat_smooth().

R option `OutDec` is obeyed based on its value at the time the plot is rendered, i.e., displayed or printed. Set `options(OutDec = ",")` for languages like Spanish or French.

References

Originally written as an answer to question 7549694 at Stackoverflow but enhanced based on suggestions from users and my own needs.

See Also

This statistics fits a model with function [lm](lm), function [rlm](rlm) or a user supplied function returning an object of class `"lm"`. Consult the documentation of these functions for the details and additional arguments that can be passed to them by name through parameter `method.args`.

For quantile regression stat_quant_eq should be used instead of stat_poly_eq while for model II or major axis regression stat_ma_eq should be used. For other types of models such as non-linear models, statistics stat_fit_glance and stat_fit_tidy should be used and the code for construction of character strings from numeric values and their mapping to aesthetic `label` needs to be explicitly supplied by the user.

Other ggplot statistics for linear and polynomial regression: stat_poly_line()

Examples

```
# generate artificial data
set.seed(4321)
x <- 1:100
y <- (x + x^2 + x^3) + rnorm(length(x), mean = 0, sd = mean(x^3) / 4)
y <- y / max(y)
my.data <- data.frame(x = x, y = y,
```

```
                              group = c("A", "B"),
                              y2 = y * c(1, 2) + c(0, 0.1),
                              w = sqrt(x))

# give a name to a formula
formula <- y ~ poly(x, 3, raw = TRUE)

# using defaults
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_poly_line() +
  stat_poly_eq()

# no weights
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(formula = formula)

# other labels
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(use_label("eq"), formula = formula)

# other labels
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(use_label("eq"), formula = formula, decreasing = TRUE)

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(use_label("eq", "R2"), formula = formula)

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(use_label("R2", "R2.CI", "P", "method"), formula = formula)

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(use_label("R2", "F", "P", "n", sep = "*\"; \"*"),
               formula = formula)

# grouping
ggplot(my.data, aes(x, y2, color = group)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(formula = formula)
```

```
# rotation
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(formula = formula, angle = 90)

# label location
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(formula = formula, label.y = "bottom", label.x = "right")

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(formula = formula, label.y = 0.1, label.x = 0.9)

# modifying the explanatory variable within the model formula
# modifying the response variable within aes()
formula.trans <- y ~ I(x^2)
ggplot(my.data, aes(x, y + 1)) +
  geom_point() +
  stat_poly_line(formula = formula.trans) +
  stat_poly_eq(use_label("eq"),
               formula = formula.trans,
               eq.x.rhs = "~x^2",
               eq.with.lhs = "y + 1~~`=`~~")

# using weights
ggplot(my.data, aes(x, y, weight = w)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(formula = formula)

# no weights, 4 digits for R square
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(formula = formula, rr.digits = 4)

# manually assemble and map a specific label using paste() and aes()
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(aes(label =  paste(after_stat(rr.label),
                                  after_stat(n.label), sep = "*\", \"*")),
               formula = formula)

# manually assemble and map a specific label using sprintf() and aes()
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(aes(label =  sprintf("%s*\" with \"*%s*\" and \"*%s",
```

```r
                                                        after_stat(rr.label),
                                                        after_stat(f.value.label),
                                                        after_stat(p.value.label))),
                    formula = formula)

# x on y regression
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_poly_line(formula = formula, orientation = "y") +
  stat_poly_eq(use_label("eq", "adj.R2"),
                formula = x ~ poly(y, 3, raw = TRUE))

# conditional user specified label
ggplot(my.data, aes(x, y2, color = group)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(aes(label =  ifelse(after_stat(adj.r.squared) > 0.96,
                                   paste(after_stat(adj.rr.label),
                                         after_stat(eq.label),
                                         sep = "*\", \"*"),
                                   after_stat(adj.rr.label))),
                rr.digits = 3,
                formula = formula)

# geom = "text"
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(geom = "text", label.x = 100, label.y = 0, hjust = 1,
                formula = formula)

# using numeric values
# Here we use columns b_0 ... b_3 for the coefficient estimates
my.format <-
  "b[0]~`=`~%.3g*\", \"*b[1]~`=`~%.3g*\", \"*b[2]~`=`~%.3g*\", \"*b[3]~`=`~%.3g"
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(formula = formula,
                output.type = "numeric",
                parse = TRUE,
                mapping =
                 aes(label = sprintf(my.format,
                                     after_stat(b_0), after_stat(b_1),
                                     after_stat(b_2), after_stat(b_3))))

# Inspecting the returned data using geom_debug()
# This provides a quick way of finding out the names of the variables that
# are available for mapping to aesthetics with after_stat().

gginnards.installed <- requireNamespace("gginnards", quietly = TRUE)

if (gginnards.installed)
```

```
    library(gginnards)

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_poly_line(formula = formula) +
    stat_poly_eq(formula = formula, geom = "debug")

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_poly_line(formula = formula) +
    stat_poly_eq(formula = formula, geom = "debug", output.type = "numeric")

# names of the variables
if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_poly_line(formula = formula) +
    stat_poly_eq(formula = formula, geom = "debug",
                 summary.fun = colnames)

# only data$eq.label
if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_poly_line(formula = formula) +
    stat_poly_eq(formula = formula, geom = "debug",
                 output.type = "expression",
                 summary.fun = function(x) {x[["eq.label"]]})

# only data$eq.label
if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_poly_line(formula = formula) +
    stat_poly_eq(aes(label = after_stat(eq.label)),
                 formula = formula, geom = "debug",
                 output.type = "markdown",
                 summary.fun = function(x) {x[["eq.label"]]})

# only data$eq.label
if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_poly_line(formula = formula) +
    stat_poly_eq(formula = formula, geom = "debug",
                 output.type = "latex",
                 summary.fun = function(x) {x[["eq.label"]]})

# only data$eq.label
if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
```

```
      geom_point() +
      stat_poly_line(formula = formula) +
      stat_poly_eq(formula = formula, geom = "debug",
                   output.type = "text",
                   summary.fun = function(x) {x[["eq.label"]]})

# show the content of a list column
if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_poly_line(formula = formula) +
    stat_poly_eq(formula = formula, geom = "debug", output.type = "numeric",
                 summary.fun = function(x) {x[["coef.ls"]][[1]]})
```

---

stat_poly_line   *Predicted line from linear model fit*

Description

Predicted values and a confidence band are computed and, by default, plotted.

