cm012 Exercises: Factors

Motivating the need for factors in R

Activity 1: Using Factors for plotting

1.1 Let's look again into `gapminder` dataset and create a new cloumn, `life_level`, that contains five categories ("very high", "high","moderate", "low" and "very low") based on life expectancy in 1997. Assign categories accoring to the table below:

Criteria	life_level
less than 23	very low
between 23 and 48	low
between 48 and 59	moderate
between 59 and 70	high
more than 70	very high

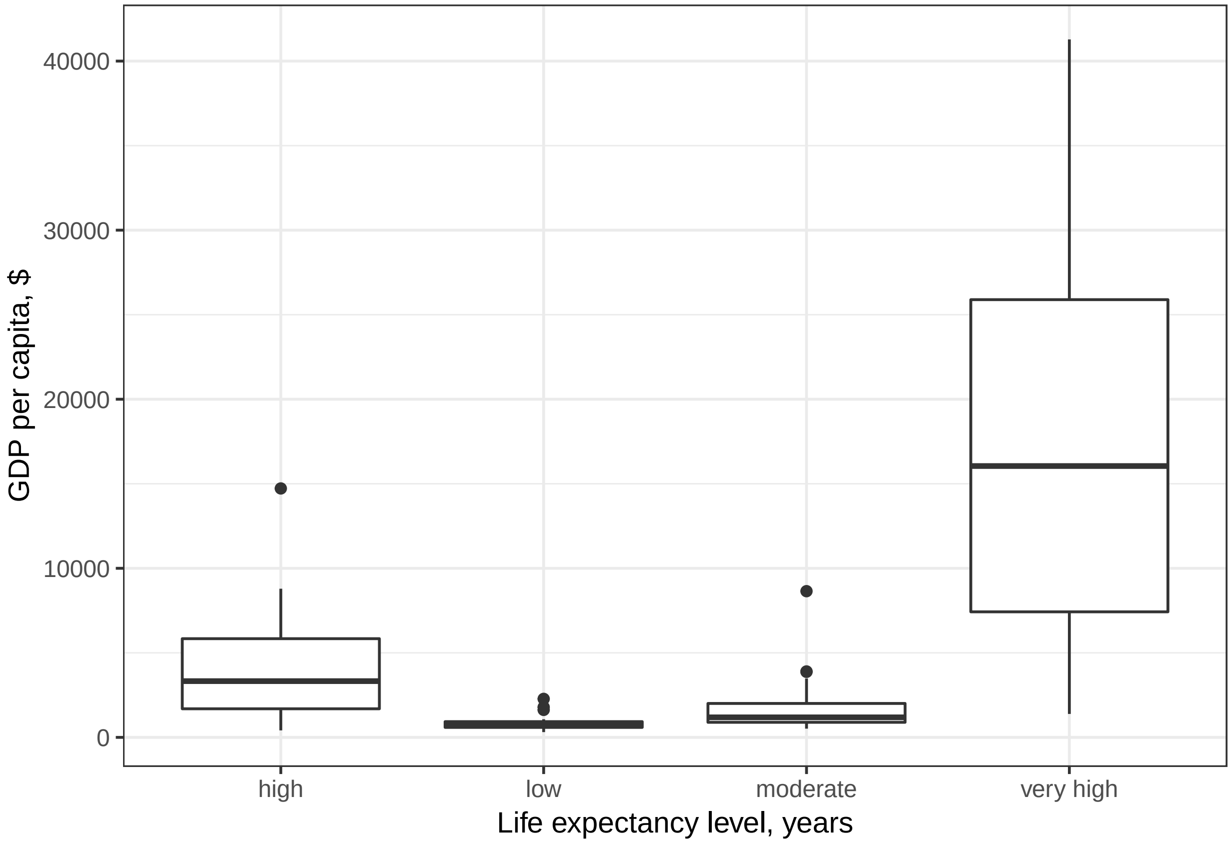
Function `case_when()` is a tidier way to vectorise multiple `if_else()` statements. you can read more about this function here.

```r
library(tidyverse)
```

```
## -- Attaching packages ------------------ tidyverse 1.2.1 --

## v ggplot2 3.0.0     v purrr   0.3.2
## v tibble  2.1.3     v dplyr   0.8.3
## v tidyr   1.0.0     v stringr 1.3.1
## v readr   1.3.1     v forcats 0.4.0

## Warning: package 'ggplot2' was built under R version 3.4.4

## Warning: package 'readr' was built under R version 3.4.4

## Warning: package 'purrr' was built under R version 3.4.4

## Warning: package 'stringr' was built under R version 3.4.4

## Warning: package 'forcats' was built under R version 3.4.4

## -- Conflicts --------------------- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```r
library(gapminder)
```

```r
gapminder %>%
  filter(year == 1997) %>%
  mutate(life_level = case_when(lifeExp < 23 ~ "very low",
                                lifeExp < 48 ~ "low",
                                lifeExp < 59 ~ "moderate",
                                lifeExp < 70 ~ "high",
                                TRUE ~ "very high")) %>%
  ggplot() + geom_boxplot(aes(x = life_level, y = gdpPercap)) +
  labs(y = "GDP per capita, $", x= "Life expectancy level, years") +
  theme_bw()
```



