R color cheatsheet

Finding a good color scheme for presenting data can be challenging. We are here to help!

R uses hexadecimal to represent colors

Hexadecimal is a base-16 number system used to describe color. Red, green, and blue are each represented by two characters (#rrggbb). Each character has 16 possible symbols: 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F (does it make more sense to anyone besides me to use A-P as the symbols?)

“00” can be interpreted as 0.0 and “FF” as 1.0
i.e., red= #FF0000 , black=#000000, white = #FFFFFF

Two additional characters (with the same scale) can be added to the end to describe transparency (#rrggbbaa)

R has 657 built in color names

To see a list of names:
colors()
The colors are displayed on P. 3.

peachpuff4

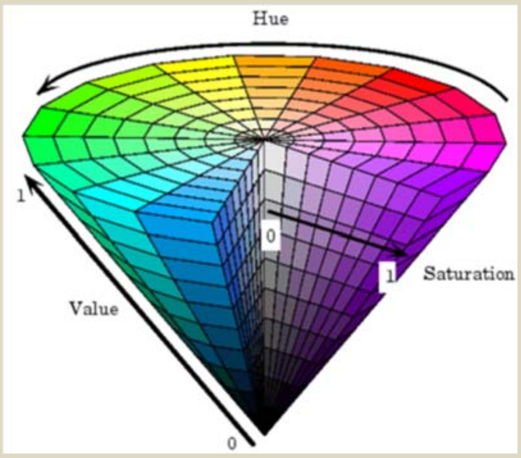
R translates various color models to hex, e.g.:

- RGB (red green blue): Default values range from 0-1; but scale is 0-255 when maxColorValue=255. *alpha* is an optional argument for transparency, with the same intensity scale as the red, green, blue values.
  rgb(r, g, b, maxColorValue=255, alpha=255)
- HSV (hue saturation value): values range from 0-1, with optional alpha argument
  hsv(h, s, v, alpha)
- HCL (hue chroma luminance): hue values range from 0-360; 0 = red, 120 = green, blue = 240, etc. Range of chroma and luminance depend on each other and hue
  hcl(h, c, l, alpha)

A few notes on HSV/HLC

HSV is a better model for how humans perceive color. HCL can be thought of as a perceptually based version of the HSV model....blah blah blah...

Without delving into color theory: color schemes based on HSV/HLC models generally just look good.



Translating colors to rgb

col2rgb(c(“#FF0000”, “blue”))

R Color Palettes

This is for all of you who don’t know anything about color theory, and don’t care but want some nice colors on your map or figure....NOW!

TIP: When it comes to selecting a color palette, **DO NOT** try to handpick individual colors! You will waste a lot of time and the result will probably not be all that great. R has some good packages for color palettes.

Option 1: grDevices and colorRamps

grDevices comes with the base installation and colorRamps must be installed. Each palette’s function has an argument for the number of colors and transparency (*alpha*):

grDevices palettes
cm.colors
topo.colors
terrain.colors
heat.colors
rainbow
See P. 4 for colorRamps options

heat.colors(4, alpha=1)
> #FF0000FF" "#FF8000FF" "#FFFF00FF" "#FFFF80FF“

For the rainbow palette you can select start/end color (red = 0, yellow = *1/6*, green = *2/6*, cyan = *3/6*, blue = *4/6* and magenta = *5/6*) and saturation (s) and value (v):
rainbow(n, s = 1, v = 1, start = 0, end = max(1, n - 1)/n, alpha = 1)

Option 2: RcolorBrewer

This function has an argument for the number of colors and the color palette (see P. 4 for options).
brewer.pal(4, “Set3”)
> "#8DD3C7" "#FFFFB3" "#BEBADA" "#FB8072“

To view the palette in R for different numbers of colors:
display.brewer.all(5)
Interactive viewer: http://colorbrewer2.org/

My Recommendation

Option 3: colorspace

These color palettes are based on HCL and HSV color models. The results can be very aesthetically pleasing. There are some default palettes:

colorspace default palettes
diverge_hsv
diverge_hsl
terrain_hcl
sequential_hcl
rainbow_hcl

