Data importing and tidy data I

Quantitative Methods for International Politics

IPOL 3270 • Fall 2026

September 20, 2026

Plan for today

Types of variables

Describing variables

Types of variables

Variables and observations

Observations

A value that is recorded about something

Variables

A set of observations about the same thing

	name	height_cm
1	Mariah Moncada	170
2	Hibaq Haro	172
3	Manaahil al-Bacchus	182
4	Kadi Kusupati	178
5	Ghaazi el-Tamer	170
6	Thanaa al-Mitri	155
7	Emilio Martinez	174
8	Jawhar al-Meskin	169
9	Iyaad al-Khalaf	171
10	Sabiyya el-Halaby	183

Observations

Mariah Moncada; 170

Variables

Name; height

Unit of observation

A person

Variables and observations

Observations

A value that is recorded about something

Variables

A set of observations about the same thing

	country	year	refugees_accepted
1	Egypt	2021	280686
2	Egypt	2022	294632
3	Egypt	2023	240507
4	Egypt	2024	238014
5	France	2021	499914
6	France	2022	612934
7	France	2023	664366
8	France	2024	721771
9	Germany	2021	1255694
10	Germany	2022	2075445
11	Germany	2023	2593007
12	Germany	2024	2749266

Observations

Egypt; 2021; 280,686

Variables

Country; year; refugees accepted

Unit of observation

Country year

General types of variables

Identification variables

Values that **identify** observations

Measurement variables

Values that **describe** the observations

	faa	name	lat	lon	alt	tz	dst
1	AAF	Apalachicola Regional Airport	29.7275	-85.0275	20	-5	A
2	AAP	Andrau Airpark	29.7225	-95.5883	79	-6	A
3	ABE	Lehigh Valley International Airport	40.6521	-75.4408	393	-5	A
4	ABI	Abilene Regional Airport	32.4113	-99.6819	1791	-6	A
5	ABL	Ambler Airport	67.1063	-157.8570	334	-9	A
6	ABQ	Albuquerque International Sunport	35.0402	-106.6090	5355	-7	A
7	ABR	Aberdeen Regional Airport	45.4491	-98.4218	1302	-6	A
8	ABY	Southwest Georgia Regional Airport	31.5355	-84.1945	197	-5	A

