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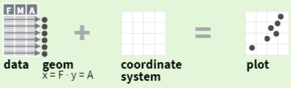
2 contributors

1.88 MB ···

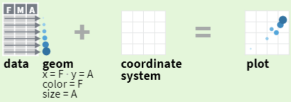
# Data visualization with ggplot2 : : CHEAT SHEET

## Basics

**ggplot2** is based on the **grammar of graphics**, the idea that you can build every graph from the same components: a **data** set, a **coordinate system**, and **geoms**—visual marks that represent data points.



To display values, map variables in the data to visual properties of the geom (**aesthetics**) like **size**, **color**, and **x** and **y** locations.



Complete the template below to build a graph.

**ggplot (data = <DATA>) +**
**<GEOM_FUNCTION>(mapping = aes(<MAPPINGS>),**
stat = <STAT>, position = <POSITION>) +
<COORDINATE_FUNCTION> +
<FACET_FUNCTION> +
<SCALE_FUNCTION> +
<THEME_FUNCTION>

required

Not required, sensible defaults supplied

**ggplot(**data = mpg, **aes(**x = cty, y = hwy**))** Begins a plot that you finish by adding layers to. Add one geom function per layer.

**last_plot()** Returns the last plot.

**ggsave(**"plot.png", width = 5, height = 5**)** Saves last plot as 5' x 5' file named "plot.png" in working directory. Matches file type to file extension.

## Aes

Common aesthetic values.

**color** and **fill** - string ("red", "#RRGGBB")

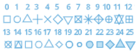
**linetype** - integer or string (0 = "blank", 1 = "solid", 2 = "dashed", 3 = "dotted", 4 = "dotdash", 5 = "longdash", 6 = "twodash")

**lineend** - string ("round", "butt", or "square")

**linejoin** - string ("round", "mitre", or "bevel")

**size** - integer (line width in mm)

**shape** - integer/shape name or a single character ("a")



## Geoms

Use a geom function to represent data points, use the geom's aesthetic properties to represent variables. Each function returns a layer.

### GRAPHICAL PRIMITIVES

a <- ggplot(economics, aes(date, unemploy))
b <- ggplot(seals, aes(x = long, y = lat))

**a + geom_blank()** and **a + expand_limits()**
Ensure limits include values across all plots.

**b + geom_curve(**aes(yend = lat + 1, xend = long + 1), curvature = 1**)** - x, xend, y, yend, alpha, angle, color, curvature, linetype, size

**a + geom_path(**lineend = "butt", linejoin = "round", linemitre = 1**)**
x, y, alpha, color, group, linetype, size

**a + geom_polygon(**aes(alpha = 50)**)** - x, y, alpha, color, fill, group, subgroup, linetype, size

**b + geom_rect(**aes(xmin = long, ymin = lat, xmax = long + 1, ymax = lat + 1)**)** - xmax, xmin, ymax, ymin, alpha, color, fill, linetype, size

**a + geom_ribbon(**aes(ymin = unemploy - 900, ymax = unemploy + 900)**)** - x, ymax, ymin, alpha, color, fill, group, linetype, size

### LINE SEGMENTS

common aesthetics: x, y, alpha, color, linetype, size

**b + geom_abline(**aes(intercept = 0, slope = 1)**)**
**b + geom_hline(**aes(yintercept = lat)**)**
**b + geom_vline(**aes(xintercept = long)**)**

**b + geom_segment(**aes(yend = lat + 1, xend = long + 1)**)**
**b + geom_spoke(**aes(angle = 1:1155, radius = 1)**)**

### ONE VARIABLE continuous

c <- ggplot(mpg, aes(hwy)); c2 <- ggplot(mpg)

**c + geom_area(**stat = "bin"**)**
x, y, alpha, color, fill, linetype, size

**c + geom_density(**kernel = "gaussian"**)**
x, y, alpha, color, fill, group, linetype, size, weight

**c + geom_dotplot()**
x, y, alpha, color, fill

**c + geom_freqpoly()**
x, y, alpha, color, group, linetype, size

**c + geom_histogram(**binwidth = 5**)**
x, y, alpha, color, fill, linetype, size, weight

**c2 + geom_qq(**aes(sample = hwy)**)**
x, y, alpha, color, fill, linetype, size, weight

### discrete

d <- ggplot(mpg, aes(fl))

**d + geom_bar()**
x, alpha, color, fill, linetype, size, weight

### TWO VARIABLES

### both continuous

e <- ggplot(mpg, aes(cty, hwy))

**e + geom_label(**aes(label = cty), nudge_x = 1, nudge_y = 1**)** - x, y, label, alpha, angle, color, family, fontface, hjust, lineheight, size, vjust

