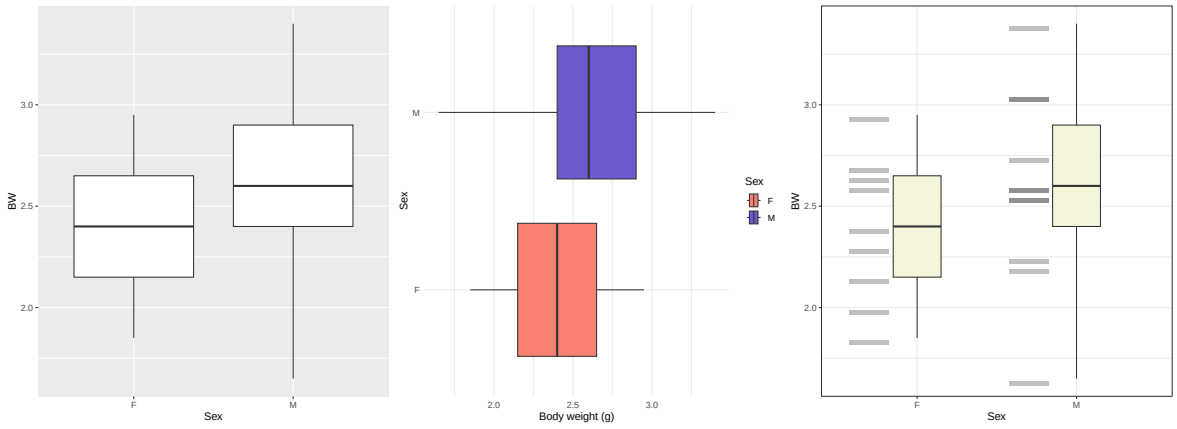
Boxplots in R with `ggplot2`

Cheatsheet

2024-07-17



About

The **boxplot** is a visual representation of a dataset's distribution, showing the median, quartiles, and outliers. It is useful for comparing distributions between groups and identifying outliers within a single group.

> **i** Assumed knowledge
>
> - You know how to install and load packages in R.
> - You know how to import data into R.
> - You recognise data frames and vectors.

Data structure

Your data should be **structured** in a way that makes it *easy* to plot. The ideal structure is **long**, i.e. one where each column represents a variable and each row an observation (Figure 1). You can either reshape your data in R or **move cells manually** in a spreadsheet program to achieve the desired structure. For boxplots comparing more than one group of data, a **categorical variable** representing the group should be present in the data.

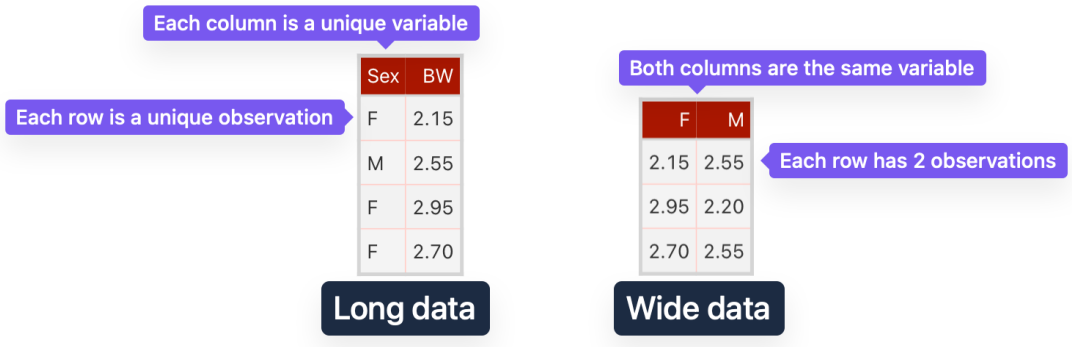


Figure 1: Long data (left) where each column is a different variable – e.g. `Sex` is categorical and `BW` is the measured, continuous response – is preferred over wide data (right), as it makes it easier to manipulate data when plotting.