Identification: `faa`, `name`

Measurement: `lat`, `lon`, `alt`, `tz`, `dst`

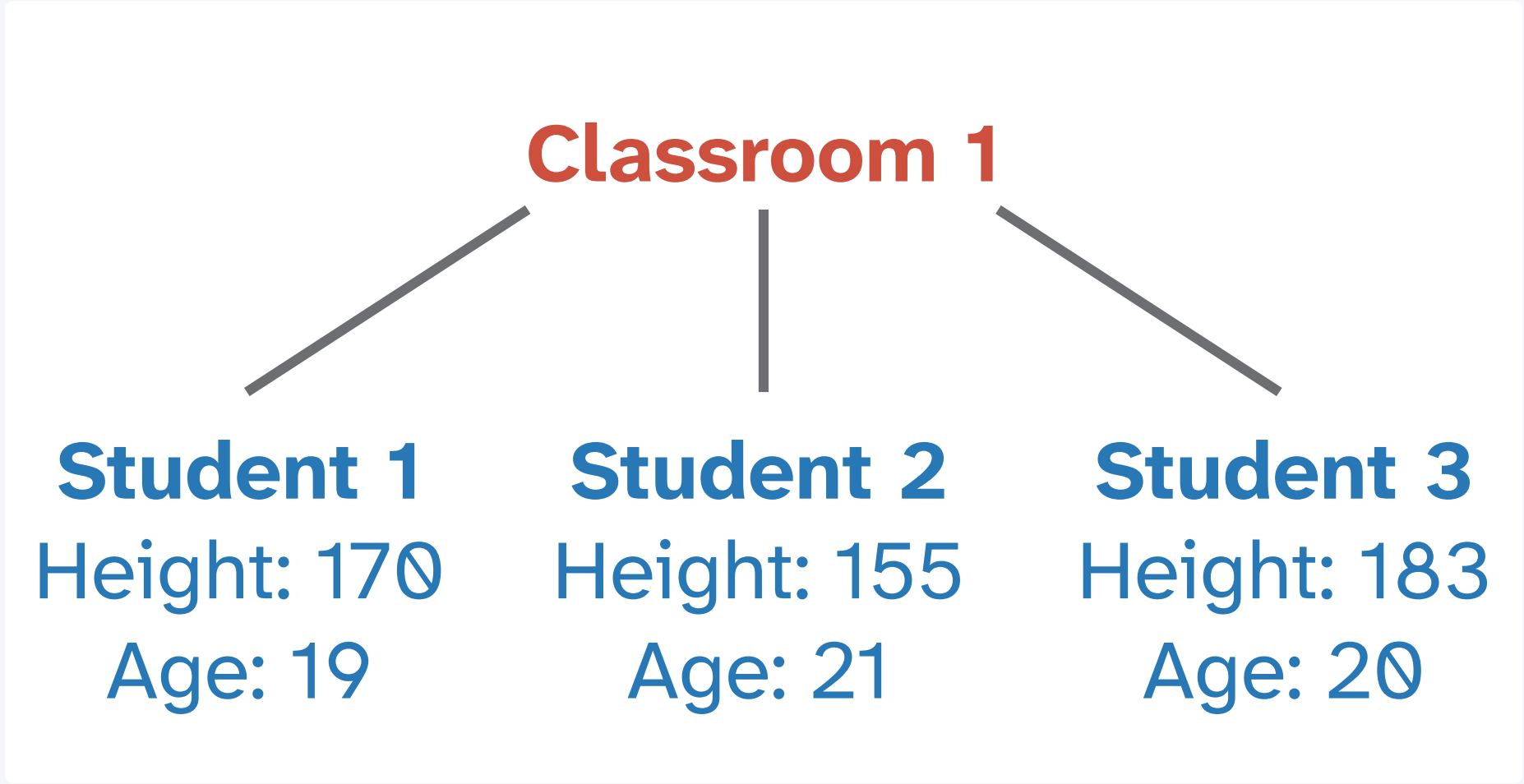
Identification vs. measurement

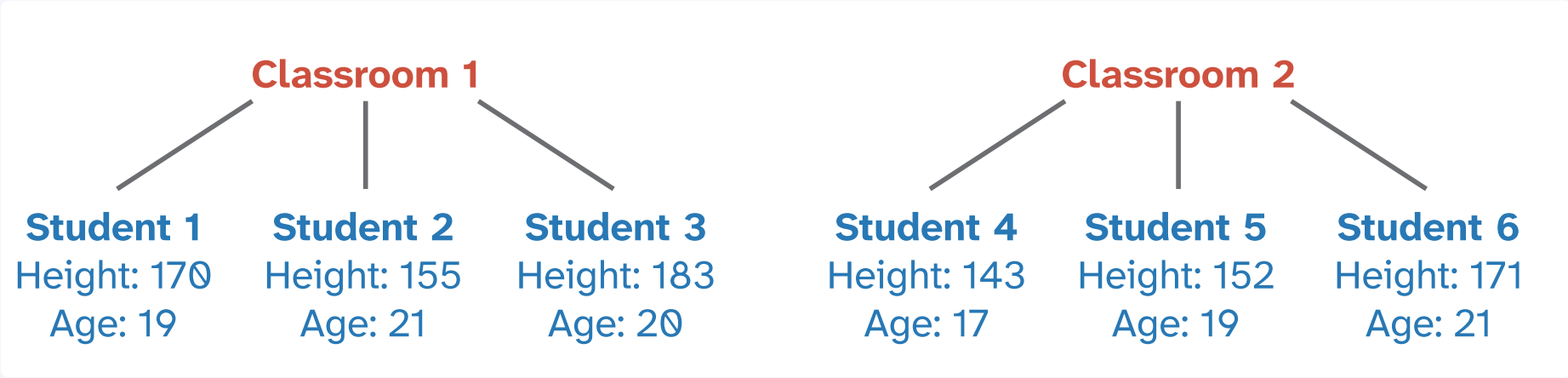
Identification variables uniquely identify each observation

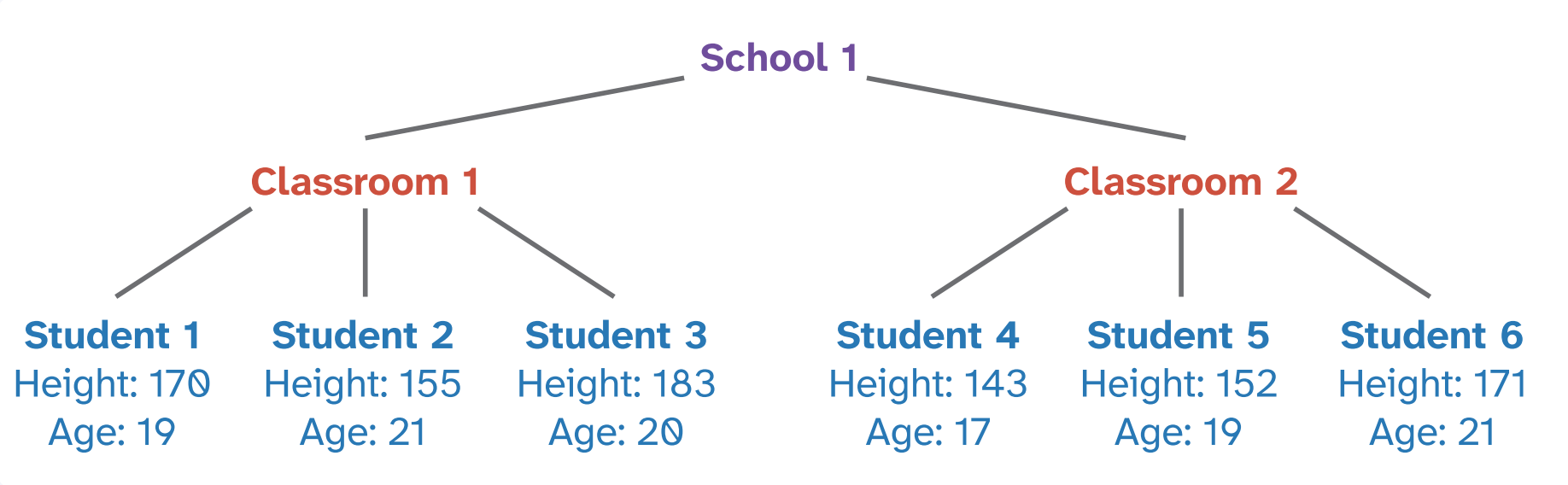
Unit of observation = what each row represents

Think of a hierarchy!

Student 1	Student 2	Student 3
Height: 170	Height: 155	Height: 183
Age: 19	Age: 21	Age: 20


Classroom 1
Student 1
Height: 170
Age: 19
Student 2
Height: 155
Age: 21
Student 3
Height: 183
Age: 20


Classroom 1
Student 1
Height: 170
Age: 19
Student 2
Height: 155
Age: 21
Student 3
Height: 183
Age: 20
Classroom 2
Student 4
Height: 143
Age: 17
Student 5
Height: 152
Age: 19
Student 6
Height: 171
Age: 21


School 1
Classroom 1
Classroom 2
Student 1
Height: 170
Age: 19
Student 2
Height: 155
Age: 21
Student 3
Height: 183
Age: 20
Student 4
Height: 143
Age: 17
Student 5
Height: 152
Age: 19
Student 6
Height: 171
Age: 21

General types of variables

Identification variables

Values that **identify** observations

Measurement variables

Values that **describe** the observations

```
      country continent year lifeExp      pop gdpPercap
1 Afghanistan      Asia 1952  28.801  8425333  779.4453
2 Afghanistan      Asia 1957  30.332  9240934  820.8530
3 Afghanistan      Asia 1962  31.997 10267083  853.1007
4 Afghanistan      Asia 1967  34.020 11537966  836.1971
5 Afghanistan      Asia 1972  36.088 13079460  739.9811
6 Afghanistan      Asia 1977  38.438 14880372  786.1134
7 Afghanistan      Asia 1982  39.854 12881816  978.0114
8 Afghanistan      Asia 1987  40.822 13867957  852.3959
```

Identification: `country`, `year` (`continent`?)

Measurement: `lifeExp`, `pop`, `gdpPercap` (`continent`?)

Your turn!

What would these datasets look like?

- The height, age, and GPA of each student in this class
- The height, age, and GPA of each student in this class in their freshman, sophomore, junior, and senior years
- The population and GDP of GCC countries in 2026
- The population and GDP of GCC countries each year from 2020 to 2026

07:00

Types of measurement variables

Numeric

Continuous variables

Numbers: values from $-\infty$ to ∞

Monthly income, duration of an exam, GDP

Count variables

Counts: values that are whole and not negative

Population, number of civil wars, number of students in a class

Often treated like continuous

Types of measurement variables

Categories

Categorical variables

Race, religion, continent, highest level of education, color of flower, species of penguin

Binary variables

Two categories only

- Person served in military?
- Country faced civil war?
- Country voted for UN resolution?
- Penguin is heavier than 3 kg?

Ordinal variables

Ordered categories

- ~~Species of penguin~~ (Adelie, Chinstrap, Gentoo)
- County income level (low, medium, high)
- Agreement with a survey question (Likert scale disagree → neutral → agree)
- Highest education completed (primary school, high school, university, graduate school)

Types of measurement variables

Qualitative data

Qualitative variables

Stuff that's not numeric and not categorical

- Survey free response fields
- Pictures and videos
- Newspaper headlines

Types of measurement variables

Numeric	Categorical	Qualitative
Continuous	Categorical	Qualitative
Count	Binary	
	Ordinal	

Your turn!

What kind of variables are these?

- Temperature
- Number of goals scored in a World Cup match
- Did country hold an election this year?
- Olympic medal type (gold/silver/bronze)
- Interview transcripts
- Grade in a class (A–F)
- Grade on an exam (0-100)
- Blood type
- Religion
- Military rank
- Political party of head of state
- Did a law pass?
- Slogans on protest signs
- Number of siblings
- Distance traveled
- QAR to EUR exchange rate

05:00

Describing variables

Why do we even care??

Most of data analysis is really just describing variables

We can describe variables with numbers and pictures

A variable's type determines *which* numbers and pictures you can use

Describing numbers with numbers

Summary statistics

- **Mean**: add up all the numbers, divide by the count
- **Median**: the middle number of the variable
- **Minimum** and **Maximum**: the smallest and biggest numbers
- **Percentiles**: how many other observations are below certain numbers (25th percentile, 75th percentile, 90th percentile, etc)
- **Standard deviation**: how much numbers are spread out from the mean

```r
gapminder |>
  filter(year == 2007) |>
  summarize(
    avg_gdp = mean(gdpPercap),
    median_gdp = median(gdpPercap),
    min_gdp = min(gdpPercap),
    max_gdp = max(gdpPercap),
    pct_25 = quantile(gdpPercap, probs = 0.25),
    pct_75 = quantile(gdpPercap, probs = 0.75),
    sd_gdp = sd(gdpPercap)
  )
```

```
# A tibble: 1 × 7
  avg_gdp median_gdp min_gdp max_gdp pct_25 pct_75 sd_gdp
    <dbl>      <dbl>   <dbl>   <dbl>  <dbl>  <dbl>  <dbl>
1  11680.      6124.    278.  49357.  1625. 18009. 12860.
```

```r
library(moderndive)

gapminder |>
  filter(year == 2007) |>
  tidy_summary(gdpPercap)
```

```
# A tibble: 1 × 11
  column        n group type      min    Q1   mean median     Q3    max     sd
  <chr>     <int> <chr> <chr>   <dbl> <dbl>  <dbl>  <dbl>  <dbl>  <dbl>  <dbl>
1 gdpPercap   142 <NA>  numeric  278. 1625. 11680.  6124. 18009. 49357. 12860.
```

