Matplotlib

Basic Plots

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Democratizing Data Science Learning

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Learning Objectives

Scatter Plot

Line Plot

Histogram

Bar Plot

Pie Chart

Basic Plots

The terms Plot, Chart and Graph partly overlap, they are used somewhat loosely, and in that overlap there isn't really any significant difference that you need to know right now.

Therefore, there’s no need to be confused if you find Bar Plot, Bar Graph and Bar Chart being used interchangeably at places.

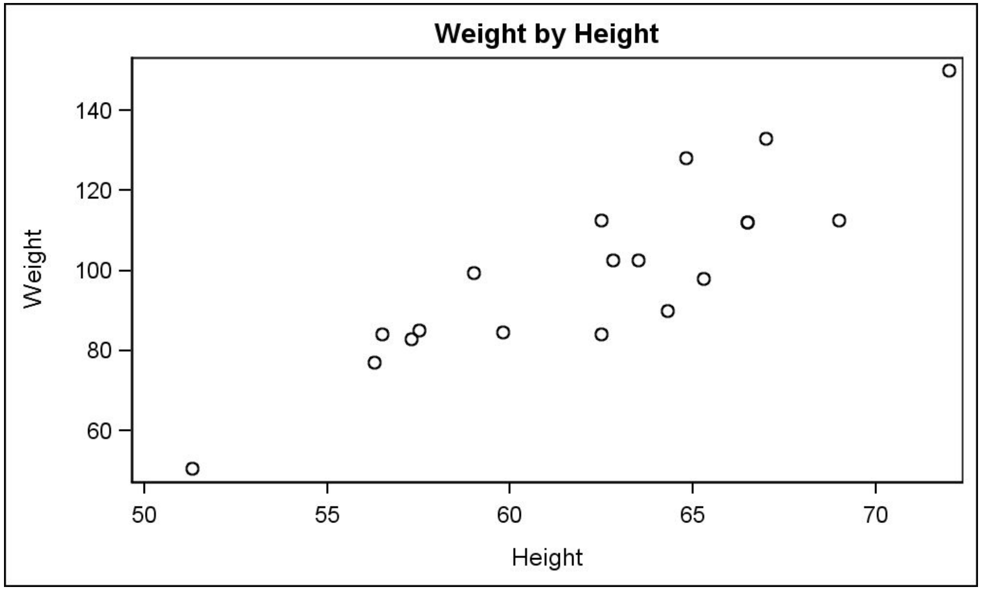
Let’s have a look at the commonly used plots in Matplotlib now.

Scatter Plot

- A scatter plot (aka scatter chart, scatter graph) uses dots to represent values for different numeric variables.

- The position of each dot on the horizontal and vertical axis indicates values for an individual data point.

- Scatter plots are used to observe relationships between variables.



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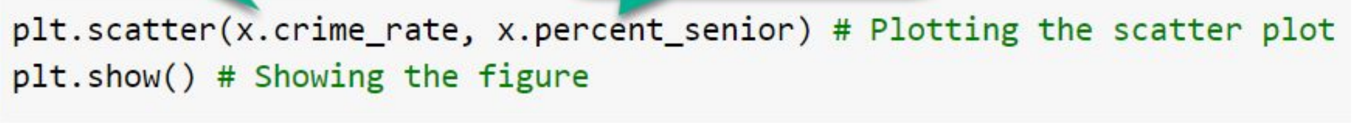
Creating a Scatter Plot

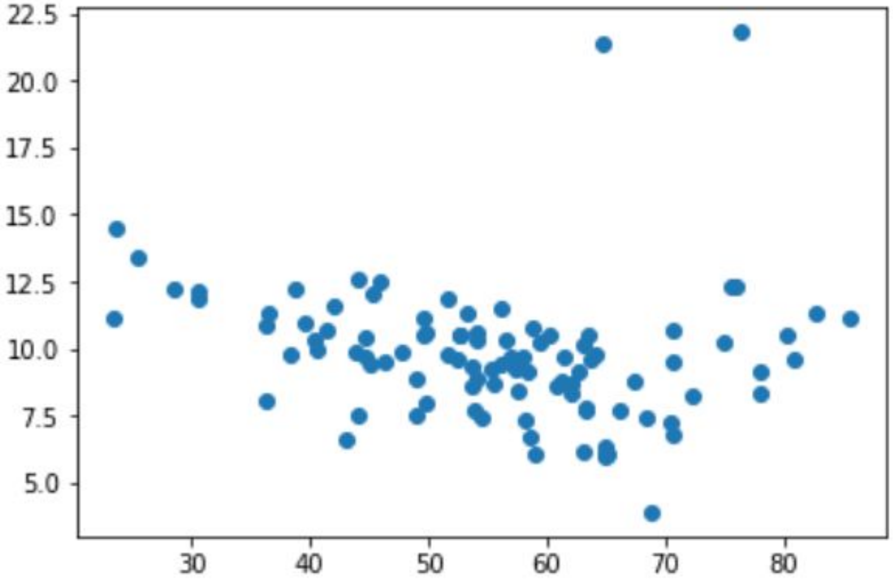
To create a scatter plot in Matplotlib we can use the .scatter() method:

Crime Rate goes on the X axis

Percent_Senior goes on the Y axis



```
plt.scatter(x.crime_rate, x.percent_senior) # Plotting the scatter plot
plt.show() # Showing the figure
```



Is plt.show( ) always required?

