Matplotlib Scatter

Creating Scatter Plots

With Pyplot, you can use the `scatter()` function to draw a scatter plot.

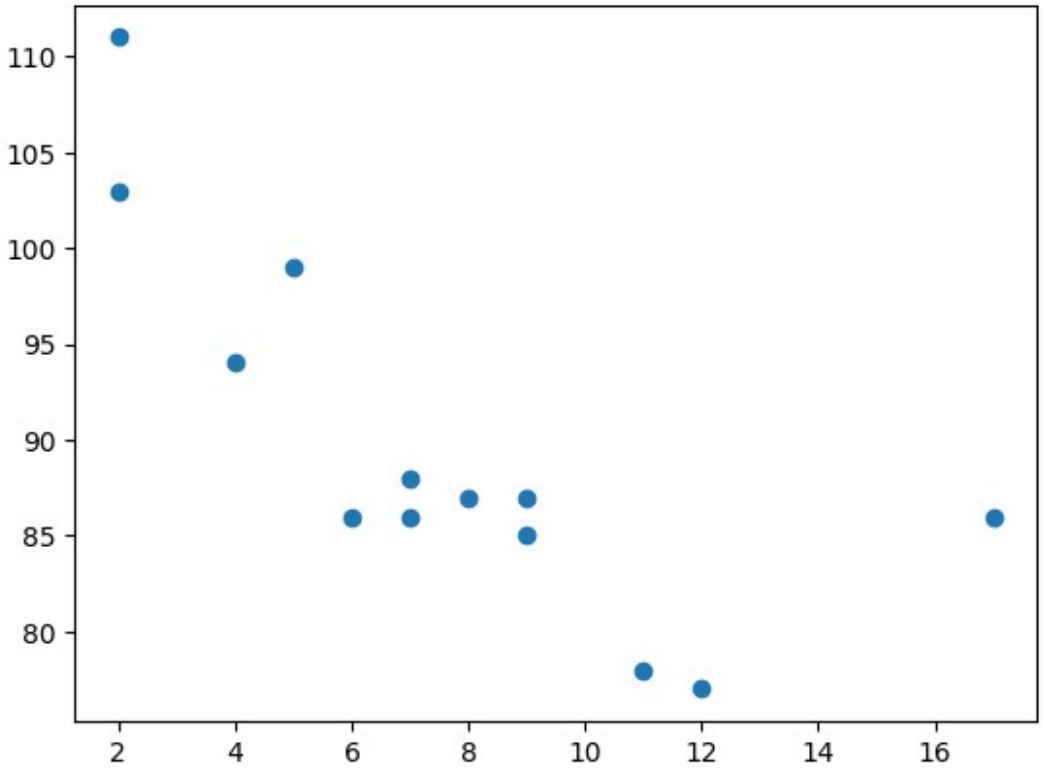
The `scatter()` function plots one dot for each observation. It needs two arrays of the same length, one for the values of the x-axis, and one for values on the y-axis:

```
#A simple scatter plot:

import matplotlib.pyplot as plt
import numpy as np

x = np.array([5,7,8,7,2,17,2,9,4,11,12,9,6])
y = np.array([99,86,87,88,111,86,103,87,94,78,77,85,86])

plt.scatter(x, y)
plt.show()
```



The observation in the example above is the result of 13 cars passing by.

The X-axis shows how old the car is.

The Y-axis shows the speed of the car when it passes.

Are there any relationships between the observations?

It seems that the newer the car, the faster it drives, but that could be a coincidence, after all we only registered 13 cars.

Compare Plots

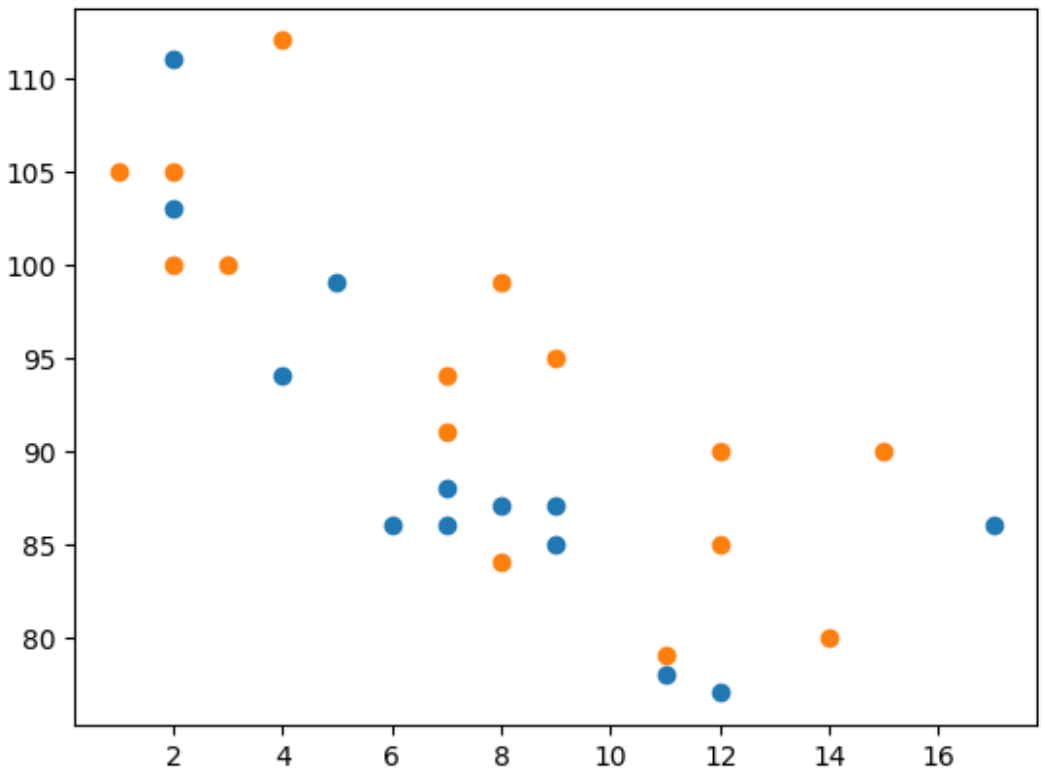
In the example above, there seems to be a relationship between speed and age, but what if we plot the observations from another day as well? Will the scatter plot tell us something else?

```
import matplotlib.pyplot as plt
import numpy as np

#day one, the age and speed of 13 cars:
x = np.array([5,7,8,7,2,17,2,9,4,11,12,9,6])
y = np.array([99,86,87,88,111,86,103,87,94,78,77,85,86])
plt.scatter(x, y)

#day two, the age and speed of 15 cars:
x = np.array([2,2,8,1,15,8,12,9,7,3,11,4,7,14,12])
y = np.array([100,105,84,105,90,99,90,95,94,100,79,112,91,80,85])
plt.scatter(x, y)

plt.show()
```



Note: The two plots are plotted with two different colors, by default blue and orange, you will learn how to change colors later in this chapter.

Colors

You can set your own color for each scatter plot with the `color` or the `c` argument:

Color Each Dot

You can even set a specific color for each dot by using an array of colors as value for the `c` argument:

Note: You cannot use the `color` argument for this, only the `c` argument.

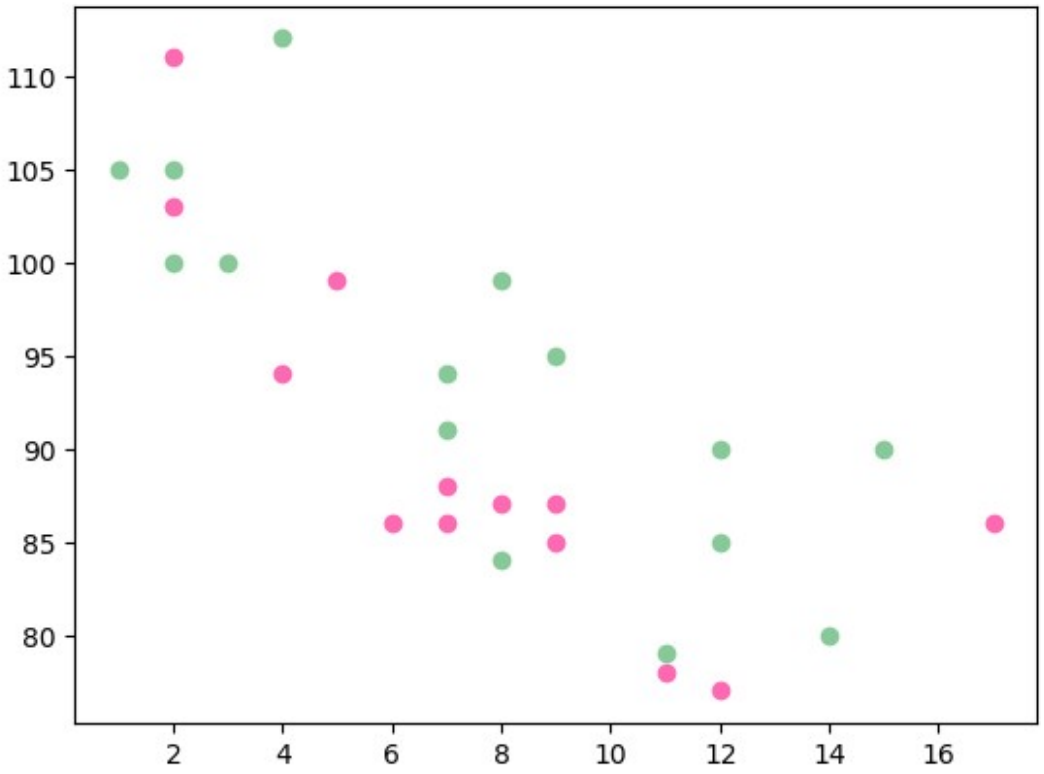
```
#Set your own color of the markers:

import matplotlib.pyplot as plt
import numpy as np

x = np.array([5,7,8,7,2,17,2,9,4,11,12,9,6])
y = np.array([99,86,87,88,111,86,103,87,94,78,77,85,86])
plt.scatter(x, y, color = 'hotpink')

x = np.array([2,2,8,1,15,8,12,9,7,3,11,4,7,14,12])
y = np.array([100,105,84,105,90,99,90,95,94,100,79,112,91,80,85])
plt.scatter(x, y, color = '#88c999')

plt.show()
```



