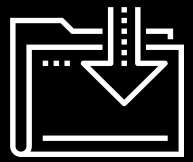
Introduction to Matplotlib

Data Boot Camp

Lesson 5.1



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WELCOME

Today's Class

In class this week, we'll turn
Pandas DataFrames into interesting visualisations!

Class Objectives

By the end of today's lesson, you will be able to:

01 Use Matplotlib's PyPlot interface.

02 Create line, bar, and pie charts and scatter plots, and change their appearance.

03 Identify basic plot configuration options, such as `xlim` and `ylim`.

Instructor Demonstration

Introduction to Matplotlib

What Is Matplotlib?

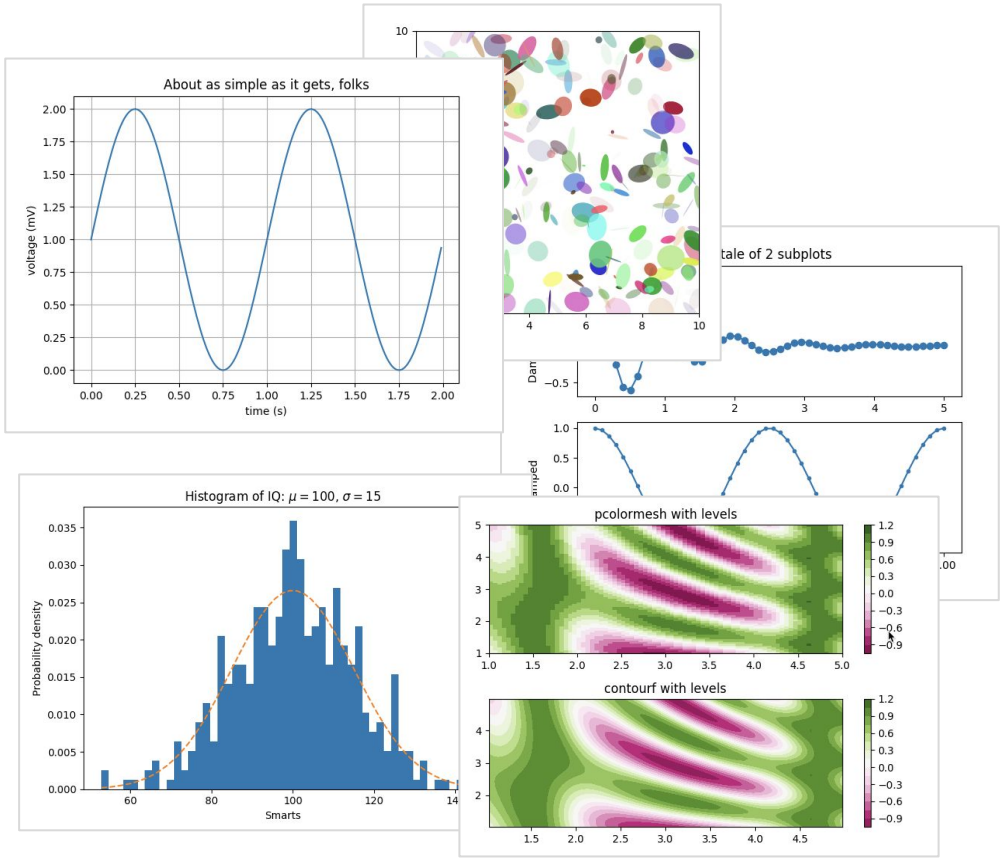
Matplotlib: A Python Library That Visualises a Dataset

Types of datasets include:

- Pandas DataFrames
- Lists, tuples, and dictionaries
- NumPy arrays

Types of visualisations include:

- Bar charts
- Pie charts
- Line charts
- Scatter plots



The PyPlot Module = The Heart of Matplotlib

- Accepts many forms of input values.
- Enables custom colours, shapes, labels, etc.
- Does most of the plotting logistics for us; we simply tell it which plot to make.
- Trust us: you'll love it!

PyPlot

General Plotting Process with PyPlot:

Create your dataset.	Data can be generated from functions, pulled from Pandas DataFrames, etc.
Generate your plot.	Use the `pyplot.plot()` function to tell Matplotlib what data to use and which plot to make.
Customise your plot.	Change the axis, label the figures, color the data points—make the plot as informative to the reader as possible.

Time’s Up! Let’s Review.

Activity: Melbourne Weather

In this activity, you will create a series of line plots by using Melbourne temperature data.

Suggested Time:

15 minutes

Activity: Melbourne Weather

Instructions

Using the following data, plot the monthly averages for temperature in New Jersey:

- Use the numeric value for months.
- Average temperature per month in Celsius:
  `[26.1, 25.3, 22.5, 20.6, 17.3, 14.5, 13.5, 15.8, 17.9, 19.2, 20.3, 24.7]`

Use list comprehension to convert the temperature to Fahrenheit, and plot that line as well.

