

# Grammer of graphics with `ggplot`

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# Introduction

# Grammer of graphics

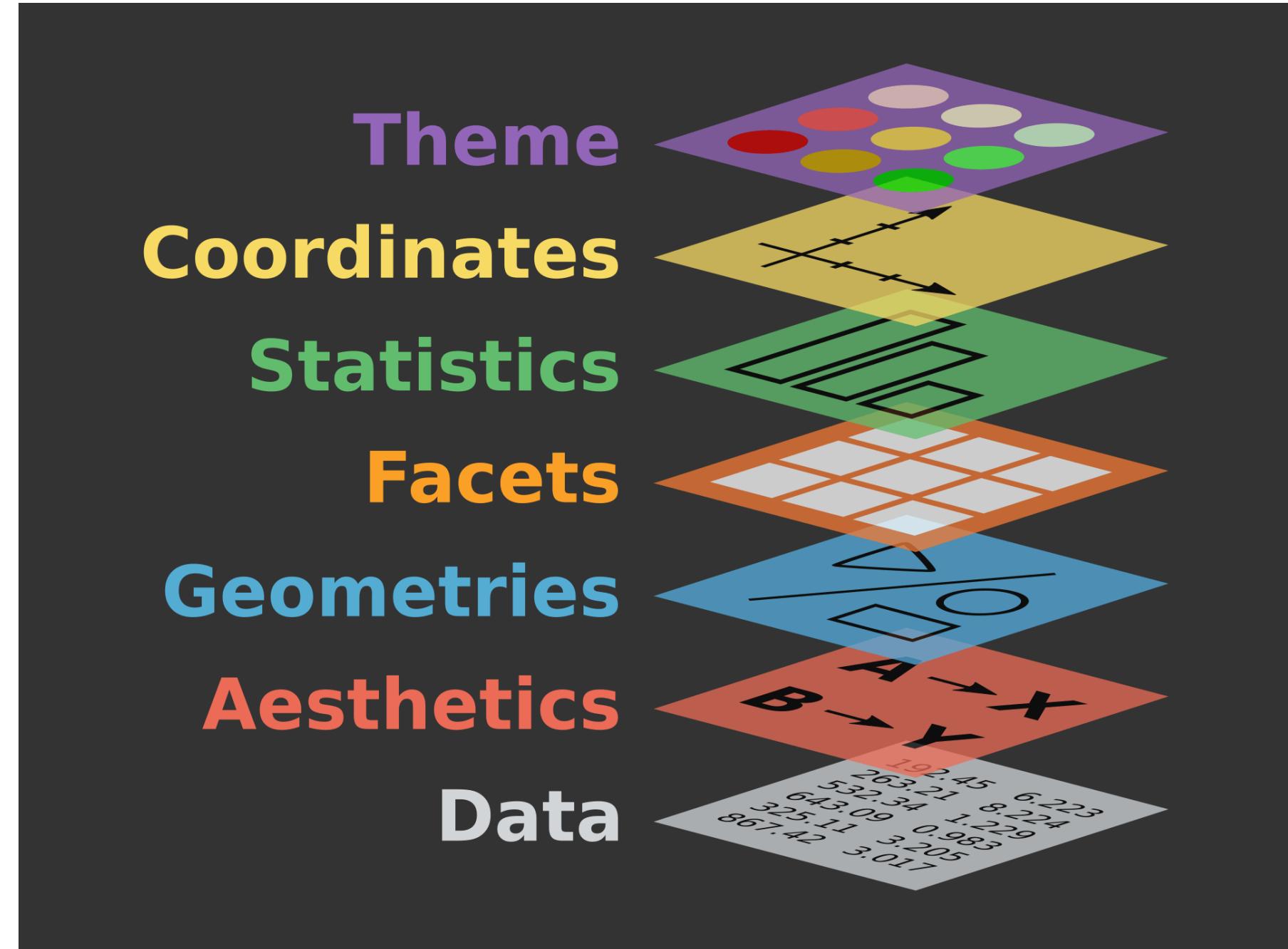
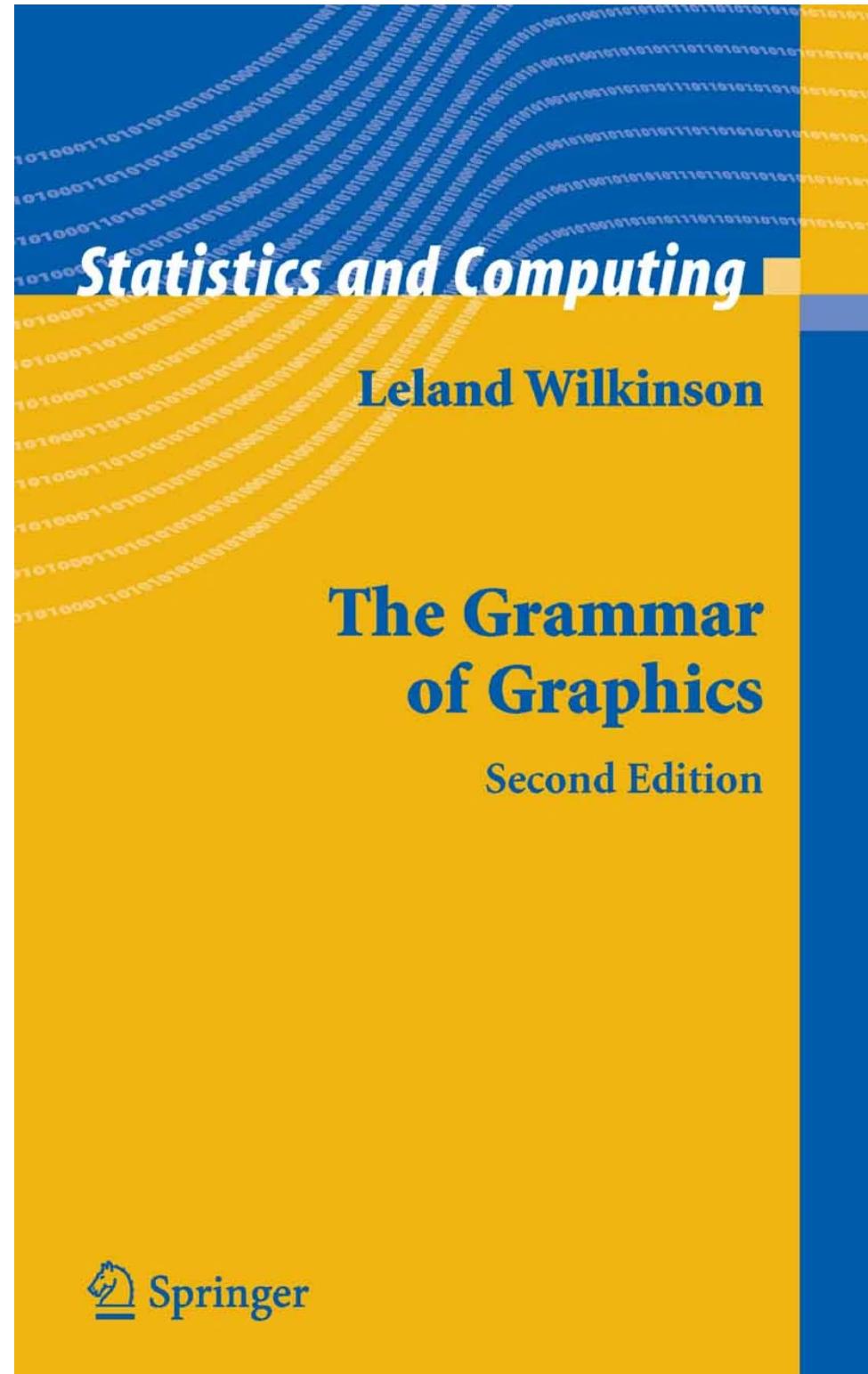


Image adapted from the [The Grammar of Graphics](#)

# Plotting system in R

## Base

[Book](#) | [Tutorials](#) | Cheatsheets: [1](#), [2](#)

# Plotting system in R

Base

Lattice

[Book](#) | [Video](#) | [Tutorial](#)

# Plotting system in R

Base

Lattice

ggplot2

[Website](#) | [Book](#) | Videos: [Part-1](#), [Part-2](#)

More: [Github:erikgahner/awesome-ggplot2](#)

# Components of ggplot2

```
1 ggplot(<DATA>, aes(<MAPPING>)) +  
2   geom_*(<MAPPING>) +  
3   scale_x_*(<SCALE_SPEC>) +  
4   scale_y_*(<SCALE_SPEC>) +  
5   facet_grid(ROW_FACET ~ COL_FACET)  
6   coord_<COORD_SYSTEM>(<SPEC>) +  
7   theme(<THEME_ARGUMENTS>)
```

THEME  
COORDINATES  
FACETS  
GEOMETRIES  
SCALES  
STATISTICS  
MAPPING  
DATA



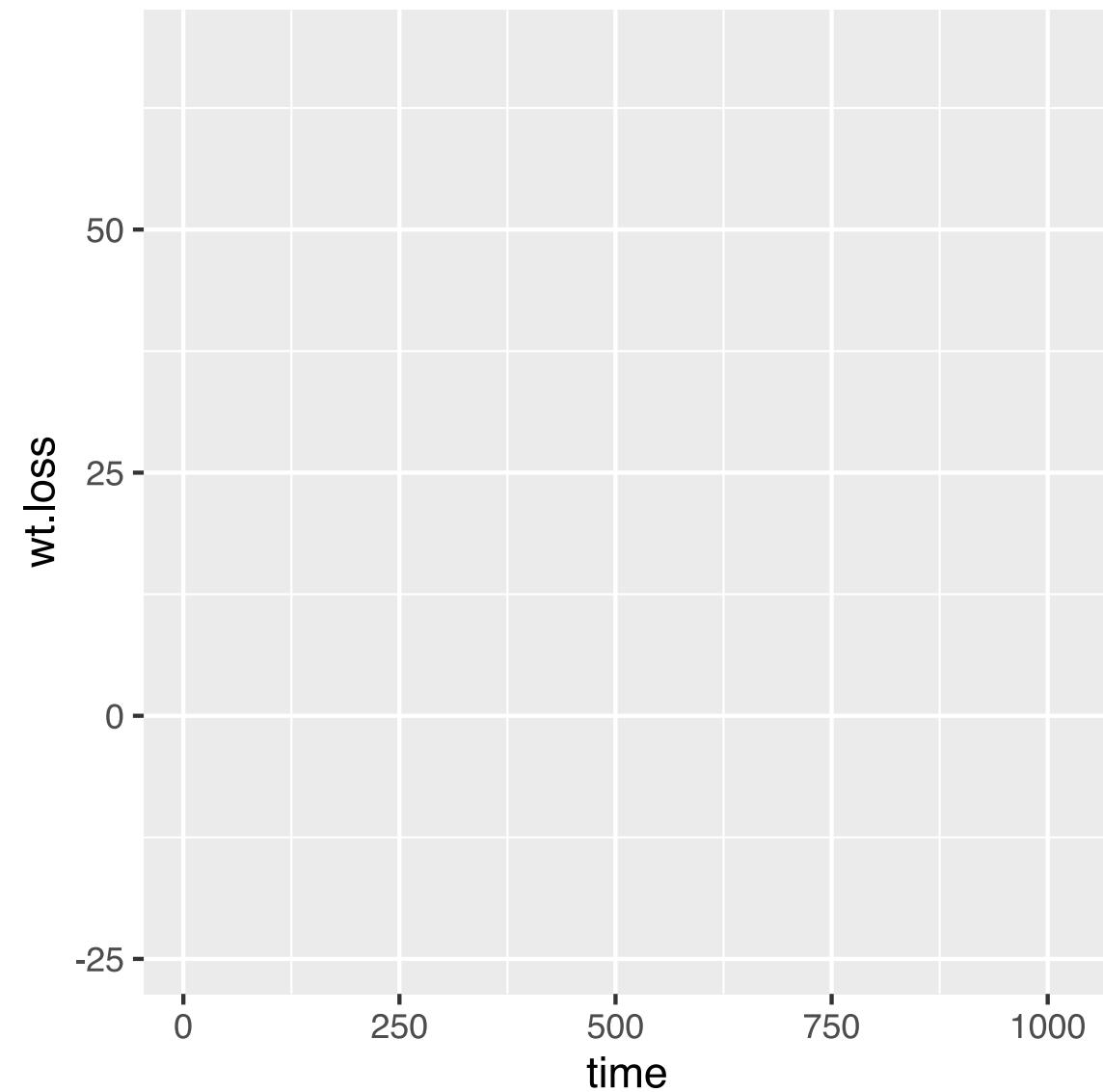
# Components of ggplot2

```
1 ggplot(<DATA>, aes(<MAPPING>)) +  
2   geom_*(<MAPPING>) +  
3   stat_*(geom = <GEOM>, fun = <FUN>) +  
4   facet_grid(ROW_FACET ~ COL_FACET) +  
5   coord_<COORD_SYSTEM>(<SPEC>) +  
6   theme(<THEME_ARGUMENTS>)
```

