

R color cheatsheet

Finding a good color scheme for presenting data can be challenging. This color cheatsheet will 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:

"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()`

These colors are displayed on P. 3.

Example:

peachpuff4

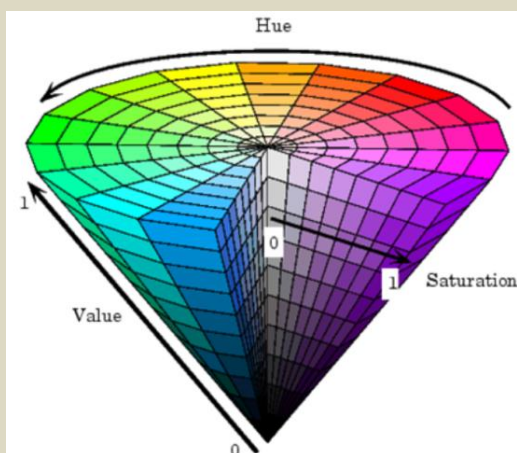
R translates various color models to hex, e.g.:

- RGB (red, green, blue): The default intensity scale in R ranges from 0-1; but another commonly used scale is 0-255. This is obtained in R using `maxColorValue=255`. *alpha* is an optional argument for transparency, with the same intensity scale.
`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 describes the color and ranges from 0-360; 0 = red, 120 = green, blue = 240, etc. Range of chroma and luminance depend on hue and each other
`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.



R can translate colors to rgb (this is handy for matching colors in other programs)

`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. Here are some of the options

Packages: 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*):

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

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

For the `rainbow` palette you can also 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)`

Package: 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 colorbrewer palettes in R: `display.brewer.all(5)`

There is also a very nice interactive viewer:

<http://colorbrewer2.org/>

My Recommendation

Package: colorspace

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

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

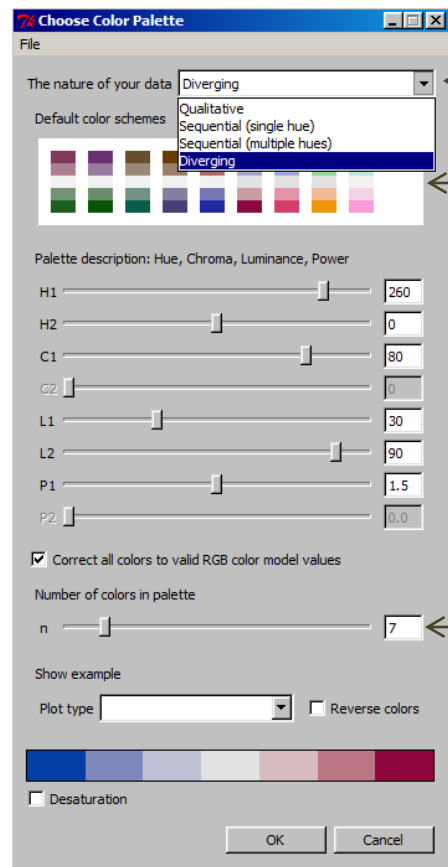
colorspace
default palettes
diverge_hcl
diverge_hsl
terrain_hcl
sequential_hcl
rainbow_hcl

However, all palettes are fully customizable:
`diverge_hcl(7, h = c(246, 40), c = 96, l = c(65, 90))`
Choosing the values *would* 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()
```

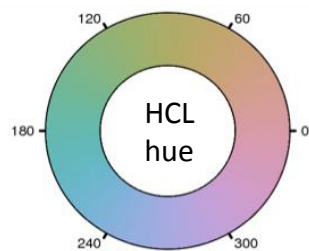


Select the type of color scheme based on the type of data

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

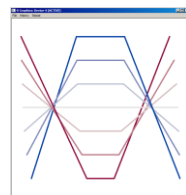
- Save palette for future R sessions:
- txt file with hex codes
 - .R file with a function describing how to generate the palette.

`source` can be used to import the function into R; but one complication is that you have to open the .R file and name the function to use it.

- Copy values into relevant colorspace functions.

Diverging color schemes:
`diverge_hcl(7, h = c(260, 0), c = 100, l = c(28, 90), power = 1.5)`
 Sequential color schemes:
`sequential_hcl(n, h, c = c(), l = c(), power)`
 Qualitative color schemes:
`rainbow_hcl(n, c, l, start, end)` (for qualitative schemes; start/ end refer to the H1/H2 hue values)

Display color scheme with different plot types



When “OK” is selected, the color palette will be saved in the R session. To return 7 hex color codes from the selected palette:

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

[NOTE: These values are not saved if you don’t save the session]

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

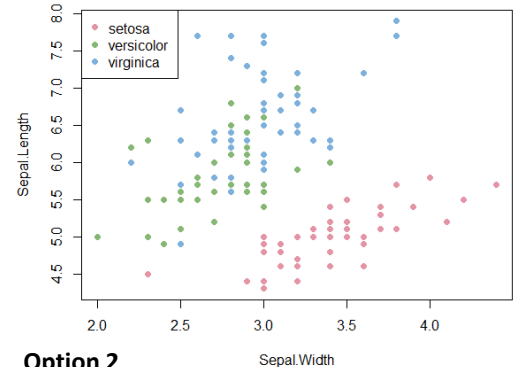
Discrete variables

Option 1

If 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), labels=sequential_hcl(3))
```

