# Joining data from multiple sources

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# Working with multiple data frames

# Fisheries of the world

Fisheries and Aquaculture Department of the Food and Agriculture Organization of the United Nations collects data on fisheries production of countries.

| Country | Capture | Aquaculture | Total |
|---|---|---|---|
| China | 17,800,000 | 63,700,000 | 81,500,000 |
| Indonesia | 6,584,419 | 16,600,000 | 23,200,000 |
| India | 5,082,332 | 5,703,002 | 10,800,000 |
| Vietnam | 2,785,940 | 3,634,531 | 6,420,471 |
| United States | 4,931,017 | 444,369 | 5,375,386 |
| Russia | 4,773,413 | 173,840 | 4,947,253 |
| Japan | 3,275,263 | 1,067,994 | 4,343,257 |
| Philippines | 2,027,992 | 2,200,914 | 4,228,906 |
| Peru | 3,811,802 | 100,187 | 3,911,989 |
| Bangladesh | 1,674,770 | 2,203,554 | 3,878,324 |

Source: https://en.wikipedia.org/wiki/Fishing_industry_by_country

...

# Load data

```
fisheries <- read_csv("data/fisheries.csv")
```

# First look at the data

```
glimpse(fisheries)
```

```
## Rows: 216
## Columns: 4
## $ country     <chr> "Afghanistan", "Albania", "Algeria", "American Samoa",
## $ capture     <dbl> 1000, 7886, 95000, 3047, 0, 486490, 3000, 755226, 3758
## $ aquaculture <dbl> 1200, 950, 1361, 20, 0, 655, 10, 3673, 16381, 0, 96847
## $ total       <dbl> 2200, 8836, 96361, 3067, 0, 487145, 3010, 758899, 2013
```

# Quick summaries of the data

```
skim(fisheries) #skimr package
```

```
## ── Data Summary ────────────────────────
##                            Values
## Name                       fisheries
## Number of rows             216
## Number of columns          4
## _______________________
## Column type frequency:
##   character                1
##   numeric                  3
## ________________________
## Group variables            None
##
## ── Variable type: character ──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
##   skim_variable n_missing complete_rate   min   max empty n_unique whitespace
## 1 country               0             1     4    32     0      215          0
##
## ── Variable type: numeric ────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
##   skim_variable n_missing complete_rate    mean       sd    p0    p25    p50     p75     p100 hist
## 1 capture               0             1 421916. 1478638.     0 3280.  33797  221884. 17800000 ▇▁▁▁
## 2 aquaculture           0             1 508368. 4496073.     0   25.2  1574.  25998  63700000 ▇▁▁▁
## 3 total                 0             1 930284. 5846301.     0 7270.  44648. 271901. 81500000 ▇▁▁▁
```

# Some summary stats

```
fisheries %>%
  summarise(
    mean_cap = mean(capture),
    mean_aqc = mean(aquaculture),
    mean_tot = mean(total)
  )
```

```
## # A tibble: 1 x 3
##   mean_cap mean_aqc mean_tot
##      <dbl>    <dbl>    <dbl>
## 1  421916.  508368.  930284.
```