Dataset: **cancer**, Package: **survival**

# Components of ggplot2

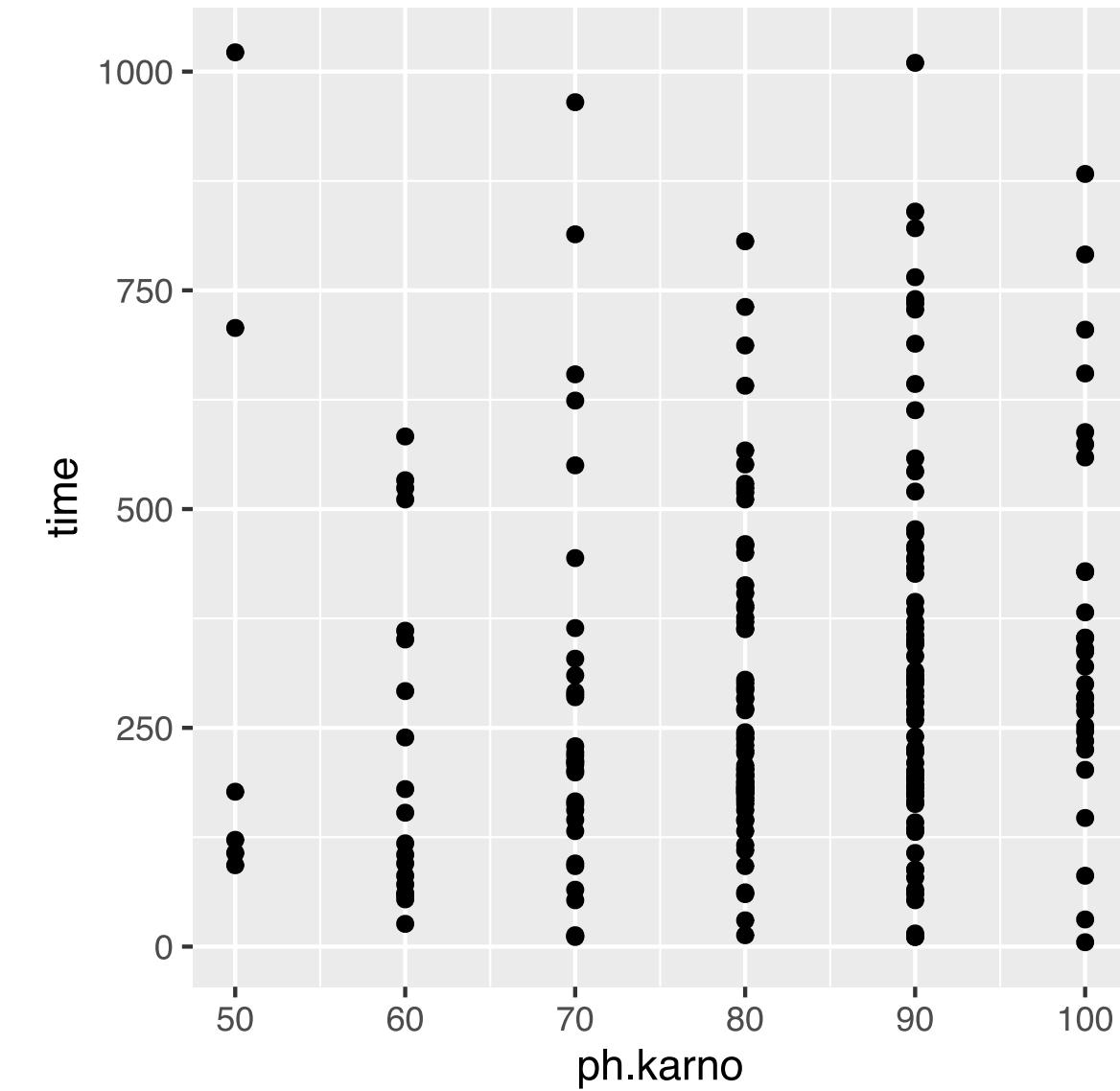
```
1 ggplot(cancer, aes(x = ph.karno, y = time))  
2   geom_*(<MAPPING>) +  
3   stat_*(geom = <GEOM>, fun = <FUN>) +  
4   facet_grid(ROW_FACET ~ COL_FACET) +  
5   coord_<COORD_SYSTEM>(<SPEC>) +  
6   theme(<THEME_ARGUMENTS>)
```



Dataset: **cancer**, Package: **survival**

# Components of ggplot2

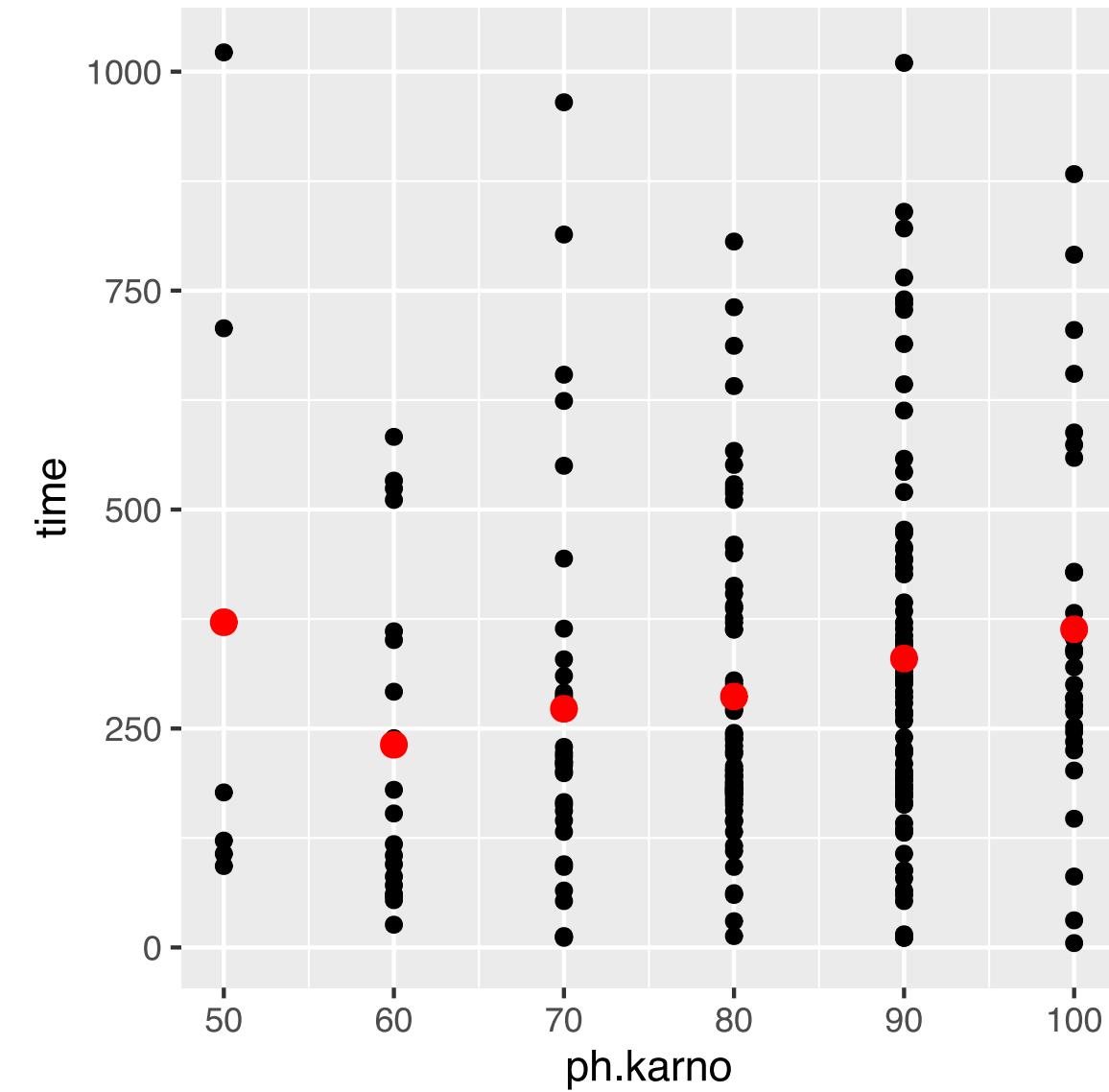
```
1 ggplot(cancer, aes(x = ph.karno, y = time))  
2   geom_point() +  
3   stat_*(geom = <GEOM>, fun = <FUN>) +  
4   facet_grid(ROW_FACET ~ COL_FACET) +  
5   coord_<COORD_SYSTEM>(<SPEC>) +  
6   theme(<THEME_ARGUMENTS>)
```



Dataset: **cancer**, Package: **survival**

# Components of ggplot2

```
1 ggplot(cancer, aes(x = ph.karno, y = time))  
2   geom_point() +  
3   stat_summary(fun = mean, color = "red") +  
4   facet_grid(ROW_FACET ~ COL_FACET) +  
5   coord_<COORD_SYSTEM>(<SPEC>) +  
6   theme(<THEME_ARGUMENTS>)
```

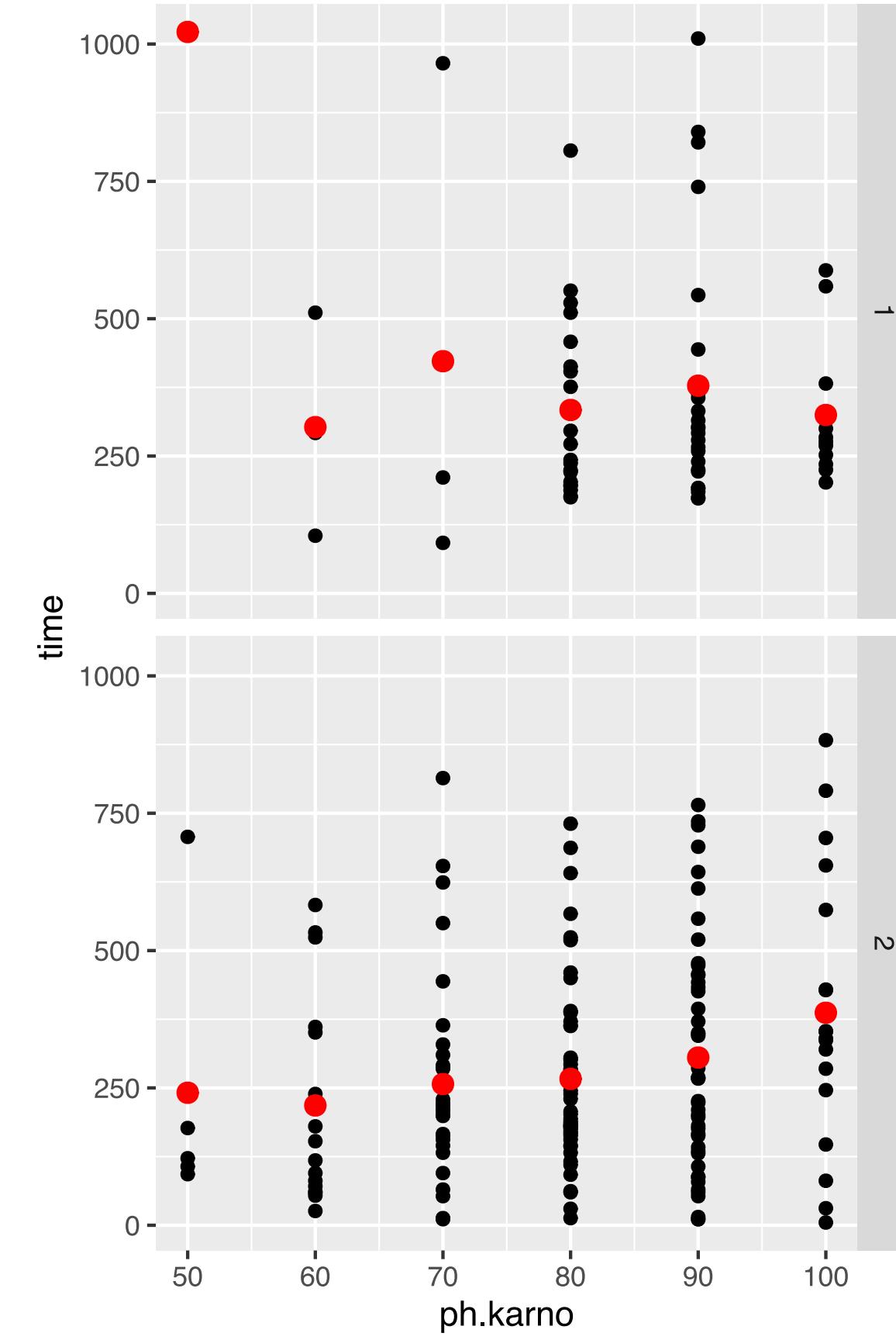


Dataset: **cancer**, Package: **survival**

# Components of ggplot2

```
1 ggplot(cancer, aes(x = ph.karno, y = time))  
2   geom_point() +  
3   stat_summary(fun = mean, color = "red") +  
4   facet_grid(status ~ .) +  
5   coord_<COORD_SYSTEM>(<SPEC>) +  
6   theme(<THEME_ARGUMENTS>)
```

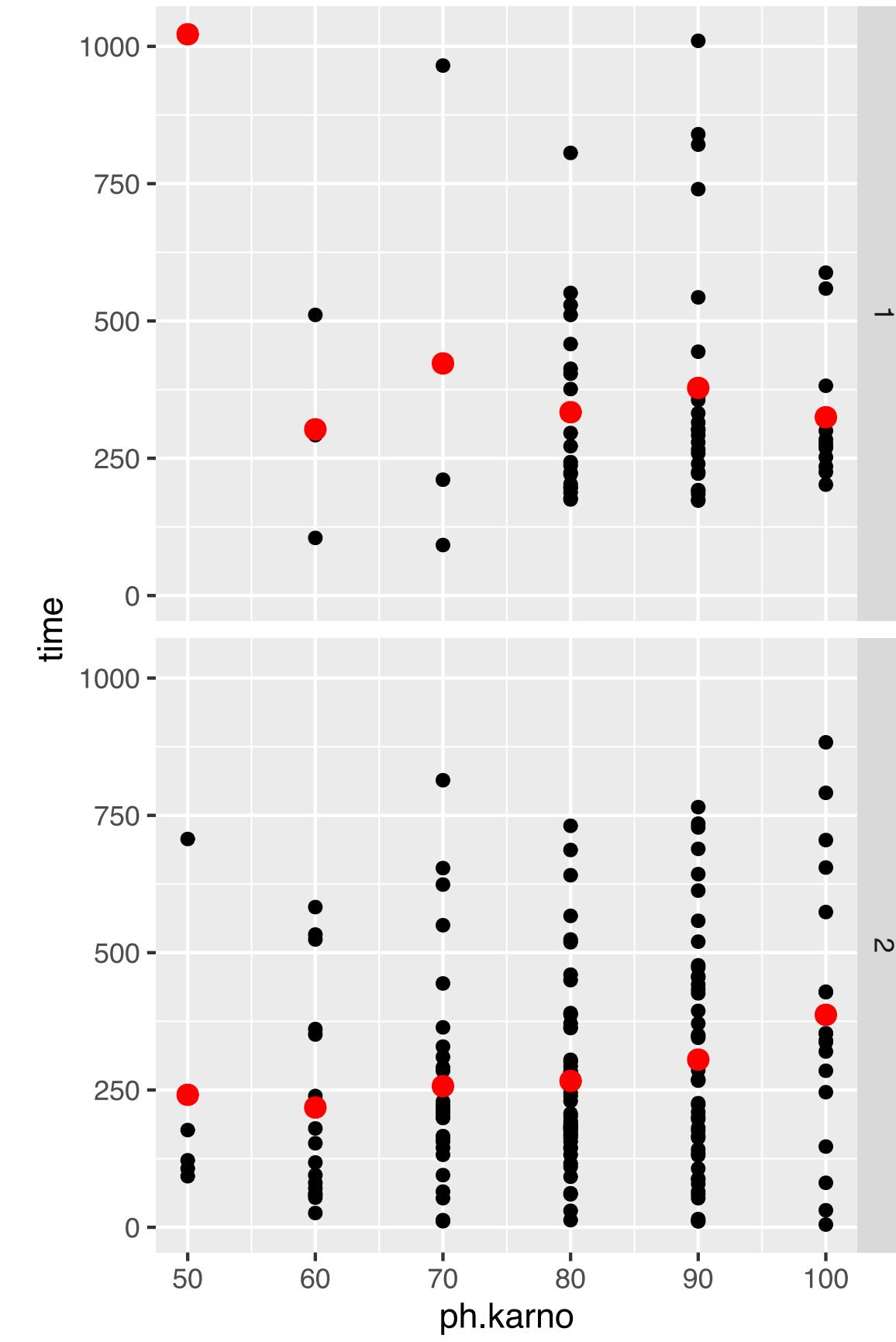
Dataset: **cancer**, Package: **survival**



