Coordinate systems and axes

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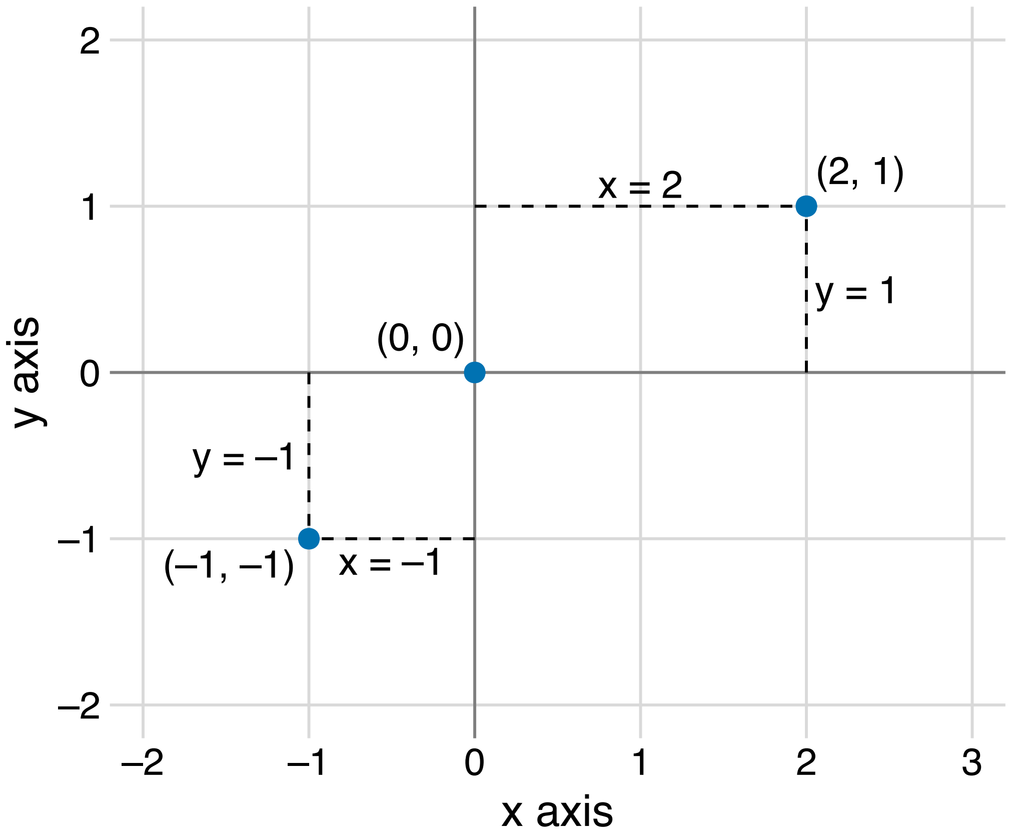
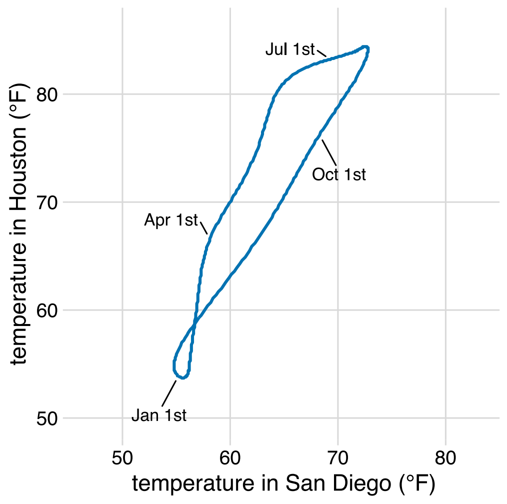
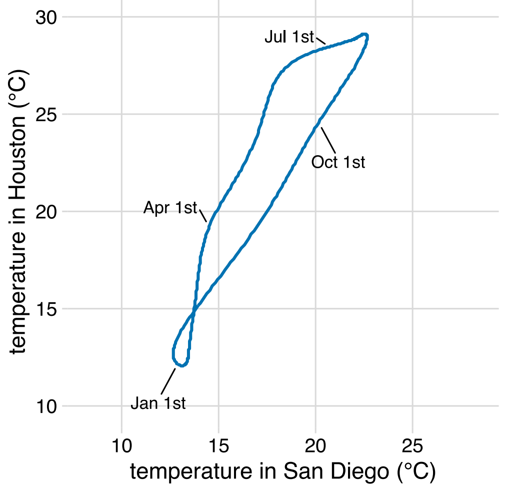
Most data visualizations use Cartesian coordinates