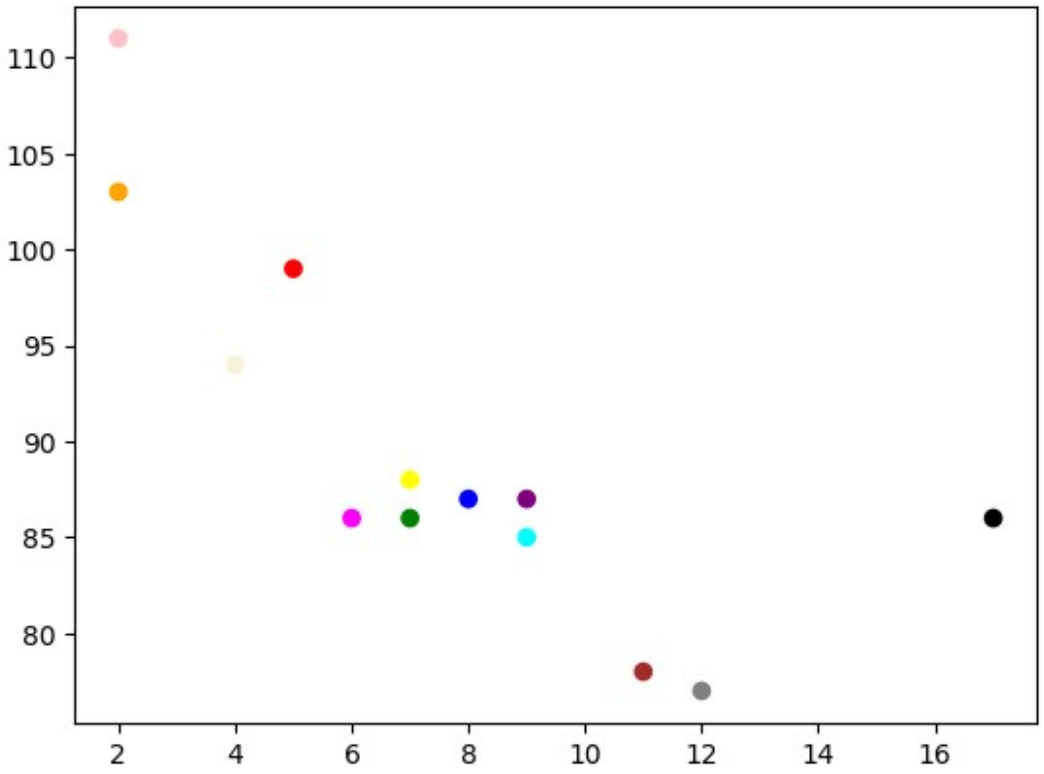

```
#Set your own color of the markers:

import matplotlib.pyplot as plt
import numpy as np

x = np.array([5,7,8,7,2,17,2,9,4,11,12,9,6])
y = np.array([99,86,87,88,111,86,103,87,94,78,77,85,86])
colors =
np.array(["red","green","blue","yellow","pink","black","orange","purpl
e","beige","brown","gray","cyan","magenta"])

plt.scatter(x, y, c=colors)

plt.show()
```



ColorMap

The Matplotlib module has a number of available colormaps.

A colormap is like a list of colors, where each color has a value that ranges from 0 to 100.

Here is an example of a colormap:

This colormap is called 'viridis' and as you can see it ranges from 0, which is a purple color, up to 100, which is a yellow color.

How to Use the ColorMap

You can specify the colormap with the keyword argument `cmap` with the value of the colormap, in this case `'viridis'` which is one of the built-in colormaps available in Matplotlib.

In addition you have to create an array with values (from 0 to 100), one value for each point in the scatter plot:

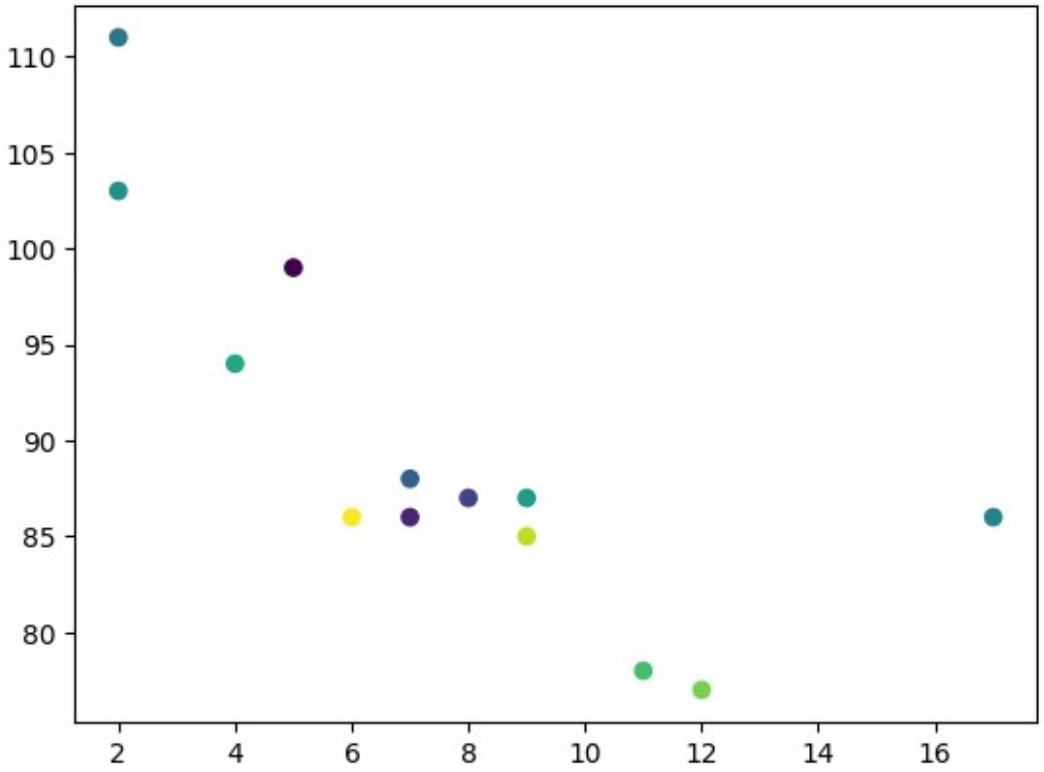
```
# Create a color array, and specify a colormap in the scatter plot:

import matplotlib.pyplot as plt
import numpy as np

x = np.array([5,7,8,7,2,17,2,9,4,11,12,9,6])
y = np.array([99,86,87,88,111,86,103,87,94,78,77,85,86])
colors = np.array([0, 10, 20, 30, 40, 45, 50, 55, 60, 70, 80, 90,
100])
```

```
plt.scatter(x, y, c=colors, cmap='viridis')

plt.show()
```



You can include the colormap in the drawing by including the `plt.colorbar()` statement:

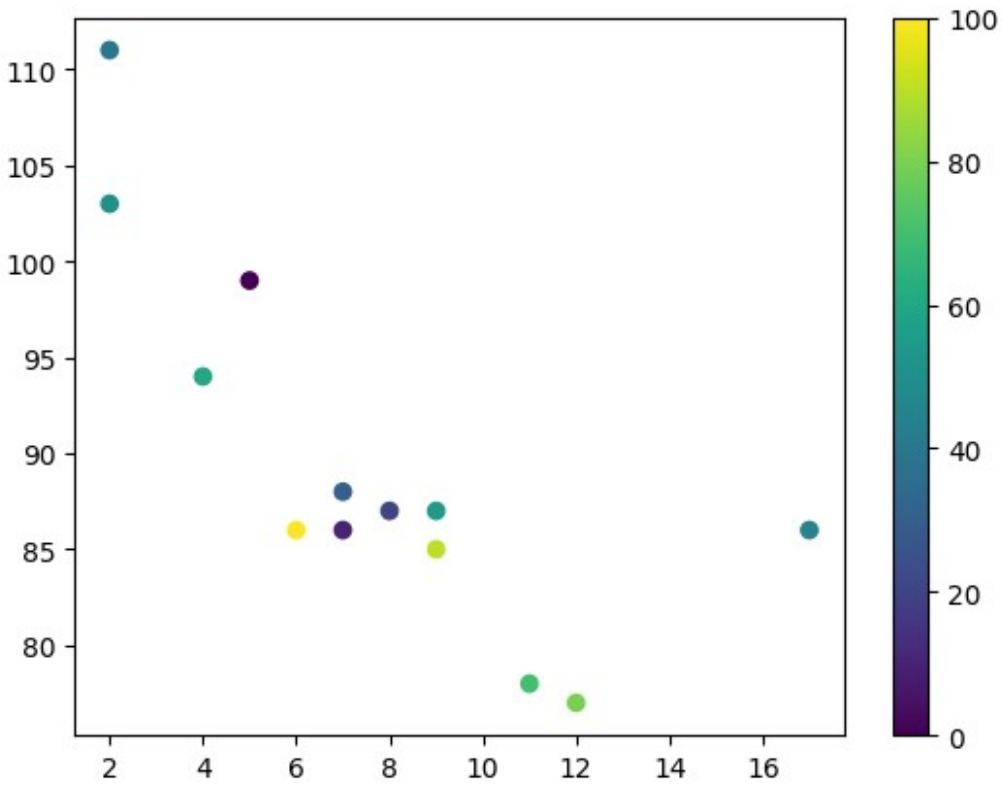
```
import matplotlib.pyplot as plt
import numpy as np

x = np.array([5,7,8,7,2,17,2,9,4,11,12,9,6])
y = np.array([99,86,87,88,111,86,103,87,94,78,77,85,86])
colors = np.array([0, 10, 20, 30, 40, 45, 50, 55, 60, 70, 80, 90,
100])

plt.scatter(x, y, c=colors, cmap='viridis')

plt.colorbar()

plt.show()
```