# Components of ggplot2

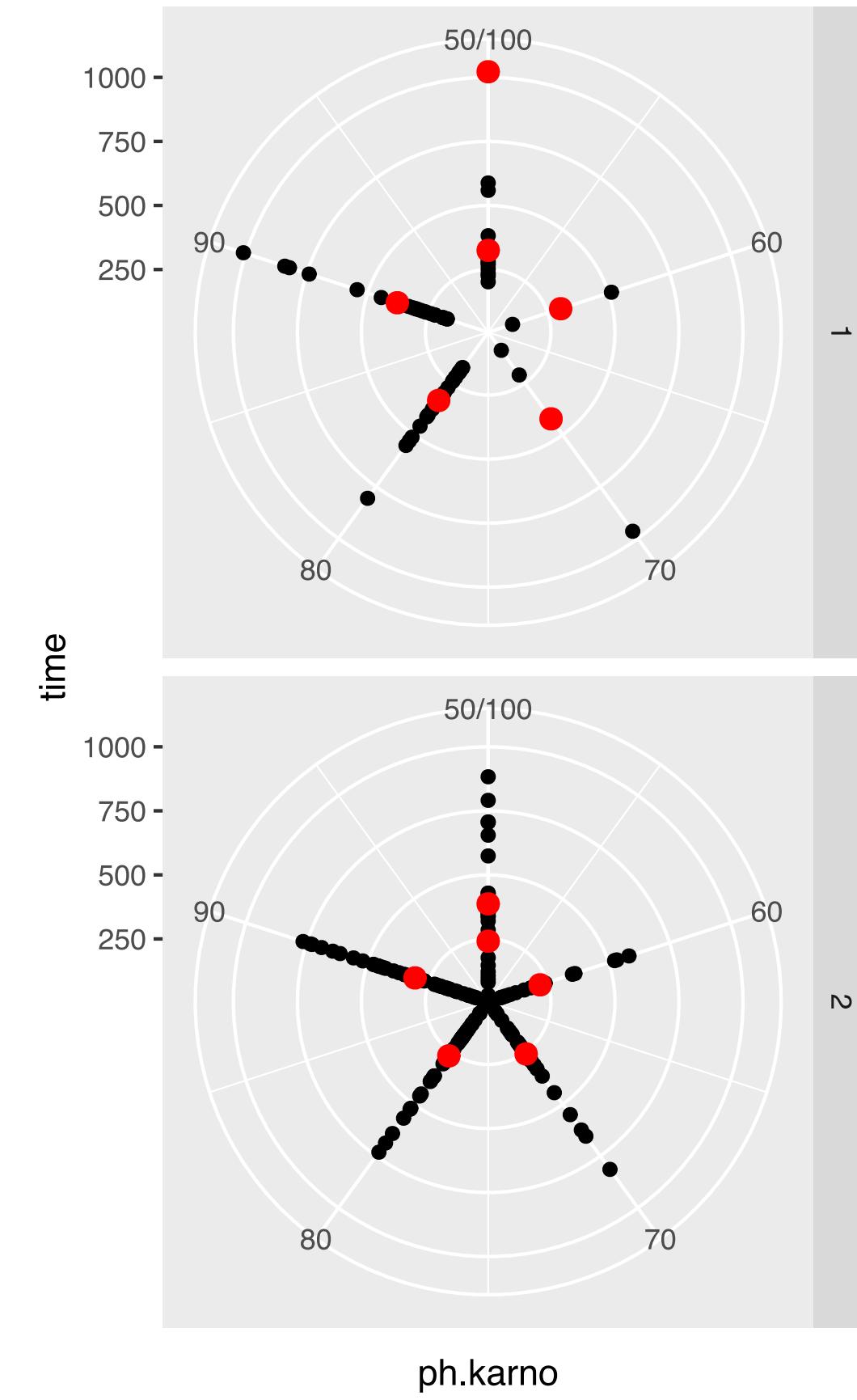
```
1 ggplot(cancer, aes(x = ph.karno, y = time))  
2   geom_point() +  
3   stat_summary(fun = mean, color = "red") +  
4   facet_grid(status ~ .) +  
5   coord_cartesian() +  
6   theme(<THEME_ARGUMENTS>)
```

Dataset: **cancer**, Package: **survival**



# Components of ggplot2

```
1 ggplot(cancer, aes(x = ph.karno, y = time))  
2   geom_point() +  
3   stat_summary(fun = mean, color = "red") +  
4   facet_grid(status ~ .) +  
5   coord_polar() +  
6   theme(<THEME_ARGUMENTS>)
```

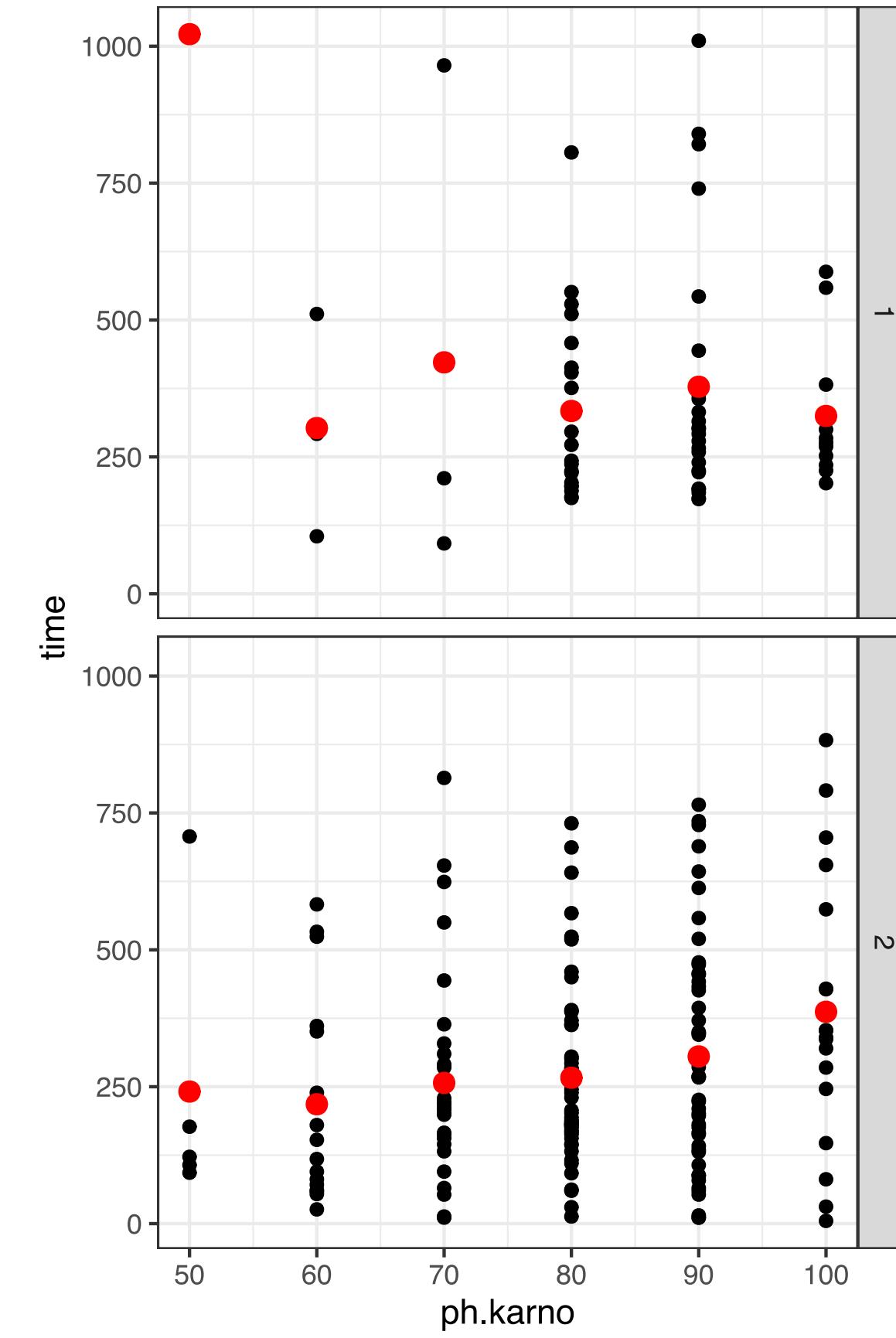


Dataset: **cancer**, Package: **survival**

# Components of ggplot2

```
1 ggplot(cancer, aes(x = ph.karno, y = time))  
2   geom_point() +  
3   stat_summary(fun = mean, color = "red") +  
4   facet_grid(status ~ .) +  
5   coord_cartesian() +  
6   theme_bw()
```