Create a third plot that includes both lines.

Hints

The formula to convert Celsius to Fahrenheit is: `F = C * 9/5 + 32`

Check the Matplotlib documentation for more information about the PyPlot library.

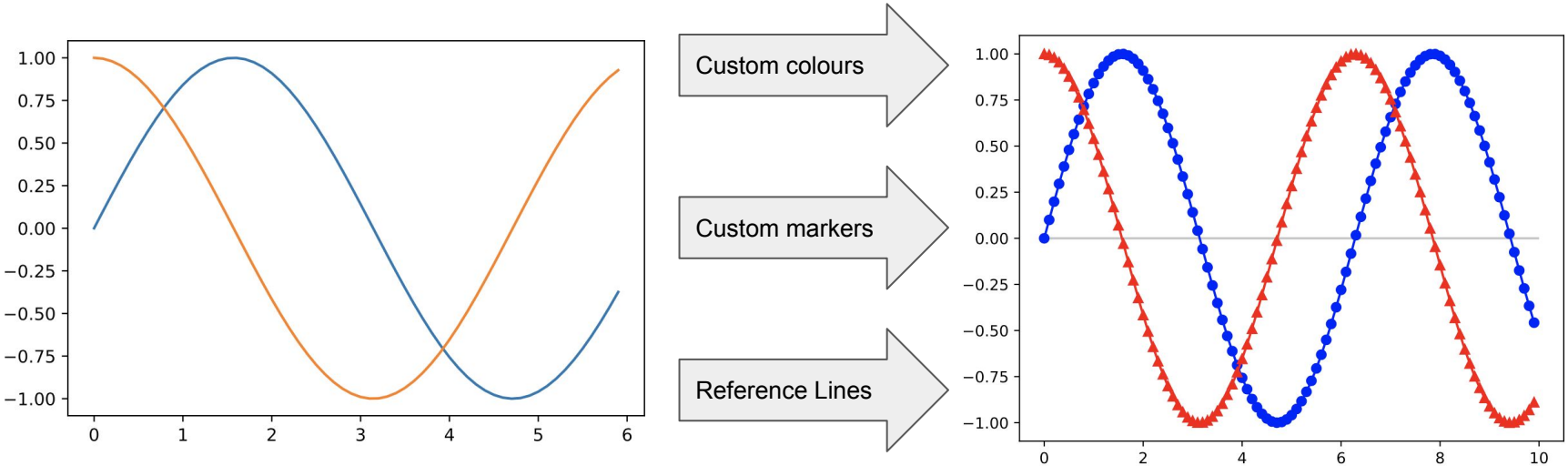
Time’s Up! Let’s Review.

Instructor Demonstration

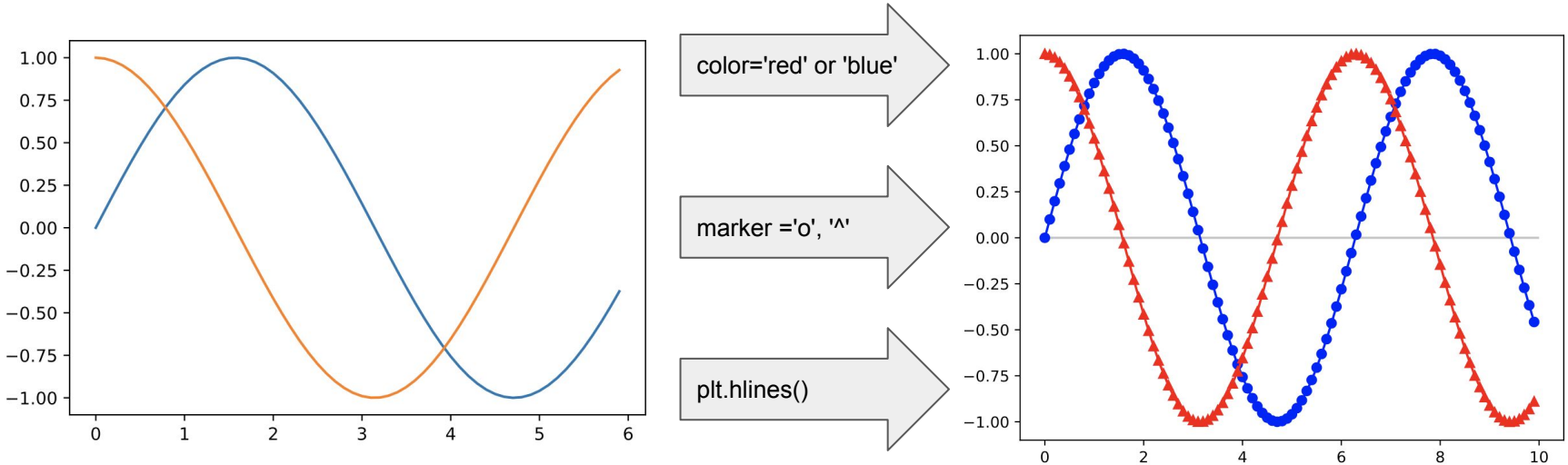
Configuring Line Plots

Basic Line Plots

Matplotlib’s basic line plots are rather bland.