**e + geom_point()**
x, y, alpha, color, fill, shape, size, stroke

**e + geom_quantile()**
x, y, alpha, color, group, linetype, size, weight

**e + geom_rug(**sides = “bl"**)**
x, y, alpha, color, linetype, size

**e + geom_smooth(**method = lm**)**
x, y, alpha, color, fill, group, linetype, size, weight

**e + geom_text(**aes(label = cty), nudge_x = 1, nudge_y = 1**)** - x, y, label, alpha, angle, color, family, fontface, hjust, lineheight, size, vjust

### one discrete, one continuous

f <- ggplot(mpg, aes(class, hwy))

**f + geom_col()**
x, y, alpha, color, fill, group, linetype, size

**f + geom_boxplot()**
x, y, lower, middle, upper, ymax, ymin, alpha, color, fill, group, linetype, shape, size, weight

**f + geom_dotplot(**binaxis = "y", stackdir = “center"**)**
x, y, alpha, color, fill, group

**f + geom_violin(**scale = “area"**)**
x, y, alpha, color, fill, group, linetype, size, weight

### both discrete

g <- ggplot(diamonds, aes(cut, color))

**g + geom_count()**
x, y, alpha, color, fill, shape, size, stroke

**e + geom_jitter(**height = 2, width = 2**)**
x, y, alpha, color, fill, shape, size

### continuous bivariate distribution

h <- ggplot(diamonds, aes(carat, price))

**h + geom_bin2d(**binwidth = c(0.25, 500)**)**
x, y, alpha, color, fill, linetype, size, weight

**h + geom_density_2d()**
x, y, alpha, color, group, linetype, size

**h + geom_hex()**
x, y, alpha, color, fill, size

### continuous function

i <- ggplot(economics, aes(date, unemploy))

**i + geom_area()**
x, y, alpha, color, fill, linetype, size

**i + geom_line()**
x, y, alpha, color, group, linetype, size

**i + geom_step(**direction = "hv"**)**
x, y, alpha, color, group, linetype, size

### visualizing error

df <- data.frame(grp = c("A", "B"), fit = 4:5, se = 1:2)
j <- ggplot(df, aes(grp, fit, ymin = fit - se, ymax = fit + se))

**j + geom_crossbar(**fatten = 2**)** - x, y, ymax, ymin, alpha, color, fill, group, linetype, size

**j + geom_errorbar()** - x, ymax, ymin, alpha, color, group, linetype, size, width
Also **geom_errorbarh()**.

**j + geom_linerange()**
x, ymin, ymax, alpha, color, group, linetype, size

**j + geom_pointrange()** - x, y, ymin, ymax, alpha, color, fill, group, linetype, shape, size

### maps

data <- data.frame(murder = USArrests$Murder,
state = tolower(rownames(USArrests)))
map <- map_data("state")
k <- ggplot(data, aes(fill = murder))

**k + geom_map(**aes(map_id = state), map = map**)**
**+ expand_limits(**x = map$long, y = map$lat**)**
map_id, alpha, color, fill, linetype, size

### THREE VARIABLES

seals$z <- with(seals, sqrt(delta_long^2 + delta_lat^2)); l <- ggplot(seals, aes(long, lat))

**l + geom_contour(**aes(z = z)**)**
x, y, z, alpha, color, group, linetype, size, weight

**l + geom_contour_filled(**aes(fill = z)**)**
x, y, alpha, color, fill, group, linetype, size, subgroup

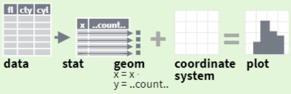
**l + geom_raster(**aes(fill = z), hjust = 0.5, vjust = 0.5, interpolate = FALSE**)**
x, y, alpha, fill

**l + geom_tile(**aes(fill = z)**)**
x, y, alpha, color, fill, linetype, size, width

## Stats

An alternative way to build a layer.

A stat builds new variables to plot (e.g., count, prop).



Visualize a stat by changing the default stat of a geom function, **geom_bar(stat="count")** or by using a stat function, **stat_count(geom="bar")**, which calls a default geom to make a layer (equivalent to a geom function). Use **..name..** syntax to map stat variables to aesthetics.