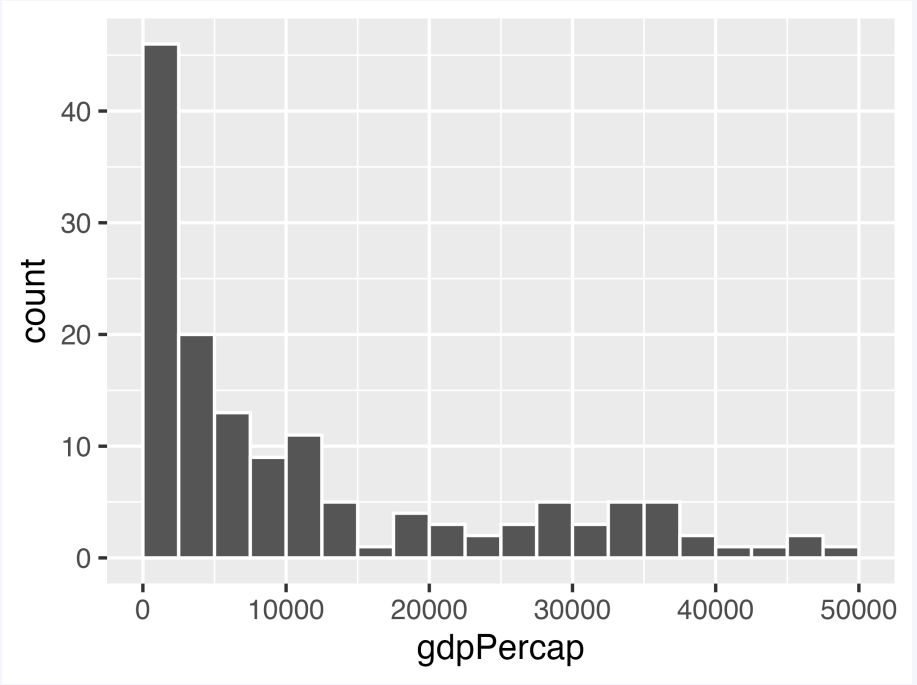
Describing numbers with plots

Distributions

- Histograms
- Density plots
- ~~Boxplots~~
- Dot plots
- Raincloud plots

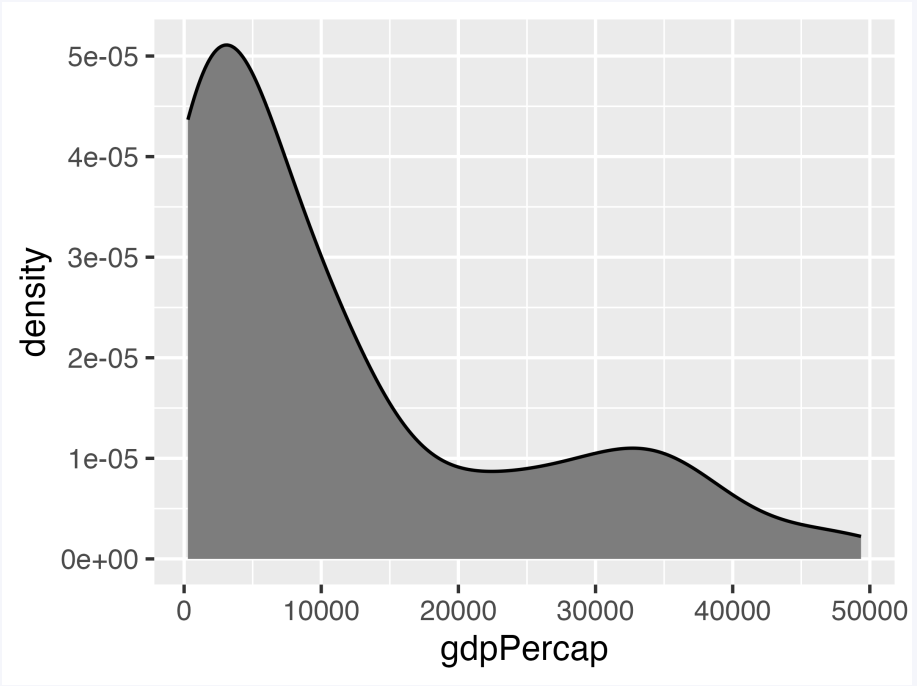
Histogram

```
gapminder |>
  filter(year == 2007) |>
  ggplot(aes(x = gdpPercap)) +
  geom_histogram(
    color = "white",
    binwidth = 2500,
    boundary = 0
  )
```



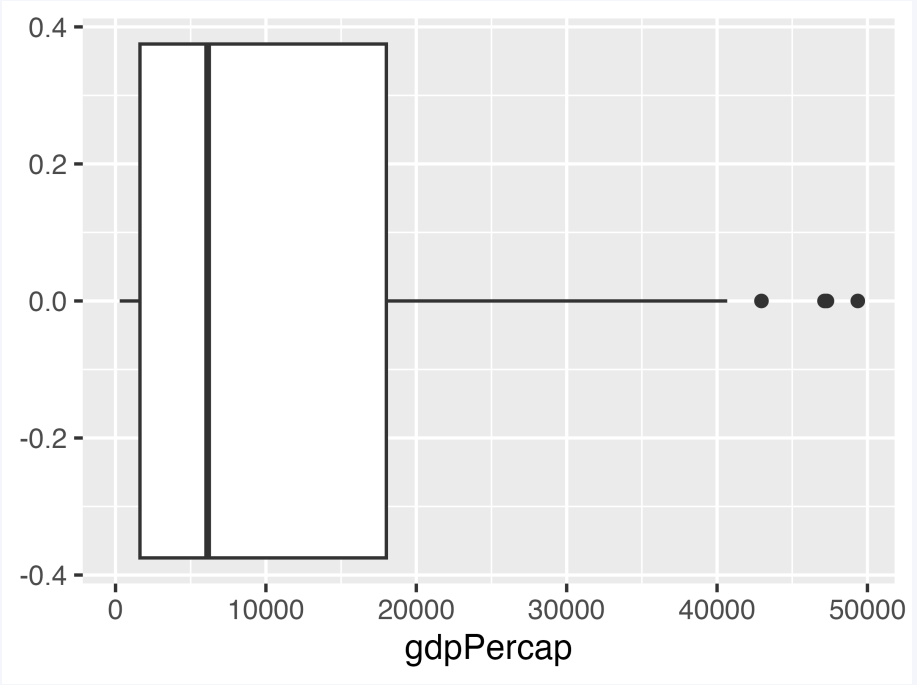
Density plot

```
gapminder |>
  filter(year == 2007) |>
  ggplot(aes(x = gdpPercap)) +
  geom_density(fill = "grey50")
```