Basic Line Plots



Activity: Legendary Temperature

In this activity, you will edit the line plots created earlier to make them more visually interesting.

Suggested Time:

15 minutes

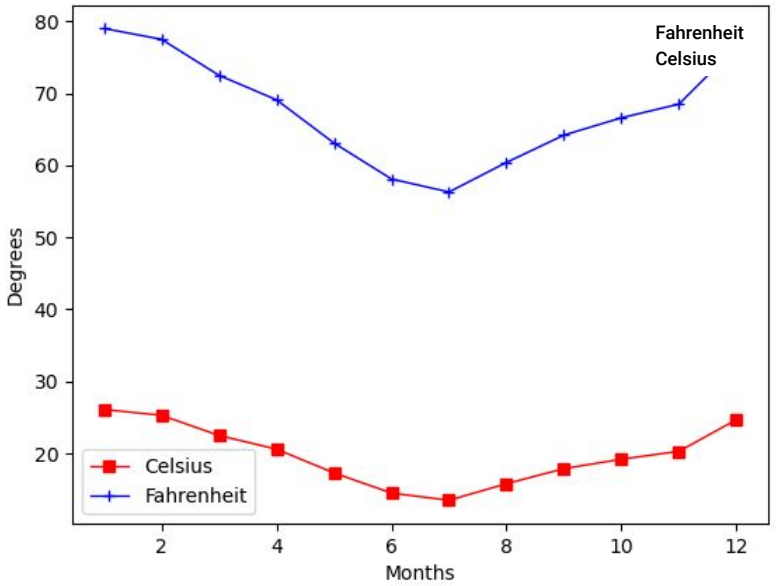
Legendary Temperature Instructions

Instructions

Modify the Melbourne temperature line charts you created earlier

Add a legend to indicate the Celsius temperatures and Fahrenheit temperatures

Once you have created the plot, use the Matplotlib documentation to find additional formatting that could be added to the chart.



Time's Up! Let's Review.

Instructor Demonstration

Aesthetics

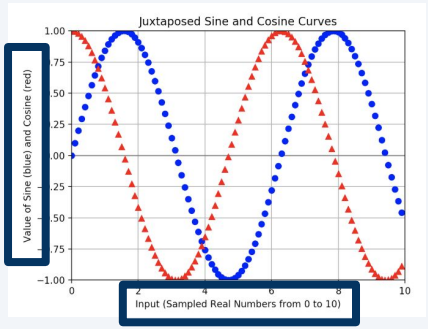
The best plots, like the best code, are easy to read.

How can we improve the readability of plots?

Steps to Improve Readability of Plots

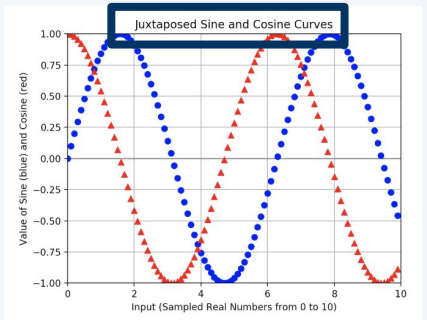
01

Add labels to the *x*- and *y*-axes.



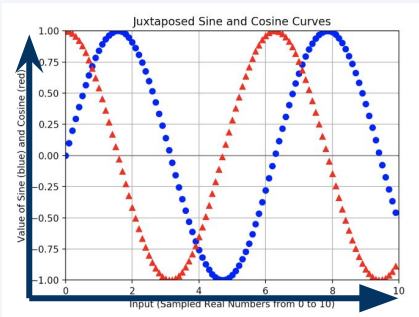
02

Add titles to plots.



03

Limit the boundaries of the *x*- and *y*-axes.