geom to use | stat function | geommappings

**i + stat_density_2d(**aes(fill = ..level..),
geom = "polygon"**)**

variable created by stat

**c + stat_bin(**binwidth = 1, boundary = 10**)**
**x, y** | ..count.., ..ncount.., ..density.., ..ndensity..

**c + stat_count(**width = 1**) x, y** | ..count.., ..prop..

**c + stat_density(**adjust = 1, kernel = "gaussian"**)**
**x, y** | ..count.., ..density.., ..scaled..

**e + stat_bin_2d(**bins = 30, drop = T**)**
**x, y, fill** | ..count.., ..density..

**e + stat_bin_hex(**bins = 30**) x, y, fill** | ..count.., ..density..

**e + stat_density_2d(**contour = TRUE, n = 100**)**
**x, y, color, size** | ..level..

**e + stat_ellipse(**level = 0.95, segments = 51, type = "t"**)**

**l + stat_contour(**aes(z = z)**) x, y, z, order** | ..level..

**l + stat_summary_hex(**aes(z = z), bins = 30, fun = max**)**
**x, y, z, fill** | ..value..

**l + stat_summary_2d(**aes(z = z), bins = 30, fun = mean**)**
**x, y, z, fill** | ..value..

**f + stat_boxplot(**coef = 1.5**)**
**x, y** | ..lower.., ..middle.., ..upper.., ..width.. , ..ymin.., ..ymax..

**f + stat_ydensity(**kernel = "gaussian", scale = "area"**) x, y** | ..density.., ..scaled.., ..count.., ..n.., ..violinwidth.., ..width..

**e + stat_ecdf(**n = 40**) x, y** | ..x.., ..y..

**e + stat_quantile(**quantiles = c(0.1, 0.9), formula = y ~ log(x), method = "rq"**) x, y** | ..quantile..

**e + stat_smooth(**method = "lm", formula = y ~ x, se = T, level = 0.95**) x, y** | ..se.., ..x.., ..y.., ..ymin.., ..ymax..

**ggplot() + xlim(**-5, 5**) + stat_function(**fun = dnorm,
n = 20, geom = “point”**) x, y** | ..x.., ..y..

## Scales

Override defaults with **scales** package.

**Scales** map data values to the visual values of an aesthetic. To change a mapping, add a new scale.

**n <- d + geom_bar(aes(fill = fl))**

scale_ | aesthetic to adjust | prepackaged scale to use | scale-specific arguments

**n + scale_fill_manual(**
**values** = c("skyblue", "royalblue", "blue", "navy"),
**limits** = c("d", "e", "p", "r"), breaks =c("d", "e", "p", “r"),
**name** = "fuel", labels = c("D", "E", "P", "R"))

range of values to include in mapping | title to use in legend/axis | labels to use in legend/axis | breaks to use in legend/axis

### GENERAL PURPOSE SCALES

Use with most aesthetics

**scale_*_continuous()** - Map cont' values to visual ones.
**scale_*_discrete()** - Map discrete values to visual ones.
**scale_*_binned()** - Map continuous values to discrete bins.
**scale_*_identity()** - Use data values as visual ones.
**scale_*_manual(**values = c()**)** - Map discrete values to manually chosen visual ones.
**scale_*_date(**date_labels = "%m/%d"), date_breaks = "2 weeks"**)** - Treat data values as dates.
**scale_*_datetime()** - Treat data values as date times. Same as scale_*_date(). See ?strptime for label formats.

### X & Y LOCATION SCALES

Use with x or y aesthetics (x shown here)

**scale_x_log10()** - Plot x on log10 scale.
**scale_x_reverse()** - Reverse the direction of the x axis.
**scale_x_sqrt()** - Plot x on square root scale.

### COLOR AND FILL SCALES (DISCRETE)

**n + scale_fill_brewer(**palette = "Blues"**)**
For palette choices:
RColorBrewer::display.brewer.all()

**n + scale_fill_grey(**start = 0.2, end = 0.8, na.value = "red"**)**

### COLOR AND FILL SCALES (CONTINUOUS)

o <- c + geom_dotplot(aes(fill = ..x..))

**o + scale_fill_distiller(**palette = “Blues”**)**

**o + scale_fill_gradient(**low="red", high=“yellow"**)**

**o + scale_fill_gradient2(**low = "red", high = “blue”, mid = "white", midpoint = 25**)**

## Coordinate Systems

r <- d + geom_bar()

**r + coord_cartesian(**xlim = c(0, 5)**)** - xlim, ylim
The default cartesian coordinate system.

**r + coord_fixed(**ratio = 1/2**)**
ratio, xlim, ylim - Cartesian coordinates with fixed aspect ratio between x and y units.

**ggplot(**mpg, aes(y = fl)**) + geom_bar()**
Flip cartesian coordinates by switching x and y aesthetic mappings.

**r + coord_polar(**theta = "x", direction=1**)**
theta, start, direction - Polar coordinates.

**r + coord_trans(**y = “sqrt"**)** - x, y, xlim, ylim
Transformed cartesian coordinates. Set xtrans and ytrans to the name of a window function.