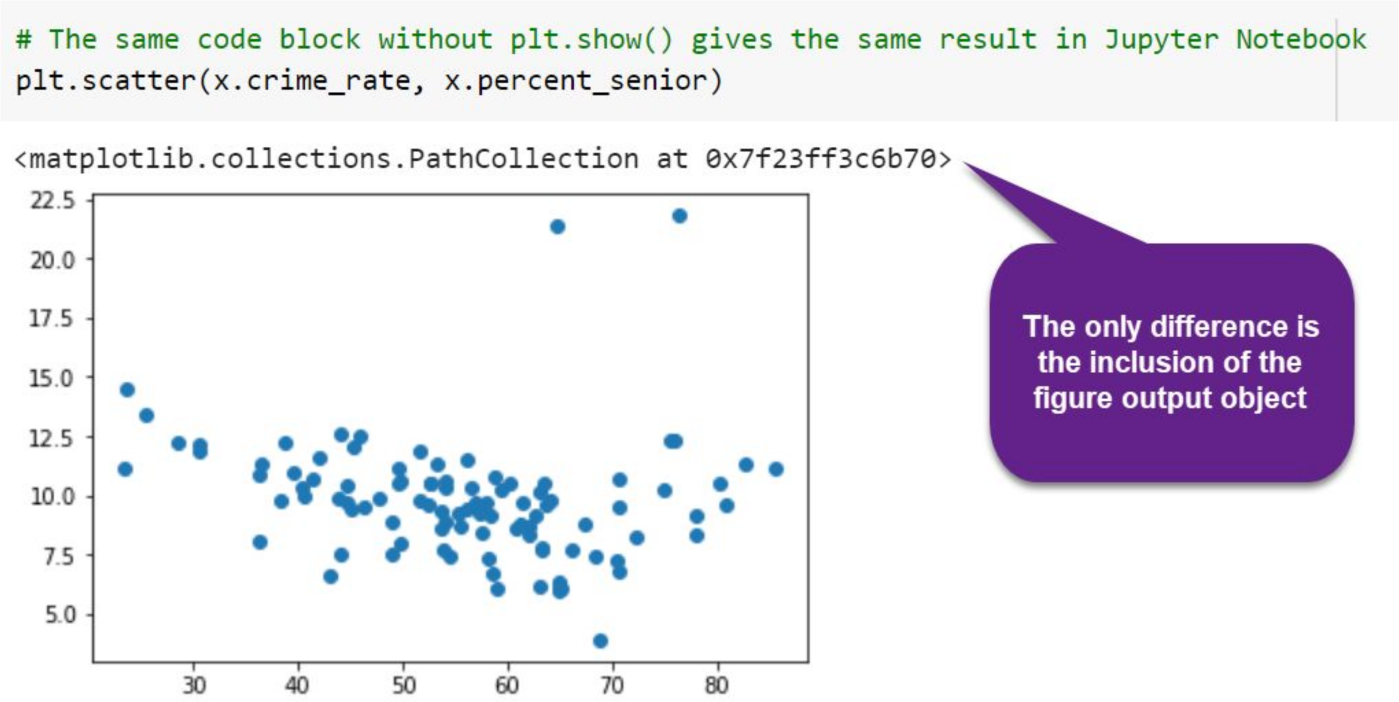
You might've observed the line plt.show( ) after the plt.scatter( ). Is it necessary to use?

- If Matplotlib is used in a terminal, scripts or specialized IDEs such as Spyder, Pycharm or VS Code, plt.show() is a must.
- If Matplotlib is used in a IPython shell or a notebook as Jupyter Notebook or Colab Notebook, plt.show() is usually unnecessary.

The plt.show() command does a lot under the hood, as it must interact with your system's interactive graphical backend. The details of this operation can vary greatly from system to system and even installation to installation, but matplotlib does its best to hide all these details from you.

Is plt.show( ) always required?

In the following cell we are executing the same script as above, removing the plt.show() instruction:



```
# The same code block without plt.show() gives the same result in Jupyter Notebook
plt.scatter(x.crime_rate, x.percent_senior)
```

```
<matplotlib.collections.PathCollection at 0x7f23ff3c6b70>
```

The only difference is the inclusion of the figure output object

If you want to prevent this from being included as a cell output, use plt.show() at the end of each plotting instruction.

Applications of Scatter Plot

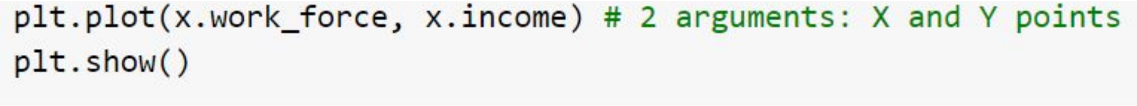
- A scatter plot can be useful for identifying other patterns in data.
  - We can divide data points into groups based on how closely sets of points cluster together.
  - Scatter plots can also show if there are any unexpected gaps in the data and if there are any outlier points. (Look at the 2 points away from rest of the data in the scatter plot. Those are outliers.)
- This can be useful if we want to segment the data into different parts, like categorising users into different groups.

Line Plot

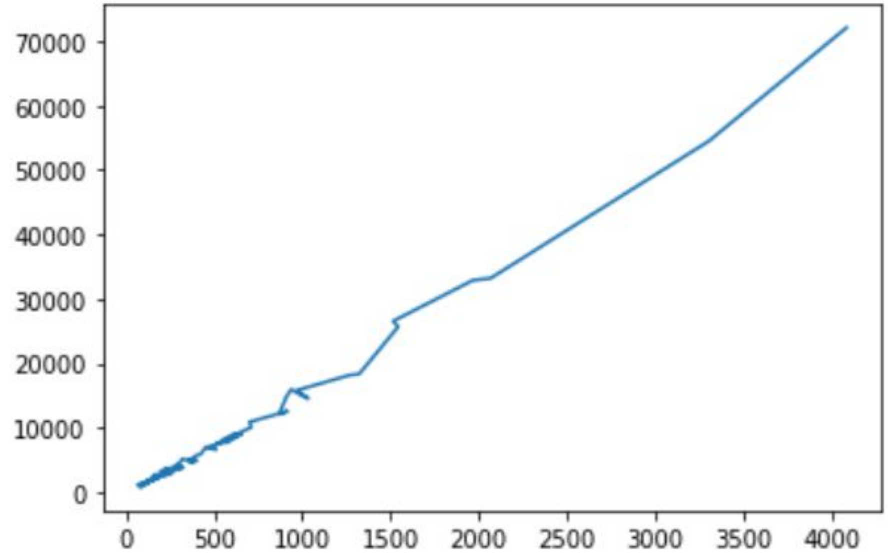
A line chart is used to represent data over a continuous time span. It is generally used to show trend of a variable over time. Data values are plotted as points that are connected using line segments.

Creating a Line Plot(with 2 arguments)

- In Matplotlib we can create a line chart by calling the plot method.
- plot() is a versatile command, and can take an arbitrary number of arguments.



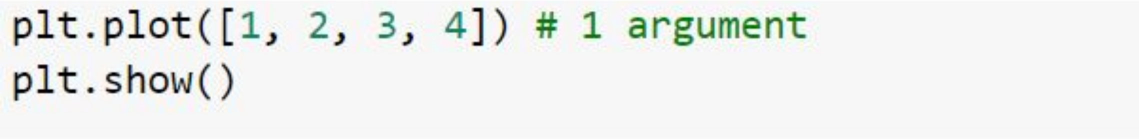
```
plt.plot(x.work_force, x.income) # 2 arguments: X and Y points
plt.show()
```



