Data Science Visualization

The textbook for the Data Science course series is freely available online.

Learning Objectives

- Data visualization principles to better communicate data-driven findings
- How to use ggplot2 to create custom plots
- The weaknesses of several widely used plots and why you should avoid them

Course Overview

Section 1: Introduction to Data Visualization and Distributions

You will get started with data visualization and distributions in R.

Section 2: Introduction to ggplot2

You will learn how to use ggplot2 to create plots.

Section 3: Summarizing with dplyr

You will learn how to summarize data using dplyr.

Section 4: Gapminder

You will see examples of ggplot2 and dplyr in action with the Gapminder dataset.

Section 5: Data Visualization Principles

You will learn general principles to guide you in developing effective data visualizations.

Section 1 Overview

Section 1 introduces you to Data Visualization and Distributions.

After completing Section 1, you will:

- understand the importance of data visualization for communicating data-driven findings.
- be able to use distributions to summarize data.
- be able to use the average and the standard deviation to understand the normal distribution.
- be able to assess how well a normal distribution fits the data using a quantile-quantile plot.
- be able to interpret data from a boxplot.

Introduction to Data Visualization

The textbook for this section is available here

Key points

- Plots of data easily communicate information that is difficult to extract from tables of raw values.
- Data visualization is a key component of exploratory data analysis (EDA), in which the properties of data are explored through visualization and summarization techniques.

- Data visualization can help discover biases, systematic errors, mistakes and other unexpected problems in data before those data are incorporated into potentially flawed analysis.
- This course covers the basics of data visualization and EDA in R using the **ggplot2** package and motivating examples from world health, economics and infectious disease.

Code

```
library(dslabs)
data(murders)
head(murders)
```

```
##        state abb region population total
## 1    Alabama  AL  South    4779736   135
## 2     Alaska  AK   West     710231    19
## 3    Arizona  AZ   West    6392017   232
## 4   Arkansas  AR  South    2915918    93
## 5 California  CA   West   37253956  1257
## 6   Colorado  CO   West    5029196    65
```

Introduction to Distributions

The textbook for this section is available here

Key points

- The most basic statistical summary of a list of objects is its distribution.
- We will learn ways to visualize and analyze distributions in the upcoming videos.
- In some cases, data can be summarized by a two-number summary: the average and standard deviation. We will learn to use data visualization to determine when that is appropriate.

Data Types

The textbook for this section is available here

Key points

- Categorical data are variables that are defined by a small number of groups.
  - Ordinal categorical data have an inherent order to the categories (mild/medium/hot, for example).
  - Non-ordinal categorical data have no order to the categories.
- Numerical data take a variety of numeric values.
  - Continuous variables can take any value.
  - Discrete variables are limited to sets of specific values.

Assessment - Data Types

1. The type of data we are working with will often influence the data visualization technique we use.

We will be working with two types of variables: categorical and numeric. Each can be divided into two other groups: categorical can be ordinal or not, whereas numerical variables can be discrete or continuous.

We will review data types using some of the examples provided in the `dslabs` package. For example, the `heights` dataset.

```
library(dslabs)
data(heights)
```

```
data(heights)
names(heights)
```

```
## [1] "sex"    "height"
```

2. We saw that `sex` is the first variable. We know what values are represented by this variable and can confirm this by looking at the first few entires:

```
head(heights)
```

```
##      sex height
## 1   Male     75
## 2   Male     70
## 3   Male     68
## 4   Male     74
## 5   Male     61
## 6 Female     65
```

What data type is the `sex` variable?

- [ ] A. Continuous
- [X] B. Categorical
- [ ] C. Ordinal
- [ ] D. None of the above

3. Keep in mind that discrete numeric data can be considered ordinal.

Although this is technically true, we usually reserve the term ordinal data for variables belonging to a small number of different groups, with each group having many members.

The `height` variable could be ordinal if, for example, we report a small number of values such as short, medium, and tall. Let's explore how many unique values are used by the heights variable. For this we can use the `unique` function:

```
x <- c(3, 3, 3, 3, 4, 4, 2)
unique(x)
```

```
x <- heights$height
length(unique(x))
```

```
## [1] 139
```

4. One of the useful outputs of data visualization is that we can learn about the distribution of variables.

For categorical data we can construct this distribution by simply computing the frequency of each unique value. This can be done with the function `table`. Here is an example:

```
x <- c(3, 3, 3, 3, 4, 4, 2)
table(x)
```

```
x <- heights$height
tab <- table(x)
```

5. To see why treating the reported heights as an ordinal value is not useful in practice we note how many values are reported only once.

In the previous exercise we computed the variable tab which reports the number of times each unique value appears. For values reported only once tab will be 1. Use logicals and the function sum to count the number of times this happens.

```
tab <- table(heights$height)
sum(tab==1)
```

```
## [1] 63
```

6. Since there are a finite number of reported heights and technically the height can be considered ordinal, which of the following is true: