different_marker_sizes_and_colours

February 6, 2025

1 Scatterplot with Different Marker Sizes and Colours

In this example we demonstrate how to modify the size of the points in a Scatterplot. This is useful when we want the size to represent something, e.g., the weight of a parcel in kilograms.

[1]:
```
import matplotlib.pyplot as plt
from random import random
```

For this example our data will just be randomly generated points. Here we define a function to return a list of randomly generated numbers.

[2]:
```
def random_values(count=50):
    """
    Returns a list of random numbers between 0 (inclusive) and 1 (exclusive).
    By default, the function returns a list of 50 numbers.
    """
    return [random() for _ in range(count)]
```

We'll store our data in a Pandas DataFrame

[3]:
```
import pandas as pd
```

[4]:
```
df = pd.DataFrame()
```

We can go ahead and use our function to generate our points.

[5]:
```
df['X'] = random_values()
df['Y'] = random_values()
```

[6]:
```
df.head()
```

[6]:

	X	Y
0	0.843513	0.684042
1	0.602221	0.972866
2	0.041865	0.097165
3	0.945940	0.701573
4	0.314311	0.631125

Here we now create another Series of randomly generated numbers to represent different colours.

[7]:
```
df['Colour'] = random_values()
```

[8]:
```
df.head()
```

[8]:

	X	Y	Colour
0	0.843513	0.684042	0.061531
1	0.602221	0.972866	0.583542
2	0.041865	0.097165	0.767407
3	0.945940	0.701573	0.565111
4	0.314311	0.631125	0.301624

And here we create yet another Series of random numbers, this time scaled by a constant value. These will determine the size of the points we're going to plot.

[9]:
```
SCALING_FACTOR = 1000

df['Size'] = [random_number * SCALING_FACTOR for random_number in␣
 ↪random_values()]
```

Before we visualize the data, let's just look at the DataFrame to get an idea of what we've got.

[10]:
```
df.head()
```

[10]:

	X	Y	Colour	Size
0	0.843513	0.684042	0.061531	446.127221
1	0.602221	0.972866	0.583542	911.252646
2	0.041865	0.097165	0.767407	258.588413
3	0.945940	0.701573	0.565111	943.477585
4	0.314311	0.631125	0.301624	253.047974

1.1 Visualize the Data

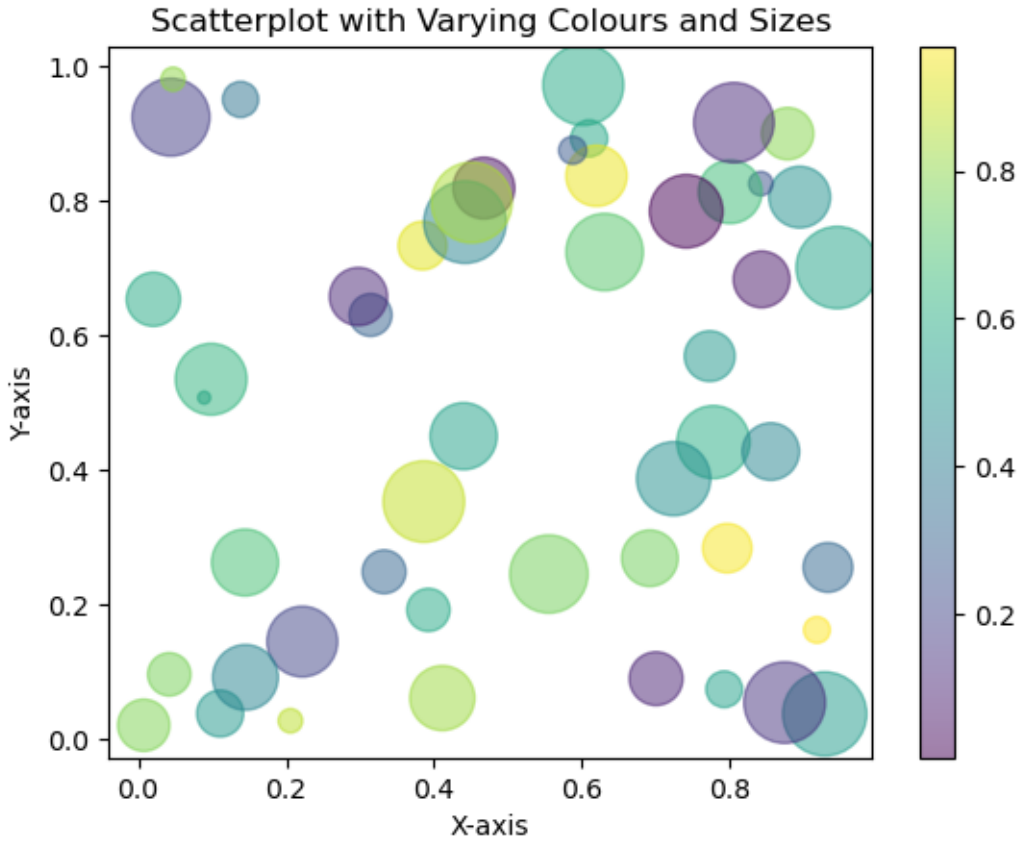
[11]:
```
# Scatter plot with varying colors and sizes
plt.scatter(x=df['X'],
            y=df['Y'],
            c=df['Colour'],
            s=df['Size'],
            alpha=0.5,
            # Built-in colormap e.g. 'viridis', 'plasma', 'coolwarm',␣
 ↪'inferno', 'rainbow', 'magma', 'cividis', 'twilight'
            cmap='viridis'
            )

plt.colorbar()  # Show colour scale (note the color spelling in colorbar -␣
 ↪Matplotlib uses American English)

plt.title("Scatterplot with Varying Colours and Sizes")
plt.xlabel("X-axis")
```

```
plt.ylabel("Y-axis")

plt.show()
```