Usage

```
stat_poly_line(
  mapping = NULL,
  data = NULL,
  geom = "smooth",
  position = "identity",
  ...,
  method = "lm",
  formula = NULL,
  se = TRUE,
  fm.values = FALSE,
  n = 80,
  fullrange = FALSE,
  level = 0.95,
  method.args = list(),
  n.min = 2L,
  na.rm = FALSE,
  orientation = NA,
  show.legend = NA,
  inherit.aes = TRUE
)
```

Arguments

mapping   The aesthetic mapping, usually constructed with [aes](). Only needs to be set at
                  the layer level if you are overriding the plot defaults.

data	A layer specific dataset, only needed if you want to override the plot defaults.
geom	The geometric object to use display the data
position	The position adjustment to use for overlapping points on this layer
...	other arguments passed on to [layer](). This can include aesthetics whose values you want to set, not map. See [layer]() for more details.
method	function or character If character, "lm", "rlm" or the name of a model fit function are accepted, possibly followed by the fit function's method argument separated by a colon (e.g. ″rlm:M″). If a function different to lm(), it must accept arguments named formula, data, weights, and method and return a model fit object of class lm.
formula	a formula object. Using aesthetic names x and y instead of original variable names.
se	Display confidence interval around smooth? ('TRUE' by default, see 'level' to control.)
fm.values	logical Add R2, adjusted R2, p-value and n as columns to returned data? ('FALSE' by default.)
n	Number of points at which to evaluate smoother.
fullrange	Should the fit span the full range of the plot, or just the data?
level	Level of confidence interval to use (0.95 by default).
method.args	named list with additional arguments.
n.min	integer Minimum number of distinct values in the explanatory variable (on the rhs of formula) for fitting to the attempted.
na.rm	a logical indicating whether NA values should be stripped before the computation proceeds.
orientation	character Either "x" or "y" controlling the default for formula.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes.
inherit.aes	If FALSE, overrides the default aesthetics, rather than combining with them. This is most useful for helper functions that define both data and aesthetics and shouldn't inherit behaviour from the default plot specification, e.g. [borders]().

Details

This statistic is similar to [stat_smooth]() but has different defaults. It interprets the argument passed to formula differently, accepting y as explanatory variable and setting orientation automatically. The default for method is ″lm″ and spline-based smoothers like loess are not supported. Other defaults are consistent with those in stat_poly_eq(), stat_quant_line(), stat_quant_eq(), stat_ma_line(), stat_ma_eq().

geom_poly_line() treats the x and y aesthetics differently and can thus have two orientations. The orientation can be deduced from the argument passed to formula. Thus, stat_poly_line() will by default guess which orientation the layer should have. If no argument is passed to formula, the formula defaults to y ~ x. For consistency with [stat_smooth]() orientation can be also specified directly passing an argument to the orientation parameter, which can be either ″x″ or ″y″. The

value of `orientation` gives the axis that is taken as the explanatory variable or `x` in the model formula. Package 'ggpmisc' does not define new geometries matching the new statistics as they are not needed and conceptually transformations of `data` are statistics in the grammar of graphics.

A ggplot statistic receives as `data` a data frame that is not the one passed as argument by the user, but instead a data frame with the variables mapped to aesthetics. `stat_poly_eq()` mimics how `stat_smooth()` works, except that only polynomials can be fitted. Similarly to these statistics the model fits respect grouping, so the scales used for `x` and `y` should both be continuous scales rather than discrete.

With method `"lm"`, singularity results in terms being dropped with a message if more numerous than can be fitted with a singular (exact) fit. In this case and if the model results in a perfect fit due to low number of observation, estimates for various parameters are NaN or NA.

With methods other than `"lm"`, the model fit functions simply fail in case of singularity, e.g., singular fits are not implemented in `"rlm"`.

In both cases the minimum number of observations with distinct values in the explanatory variable can be set through parameter `n.min`. The default `n.min = 2L` is the smallest suitable for method `"lm"` but too small for method `"rlm"` for which `n.min = 3L` is needed. Anyway, model fits with very few observations are of little interest and using larger values of `n.min` than the default is wise.

Value

The value returned by the statistic is a data frame, with n rows of predicted values and their confidence limits. Optionally it will also include additional values related to the model fit.

Computed variables

'stat_poly_line()' provides the following variables, some of which depend on the orientation:

y *or* x predicted value

ymin *or* xmin lower pointwise confidence interval around the mean

ymax *or* xmax upper pointwise confidence interval around the mean

se standard error

If `fm.values = TRUE` is passed then columns based on the summary of the model fit are added, with the same value in each row within a group. This is wasteful and disabled by default, but provides a simple and robust approach to achieve effects like colouring or hiding of the model fit line based on P-values, r-squared, adjusted r-squared or the number of observations.

Aesthetics

`stat_poly_line` understands `x` and `y`, to be referenced in the `formula` and `weight` passed as argument to parameter `weights`. All three must be mapped to `numeric` variables. In addition, the aesthetics understood by the geom (`"geom_smooth"` is the default) are understood and grouping respected.

See Also

Other ggplot statistics for linear and polynomial regression: stat_poly_eq()

Examples

```
ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_poly_line()

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_poly_line(formula = x ~ y)

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_poly_line(formula = y ~ poly(x, 3))

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_poly_line(formula = x ~ poly(y, 3))

# Smooths are automatically fit to each group (defined by categorical
# aesthetics or the group aesthetic) and for each facet.

ggplot(mpg, aes(displ, hwy, colour = class)) +
  geom_point() +
  stat_poly_line(se = FALSE)

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_poly_line() +
  facet_wrap(~drv)

# Inspecting the returned data using geom_debug()
gginnards.installed <- requireNamespace("gginnards", quietly = TRUE)

if (gginnards.installed)
  library(gginnards)

if (gginnards.installed)
  ggplot(mpg, aes(displ, hwy)) +
    stat_poly_line(geom = "debug")

if (gginnards.installed)
  ggplot(mpg, aes(displ, hwy)) +
    stat_poly_line(geom = "debug", fm.values = TRUE)

if (gginnards.installed)
  ggplot(mpg, aes(displ, hwy)) +
    stat_poly_line(geom = "debug", method = lm, fm.values = TRUE)
```

---

stat_quant_band   *Predicted band from quantile regression fits*

Description

Predicted values are computed and, by default, plotted as a band plus an optional line within. stat_quant_band() supports the use of both x and y as explanatory variable in the model formula.