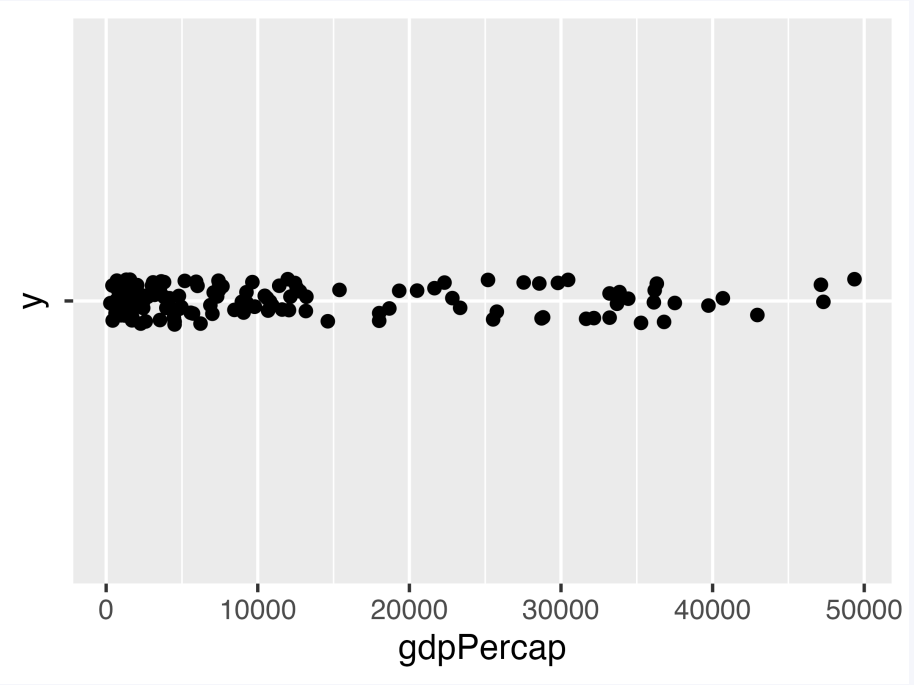
Boxplot

```
gapminder |>
  filter(year == 2007) |>
  ggplot(aes(x = gdpPercap)) +
  geom_boxplot()
```



Dot plot

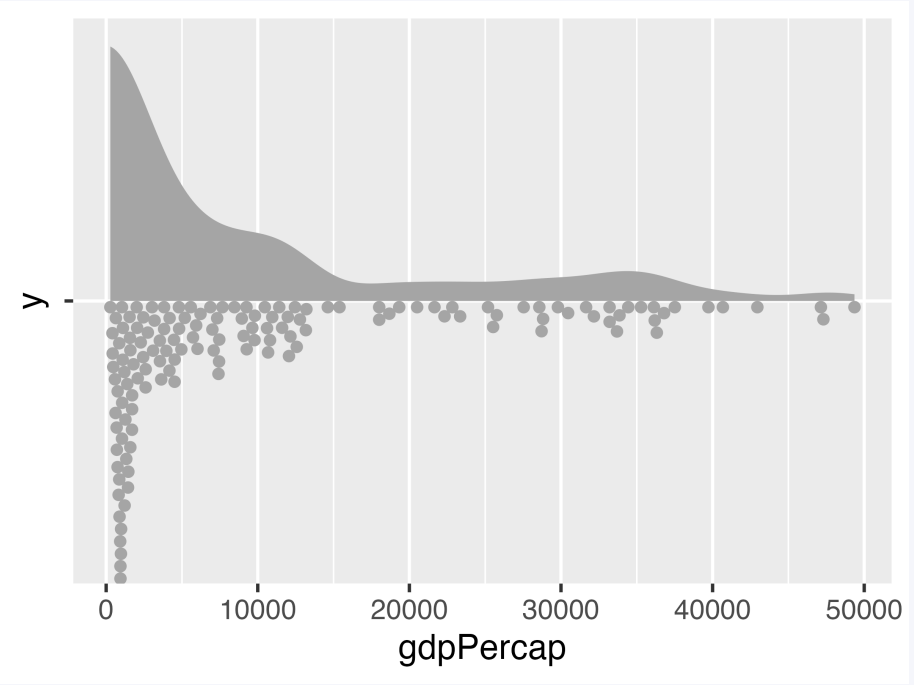
```
gapminder |>
  filter(year == 2007) |>
  ggplot(
    aes(x = gdpPercap, y = "")
  ) +
  geom_point(
    position = position_jitter(
      width = 0,
      height = 0.05
    )
  )
```



Raincloud plot

```
library(ggdist)

gapminder |>
  filter(year == 2007) |>
  ggplot(
    aes(x = gdpPercap, y = "")
  ) +
  stat_slab(
    side = "top",
    color = NA
  ) +
  stat_dots(
    side = "bottom",
    layout = "swarm"
  )
```



Describing categorical variables

	species	island	body_mass	bill_len
1	Adelie	Dream	3475	40.6
2	Adelie	Biscoe	3500	39.6
3	Gentoo	Biscoe	5050	45.0
4	Gentoo	Biscoe	5700	49.8
5	Gentoo	Biscoe	5800	49.5
6	Adelie	Dream	4000	41.5
7	Chinstrap	Dream	4800	52.0
8	Adelie	Dream	3400	34.0
9	Adelie	Torgersen	3700	35.5
10	Gentoo	Biscoe	5650	54.3

What's the average species?

What's the maximum island?

Not possible!

Regular summary statistics don't work with categorical data!

Describing categories

Summary statistics

- **Counts**: Count each category
- **Proportions**: Find the proportion of each category relative to something else (total, another category, etc.)