1.2 Colours with Categorical Data

Here we add another new column called ItemID. This will just hold random integers to represent some kind of ID.

[12]:
```
from random import randint
df['ItemID'] = [randint(0, 3) for _ in range(len(df))]
```

Let's check that it's there.

[13]:
```
df.sample(15)
```

[13]:

	X	Y	Colour	Size	ItemID
23	0.773316	0.569960	0.514660	357.350471	3
43	0.144323	0.263358	0.677246	621.808630	1
28	0.778265	0.442275	0.599465	743.150042	2
2	0.041865	0.097165	0.767407	258.588413	0

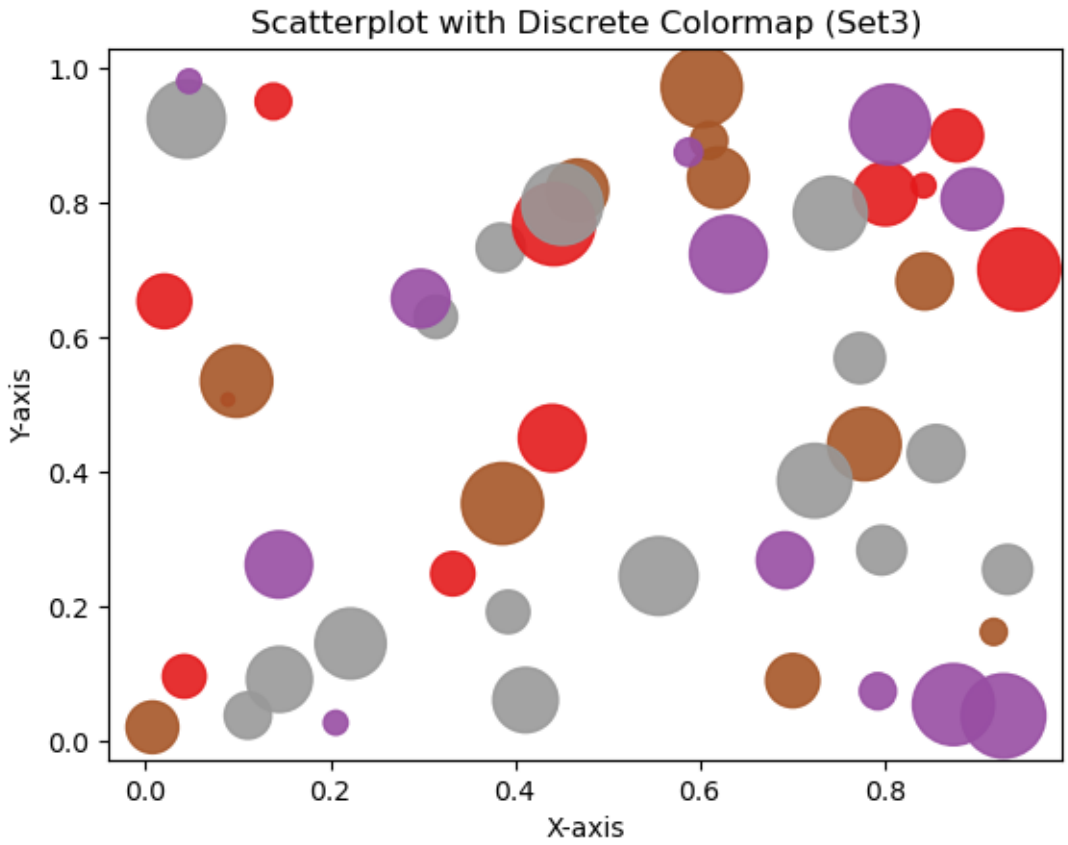
```
14  0.044124  0.924997  0.175807  842.884485       3
25  0.007278  0.021560  0.777626  377.059123       2
15  0.610074  0.893365  0.573481  189.883290       2
7   0.110727  0.038959  0.511453  304.107045       3
1   0.602221  0.972866  0.583542  911.252646       2
13  0.928958  0.038403  0.530104  984.876273       1
37  0.098537  0.535607  0.629463  715.302616       2
31  0.555600  0.246199  0.760941  852.547699       3
30  0.587785  0.875830  0.267799  107.197976       1
46  0.451182  0.798248  0.845532  911.045669       3
3   0.945940  0.701573  0.565111  943.477585       0
```