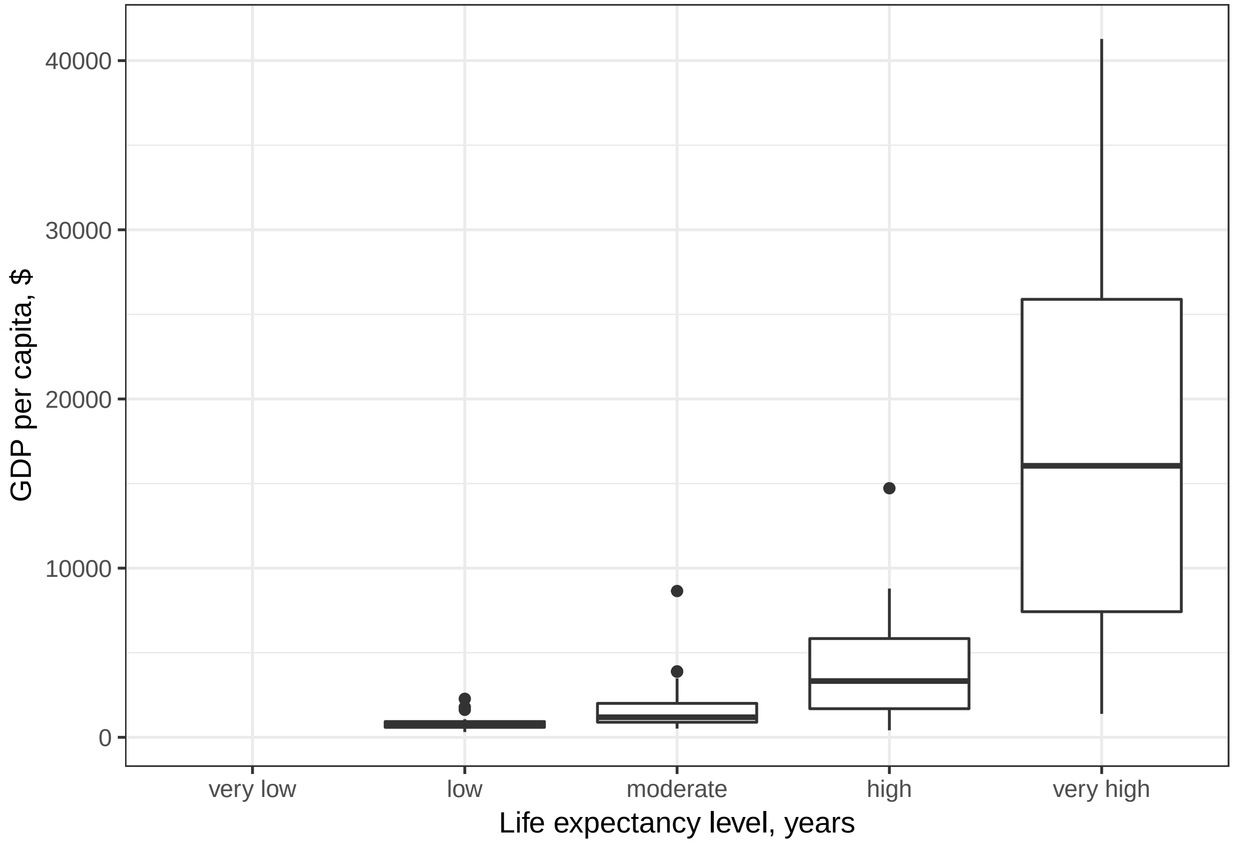
Do you notice anything odd/wrong about the graph?