Available ColorMaps

You can choose any of the built-in colormaps:

Name	Reverse
Accent	Accent_r
Blues	Blues_r
BrBG	BrBG_r
BuGn	BuGn_r
BuPu	BuPu_r
CMRmap	CMRmap_r
Dark2	Dark2_r
GnBu	GnBu_r
Greens	Greens_r
Greys	Greys_r
OrRd	OrRd_r
Oranges	Oranges_r
PRGn	PRGn_r
Paired	Paired_r
Pastel1	Pastel1_r

Name	Reverse
Pastel2	Pastel2_r
PiYG	PiYG_r
PuBu	PuBu_r
PuBuGn	PuBuGn_r
PuOr	PuOr_r
PuRd	PuRd_r
Purples	Purples_r
RdBu	RdBu_r
RdGy	RdGy_r
RdPu	RdPu_r
RdYlBu	RdYlBu_r
RdYlGn	RdYlGn_r
Reds	Reds_r
Set1	Set1_r
Set2	Set2_r
Set3	Set3_r
Spectral	Spectral_r
Wistia	Wistia_r
YlGn	YlGn_r
YlGnBu	YlGnBu_r
YlOrBr	YlOrBr_r
YlOrRd	YlOrRd_r
afmhot	afmhot_r
autumn	autumn_r
binary	binary_r
bone	bone_r
brg	brg_r
bwr	bwr_r
cividis	cividis_r
cool	cool_r
coolwarm	coolwarm_r
copper	copper_r
cubehelix	cubehelix_r
flag	flag_r
gist_earth	gist_earth_r
gist_gray	gist_gray_r
gist_heat	gist_heat_r

Name	Reverse
gist_ncar	gist_ncar_r
gist_rainbow	gist_rainbow_r
gist_stern	gist_stern_r
gist_yarg	gist_yarg_r
gnuplot	gnuplot_r
gnuplot2	gnuplot2_r
gray	gray_r
hot	hot_r
hsv	hsv_r
inferno	inferno_r
jet	jet_r
magma	magma_r
nipy_spectral	nipy_spectral_r
ocean	ocean_r
pink	pink_r
plasma	plasma_r
prism	prism_r
rainbow	rainbow_r
seismic	seismic_r
spring	spring_r
summer	summer_r
tab10	tab10_r
tab20	tab20_r
tab20b	tab20b_r
tab20c	tab20c_r
terrain	terrain_r
twilight	twilight_r
twilight_shifted	twilight_shifted_r
viridis	viridis_r
winter	winter_r

Size

You can change the size of the dots with the `s` argument.

