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# Matplotlib Tutorial in Python | Chapter 1 | Introduction

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## Matplotlib Tutorial in Python

In this series of **Matplotlib Tutorials** in Python, we will cover all the concepts from beginners to expert level. Starting with how to install Matplotlib library to how to create the plots, this series is an exhaustive tutorial and by the end of this series you will be able to create most of the plot types.

## What is Matplotlib?

[Matplotlib](#) is a plotting library which is used to generate 2D figures/graphs from data in [Python](#). It is extensively used in data sciences as it produces high quality images which can be used in publication also. It can be used in Python scripts, the [Python](#) and [IPython](#) shells, the [Jupyter](#) notebook, web application servers etc.

## How to install Matplotlib?

The easiest way to install Matplotlib library in Python is using the standard package manager of Python i.e. pip. So, simply typing ‘pip install matplotlib’ in terminal/command line (MacOS/Unix) or PowerShell(Windows) will install it on your MacOS/Linux/Windows PC.

```
$ pip install matplotlib
```



## Install Matplotlib using third party distributions

Alternatively, you can install Matplotlib library in Python using the third party scientific distributions like [Anaconda](#), [Canopy](#), [ActiveState](#), etc. for MacOS, Windows and major linux platforms. On Windows, you have another distribution called [WinPython](#), which can be used to install Matplotlib. If you are using miniconda, then you can use ‘conda install matplotlib’ to install the library.

## How to install Matplotlib on Linux using package manager?

You can install Matplotlib on major distributions of Linux OS by using the package manager as detailed in the table below:-

#	Linux Distribution	Command
1	Debian/Ubuntu	sudo apt-get install python3-matplotlib
2	Fedora	sudo dnf install python3-matplotlib





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# Create a simple line plot in Python using Matplotlib

We can create a simple line plot in Python using [matplotlib.pyplot.plot\(\)](#) method.

## Syntax of matplotlib.pyplot.plot()

The syntax for plt.plot() is :-

```
matplotlib.pyplot.plot(*args, scalex=True, scaley=True, data=None, **kwargs)
```



It returns a list of Line2D objects representing the plotted data. And, the basic parameters of pyplot.plot() are as shown in the table below:-

#	Parameters	Type	Details
1	x, y	array-like or scalar	<p>The horizontal / vertical coordinates of the data points. x values are optional and default to range(len(y)).</p> <p>Commonly, these parameters are 1D arrays.</p> <p>They can also be scalars, or two-dimensional (in that case, the columns represent separate data sets).</p> <p>These arguments cannot be passed as keywords.</p>
2	fmt	str, optional	<p>A format string, e.g. 'ro' for red circles. See the Notes section for a full description of the format strings.</p> <p>Format strings are just an abbreviation for quickly setting basic line properties. All of these and more can also be controlled by keyword arguments.</p> <p>This argument cannot be passed as keyword.</p>
3	data	indexable object, optional	<p>An object with labelled data. If given, provide the label names to plot in x and y.</p>

We can create a simple line chart as under:-

1. Create an empty file matplotlib\_tutorial.py and start editing it in your favourite editor. (I like to use [Sublime Text](#) as my editor). You can read more about the editors/shell [here](#).
2. Import matplotlib.pyplot.
3. I have taken age-wise data of Indian population in a [Python list](#) from [here](#).
4. Then we will pass two lists to [plt.plot\(\)](#) method as x-axis and y-axis.
5. Finally, we will create a line plot using [plt.show\(\)](#).

```
import matplotlib.pyplot as plt #This is the general convention
```

```
ages = [12, 13, 14, 15, 16, 17, 18, 19, 20, 21]
```

```
total_population = [27877307, 24280683, 25258169, 25899454, 24592293, 21217467, 27958147, 20859088, 28882735, 19978972]
```

```
plt.plot(ages, total_population)
```

```
plt.show()
```