1.2.1 Scatter plot for categorical data with discrete colormap

Here we use a discrete colormap - there should only be as many colours as there are unique values of ItemID.

[14]:
```
plt.scatter(
    x=df['X'],
    y=df['Y'],
    c=df['ItemID'],
    s=df['Size'],
    alpha=0.9,
    cmap='Set1'  # A discrete colormap from Matplotlib
)

plt.title("Scatterplot with Discrete Colormap (Set3)")
plt.xlabel("X-axis")
plt.ylabel("Y-axis")
plt.show()
```



1.2.2 Custom colour map (Colormap)

We might prefer to use our own colour palette.

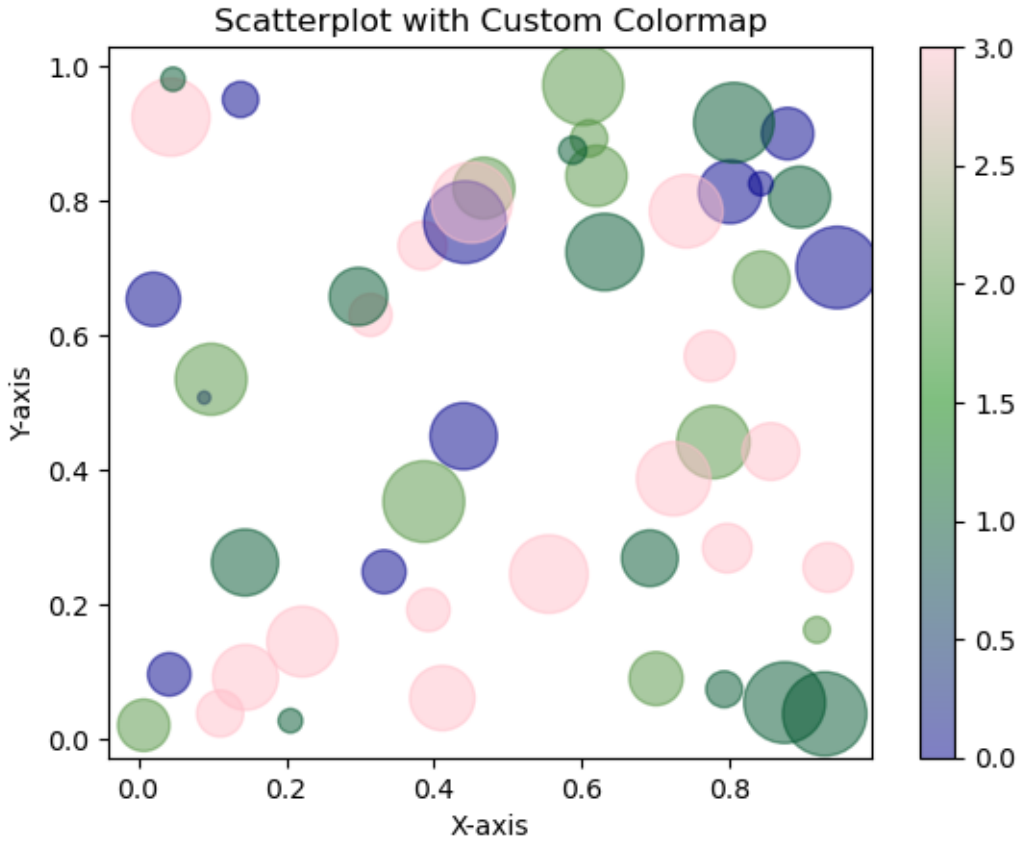
[15]:
```
import matplotlib.colors as mcolors

# Define a custom color list
my_colours = ["darkblue", "green", "pink"]

# Create a custom colormap
my_cmap = mcolors.LinearSegmentedColormap.from_list("my_cmap", my_colours)

plt.scatter(
    x=df['X'],
    y=df['Y'],
    c=df['ItemID'],
    s=df['Size'],
    alpha=0.5,
    cmap=my_cmap  # Use the custom colormap
)
```

```
plt.colorbar()
plt.title("Scatterplot with Custom Colormap")
plt.xlabel("X-axis")
plt.ylabel("Y-axis")
plt.show()
```