**π + coord_quickmap()**
**π + coord_map(**projection = "ortho", orientation = c(41, -74, 0)**)** - projection, xlim, ylim
Map projections from the mapproj package (mercator (default), azequalarea, lagrange, etc.).

## Position Adjustments

Position adjustments determine how to arrange geoms that would otherwise occupy the same space.

s <- ggplot(mpg, aes(fl, fill = drv))

**s + geom_bar(position = "dodge")**
Arrange elements side by side.

**s + geom_bar(position = "fill")**
Stack elements on top of one another, normalize height.

**e + geom_point(position = "jitter")**
Add random noise to X and Y position of each element to avoid overplotting.

**e + geom_label(position = "nudge")**
Nudge labels away from points.

**s + geom_bar(position = "stack")**
Stack elements on top of one another.

Each position adjustment can be recast as a function with manual **width** and **height** arguments:
s + geom_bar(position = position_dodge(width = 1))

## Themes

## Faceting

Facets divide a plot into subplots based on the values of one or more discrete variables.

t <- ggplot(mpg, aes(cty, hwy)) + geom_point()

**t + facet_grid(cols = vars(fl))**
Facet into columns based on fl.

**t + facet_grid(rows = vars(year))**
Facet into rows based on year.

**t + facet_grid(rows = vars(year), cols = vars(fl))**
Facet into both rows and columns.

**t + facet_wrap(vars(fl))**
Wrap facets into a rectangular layout.

Set **scales** to let axis limits vary across facets.

**t + facet_grid(rows = vars(drv), cols = vars(fl), scales = "free")**
x and y axis limits adjust to individual facets:
**"free_x"** - x axis limits adjust
**"free_y"** - y axis limits adjust

Set **labeller** to adjust facet label:

**t + facet_grid(cols = vars(fl), labeller = label_both)**

| | | | | |
|---|---|---|---|---|
| fl: c | fl: d | fl: e | fl: p | fl: r |

**t + facet_grid(rows = vars(fl), labeller = label_bquote(**alpha ^ .(fl)**))**

| | | | | |
|---|---|---|---|---|
| $\alpha^c$ | $\alpha^d$ | $\alpha^e$ | $\alpha^p$ | $\alpha^r$ |

## Labels and Legends

Use **labs()** to label the elements of your plot.

**t + labs(x** = "New x axis label", **y** = "New y axis label",
**title** ="Add a title above the plot",
**subtitle** = "Add a subtitle below title",
**caption** = "Add a caption below plot",
**alt** = "Add alt text to the plot",
<AES> = "New <AES> legend title"**)**

**t + annotate(**geom = "text", x = 8, y = 9, label = “A"**)**
Places a geom with manually selected aesthetics.

**p + guides(**x = guide_axis(n.dodge = 2)**)** Avoid crowded or overlapping labels with guide_axis(n.dodge or angle).

**n + guides(**fill = “none"**)** Set legend type for each aesthetic: colorbar, legend, or none (no legend).

**n + theme(**legend.position = "bottom"**)**
Place legend at "bottom", "top", "left", or “right”.

n = 20, geom = "point") **x** | ..x.., ..y..

**ggplot() + stat_qq(**aes(sample = 1:100)**)**
**x, y, sample** | ..sample.., ..theoretical..

**e + stat_sum() x, y, size** | ..n.., ..prop..

**e + stat_summary(**fun.data = "mean_cl_boot"**)**

**h + stat_summary_bin(**fun = "mean", geom = "bar"**)**

**e + stat_identity()**

**e + stat_unique()**

**o + scale_fill_gradientn(**colors = topo.colors(6)**)**
Also: rainbow(), heat.colors(), terrain.colors(), cm.colors(), RColorBrewer::brewer.pal()

### SHAPE AND SIZE SCALES

p <- e + geom_point(aes(shape = fl, size = cyl))

**p + scale_shape() + scale_size()**
**p + scale_shape_manual(**values = c(3:7)**)**

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

**r + theme_bw()**
White background with grid lines.

**r + theme_gray()**
Grey background (default theme).

**r + theme_dark()**
Dark for contrast.

**r + theme_classic()**

**r + theme_light()**

**r + theme_linedraw()**

**r + theme_minimal()**
Minimal theme.

**r + theme_void()**
Empty theme.

**r + theme()** Customize aspects of the theme such

**n + scale_fill_discrete(**name = "Title", labels = c("A", "B", "C", "D", "E")**)**
Set legend title and labels with a scale function.

## Zooming

**Without clipping** (preferred):

**t + coord_cartesian(**xlim = c(0, 100), ylim = c(10, 20)**)**

**With clipping** (removes unseen data points):