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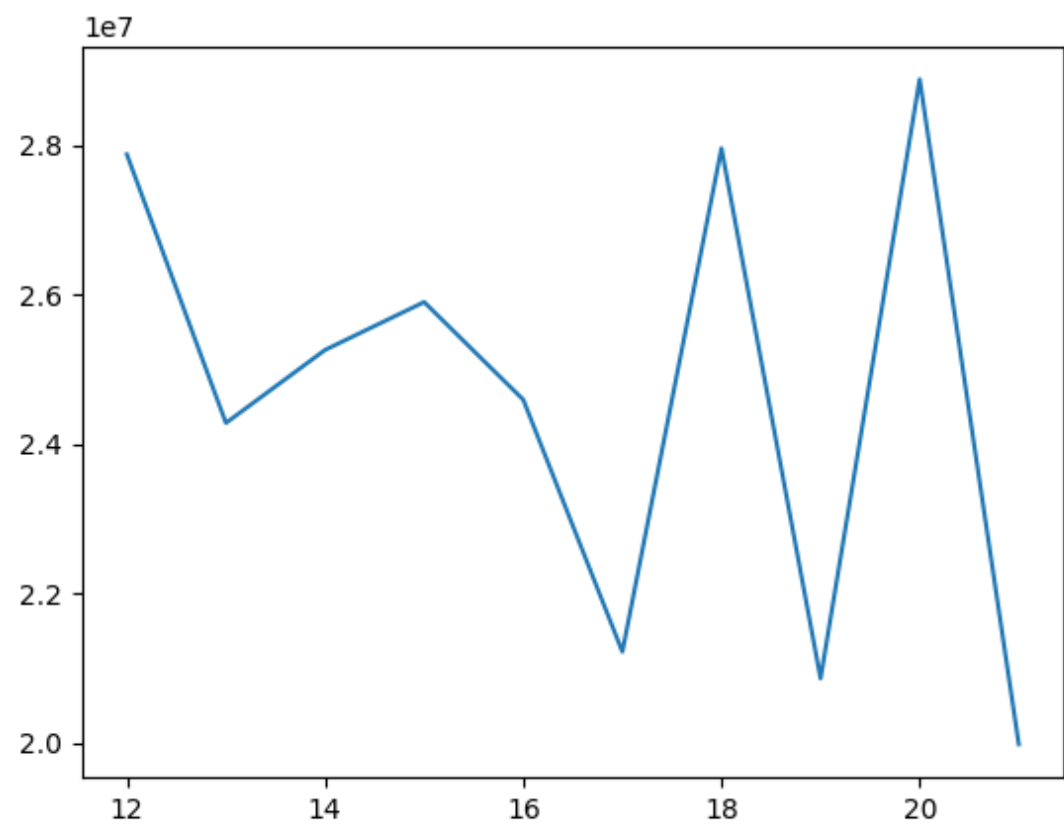
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As you can see in the above line plot, the x-axis denotes the ages and the y-axis denotes the total population. Even, the simple Line chart comes with so many inbuilt functions:-

- 1. Home Button - It takes back to the home/basic position, if you have used other options and moved/zoomed/panned your plot.
- 2. Left Arrow - It moves the plot left-wards.
- 3. Right Arrow - It moves the plot right-wards.
- 4. Pan - It helps you to move the plot by panning.
- 5. Zoom- It helps you to select a rectangular portion of the map and zoom into it.
- 6. Configuration tool - It is used to set top/bottom/left/right padding and width and height space.
- 7. Save - It saves the plot as a png at your desired location.

## How to set title and axis-labels in a Matplotlib Plot?

We can further customize our Matplotlib Plots and add title and axis-labels to the chart by using `plt.xlabel()`, `plt.ylabel()`, `plt.title()` before `plt.show()`.

```
plt.xlabel("Age")
plt.ylabel("Total Population")
plt.title("Age-wise population of India")
plt.show()
```



Just by using the above options, our Plot has more information vis-a-vis a title and axes-labels.