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

```
color <- cut(iris2$Petal.Length,
            breaks=quantile(iris$Petal.Length, c(0, 0.25, 0.5, 0.75, 1)), labels=sequential_hcl(3))
```

```
plot(Sepal.Width ~ Sepal.Length, pch=16,
     col=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)
```

For ggplot2, I think the most flexible color scales are:

```
scale_colour_manual
scale_colour_gradient
```

for discrete and continuous variables, respectively

grDevices::colors

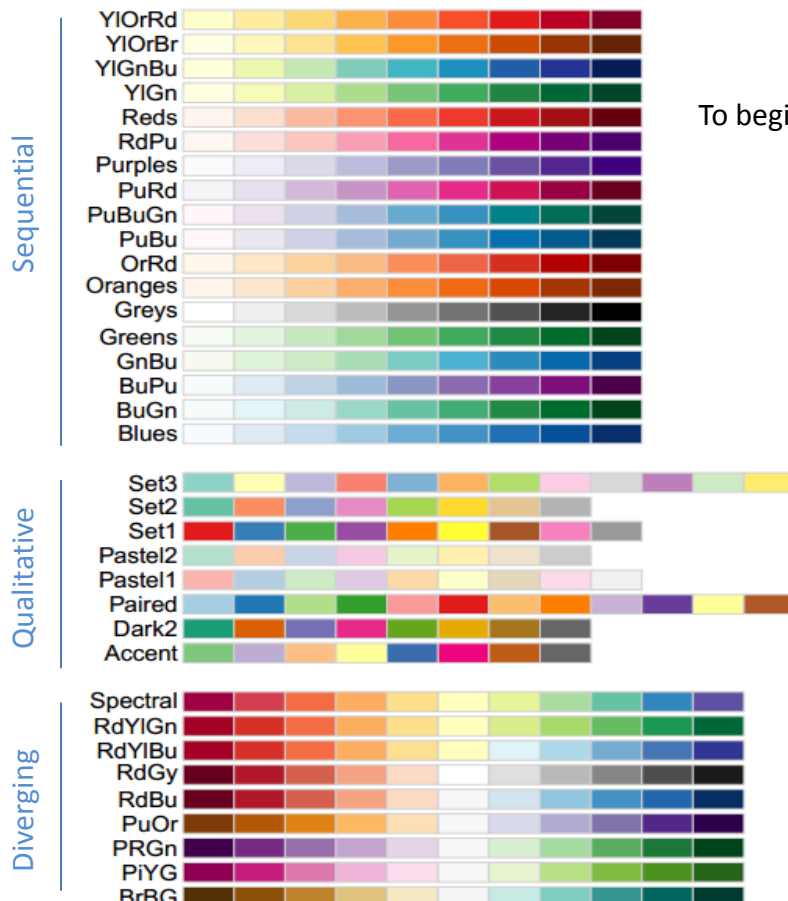
coral3	deeppink4	gray27	gray87	gray39	gray99	lightpink1	mistyrose1	pink4	slategray1	
coral2	deeppink3	gray26	gray86	gray38	gray98	lightpink	mistyrose	pink3	slategray	
coral1	deeppink2	gray25	gray85	gray37	gray97	lightgrey	mintcream	pink2	slateblue4	
coral	deeppink1	gray24	gray84	gray36	gray96	lightgreen	midnightblue	pink1	slateblue3	yellowgreen
chocolate4	deeppink	gray23	gray83	gray35	gray95	lightgray	mediumvioletred	pink	slateblue2	yellow4
chocolate3	darkviolet	gray22	gray82	gray34	gray94	lightgoldenrodyellow	mediumturquoise	peru	slateblue1	yellow3
chocolate2	darkturquoise	gray21	gray81	gray33	gray93	lightgoldenrod4	mediumspringgreen	peachpuff4	slateblue	yellow2
chocolate1	darkslategrey	gray20	gray80	gray32	gray92	lightgoldenrod3	mediumslateblue	peachpuff3	skyblue4	yellow1
chocolate	darkslategrey4	gray19	gray79	gray31	gray91	lightgoldenrod2	mediumseagreen	peachpuff2	skyblue3	yellow
chartreuse4	darkslategrey3	gray18	gray78	gray30	gray90	lightgoldenrod1	mediumpurple4	peachpuff1	skyblue2	whitesmoke
chartreuse3	darkslategrey2	gray17	gray77	gray29	gray89	lightgoldenrod	mediumpurple3	peachpuff	skyblue1	wheat4
chartreuse2	darkslategrey1	gray16	gray76	gray28	gray88	lightcyan4	mediumpurple2	papayawhip	skyblue	wheat3
chartreuse1	darkslategrey	gray15	gray75	gray27	gray87	lightcyan3	mediumpurple1	palevioletred4	sienna4	wheat2
chartreuse	darkslateblue	gray14	gray74	gray26	gray86	lightcyan2	mediumpurple	palevioletred3	sienna3	wheat1
cadetblue4	darkseagreen4	gray13	gray73	gray25	gray85	lightcyan1	mediumorchid4	palevioletred2	sienna2	wheat
cadetblue3	darkseagreen3	gray12	gray72	gray24	gray84	lightcyan	mediumorchid3	palevioletred1	sienna1	violetred4
cadetblue2	darkseagreen2	gray11	gray71	gray23	gray83	lightcoral	mediumorchid2	palevioletred	sienna	violetred3
cadetblue1	darkseagreen1	gray10	gray70	gray22	gray82	lightblue4	mediumorchid1	paleturquoise4	seashell4	violetred2
