

Package ‘qualpalr’

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Title Automatic Generation of Qualitative Color Palettes

Version 1.0.1

Description Automatic generation of maximally distinct qualitative color palettes, optionally tailored to color deficiency. A list of colors or a subspace of a color space is used as input and then projected to the DIN99d color space, where colors that are maximally distinct are chosen algorithmically.

License GPL-3

BugReports <https://github.com/jolars/qualpalr/issues>

URL <https://jolars.github.io/qualpalr/>

Encoding UTF-8

RoxygenNote 7.3.2

VignetteBuilder knitr

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Depends R (>= 4.0.0)

Imports graphics, stats, utils, Rcpp

Suggests randtoolbox (>= 1.17), testthat, knitr, rmarkdown, maps, rgl, spelling, covr

LinkingTo Rcpp (>= 0.12.9)

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analyze_palette	Analyze a categorical color palette
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Description

Analyze a categorical color palette with respect to the differences between the colors in the palette.

Usage

```
analyze_palette(  
  palette,  
  cvd = c(protan = 0, deutan = 0, tritan = 0),  
  bg = NULL,  
  metric = c("cie1931", "din99d", "cie76")  
)
```

Arguments

palette	Either a matrix of RGB values (with values between 0 and 1), a data frame with RGB values, or a character vector of hex colors.
cvd	Color vision deficiency adaptation. This must be a named vector with names protan, deutan, and tritan and values between 0 and 1, where 0 means no adaptation and 1 means full adaptation.
bg	Background color to consider (but not include) when generating the palette. This is useful to avoid colors that are too close to the background/canvas color. If NULL (the default), the background color is not considered at all. Any color that is convertible via col2rgb is acceptable, including hex colors.
metric	The color metric to use for the color distance matrix.

Value

A list of lists, one for each type of color vision deficiency plus normal vision. Each list contains difference_matrix, min_distances, and bg_min_distance

See Also[qualpal\(\)](#)**Examples**

```
pal <- qualpal(5)
analyze_palette(pal$hex, cvd = c(protan = 1))
```

convert_colors	<i>Convert colors between colorspaces</i>
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Description

Convert colors between colorspaces

Usage

```
convert_colors(colors, from, to)
```

Arguments

colors	A matrix of colors
from	The colorspace of the input colors, one of "rgb", "hsl", "din99d", "lab", "xyz"
to	The colorspace of the output colors, one of "rgb", "hsl", "lab", "xyz"

Value

The colors converted to the new colorspace

get_palette	<i>Retrieve one of the built-in color palettes</i>
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Description

This function retrieves a color palette from the built-in palettes. To see the available palettes, use [list_palettes\(\)](#).

Usage

```
get_palette(palette = "ColorBrewer:Accent")
```

Arguments

palette	A character string specifying the name of the color palette to
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Value

A character vector of colors in hex format.

See Also

[list_palettes\(\)](#)

Examples

```
get_palette("Vermeer:LittleStreet")
```

list_palettes	<i>List available color palettes</i>
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Description

List available color palettes

Usage

```
list_palettes()
```

Value

A list of available color palettes. Each palette is a named list with a character vector.

See Also

[qualpal\(\)](#)

Examples

```
list_palettes()
```

pairs.qualpal	Scatterplot matrix of qualitative color palette
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Description

Plots the colors in an object of class "qualpal" as a scatterplot matrix on either the DIN99d (the default) or HSL color space.

Usage

```
## S3 method for class 'qualpal'
pairs(x, colorspace = c("DIN99d", "HSL", "RGB"), ...)
```

Arguments

x	A list object of class "qualpal" generated from qualpal .
colorspace	The color space in which to plot the colors ("DIN99d", "HSL", or "RGB").
...	Arguments to pass on to pairs .

See Also

[qualpal](#), [plot.qualpal](#), [pairs](#)

Examples

```
col_pal <- qualpal(3)
pairs(col_pal)
pairs(col_pal, colorspace = "HSL")
```

plot.qualpal	Multidimensional scaling map of qualitative color palette
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Description

Uses the colors in a [qualpal](#) object to compute and plot a multidimensional scaling (MDS) map using [cmdscale](#) on the Delta E DIN99d distance matrix.

Usage

```
## S3 method for class 'qualpal'
plot(x, ...)
```

Arguments

x	An object of class "qualpal" generated from qualpal .
...	Arguments to pass on to plot .

See Also

[qualpal](#), [pairs.qualpal](#), [plot](#)

Examples

```
col_pal <- qualpal(3)
plot(col_pal)
```

<code>print.qualpal</code>	<i>Print qualpal palette</i>
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Description

Print the result from a call to [qualpal](#).

Usage

```
## S3 method for class 'qualpal'
print(x, colorspace = c("HSL", "DIN99d", "RGB"), digits = 2, ...)
```

Arguments

<code>x</code>	An object of class "qualpal".
<code>colorspace</code>	Color space to print colors in.
<code>digits</code>	Number of significant digits for the output. (See print.default .) Setting it to NULL uses getOption("digits") .
<code>...</code>	Arguments to pass to print.default .