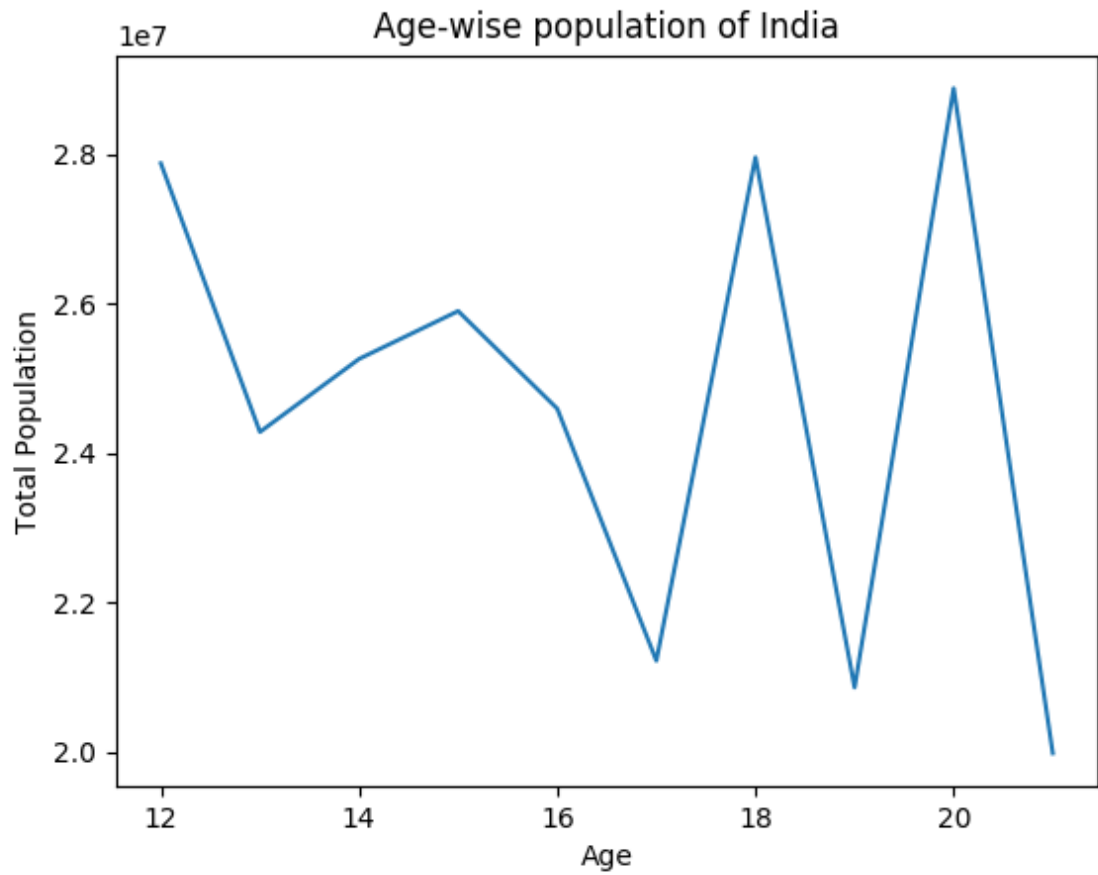


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## Positioning the title of the Matplotlib Plot

By default `pyplot.title()` position the title above the plot at the very center but you can position it by passing `loc = {'center', 'left', 'right'}` in `pyplot.title()` method.

## Creating Multiple Line Plots in Python using Matplotlib

We can also create multiple line plots in Python using Matplotlib by passing the data to `plt.plot()` method. The line plots will share the x-axis and y-axis but will have different data/values.

```
# matplotlib_tutorial.py

# Male Population
male_population = [14637892, 12563775, 13165128, 13739746, 13027935, 11349449, 15020851, 10844415, 14892165, 10532278]

#Female Population
female_population = [13239415, 11716908, 12093041, 12159708, 11564358, 9868018, 12937296, 10014673, 13990570, 9446694]

plt.plot(ages, total_population)
plt.plot(ages, male_population)
plt.plot(ages, female_population)
```

Matplotlib will automatically set different colors for the multiple line plots.