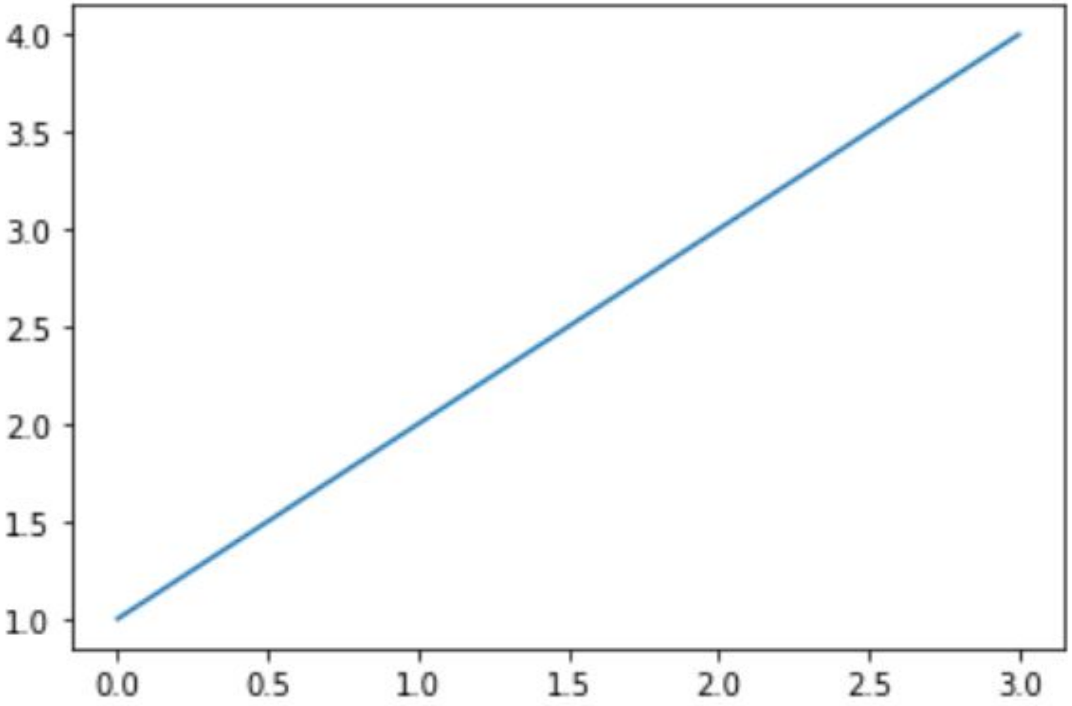
Because it is a line chart, matplotlib automatically draws a line to connect each pair of consecutive points that represent coordinates on the graph.

Creating a Line Plot (with a single argument)

- We can make a graph with a simple line of code as mentioned in the image:



```
plt.plot([1, 2, 3, 4]) # 1 argument
plt.show()
```



Creating a Line Plot (with a single argument)

- Referring to the previous slide, you may be wondering why the x-axis ranges from 0-3 and the y-axis from 1-4.

- If you provide a list of n elements to the .plot() function, matplotlib will assume it is a sequence of y values, and automatically generates the x values for you as a range of n elements starting from 0.

- Since python ranges start with 0, the default list x has the same length as y . Hence the x data will be [0,1,2,3]. (Length same as y(4) but starts from 0 instead)

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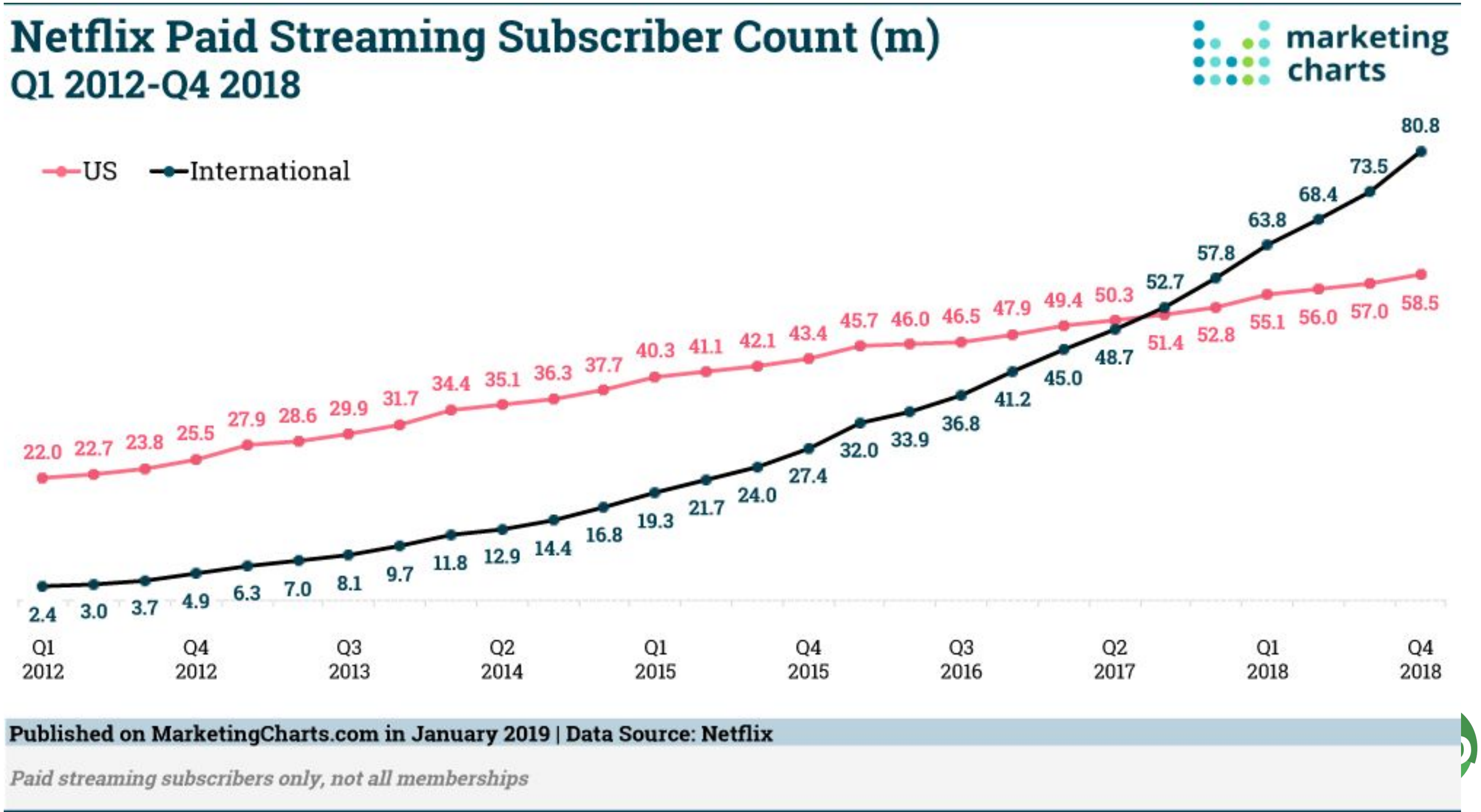
Applications of Line Plot

Using a line chart one can see the pattern of any dependent variable over time like share price, weather recordings (like temperature, precipitation or humidity), etc.