We can make a few observations:

- It seems that none of the countries had a “very low” life-expectancy in 1997.
- However, since it was an option in our analysis it should be included in our plot. Right?
- Notice also how levels on x-axis are placed in the “wrong” order.

1.2 You can correct these issues by explicitly setting the levels parameter in the call to `factor()`. Use, `drop = FALSE` to tell the plot not to drop unused levels

```
gapminder %>%
  filter(year == 1997) %>%
  mutate(life_level = factor(case_when(lifeExp < 23 ~ "very low",
                                       lifeExp < 48 ~ "low",
                                       lifeExp < 59 ~ "moderate",
                                       lifeExp < 70 ~ "high",
                                       TRUE ~ "very high"),
                       levels = c("very low", "low",
                                  "moderate", "high", "very high"))) %>%
  ggplot() + geom_boxplot(aes(x = life_level, y = gdpPercap)) +
  labs(y = "GDP per capita, $", x= "Life expectancy level, years") +
  scale_x_discrete(drop=FALSE) +
  theme_bw()
```



Inspecting factors (activity 2)

In Activity 1, we created our own factors, so now let's explore what categorical variables that we have in the `gapminder` dataset.

Exploring `gapminder$continent` (activity 2.1)

Use functions such as `str()`, `levels()`, `nlevels()` and `class()` to answer the following questions:

- what class is `continent`(a factor or charecter)?
- How many levels? What are they?
- What integer is used to represent factor "Asia"?

```
gapminder$continent %>%
  class()
```

```
## [1] "factor"
```

```
gapminder$continent %>%
  levels()
```

```
## [1] "Africa"   "Americas" "Asia"     "Europe"   "Oceania"
```

```
gapminder$continent %>%
  nlevels()
```

```
## [1] 5
```

```
gapminder$continent %>%
  str()
```

```
##  Factor w/ 5 levels "Africa","Americas",..: 3 3 3 3 3 3 3 3 3 3 ...
```

Exploring `gapminder$country` (activity 2.2)

Let's explore what else we can do with factors:

Answer the following questions:

- How many levels are there in `country`?
- Filter `gapminder` dataset by 5 countries of your choice. How many levels are in your filtered dataset?

```
h_countries <- c("Canada", "Brazil", "France", "Bolivia", "Russia")
gap <- gapminder %>%
  filter(country %in% h_countries)
```

Dropping unused levels

What if we want to get rid of some levels that are "unused" - how do we do that?

The function `droplevels()` operates on all the factors in a data frame or on a single factor. The function `forcats::fct_drop()` operates on a factor.

```
h_gap_dropped <- gap %>%
  droplevels()
h_gap_dropped %>%
  nlevels()
```

```
## [1] 0
```