Changing Aesthetics in PyPlot

01

Add labels to the *x*- and *y*-axes.

```
plt.xlabel()
plt.ylabel()
```

02

Add titles to plots.

```
plt.title()
```

03

Limit the boundaries of the *x*- and *y*-axes.

```
plt.xlim()
plt.ylim()
```

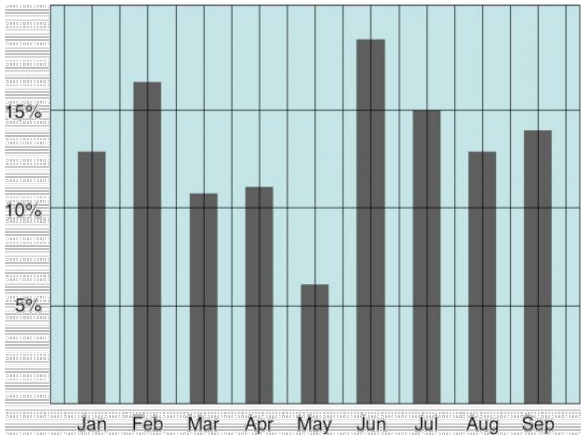
Advantages of Adding Aesthetics

Adding labels makes graphics easier to understand and prevents them from being unintentionally misleading.

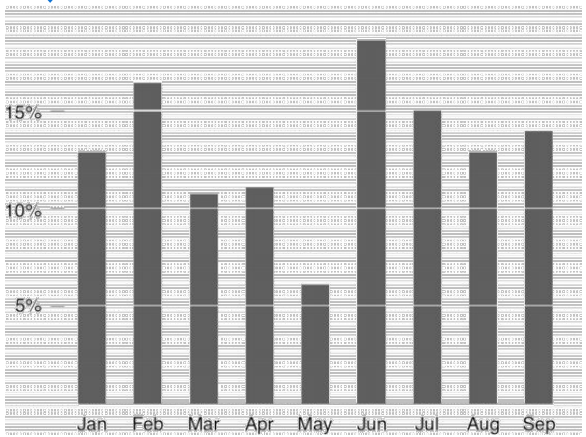
Limiting the range of the plot maximizes the data-to-ink ratio:

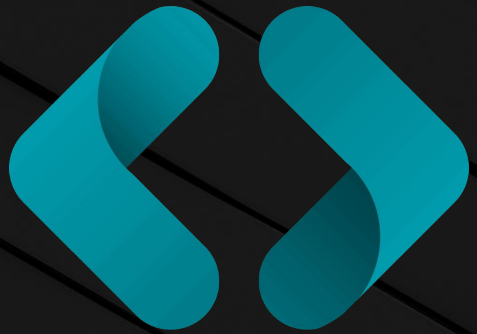
- “Ink” used to make data ÷ Total “ink” of the plot
- It’s best to use the least amount of ink to show the most amount of data.

Low data-to-ink ratio



High data-to-ink ratio





Time to <code>

Activity: Coaster Speed

In this activity, you will create a line chart that graphs the speed of a roller coaster over time. You will then style the chart and add aesthetics to it.

Suggested Time:

10 minutes

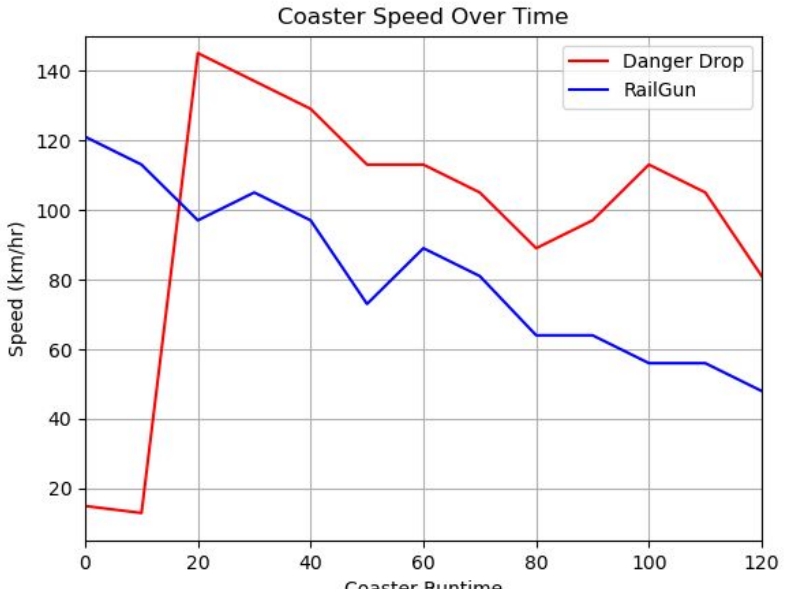
Coaster Speed Instructions

Create a line chart with two plots by using the following data:

Danger Drop	`[15, 13, 145, 137, 129, 113, 113, 105, 89, 97, 113, 105, 81]`
RailGun	`[121, 113, 97, 105, 97, 73, 89, 81, 64, 64, 56, 56, 48]`

Both coasters are 120 seconds long, and the speed was measured every 10 seconds.

Apply styling and labels that match the image provided.



Time’s Up! Let’s Review.