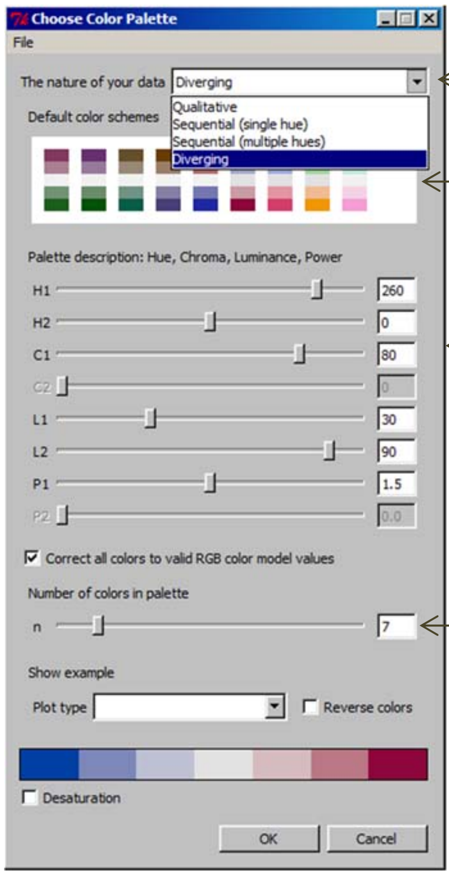
rainbow_hcl(4)
"#E495A5" "#ABB065" "#39BEB1" "#ACA4E2“

However, all palettes are fully customizable:
diverge_hcl(7, h = c(246, 40), c = 96, l = c(65, 90))
Choosing the values could be daunting. But there are some recommended palettes in the colorspace documentation. There is also an interactive tool that can be used to obtain a customized palette. To start the tool:
pal <- choose_palette()

R color cheatsheet

Overview of colorspace palette selector

```
library("colorspace")
pal <- choose_palette()
```



Choose Color Palette

File

The nature of your data: Diverging
- Qualitative
- Sequential (single hue)
- Sequential (multiple hues)
- Diverging

Default color schemes

Palette description: Hue, Chroma, Luminance, Power

H1	260
H2	0
C1	80
C2	0
L1	30
L2	90
P1	1.5
P2	0.0

☑ Correct all colors to valid RGB color model values

Number of colors in palette

n 7

Show example

Plot type ☐ Reverse colors

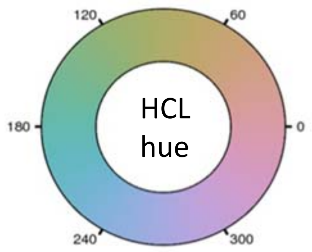
☐ Desaturation

OK Cancel

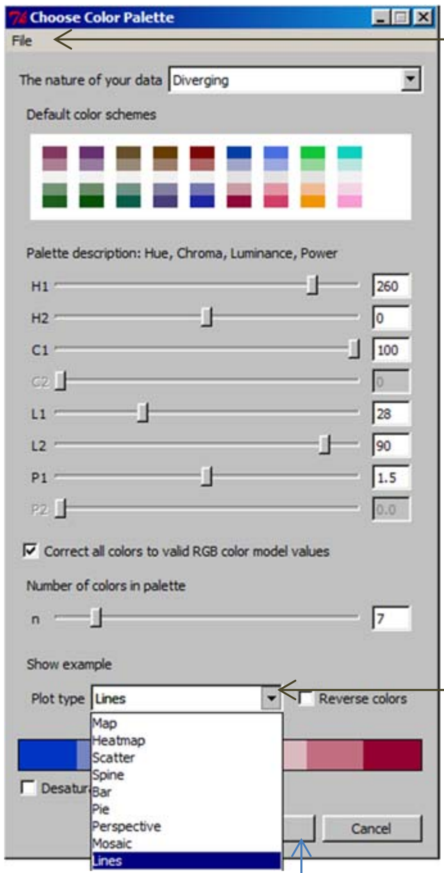
Select the type of color scheme based on the type of data