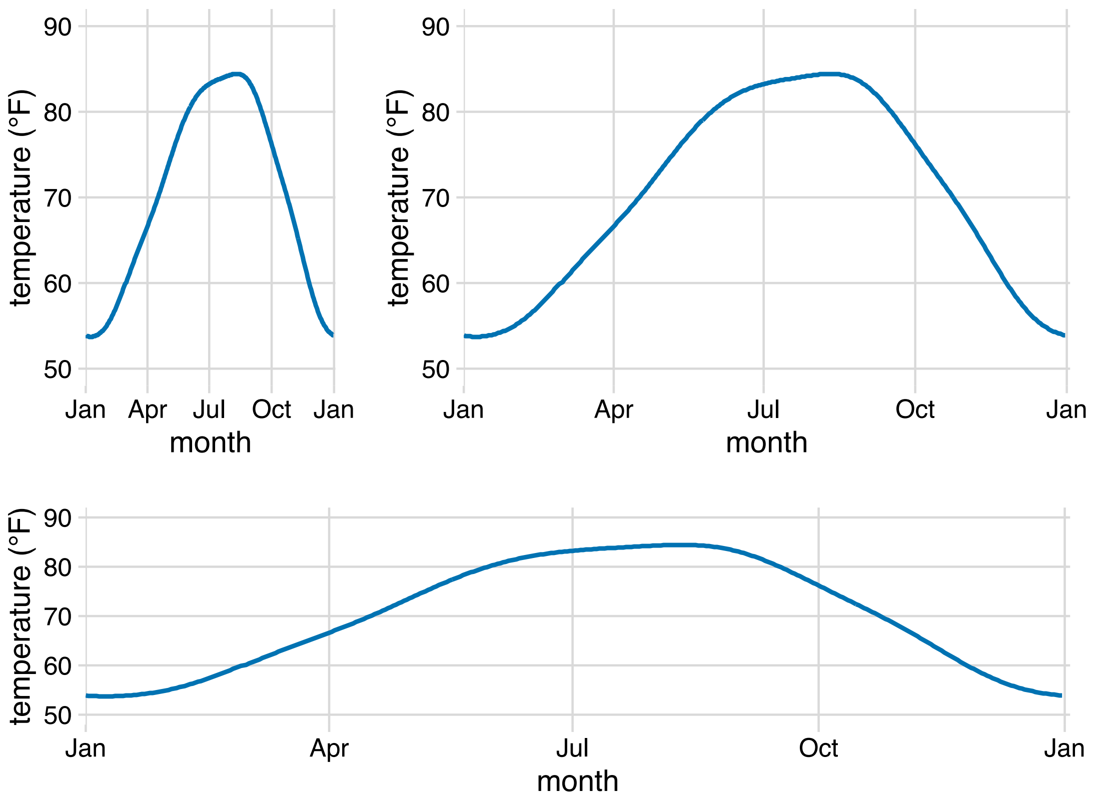


Changing units does not change the plot



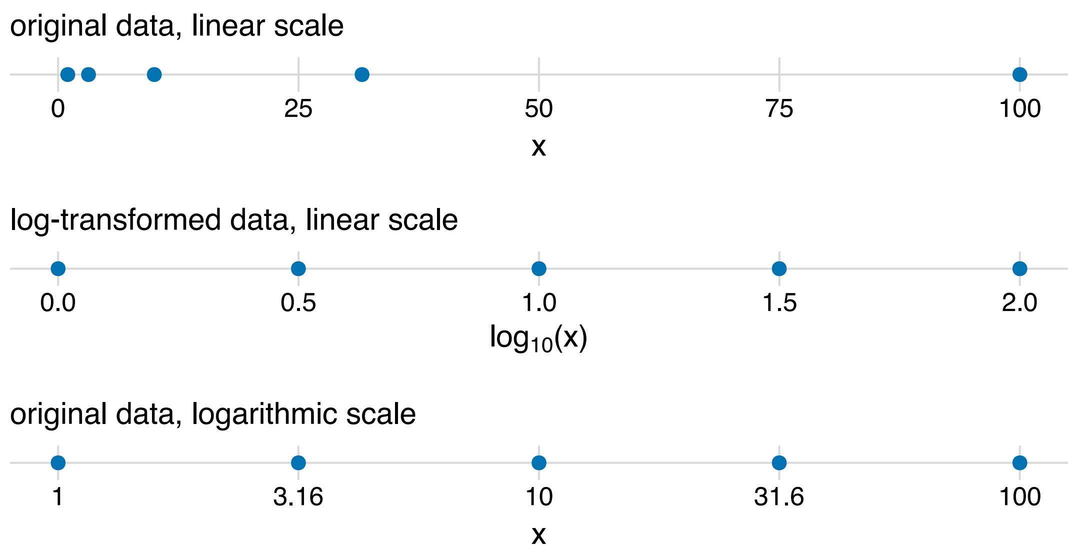


If scale units are unrelated, aspect ratio is arbitrary



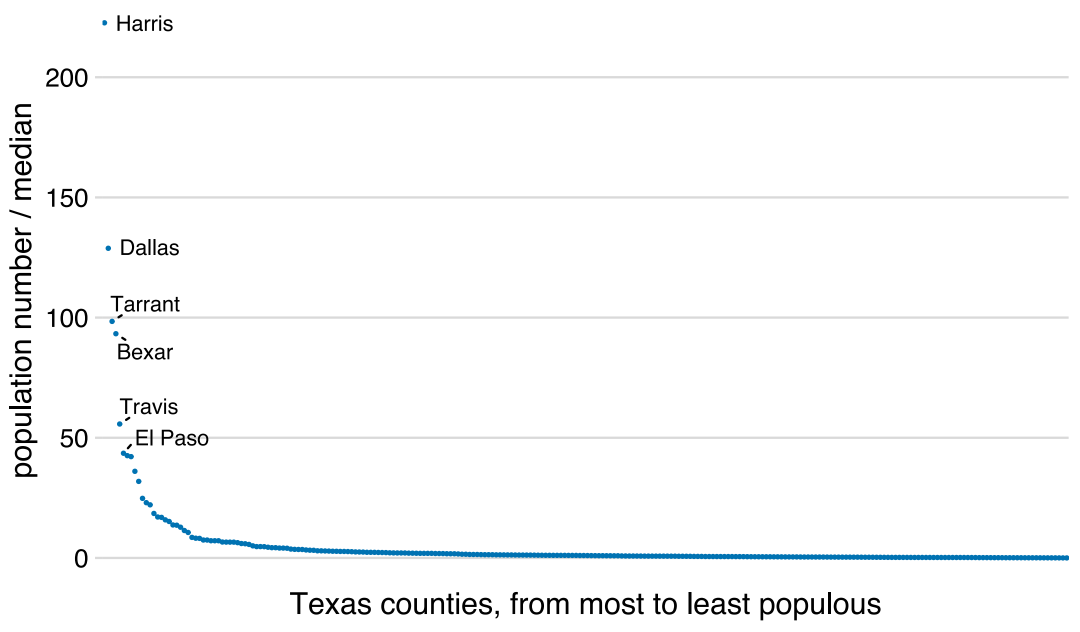
Non-linear scales: log-scales