Let's look at an example of the graphical representation of Netflix Paid Subscriber Count growth from 2012 to 2018:



Published on MarketingCharts.com in January 2019 | Data Source: Netflix

Paid streaming subscribers only, not all memberships

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Histogram

A histogram is a graphical display of data using bars(rectangles) of different heights.

Parts of a Histogram:

- **The title:** The title describes the information included in the histogram.
- **X-axis:** The X-axis are intervals that show the scale of values which the measurements fall under. These intervals are also called bins.
- **Y-axis:** The Y-axis shows the number of times that the values occurred(frequency) for each interval on the X-axis.
- **The bars:** The height of the bar shows the number of times that the values occurred within the interval, while the width of the bar shows the interval that is covered.

Example: Height of Orange Trees

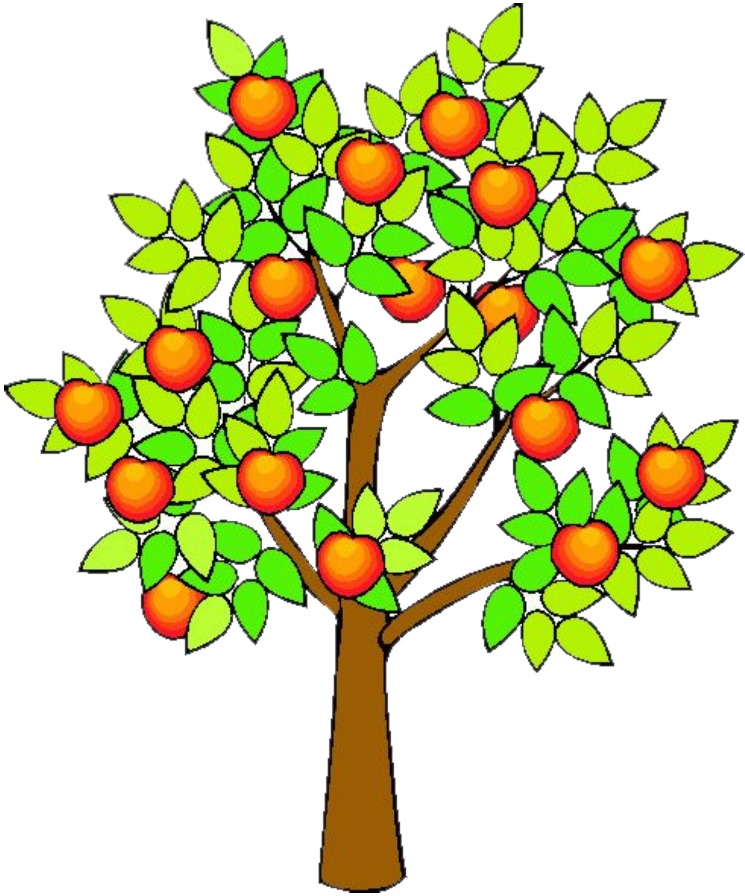
You measure the height of every tree in the orchard in centimeters (cm)

The heights vary from 100 cm to 340 cm

You decide to put the results into groups of 50 cm:

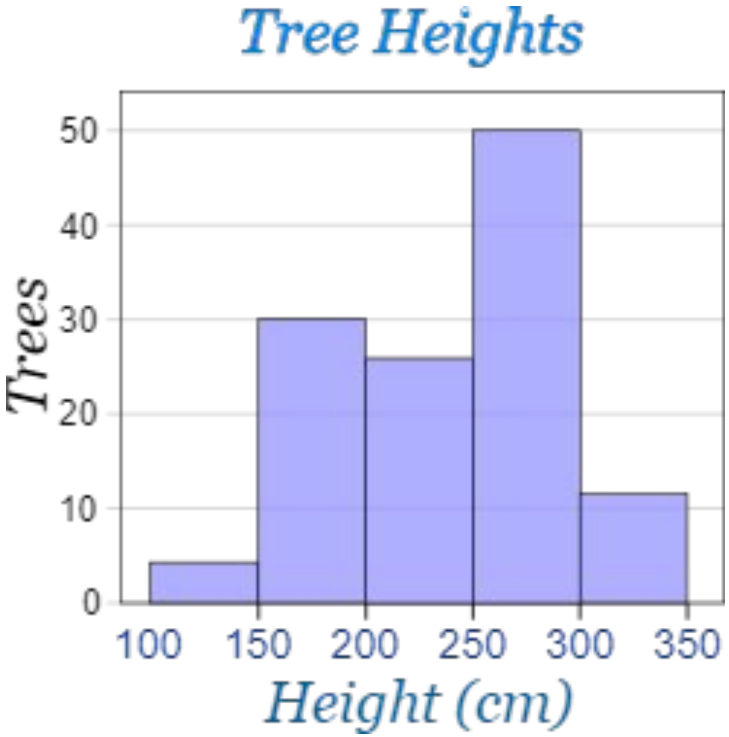
The 100 to just below 150 cm range,
The 150 to just below 200 cm range,
Etc...

So a tree that is 260 cm tall is added to the "250-300" range.



Example: Height of Orange Trees

And here is the result:



You can see (for example) that there are 30 trees from 150 cm to just below 200 cm tall. You just created a histogram!

Source: https://www.mathsisfun.com/data/histograms.html

Creating a Histogram

Matplotlib can be used to create histograms using the `hist()` method.

Parameters:

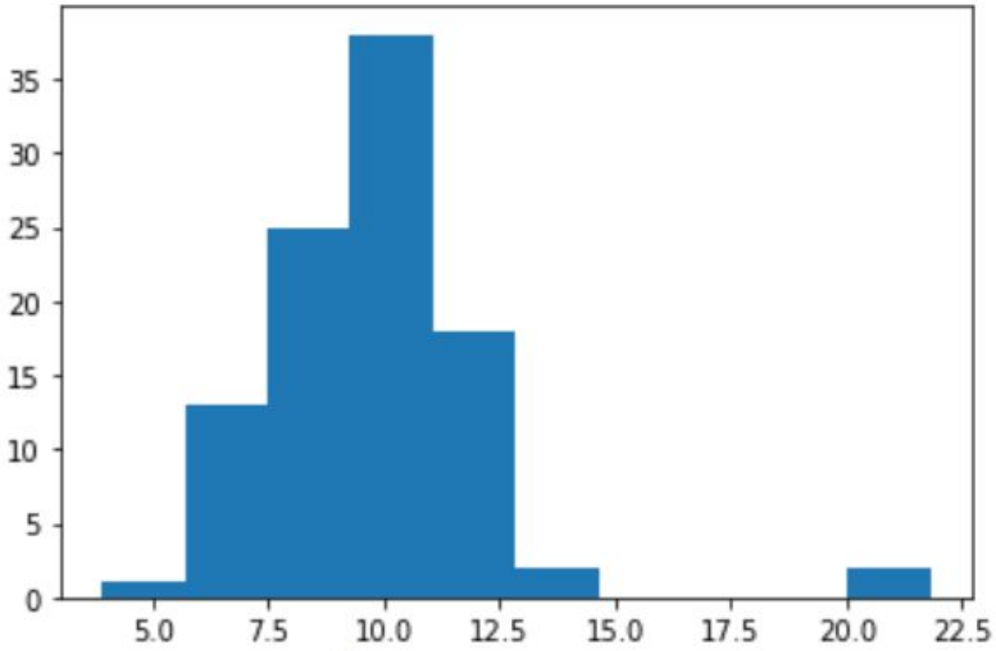
- x(n,) : this takes either a single array or a sequence of arrays which are not required to be of the same length.
- bins : intervals of any quantity