Plots

- Bar plots
- Lollipop plots
- Heatmaps

```r
library(moderndive)

gapminder |>
  filter(year == 2007) |>
  tidy_summary(continent)
```

```
# A tibble: 5 × 11
  group        n column    type     min    Q1  mean median    Q3   max    sd
  <chr>    <int> <chr>     <chr>  <dbl> <dbl> <dbl>  <dbl> <dbl> <dbl> <dbl>
1 Africa      52 continent factor    NA    NA    NA     NA    NA    NA    NA
2 Americas    25 continent factor    NA    NA    NA     NA    NA    NA    NA
3 Asia        33 continent factor    NA    NA    NA     NA    NA    NA    NA
4 Europe      30 continent factor    NA    NA    NA     NA    NA    NA    NA
5 Oceania      2 continent factor    NA    NA    NA     NA    NA    NA    NA
```

```
gapminder |>
  filter(year == 2007) |>
  count(continent)
```

```
# A tibble: 5 × 2
  continent     n
  <fct>     <int>
1 Africa       52
2 Americas     25
3 Asia         33
4 Europe       30
5 Oceania       2
```

```
gapminder |>
  filter(year == 2007) |>
  count(continent) |>
  mutate(prop = n / sum(n))
```

```
# A tibble: 5 × 3
  continent     n   prop
  <fct>     <int>  <dbl>
1 Africa       52 0.366
2 Americas     25 0.176
3 Asia         33 0.232
4 Europe       30 0.211
5 Oceania       2 0.0141
```

```
penguins |>
  count(species, island)
```

```
    species    island   n
1    Adelie    Biscoe  44
2    Adelie     Dream  56
3    Adelie Torgersen  52
4 Chinstrap     Dream  68
5    Gentoo    Biscoe 124
```

```
penguins |>
  count(species, island) |>
  mutate(prop = n / sum(n))
```

```
    species    island   n      prop
1    Adelie    Biscoe  44 0.1279070
2    Adelie     Dream  56 0.1627907
3    Adelie Torgersen  52 0.1511628
4 Chinstrap     Dream  68 0.1976744
5    Gentoo    Biscoe 124 0.3604651
```

```r
penguins |>
  count(species, island) |>
  group_by(species) |>
  mutate(prop = n / sum(n))
```

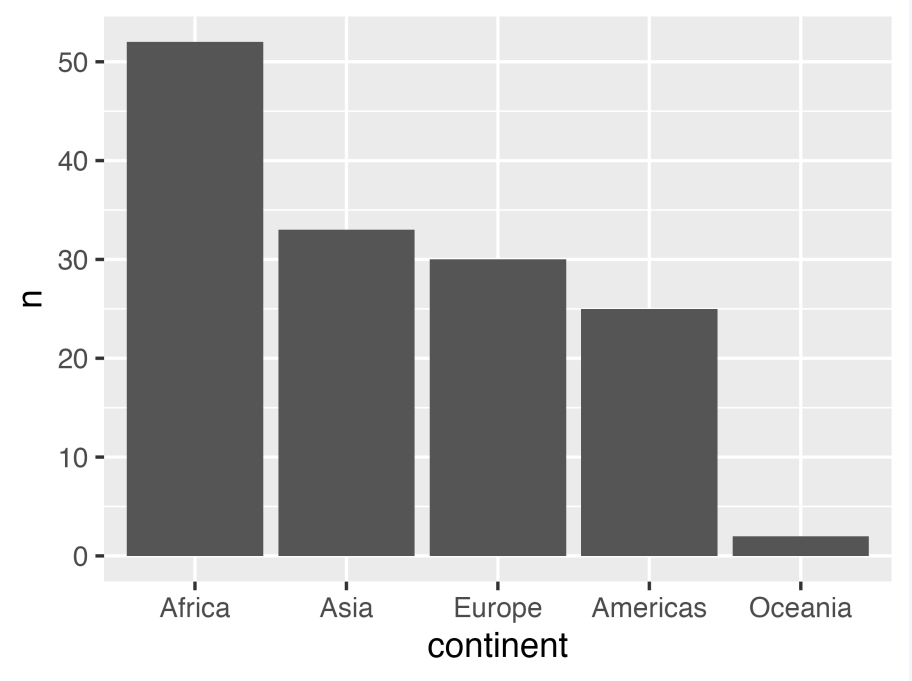
```
# A tibble: 5 × 4
# Groups:   species [3]
  species   island        n  prop
  <fct>     <fct>     <int> <dbl>
1 Adelie    Biscoe       44 0.289
2 Adelie    Dream        56 0.368
3 Adelie    Torgersen    52 0.342
4 Chinstrap Dream        68 1
5 Gentoo    Biscoe      124 1
```

```r
penguins |>
  count(species, island) |>
  group_by(island) |>
  mutate(prop = n / sum(n))
```

```
# A tibble: 5 × 4
# Groups:   island [3]
  species   island        n  prop
  <fct>     <fct>     <int> <dbl>
1 Adelie    Biscoe       44 0.262
2 Adelie    Dream        56 0.452
3 Adelie    Torgersen    52 1
4 Chinstrap Dream        68 0.548
5 Gentoo    Biscoe      124 0.738
```