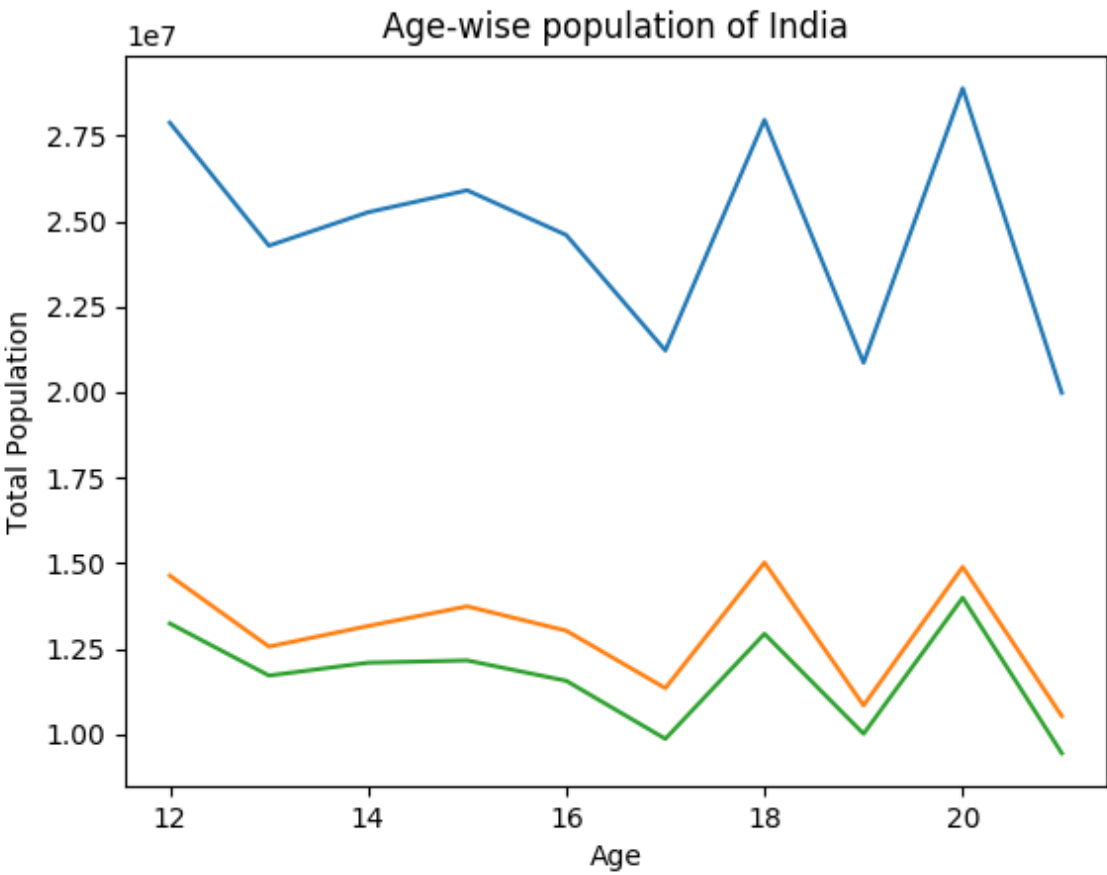




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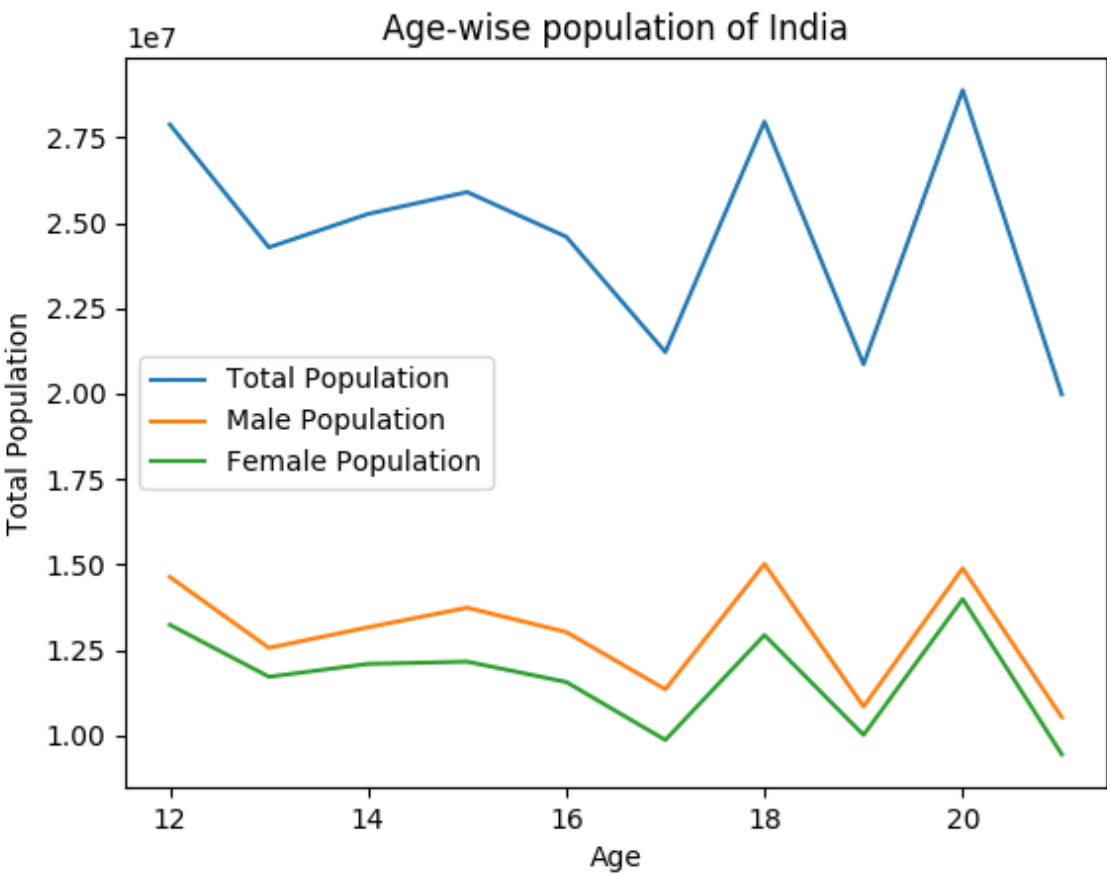


# Adding legends to the Matplotlib Plot in Python

Though all the three plots above are of different color, but still it is not clear, what each plot represents. So, we can easily add legends to our plot by passing labels in `plt.plot()` method and calling `plt.legend()`:-

```
# matplotlib_tutorial.py

plt.plot(ages, total_population, label = "Total Population")
plt.plot(ages, male_population, label = "Male Population")
plt.plot(ages, female_population, label = "Female Population" )
plt.legend()
plt.show()
```