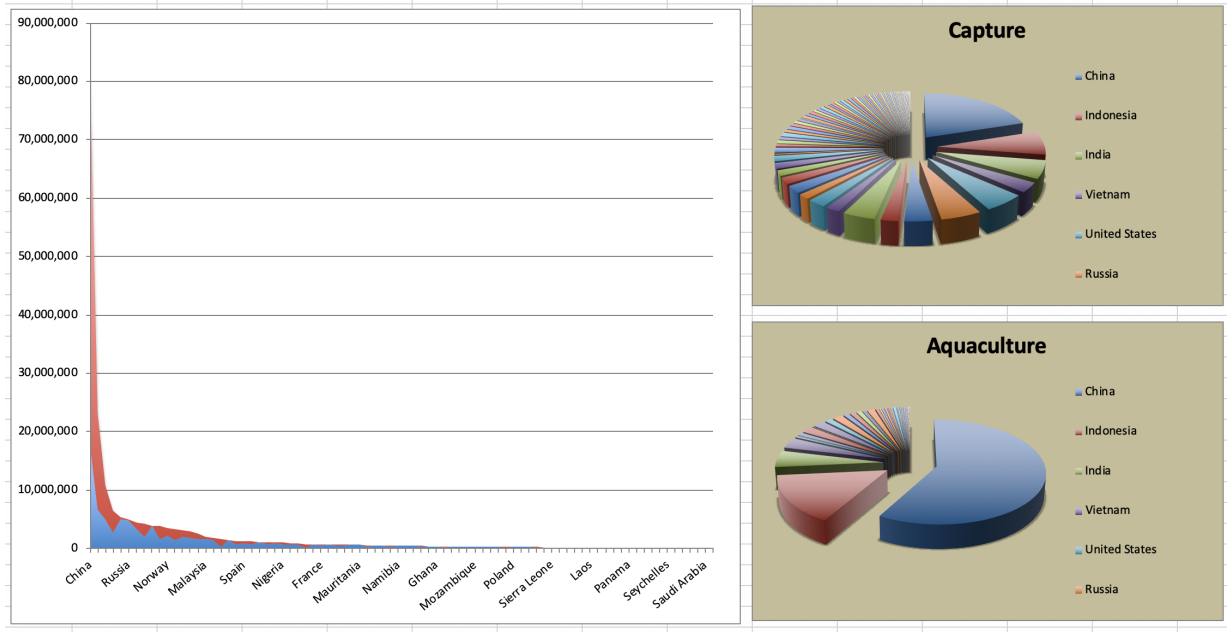
well, that was boring...

# A new approach!

```
fisheries %>%
  summarise(across(capture:total, mean))
```

```
## # A tibble: 1 x 3
##   capture aquaculture   total
##     <dbl>       <dbl>   <dbl>
## 1 421916.     508368. 930284.
```

The (not-so-great) visualization below shows the distribution of fishery harvest of countries for 2016, by capture and aquaculture. What are some ways you would improve this visualization? Note that countries whose total harvest was less than 100,000 tons are not included in the visualization.



## Goal: calculate summary statistics at the continent level and visualize them

# Data prep

```
continents <- read_csv("data/continents.csv")
```

Filter out countries whose total harvest was less than 100,000 tons since they are not included in the visualization:

```
fisheries <- fisheries %>%
  filter(total >= 100000)

fisheries
```

```
## # A tibble: 82 x 4
##    country    capture aquaculture   total
##    <chr>        <dbl>       <dbl>   <dbl>
##  1 Angola      486490         655  487145
##  2 Argentina   755226        3673  758899
##  3 Australia   174629       96847  271476
##  4 Bangladesh 1674770     2203554 3878324
```

# Data joins

```
fisheries %>% select(country)
```

```
## # A tibble: 82 x 1
##    country
##    <chr>
##  1 Angola
##  2 Argentina
##  3 Australia
##  4 Bangladesh
##  5 Brazil
##  6 Cambodia
##  7 Cameroon
##  8 Canada
##  9 Chad
## 10 Chile
## # … with 72 more rows
```

```
continents
```

```
## # A tibble: 245 x 2
##    country            continent
##    <chr>              <chr>
##  1 Afghanistan        Asia
##  2 Åland Islands      Europe
##  3 Albania            Europe
##  4 Algeria            Africa
##  5 American Samoa     Oceania
##  6 Andorra            Europe
##  7 Angola             Africa
##  8 Anguilla           Americas
##  9 Antigua & Barbuda Americas
## 10 Argentina          Americas
## # … with 235 more rows
```

# Joining data frames

```
something_join(x, y)
```

- **`inner_join()`**: all rows from x where there are matching values in y, return all combination of multiple matches in the case of multiple matches
- **`left_join()`**: all rows from x
- **`right_join()`**: all rows from y
- **`full_join()`**: all rows from both x and y
- **`semi_join()`**: all rows from x where there are matching values in y, keeping just columns from x.
- **`anti_join()`**: return all rows from x where there are not matching values in y, never duplicate rows of x
- ...

