

Week3

October 12, 2020

1 Subplots

```
In [4]: %matplotlib notebook
```

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

```
plt.subplot?
```

```
In [5]: plt.figure()
        # subplot with 1 row, 2 columns, and current axis is 1st subplot axes
        plt.subplot(1, 2, 1)
```

```
linear_data = np.array([1,2,3,4,5,6,7,8])
```

```
plt.plot(linear_data, '-o')
```

```
<IPython.core.display.Javascript object>
```

```
<IPython.core.display.HTML object>
```

```
Out[5]: [<matplotlib.lines.Line2D at 0x7fc0afa4f2b0>]
```

```
In [6]: exponential_data = linear_data**2
```

```
# subplot with 1 row, 2 columns, and current axis is 2nd subplot axes
plt.subplot(1, 2, 2)
plt.plot(exponential_data, '-o')
```

```
Out[6]: [<matplotlib.lines.Line2D at 0x7fc0afa4f438>]
```

```
In [7]: # plot exponential data on 1st subplot axes
        plt.subplot(1, 2, 1)
        plt.plot(exponential_data, '-x')
```

```
Out[7]: [<matplotlib.lines.Line2D at 0x7fc0afabeb70>]
```

```
In [8]: plt.figure()
        ax1 = plt.subplot(1, 2, 1)
        plt.plot(linear_data, '-o')
        # pass sharey=ax1 to ensure the two subplots share the same y axis
        ax2 = plt.subplot(1, 2, 2, sharey=ax1)
        plt.plot(exponential_data, '-x')
```

<IPython.core.display.Javascript object>

<IPython.core.display.HTML object>

```
Out[8]: [<matplotlib.lines.Line2D at 0x7fc104dd8400>]
```

```
In [9]: plt.figure()
        # the right hand side is equivalent shorthand syntax
        plt.subplot(1,2,1) == plt.subplot(121)
```

<IPython.core.display.Javascript object>

<IPython.core.display.HTML object>

```
Out[9]: True
```

```
In [10]: # create a 3x3 grid of subplots
         fig, ((ax1,ax2,ax3), (ax4,ax5,ax6), (ax7,ax8,ax9)) = plt.subplots(3, 3, sh
         # plot the linear_data on the 5th subplot axes
         ax5.plot(linear_data, '-')
```

<IPython.core.display.Javascript object>

<IPython.core.display.HTML object>

```
Out[10]: [<matplotlib.lines.Line2D at 0x7fc104cb1c18>]
```

```
In [11]: # set inside tick labels to visible
         for ax in plt.gcf().get_axes():
             for label in ax.get_xticklabels() + ax.get_yticklabels():
                 label.set_visible(True)
```

```
In [12]: # necessary on some systems to update the plot
         plt.gcf().canvas.draw()
```

2 Histograms

```
In [13]: # create 2x2 grid of axis subplots
fig, ((ax1, ax2), (ax3, ax4)) = plt.subplots(2, 2, sharex=True)
axs = [ax1, ax2, ax3, ax4]

# draw n = 10, 100, 1000, and 10000 samples from the normal distribution
for n in range(0, len(axs)):
    sample_size = 10**(n+1)
    sample = np.random.normal(loc=0.0, scale=1.0, size=sample_size)
    axs[n].hist(sample)
    axs[n].set_title('n={}'.format(sample_size))
```

<IPython.core.display.Javascript object>

<IPython.core.display.HTML object>

```
In [14]: # repeat with number of bins set to 100
fig, ((ax1, ax2), (ax3, ax4)) = plt.subplots(2, 2, sharex=True)
axs = [ax1, ax2, ax3, ax4]

for n in range(0, len(axs)):
    sample_size = 10**(n+1)
    sample = np.random.normal(loc=0.0, scale=1.0, size=sample_size)
    axs[n].hist(sample, bins=100)
    axs[n].set_title('n={}'.format(sample_size))
```

<IPython.core.display.Javascript object>

<IPython.core.display.HTML object>

```
In [ ]: plt.figure()
Y = np.random.normal(loc=0.0, scale=1.0, size=10000)
X = np.random.random(size=10000)
plt.scatter(X, Y)
```

<IPython.core.display.Javascript object>

<IPython.core.display.HTML object>

```
Out[ ]: <matplotlib.collections.PathCollection at 0x7fc0ac786cc0>
```

```
In [ ]: # use gridspec to partition the figure into subplots
import matplotlib.gridspec as gridspec
```

```
plt.figure()
gspec = gridspec.GridSpec(3, 3)

top_histogram = plt.subplot(gspec[0, 1:])
side_histogram = plt.subplot(gspec[1:, 0])
lower_right = plt.subplot(gspec[1:, 1:])
```