If the bins are:
[1, 2, 3, 4]

then the first bin is [1, 2) (including 1, but excluding 2) and the second [2, 3). The last bin, however, is [3, 4], which includes 4.

Creating a Histogram

```
plt.hist(x.percent_senior)
plt.show()
```



The number of values in each bin

The bins created from senior percentages

Applications of Histogram

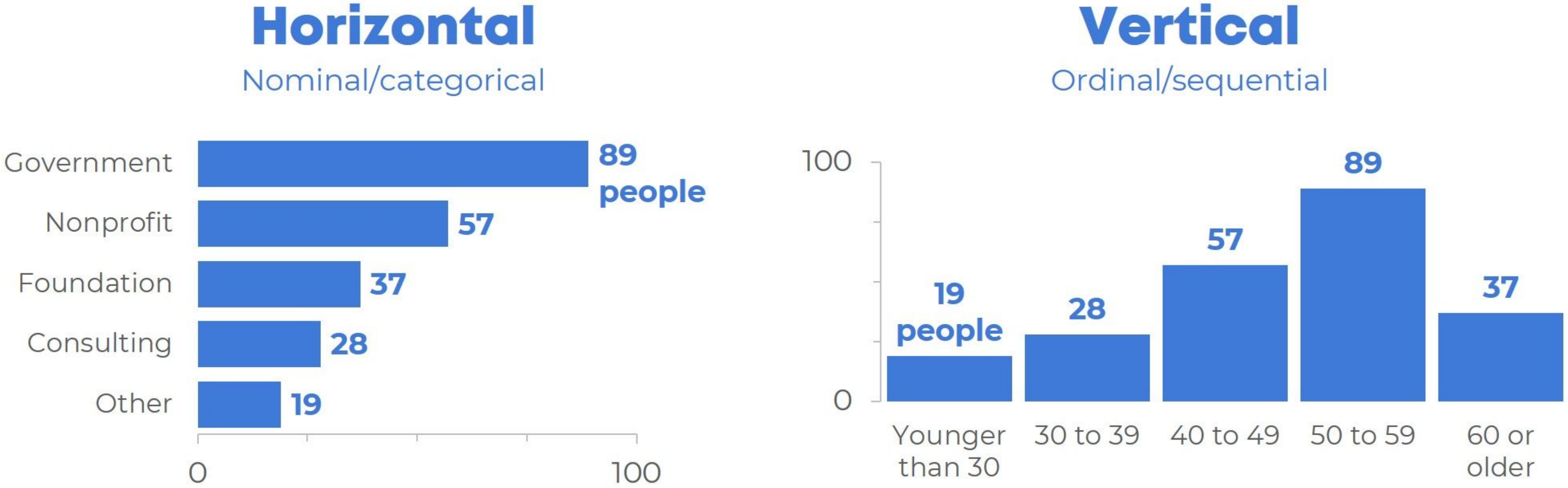
- Histograms are a very common type of plots when we are looking at data like height and weight, stock prices, waiting time for a customer, etc which are continuous in nature.

- Histograms are good for showing general distributional features of dataset variables. You can see roughly where the peaks of the distribution are, whether the distribution is skewed or symmetric, and if there are any outliers.

Bar Plot

Bar charts are one of the most common types of graphs and are used to show data associated with the categorical variables.

Let's see some ways to display a bar graph with matplotlib:



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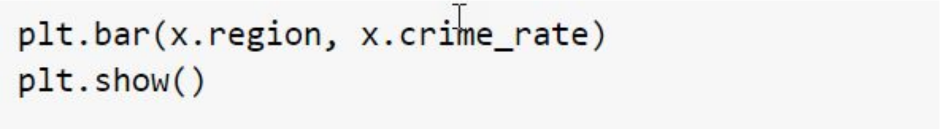
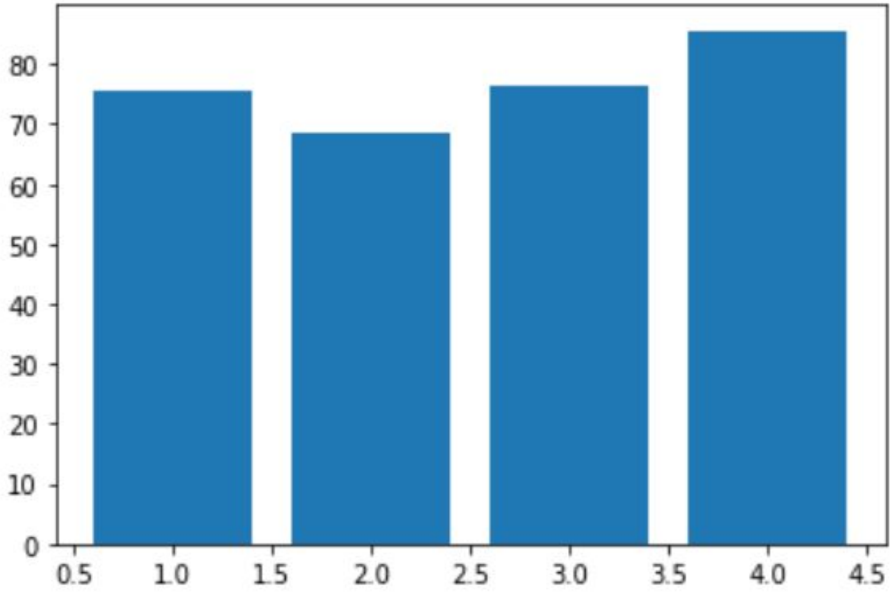
Creating a Vertical Bar Plot

- Pyplot provides a bar() method to make bar graphs which take the following arguments: categorical variables, their values and color (if you want to specify any).