Visualize these five values: 1, 3.16, 10, 31.6, 100



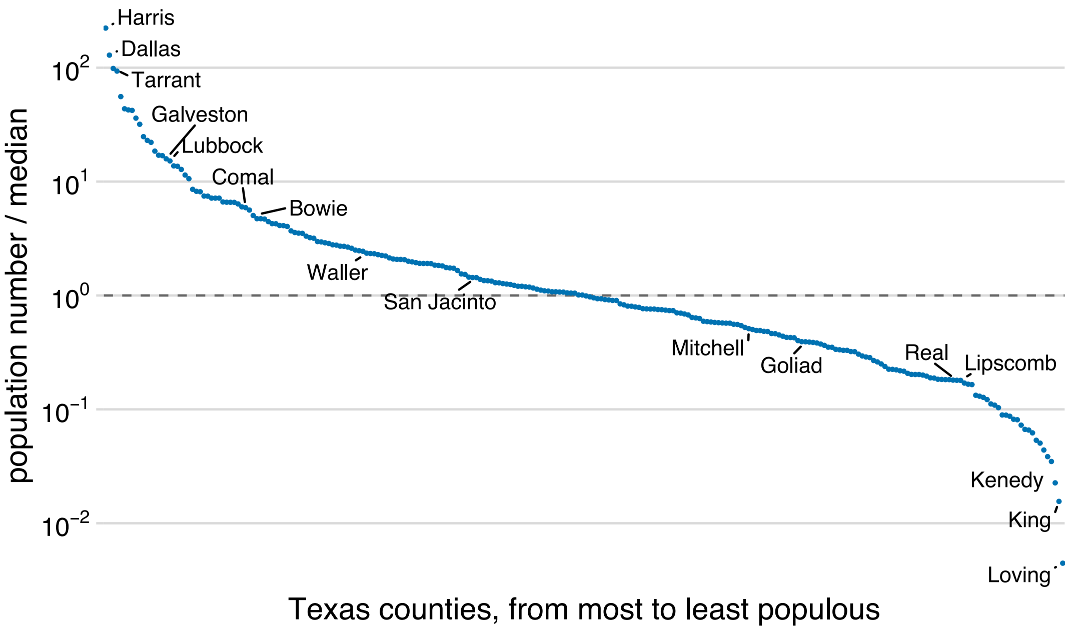
Example: Population number of Texas counties

A linear scale emphasizes large counties

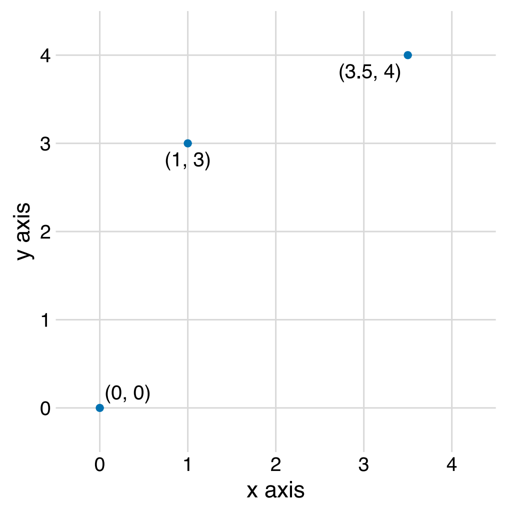