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The matplotlib library will automatically place the legends at the best location (as per the library) but we can change the location of the legend by passing loc to plt.legend(). The permissible location strings and location codes for 'loc' parameter of plt.legend() are as under:-

#	Location String	Location Code
1	'best'	0
2	'upper right'	1
3	'upper left'	2
4	'lower left'	3
5	'lower right'	4
6	'right'	5
7	'centre left'	6
8	'center right'	7
9	'lower center	8
10	'upper center'	9
11	'center'	10

## Setting Markers, line-style and colors of the charts in Matplotlib Plot

You can also set the markers, line-style and colors of the Matplotlib Plot by using the format method. The details of the same can be found [here](#)

Setting up the markers, line-style and colors of the plot is as easy as providing the following format in [plt.plot\(\)](#) method.

```
# matplotlib_tutorial.py

fmt = '[marker][line][color]'
```



## Markers in Matplotlib

You can choose from the following markers :-

#	Character	Description
1	'.'	point marker
2	','	pixel marker
3	'o'	circle marker





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#	Character	Description
5	'^'	triangle_up marker
6	'<'	triangle_left marker
7	'>'	triangle_right marker
8	'1'	tri_down marker
9	'2'	tri_up marker
10	'3'	tri_left marker
11	'4'	tri_right marker
12	's'	square marker
13	'p'	pentagon marker
14	'*'	star marker
15	'h'	hexagon1 marker
16	'H'	hexagon2 marker
17	'+'	plus marker
18	'x'	x marker
19	'D'	diamond marker
20	'd'	thin_diamond marker
21	' '	vline marker
22	'_'	hline marker

## Line Styles in Matplotlib

The available line styles in Matplotlib are :-

#	character	description
1	'_'	solid line style
2	'--'	dashed line style
3	'-.'	dash-dot line style





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The supported color abbreviations in Matplotlib are the single letter codes:-

#	character	color
1	'b'	blue
2	'g'	green
3	'r'	red
4	'c'	cyan
5	'm'	magenta
6	'y'	yellow
7	'k'	black
8	'w'	white

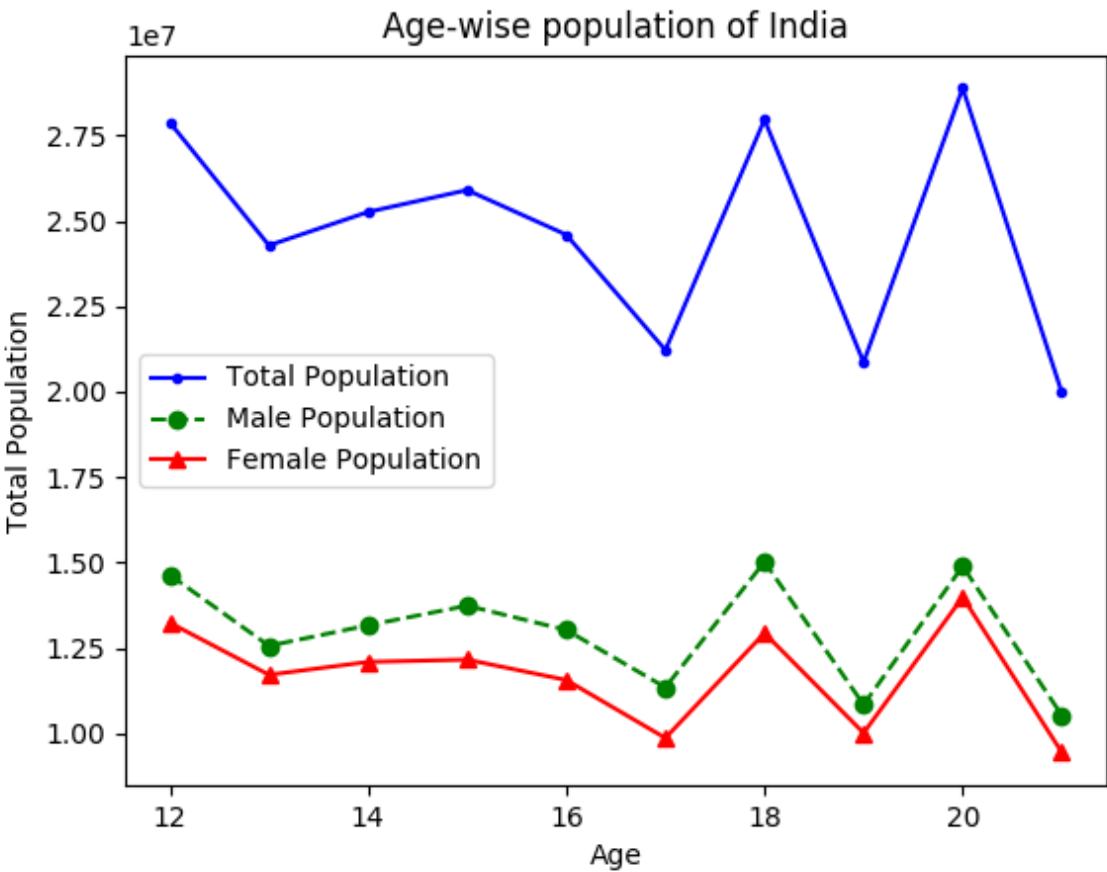
If the color is the only part of the format string, you can additionally use any [matplotlib.colors](#) spec, e.g. full names ('green') or hex strings ('#008000').