Data

For this cheatsheet we will use part of the possums dataset used in BIOL2022 labs.

Import data

```
library(readxl) # load the readxl package
possums <- read_excel("possum_bw.xlsx") # read file, store as "possums" object
```

Plot

Below are multiple versions of a boxplot comparing the body weight, `BW`, of possums between two groups defined by the `Sex` variable. Use the code snippets and their different implementations to understand how to customise your boxplot.

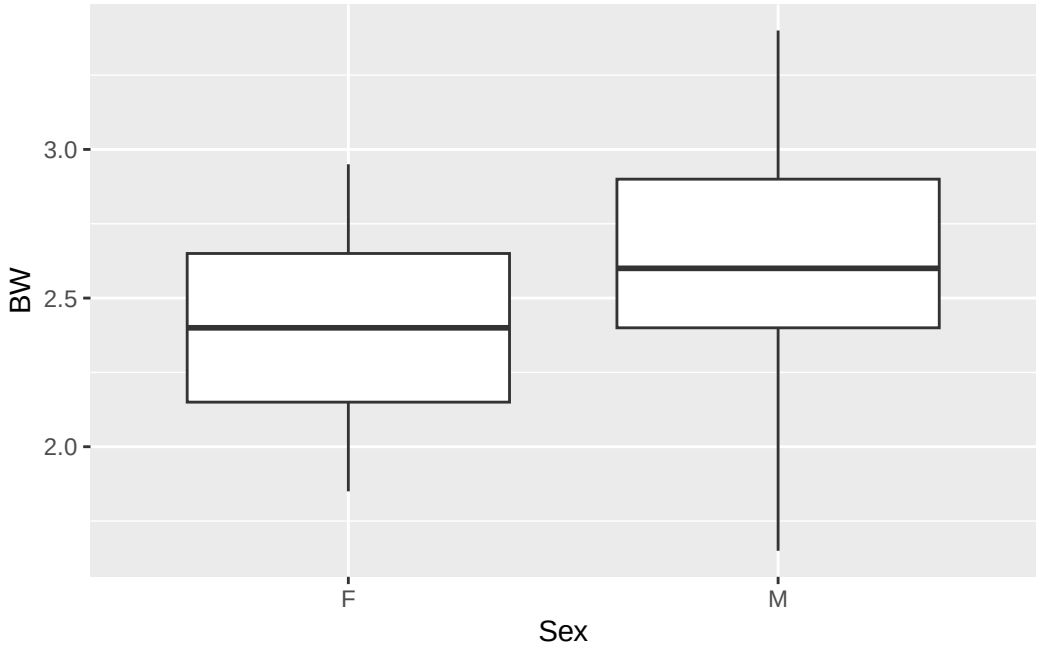
Version 1

```
library(ggplot2)                                                    ①
ggplot(possums, aes(x = Sex, y = BW)) +                             ②
  geom_boxplot()                                                    ③
```

① The `library()` function loads a package. Here, we load the `ggplot2` package to enable the functions required to create the plot.

② The `ggplot()` function creates a plot canvas. The `aes()` function specifies the aesthetic mappings, i.e. which variables are mapped to the x and y axes.

③ Once the canvas is defined, the data can be added automatically using `geom_*()` functions. Here, `geom_boxplot()` adds the boxplot to the canvas, structured according to the aesthetic mappings.