Changing the order of levels

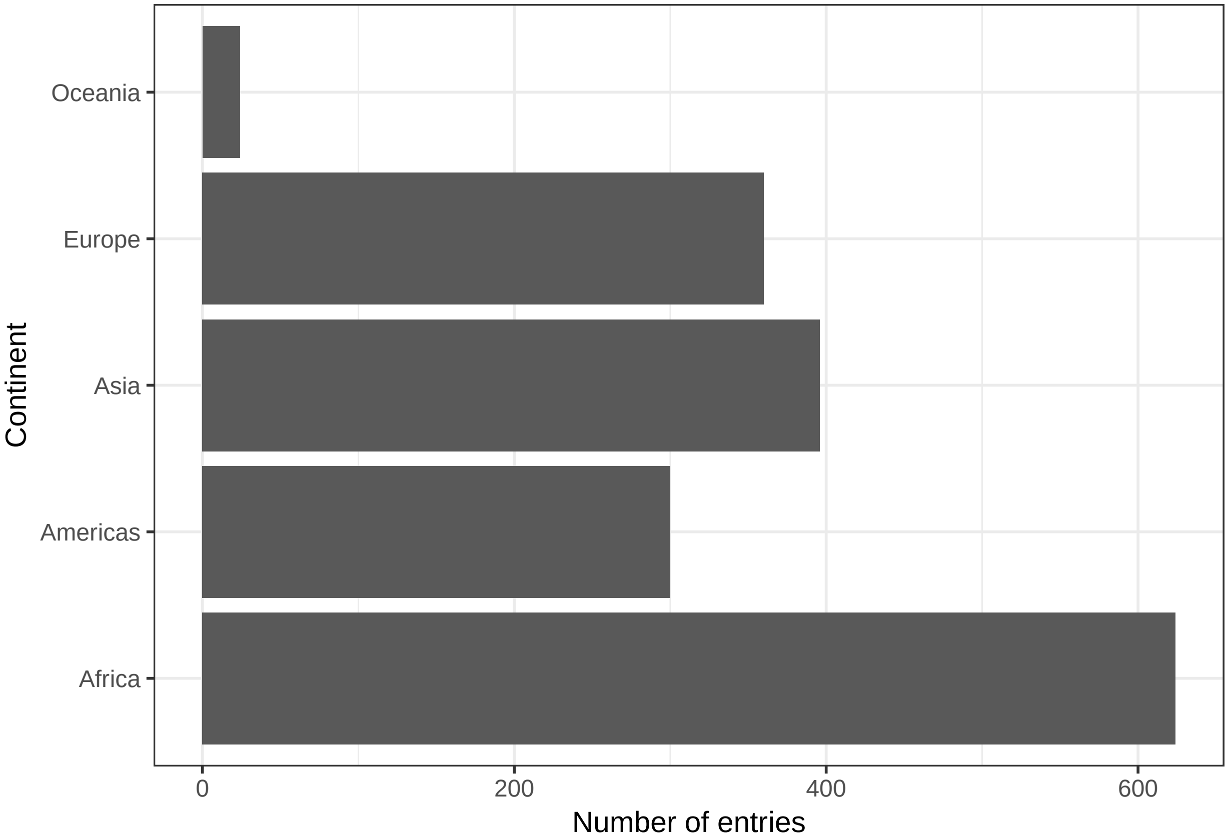
Let's say we wanted to re-order the levels of a factor using a new metric - say, count().

We should first produce a frequency table as a tibble using `dplyr::count()`:

```
gapcount <- gapminder %>%
  count(continent)
```

The table is nice, but it would be better to visualize the data. Factors are most useful/helpful when plotting data. So let's first plot this:

```
gapminder %>%
  ggplot() +
  geom_bar(aes(continent)) +
  coord_flip() +
  theme_bw() +
  ylab("Number of entries") + xlab("Continent")
```