Now, let us add these features i.e. markers, line-style and colors to our Matplotlib plot.

# matplotlib\_tutorial.py

```
plt.plot(ages, total_population, '-b', label="Total Population")
plt.plot(ages, male_population, 'o--g', label="Male Population")
plt.plot(ages, female_population, '^--r', label="Female Population")
```

We will get the following Matplotlib Plot with markers, line-styles and colors:-





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However, if you find the above notation less-readable and want your code to be more explicit, you can pass all these arguments- marker, linestyle and color to plt.plot() method. The following code will produce the same plot:-

```
# matplotlib_tutorial.py

plt.plot(ages, total_population, color='b', linestyle='--', marker='.', label="Total Population")
plt.plot(ages, male_population, color='g', linestyle='--', marker='o', label="Male Population")
plt.plot(ages, female_population, color='r', linestyle='--', marker='^', label="Female Population")
```

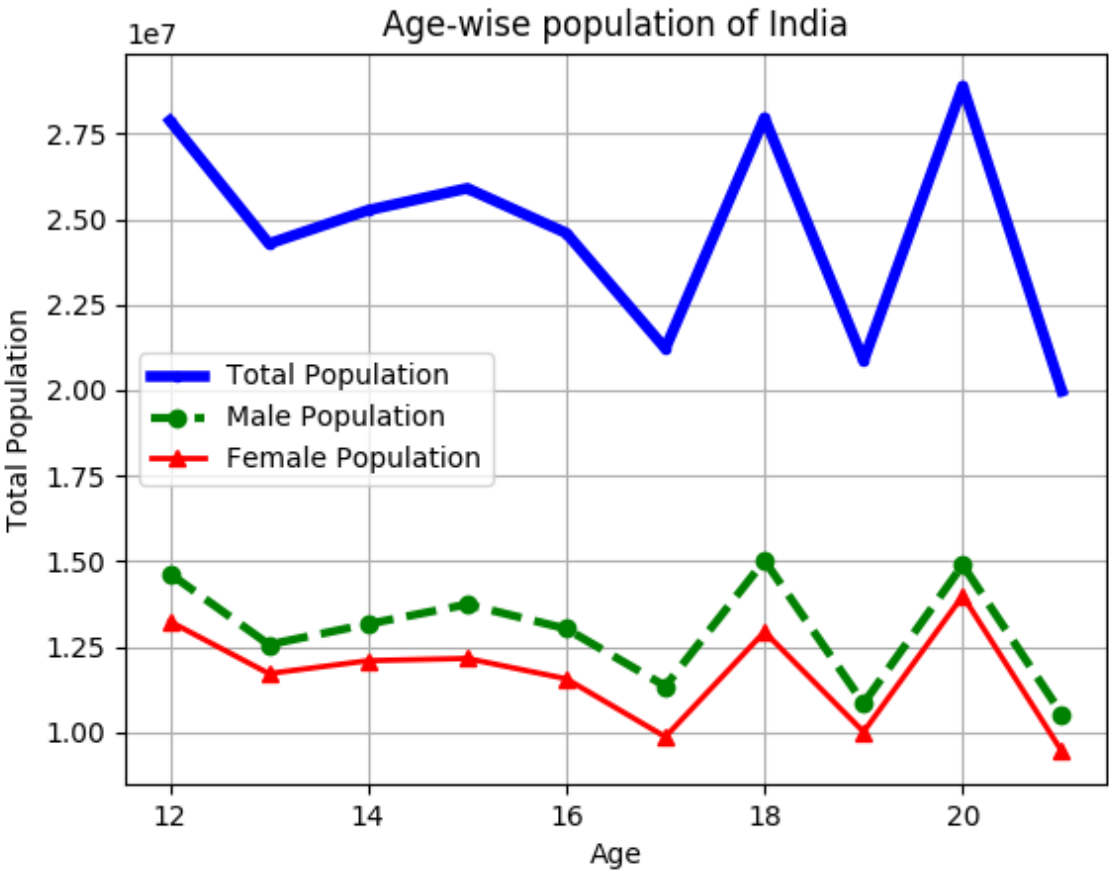
## Adding grids and setting line-width of Matplotlib Plots

We can easily set the linewidth of the plot by passing [linewidth](#), which takes a float as argument, to [plt.plot\(\)](#).