cadetblue	darkseagreen	gray9	gray69	gray21	gray81	lightblue3	mediumorchid	paleturquoise3	seashell3	violetred1
burlywood4	darksalmon	gray8	gray68	gray20	gray80	lightblue2	mediumblue	paleturquoise2	seashell2	violetred
burlywood3	darkred	gray7	gray67	gray19	gray79	lightblue1	mediumaquamarine	paleturquoise1	seashell1	violet
burlywood2	darkorchid4	gray6	gray66	gray18	gray78	lightblue	maroon4	paleturquoise	seashell	turquoise4
burlywood1	darkorchid3	gray5	gray65	gray17	gray77	lemonchiffon4	maroon3	palegreen4	seagreen4	turquoise3
burlywood	darkorchid2	gray4	gray64	gray16	gray76	lemonchiffon3	maroon2	palegreen3	seagreen3	turquoise2
brown4	darkorchid1	gray3	gray63	gray15	gray75	lemonchiffon2	maroon1	palegreen2	seagreen2	turquoise1
brown3	darkorchid	gray2	gray62	gray14	gray74	lemonchiffon1	maroon	palegreen1	seagreen1	turquoise
brown2	darkorange4	gray1	gray61	gray13	gray73	lemonchiffon	magenta4	palegreen	seagreen	tomato4
brown1	darkorange3	gray0	gray60	gray12	gray72	lawngreen	magenta3	palegoldenrod	sandybrown	tomato3
brown	darkorange2	gray	gray59	gray11	gray71	lavenderblush4	magenta2	orchid4	salmon4	tomato2
blueviolet	darkorange1	goldenrod4	gray58	gray10	gray70	lavenderblush3	magenta1	orchid3	salmon3	tomato1
blue4	darkorange	goldenrod3	gray57	gray9	gray69	lavenderblush2	magenta	orchid2	salmon2	tomato
blue3	darkolivegreen4	goldenrod2	gray56	gray8	gray68	lavenderblush1	linen	orchid1	salmon1	thistle4
blue2	darkolivegreen3	goldenrod	gray55	gray7	gray67	lavenderblush	limegreen	orchid	salmon	thistle3
blue1	darkolivegreen2	goldenrod	gray54	gray6	gray66	lavender	lightyellow4	orangered4	saddlebrown	thistle2
blue	darkolivegreen1	gold4	gray53	gray5	gray65	khaki4	lightyellow3	orangered3	royalblue4	thistle1
blanchedalmond	darkolivegreen	gold3	gray52	gray4	gray64	khaki3	lightyellow2	orangered2	royalblue3	thistle
black	darkmagenta	gold2	gray51	gray3	gray63	khaki2	lightyellow1	orangered1	royalblue2	tan4
bisque4	darkkhaki	gold1	gray50	gray2	gray62	khaki1	lightyellow	orangered	royalblue1	tan3
bisque3	darkgrey	gold	gray49	gray1	gray61	khaki	lightsteelblue4	orange4	royalblue	tan2
bisque2	darkgreen	ghostwhite	gray48	gray0	gray60	ivory4	lightsteelblue3	orange3	rosybrown4	tan1
bisque1	darkgray	gainsboro	gray47	gray	gray59	ivory3	lightsteelblue2	orange2	rosybrown3	tan