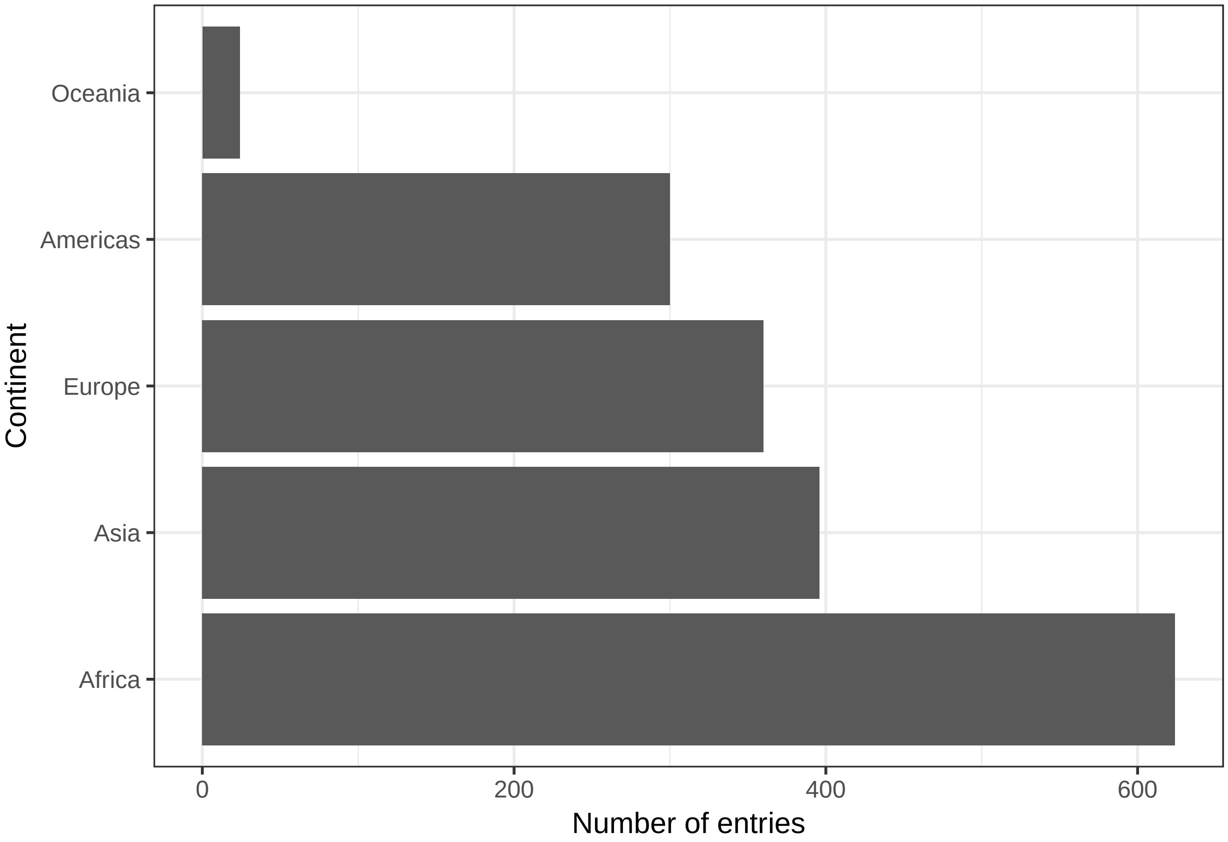
Think about how levels are normally ordered. It turns out that by default, R always sorts levels in alphabetical order. However, it is preferable to order the levels according to some principle:

1. Frequency/count.

- Make the most common level the first and so on. Function `fct_infreq()` might be useful.
- The function `fct_rev()` will sort them in the opposite order.

For instance , '

```
gapminder %>%
  ggplot() +
  geom_bar(aes(fct_infreq(continent))) +
  coord_flip()+
  theme_bw() +
  ylab("Number of entries") + xlab("Continent")
```

