Lecture - Behind the scenes of ggplot2

Data Visualisation

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Statistical layers vs. geometrical layers

Statistics in geometrical layers

Behind the scenes, some geometrical layers are calculating some statistics before they plot output:

Example: geom_bar is calculating counts

```
geom_bar
```

```
## function (mapping = NULL, data = NULL, stat = "count", position = "stack",
##     ..., just = 0.5, width = NULL, na.rm = FALSE, orientation = NA,
##     show.legend = NA, inherit.aes = TRUE)
## {
##     layer(data = data, mapping = mapping, stat = stat, geom = GeomBar,
##         position = position, show.legend = show.legend, inherit.aes = inherit.aes,
##         params = list2(just = just, width = width, na.rm = na.rm,
##             orientation = orientation, ...))
## }
## <bytecode: 0x7ff2a7d89110>
## <environment: namespace:ggplot2>
```

Statistics in geometrical layers

Behind the scenes, some geometrical layers are calculating some statistics before they plot output:

Example: geom_histogram is binning the data

```
geom_histogram
```

```
## function (mapping = NULL, data = NULL, stat = "bin", position = "stack",
##     ..., binwidth = NULL, bins = NULL, na.rm = FALSE, orientation = NA,
##     show.legend = NA, inherit.aes = TRUE)
## {
##     layer(data = data, mapping = mapping, stat = stat, geom = GeomBar,
##         position = position, show.legend = show.legend, inherit.aes = inherit.aes,
##         params = list2(binwidth = binwidth, bins = bins, na.rm = na.rm,
##             orientation = orientation, pad = FALSE, ...))
## }
## <bytecode: 0x7fdee9f01d28>
## <environment: namespace:ggplot2>
```

Statistics in geometrical layers

Behind the scenes, some geometrical layers are calculating some statistics before they plot output:

Example: geom_density is estimating the density

```
geom_density
```

```
## function (mapping = NULL, data = NULL, stat = "density", position = "identity",
##     ..., na.rm = FALSE, orientation = NA, show.legend = NA, inherit.aes = TRUE,
##     outline.type = "upper")
## {
##     outline.type <- arg_match0(outline.type, c("both", "upper",
##         "lower", "full"))
##     layer(data = data, mapping = mapping, stat = stat, geom = GeomDensity,
##         position = position, show.legend = show.legend, inherit.aes = inherit.aes,
##         params = list2(na.rm = na.rm, orientation = orientation,
##             outline.type = outline.type, ...))
## }
## <bytecode: 0x7f7c0c1e6910>
## <environment: namespace:ggplot2>
```

Statistics in geometrical layers

But some geometrical layers do not require any calculations, so these use the data “as is” (“identity”):

Example: geom_line

```
geom_line
```

```
## function (mapping = NULL, data = NULL, stat = "identity", position = "identity",
##     na.rm = FALSE, orientation = NA, show.legend = NA, inherit.aes = TRUE,
##     ...)
## {
##     layer(data = data, mapping = mapping, stat = stat, geom = GeomLine,
##         position = position, show.legend = show.legend, inherit.aes = inherit.aes,
##         params = list2(na.rm = na.rm, orientation = orientation,
##             ...))
## }
## <bytecode: 0x7f7bdd2a8138>
## <environment: namespace:ggplot2>
```

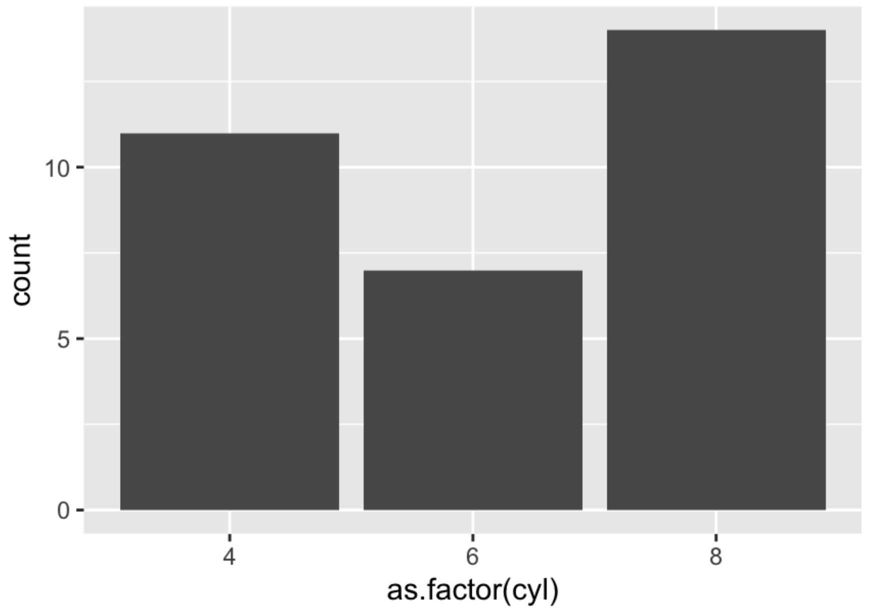
Example:

Using the fact that ggplot can do calculations in the background, we can ask it to plot the number of cars grouped by number of cylinders in a bar chart:

geom_bar will count the number of cars in each group:

```
ggplot(data = mtcars,
       mapping = aes(x = as.factor(cyl))) +
  geom_bar()

# in the background:
ggplot(data = mtcars,
       mapping = aes(x = as.factor(cyl))) +
  geom_bar(stat = 'count')
```

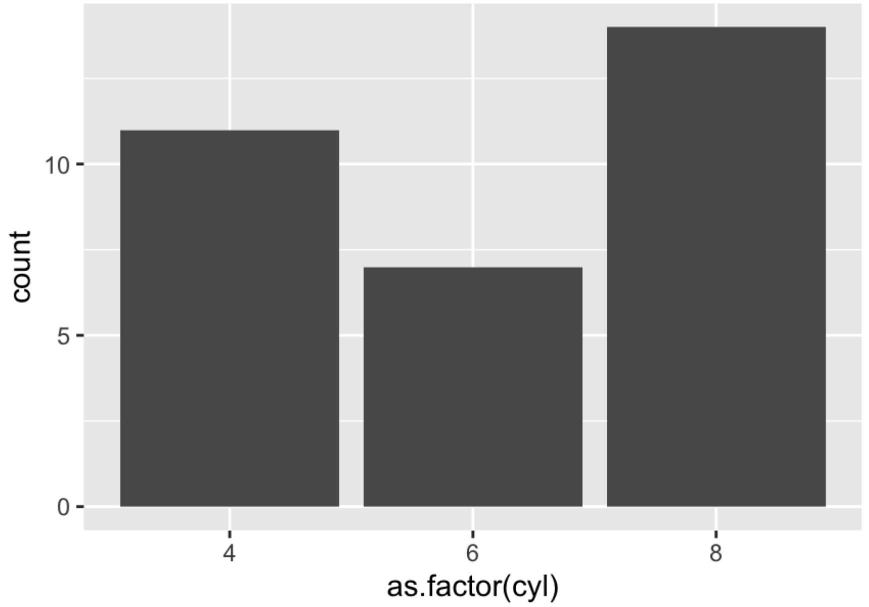


Reverse: geometric object to plot statistics

You can also do this the other way around with the stat_*() functions.

- First, specify which statistic ggplot should calculate
- Then, specify the type of plot you want to make with it

```
ggplot(data = mtcars,
       mapping = aes(x = as.factor(cyl))) +
  stat_count(geom = "bar")
```

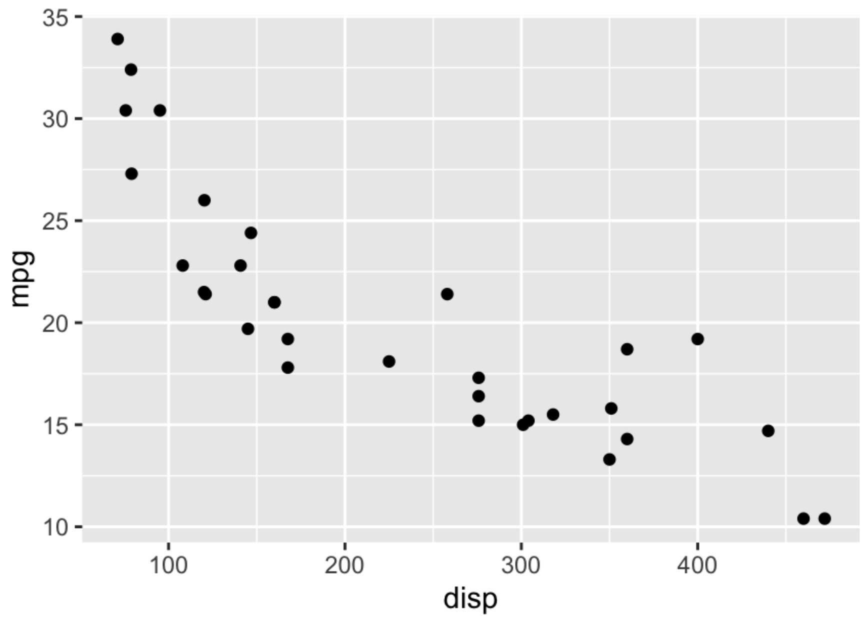


Reverse: geometric object to plot statistics

You can also do this the other way around with the stat_*() functions.