Default color schemes – can be used "as is" or as a starting point for modification

Interactively select:
- hue: color
- chroma: low chroma = gray
- luminance: high luminance = pastel
- power: how the color changes along a gradient



Select # of colors in palette



Choose Color Palette

File

The nature of your data: Diverging

Default color schemes

Palette description: Hue, Chroma, Luminance, Power

H1	260
H2	0
C1	100
C2	0
L1	28
L2	90
P1	1.5
P2	0.0

☑ Correct all colors to valid RGB color model values

Number of colors in palette

n 7

Show example

Plot type: Lines ☐ Reverse colors
- Map
- Heatmap
- Scatter
- Spine
- Bar
- Pie
- Perspective
- Mosaic
- Lines

☐ Desaturation

Cancel

Save palette for future R sessions:
- txt file with hex codes
- .R file with a function describing how to generate the palette. source can be used to import the function into R; but one complication is that I had to open the .R file and name the function to use it.
- Copy hue, chroma,luminance, and power values into relevant colorspace functions:

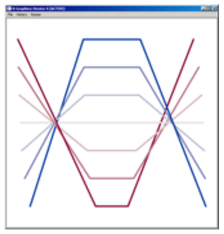
```
diverge_hcl(7, h = c(260, 0), c = 100, l = c(28, 90), power = 1.5)
```

Other functions are:

```
sequential_hcl(n, h, c.= c(), l=c(), power)
rainbow_hcl(n, c, l, start, end)
```

(qualtitative schemes; start/ end refer to the H1/H2 hue values)

Display color scheme with different plot types



How to use hex codes to define color using the plot function

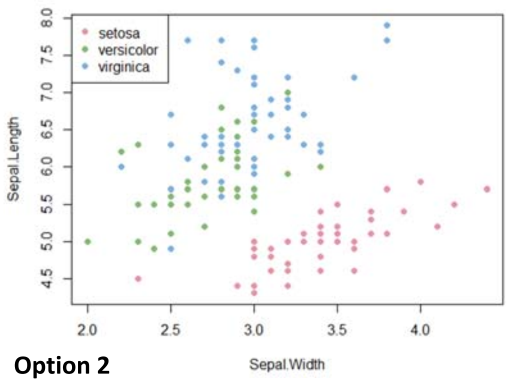
Discrete variables

Option 1

You don't need to control which colors are associated with each level of a variable:

```
plot(Sepal.Length ~ Sepal.Width,
col=rainbow_hcl(3)[c(Species)],
data=iris, pch=16)

legend("topleft", pch=16, col=rainbow_hcl(3),
legend=unique(iris$Species))
```



Option 2

If you want to control which colors are associated with the levels of a variable, I find it easiest to create a variable in the data:

```
iris$color <- factor(iris$Species,
levels=c("virginica", "versicolor", "setosa"),
labels=rainbow_hcl(3))

plot(Sepal.Length ~ Sepal.Width,
col=as.character(color), pch=16, data=iris)
```

Continuous variables

Option 1

Break into categories and assign colors:

```
iris2 <- subset(iris, Species=="setosa")

color <- cut(iris2$Petal.Length,
breaks=c(0,1.3,1.5,2))
```

Or, break by quantiles (include 0 & 1 quantiles):

```
color <- cut(iris2$Petal.Length,
breaks=quantile(iris$Petal.Length, c(0, 0.25,
0.5, 0.75, 1)))

plot(Sepal.Width ~ Sepal.Length, pch=16,
col=sequential_hcl(3)[c(color)], data=iris2)
```

Option 2

Fully continuous gradient:

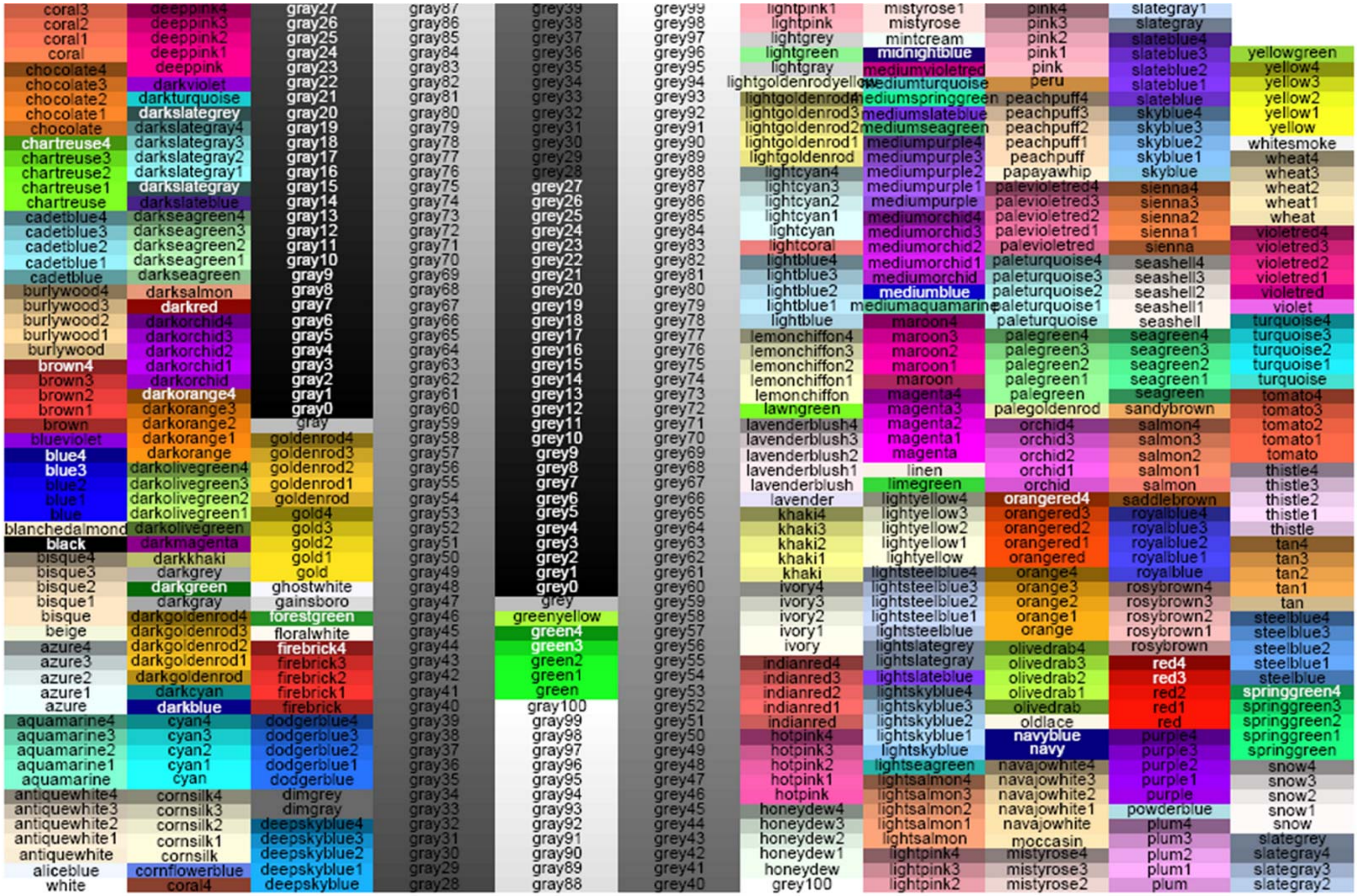
```
data <- data.frame("a"=runif(10000),
"b"=runif(10000))

color=diverge_hcl(length(data$a))[rank(data$a)]
plot(a~b, col=color, pch=16, data=data)
```