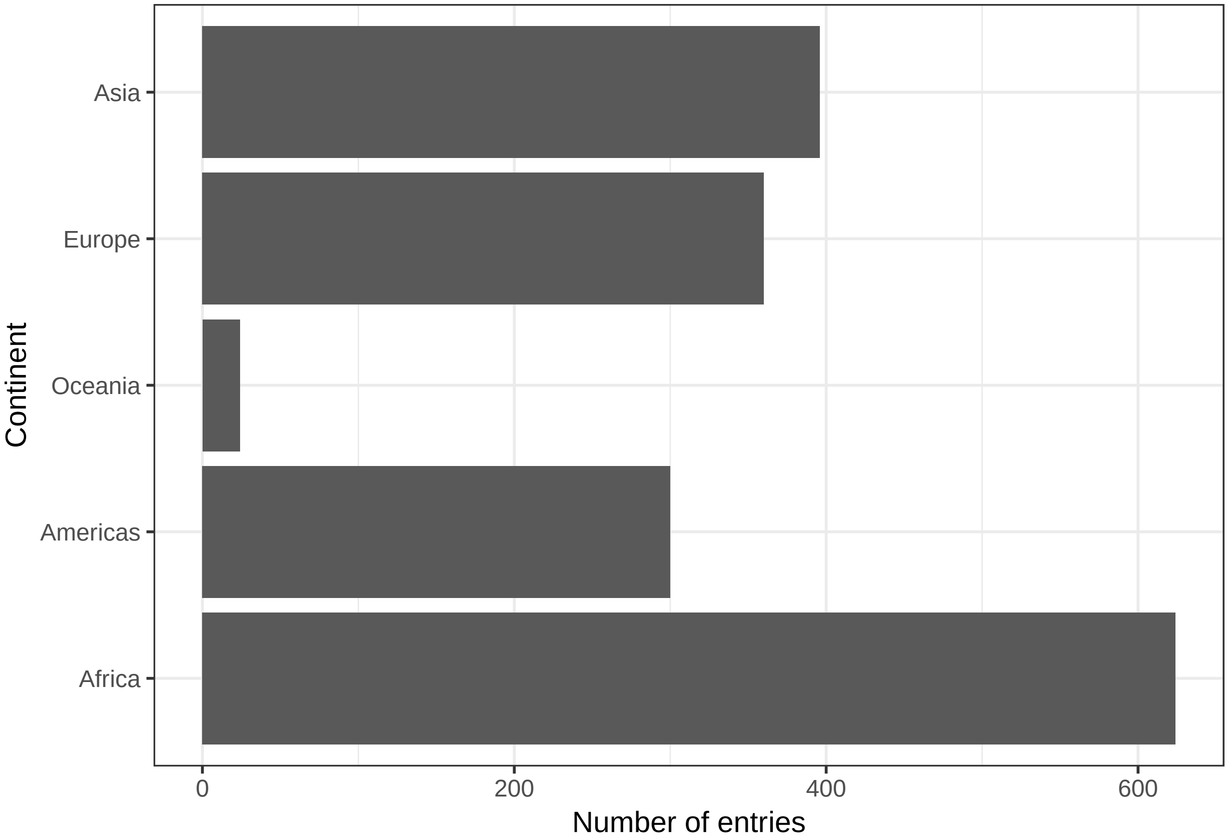


Section 9.6 of Jenny Bryan's notes have some helpful examples.

2. Another variable.

- For example, if we wanted to bring back our example of ordering `gapminder` countries by life expectancy, we can visualize the results using `fct_reorder()`.

```
##  default summarizing function is median()
gapminder %>%
  ggplot() +
  geom_bar(aes(fct_reorder(continent, lifeExp, max))) +
  coord_flip()+
  theme_bw() +
  xlab("Continent") + ylab("Number of entries")
```



Use `fct_reorder2()` when you have a line chart of a quantitative x against another quantitative y and your factor provides the color.