Dataset: **cancer**, Package: **survival**

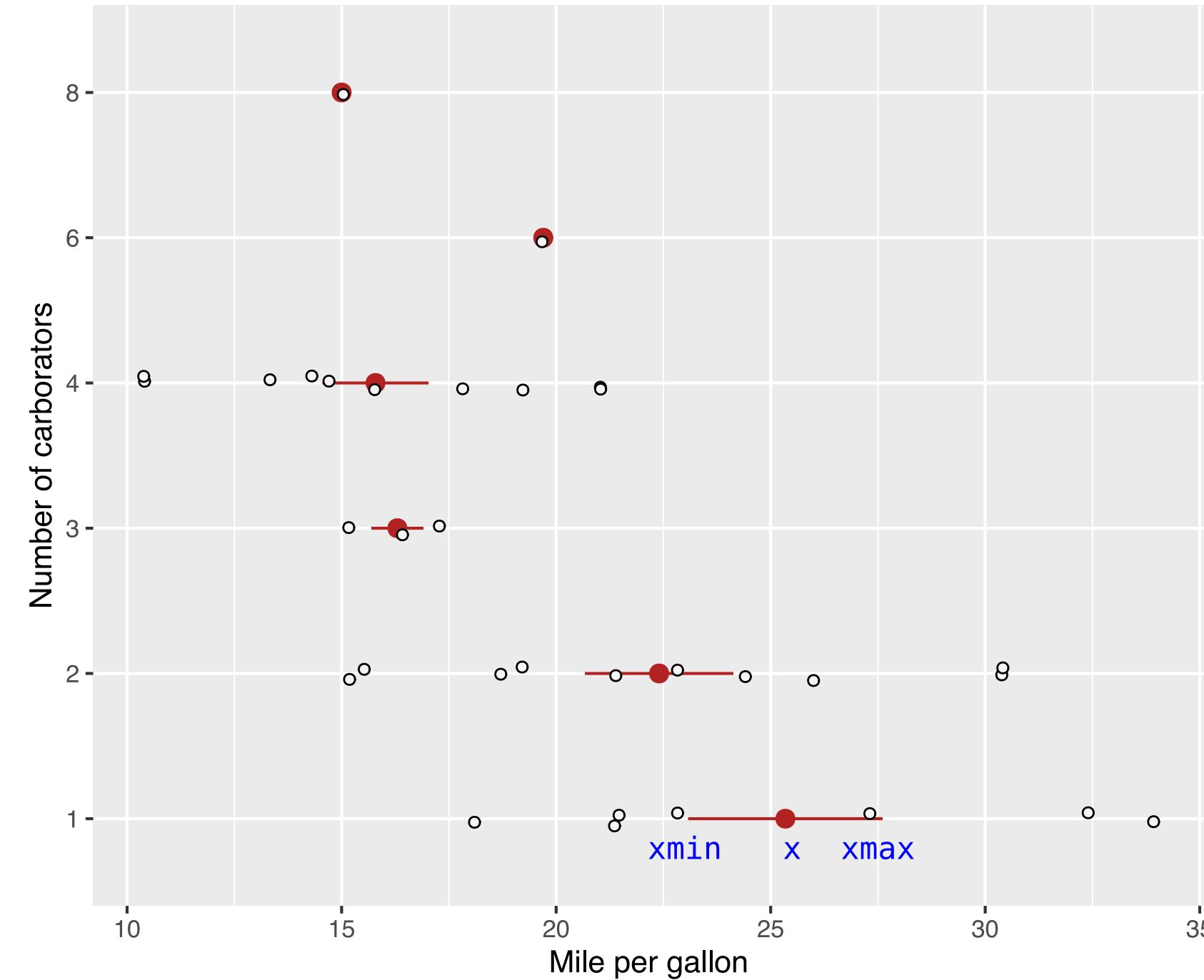


# Customizing ggplot2

# Aesthetic mappings

- `x, xmin, xmax`

► Code

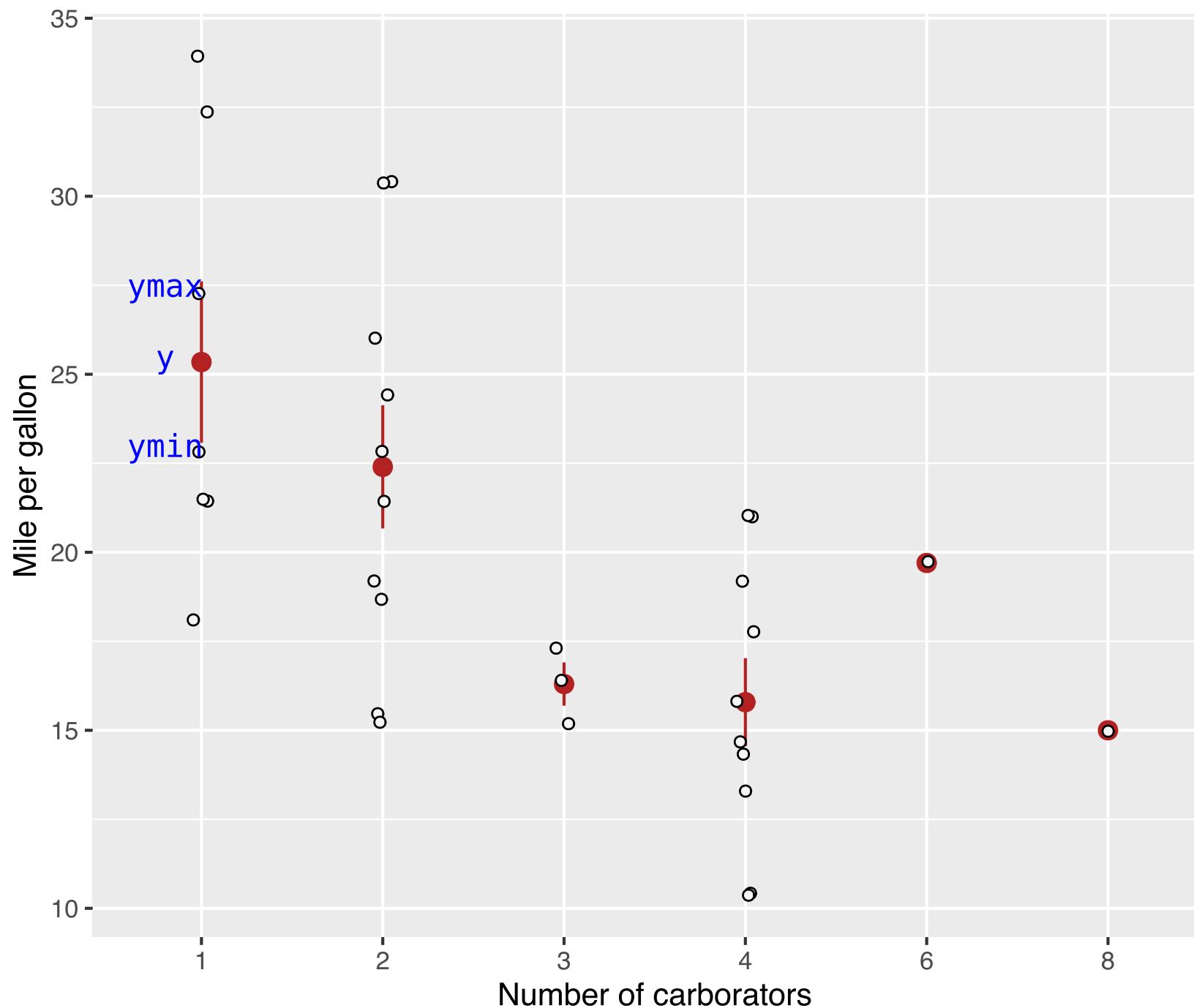


Dataset: `mtcars`, Package: `datasets`

# Aesthetic mappings

- `x, xmin, xmax`
- `y, ymin, ymax`

► Code

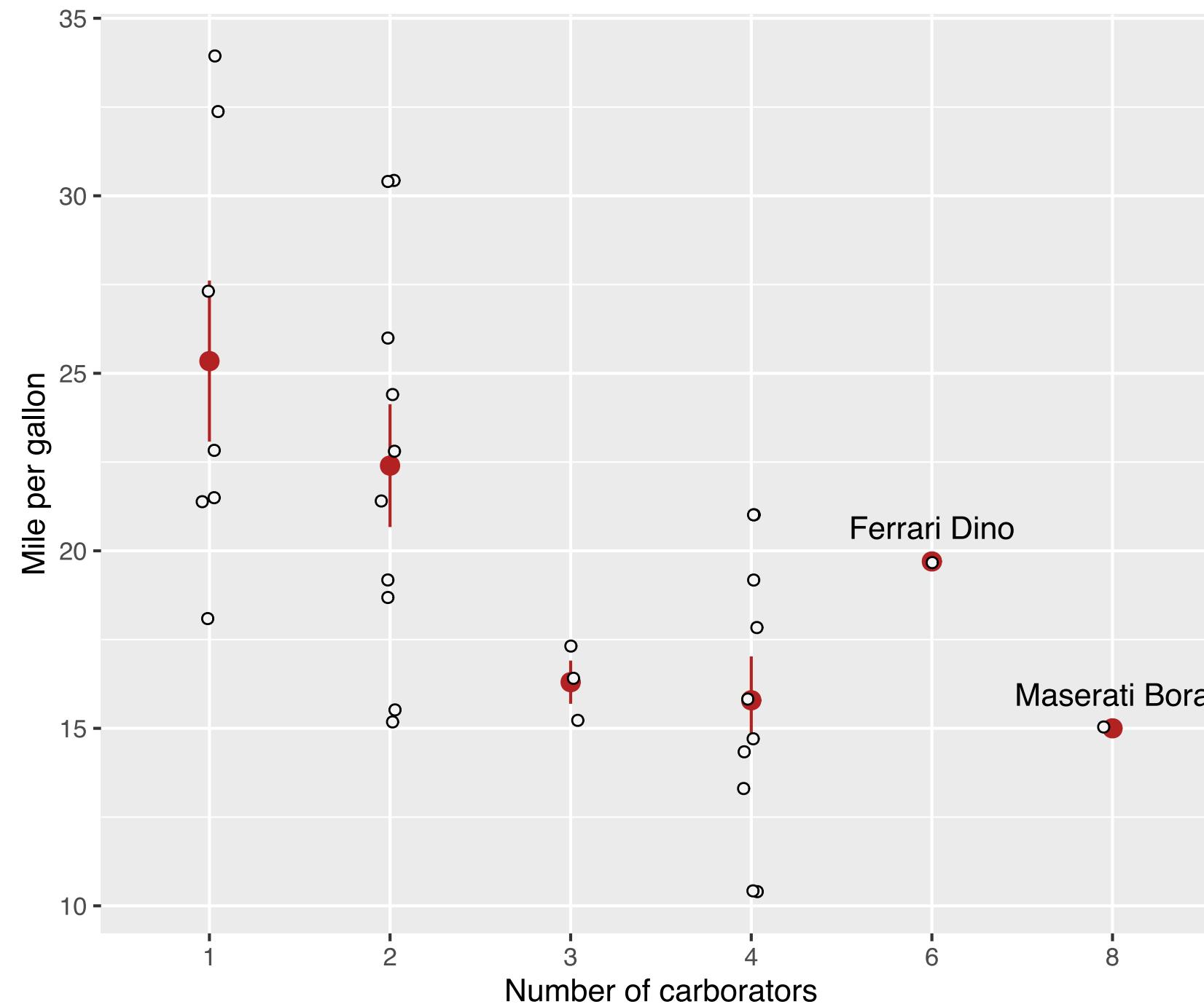


Dataset: `mtcars`, Package: `datasets`

# Aesthetic mappings

- `x, xmin, xmax`
- `y, ymin, ymax`
- `label`

► Code

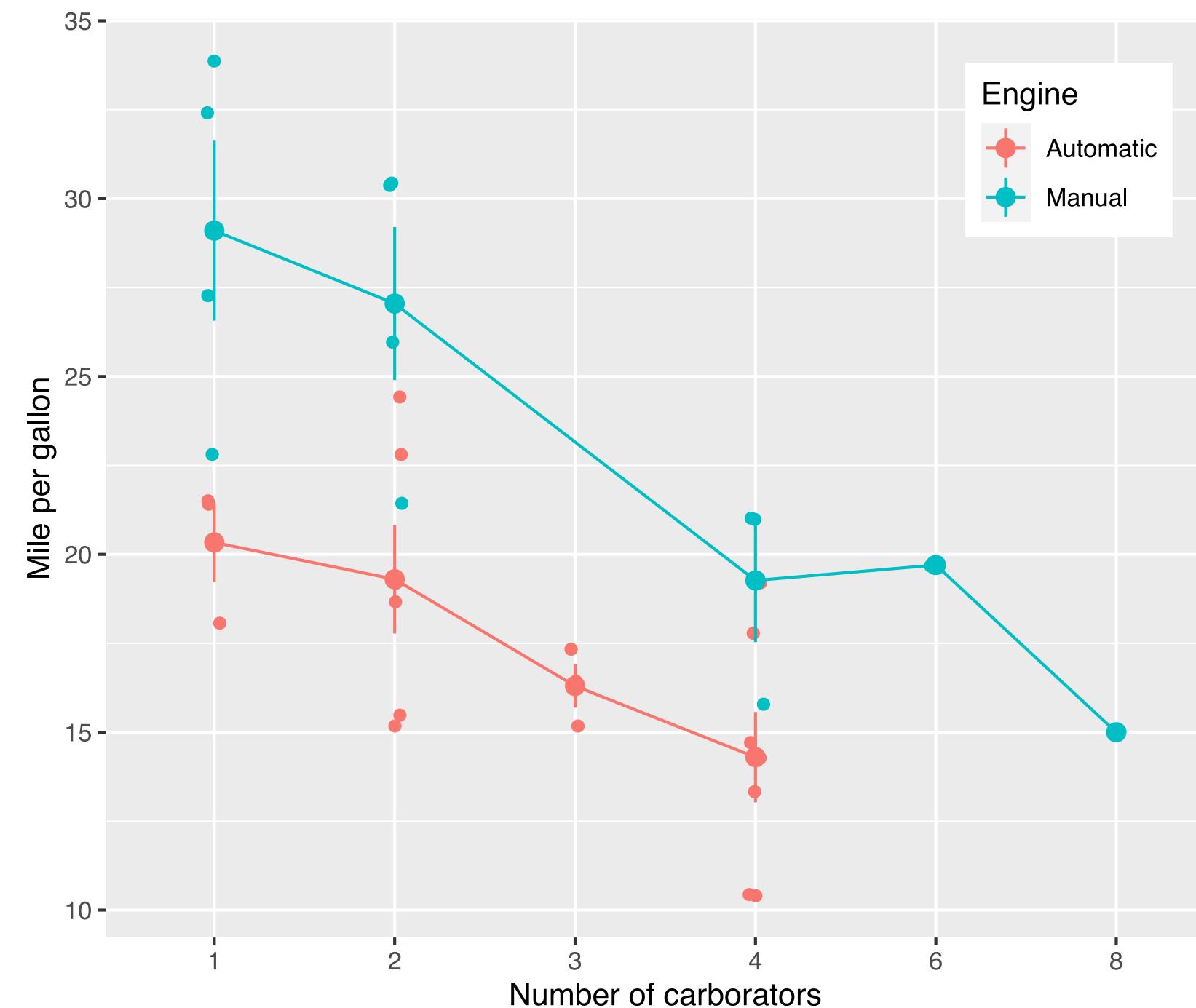


Dataset: `mtcars`, Package: `datasets`

# Aesthetic mappings

- `x, xmin, xmax`
- `y, ymin, ymax`
- `label`
- `group`
- `fill, color`

► Code

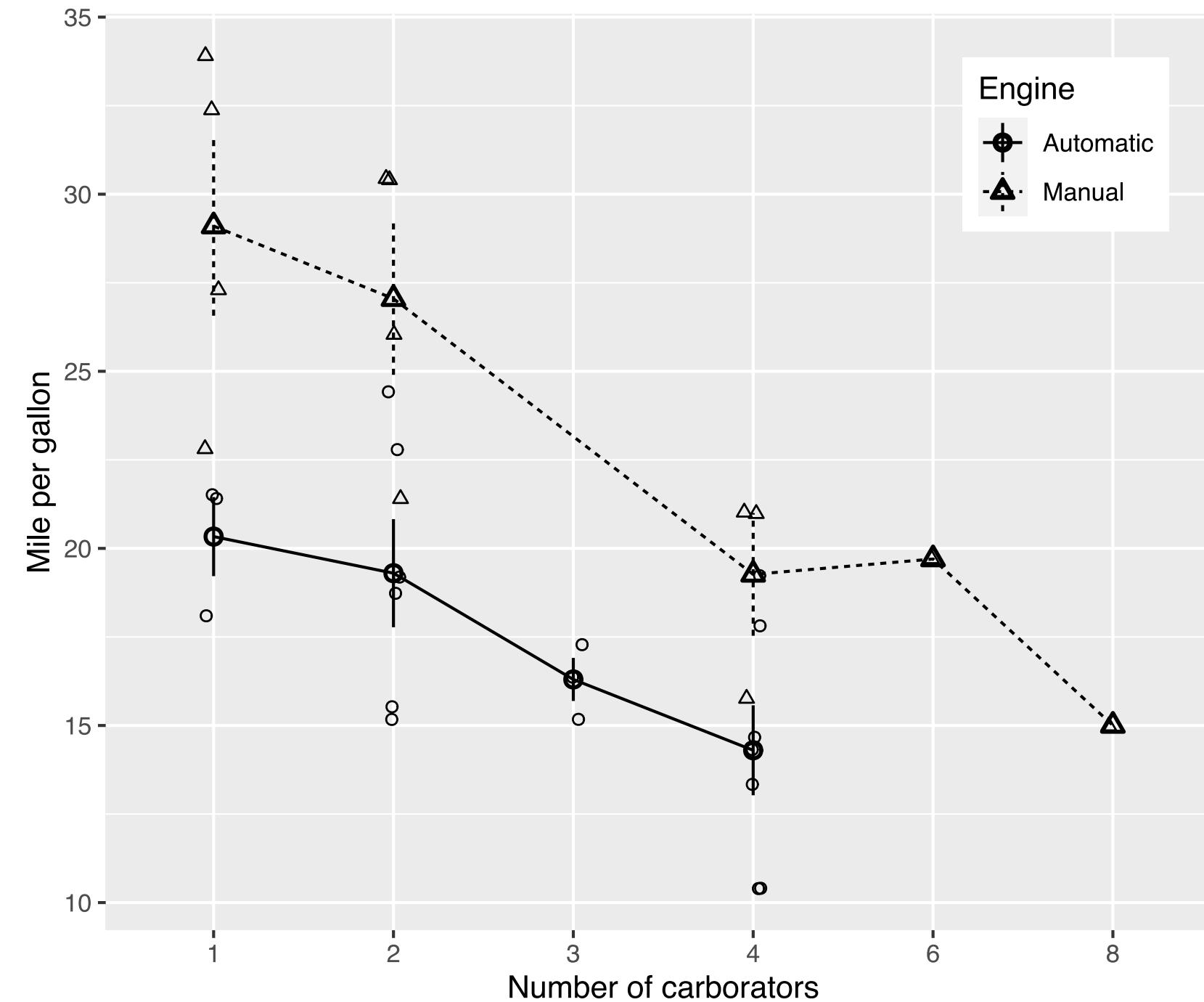


Dataset: `mtcars`, Package: `datasets`

# Aesthetic mappings

- `x, xmin, xmax`
- `y, ymin, ymax`
- `label`
- `group`
- `fill, color`
- `size, alpha`
- `shape, linetype`

