Package 'lvplot'

September 3, 2025

Title Letter Value 'Boxplots'

Version 0.2.2

Description Implements the letter value 'boxplot' which extends the standard 'boxplot' to deal with both larger and smaller number of data points by dynamically selecting the appropriate number of letter values to display.

License GPL (>= 2)

Depends R (>= 2.14)

Imports ggplot2 (>= 3.3.0), grid, RColorBrewer, tibble

Encoding UTF-8

LazyData true

LazyDataCompression xz

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URL https://github.com/hadley/lvplot

BugReports https://github.com/hadley/lvplot/issues

NeedsCompilation no

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Repository CRAN

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Contents

census *County demographics based on 1980 US Census*

Description

County level statistics based on the 1980 US Census.

Usage

```
census
```

Format

A data frame with 10 variables

county County name

FIPS FIPS county code

Latitude,Longitude Geographic location of county centers

JanTmp,JulTmp (normalized) Temperatures in January & July

JanSun,JulSun (normalized) Sunshine measurment in January & July

Elevtn Elevation above sea level

totalpop Population

determineDepth *Determine depth of letter values needed for n observations.*

Description

Determine depth of letter values needed for n observations.

Usage

```
determineDepth(n, k = NULL, alpha = NULL, perc = NULL)
```

Arguments

n	number of observation to be shown in the LV boxplot
k	number of letter value statistics used
alpha	if supplied, depth k is calculated such that (1-alpha)100 intervals of an LV statistic do not extend into neighboring LV statistics.
perc	if supplied, depth k is adjusted such that perc percent outliers are shown

Details

Supply one of k, alpha or perc.

geom_lv *Side-by-side LV boxplots with ggplot2.*

Description

An extension of standard boxplots which draws k letter statistics. Conventional boxplots (Tukey 1977) are useful displays for conveying rough information about the central 50% of the data and the extent of the data. For moderate-sized data sets ($n < 1000$), detailed estimates of tail behavior beyond the quartiles may not be trustworthy, so the information provided by boxplots is appropriately somewhat vague beyond the quartiles, and the expected number of "outliers" and "far-out" values for a Gaussian sample of size n is often less than 10 (Hoaglin, Iglewicz, and Tukey 1986). Large data sets ($n \approx 10,000 - 100,000$) afford more precise estimates of quantiles in the tails beyond the quartiles and also can be expected to present a large number of "outliers" (about $0.4 + 0.007n$). The letter-value box plot addresses both these shortcomings: it conveys more detailed information in the tails using letter values, only out to the depths where the letter values are reliable estimates of their corresponding quantiles (corresponding to tail areas of roughly 2^{-i}); "outliers" are defined as a function of the most extreme letter value shown. All aspects shown on the letter-value boxplot are actual observations, thus remaining faithful to the principles that governed Tukey's original boxplot.

Usage

```
geom_lv(
  mapping = NULL,
  data = NULL,
  stat = "lv",
  position = "dodge",
  outlier.colour = "black",
  outlier.shape = 19,
  outlier.size = 1.5,
  outlier.stroke = 0.5,
  na.rm = TRUE,
  varwidth = FALSE,
  width.method = "linear",
  show.legend = NA,
  inherit.aes = TRUE,
  ...
)

GeomLv

scale_fill_lv(...)

stat_lv(
  mapping = NULL,
  data = NULL,
  geom = "lv",
  position = "dodge",
```

```
  na.rm = TRUE,
  conf = 0.95,
  percent = NULL,
  k = NULL,
  show.legend = NA,
  inherit.aes = TRUE,
  ...
)

StatLv
```

Arguments

mapping	Set of aesthetic mappings created by aes(). If specified and inherit.aes = TRUE (the default), it is combined with the default mapping at the top level of the plot. You must supply mapping if there is no plot mapping.
data	The data to be displayed in this layer. There are three options: If NULL, the default, the data is inherited from the plot data as specified in the call to ggplot(). A data.frame, or other object, will override the plot data. All objects will be fortified to produce a data frame. See fortify() for which variables will be created. A function will be called with a single argument, the plot data. The return value must be a data.frame, and will be used as the layer data. A function can be created from a formula (e.g. ~ head(.x, 10)).
position	A position adjustment to use on the data for this layer. This can be used in various ways, including to prevent overplotting and improving the display. The position argument accepts the following: • The result of calling a position function, such as position_jitter(). This method allows for passing extra arguments to the position. • A string naming the position adjustment. To give the position as a string, strip the function name of the position_ prefix. For example, to use position_jitter(), give the position as "jitter". • For more information and other ways to specify the position, see the layer position documentation.
outlier.colour	Override aesthetics used for the outliers. Defaults come from geom_point().
outlier.shape	Override aesthetics used for the outliers. Defaults come from geom_point().
outlier.size	Override aesthetics used for the outliers. Defaults come from geom_point().
outlier.stroke	Override aesthetics used for the outliers. Defaults come from geom_point().
na.rm	If FALSE (the default), removes missing values with a warning. If TRUE silently removes missing values.
varwidth	if FALSE (default) draw boxes that are the same size for each group. If TRUE, boxes are drawn with widths proportional to the square-roots of the number of observations in the groups (possibly weighted, using the weight aesthetic).