Countdown timer

15:00

(with alarm)

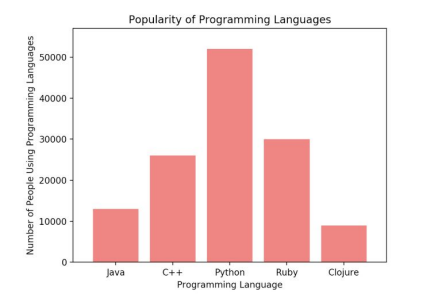
Instructor Demonstration

Different Plots

Matplotlib: Not Just for Line Plots!

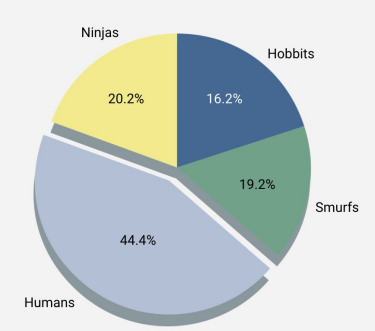
Bar Charts

Useful for comparing different entities to one another



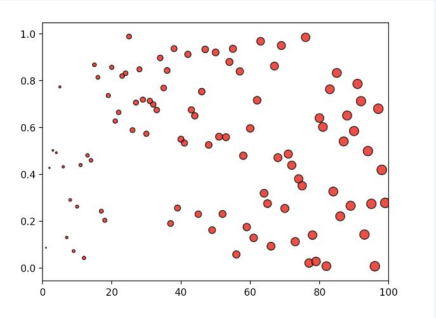
Pie Charts

Useful for demonstrating different elements of a complete dataset



Scatter Plots

Useful for displaying where values fall with respect to two factors



It’s important to choose the right plot for a given dataset!

Instructor Demonstration

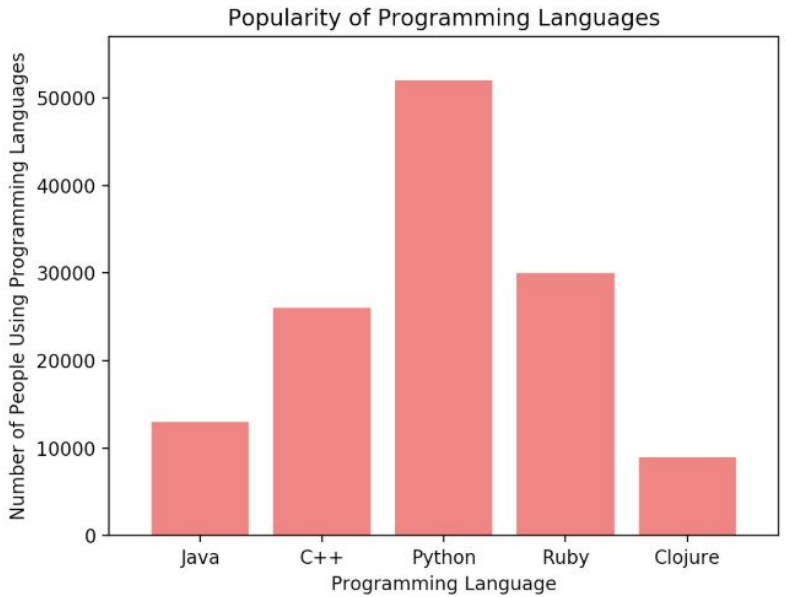
Bar Charts

Bar Charts Help to Visualise Univariate Data

Univariate data refers to data with **one** variable, or one type of measurement.

Examples:

- Amount of rainfall in centimetres
- Number of votes in a poll
- Number of people per category



Bar charts are particularly useful when a single variable is being counted multiple times.

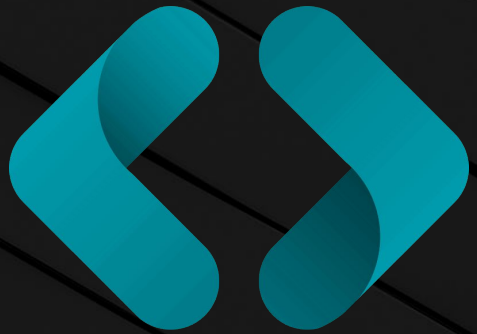
Bar Charts

Bar charts are NOT effective for visualizing bivariate data.

Bivariate data refers to data with two variables. Anything you can plot as a line or scatter plot is bivariate data.

Example: A dataset comparing the number of ice cream bars sold with the daily temperature.

Think of other examples where a bar chart would be effective.



Time to <code>

Activity: Cars Bar Chart

In this activity, you will create a bar chart that visualises the density of commuting cars per 1,000 population aged 16 and over within major U.S. cities.

