CEE 260/MIE 273: Probability and Statistics in Civil Engineering

M1c: Case studies and experiments

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September 9, 2025

Outline

Your expectations (Fall 2025)

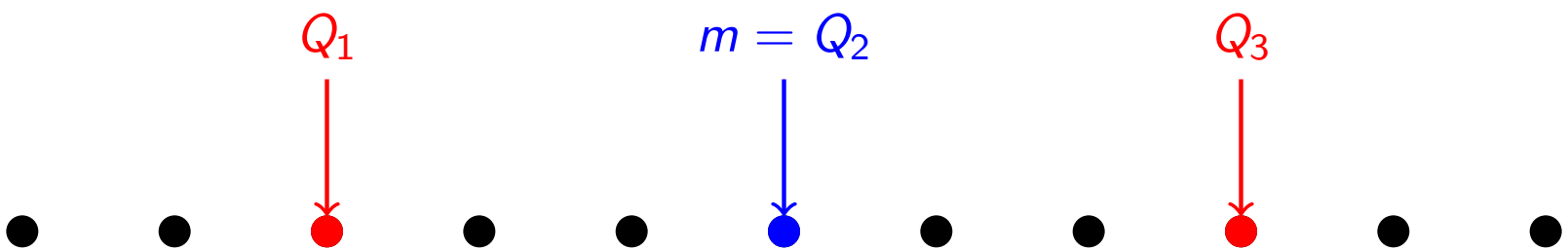
Quantiles

Quantiles are cutoff points that partition an ordered sample or dataset into equal-sized groups.

- A **median** splits a sample into two: m
- Two **terciles** split a sample into 3 groups: T_1, T_2
- Three **quartiles** split a sample into 4 groups: Q_1, Q_2, Q_3
- Four **quintiles** split a sample into 5 groups: QU_1, QU_2, QU_3, QU_4
- ...
- Ninety-nine **[per]centiles** split a sample into 100 groups: $P_1, \ldots, P_{99}$

Quantiles (cont.)

Certain quantiles are equivalent to others:



- The median is the second quartile Q_2
- The 25th percentile is equivalent to the first quartile Q_1

Sextiles ($S_1, S_2, \ldots$) partition a distribution into 6 equal groups.

1. How many sextiles are there?
2. The second sextile S_2 can be expressed as which tercile?[a]

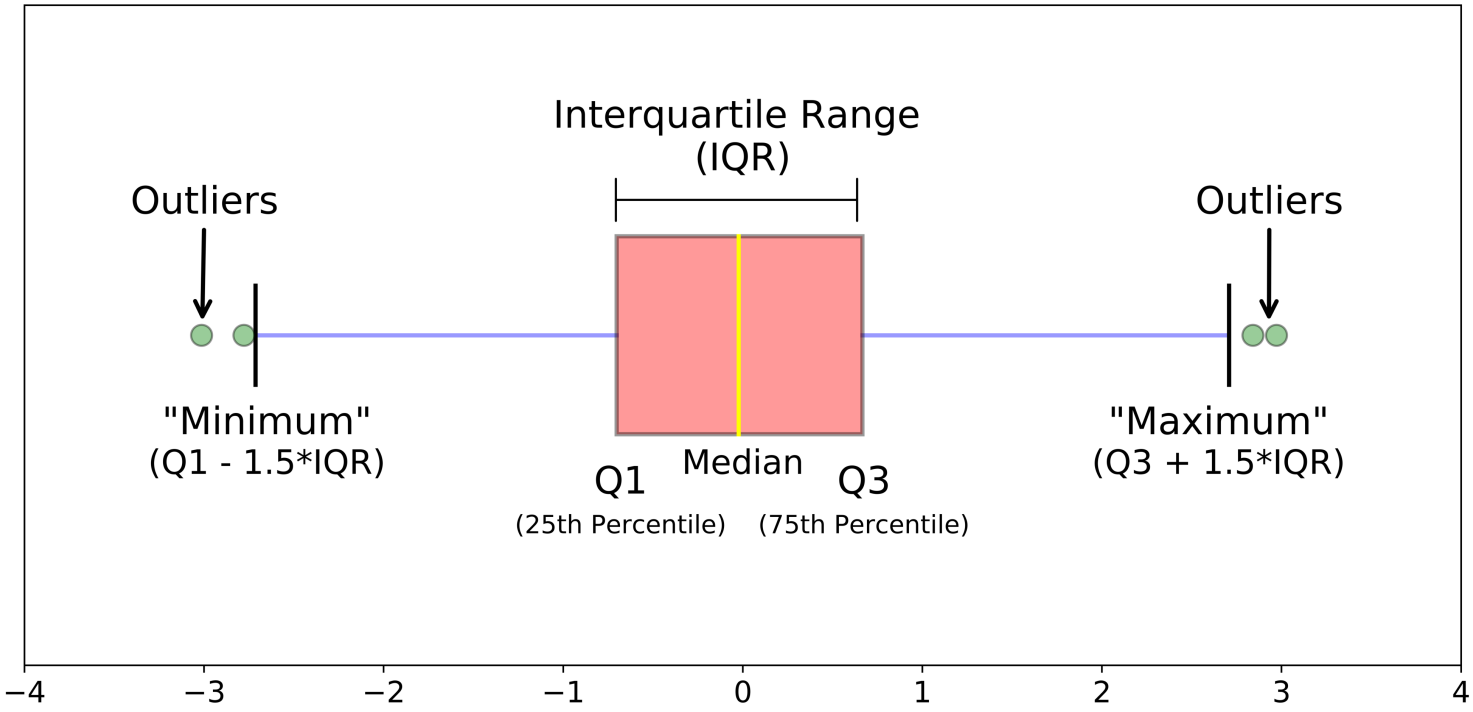
Answers: Q1: There are 5 sextiles; Q2: $S_2 = T_1$ (first tercile)

[a] Recall that a tercile splits a sample into 3 equal groups.