# Setup

For the next few slides...

```
x
```

```
## # A tibble: 3 x 1
##   value
##   <dbl>
## 1     1
## 2     2
## 3     3
```

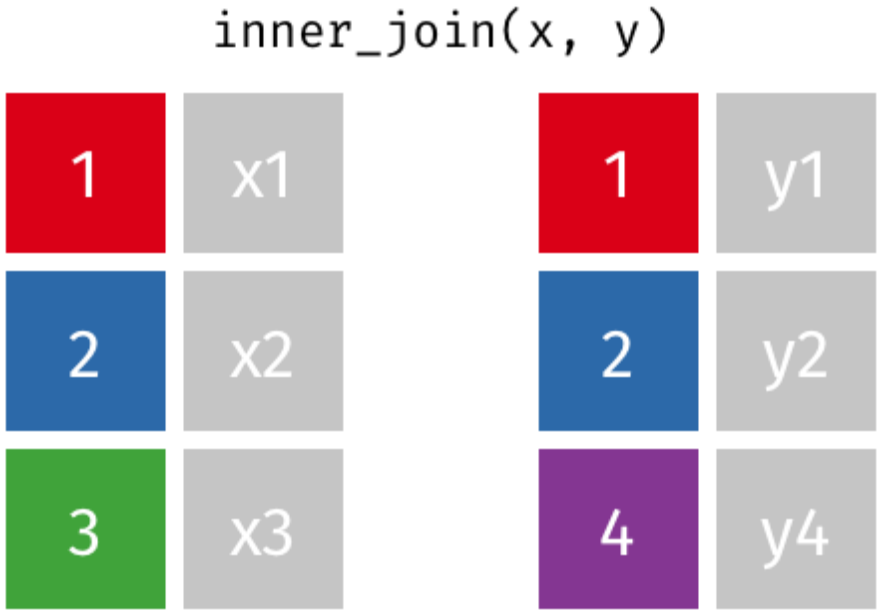
```
y
```

```
## # A tibble: 3 x 1
##   value
##   <dbl>
## 1     1
## 2     2
## 3     4
```

# inner_join()

```
inner_join(x, y)
```

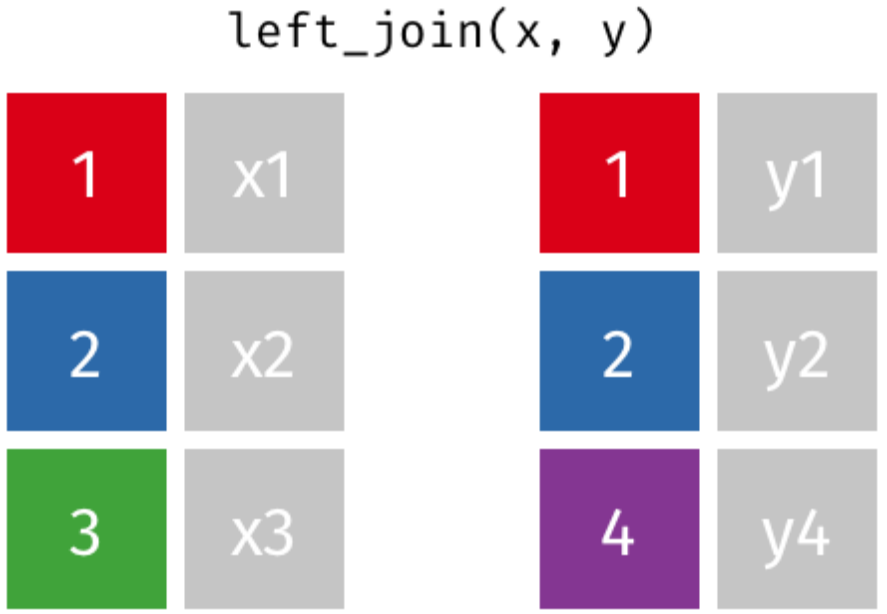
```
## # A tibble: 2 x 1
##   value
##   <dbl>
## 1     1
## 2     2
```