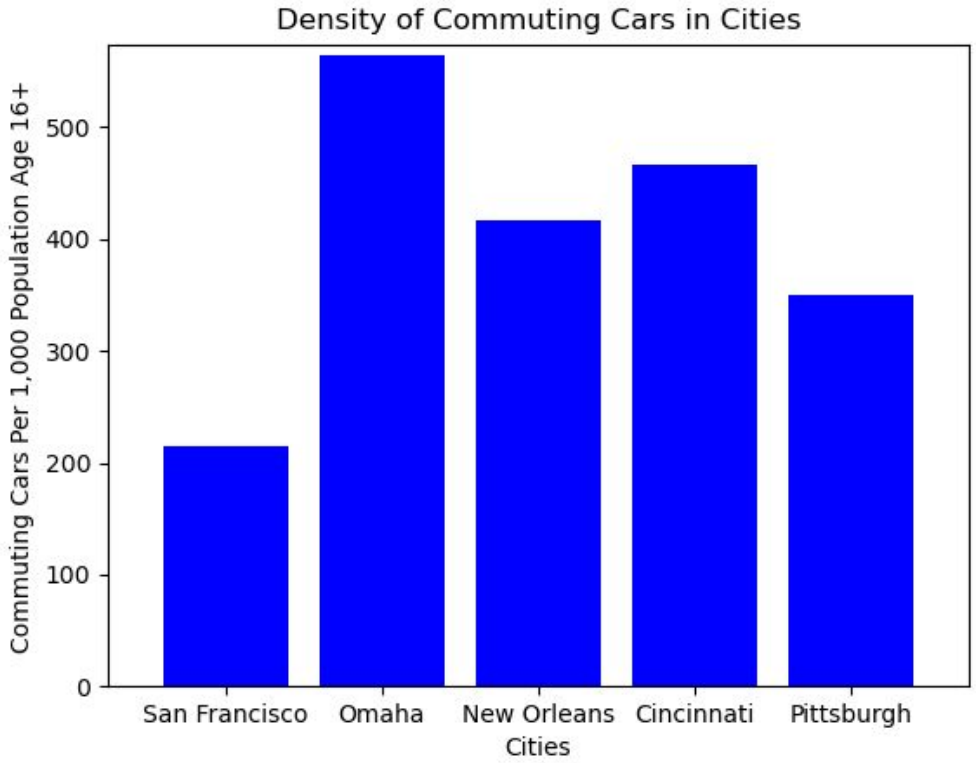
Suggested Time:

10 minutes

Activity: Cars Bar Chart

Using the provided starter code in your folders, recreate the figure as shown.

File: `Unsolved/py_bars.ipynb`



Time’s Up! Let’s Review.

Instructor Demonstration

Pie Charts

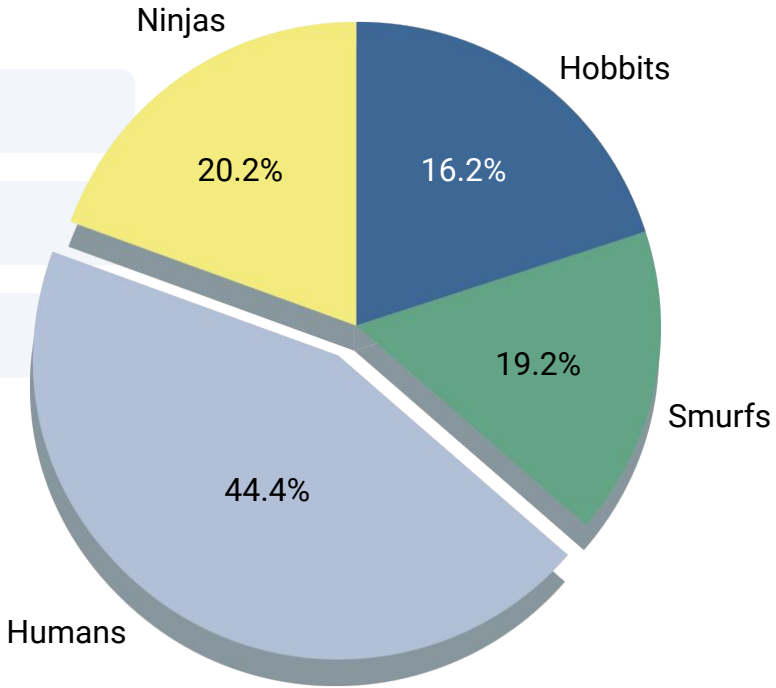
Pie Charts Help Visualise Simple Categorical Data

Pie charts are great for visualising data that is percentages, or proportions.

For example:

- Proportion of Labor versus Liberal versus Green Party voters
- Percentages for children's favourite story characters
- Distribution of left-handed versus right-handed calligraphy artists

Fewer categories increase the effectiveness of a pie chart.



Pie charts

Pie charts are NOT effective for large or multivariate datasets.

01

With more than ~10 categories, pie charts become too crowded and lose effectiveness.