- First, specify which statistic ggplot should calculate
- Then, specify the type of plot you want to make with it

```
ggplot(data = mtcars,
       mapping = aes(x = disp,
                     y = mpg)) +
  stat_identity(geom = "point")
```

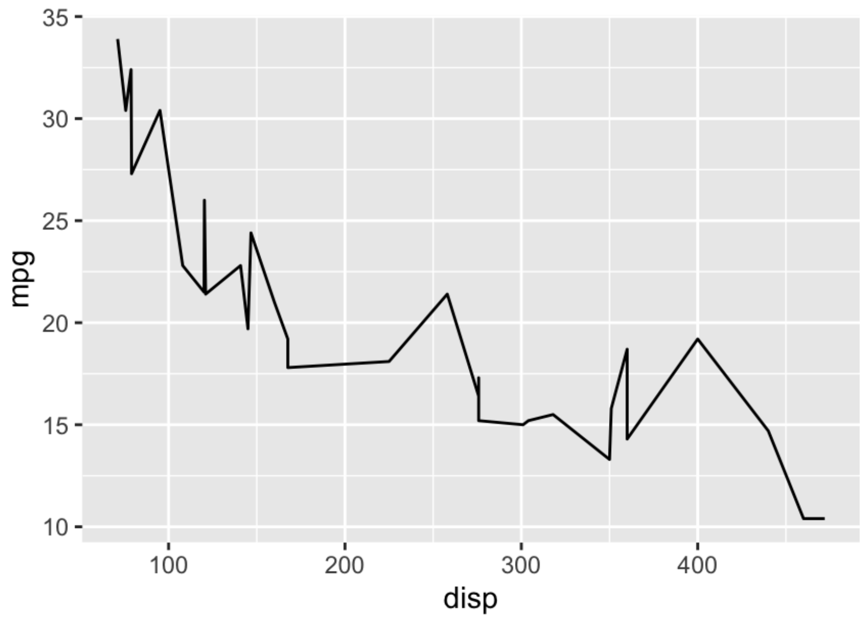


Reverse: geometric object to plot statistics

You can also do this the other way around with the stat_*() functions.

- First, specify which statistic ggplot should calculate
- Then, specify the type of plot you want to make with it

```r
ggplot(data = mtcars,
       mapping = aes(x = disp,
                     y = mpg)) +
  stat_identity(geom = "line")
```



Statistical layers vs. Geometrical layers

- In this course we focus on geometrical layers that calculate statistics
- This puts more focus on the visual aspects of the plot

The stages of ggplot

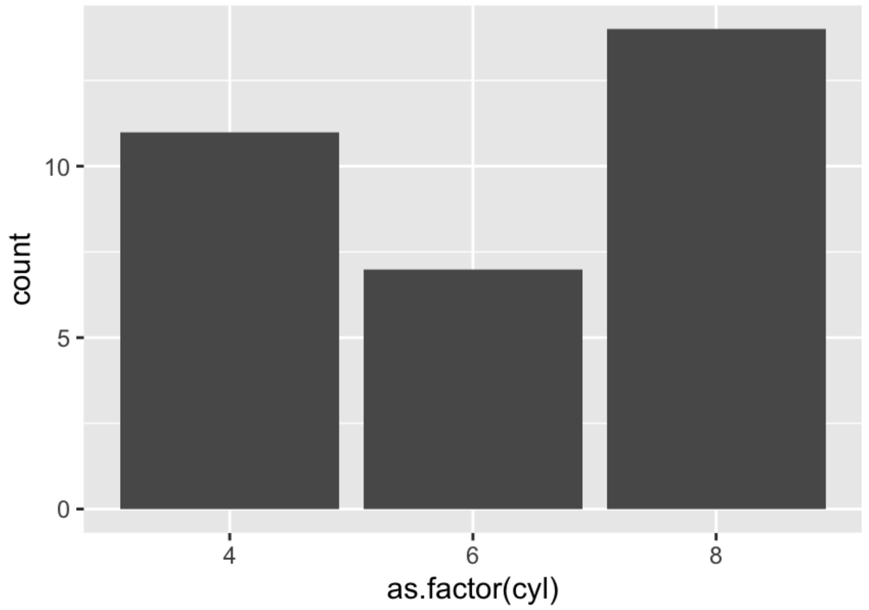
The stages of ggplot

- Stage 1: direct input - plot data provided by the user (including calculating statistics)
- Stage 2: after stat transformation - statistics have been calculated and can be used for plotting
- Stage 3: after scale transformation - values have been maped to scales