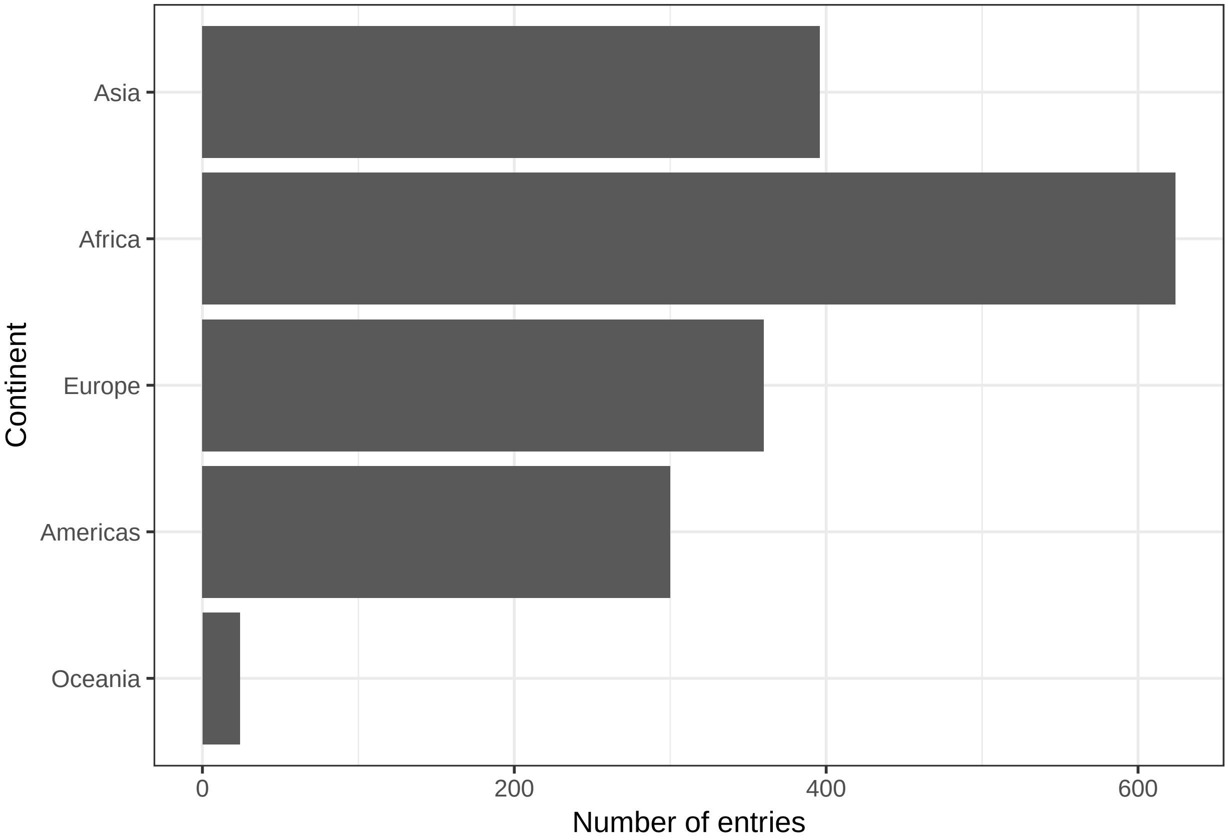
```
## order by life expectancy
ggplot(h_gap, aes(x = year, y = lifeExp,
                  color = FILL_IN_THIS)) +
  geom_line() +
  labs(color = "country")
```

```
## Error in ggplot(h_gap, aes(x = year, y = lifeExp, color = FILL_IN_THIS)): object 'h_gap' not found
```

Change order of the levels manually

This might be useful if you are preparing a report for say, the state of affairs in Africa.

```
gapminder %>%
  ggplot() +
  geom_bar(aes(fct_relevel(continent, "Oceania", "Americas", "Europe"))) +
  coord_flip()+
  theme_bw() +
  xlab("Continent") + ylab("Number of entries")
```