► Code

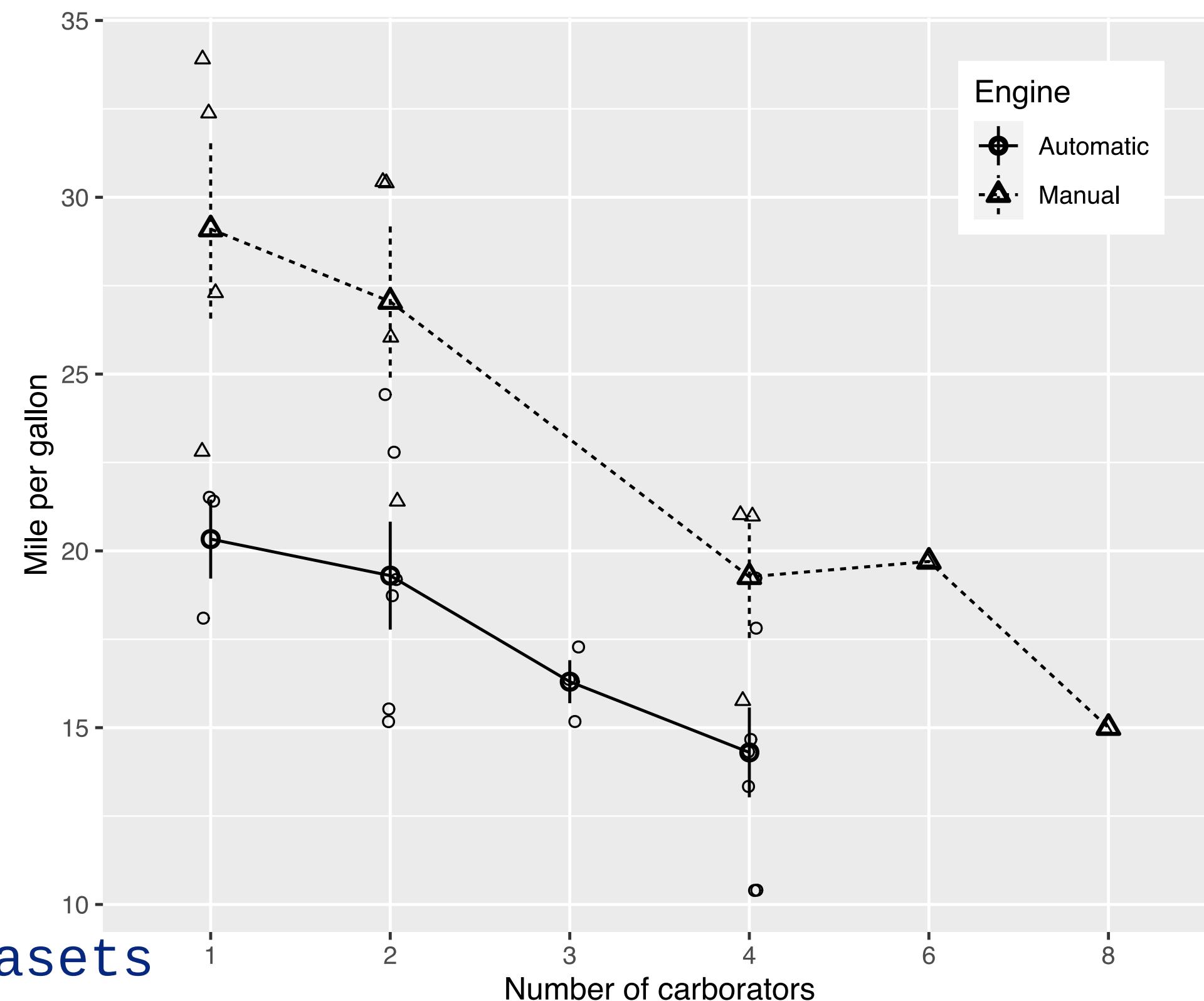


Dataset: `mtcars`, Package: `datasets`

# Summary statistics

- mean, median
- standard error  
(`mean_se`)
- standard deviation  
(`mean_sd`)

► Code

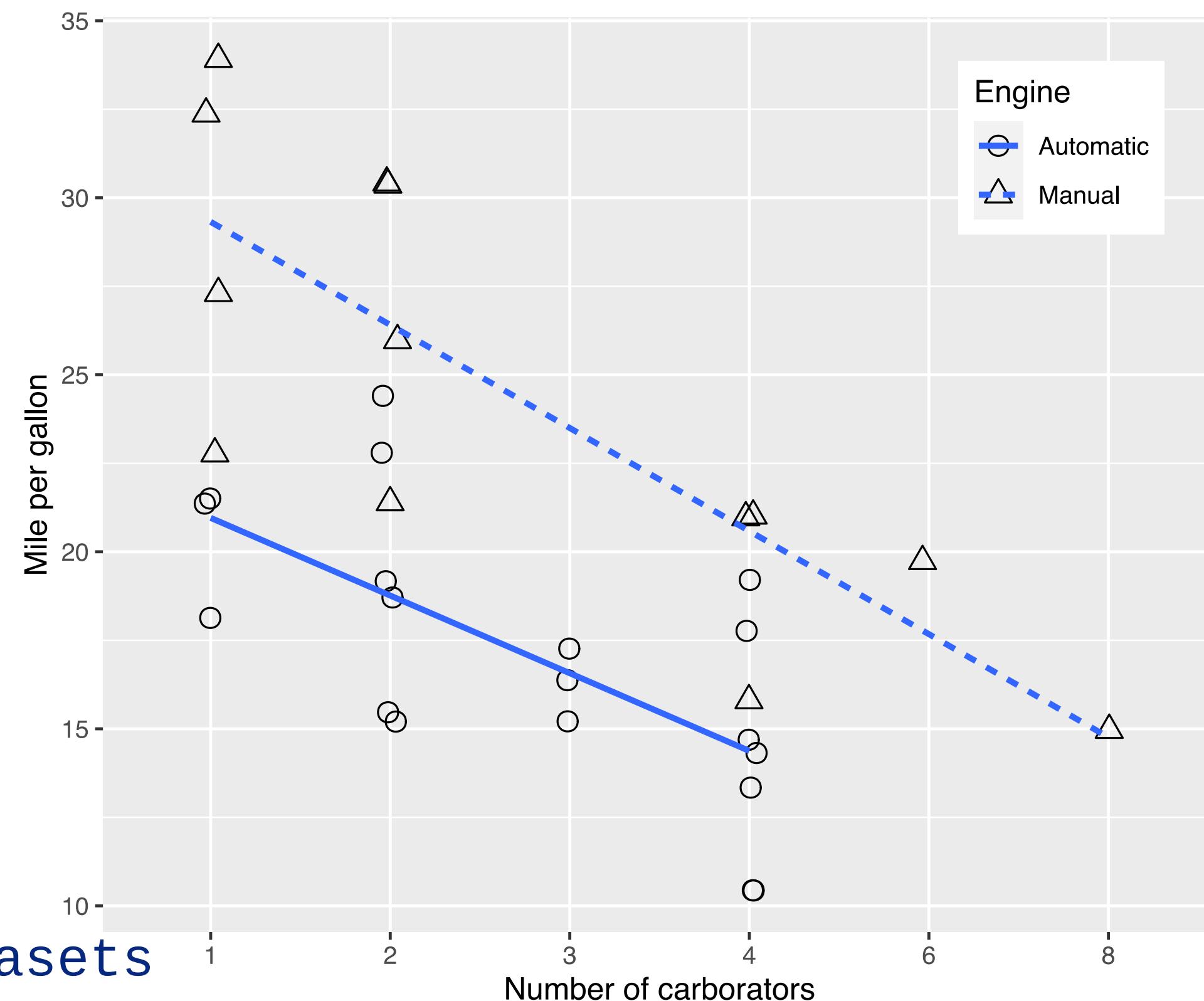


Dataset: `mtcars`, Package: `datasets`

# Summary statistics

- mean, median
- standard error  
(mean\_se)
- standard deviation  
(mean\_sdl)
- fitted model  
(geom\_smooth)