Also to make plot more readable, we can add grids to our Matplotlib plot by passing [plt.grid\(\)](#).

```
# matplotlib_tutorial.py

plt.plot(ages, total_population, color='b', linestyle='--', marker='.', linewidth=4, label="Total Population")
plt.plot(ages, male_population, color='g', linestyle='--', marker='o', linewidth=3, label="Male Population")
plt.plot(ages, female_population, color='r', linestyle='--', marker='^', linewidth=2, label="Female Population")
plt.grid()
```



## Using inbuilt plot styles in Matplotlib

There are many inbuilt styles in Matplotlib, which can be used to style your plots. To get the list of the available styles:-

```
print(plt.style.available)
```

# Output

```
['seaborn-dark', 'seaborn-darkgrid', 'seaborn-ticks', 'fivethirtyeight', 'seaborn-whitegrid', 'classic', '_classic_test', 'fast', 'seaborn-talk', 'seaborn-dark-palette', 'seaborn-bright', 'seaborn-pastel', 'grayscale', 'seaborn-notebook', 'ggplot', 'seaborn-colorblind', 'seaborn-muted', 'seaborn', 'Solarize_Light2', 'seaborn-paper', 'bmh', 'tableau-colorblind10', 'seaborn-white', 'dark_background', 'seaborn-poster', 'seaborn-deep']
```