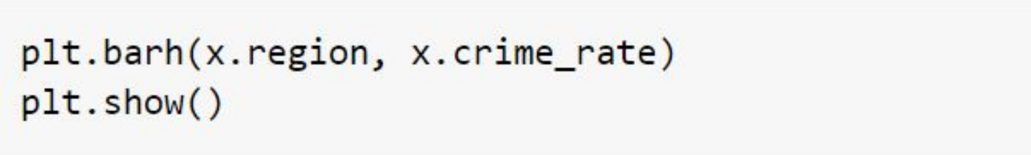


```
plt.bar(x.region, x.crime_rate)
plt.show()
```

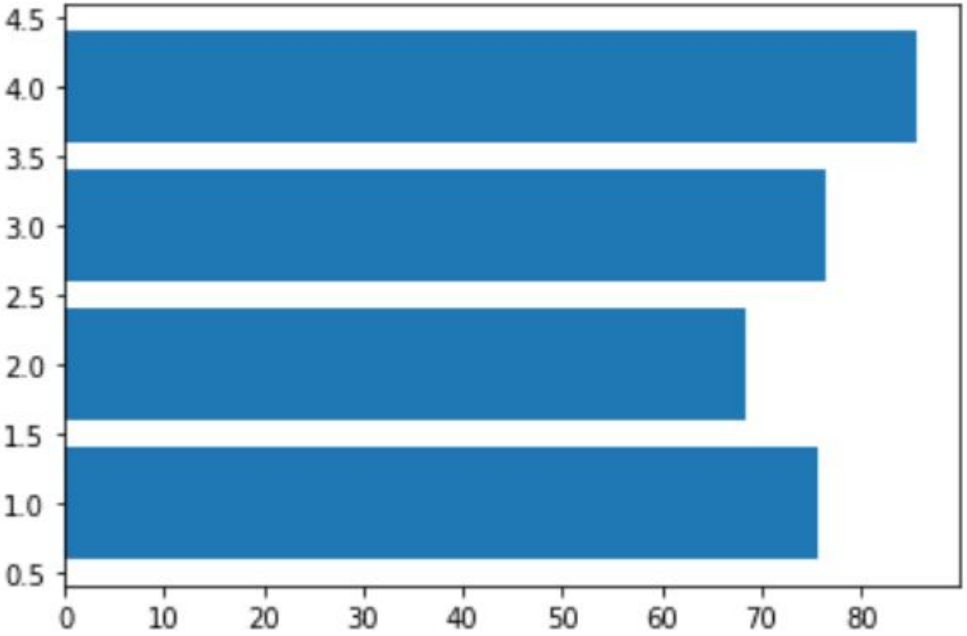


Creating a Horizontal Bar Plot

- It’s also really simple to make a horizontal bar-chart using the plot.barh() method.



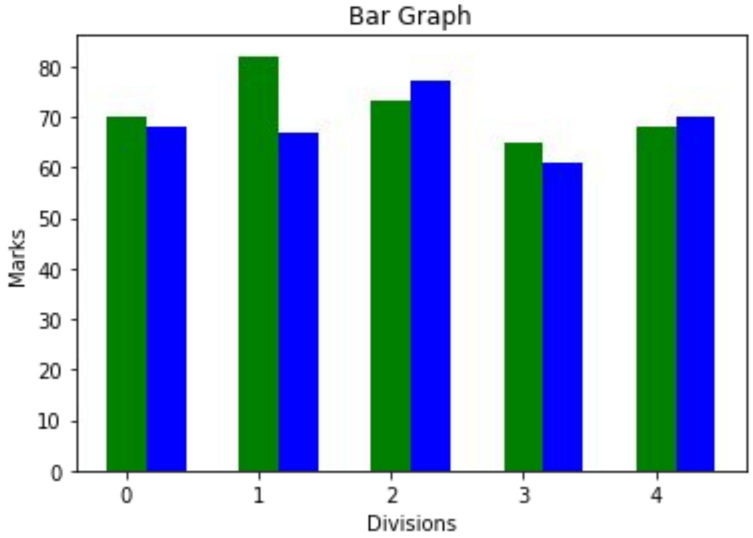
```
plt.barh(x.region, x.crime_rate)
plt.show()
```



Bar Charts with multiple quantities

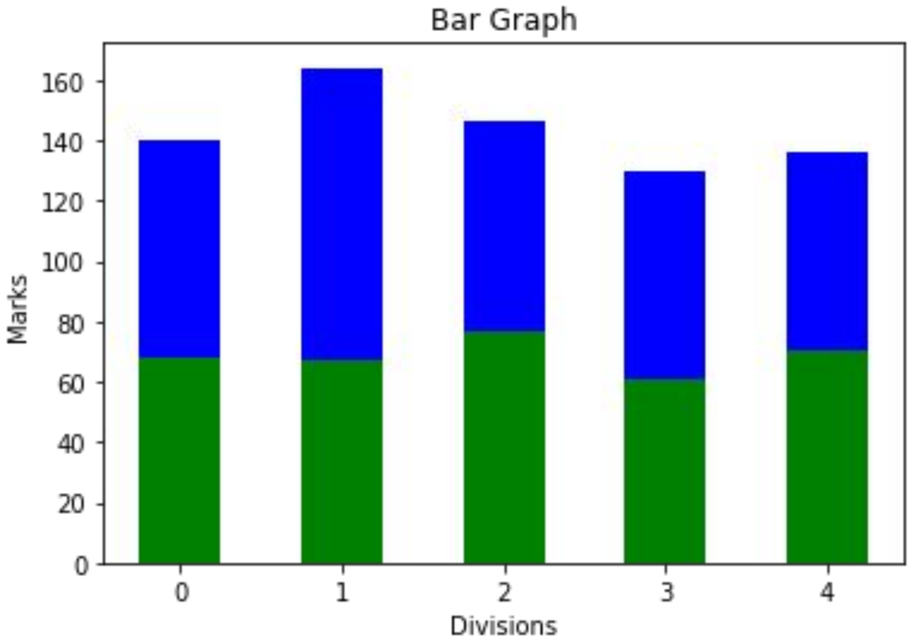
When comparing several quantities and when changing one variable, we might want a bar chart where we have bars of one color for one quantity value.

We can plot multiple bar charts by playing with the thickness and the positions of the bars.