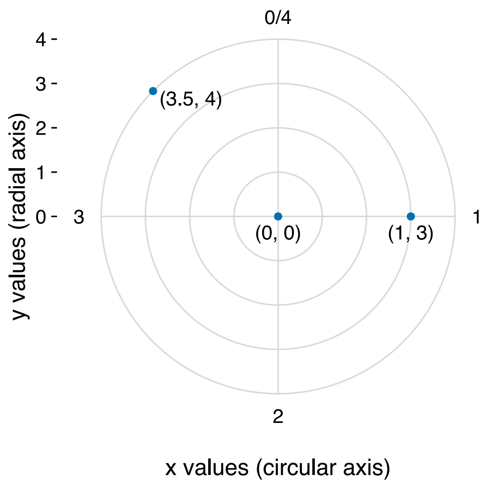
Example: Population number of Texas counties

A log scale shows symmetry around the median

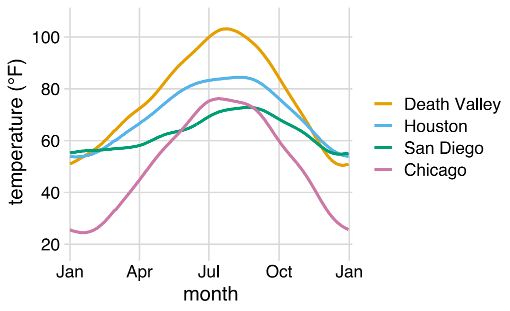


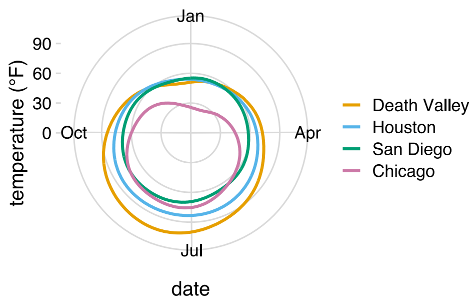
Nonlinear coordinate systems: Polar coordinates