► Code



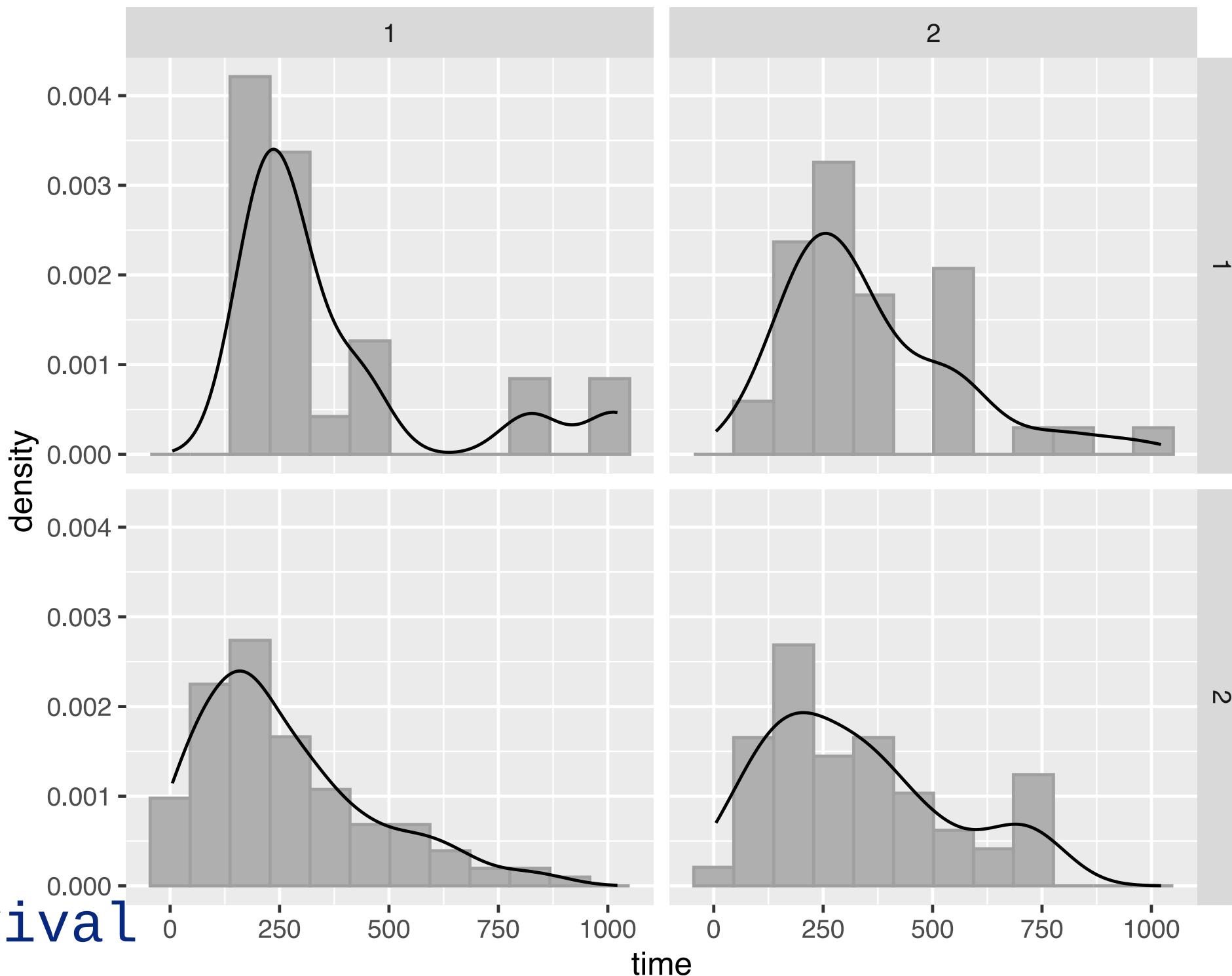
Dataset: mtcars, Package: datasets

# Faceting

► Code

facet\_grid

Example of facet grid



Dataset: **cancer**, Package: **survival**

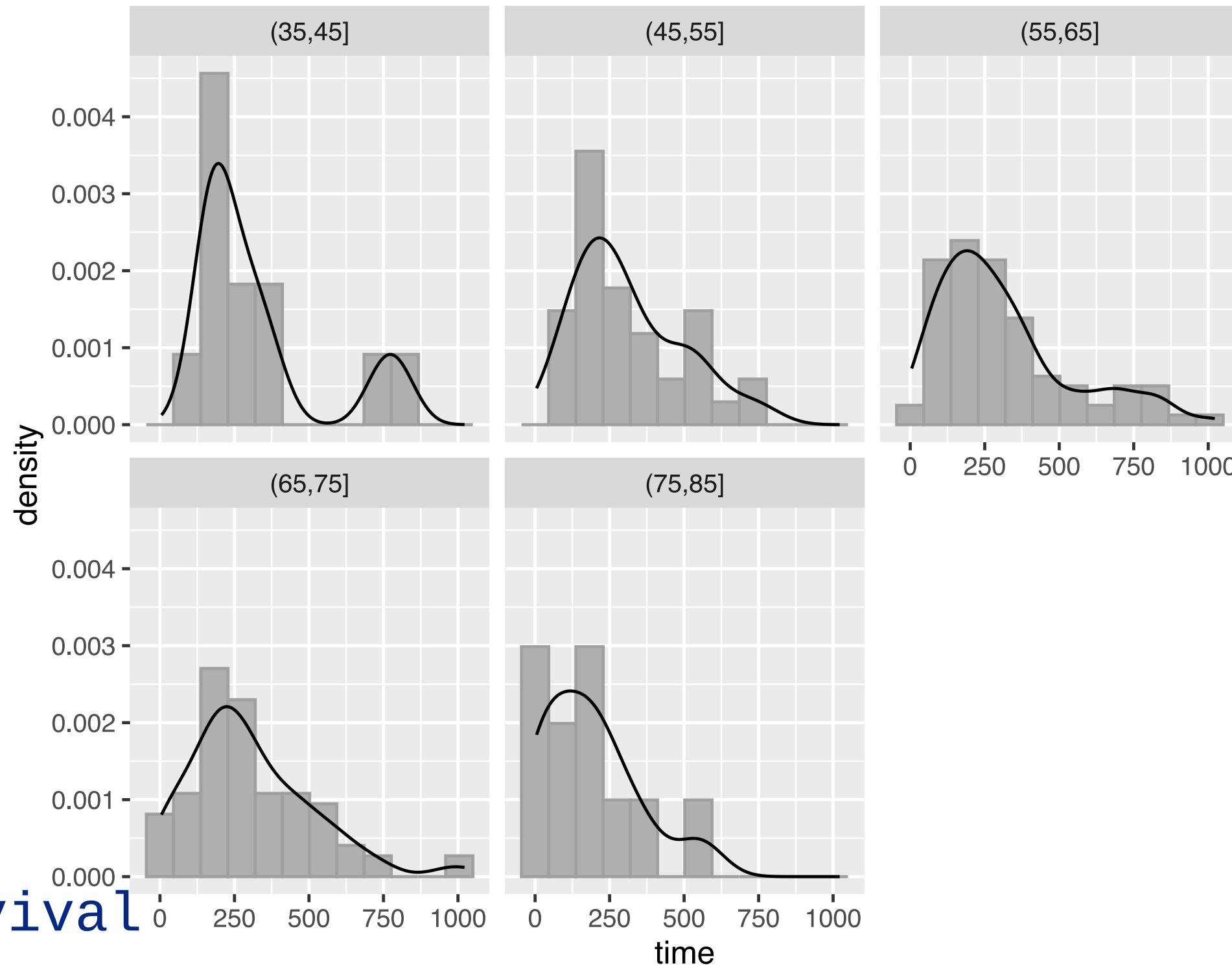
# Faceting

► Code

facet\_grid

facet\_wrap

Example of facet wrap



Dataset: **cancer**, Package: **survival**

# Faceting

► Code

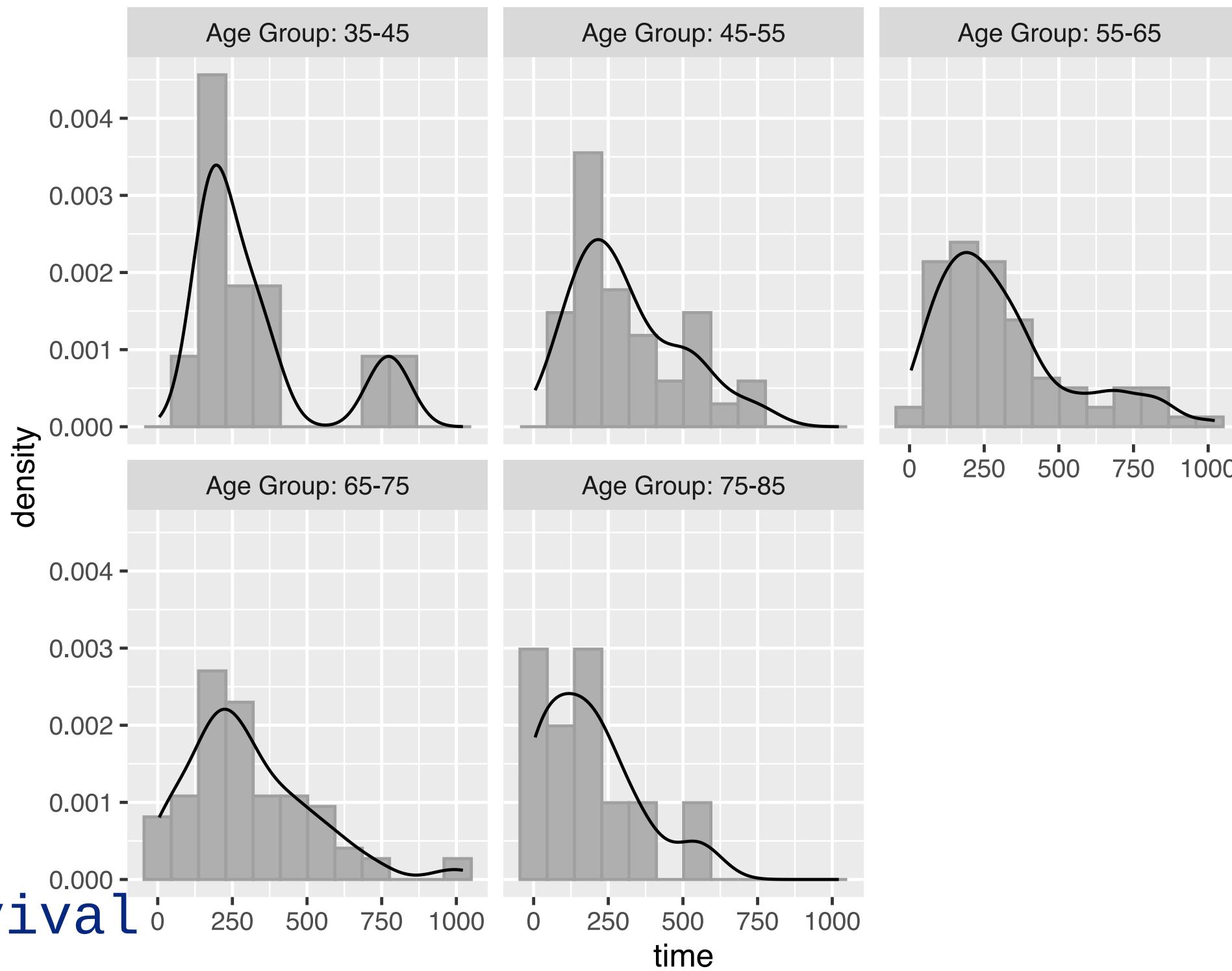
facet\_grid

facet\_wrap

labeller

Dataset: **cancer**, Package: **survival**

Example of facet wrap

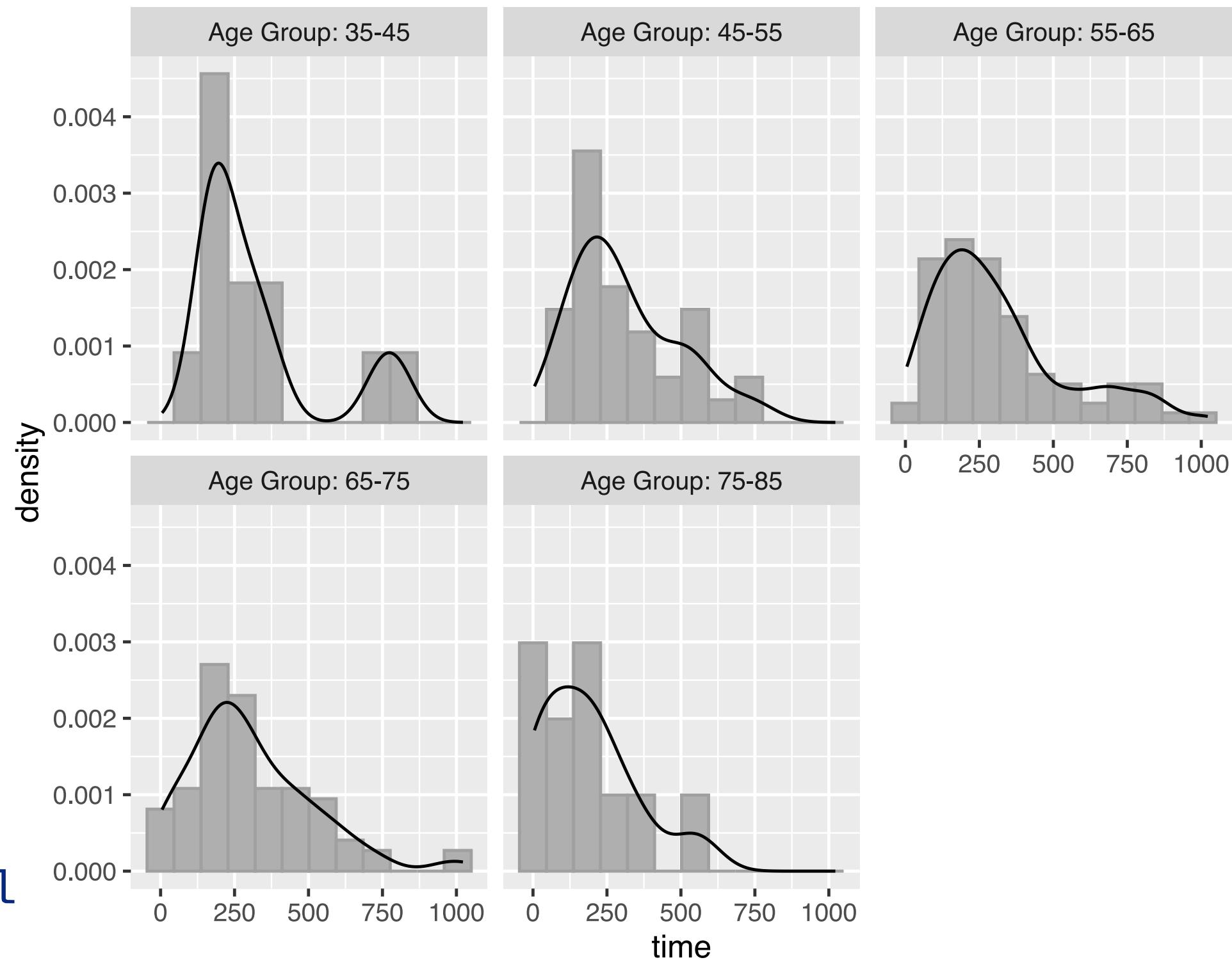


# Scale

Function to specify  
(customize) scales.  
Usually takes the form  
`scale_<GEOM>_<TYPE>`

## ► Code

Example of facet wrap



Dataset: `cancer`, Package: `survival`

# Scale

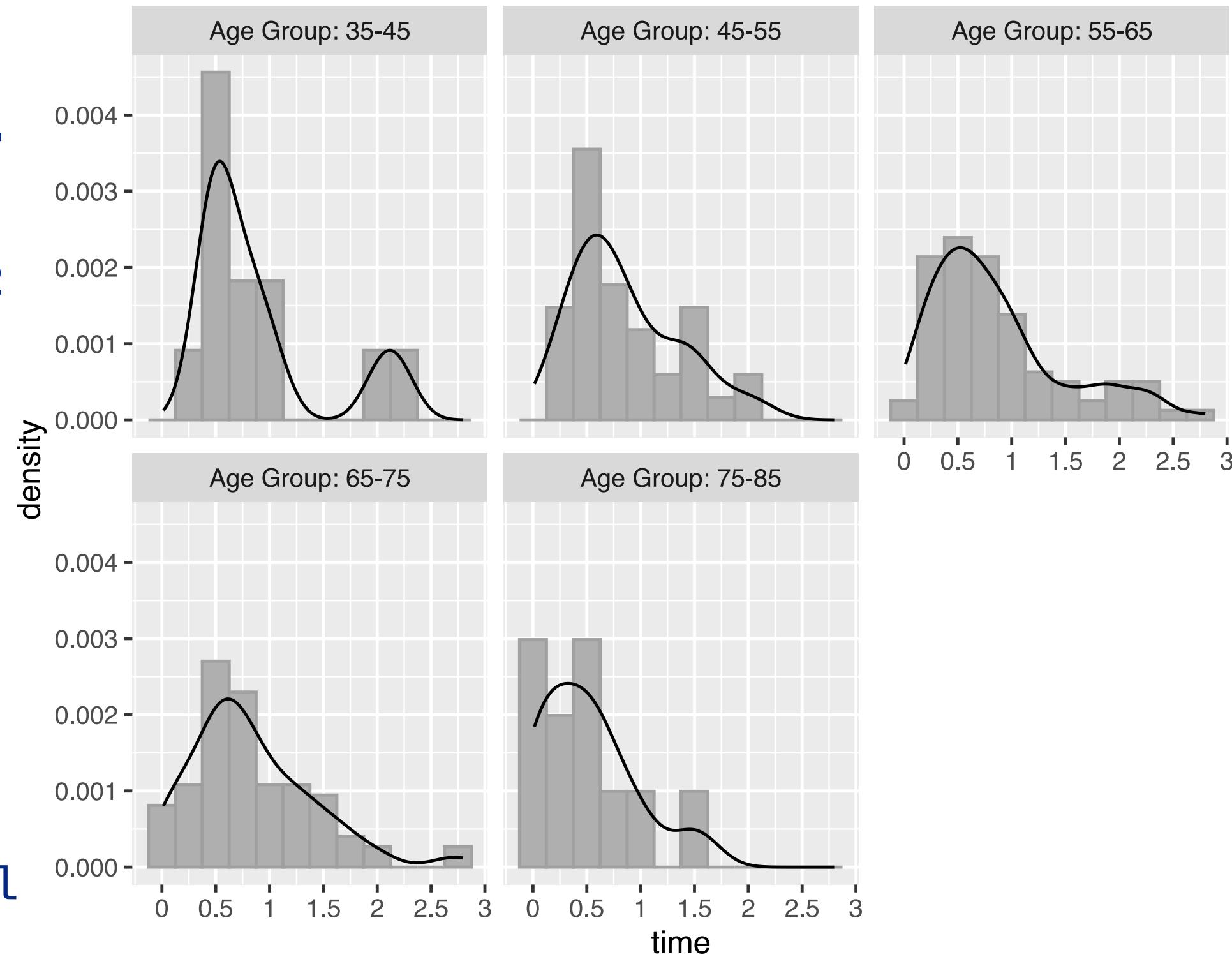
Function to specify  
(customize) scales.  
Usually takes the form  
`scale_<GEOM>_<TYPE>`