Stacked Bar Charts

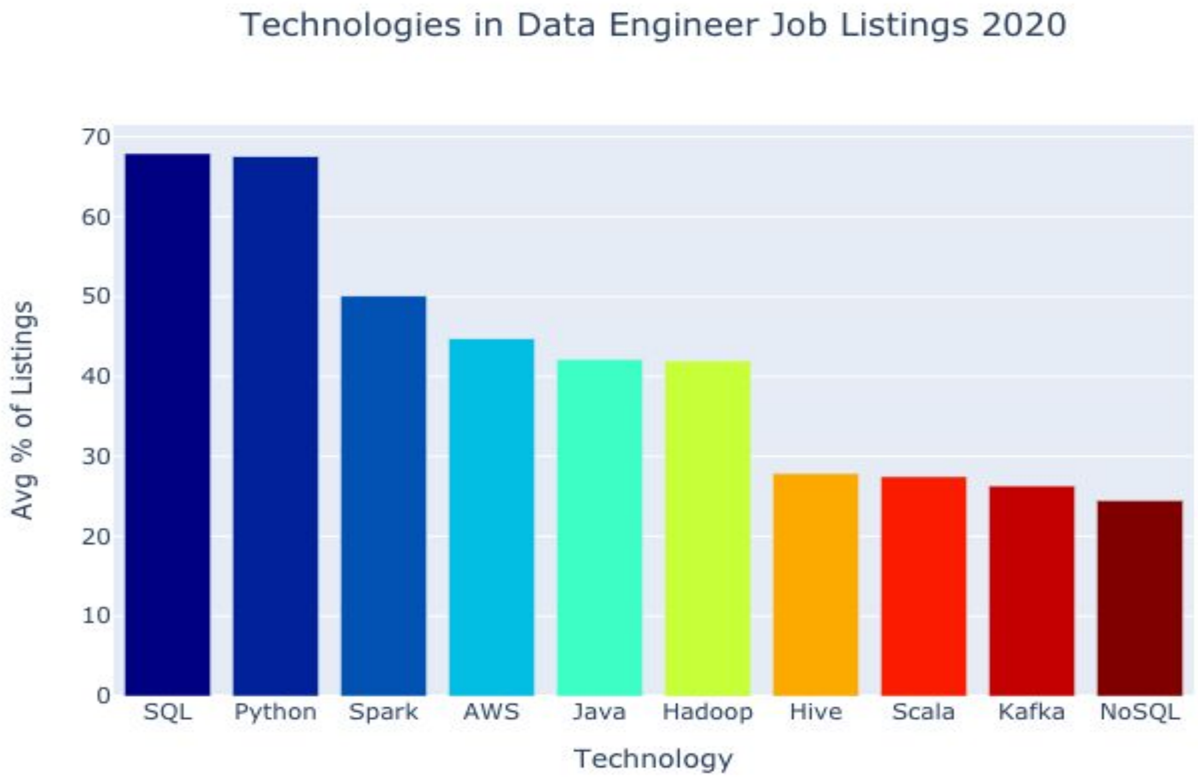
The stacked bar chart stacks bars that represent different groups on top of each other. The height of the resulting bar shows the combined result of the groups.



Applications of Bar Charts

Bar graphs are used to match things between different groups or to trace changes over time. Look at the bar chart below representing the most in-demand tech skills for data engineers.

Source: https://www.experfy.com/blog/most-in-demand-tech-skills-for-data-engineers-58f4c1ca25ab/



Bar Chart vs Histogram

Histograms are a great way to show results of continuous data, such as:

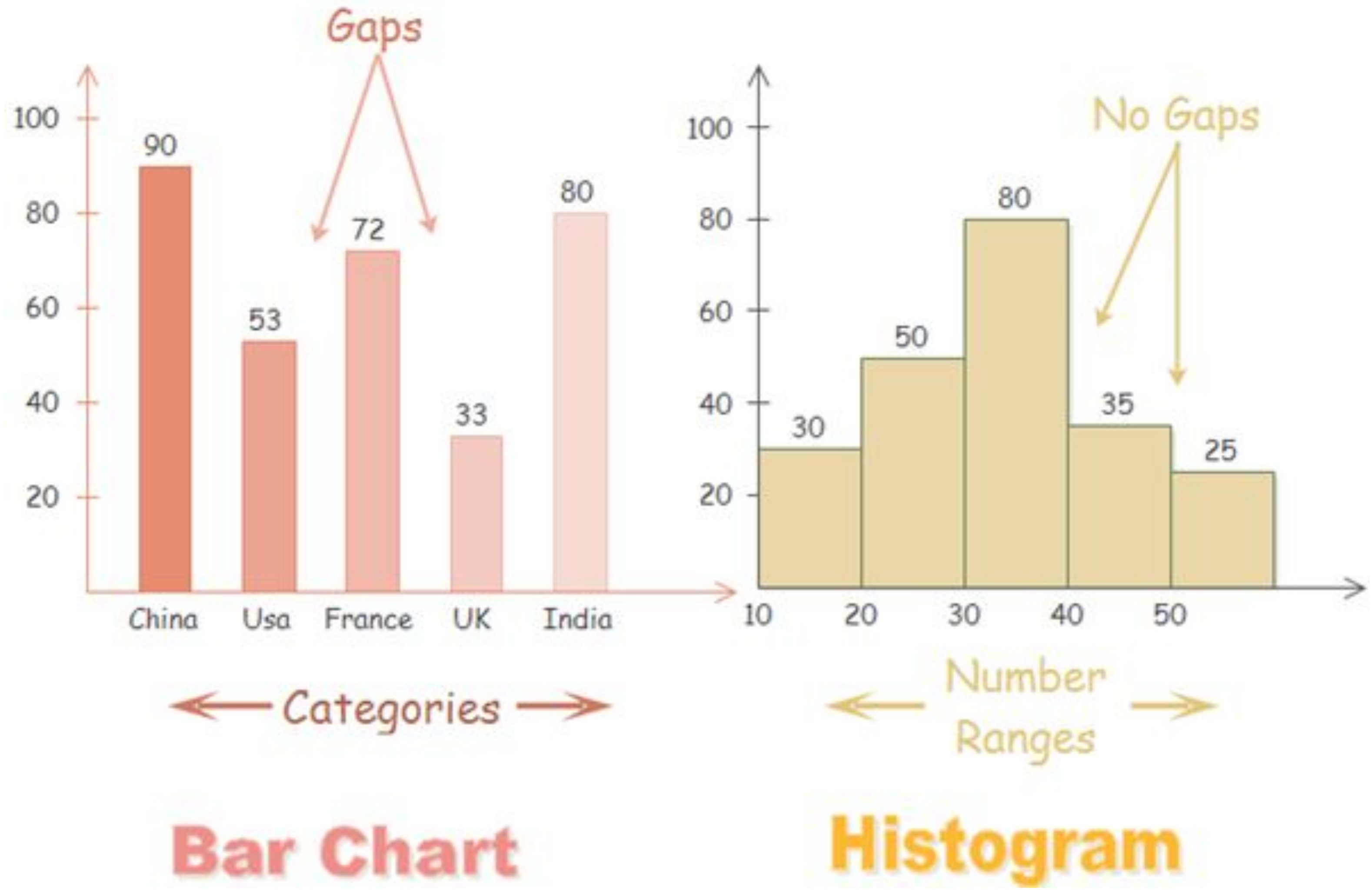
- weight
- height
- how much time

  Etc.