# left_join()

```
left_join(x, y)
```

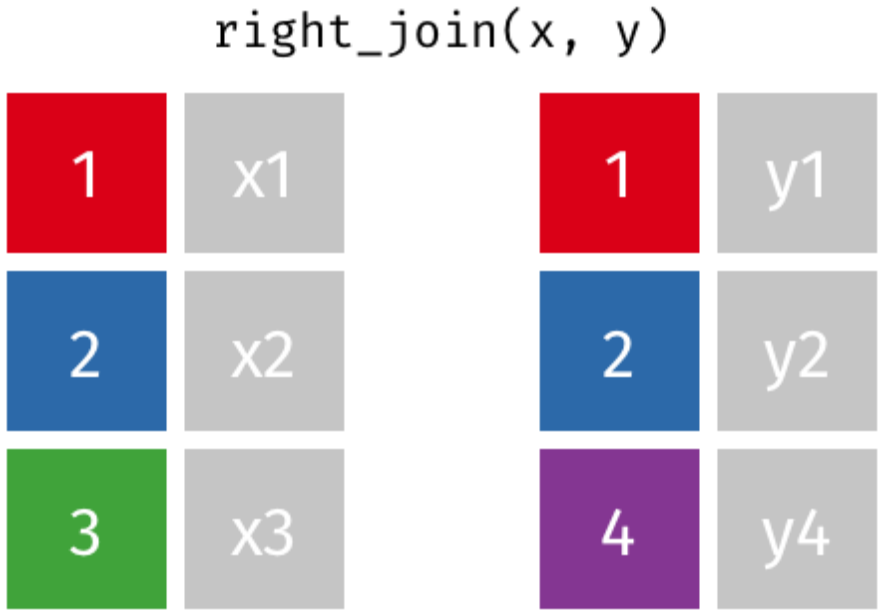
```
## # A tibble: 3 x 1
##   value
##   <dbl>
## 1     1
## 2     2
## 3     3
```



# right_join()

```
right_join(x, y)
```

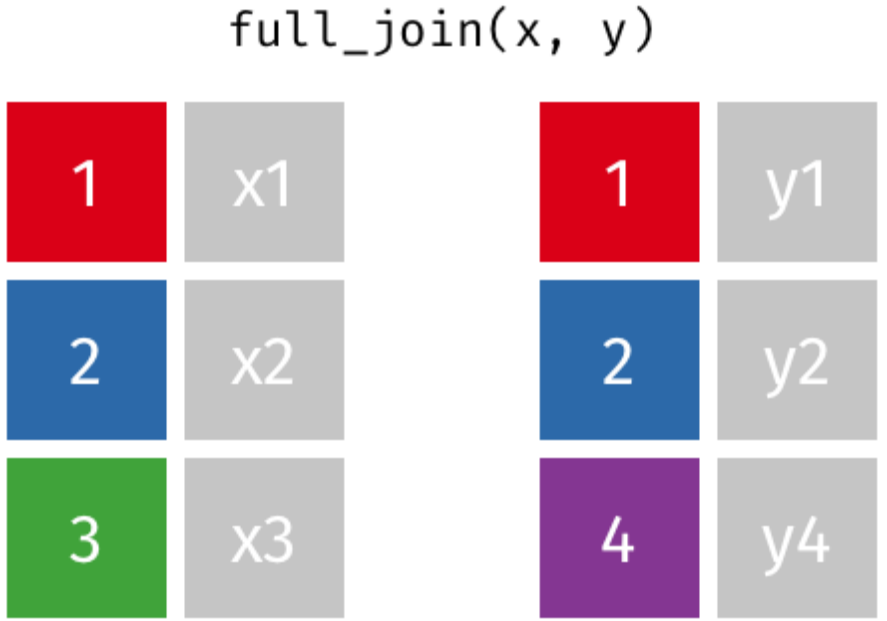
```
## # A tibble: 3 x 1
##   value
##   <dbl>
## 1     1
## 2     2
## 3     4
```