`width.method` character, one of 'linear' (default), 'area', or 'height'. This parameter determines whether the width of the box for letter value `LV(i)` should be proportional to i (linear), proportional to 2^{-i} (height), or whether the area of the box should be proportional to 2^{-i} (area).

`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. It can also be a named logical vector to finely select the aesthetics to display. To include legend keys for all levels, even when no data exists, use `TRUE`. If `NA`, all levels are shown in legend, but unobserved levels are omitted.

`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.

`...` Other arguments passed on to `layer()`'s `params` argument. These arguments broadly fall into one of 4 categories below. Notably, further arguments to the `position` argument, or aesthetics that are required can *not* be passed through `....` Unknown arguments that are not part of the 4 categories below are ignored.

- Static aesthetics that are not mapped to a scale, but are at a fixed value and apply to the layer as a whole. For example, `colour = "red"` or `linewidth = 3`. The geom's documentation has an **Aesthetics** section that lists the available options. The 'required' aesthetics cannot be passed on to the `params`. Please note that while passing unmapped aesthetics as vectors is technically possible, the order and required length is not guaranteed to be parallel to the input data.
- When constructing a layer using a `stat_*()` function, the `...` argument can be used to pass on parameters to the `geom` part of the layer. An example of this is `stat_density(geom = "area", outline.type = "both")`. The geom's documentation lists which parameters it can accept.
- Inversely, when constructing a layer using a `geom_*()` function, the `...` argument can be used to pass on parameters to the `stat` part of the layer. An example of this is `geom_area(stat = "density", adjust = 0.5)`. The stat's documentation lists which parameters it can accept.
- The `key_glyph` argument of `layer()` may also be passed on through `....` This can be one of the functions described as key glyphs, to change the display of the layer in the legend.

`geom, stat` Use to override the default connection between `geom_lv` and `stat_lv`.

`conf` confidence level

`percent` numeric value: percent of data in outliers

`k` number of letter values shown

Format

An object of class `GeomLv` (inherits from `Geom`, `ggproto`, `gg`) of length 6.

An object of class `StatLv` (inherits from `Stat`, `ggproto`, `gg`) of length 5.

Computed/reported variables

k Number of Letter Values used for the display

LV Name of the Letter Value

width width of the interquartile box

References

McGill, R., Tukey, J. W. and Larsen, W. A. (1978) Variations of box plots. The American Statistician 32, 12-16.

See Also

stat_quantile to view quantiles conditioned on a continuous variable.

Examples

```
library(ggplot2)
p <- ggplot(mpg, aes(class, hwy))
p + geom_lv(aes(fill = after_stat(LV))) + scale_fill_brewer()
p + geom_lv() + geom_jitter(width = 0.2)
p + geom_lv(aes(fill = after_stat(LV))) + scale_fill_lv()

# Outliers
p + geom_lv(varwidth = TRUE, aes(fill = after_stat(LV))) + scale_fill_lv()
p + geom_lv(fill = "grey80", colour = "black")
p + geom_lv(outlier.colour = "red", outlier.shape = 1)

# Plots are automatically dodged when any aesthetic is a factor
p + geom_lv(aes(fill = drv))

# varwidth adjusts the width of the boxes according to the number of observations
ggplot(ontime, aes(UniqueCarrier, TaxiIn + TaxiOut)) +
  geom_lv(aes(fill = after_stat(LV)), varwidth=TRUE) +
  scale_fill_lv() +
  scale_y_sqrt() +
  theme_bw()

ontime$DayOfWeek <- as.POSIXlt(ontime$FlightDate)$wday
ggplot(ontime, aes(factor(DayOfWeek), TaxiIn + TaxiOut)) +
  geom_lv(aes(fill = after_stat(LV))) +
  scale_fill_lv() +
  scale_y_sqrt() +
  theme_bw()
```

LVboxplot *Side-by-side LV boxplots with base graphics*

Description

An extension of standard boxplots which draws k letter statistics. Conventional boxplots (Tukey 1977) are useful displays for conveying rough information about the central 50% of the data and the extent of the data.