1.2.3 Category to colour mapping

We might also want to map specific colours to particular categories. We will create a new Fruit column and associate different types of fruit with different colours.

[16]:
```
from random import choice

# Oops, we've added DVD Players and Energy Drinks into the Fruit column.
# Not to worry, we'll handle for unexpected values.
df['Fruit'] = [choice(['Apple', 'Banana', 'Cherry', 'DVD Player', 'Energy␣
 ↪Drink']) for _ in range(len(df))]

df.sample(10)
```

[16]:

	X	Y	Colour	Size	ItemID	Fruit
4	0.314311	0.631125	0.301624	253.047974	3	Energy Drink
11	0.801012	0.814109	0.660972	563.777420	0	Cherry
20	0.741484	0.785253	0.005236	750.482217	3	Apple
49	0.332601	0.249565	0.314137	265.664684	0	DVD Player
32	0.386349	0.353899	0.878583	925.834482	2	Cherry
23	0.773316	0.569960	0.514660	357.350471	3	Energy Drink
48	0.855957	0.428236	0.445100	458.636307	3	Energy Drink
10	0.440214	0.451041	0.555924	626.243858	0	Apple
13	0.928958	0.038403	0.530104	984.876273	1	Cherry
8	0.842496	0.826245	0.242798	80.940412	0	Cherry

[17]:
```
import matplotlib.patches as mpatches

# Dictionary mapping categories to specific colors
fruit_category_colours = {
    'Apple': 'green',
    'Banana': 'gold',
    'Cherry': 'red'
}

# Map df['Colour'] (categories) to actual colour codes
# Any category not in 'category_colours' becomes 'grey'
# This will apply to our DVD Players and Energy Drinks
colour_values = df['Fruit'].map(fruit_category_colours).fillna('grey')

plt.scatter(
    x=df['X'],
    y=df['Y'],
    c=colour_values,
    s=df['Size'],
    alpha=0.5
)

plt.title("Scatterplot with Manual Category-to-Colour Mapping")
plt.xlabel("X-axis")
plt.ylabel("Y-axis")

# Construct custom legend entries for each fruit in the dictionary
# plus a 'Not Fruit' patch for any unmapped category.
legend_entries = []
for fruit_name, color in fruit_category_colours.items():
    legend_entries.append(mpatches.Patch(color=color, label=fruit_name))

# Add an entry for 'Not Fruit' (grey)
legend_entries.append(mpatches.Patch(color='grey', label='Not Fruit'))
```

```
# Display the custom legend
plt.legend(handles=legend_entries,
           title="Fruit Categories",
           bbox_to_anchor=(1, 1))  # move the legend outside the main plot area

plt.show()
```