- `scale_x_continuous`
- `scale_x_discrete`

Dataset: `cancer`, Package: `survival`

## ► Code

Example of facet wrap



# Scale

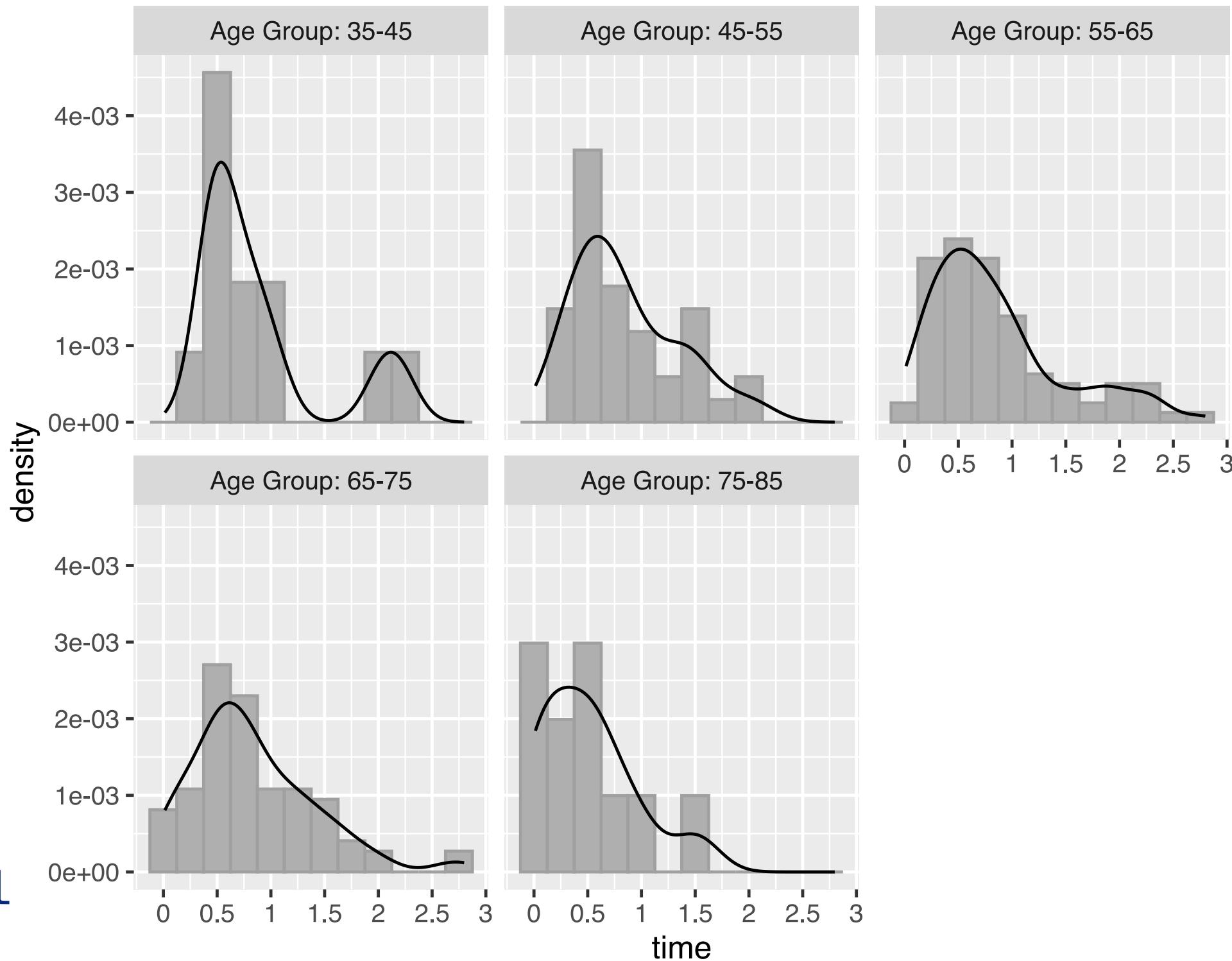
Function to specify  
(customize) scales.  
Usually takes the form  
`scale_<GEOM>_<TYPE>`

- `scale_x_continuous`
- `scale_x_discrete`
- `scale_y_continuous`
- `scale_y_discrete`

Dataset: `cancer`, Package: `survival`

## ► Code

Example of facet wrap



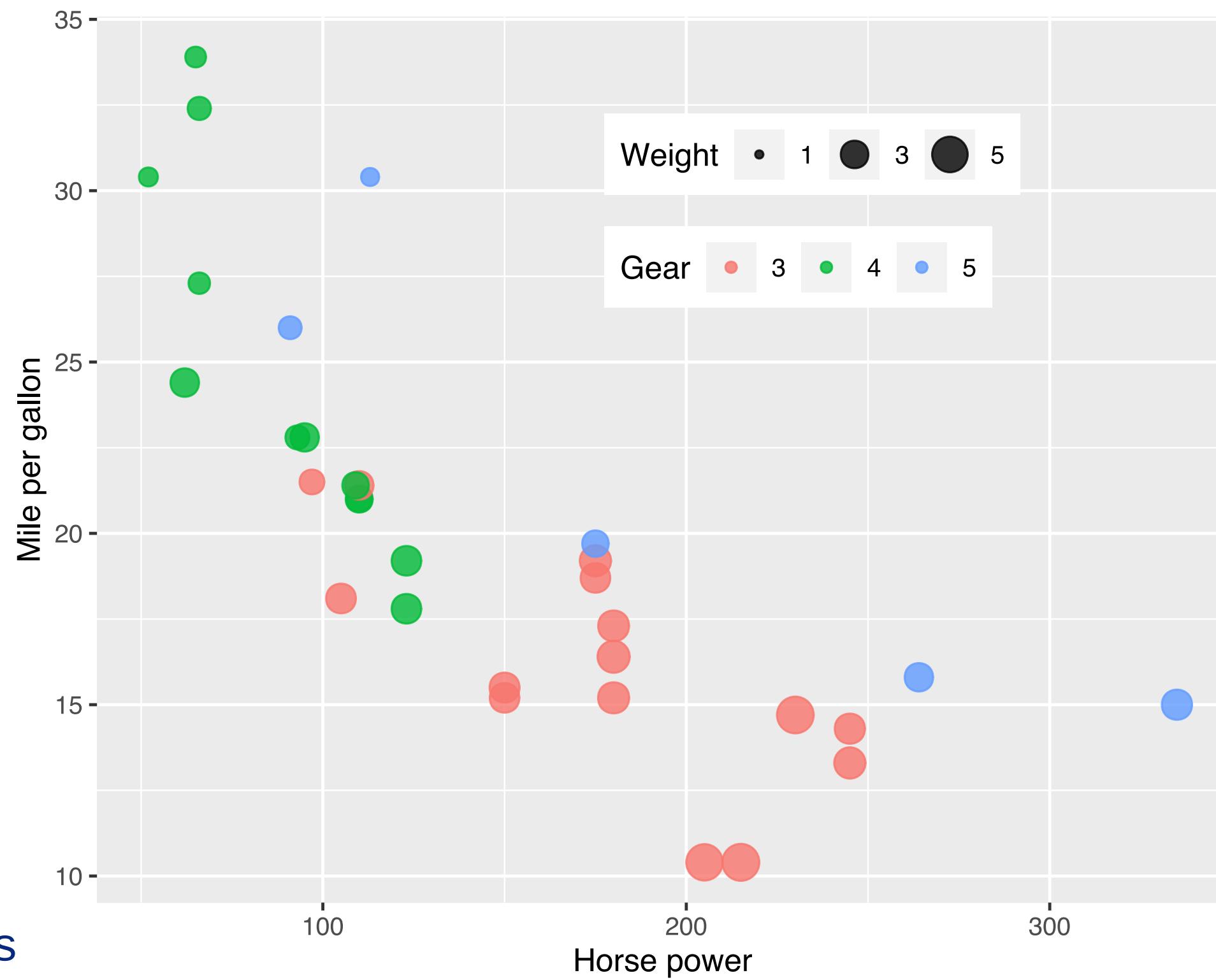
# Scale

- **scale\_color\_\***
- **scale\_fill\_\***
- **scale\_shape\_\***
- **scale\_linetype\_\***
- **scale\_alpha\_\***
- **scale\_size\_\***

See more at: [Scales and Guides](#)

Dataset: `mtcars`, Package: `datasets`

► Code



# Theming `ggplot2`

**axis**

title, text, ticks, line

**legend**

background, margin, spacing, key, title,  
position, direction justification, box

**panel**

spacing, grid, background

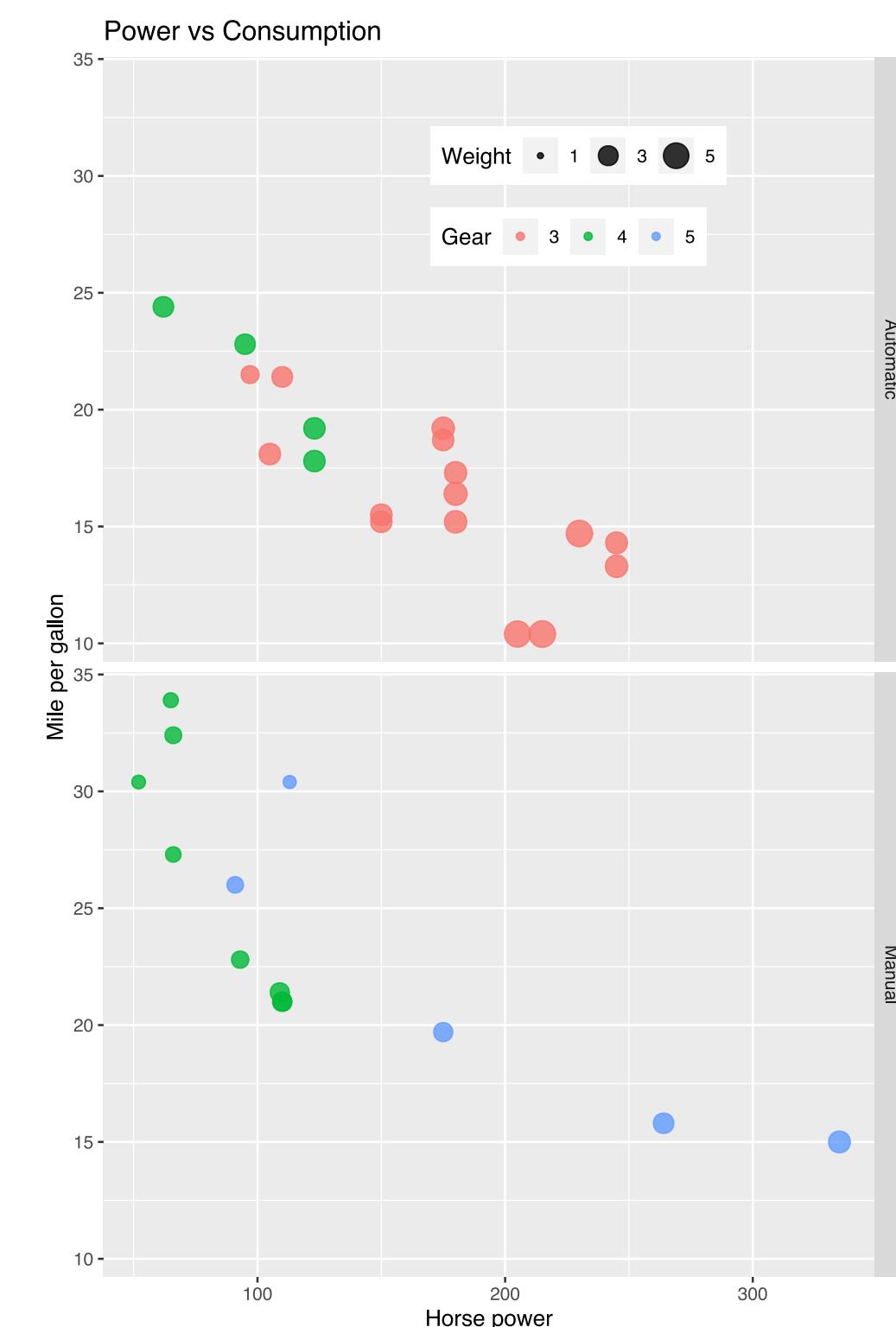
**plot**

title, subtitle, caption, tag, margin

**strip**

background, text

► Code



# Theming ggplot2

axis

title, text, ticks, line

legend

background, margin, spacing, key, title,  
position, direction justification, box