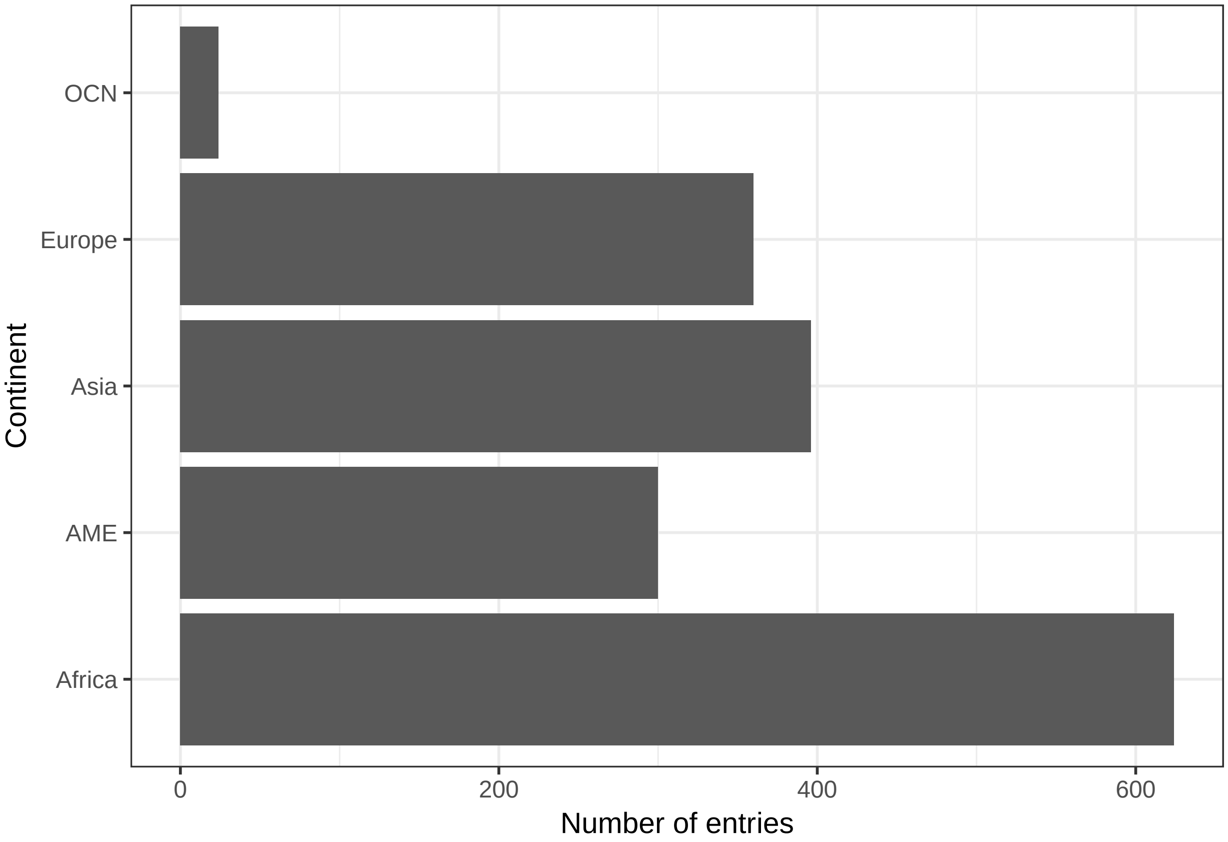


More details on reordering factor levels by hand can be found [here]https://forcats.tidyverse.org/reference/fct_relevel.html

Recoding factors

Sometimes you want to specify what the levels of a factor should be. For instance, if you had levels called "blk" and "brwn", you would rather they be called "Black" and "Brown" - this is called recoding. Lets recode `Oceania` and the `Americas` in the graph above as abbreviations `OCN` and `AME` respectively using the function `fct_recode()`.

```r
gapminder %>%
  ggplot() +
  geom_bar(aes(fct_recode(continent, "OCN" = "Oceania",
                           "AME" = "Americas"))) +
  coord_flip() +
  theme_bw() +
  xlab("Continent") + ylab("Number of entries")
```



Grow a factor (OPTIONAL)

Let's create two data frames,`df1` and `df2` each with data from two countries, dropping unused factor levels.

The country factors in df1 and df2 have different levels. Can we just combine them?

The country factors in `df1` and `df2` have different levels. Can you just combine them using `c()`?

Explore how different forms of row binding work behave here, in terms of the country variable in the result.