Usage

```
stat_quant_band(
  mapping = NULL,
  data = NULL,
  geom = "smooth",
  position = "identity",
  ...,
  quantiles = c(0.25, 0.5, 0.75),
  formula = NULL,
  fm.values = FALSE,
  n = 80,
  method = "rq",
  method.args = list(),
  na.rm = FALSE,
  orientation = NA,
  show.legend = NA,
  inherit.aes = TRUE
)
```

Arguments

mapping	The aesthetic mapping, usually constructed with [aes](). Only needs to be set at the layer level if you are overriding the plot defaults.
data	A layer specific dataset, only needed if you want to override the plot defaults.
geom	The geometric object to use display the data.
position	The position adjustment to use for overlapping points on this layer.
...	other arguments passed on to [layer](). This can include aesthetics whose values you want to set, not map. See [layer]() for more details.
quantiles	numeric vector Two or three values in 0..1 indicating the quantiles at the edges of the band and optionally a line within the band.
formula	a formula object. Using aesthetic names x and y instead of original variable names.
fm.values	logical Add n as a column to returned data? ('FALSE' by default.)
n	Number of points at which to evaluate smoother.
method	function or character If character, "rq", "rqss" or the name of a model fit function are accepted, possibly followed by the fit function's method argument separated by a colon (e.g. "rq:br"). If a function different to rq(), it must accept arguments named formula, data, weights, tau and method and return a model fit object of class rq, rqs or rqss.

method.args	named list with additional arguments.
na.rm	a logical indicating whether NA values should be stripped before the computation proceeds.
orientation	character Either "x" or "y" controlling the default for formula.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes.
inherit.aes	If FALSE, overrides the default aesthetics, rather than combining with them. This is most useful for helper functions that define both data and aesthetics and shouldn't inherit behaviour from the default plot specification, e.g. borders.

Details

This statistic is similar to stat_quant_line but plots the quantiles differently with the band representing a region between two quantiles, while in stat_quant_line() the bands plotted when se = TRUE represent confidence intervals for the fitted quantile lines.

geom_smooth, which is used by default, treats each axis differently and thus is dependent on orientation. If no argument is passed to formula, it defaults to y ~ x but x ~y is also accepted, and equivalent to y ~ x plus orientation = "y". Package 'ggpmisc' does not define a new geometry matching this statistic as it is enough for the statistic to return suitable 'x' and 'y' values.

Value

The value returned by the statistic is a data frame, that will have n rows of predicted values for three quantiles as y, ymin and ymax, plus x.

Aesthetics

stat_quant_eq expects x and y, aesthetics to be used in the formula rather than the names of the variables mapped to them. If present, the variable mapped to the weight aesthetics is passed as argument to parameter weights of the fitting function. All three must be mapped to numeric variables. In addition, the aesthetics recognized by the geometry ("geom_smooth" is the default) are obeyed and grouping respected.

See Also

Other ggplot statistics for quantile regression: stat_quant_eq(), stat_quant_line()

Examples

```
ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_band()

# If you need the fitting to be done along the y-axis set the orientation
ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_band(orientation = "y")

ggplot(mpg, aes(displ, hwy)) +
```

```
  geom_point() +
  stat_quant_band(formula = y ~ x)

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_band(formula = x ~ y)

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_band(formula = y ~ poly(x, 3))

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_band(formula = x ~ poly(y, 3))

# Instead of rq() we can use rqss() to fit an additive model:
ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_band(method = "rqss",
                  formula = y ~ qss(x))

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_band(method = "rqss",
                  formula = x ~ qss(y, constraint = "D"))

# Regressions are automatically fit to each group (defined by categorical
# aesthetics or the group aesthetic) and for each facet.

ggplot(mpg, aes(displ, hwy, colour = class)) +
  geom_point() +
  stat_quant_band(formula = y ~ x)

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_band(formula = y ~ poly(x, 2)) +
  facet_wrap(~drv)

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_band(linetype = "dashed", color = "darkred", fill = "red")

ggplot(mpg, aes(displ, hwy)) +
  stat_quant_band(color = NA, alpha = 1) +
  geom_point()

ggplot(mpg, aes(displ, hwy)) +
  stat_quant_band(quantiles = c(0, 0.1, 0.2)) +
  geom_point()

# Inspecting the returned data using geom_debug()
gginnards.installed <- requireNamespace("gginnards", quietly = TRUE)
```

```
if (gginnards.installed)
  library(gginnards)

if (gginnards.installed)
  ggplot(mpg, aes(displ, hwy)) +
    stat_quant_band(geom = "debug")

if (gginnards.installed)
  ggplot(mpg, aes(displ, hwy)) +
    stat_quant_band(geom = "debug", fm.values = TRUE)
```

---

stat_quant_eq   *Equation, rho, AIC and BIC from quantile regression*

Description

`stat_quant_eq` fits a polynomial model by quantile regression and generates several labels including the equation, rho, 'AIC' and 'BIC'.