When the "OK" button is selected, the function describing the color palette will be saved in R. To return 7 hex color codes from the selected palette:

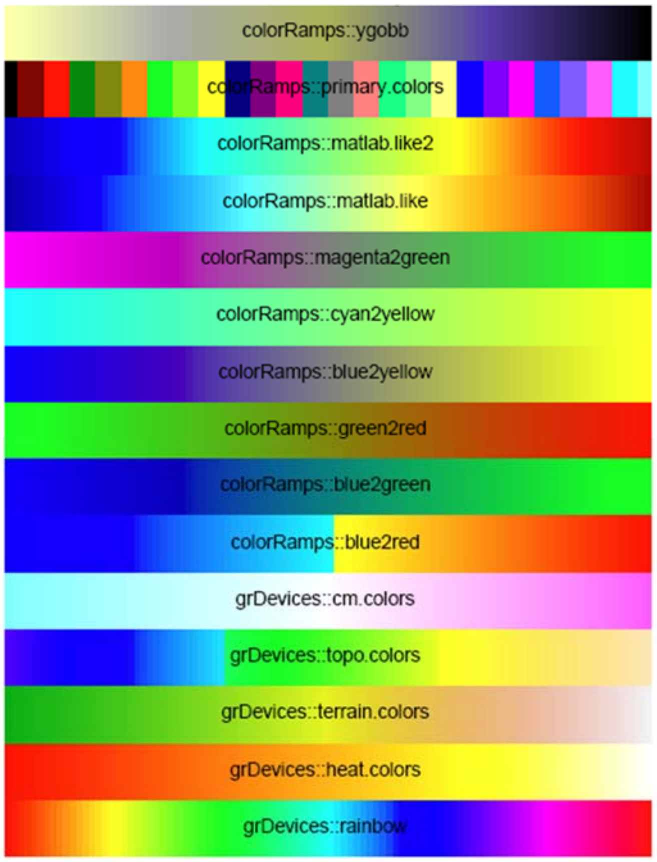
```
pal <- choose_palette()
pal(7)
```

[NOTE: This will not be saved to future R sessions!]



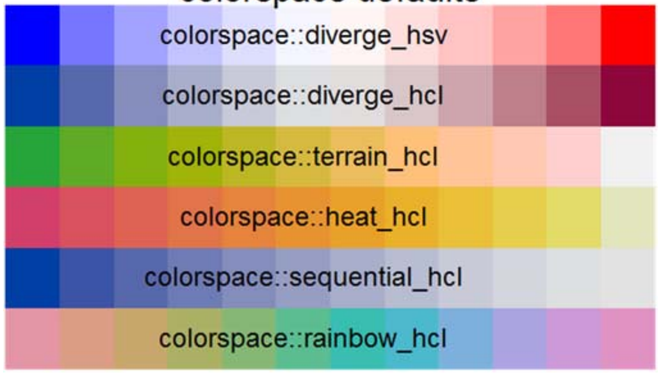
code to produce R color chart from: http://www.biecek.pl/R/R.pdf and http://bc.bojanorama.pl/2013/04/r-color-reference-sheet