Cartesian vs polar example

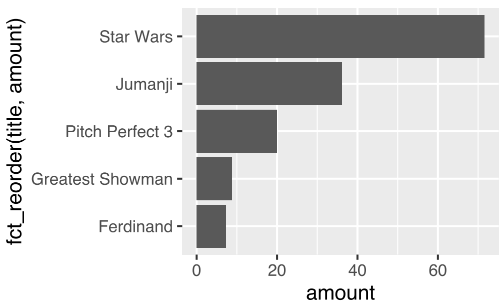




Scale functions customize the x and y axes

Recall the box-office example from class 3

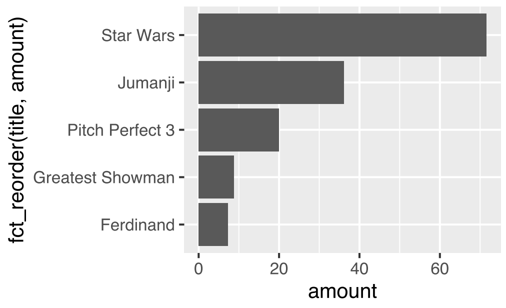
```
ggplot(boxoffice) +
  aes(amount, fct_reord
  geom_col()
```



Scale functions customize the x and y axes

Add scale functions (no change in figure so far)

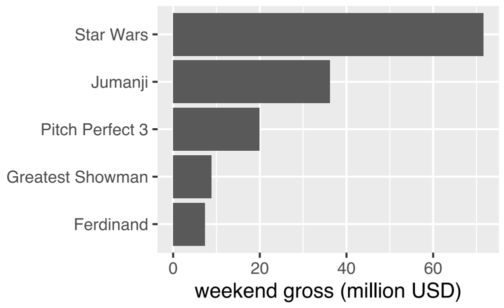
```
ggplot(boxoffice) +
  aes(amount, fct_reord
  geom_col() +
  scale_x_continuous()
  scale_y_discrete()
```



Scale functions customize the x and y axes

The parameter `name` sets the axis title

```
ggplot(boxoffice) +
  aes(amount, fct_reord
  geom_col() +
  scale_x_continuous(
    name = "weekend grc
  ) +
  scale_y_discrete(
    name = NULL   # no a
  )
```

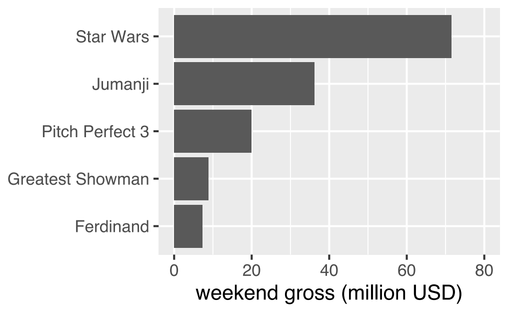


Note: We could do the same with `xlab()` and `ylab()`

Scale functions customize the x and y axes

The parameter `limits` sets the scale limits

```
ggplot(boxoffice) +
  aes(amount, fct_reord
  geom_col() +
  scale_x_continuous(
    name = "weekend grc
    limits = c(0, 80)
  ) +
  scale_y_discrete(
    name = NULL
  )
```

