

Package ‘qicharts2’

March 16, 2019

Title Quality Improvement Charts

Version 0.6.0

Date 2019-03-16

Description Functions for making run charts, Shewhart control charts and Pareto charts for continuous quality improvement. Included control charts are: I, MR, Xbar, S, T, C, U, U', P, P', and G charts. Non-random variation in the form of minor to moderate persistent shifts in data over time is identified by the Anhoej rules for unusually long runs and unusually few crossing [Anhoej, Olesen (2014) <doi:10.1371/journal.pone.0113825>]. Non-random variation in the form of larger, possibly transient, shifts is identified by Shewhart's 3-sigma rule [Mohammed, Worthington, Woodall (2008) <doi:10.1136/qshc.2004.012047>].

Depends R (>= 3.0.0)

Imports dplyr (>= 0.7.0), ggplot2 (>= 2.2.0), scales, stats

Suggests knitr, rmarkdown, testthat, tidyr

License GPL-3

Encoding UTF-8

LazyData true

RoxygenNote 6.1.1

VignetteBuilder knitr

URL <https://github.com/anhoej/qicharts2>

NeedsCompilation no

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Repository CRAN

Date/Publication 2019-03-16 20:40:03 UTC

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cabg	<i>Coronary artery bypass graft operations</i>
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Description

A dataset with data on individual coronary artery bypass graft operations.

Usage

cabg

Format

A data frame with 2205 rows and 6 variables:

- data Date of operation.
- age Patient age in years.
- gender Patient gender.
- los Length of stay in days.
- death TRUE if patient died within 30 days after surgery.
- readmission TRUE if patient were readmitted for any reason within 30 days after surgery.

Source

Omitted for privacy concerns.

cdi	<i>Clostridium difficile infections</i>
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Description

A dataset with data on hospital acquired Clostridium difficile infections (CDI) before and after an intervention to reduce the risk of CDI.

Usage

cdi

Format

A data frame with 36 rows and 5 variables:

- month Month of observation.
- n Number of hospital acquired CDI.
- days Number of risk days. A risk day is a patient day without CDI.
- period Factor indicating the period 'pre' or 'post' intervention.
- notes Annotations.

Source

<http://www.haiba.dk/> (Amager Hvidovre Hospital).

gtt	<i>Patient harm indentified using the Global Trigger Tool</i>
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Description

A dataset with data on adverse events during hospitalisation found by the Global Trigger Tool.

Usage

gtt

Format

A data frame with 340 rows and 11 variables:

- admission_id Admission ID.
- admission_dte Date of admission.
- discharge_dte Date of discharge.
- month Month of discharge.
- days Duration of hospital stay in days.
- harms Number of adverse events.
- E-I Type of adverse event by severity category. E-F: Temporary harm; G-H: Permanent harm; I: Fatal harm.

Source

Omitted for privacy concerns.

References

<http://www.ihl.org/resources/Pages/Tools/IHIGlobalTriggerToolforMeasuringAEs.aspx>

hospital_infections *Hospital acquired infections*

Description

A dataset containing the number of hospital acquired bacteremia, Clostridium difficile infections, and urinary tract infections in six hospitals in the Capital Region of Denmark 2015-2016.

Usage

```
hospital_infections
```

Format

A data frame with 432 rows and 5 variables:

- hospital Abbreviated hospital name.
- infection Type of infection. BAC: Bacteremia, CDI: Clostridium difficile infection. UTI: Urinary tract infection.
- month First day of month.
- n Number of cases.
- days Number of risk days. A risk day is a patient day without infection.

Source

<http://www.haiba.dk/> (Capital Region of Denmark).

nhs_accidents	<i>NHS accidents</i>
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Description

The number of attendances to major accident and emergency hospital departments in the NHS that were seen within 4 hours of arrival over twenty weeks.

Usage

nhs_accidents

Format

A data frame with 20 rows and 3 variables:

- i Week number.
- r Attendances seen within 4 hours.
- n Total number of attendances.

Source

Mohammed MA, et al. Quality and Safety in Health Care 2013;22:362–368. <https://doi.org/10.1136/bmjqs-2012-001373>.

paretochart	<i>Paretochart</i>
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Description

Creates a pareto chart from a categorical variable

Usage

```
paretochart(x, title = "", subtitle = NULL, caption = NULL,  
  ylab = NULL, xlab = NULL, x.angle = NULL, useNA = FALSE,  
  print.data = FALSE)
```

Arguments

<code>x</code>	Categorical variable to plot.
<code>title</code>	Chart title.
<code>subtitle</code>	Chart subtitle.
<code>caption</code>	Chart caption.
<code>ylab</code>	Y axis label.
<code>xlab</code>	X axis label.
<code>x.angle</code>	Number indicating the angle of x axis labels.
<code>useNA</code>	If TRUE, NA values will be included in the analysis.
<code>print.data</code>	If TRUE, prints data frame with results.

Value

An object of class `ggplot`.

Examples

```
# Generate categorical vector
x <- rep(LETTERS[1:9], c(256, 128, 64, 32, 16, 8, 4, 2, 1))

# Make paretochart
paretochart(x)

# Save paretochart object to variable
p <- paretochart(x)

# Print data frame
p$data
```

qic

Statistical process control charts.

Description

The `qic()` function creates run charts and Shewhart control charts for process control and improvement. Included control charts are: I, MR, Xbar, S, T, C, U, U', P, P', and G charts.