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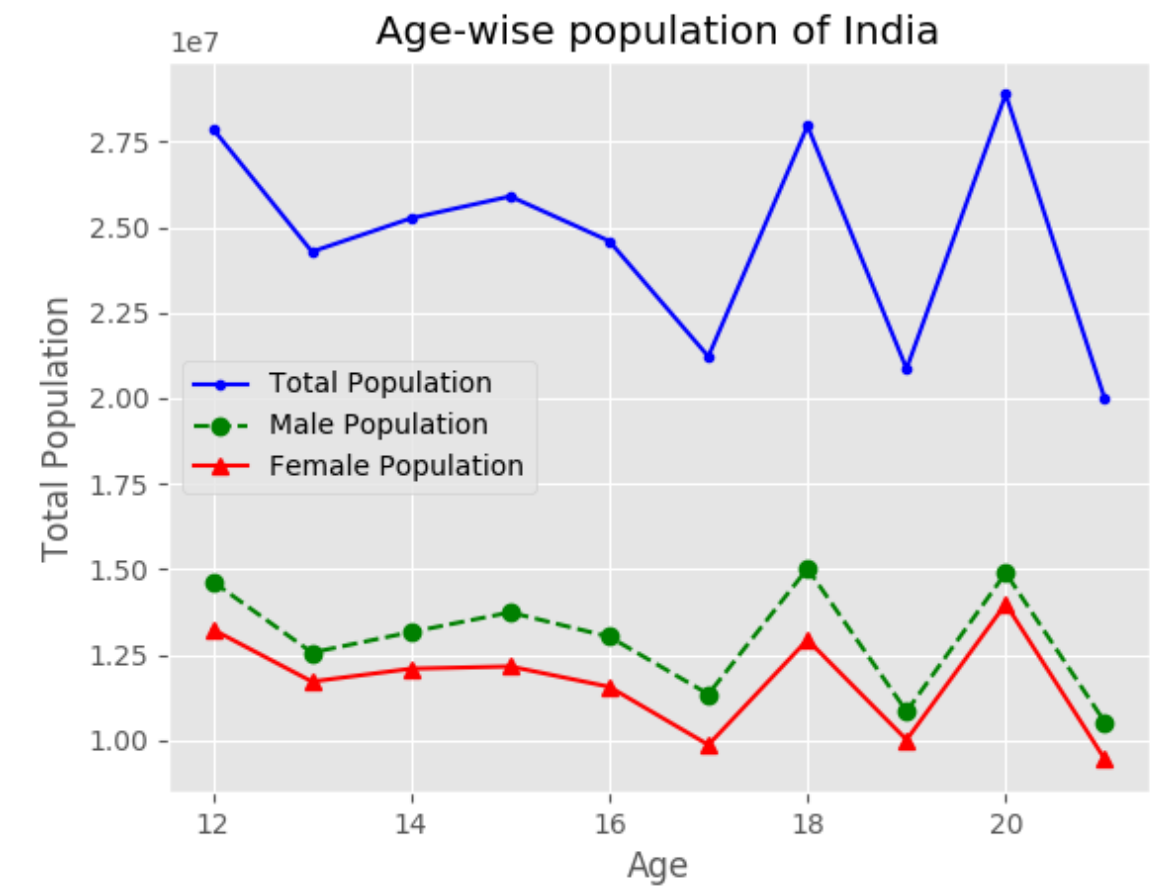
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```
plt.style.use('ggplot')
```

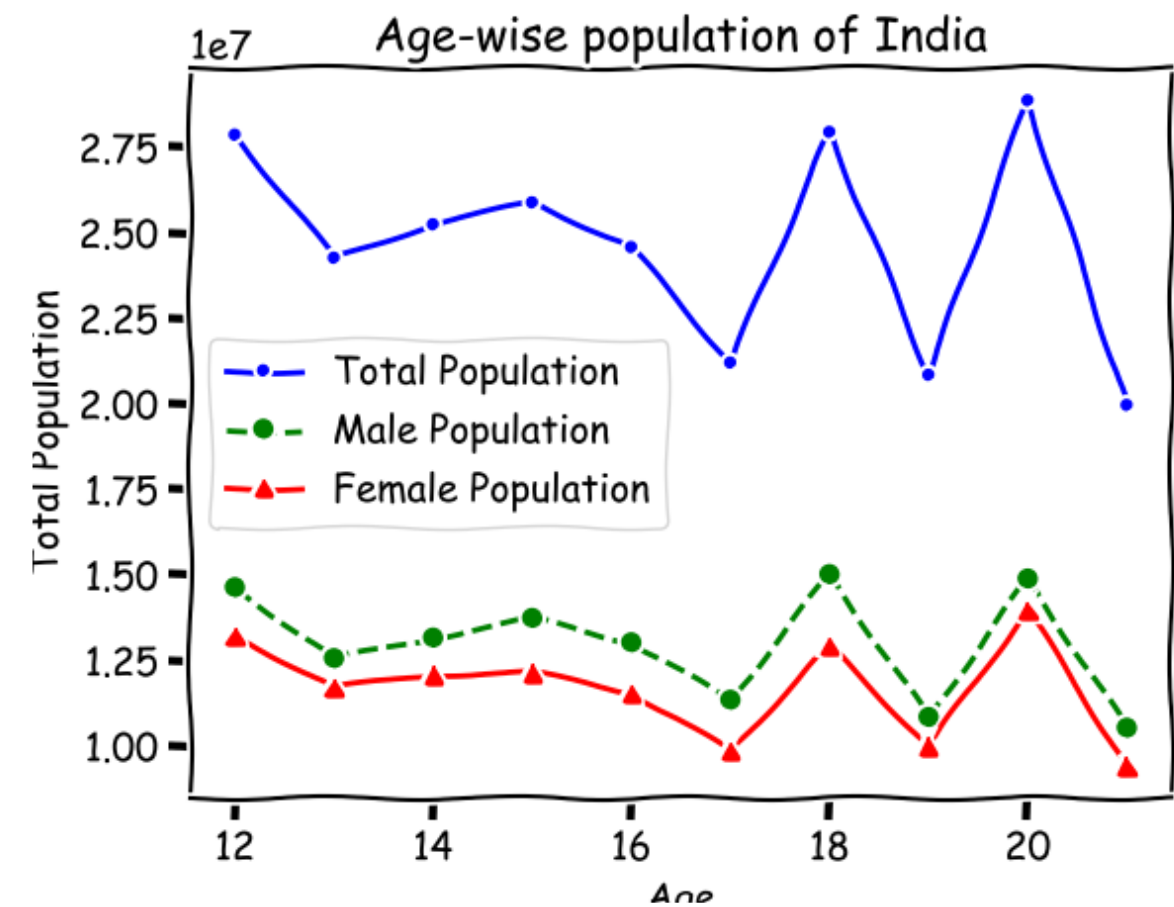


## Matplotlib Style- ggplot (Example)



## Matplotlib Style- xkcd (Example)

You can also draw plots with the comic style of [xkcd](#) by simply passing [plt.xkcd\(\)](#) instead of [plt.style.use\(\)](#).



## Saving the Matplotlib plot as an image

Instead of using the save button on the matplotlib plot, you can directly save the Matplotlib plot as image directly from the code by using [plt.savefig\('yourfilename.png'\)](#).





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# Matplotlib Tutorial in Python - Introduction, Installation and Line Plots - Video Tutorial



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In the [next chapter](#) , we will learn about extracting data from csv (instead of passing lists) and bar charts.

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