Usage

```
stat_quant_eq(
  mapping = NULL,
  data = NULL,
  geom = "text_npc",
  position = "identity",
  ...,
  formula = NULL,
  quantiles = c(0.25, 0.5, 0.75),
  method = "rq:br",
  method.args = list(),
  n.min = 3L,
  eq.with.lhs = TRUE,
  eq.x.rhs = NULL,
  coef.digits = 3,
  coef.keep.zeros = TRUE,
  decreasing = getOption("ggpmisc.decreasing.poly.eq", FALSE),
  rho.digits = 4,
  label.x = "left",
  label.y = "top",
  hstep = 0,
  vstep = NULL,
  output.type = NULL,
  na.rm = FALSE,
  orientation = NA,
  parse = NULL,
  show.legend = FALSE,
```

```
   inherit.aes = TRUE
)
```

Arguments

mapping	The aesthetic mapping, usually constructed with [aes](). Only needs to be set at the layer level if you are overriding the plot defaults.
data	A layer specific dataset, only needed if you want to override the plot defaults.
geom	The geometric object to use display the data
position	The position adjustment to use for overlapping points on this layer
...	other arguments passed on to [layer](). This can include aesthetics whose values you want to set, not map. See [layer]() for more details.
formula	a formula object. Using aesthetic names instead of original variable names.
quantiles	numeric vector Values in 0..1 indicating the quantiles.
method	function or character If character, "rq" or the name of a model fit function are accepted, possibly followed by the fit function's method argument separated by a colon (e.g. "rq:br"). If a function different to rq(), it must accept arguments named formula, data, weights, tau and method and return a model fit object of class rq or rqs.
method.args	named list with additional arguments passed to rq() or to a function passed as argument to method.
n.min	integer Minimum number of observations needed for fiting a the model.
eq.with.lhs	If character the string is pasted to the front of the equation label before parsing or a logical (see note).
eq.x.rhs	character this string will be used as replacement for "x" in the model equation when generating the label before parsing it.
coef.digits, rho.digits	
	integer Number of significant digits to use for the fitted coefficients and rho in labels.
coef.keep.zeros	
	logical Keep or drop trailing zeros when formatting the fitted coefficients and F-value.
decreasing	logical It specifies the order of the terms in the returned character string; in increasing (default) or decreasing powers.
label.x, label.y	
	numeric with range 0..1 "normalized parent coordinates" (npc units) or character if using geom_text_npc() or geom_label_npc(). If using geom_text() or geom_label() numeric in native data units. If too short they will be recycled.
hstep, vstep	numeric in npc units, the horizontal and vertical step used between labels for different groups.
output.type	character One of "expression", "LaTeX", "text", "markdown" or "numeric". In most cases, instead of using this statistics to obtain numeric values, it is better to use stat_fit_tidy().

na.rm   a logical indicating whether NA values should be stripped before the computa-
               tion proceeds.

orientation   character Either "x" or "y" controlling the default for formula.

parse   logical Passed to the geom. If TRUE, the labels will be parsed into expressions
               and displayed as described in ?plotmath. Default is TRUE if output.type =
               "expression" and FALSE otherwise.

show.legend   logical. Should this layer be included in the legends? NA, the default, includes if
               any aesthetics are mapped. FALSE never includes, and TRUE always includes.

inherit.aes   If FALSE, overrides the default aesthetics, rather than combining with them.
               This is most useful for helper functions that define both data and aesthetics and
               shouldn't inherit behaviour from the default plot specification, e.g. borders.

Details

This statistic interprets the argument passed to formula differently than stat_quantile accepting
y as well as x as explanatory variable, matching stat_quant_line().

When two variables are subject to mutual constrains, it is useful to consider both of them as ex-
planatory and interpret the relationship based on them. So, from version 0.4.1 'ggpmisc' makes it
possible to easily implement the approach described by Cardoso (2019) under the name of "Double
quantile regression".

This stat can be used to automatically annotate a plot with rho or the fitted model equation. The
model fitting is done using package 'quantreg', please, consult its documentation for the details. It
supports only linear models fitted with function rq(), passing method = "br" to it, should work well
with up to several thousand observations. The rho, AIC, BIC and n annotations can be used with
any linear model formula. The fitted equation label is correctly generated for polynomials or quasi-
polynomials through the origin. Model formulas can use poly() or be defined algebraically with
terms of powers of increasing magnitude with no missing intermediate terms, except possibly for
the intercept indicated by "- 1" or "-1" or "+ 0" in the formula. The validity of the formula is not
checked in the current implementation. The default aesthetics sets rho as label for the annotation.
This stat generates labels as R expressions by default but LaTeX (use TikZ device), markdown (use
package 'ggtext') and plain text are also supported, as well as numeric values for user-generated text
labels. The value of parse is set automatically based on output-type, but if you assemble labels
that need parsing from numeric output, the default needs to be overridden. This stat only generates
annotation labels, the predicted values/line need to be added to the plot as a separate layer using
stat_quant_line, stat_quant_band or stat_quantile, so to make sure that the same model
formula is used in all steps it is best to save the formula as an object and supply this object as
argument to the different statistics.

A ggplot statistic receives as data a data frame that is not the one passed as argument by the user,
but instead a data frame with the variables mapped to aesthetics. stat_quant_eq() mimics how
stat_smooth() works, except that only polynomials can be fitted. In other words, it respects the
grammar of graphics. This helps ensure that the model is fitted to the same data as plotted in other
layers.

Function rq does not support singular fits, in contrast to lm.

The minimum number of observations with distinct values in the explanatory variable can be set
through parameter n.min. The default n.min = 3L is the smallest usable value. However, model fits
with very few observations are of little interest and using larger values of n.min than the default is
usually wise.

Value

A data frame, with one row per quantile and columns as described under **Computed variables**. In cases when the number of observations is less than n.min a data frame with no rows or columns is returned rendered as an empty/invisible plot layer.

User-defined methods

User-defined functions can be passed as argument to method. The requirements are 1) that the signature is similar to that of functions from package 'quantreg' and 2) that the value returned by the function is an object belonging to class "rq", class "rqs", or an atomic NA value.

The formula and tau used to build the equation and quantile labels aer extracted from the returned "rq" or "rqs" object and can safely differ from the argument passed to parameter formula in the call to stat_poly_eq(). Thus, user-defined methods can implement both model selection or conditional skipping of labelling.

Warning!

For the formatted equations to be valid, the fitted model must be a polynomial, with or without intercept. If defined using poly() the argument raw = TRUE must be passed. If defined manually as powers of x, **the terms must be in order of increasing powers, with no missing intermediate power term.** Please, see examples below. A check on the model is used to validate that it is a polynomial, in most cases a warning is issued. Failing to comply with this requirement results in the return of NA as the formatted equation.

Aesthetics

stat_quant_eq() understands x and y, to be referenced in the formula and weight passed as argument to parameter weights of rq(). All three must be mapped to numeric variables. In addition, the aesthetics understood by the geom used ("text" by default) are understood and grouping respected.