bisque	darkgoldenrod4	forestgreen	gray46	greenyellow	gray58	ivory2	lightsteelblue1	orange1	rosybrown2	steelblue4
beige	darkgoldenrod3	floralwhite	gray45	green4	gray57	ivory1	lightsteelblue	orange	rosybrown1	steelblue3
azure4	darkgoldenrod2	firebrick4	gray44	green3	gray56	ivory	lightslategray	olivedrab4	rosybrown	steelblue2
azure3	darkgoldenrod1	firebrick3	gray43	green2	gray55	indianred4	lightslategray	olivedrab3	red4	steelblue1
azure2	darkgoldenrod	firebrick2	gray42	green1	gray54	indianred3	lightslateblue	olivedrab2	red3	steelblue
azure1	darkcyan	firebrick1	gray41	green	gray53	indianred2	lightskyblue4	olivedrab1	red2	springgreen4
azure	darkblue	firebrick	gray40	gray100	gray52	indianred1	lightskyblue3	olivedrab	red1	springgreen3
aquamarine4	cyan4	dodgerblue4	gray39	gray99	gray51	indianred	lightskyblue2	oldlace	red	springgreen2
aquamarine3	cyan3	dodgerblue3	gray38	gray98	gray50	hotpink4	lightskyblue1	navyblue	purple4	springgreen1
aquamarine2	cyan2	dodgerblue2	gray37	gray98	gray49	hotpink3	lightskyblue	navy	purple3	springgreen
aquamarine1	cyan1	dodgerblue1	gray36	gray97	gray48	hotpink2	lightseagreen	navajowhite4	purple2	snow4
aquamarine	cyan	dodgerblue	gray35	gray96	gray47	hotpink1	lightsalmon4	navajowhite3	purple1	snow3
antiquewhite4	cornsilk4	dimgray	gray34	gray95	gray46	hotpink	lightsalmon3	navajowhite2	purple	snow2
antiquewhite3	cornsilk3	dimgray	gray33	gray94	gray45	honeydew4	lightsalmon2	navajowhite1	powderblue	snow1
antiquewhite2	cornsilk2	deepskyblue4	gray32	gray93	gray44	honeydew3	lightsalmon1	navajowhite	plum4	snow
antiquewhite1	cornsilk1	deepskyblue3	gray31	gray92	gray43	honeydew2	lightsalmon	moccasin	plum3	slategray
antiquewhite	cornsilk	deepskyblue2	gray30	gray91	gray42	honeydew1	lightsalmon	moccasin	plum2	slategray4
aliceblue	cornflowerblue	deepskyblue1	gray29	gray90	gray41	honeydew	lightpink4	mistyrose4	plum1	slategray3
white	coral4	deepskyblue	gray28	gray89	gray40	honeydew	lightpink3	mistyrose3	plum	slategray2
				gray88	gray40	gray100	lightpink2	mistyrose2	plum	

colorRamps and grDevices



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

RColorBrewer



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

colorspace defaults



colorspace useful palette examples



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

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.washington.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