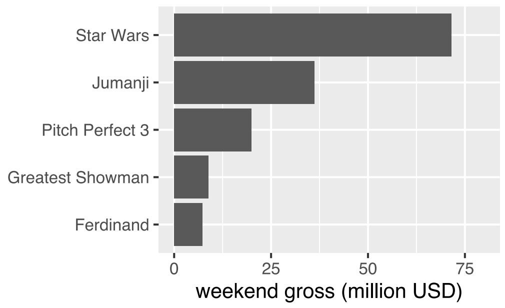


Note: We could do the same with `xlim()` and `ylim()`

Scale functions customize the x and y axes

The parameter `breaks` sets the axis tick positions

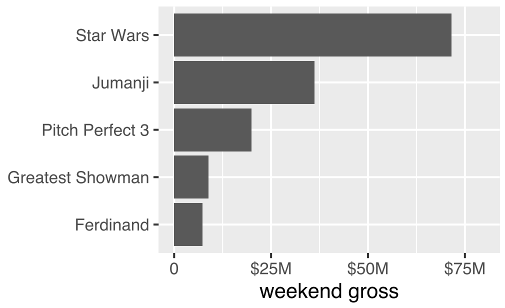
```
ggplot(boxoffice) +
  aes(amount, fct_reord
  geom_col() +
  scale_x_continuous(
    name = "weekend grc
    limits = c(0, 80),
    breaks = c(0, 25, 5
  ) +
  scale_y_discrete(
    name = NULL
  )
```



Scale functions customize the x and y axes

The parameter `labels` sets the axis tick labels

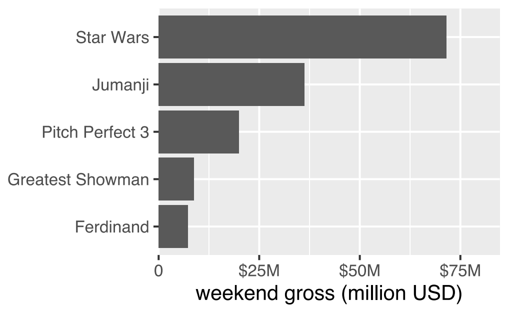
```
ggplot(boxoffice) +
  aes(amount, fct_reord
  geom_col() +
  scale_x_continuous(
    name = "weekend grc
    limits = c(0, 80),
    breaks = c(0, 25, 5
    labels = c("0", "$2
  ) +
  scale_y_discrete(
    name = NULL
  )
```



Scale functions customize the x and y axes

The parameter expand sets the axis expansion

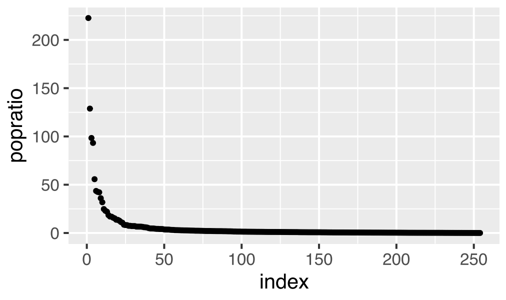
```
ggplot(boxoffice) +
  aes(amount, fct_reord
  geom_col() +
  scale_x_continuous(
    name = "weekend gro
    limits = c(0, 80),
    breaks = c(0, 25, 5
    labels = c("0", "$2
    expand = expansion(
  ) +
  scale_y_discrete(
    name = NULL
  )
```



Scale functions define transformations

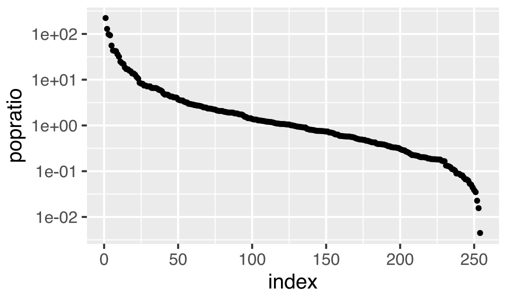
Linear y scale:

```
ggplot(tx_counties) +
  aes(x = index, y = po
  geom_point() +
  scale_y_continuous()
```



Log y scale:

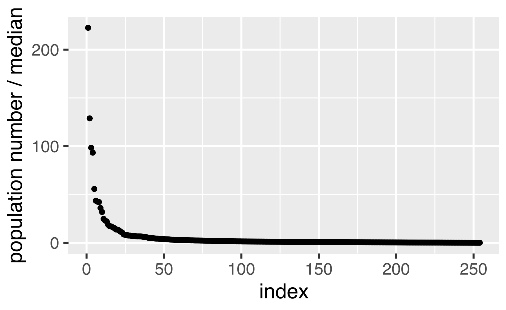
```
ggplot(tx_counties) +
  aes(x = index, y = po
  geom_point() +
  scale_y_log10()
```