Usage

```
LVboxplot(x, ...)

## S3 method for class 'formula'
LVboxplot(
  formula,
  alpha = 0.95,
  k = NULL,
  perc = NULL,
  horizontal = TRUE,
  xlab = NULL,
  ylab = NULL,
  col = "grey30",
  bg = "grey90",
  width = 0.9,
  width.method = "linear",
  median.col = "grey10",
  ...
)

## S3 method for class 'numeric'
LVboxplot(
  x,
  alpha = 0.95,
  k = NULL,
  perc = NULL,
  horizontal = TRUE,
  xlab = NULL,
  ylab = NULL,
  col = "grey30",
  bg = "grey90",
  width = 0.9,
  width.method = "linear",
  median.col = "grey10",
  ...
)
```

Arguments

x	numeric vector of data
...	passed onto plot
formula	a plotting formula of the form y ~ x, where x is a string or factor. The values of y will be split into groups according to their values on x and separate letter value box plots of y are drawn side by side in the same display.
alpha	if supplied, depth k is calculated such that (1-alpha)100 intervals of an LV statistic do not extend into neighboring LV statistics.
k	number of letter value statistics used
perc	if supplied, depth k is adjusted such that perc percent outliers are shown
horizontal	display horizontally (TRUE) or vertically (FALSE)
xlab	x axis label
ylab	y axis label
col	vector of colours to use
bg	background colour
width	maximum height/width of box
width.method	one of 'linear', 'height' or 'area'. Methods 'height' and 'area' ensure that these dimension are proportional to the number of observations within each box.
median.col	colour of the line for the median

Details

For moderate-sized data sets ($n < 1000$), detailed estimates of tail behavior beyond the quartiles may not be trustworthy, so the information provided by boxplots is appropriately somewhat vague beyond the quartiles, and the expected number of "outliers" and "far-out" values for a Gaussian sample of size n is often less than 10 (Hoaglin, Iglewicz, and Tukey 1986). Large data sets ($n \approx 10,000 - 100,000$) afford more precise estimates of quantiles in the tails beyond the quartiles and also can be expected to present a large number of "outliers" (about $0.4 + 0.007n$).

The letter-value box plot addresses both these shortcomings: it conveys more detailed information in the tails using letter values, only out to the depths where the letter values are reliable estimates of their corresponding quantiles (corresponding to tail areas of roughly 2^{-i}); "outliers" are defined as a function of the most extreme letter value shown. All aspects shown on the letter-value boxplot are actual observations, thus remaining faithful to the principles that governed Tukey's original boxplot.

Examples

```
n <- 10
oldpar <- par()
par(mfrow=c(4,2), mar=c(3,3,3,3))
for (i in 1:4) {
  x <- rexp(10 ^ (i + 1))
  boxplot(x, col = "grey", horizontal = TRUE)
  title(paste("Exponential, n = ", length(x)))
  LVboxplot(x, col = "grey", xlab = "")
}
```

```
par(mfrow=oldpar$mfrow, mar=oldpar$mar)

with(ontime, LVboxplot(sqrt(TaxiIn + TaxiOut) ~ UniqueCarrier, horizontal=FALSE))
```

`lvtable` *Compute table of k letter values for vector x*

Description

Compute table of k letter values for vector x

Usage

```
lvtable(x, k, alpha = 0.95)
```

Arguments

`x`	input numeric vector
`k`	number of letter values to compute
`alpha`	alpha-threshold for confidence level

`ontime` *Ontime Flight Data*

Description

Data set detailing on-time performance of national US flights in January 2015. This data is a subset of the data provided by the US Department of Transportation. The full data as well as archived or more recent data is available for download from http://www.transtats.bts.gov/DL_SelectFields.asp?Table_ID=236&DB_Short_Name=On-Time.

Usage

```
ontime
```

Format

A data frame consisting of the variables

FlightDate a date variable of the day of the flight

UniqueCarrier factor variable of the carrier (using the two letter abbreviation)

FlightNum numeric variable of the flight number

CRSDepTime scheduled departure time in hhmm format

DepTime actual departure time in hhmm format

CRSArrTime scheduled arrival time in hhmm format

ArrTime actual arrival time in hhmm format

TaxiOut numeric variable of the taxi out time in minutes

TaxiIn numeric variable of the taxi in time in minutes

ArrDelay Arrival delay, in Minutes

DepDelay Departure delay, in Minutes

CarrierDelay Carrier Delay, in Minutes

WeatherDelay Weather Delay, in Minutes

NASDelay National Air System Delay, in Minutes

SecurityDelay Security Delay, in Minutes

LateAircraftDelay Late Aircraft Delay, in Minutes

References

http://www.transtats.bts.gov/DL_SelectFields.asp?Table_ID=236&DB_Short_Name=On-Time

Examples

```
library(ggplot2)
ggplot(ontime, aes(UniqueCarrier, TaxiIn + TaxiOut)) +
  geom_lv(aes(fill = after_stat(LV))) +
  scale_fill_lv() +
  scale_y_sqrt() +
  theme_bw()
```

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