Value

Prints the colors as a matrix in the specified color space as well as a distance matrix of the color differences. Invisibly returns `x`.

Examples

```
f <- qualpal(3)
print(f, colorspace = "DIN99d", digits = 3)
```

qualpal

*Generate qualitative color palettes***Description**

Given a collection of colors, `qualpal()` algorithmically tries to select to `n` most distinct colors from the provided input colors, optionally taking color vision deficiency into account.

Usage

```
qualpal(
  n,
  colorspace = list(h = c(0, 360), s = c(0.2, 0.5), l = c(0.6, 0.85)),
  cvd = c(protan = 0, deutan = 0, tritan = 0),
  cvd_severity,
  bg = NULL,
  metric = c("cie1931", "din99d", "cie76"),
  extend = NULL
)
```

Arguments

- | | |
|-------------------------|--|
| <code>n</code> | The number of colors to generate. |
| <code>colorspace</code> | <p>A color space to generate colors from. Can be any of the following:</p> <ul style="list-style-type: none"> A list that describes a color space in either HSL or LCHab color space. In the first case (HSL), the list must contain the following <i>named</i> vectors, each of length two, giving a range for each item. <ul style="list-style-type: none"> <code>h</code> Hue, in range from -360 to 360 <code>s</code> Saturation, in the range from 0 to 1 <code>l</code> Lightness, in the range from 0 to 1 <p>In the second case (LCHab), the list must contain the following <i>named</i> vectors, each of length two, giving a range for each item.</p> <ul style="list-style-type: none"> <code>h</code> Hue, in range from -360 to 360 <code>c</code> Chroma, in the range from 0 to infinity <code>l</code> Lightness, in the range from 0 to 100 <p>In these cases, <code>qualpal()</code> will generate</p> A character vector of length one in the form of "Source:Palette", where <i>Domain</i> is the name of a source that provides a color palette, and <i>Palette</i> is the name of a color palette from that source. See <code>list_palettes()</code> for available palettes. A matrix or data frame of RGB values (with values between 0 and 1). |
| <code>cvd</code> | Color vision deficiency adaptation. This must be a named vector with names <code>protan</code> , <code>deutan</code> , and <code>tritan</code> and values between 0 and 1, where 0 means no adaptation and 1 means full adaptation. |

<code>cvd_severity</code>	DEPRECATED. Use a named <code>cvd</code> vector instead, e.g. <code>c(protan = 0.5, deutan = 0.2, tritan = 0)</code> .
<code>bg</code>	Background color to consider (but not include) when generating the palette. This is useful to avoid colors that are too close to the background/canvas color. If <code>NULL</code> (the default), the background color is not considered at all. Any color that is convertible via <code>col2rgb</code> is acceptable, including hex colors.
<code>metric</code>	The color metric to use for the color distance matrix.
<code>extend</code>	A palette of colors to use as a fixed set of initial colors in the palette, which can be either a matrix or data frame of RGB values (with values between 0 and 1) or a character vector of hex colors (or any other format that's acceptable in <code>grDevices::col2rgb()</code>).

Details

The main idea is to compute a distance matrix from all the input colors, and then try to select the most distinct colors based on the color differences between them. It does this iteratively by first selecting the first n colors from the input colors, then iterates over the palette, putting colors back into the total set and replaces it with a new color until it has gone through the whole range without changing any of the colors.

Optionally, `qualpal` can adapt palettes to cater to color vision deficiency (CVD). This is accomplished by taking the colors provided by the user and transforming them to colors that someone with CVD would see, that is, simulating CVD `qualpal` then chooses colors from these new colors.

Value

A list of class `qualpal` with the following components.

<code>HSL</code>	A matrix of the colors in the HSL color space.
<code>RGB</code>	A matrix of the colors in the sRGB color space.
<code>hex</code>	A character vector of the colors in hex notation.
<code>de_DIN99d</code>	A distance matrix of color differences according to the metric used. The name is misleading, but kept for backwards compatibility.
<code>hex</code>	A character vector of the colors in hex notation.
<code>min_de_DIN99d</code>	The minimum pairwise DIN99d color difference among all colors in the palette.

See Also

`plot.qualpal()`, `pairs.qualpal()`, `list_palettes()`

Examples

```
# Generate 3 distinct colors from the default color space
qualpal(3)

# Provide a custom color space
qualpal(n = 3, list(h = c(35, 360), s = c(0.5, 0.7), l = c(0, 0.45)))
```



```
qualpal(3, "ColorBrewer:Set2")

# Adapt palette to deuteranopia
qualpal(5, "ColorBrewer:Dark2", cvd = c(deutan = 1))

# Adapt palette to protanomaly with severity 0.4
qualpal(8, cvd = c(protan = 0.4))

# Generate and extend a palette with 3 colors, using the DIN99d
# metric
pal <- qualpal(3)
qualpal(5, extend = pal$hex, metric = "din99d")

## Not run:
# The range of hue cannot exceed 360
qualpal(3, list(h = c(-20, 360), s = c(0.5, 0.7), l = c(0, 0.45)))

## End(Not run)
```

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