colorRamps and grDevices

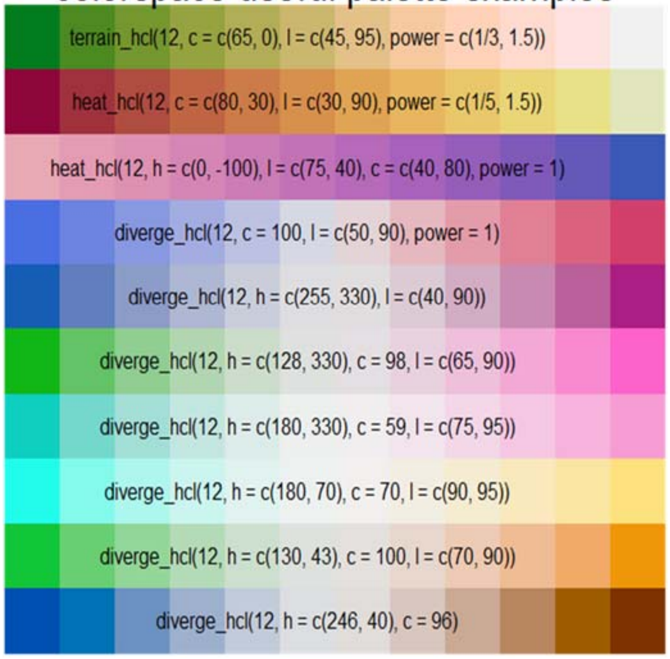


colorRamps and grDevices color palette, display from:
http://bc.bojanorama.pl/2013/04/r-color-reference-sheet/

colorspace defaults

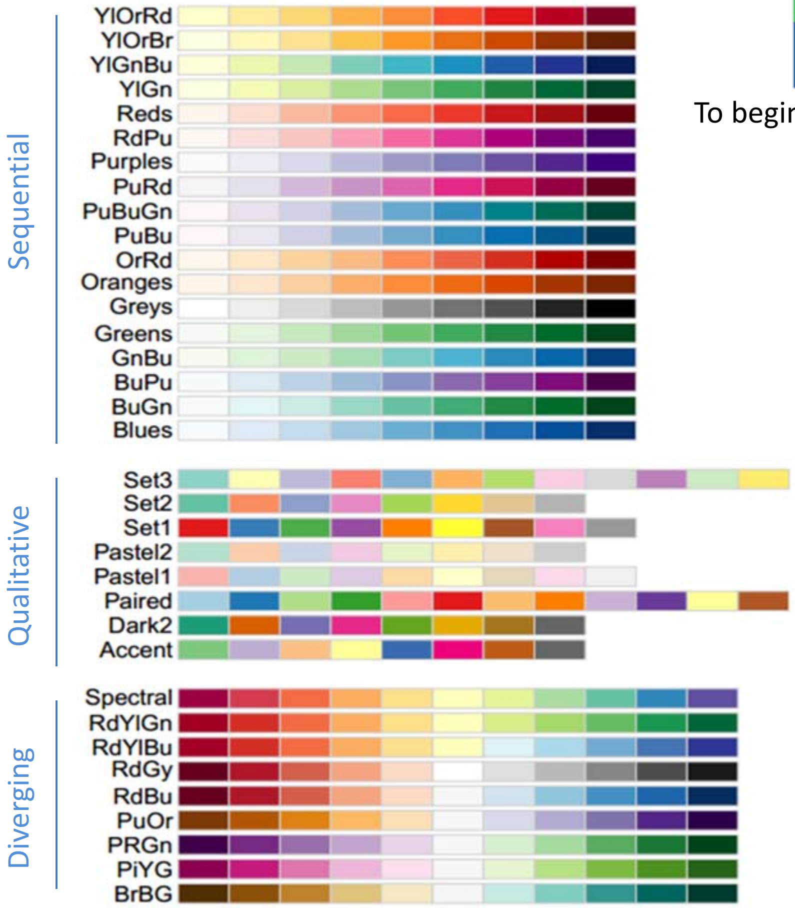


colorspace useful palette examples



To begin interactive color selector: pal <- choose_palette()

RColorBrewer



To display RColorBrewer palette: display.brewer.all()
For interactive color selector: http://colorbrewer2.org/

Useful Resources:

A larger color chart of R named colors:
http://research.stowers-institute.org/efg/R/Color/Chart/ColorChart.pdf

Nice overview of color in R:
http://research.stowers-institute.org/efg/Report/UsingColorInR.pdf

http://students.washignton.edu/mclarkso/documents/colors Ver2.pdf

A color theory reference:
Zeileis, A. K. Hornik, P. Murrell. 2009. Escaping RGBland: selecting colors for statistical graphics. Computational and Statistics & Data Analysis 53:3259-3270

Another website for selecting palettes:
http://tools.medialab.sciences-po.fr/iwanthue/