# full_join()

```
full_join(x, y)
```

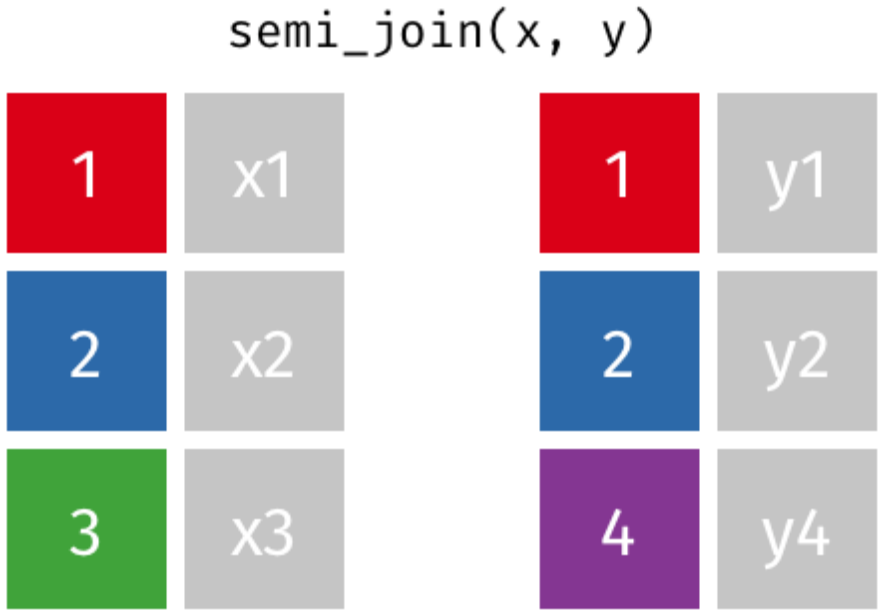
```
## # A tibble: 4 x 1
##   value
##   <dbl>
## 1     1
## 2     2
## 3     3
## 4     4
```



# semi_join()

```
semi_join(x, y)
```

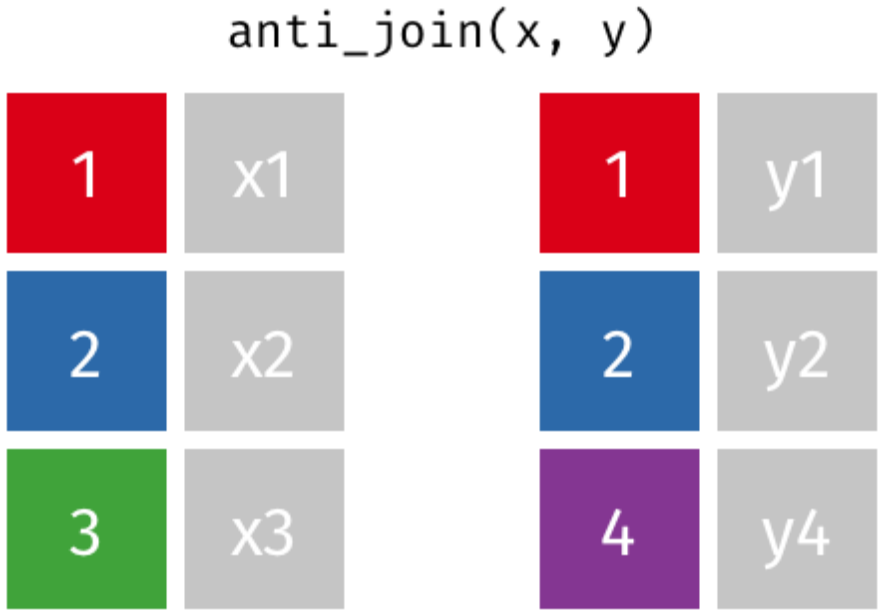
```
## # A tibble: 2 x 1
##   value
##   <dbl>
## 1     1
## 2     2
```



# anti_join()

```
anti_join(x, y)
```

```
## # A tibble: 1 x 1
##   value
##   <dbl>
## 1     3
```



We want to keep all rows and columns from **`fisheries`** and add a column for corresponding continents. Which join function should we use?

```
fisheries %>% select(country)
```

```
## # A tibble: 82 x 1
##    country
##    <chr>
##  1 Angola
##  2 Argentina
##  3 Australia
##  4 Bangladesh
##  5 Brazil
##  6 Cambodia
##  7 Cameroon
##  8 Canada
```

```
continents
```

```
## # A tibble: 245 x 2
##    country           continent
##    <chr>             <chr>
##  1 Afghanistan       Asia
##  2 Åland Islands     Europe
##  3 Albania           Europe
##  4 Algeria           Africa
##  5 American Samoa    Oceania
##  6 Andorra           Europe
##  7 Angola            Africa
##  8 Anguilla          Americas
```

# Join fisheries and continents

```
fisheries <- left_join(fisheries, continents)
```

> How does **`left_join()`** know to join the two data frames by **`country`**?