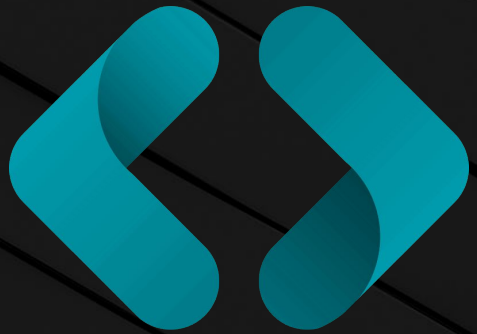
02

Like bar charts, pie charts are only effective for visualising univariate data.

03

When in doubt, just use a bar chart.

Think of other examples where a pie chart would be effective.



Time to <code>

Activity: Pies Pie Chart

In this activity, you will create a pie chart that visualises pie flavour preferences in Australia.

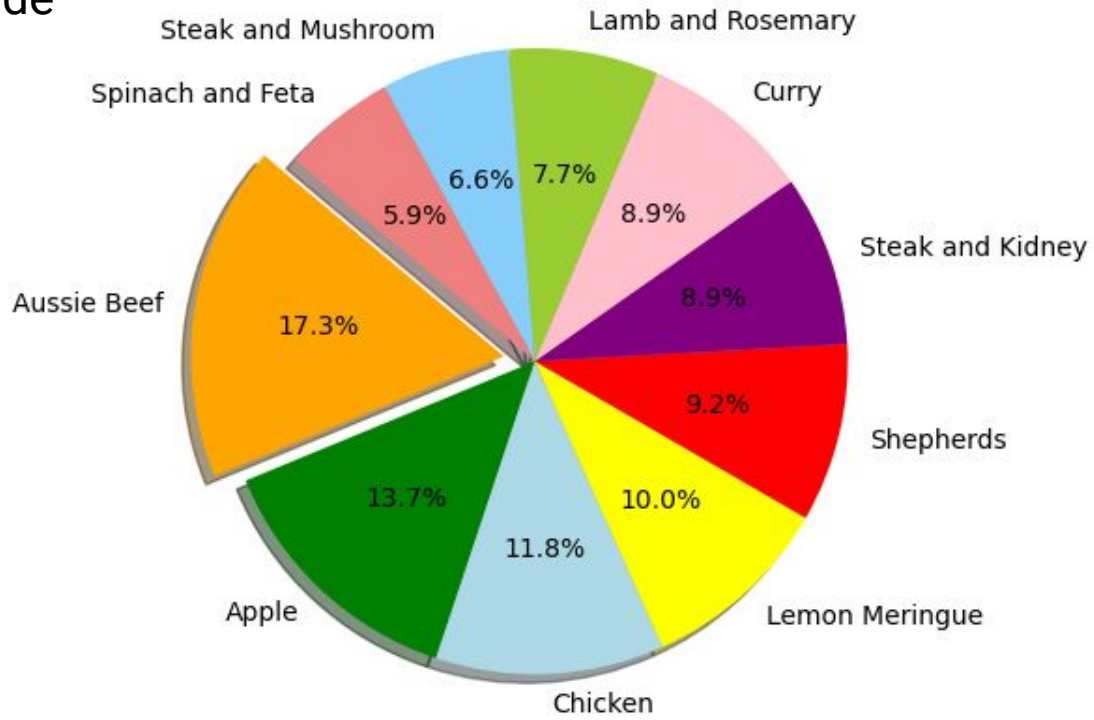
Suggested Time:

10 minutes

Pies Pie Chart Instructions

Using the provided starter code in your folders, recreate the figure as shown.

File: `Unsolved/py_pie.ipynb`



Time's Up! Let's Review.