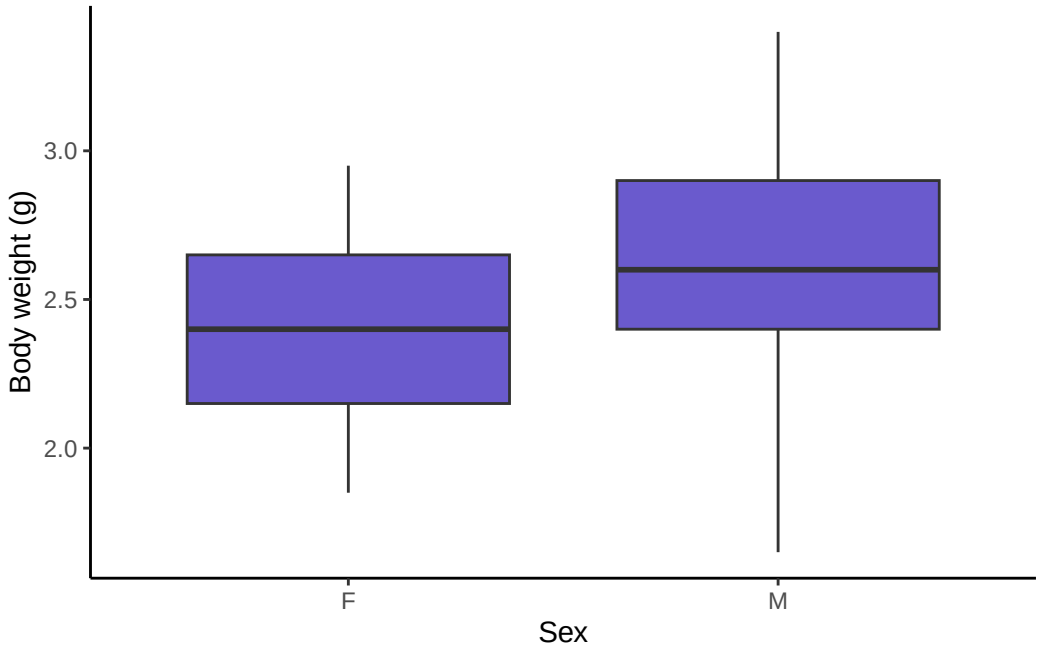


Version 2

```
library(ggplot2)
ggplot(possums, aes(x = Sex, y = BW)) +
  geom_boxplot(fill = "slateblue") +                                ①
  xlab("Sex") +                                                     ②
```

```
  ylab("Body weight (g)") +
  theme_classic()                                                    ③
```

① Adding a `fill` argument to the `geom_boxplot()` function changes the colour of the boxplot.
② `xlab()` and `ylab()` add labels to the x and y axes, respectively.
③ An optional step, `theme_classic()` changes the plot's appearance without needing to specify complex customisations.