If the model formula includes a transformation of x, *a matching argument should be passed to parameter* eq.x.rhs *as its default value* "x" *will not reflect the applied transformation. In plots, transformation should never be applied to the left hand side of the model formula, but instead in the mapping of the variable within* aes, *as otherwise plotted observations and fitted curve will not match. In this case it may be necessary to also pass a matching argument to parameter* eq.with.lhs.

Computed variables

If output.type different from "numeric" the returned tibble contains columns below in addition to a modified version of the original group:

x,npcx x position

y,npcy y position

eq.label equation for the fitted polynomial as a character string to be parsed

r.label, and one of cor.label, rho.label, or tau.label rho of the fitted model as a character string to be parsed

AIC.label AIC for the fitted model.

n.label Number of observations used in the fit.

method.label Set according `method` used.

rq.method character, method used.

rho, n numeric values extracted or computed from fit object.

hjust, vjust Set to "inward" to override the default of the "text" geom.

quantile Numeric value of the quantile used for the fit

quantile.f Factor with a level for each quantile

If output.type is `"numeric"` the returned tibble contains columns in addition to a modified version of the original `group`:

x,npcx x position

y,npcy y position

coef.ls list containing the "coefficients" matrix from the summary of the fit object

rho, AIC, n numeric values extracted or computed from fit object

rq.method character, method used.

hjust, vjust Set to "inward" to override the default of the "text" geom.

quantile Indicating the quantile used for the fit

quantile.f Factor with a level for each quantile

b_0.constant TRUE is polynomial is forced through the origin

b_i One or columns with the coefficient estimates

To explore the computed values returned for a given input we suggest the use of [geom_debug](#) as shown in the example below.

Note

For backward compatibility a logical is accepted as argument for eq.with.lhs. If `TRUE`, the default is used, either `"x"` or `"y"`, depending on the argument passed to `formula`. However, `"x"` or `"y"` can be substituted by providing a suitable replacement character string through eq.x.rhs. Parameter `orientation` is redundant as it only affects the default for `formula` but is included for consistency with ggplot2::stat_smooth().

R option `OutDec` is obeyed based on its value at the time the plot is rendered, i.e., displayed or printed. Set options(OutDec = ",") for languages like Spanish or French.

Support for the `angle` aesthetic is not automatic and requires that the user passes as argument suitable numeric values to override the defaults for label positions.

References

Written as an answer to question 65695409 by Mark Neal at Stackoverflow.

See Also

The quantile fit is done with function rq, please consult its documentation. This stat_quant_eq statistic can return ready formatted labels depending on the argument passed to output.type. This is possible because only polynomial models are supported. For other types of models, statistics stat_fit_glance, stat_fit_tidy and stat_fit_glance should be used instead and the code for construction of character strings from numeric values and their mapping to aesthetic label needs to be explicitly supplied in the call.

Other ggplot statistics for quantile regression: stat_quant_band(), stat_quant_line()

Examples

```
# generate artificial data
set.seed(4321)
x <- 1:100
y <- (x + x^2 + x^3) + rnorm(length(x), mean = 0, sd = mean(x^3) / 4)
y <- y / max(y)
my.data <- data.frame(x = x, y = y,
                      group = c("A", "B"),
                      y2 = y * c(1, 2) + max(y) * c(0, 0.1),
                      w = sqrt(x))

# using defaults
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_quant_line() +
  stat_quant_eq()

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_quant_line() +
  stat_quant_eq(mapping = use_label("eq"))

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_quant_line() +
  stat_quant_eq(mapping = use_label("eq"), decreasing = TRUE)

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_quant_line() +
  stat_quant_eq(mapping = use_label("eq", "method"))

# same formula as default
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_quant_line(formula = y ~ x) +
  stat_quant_eq(formula = y ~ x)

# explicit formula "x explained by y"
ggplot(my.data, aes(x, y)) +
  geom_point() +
```

```
  stat_quant_line(formula = x ~ y) +
  stat_quant_eq(formula = x ~ y)

# using color
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_quant_line(mapping = aes(color = after_stat(quantile.f))) +
  stat_quant_eq(mapping = aes(color = after_stat(quantile.f))) +
  labs(color = "Quantiles")

# location and colour
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_quant_line(mapping = aes(color = after_stat(quantile.f))) +
  stat_quant_eq(mapping = aes(color = after_stat(quantile.f)),
                label.y = "bottom", label.x = "right") +
  labs(color = "Quantiles")

# give a name to a formula
formula <- y ~ poly(x, 3, raw = TRUE)

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_quant_line(formula = formula, linewidth = 0.5) +
  stat_quant_eq(formula = formula)

# angle
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_quant_line(formula = formula, linewidth = 0.5) +
  stat_quant_eq(formula = formula, angle = 90, hstep = 0.04, vstep = 0,
                label.y = 0.02, hjust = 0) +
  expand_limits(x = -15) # make space for equations

# user set quantiles
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_quant_line(formula = formula, quantiles = 0.5) +
  stat_quant_eq(formula = formula, quantiles = 0.5)

ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_quant_band(formula = formula,
                    quantiles = c(0.1, 0.5, 0.9)) +
  stat_quant_eq(formula = formula, parse = TRUE,
                quantiles = c(0.1, 0.5, 0.9))

# grouping
ggplot(my.data, aes(x, y2, color = group)) +
  geom_point() +
  stat_quant_line(formula = formula, linewidth = 0.5) +
  stat_quant_eq(formula = formula)
```

```
ggplot(my.data, aes(x, y2, color = group)) +
  geom_point() +
  stat_quant_band(formula = formula, linewidth = 0.75) +
  stat_quant_eq(formula = formula) +
  theme_bw()

# labelling equations
ggplot(my.data, aes(x, y2,  shape = group, linetype = group,
       grp.label = group)) +
  geom_point() +
  stat_quant_band(formula = formula, color = "black", linewidth = 0.75) +
  stat_quant_eq(mapping = use_label("grp", "eq", sep = "*\": \"*"),
                formula = formula) +
  expand_limits(y = 3) +
  theme_classic()

# modifying the explanatory variable within the model formula
# modifying the response variable within aes()
formula.trans <- y ~ I(x^2)
ggplot(my.data, aes(x, y + 1)) +
  geom_point() +
  stat_quant_line(formula = formula.trans) +
  stat_quant_eq(mapping = use_label("eq"),
                formula = formula.trans,
                eq.x.rhs = "~x^2",
                eq.with.lhs = "y + 1~~`=`~~")

# using weights
ggplot(my.data, aes(x, y, weight = w)) +
  geom_point() +
  stat_quant_line(formula = formula, linewidth = 0.5) +
  stat_quant_eq(formula = formula)

# no weights, quantile set to upper boundary
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_quant_line(formula = formula, quantiles = 0.95) +
  stat_quant_eq(formula = formula, quantiles = 0.95)

# manually assemble and map a specific label using paste() and aes()
ggplot(my.data, aes(x, y2, color = group, grp.label = group)) +
  geom_point() +
  stat_quant_line(method = "rq", formula = formula,
                  quantiles = c(0.05, 0.5, 0.95),
                  linewidth = 0.5) +
  stat_quant_eq(mapping = aes(label = paste(after_stat(grp.label), "*\": \"*",
                                            after_stat(eq.label), sep = "")),
                quantiles = c(0.05, 0.5, 0.95),
                formula = formula, size = 3)

# manually assemble and map a specific label using sprintf() and aes()
ggplot(my.data, aes(x, y2, color = group, grp.label = group)) +
  geom_point() +
```

```
    stat_quant_band(method = "rq", formula = formula,
                    quantiles = c(0.05, 0.5, 0.95)) +
    stat_quant_eq(mapping = aes(label = sprintf("%s*\": \"*%s",
                                                after_stat(grp.label),
                                                after_stat(eq.label))),
                  quantiles = c(0.05, 0.5, 0.95),
                  formula = formula, size = 3)

# geom = "text"
ggplot(my.data, aes(x, y)) +
  geom_point() +
  stat_quant_line(formula = formula, quantiles = 0.5) +
  stat_quant_eq(label.x = "left", label.y = "top",
                formula = formula,
                quantiles = 0.5)

# Inspecting the returned data using geom_debug()
# This provides a quick way of finding out the names of the variables that
# are available for mapping to aesthetics using after_stat().

gginnards.installed <- requireNamespace("gginnards", quietly = TRUE)

if (gginnards.installed)
  library(gginnards)

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_quant_eq(formula = formula, geom = "debug")

## Not run:
if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_quant_eq(mapping = aes(label = after_stat(eq.label)),
                  formula = formula, geom = "debug",
                  output.type = "markdown")

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_quant_eq(formula = formula, geom = "debug", output.type = "text")

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_quant_eq(formula = formula, geom = "debug", output.type = "numeric")

if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_quant_eq(formula = formula, quantiles = c(0.25, 0.5, 0.75),
                  geom = "debug", output.type = "text")
```

```
if (gginnards.installed)
  ggplot(my.data, aes(x, y)) +
    geom_point() +
    stat_quant_eq(formula = formula, quantiles = c(0.25, 0.5, 0.75),
                  geom = "debug", output.type = "numeric")

## End(Not run)
```