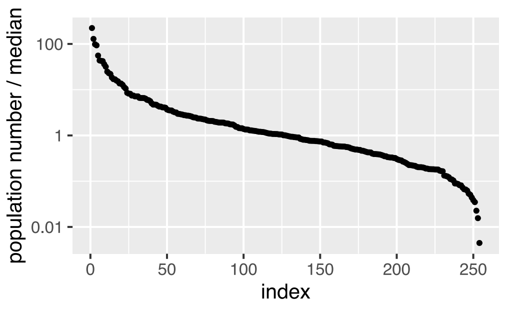


Scale parameters work the same

```
ggplot(tx_counties) +
  aes(x = index, y = po
  geom_point() +
  scale_y_continuous(
    name = "population
    breaks = c(0, 100,
    labels = c("0", "10
  )
```

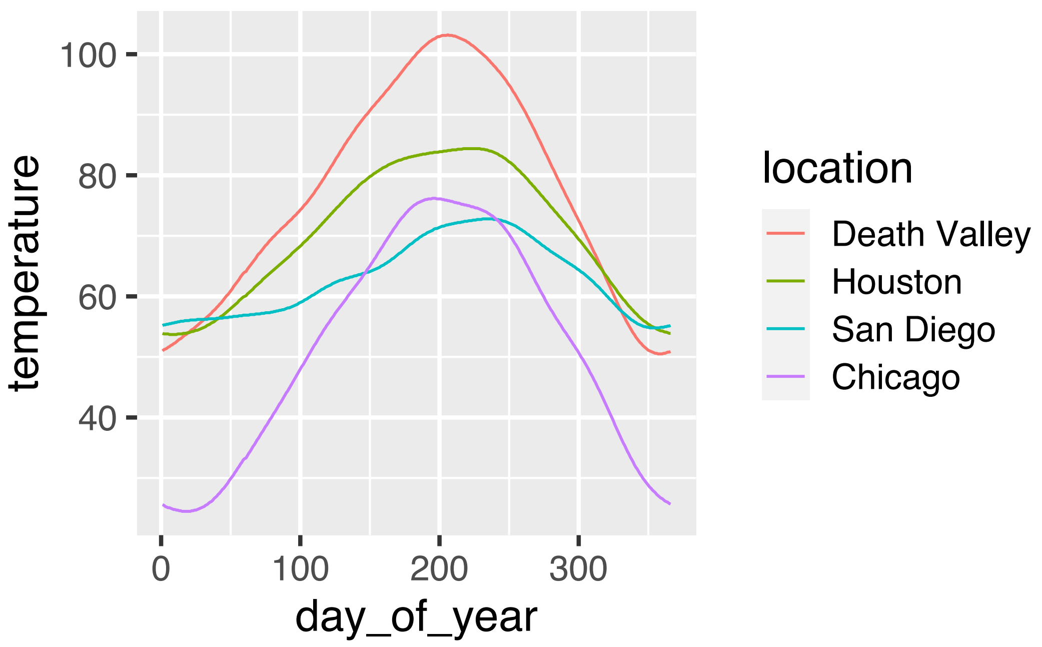
```
ggplot(tx_counties) +
  aes(x = index, y = po
  geom_point() +
  scale_y_log10(
    name = "population
    breaks = c(0.01, 1,
    labels = c("0.01",
  )
```