Using the stages of ggplot

Stage 1: direct input

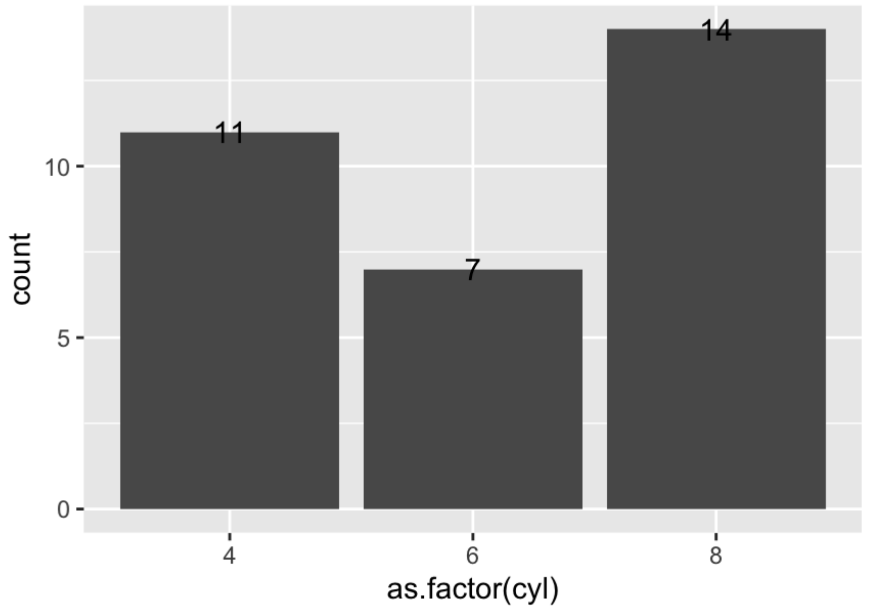
```
ggplot(data = mtcars,
       mapping = aes(x = as.factor(cyl))) +
  geom_bar(stat = 'count')
```



Using the stages of ggplot

Stage 2: after stat transformation

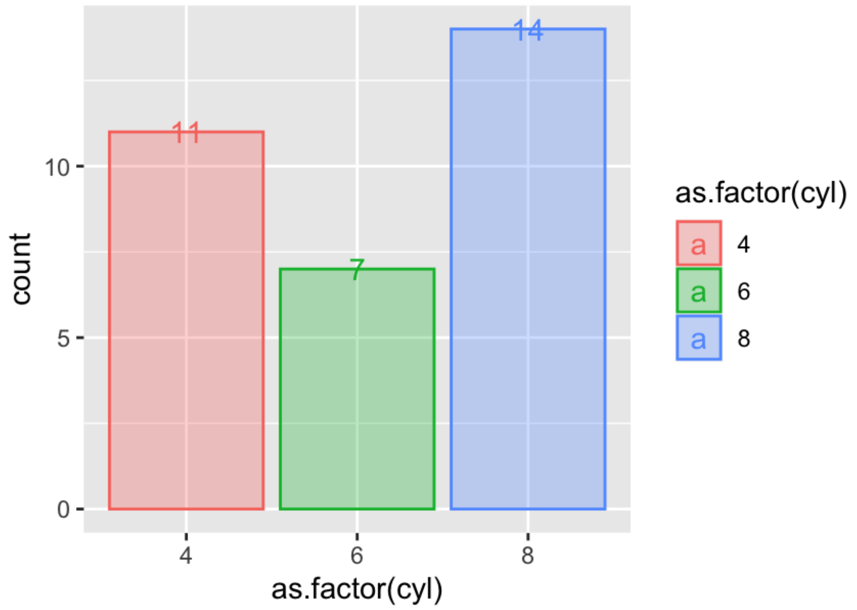
```
ggplot(data = mtcars,
       mapping = aes(x = as.factor(cyl))) +
  geom_bar(stat = 'count') +
  geom_text(mapping = aes(
              label = after_stat(count)),
            stat = 'count')
```



Using the stages of ggplot

Stage 3: after scale transformation

```
ggplot(data = mtcars,
       mapping = aes(x = as.factor(cyl),
                     color = as.factor(cyl),
                     fill = after_scale(
                       alpha(color, 0.3)))) +
  geom_bar(stat = 'count') +
  geom_text(mapping = aes(
                label = after_stat(count)),
            stat = 'count')
```



The stages of ggplot

- Stage 1: direct input - plot data provided by the user (including calculating statistics)
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More info: https://ggplot2.tidyverse.org/reference/aes_eval.html