---

stat_quant_line   *Predicted line from quantile regression fit*

Description

Predicted values are computed and, by default, plotted. Depending on the fit method, a confidence
band can be computed and plotted. The confidence band can be interpreted similarly as that pro-
duced by `stat_smooth()` and `stat_poly_line()`.

Usage

```
stat_quant_line(
  mapping = NULL,
  data = NULL,
  geom = "smooth",
  position = "identity",
  ...,
  quantiles = c(0.25, 0.5, 0.75),
  formula = NULL,
  se = length(quantiles) == 1L,
  fm.values = FALSE,
  n = 80,
  method = "rq",
  method.args = list(),
  n.min = 3L,
  level = 0.95,
  type = "direct",
  interval = "confidence",
  na.rm = FALSE,
  orientation = NA,
  show.legend = NA,
  inherit.aes = TRUE
)
```

Arguments

mapping   The aesthetic mapping, usually constructed with [aes](#). Only needs to be set at
                   the layer level if you are overriding the plot defaults.

data	A layer specific dataset, only needed if you want to override the plot defaults.
geom	The geometric object to use display the data
position	The position adjustment to use for overlapping points on this layer
...	other arguments passed on to [layer](). This can include aesthetics whose values you want to set, not map. See [layer]() for more details.
quantiles	numeric vector Values in 0..1 indicating the quantiles.
formula	a formula object. Using aesthetic names x and y instead of original variable names.
se	logical Passed to quantreg::predict.rq().
fm.values	logical Add n as a column to returned data? ('FALSE' by default.)
n	Number of points at which to evaluate smoother.
method	function or character If character, "rq", "rqss" or the name of a model fit function are accepted, possibly followed by the fit function's method argument separated by a colon (e.g. "rq:br"). If a function different to rq(), it must accept arguments named formula, data, weights, tau and method and return a model fit object of class rq, rqs or rqss.
method.args	named list with additional arguments passed to rq(), rqss() or to a function passed as argument to method.
n.min	integer Minimum number of distinct values in the explanatory variable (on the rhs of formula) for fitting to the attempted.
level	numeric in range [0..1] Passed to quantreg::predict.rq().
type	character Passed to quantreg::predict.rq().
interval	character Passed to quantreg::predict.rq().
na.rm	a logical indicating whether NA values should be stripped before the computation proceeds.
orientation	character Either "x" or "y" controlling the default for formula.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes.
inherit.aes	If FALSE, overrides the default aesthetics, rather than combining with them. This is most useful for helper functions that define both data and aesthetics and shouldn't inherit behaviour from the default plot specification, e.g. [borders]().

Details

stat_quant_line() behaves similarly to ggplot2::stat_smooth() and stat_poly_line() but supports fitting regressions for multiple quantiles in the same plot layer. This statistic interprets the argument passed to formula accepting y as well as x as explanatory variable, matching stat_quant_eq(). While stat_quant_eq() supports only method "rq", stat_quant_line() and stat_quant_band() support both "rq" and "rqss", In the case of "rqss" the model formula makes normally use of qss() to formulate the spline and its constraints.

[geom_smooth](), which is used by default, treats each axis differently and thus is dependent on orientation. If no argument is passed to formula, it defaults to y ~ x. Formulas with y as explanatory variable are treated as if x was the explanatory variable and orientation = "y".