But when the data is in categories (such as Country or Favorite Movie), we should use a Bar Chart.

Have a look at the next slide descripting the difference between histogram and bar chart:

Bar Chart vs Histogram



Pie Charts

A pie chart (or a circle chart) is a circular statistical graphic, which is divided into slices(wedges) to illustrate numerical proportion.

Imagine a pizza where different slices contain different toppings. Bigger the slice, larger the amount of that topping is present.

Pie Charts

Parameters of a pie chart:

- **x:** The wedge sizes.
- **labels:** A sequence of strings providing the labels for each wedge.
- **Colors:** A sequence of colors through which the pie chart will cycle. If None, will use the colors in the currently active cycle.
- **Autopct:** string, used to label the wedges with their numeric value. The label will be placed inside the wedge. The format string will be fmt%pct.

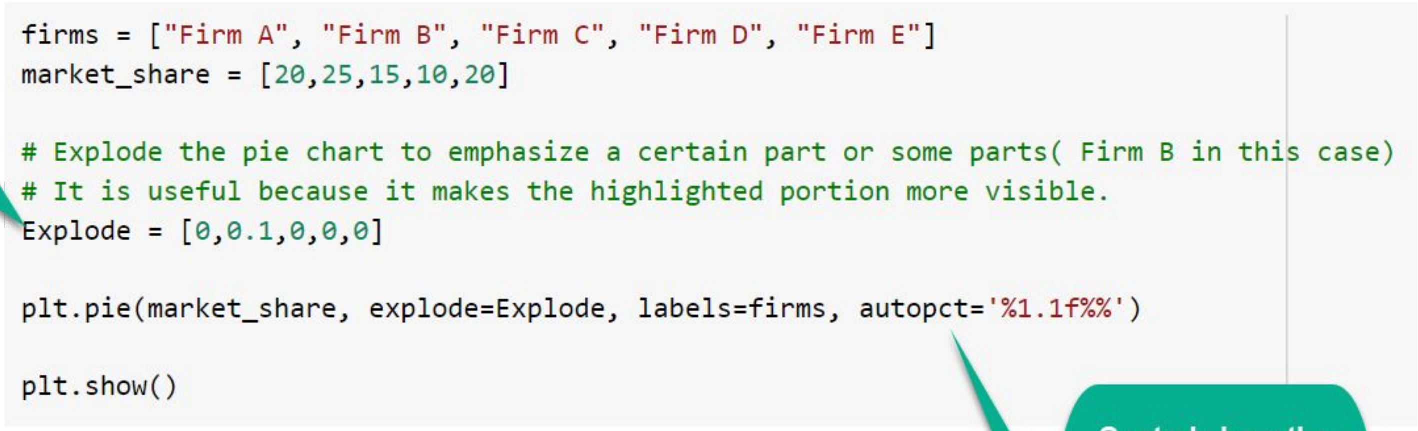
We can also pass in arguments to customize our Pie chart to show shadow, explode a part of it, tilt it at an angle or do lot more exciting things!

Don’t get overwhelmed with the terms being used, it’ll be all clear in the next slide.

Creating a Pie Chart

Pie chart can be made using the method pie().

Amount by which we want each wedge to be exploded

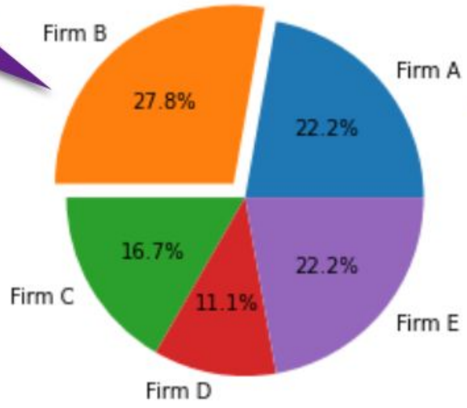


```
firms = ["Firm A", "Firm B", "Firm C", "Firm D", "Firm E"]
market_share = [20,25,15,10,20]

# Explode the pie chart to emphasize a certain part or some parts( Firm B in this case)
# It is useful because it makes the highlighted portion more visible.
Explode = [0,0.1,0,0,0]

plt.pie(market_share, explode=Explode, labels=firms, autopct='%1.1f%%')

plt.show()
```

Controls how the percentages are displayed in the wedges.
Here, we are displaying only 1 decimal place.

If None, no value will be displayed inside the wedges

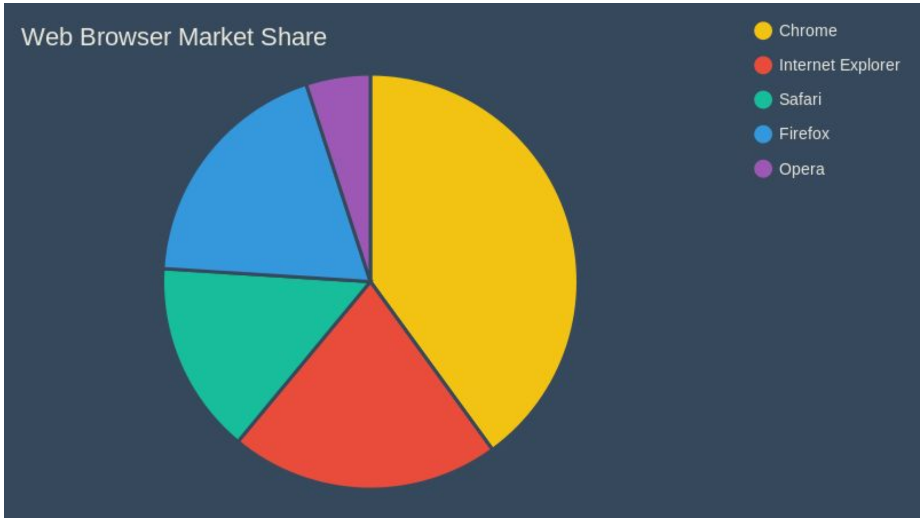
To emphasize on the market share of Firm B, we have exploded it



labels = firms provides the labels for each wedge
Firm A in this case

Applications of Pie Charts

- A pie chart is best used when trying to work out the composition of something. If you have categorical data then using a pie chart would work really well as each slice can represent a different category. A good example of a pie chart can be seen below.



- Another good use for a pie chart would be to compare areas of growth within a business such as turnover, profit and exposure.

- Try creating a pie chart to see how much money you spend in different areas

Slide Download Link

You can download these slides from the below link:

https://docs.google.com/presentation/d/1Sm9xtY3ETO0ZZz2CZqx3Z4HxjZ99WKh_-RbBecL_HuE/edit?usp=sharing

That's it for this unit. Thank you!

Feel free to post any queries on Discuss.

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