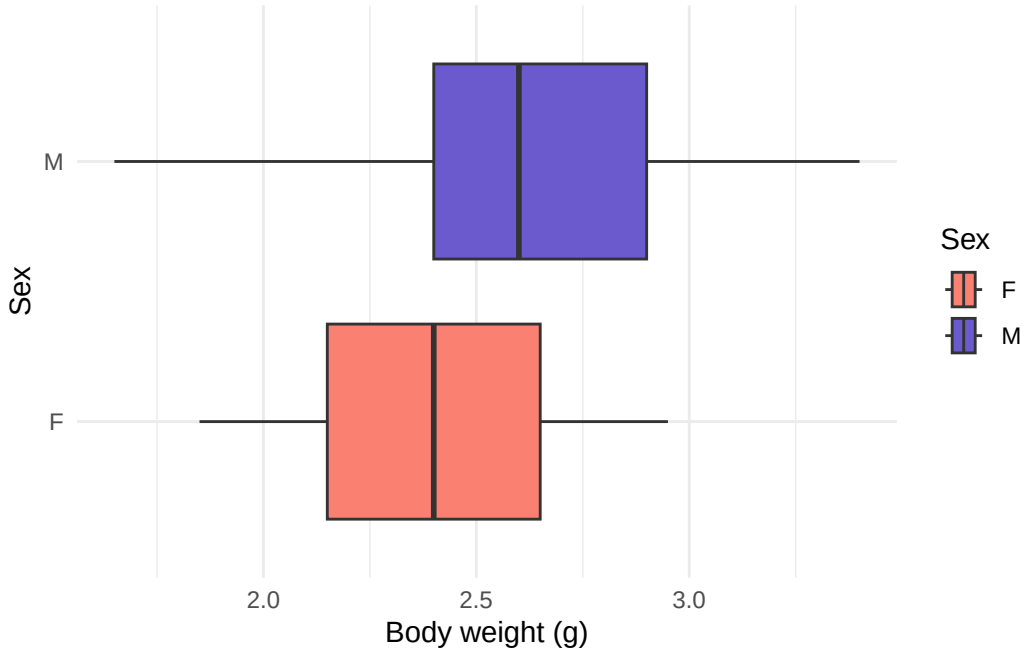


Version 3

```
library(ggplot2)
ggplot(possums, aes(x = BW, y = Sex, fill = Sex)) +                  ①
  geom_boxplot() +
  xlab("Body weight (g)") +
  ylab("Sex") +
  theme_minimal() +
  scale_fill_manual(values = c("salmon", "slateblue"))               ②
```

① The `Sex` variable is mapped to the y-axis and the `BW` variable to the x-axis. The `fill` aesthetic is used to colour the boxplots by the `Sex` variable.

② The `scale_fill_manual()` function allows you to manually set the colours of the boxplots defined by the `fill` aesthetic in the `aes()` function above. There must be one colour for each level of the `Sex` variable.

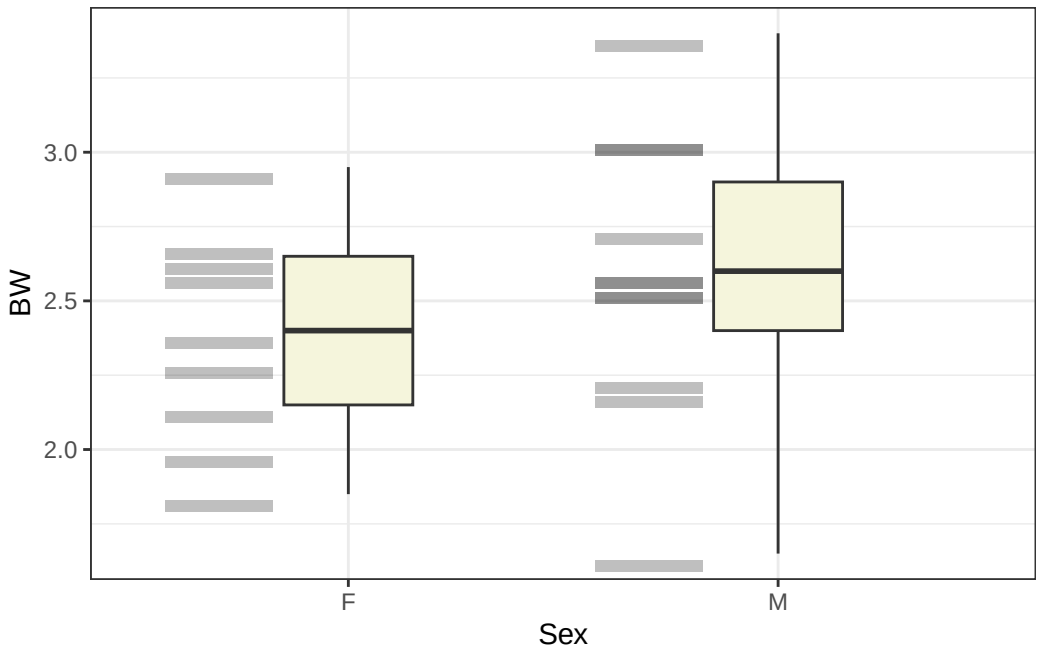


Version 4

```
library(ggplot2)
ggplot(possums) +
  aes(x = Sex, y = BW) +                                    ①
  geom_boxplot(width = .3, fill = "beige") +                ②
  geom_point(                                               ③
    position = position_nudge(x = -.3),                     ④
    shape = 95, size = 24, alpha = .25                      ⑤
  ) +
  theme_bw()
```

① The `aes()` function is placed outside the `ggplot()` function, allowing the aesthetic mappings to be used across multiple `geom_*()` functions.
② `geom_boxplot()` can be customised further using the `width` argument to change the width of the boxplots.
③ `geom_point()` adds points to the plot.
④ The `position_nudge()` function moves the points to the left of the boxplots by -0.3 units.