Using boxplots

A boxplot[1] displays the distribution of data

- Useful for identifying outliers
- Efficient for comparing multiple datasets
- The lines indicating the "maximum/minimum" points (excluding outliers) are called *whiskers*



[1] Figure source: https://towardsdatascience.com/understanding-boxplots-5e2df7bcbd51

Google Colaboratory

We will begin our introduction to Python via basic statistical analyses using the Google Colab platform (https://colab.google/).

For an introduction, visit: https://www.mathworks.com/help/matlab/getting-started-with-matlab.html.

Notebooks

Today, we will use the following Notebooks:

- `m1-blind-stork.ipynb` https://colab.research.google.com/drive/1G2_UPPli1rdfWv_9wRJvT-m2kLwg3GFu?usp=sharing
- `m1-usa-housing.ipynb` https://colab.research.google.com/drive/1onpllyTzNuoO9op89WDR4ft7o_U-eJVL?usp=sharing

Bonus Example

Example 1: Walking cadence

In the article "Can We Really Walk Straight?" (*Amer. J. of Physical Anthropology*, 1992: 19–27) reported on an experiment in which each of 20 healthy men was asked to walk as straight as possible to a target 60m away at normal speed.

Consider the following observations on cadence (number of strides per second):

.95 .85 .92 .95 .93 .86 1.00 .92 .85 .81 .78 .93 .93 1.05 .93 1.06 .96 .81 .96

Summarize the data; interpret and discuss.

To be assigned: Iris dataset

We will explore the properties and applications of boxplots using the following datasets:

- Popularized in Ronald A. Fisher's classic 1936 paper, "The Use of Multiple Measurements in Taxonomic Problems" https://onlinelibrary.wiley.com/doi/10.1111/j.1469-1809.1936.tb02137.x
- Data collected by Edgar Anderson on various measurements of 3 species of Iris flowers
- Also found on the UCI Machine Learning Repository. Data available by default on MATLAB

Example 2: Iris species

Three species of the *Iris* flower:

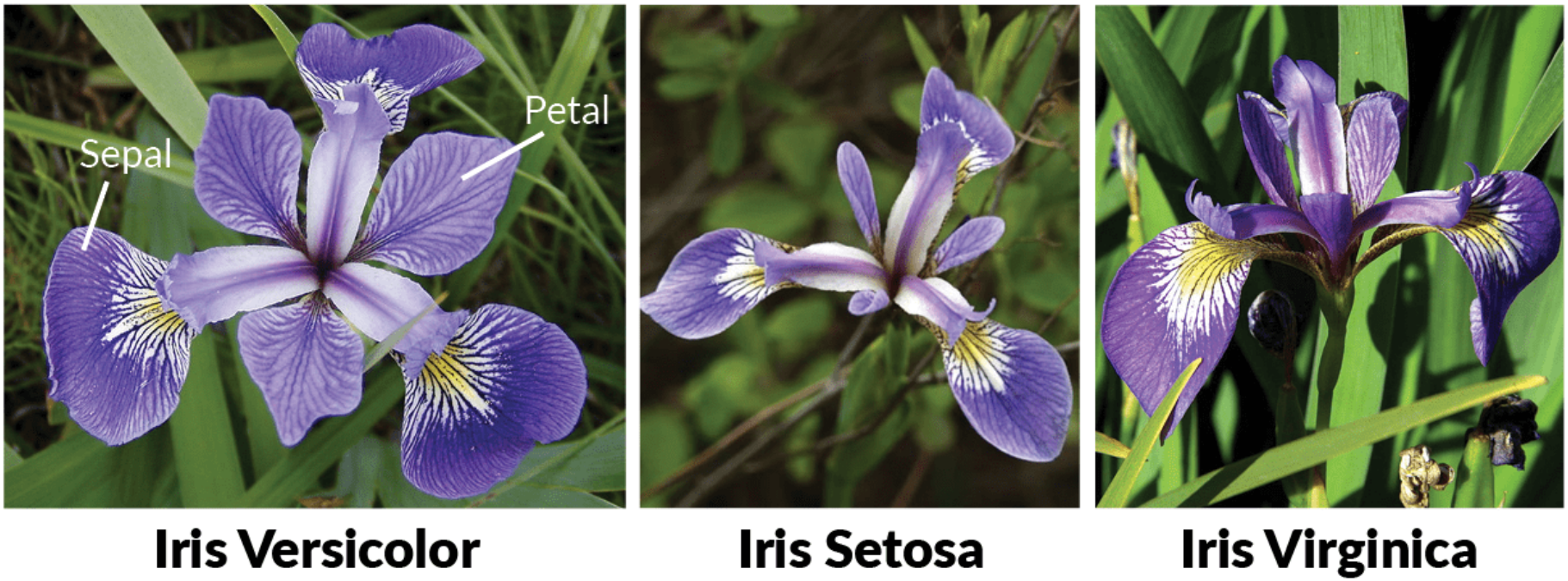


Figure: Iris species (Source:
https://s3.amazonaws.com/assets.datacamp.com/blog_assets/Machine+Learning+R/iris-machinelearning.png)

Recap

- Pre-survey review
- Python/Colab Introduction:
  - Summarizing data
  - Visualizing data: histograms, boxplots

Problem Sets

- PS1 due at 1pm today
- PS2 will be assigned this afternoon