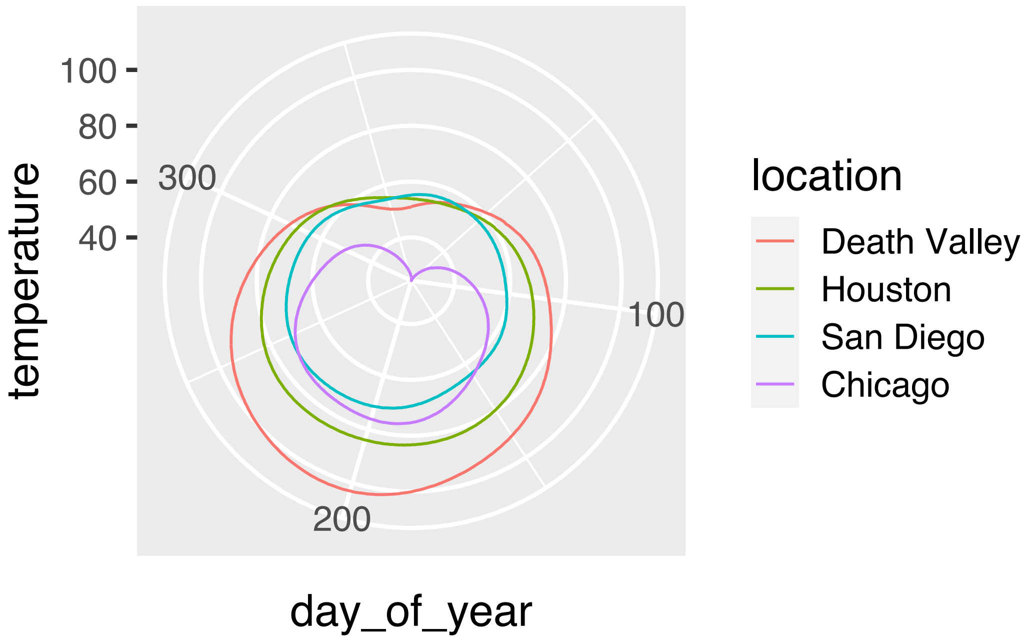
Coords define the coordinate system

```
ggplot(temperatures, aes(day_of_year, temperature,
  geom_line() +
  coord_cartesian()  # cartesian coords are the de
```



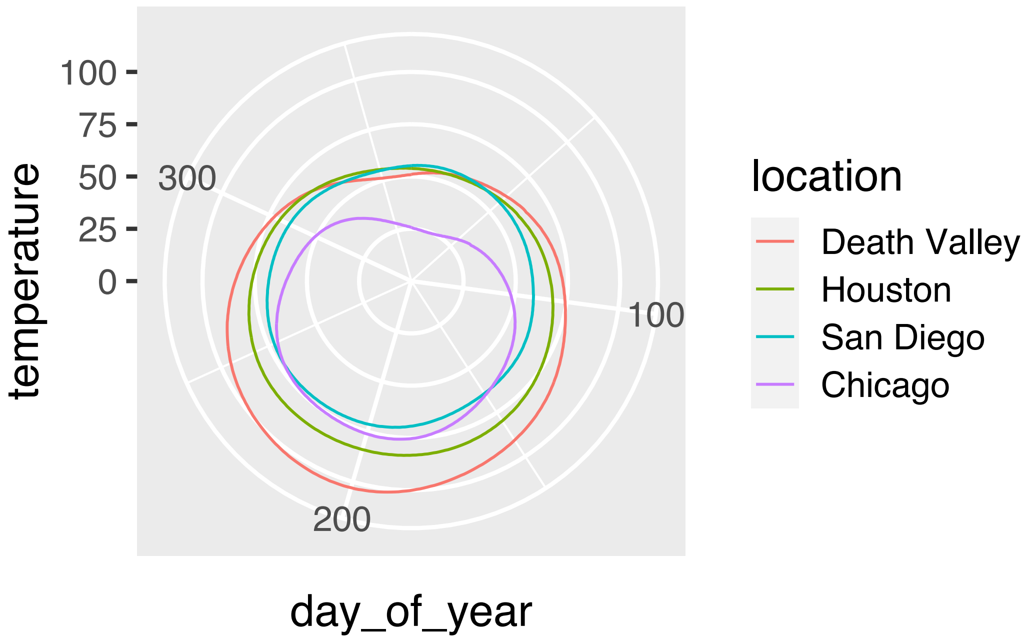
Coords define the coordinate system

```
ggplot(temperatures, aes(day_of_year, temperature,
  geom_line() +
  coord_polar()    # polar coords
```



Coords define the coordinate system

```
ggplot(temperatures, aes(day_of_year, temperature,
  geom_line() +
  coord_polar() +
  scale_y_continuous(limits = c(0, 105))   # fix u
```



Further reading

- Fundamentals of Data Visualization: Chapter 3: Coordinate systems and axes
- **ggplot2** reference documentation: Scales
- **ggplot2** reference documentation: Coordinate systems
- **ggplot2** book: Position scales
- **ggplot2** book: Coordinate systems