Package 'ggpmisc' does not define a new geometry matching this statistic as it is enough for the statistic to return suitable x, y, ymin, ymax and group values.

The minimum number of observations with distinct values in the explanatory variable can be set through parameter n.min. The default n.min = 3L is the smallest usable value. However, model fits with very few observations are of little interest and using larger values of n.min than the default is wise.

There are multiple uses for double regression on x and y. For example, when two variables are subject to mutual constrains, it is useful to consider both of them as explanatory and interpret the relationship based on them. So, from version 0.4.1 'ggpmisc' makes it possible to easily implement the approach described by Cardoso (2019) under the name of "Double quantile regression".

Value

The value returned by the statistic is a data frame, that will have n rows of predicted values and and their confidence limits for each quantile, with each quantile in a group. The variables are x and y with y containing predicted values. In addition, quantile and quantile.f indicate the quantile used and and edited group preserves the original grouping adding a new "level" for each quantile. Is se = TRUE, a confidence band is computed and values for it returned in ymax and ymin.

The value returned by the statistic is a data frame, that will have n rows of predicted values and their confidence limits. Optionally it will also include additional values related to the model fit.

Computed variables

'stat_quant_line()' provides the following variables, some of which depend on the orientation:

y *or* x predicted value

ymin *or* xmin lower confidence interval around the mean

ymax *or* xmax upper confidence interval around the mean

If fm.values = TRUE is passed then one column with the number of observations n used for each fit is also included, with the same value in each row within a group. This is wasteful and disabled by default, but provides a simple and robust approach to achieve effects like colouring or hiding of the model fit line based on the number of observations.

Aesthetics

stat_quant_line understands x and y, to be referenced in the formula and weight passed as argument to parameter weights. All three must be mapped to numeric variables. In addition, the aesthetics understood by the geom ("geom_smooth" is the default) are understood and grouping respected.

References

Cardoso, G. C. (2019) Double quantile regression accurately assesses distance to boundary trade-off. Methods in ecology and evolution, 10(8), 1322-1331.

See Also

rq, rqss and qss.

Other ggplot statistics for quantile regression: stat_quant_band(), stat_quant_eq()

Examples

```
ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_line()

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_line(se = TRUE)

# If you need the fitting to be done along the y-axis set the orientation
ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_line(orientation = "y")

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_line(orientation = "y", se = TRUE)

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_line(formula = y ~ x)

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_line(formula = x ~ y)

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_line(formula = y ~ poly(x, 3))

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_line(formula = x ~ poly(y, 3))

# Instead of rq() we can use rqss() to fit an additive model:
ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_line(method = "rqss",
                  formula = y ~ qss(x, constraint = "D"),
                  quantiles = 0.5)

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_line(method = "rqss",
                  formula = x ~ qss(y, constraint = "D"),
                  quantiles = 0.5)
```

```
ggplot(mpg, aes(displ, hwy)) +
  geom_point()+
  stat_quant_line(method="rqss",
                  interval="confidence",
                  se = TRUE,
                  mapping = aes(fill = factor(after_stat(quantile)),
                                color = factor(after_stat(quantile))),
                  quantiles=c(0.05,0.5,0.95))

# Smooths are automatically fit to each group (defined by categorical
# aesthetics or the group aesthetic) and for each facet.

ggplot(mpg, aes(displ, hwy, colour = drv, fill = drv)) +
  geom_point() +
  stat_quant_line(method = "rqss",
                  formula = y ~ qss(x, constraint = "V"),
                   quantiles = 0.5)

ggplot(mpg, aes(displ, hwy)) +
  geom_point() +
  stat_quant_line(formula = y ~ poly(x, 2)) +
  facet_wrap(~drv)

# Inspecting the returned data using geom_debug()
gginnards.installed <- requireNamespace("gginnards", quietly = TRUE)

if (gginnards.installed)
  library(gginnards)

if (gginnards.installed)
  ggplot(mpg, aes(displ, hwy)) +
    stat_quant_line(geom = "debug")

if (gginnards.installed)
  ggplot(mpg, aes(displ, hwy)) +
    stat_quant_line(geom = "debug", fm.values = TRUE)
```

---

swap_xy   *Swap x and y in a formula*

Description

By default a formula of x on y is converted into a formula of y on x, while the reverse swap is done
only if backward = TRUE.

Usage

```
swap_xy(f, backwards = FALSE)
```

Arguments

f	formula An R model formula
backwards	logical

Details

This function is meant to be used only as a helper within 'ggplot2' statistics. Normally together with geometries supporting orientation when we want to automate the change in orientation based on a user-supplied formula. Only x and y are changed, and in other respects the formula is rebuilt copying the environment from f.

Value

A copy of f with x and y swapped by each other in the lhs and rhs.

---

symmetric_limits	*Expand a range to make it symmetric*

Description

Expand scale limits to make them symmetric around zero. Can be passed as argument to parameter limits of continuous scales from packages 'ggplot2' or 'scales'. Can be also used to obtain an enclosing symmetric range for numeric vectors.

Usage

```
symmetric_limits(x)
```

Arguments

x	numeric The automatic limits when used as argument to a scale's limits formal parameter. Otherwise a numeric vector, possibly a range, for which to compute a symmetric enclosing range.

Value

A numeric vector of length two with the new limits, which are always such that the absolute value of upper and lower limits is the same.

Examples

```
symmetric_limits(c(-1, 1.8))
symmetric_limits(c(-10, 1.8))
symmetric_limits(-5:20)
```

---

typeset_numbers   *Typeset/format numbers preserving trailing zeros*

Description

Typeset/format numbers preserving trailing zeros

Usage

```
typeset_numbers(eq.char, output.type)
```

Arguments

`eq.char`	character A polynomial model equation as a character string.
`output.type`	character One of "expression", "latex", "tex", "text", "tikz", "markdown".

Value

A `character` string.

Note

exponential number notation to typeset equivalent: Protecting trailing zeros in negative numbers is more involved than I would like. Not only we need to enclose numbers in quotations marks but we also need to replace dashes with the minus character. I am not sure we can do the replacement portably, but that recent R supports UTF gives some hope.

---

use_label   *Assemble label and map it*

Description

Assemble model-fit-derived text or expressions and map them to the `label` aesthetic.