Hint:

- Variables in the original fisheries dataset:

```
## [1] "country"     "capture"     "aquaculture" "total"
```

- Variables in the continents dataset:

```
## [1] "country"   "continent"
```

# Check the data

```
fisheries %>%
  filter(is.na(continent))
```

```
## # A tibble: 3 x 5
##   country                              capture aquaculture   total continent
##   <chr>                                  <dbl>       <dbl>   <dbl> <chr>
## 1 Democratic Republic of the Congo  237372        3161  240533 <NA>
## 2 Hong Kong                          142775        4258  147033 <NA>
## 3 Myanmar                           2072390     1017644 3090034 <NA>
```

# Implement fixes

```
fisheries <- fisheries %>%
  mutate(continent = case_when(
    country == "Democratic Republic of the Congo" ~ "Africa",
    country == "Hong Kong"                        ~ "Asia",
    country == "Myanmar"                          ~ "Asia",
    TRUE                                          ~ continent
    )
  )
```

...and check again

```
fisheries %>%
  filter(is.na(continent))
```

```
## # A tibble: 0 x 5
## # … with 5 variables: country <chr>, capture <dbl>, aquaculture <dbl>, tota
## #   continent <chr>
```

What does the following code do?

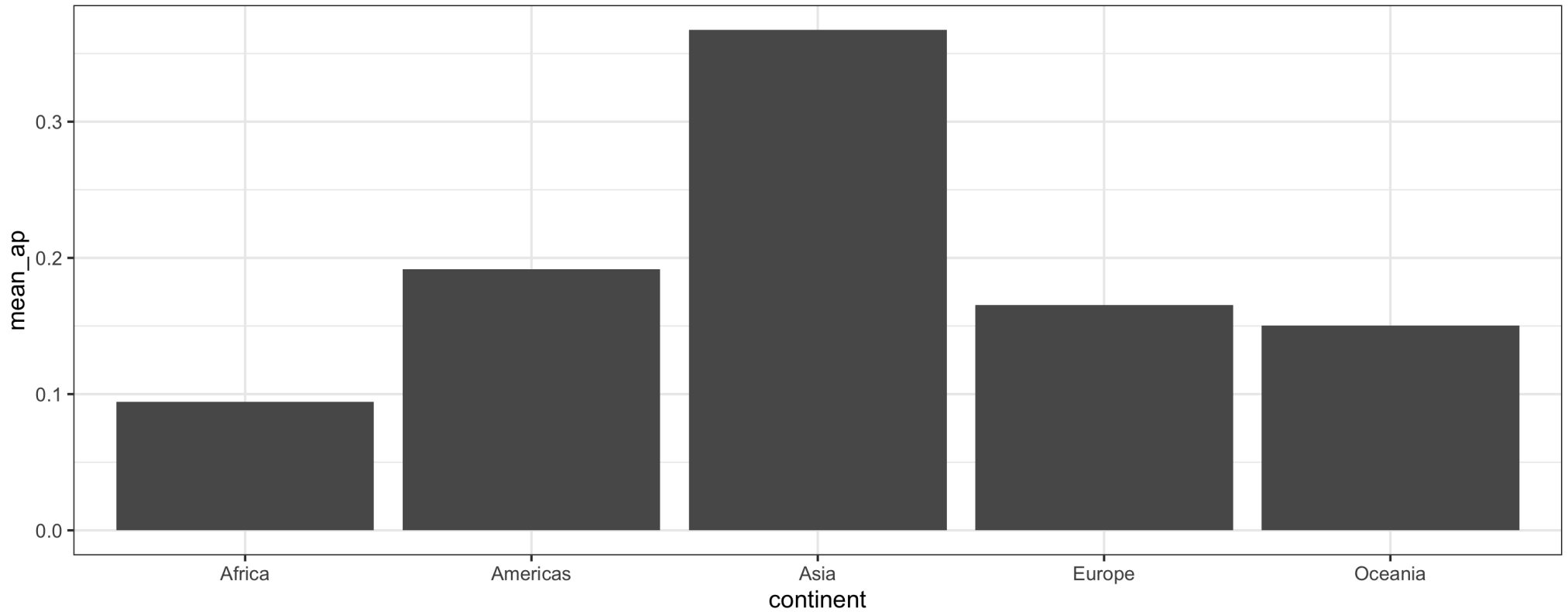
```
fisheries %>%
  mutate(aquaculture_perc = aquaculture / total)
```