Just like colors, make sure the array for sizes has the same length as the arrays for the x- and y-axis:

Alpha

You can adjust the transparency of the dots with the `alpha` argument.

Just like colors, make sure the array for sizes has the same length as the arrays for the x- and y-axis:

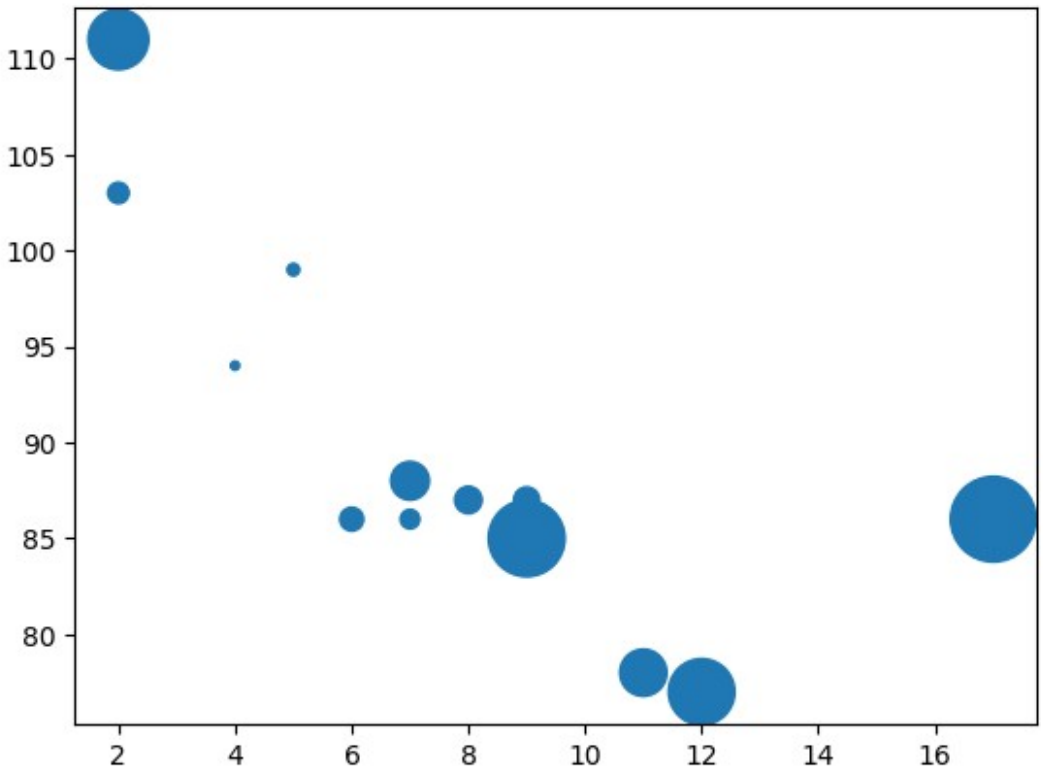
```
#Set your own size for the markers:

import matplotlib.pyplot as plt
import numpy as np

x = np.array([5,7,8,7,2,17,2,9,4,11,12,9,6])
y = np.array([99,86,87,88,111,86,103,87,94,78,77,85,86])
sizes = np.array([20,50,100,200,500,1000,60,90,10,300,600,800,75])

plt.scatter(x, y, s=sizes)

plt.show()
```



Combine Color Size and Alpha

You can combine a colormap with different sizes of the dots. This is best visualized if the dots are transparent:

```
#Create random arrays with 100 values for x-points, y-points, colors
and sizes:

import matplotlib.pyplot as plt
import numpy as np

x = np.random.randint(100, size=(100))
y = np.random.randint(100, size=(100))
colors = np.random.randint(100, size=(100))
sizes = 10 * np.random.randint(100, size=(100))

plt.scatter(x, y, c=colors, s=sizes, alpha=0.5, cmap='nipy_spectral')

plt.colorbar()

plt.show()
```