panel

spacing, grid, background

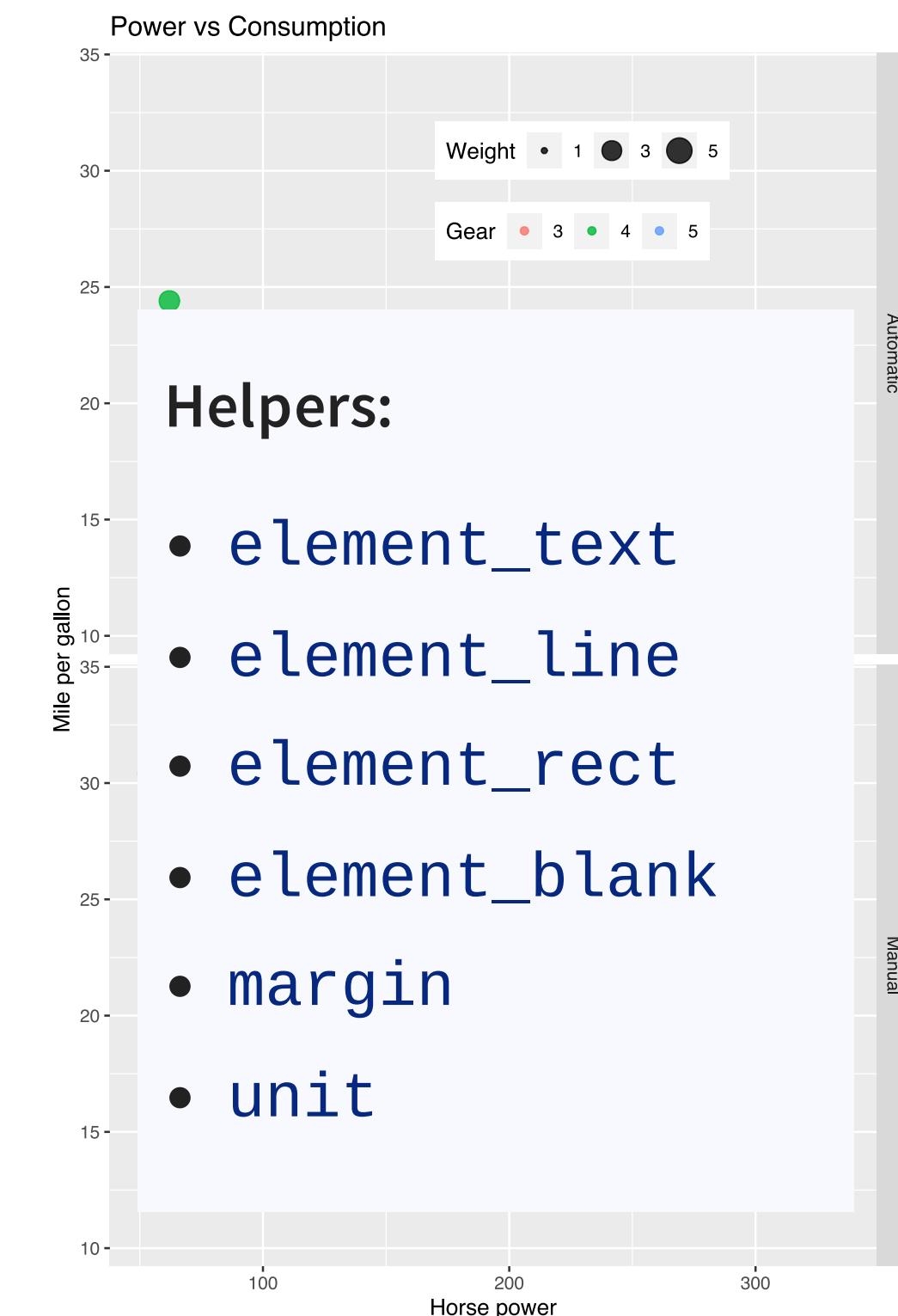
plot

title, subtitle, caption, tag, margin

strip

background, text

► Code



Helpers:

- element\_text
- element\_line
- element\_rect
- element\_blank
- margin
- unit

# ggplot2 theme elements reference

Set `minimal` as the baseline theme:

```
theme_minimal() +  
  theme(element = element_type())
```

Use `element_blank()` to remove an element

Axis titles, text, ticks, and lines can be specified per axis using theme inheritance by putting `.x/.y` at the end of the theme element.

```
axis.line.y = element_line()
```

```
axis.title.y = element_text()
```

```
panel.grid.major = element_line()
```

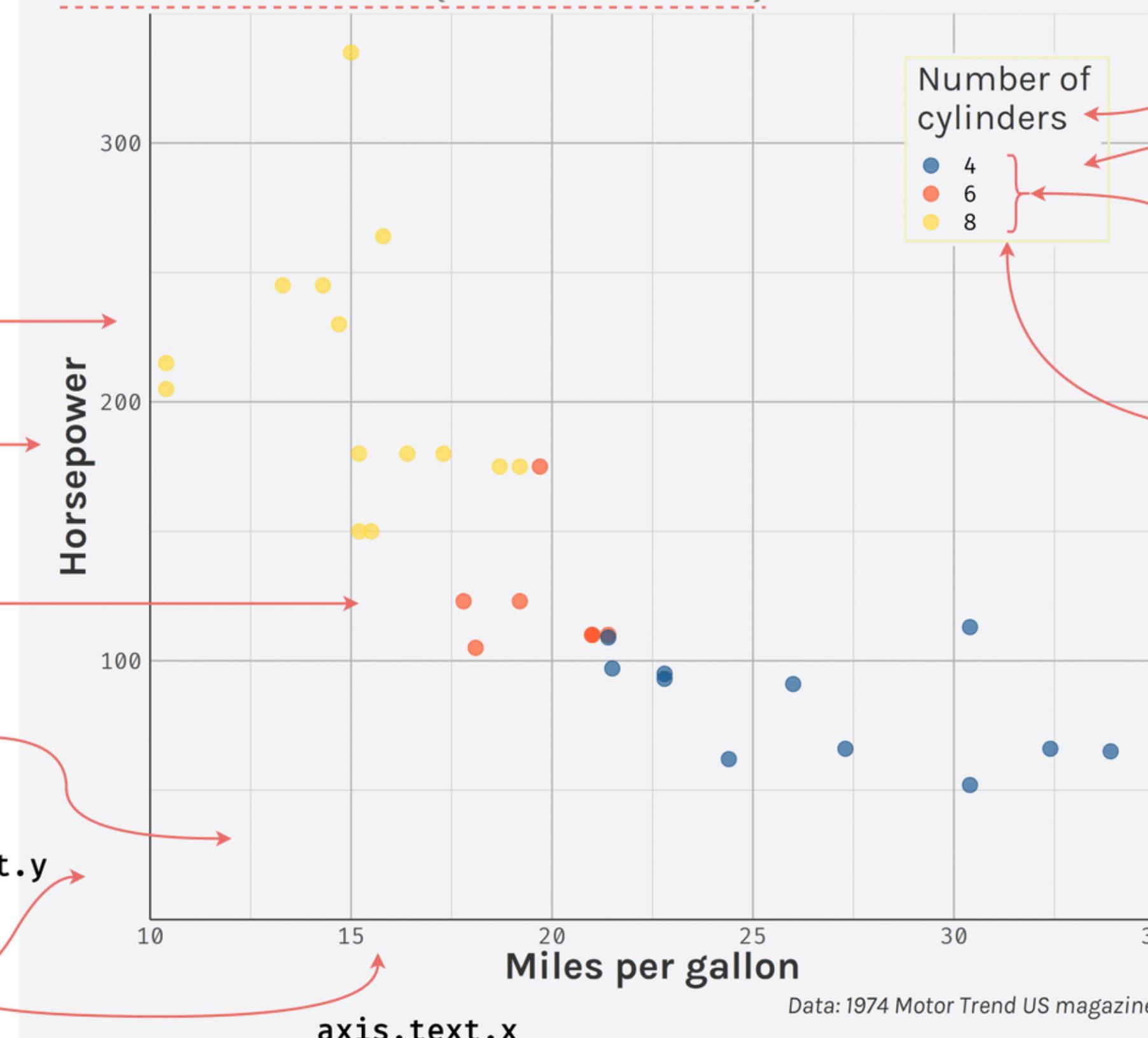
```
panel.grid.minor = element_line()
```

```
axis.text = element_text()
```

```
plot.title.position = "plot"  
plot.caption.position = "plot"  
plot.title = element_text()  
plot.subtitle = element_text()
```

```
plot.margin = margin(25, 25, 25, 25)
```

Miles per Gallon & Horsepower  
of 32 Automobiles (1973-74 models)



```
legend.title = element_text()
```

```
legend.background = element_rect()
```

```
legend.text = element_text()
```

```
legend.position = c(.85,.85) / "none" /  
  "left" / "right" /  
  "bottom" / "top"
```

```
plot.background = element_rect()
```

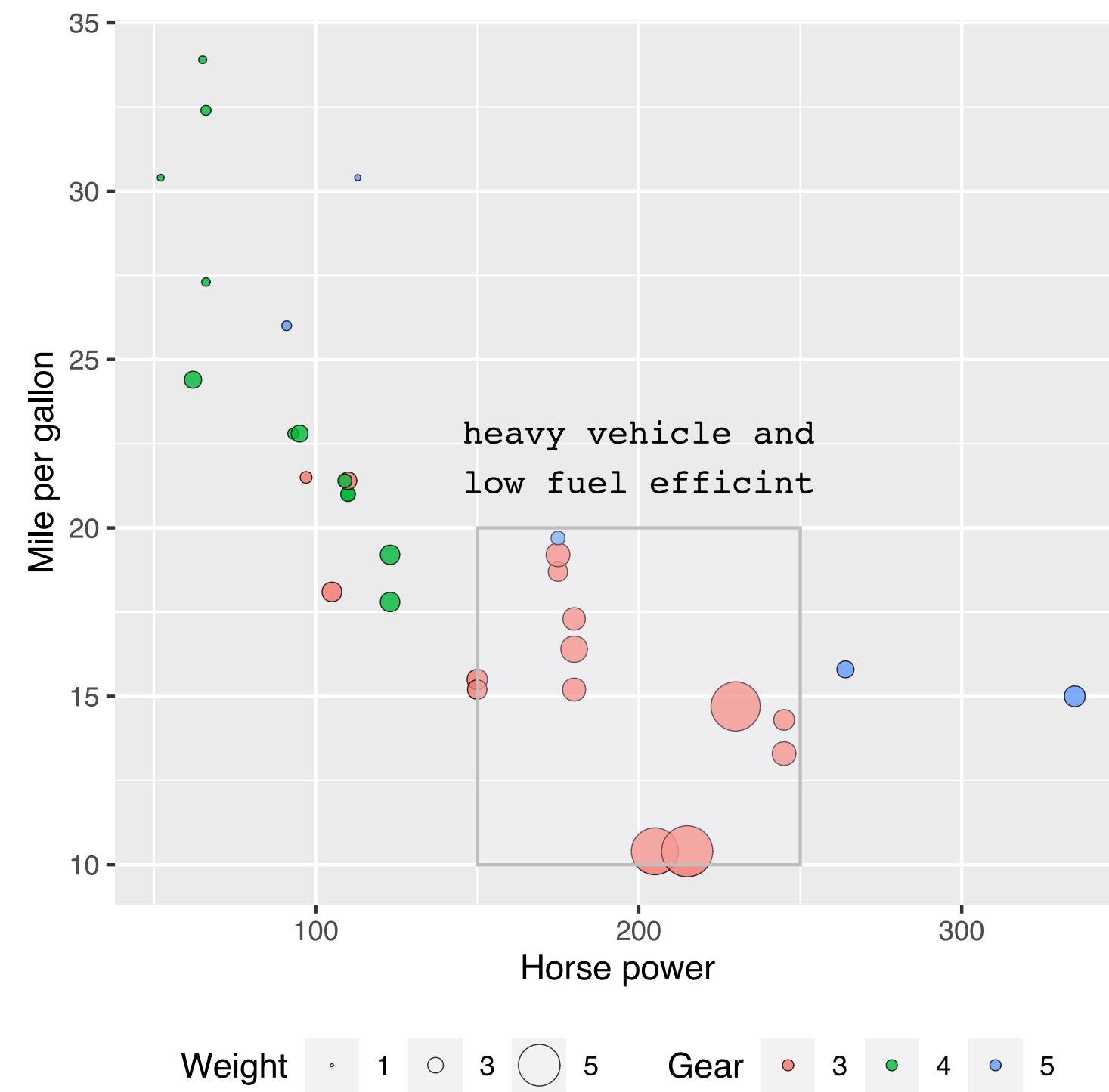
```
plot.caption = element_text()
```

isabella-b

# Annotations

- Use `geom` to add custom elements
- `geom` can be `point`, `line`, `segment`, `rect` and more
- Add custom *grob* using `annotation_custom`

► Code



# Extensions

## **patchwork, cowplot**

Composing multiple ggplot plots

## **ggridge**

Grammar of animated graphics  
with **ggplot2**

## **ggstatsplot and ggpubr**

Enhance **ggplot2** with  
statistics and annotations

More: **survminer, ggridge, ggh4x**

## **ggthemes, ggtech, see, ggsci**

Extra themes and schemes for  
**ggplot2**

## **ggraph**

Visualize network, graphs and  
trees

## **ggrepel, geomtextpath**

Manage and direct text in your  
plot

See more at: <https://exts.ggplot2.tidyverse.org/gallery/>

# Demo

# Resources

## Books and Resources

- <https://posit.co/resources/cheatsheets>
- <https://ggplot2.tidyverse.org/>
- <https://ggplot2-book.org/>
- <https://github.com/erikgahner/awesome-ggplot2>

## Dataset collection

<https://vincentarelbundock.github.io/Rdatasets/datasets.html>

Three columns of "Thank You" in various languages:

�ন্যবাদ TAKK	GRACIAS ASANTE	Dakujem teşekkür ederim
HVALA	mersi	TAK SUWUN
Eυχαριστώ GRAZZii	감사합니다 GRAZAS salamat	hvala salamat
DANKE Paxmet kiitos ARIGATO	kiitos TAKK	MAHALO merci arigato takk
MERCi ありがとう Благодарам grazie	HVALA teşekkür ederim Mahalo GRACIAS ASANTE TAKK спасибо	GRAZIE DAKUJEM hvala TAKK GRAZAS salamat 多謝 SALAMAT gracias

Thank You