# Demo

# Demo

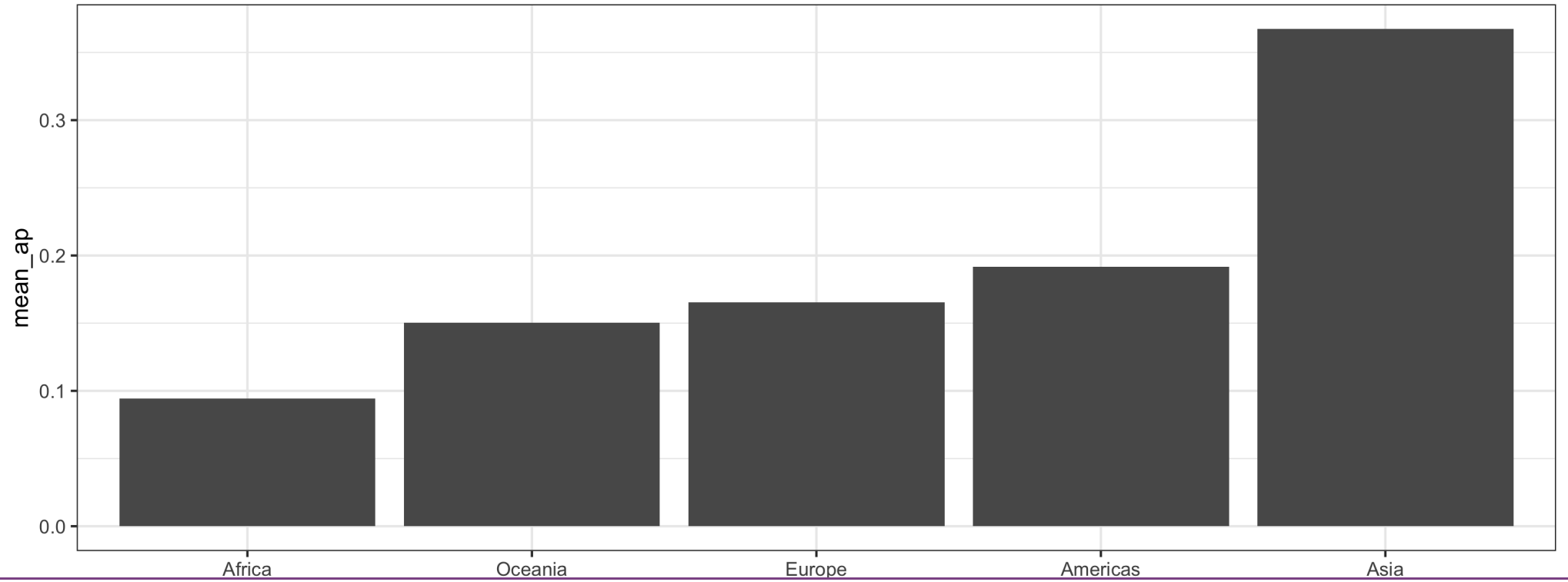
# Visualize continent summary stats

```
ggplot(fisheries_summary, aes(x = continent, y = mean_ap)) +
  geom_col()
```