Usage

```
qic(x, y = NULL, n = NULL, data = NULL, facets = NULL,
    notes = NULL, chart = c("run", "i", "mr", "xbar", "s", "t", "p",
    "pp", "c", "u", "up", "g"), agg.fun = c("mean", "median", "sum", "sd"),
    multiply = 1, freeze = NULL, part = NULL, exclude = NULL,
    target = NA * 1, cl = NA * 1, nrow = NULL, ncol = NULL,
```

```
scales = "fixed", title = "", ylab = "Value", xlab = "Subgroup",
subtitle = NULL, caption = NULL, part.labels = NULL,
show.labels = is.null(facets), decimals = 1, point.size = 1,
x.period = NULL, x.format = NULL, x.angle = NULL, x.pad = 1,
y.expand = NULL, y.neg = TRUE, y.percent = FALSE,
show.grid = FALSE, flip = FALSE, strip.horizontal = FALSE,
print.summary = FALSE)
```

Arguments

x	Vector of subgroup values to plot along the x axis.
y	Vector of measures or counts to plot on the y axis (numerator).
n	Vector of subgroup sizes (denominator).
data	Data frame containing variables used in the plot.
facets	One or two sided formula with factors used for facetting plots.
notes	Character vector of notes to be added to individual data points.
chart	Character value indicating the chart type. Possible values are: 'run' (default), 'i', 'mr', 'xbar', 't', 's', 'c', 'u', 'up', 'p', 'pp', and 'g'.
agg.fun	Aggregate function for summarising the y variable if there are more than one observation per subgroup. Only relevant for run charts and I charts. Possible values are: 'mean' (default), 'median', 'sum', and 'sd'.
multiply	Number indicating a number to multiply y axis by, e.g. 100 for percents rather than proportions. See also y.percent argument.
freeze	Integer indicating the last data point to include in calculation of baseline parameters for centre and control lines. Ignored if part argument is given.
part	Integer vector indicating data points before recalculation of centre and control lines.
exclude	Integer vector indicating data points to exclude from calculations of centre and control lines.
target	Numeric, either a single value indicating a target value to be plotted as a horizontal line or a vector for variable target line.
cl	Numeric, either a single value indicating the centre line if known in advance or a vector for variable centre line.
nrow, ncol	Number indicating the preferred number of rows and columns in facets.
scales	Character string, one of 'fixed' (default), 'free_y', 'free_x', or 'free' indicating whether y and x axis scales should be the same for all panels or free.
title	Character string specifying the title of the plot.
ylab	Character string specifying the y axis label.
xlab	Character string specifying the x axis label.
subtitle	Character string specifying the subtitle.
caption	Character string specifying the caption.
part.labels	Character vector specifying labels for chart parts created with the freeze or part argument.

<code>show.labels</code>	Logical indicating whether to show labels for centre and control lines on chart. Defaults to TRUE when facets argument is NULL.
<code>decimals</code>	Integer indicating the preferred number of decimals in centre and control line labels.
<code>point.size</code>	Number specifying the size of data points.
<code>x.period</code>	Character string specifying the interval cut points of datetime x values used for aggregating y values by week, month, etc. See the breaks argument of <code>?cut.POSIXt()</code> for possible values.
<code>x.format</code>	Date format of x axis labels. See <code>?strftime()</code> for possible date formats.
<code>x.angle</code>	Number indicating the angle of x axis labels.
<code>x.pad</code>	Number indicating expansion of x axis to make room for axis labels.
<code>y.expand</code>	Numeric value to include in y axis. Useful e.g. for starting the y axis at zero.
<code>y.neg</code>	If TRUE (default), the y axis is allowed to be negative (only relevant for I and Xbar charts).
<code>y.percent</code>	If TRUE, formats y axis labels as percentages.
<code>show.grid</code>	If TRUE, shows grid.
<code>flip</code>	If TRUE, rotates the plot 90 degrees.
<code>strip.horizontal</code>	If TRUE, makes y strip horizontal.
<code>print.summary</code>	If TRUE, prints summary.

Details

Non-random variation in the form of minor to moderate persists shifts in data over time is identified by the Anhoej rules for unusually long runs and unusually few crossing. Special cause variation in the form of larger, possibly transient, shifts in data is identified by Shewhart's 3-sigma rule.

Value

A qic object. Inherits from 'ggplot'.

See Also

`vignette('qic')`

Examples

```
# Lock random number generator to make reproducible results.
set.seed(2)

# Generate vector of 24 random normal numbers
y <- rnorm(24)

# Run chart
qic(y)
```



```
# I control chart
qic(y, chart = 'i')

# U control chart from build-in data set of hospital infection rates faceted
# by hospital and type of infection.
qic(month, n,
      n      = days,
      data   = hospital_infections,
      facets = infection ~ hospital,
      chart  = 'u',
      multiply = 10000,
      title  = 'Hospital infection rates',
      ylab   = 'Number of infections per 10.000 risk days',
      xlab   = 'Month')
```

qicharts2

qicharts2 *package*

Description

Statistical Process Control chart for R

Details

#' See the README on <https://github.com/anhoej/qicharts2/>

summary.qic

Prints summary of a qic object

Description

Prints summary of a qic object

Usage

```
## S3 method for class 'qic'
summary(object, ...)
```

Arguments

object A qic object.
... For compatibility with generic summary function.

Value

A data frame of summary values of each facet and part of a qic plot.

- facet1 Vertical facets.
- facet2 Horizontal facets
- part Number of chart part when argument break.points is given.
- aLCL Average of lower control limit.
- CL Centre line.
- aUCL Average of upper control limit.
- longest.run Length of the longest run of data points on the same side of the centre line.
- longest.run.max Upper limit of expected length of longest run.
- n.crossings Number of times the data line crosses the centre line.
- n.crossings.min Lower limit of expected number of crossings.
- runs.signal 1 if either longest run or number of crossings are outside expected limits.
- sigma.signal Number of data points outside control limits.

Examples

```
p <- qic(rnorm(24), chart = 'i')
p
summary(p)
```

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