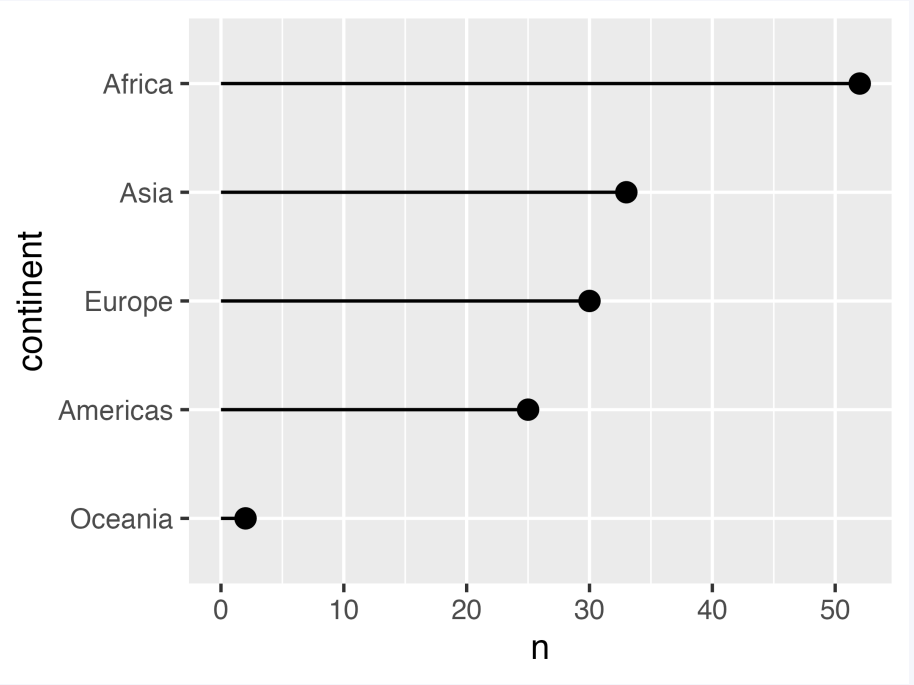
Bar plot

```
gapminder |>
  filter(year == 2007) |>
  count(continent) |>
  mutate(
    continent = fct_reorder(
      continent,
      desc(n)
    )
  ) |>
  ggplot(
    aes(x = continent, y = n)
  ) +
  geom_col()
```



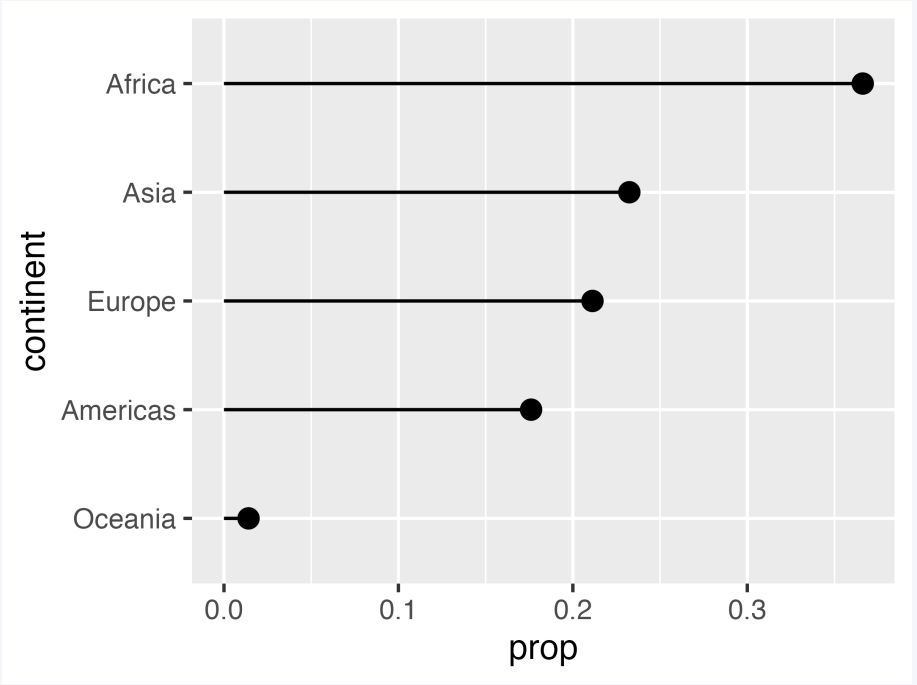
Lollipop plot

```
gapminder |>
  filter(year == 2007) |>
  count(continent) |>
  mutate(
    continent = fct_reorder(
      continent,
      n
    )
  ) |>
  ggplot(
    aes(x = n, y = continent)
  ) +
  geom_pointrange(
    aes(xmin = 0, xmax = n)
  )
```