Usage

```
use_label(..., labels = NULL, other.mapping = NULL, sep = "*\", \"*")
```

Arguments

`...`	character Strings giving the names of the label components in the order they will be included in the combined label.
`labels`	character A vector with the name of the label components. If provided, values passed through `...` are ignored.
`other.mapping`	An unevaluated expression constructed with function [aes](#) to be included in the returned value.
`sep`	character A string used as separator when pasting the label components together.

Details

Statistics stat_poly_eq, stat_ma_eq, stat_quant_eq and stat_correlation return multiple text strings to be used individually or assembled into longer character strings depending on the labels actually desired. Assembling and mapping them requires verbose R code and familiarity with R expression syntax. Function use_label() automates these two tasks and accepts abbreviated familiar names for the parameters in addition to the name of the columns in the data object returned by the statistics. The default separator is that for expressions.

The statistics return variables with names ending in .label. This ending can be omitted, as well as .value for f.value.label, t.value.label, z.value.label, S.value.label and p.value.label. R2 can be used in place of rr. Furthermore, case is ignored.

Function use_label() calls aes() to create a mapping for the label aesthetic, but it can in addition combine this mapping with other mappings created with aes().

Value

A mapping to the label aesthetic and optionally additional mappings as an unevaluated R expression, built using function aes, ready to be passed as argument to the mapping parameter of the supported statistics.

Note

Function use_label() can be only used to generate an argument passed to formal parameter mapping of the statistics stat_poly_eq, stat_ma_eq, stat_quant_eq and stat_correlation.

See Also

stat_poly_eq, stat_ma_eq, stat_quant_eq and stat_correlation.

Examples

```
# generate artificial data
set.seed(4321)
x <- 1:100
y <- (x + x^2 + x^3) + rnorm(length(x), mean = 0, sd = mean(x^3) / 4)
my.data <- data.frame(x = x,
                      y = y * 1e-5,
                      group = c("A", "B"),
                      y2 = y * 1e-5 + c(2, 0))

# give a name to a formula
formula <- y ~ poly(x, 3, raw = TRUE)

# default label constructed by use_label()
ggplot(data = my.data,
       mapping = aes(x = x, y = y2, colour = group)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(mapping = use_label(),
               formula = formula)
```

```
# user specified label components
ggplot(data = my.data,
       mapping = aes(x = x, y = y2, colour = group)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(mapping = use_label("eq", "F"),
               formula = formula)

# user specified label components and separator
ggplot(data = my.data,
       mapping = aes(x = x, y = y2, colour = group)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(mapping = use_label("R2", "F", sep = "*\" with \"*"),
               formula = formula)

# combine the mapping to the label aesthetic with other mappings
ggplot(data = my.data,
       mapping = aes(x = x, y = y2)) +
  geom_point(mapping = aes(colour = group)) +
  stat_poly_line(mapping = aes(colour = group), formula = formula) +
  stat_poly_eq(mapping = use_label("grp", "eq", "F",
                                   aes(grp.label = group)),
               formula = formula)

# combine other mappings with default labels
ggplot(data = my.data,
       mapping = aes(x = x, y = y2)) +
  geom_point(mapping = aes(colour = group)) +
  stat_poly_line(mapping = aes(colour = group), formula = formula) +
  stat_poly_eq(mapping = use_label(aes(colour = group)),
               formula = formula)

# example with other available components
ggplot(data = my.data,
       mapping = aes(x = x, y = y2, colour = group)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(mapping = use_label("eq", "adj.R2", "n"),
               formula = formula)

# multiple labels
ggplot(data = my.data,
       mapping = aes(x, y2, colour = group)) +
  geom_point() +
  stat_poly_line(formula = formula) +
  stat_poly_eq(mapping = use_label("R2", "F", "P", "AIC", "BIC"),
               formula = formula) +
  stat_poly_eq(mapping = use_label(c("eq", "n")),
               formula = formula,
               label.y = "bottom",
               label.x = "right")
```

```
# quantile regression
ggplot(data = my.data,
       mapping = aes(x, y)) +
  stat_quant_band(formula = formula) +
  stat_quant_eq(mapping = use_label("eq", "n"),
                formula = formula) +
  geom_point()

# major axis regresion
ggplot(data = my.data, aes(x = x, y = y)) +
  stat_ma_line() +
  stat_ma_eq(mapping = use_label("eq", "n")) +
  geom_point()

# correlation
ggplot(data = my.data,
       mapping = aes(x = x, y = y)) +
  stat_correlation(mapping = use_label("r", "t", "p")) +
  geom_point()
```

---

xy_outcomes2factor   *Convert two numeric ternary outcomes into a factor*

Description

Convert two numeric ternary outcomes into a factor

Usage

```
xy_outcomes2factor(x, y)

xy_thresholds2factor(x, y, x_threshold = 0, y_threshold = 0)
```

Arguments

x, y
: numeric vectors of -1, 0, and +1 values, indicating down regulation, uncertain response or up-regulation, or numeric vectors that can be converted into such values using a pair of thresholds.

x_threshold, y_threshold
: numeric vector Ranges enclosing the values to be considered uncertain for each of the two vectors..

Details

This function converts the numerically encoded values into a factor with the four levels "xy", "x", "y" and "none". The factor created can be used for faceting or can be mapped to aesthetics.

Note

This is an utility function that only saves some typing. The same result can be achieved by a direct call to `factor`. This function aims at making it easier to draw quadrant plots with facets based on the combined outcomes.

See Also

Other Functions for quadrant and volcano plots: `FC_format()`, `outcome2factor()`, `scale_colour_outcome()`, `scale_shape_outcome()`, `scale_y_Pvalue()`

Other scales for omics data: `outcome2factor()`, `scale_colour_logFC()`, `scale_shape_outcome()`, `scale_x_logFC()`

Examples

```
xy_outcomes2factor(c(-1, 0, 0, 1, -1), c(0, 1, 0, 1, -1))
xy_thresholds2factor(c(-1, 0, 0, 1, -1), c(0, 1, 0, 1, -1))
xy_thresholds2factor(c(-1, 0, 0, 0.1, -5), c(0, 2, 0, 1, -1))
```

Index