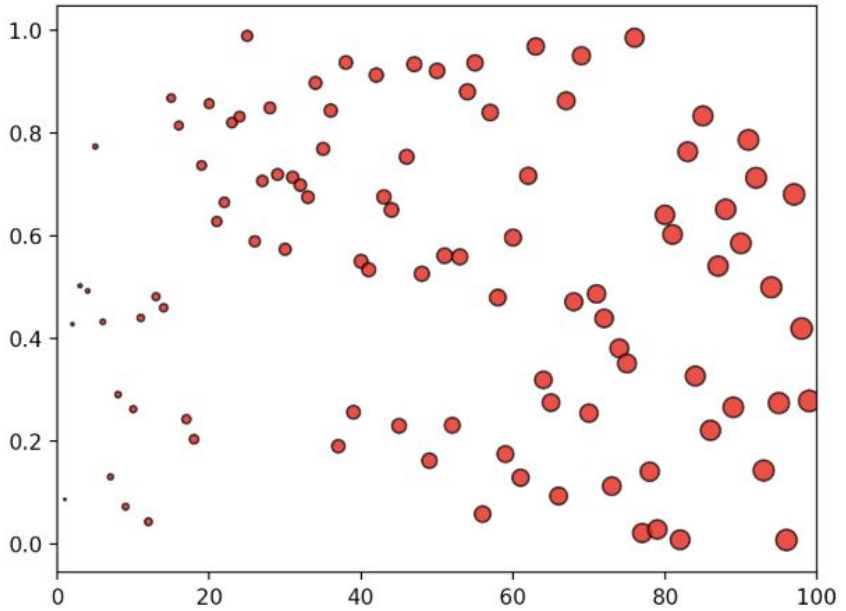
Instructor Demonstration

Scatter Plots

Scatter Plots = Powerful Visualisations for Bivariate Data

Bivariate data refers to data with two variables.

- Each data point is a combination of two variables.
- Anything plotted on an x- and y-axis is bivariate data.
- **Example:** The amount of ice cream sold versus daily temperature



Scatter plots are helpful for visualising large datasets (with thousands of data points).

Scatter plots are frequently used to visualise clustering in a dataset.

Scatter plots

Scatter plots are NOT effective for continuous measurements.

01

When data is continuous, we'll often want to interpolate between measurements.

The most common continuous data is time series data.

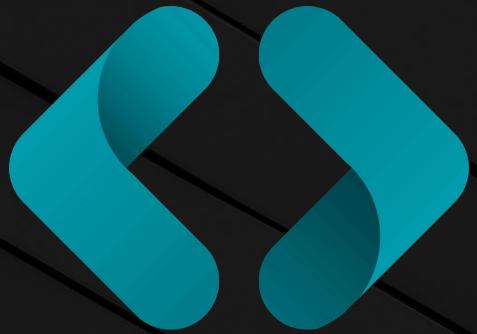
02

Scatter plots visualise "scattered" data, so interpolation is almost impossible.

03

Line plots allow the audience to read between the data points.

Think of other examples where a scatter plot would be effective.



Time to <code>

Activity: Scatter Py

In this activity, you will create a scatter plot that visualises ice cream sales in comparison to temperature increases.

Suggested Time:

10 minutes

Activity: Scatter Py

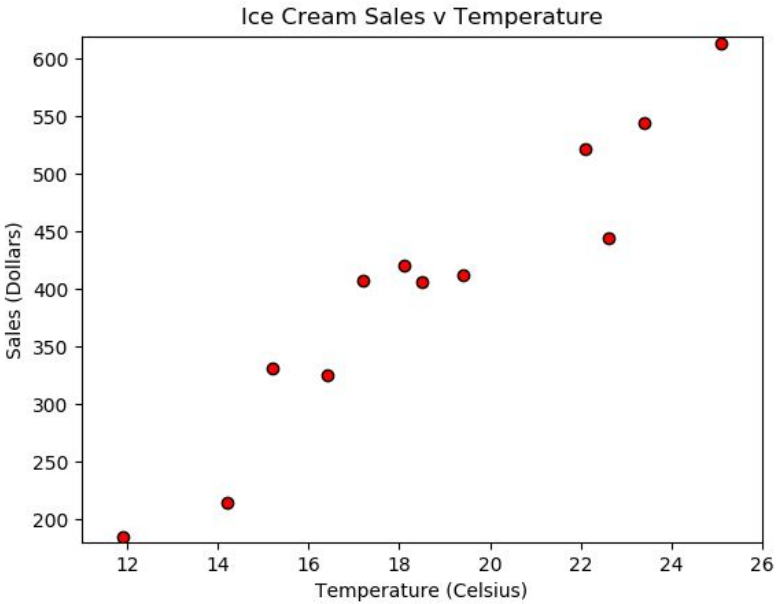
Instructions

Using the provided starter code in your folders, recreate the figure as shown.

File: `Unsolved/ice_cream_sales.ipynb`

Hints

Create a new list called `scoop_price`, fill it with values, and then set it so that the size of the dots are set according to those values.



Time's Up! Let's Review.

We’re almost there!
Just one more activity!

Activity: Average Rainfall

In this activity, you will create a bar chart that shows the average rainfall in different states by importing data from a CSV file.

Suggested Time:

15 minutes

Activity: Average Rainfall

Instructions	Examine the raw data in your Resources folder. This dataset contains the average rainfall in major Australian cities in any given year. **File:** `Resources/avg_rain_cities.csv`
	Using the file provided as a starter, generate a plot of the average rainfall per city. **File:** `Unsolved/avg_cities_rain.ipynb`
Hints	Think critically about the different plots that we discussed today. Ask yourself which type of plot summarises the data most effectively.
	Be sure to add a title, axis labels, and any other aesthetics that may help make the visualisation more effective.

Time's Up! Let's Review.

Questions?