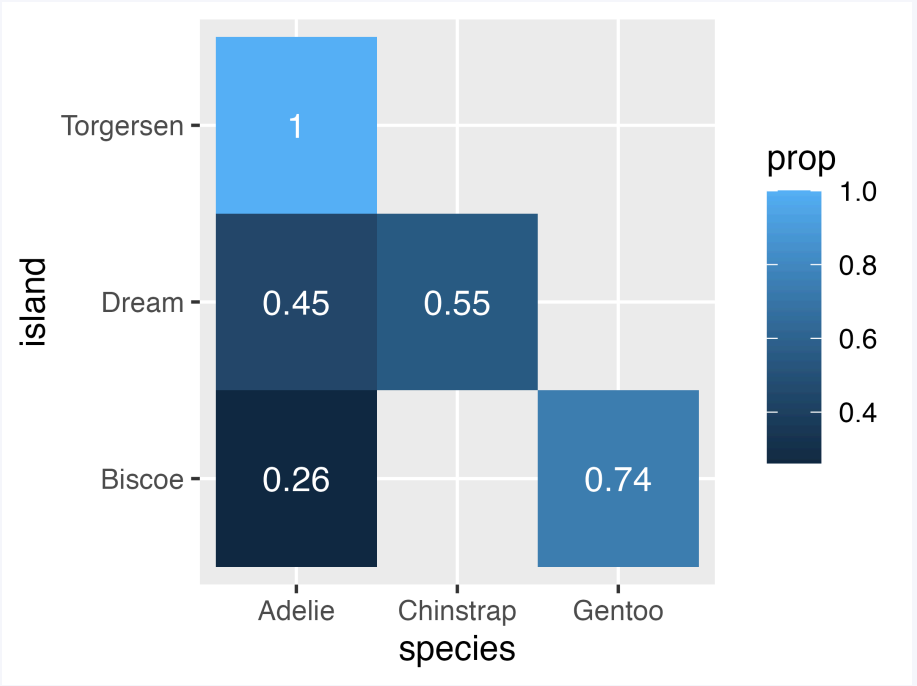
Lollipop plot

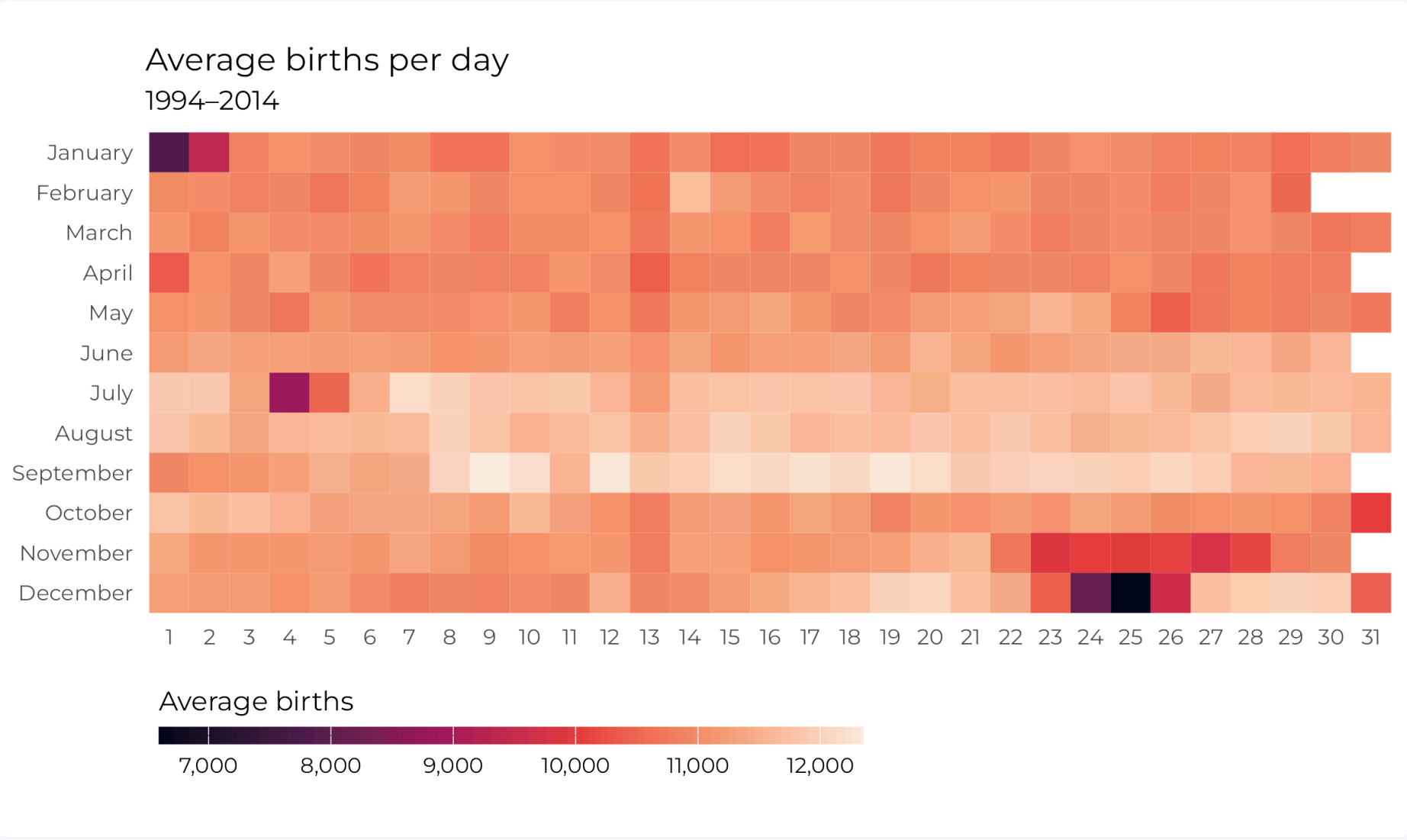
```
gapminder |>
  filter(year == 2007) |>
  count(continent) |>
  mutate(
    continent = fct_reorder(
      continent,
      n
    ),
    prop = n / sum(n)
  ) |>
  ggplot(
    aes(x = prop, y = continent)
  ) +
  geom_pointrange(
    aes(xmin = 0, xmax = prop)
  )
```



Heat map

```
penguins |>
  count(species, island) |>
  group_by(island) |>
  mutate(prop = n / sum(n)) |>
  ggplot(
    aes(
      x = species,
      y = island,
      fill = prop
    )
  ) +
  geom_tile() +
  geom_text(
    aes(label = round(prop, 2)),
    color = "white"
  )
```




Average births per day
1994–2014
January
February
March
April
May
June
July
August
September
October
November
December
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 26 27 28 29 30 31
Average births
7,000
8,000
9,000
10,000
11,000
12,000

Summary

Describing variables

Variable = column; observation = row

Variables

Identification vs. measurement

Numbers: continuous, count

Categories: categorical, binary, ordinal

Qualitative

Descriptions

Numeric variables

- *Summary statistics*: mean, median, standard deviation, min, max, percentiles
- *Plots*: histograms, density plots, dot plots, raincloud plots

Categorical variables

- *Summary statistics*: counts, proportions
- *Plots*: Bar plots, lollipop plots, heatmaps

Our turn!

Exploring cars in Qatar

https://profmusgrave.github.io/qatarcars/

- Identifying variable types
  - Identification vs. measurement
  - Numeric vs. categorical (and subtypes)
- Describe variables
  - Numbers
  - Plots