# Improve visualization

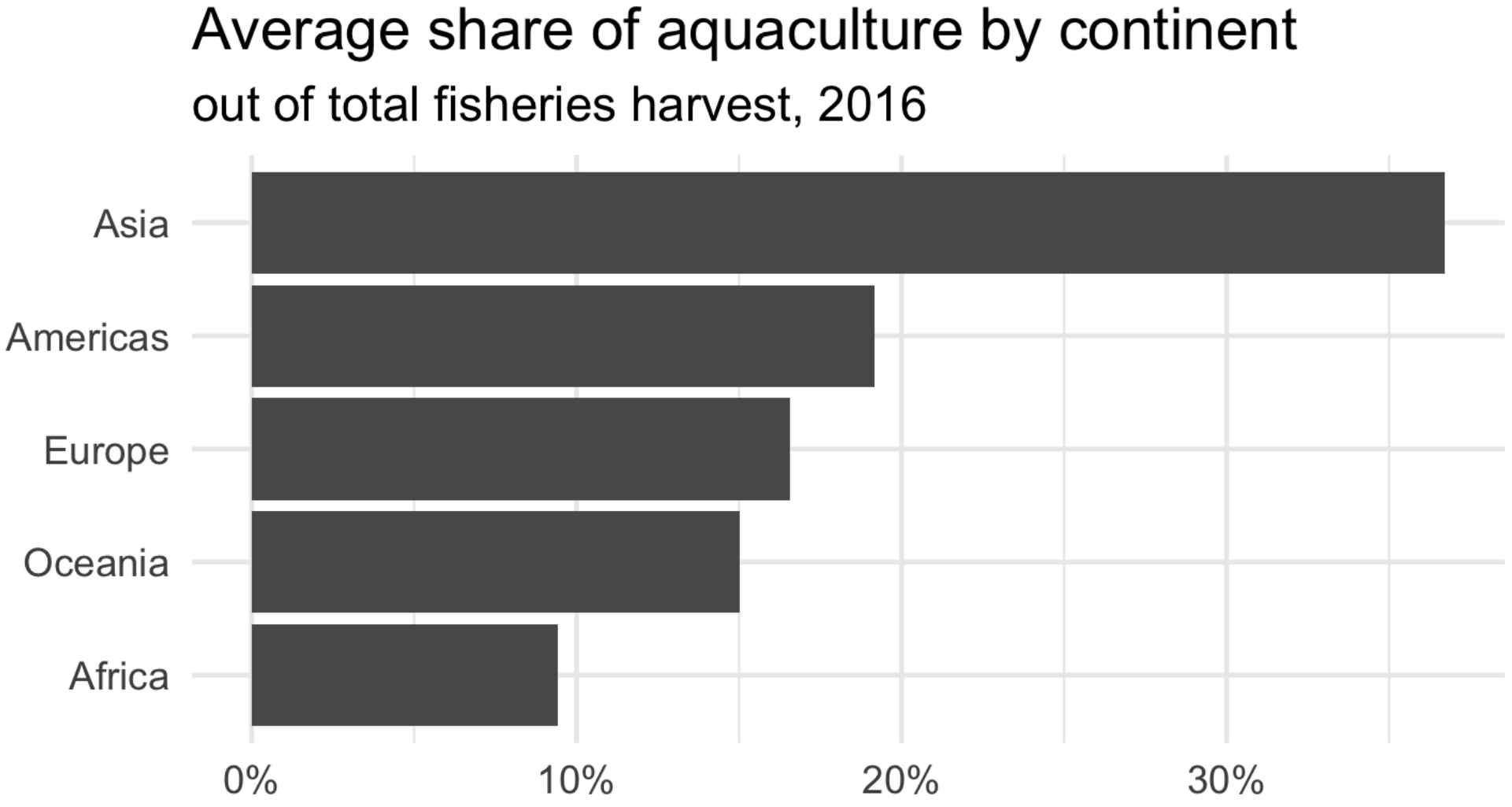
```
ggplot(fisheries_summary,
       aes(x = fct_reorder(continent, mean_ap), y = mean_ap)) +
  geom_col()
```



# Improve visualization further

```
ggplot(fisheries_summary,
       aes(y = fct_reorder(continent, mean_ap), x = mean_ap)) +
  geom_col() +
  scale_x_continuous(labels = label_percent(accuracy = 1)) +
  labs(
    x = "",
    y = "",
    title = "Average share of aquaculture by continent",
    subtitle = "out of total fisheries harvest, 2016",
    caption = "Source: bit.ly/2VrawTt"
  ) +
  theme_minimal()
```

➡️ See next slide...




Source: bit.ly/2VrawTt