⑤ The `shape`, `size`, and `alpha` arguments customise the appearance of the points, resulting in a different visual representation of the data "points".



Version 5

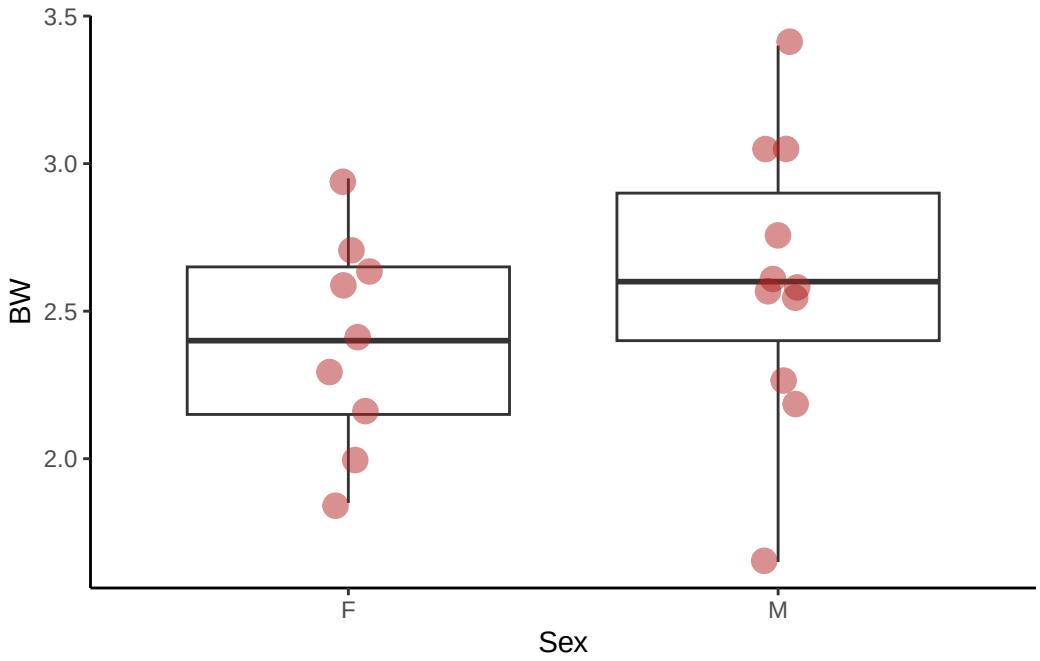
```
library(ggplot2)
plot1 <-
  ggplot(possums) +
  aes(x = Sex, y = BW)                                                    ①

plot1 +                                                                   ②
  geom_boxplot() +
  geom_point(
    position = position_jitter(width = .05, seed = 0),                    ③
    size = 4, alpha = .5,
    colour = "firebrick"
  ) +
  theme_classic()
```

① It is possible to save current work on a plot for later use by assigning it to an object, e.g. `plot1`.

② To continue working on the plot, use the `+` operator on the saved object and continue adding layers.

③ The `position_jitter()` function adds a small amount of random noise to the points, preventing them from overlapping. The `seed` argument ensures the noise is consistent across multiple plots.



More resources

- R colors – a good resource for choosing colours using words in R.
- Beyond bar and box plots – alternative visualisation methods in R for comparing groups.
- Boxplot – the R Graph Gallery – a gallery of boxplot examples in R.