<IPython.core.display.Javascript object>

<IPython.core.display.HTML object>

```
In [ ]: Y = np.random.normal(loc=0.0, scale=1.0, size=10000)
X = np.random.random(size=10000)
lower_right.scatter(X, Y)
top_histogram.hist(X, bins=100)
s = side_histogram.hist(Y, bins=100, orientation='horizontal')
```

```
In [ ]: # clear the histograms and plot normed histograms
top_histogram.clear()
top_histogram.hist(X, bins=100, normed=True)
side_histogram.clear()
side_histogram.hist(Y, bins=100, orientation='horizontal', normed=True)
# flip the side histogram's x axis
side_histogram.invert_xaxis()
```

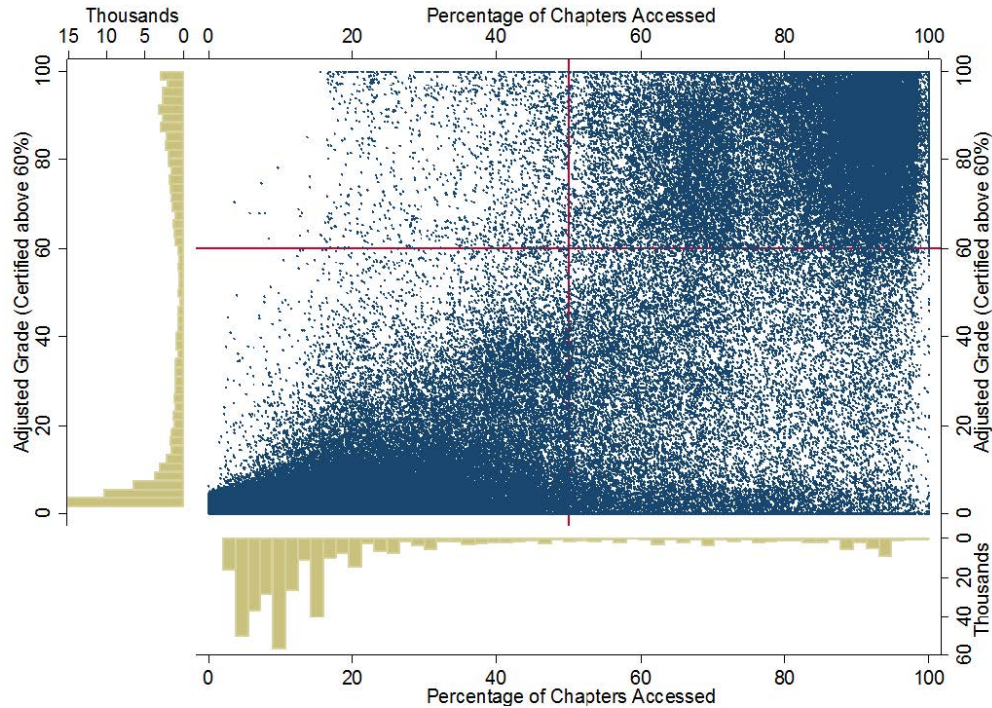
```
In [ ]: # change axes limits
for ax in [top_histogram, lower_right]:
    ax.set_xlim(0, 1)
for ax in [side_histogram, lower_right]:
    ax.set_ylim(-5, 5)
```

3 Box and Whisker Plots

```
In [ ]: import pandas as pd
normal_sample = np.random.normal(loc=0.0, scale=1.0, size=10000)
random_sample = np.random.random(size=10000)
gamma_sample = np.random.gamma(2, size=10000)
```

```
df = pd.DataFrame({'normal': normal_sample,
                  'random': random_sample,
                  'gamma': gamma_sample})
```

```
In [ ]: df.describe()
```



MOOC DATA

```
In [ ]: plt.figure()
        # create a boxplot of the normal data, assign the output to a variable to s
        _ = plt.boxplot(df['normal'], whis='range')

In [ ]: # clear the current figure
        plt.clf()
        # plot boxplots for all three of df's columns
        _ = plt.boxplot([ df['normal'], df['random'], df['gamma'] ], whis='range')

In [ ]: plt.figure()
        _ = plt.hist(df['gamma'], bins=100)

In [ ]: import mpl_toolkits.axes_grid1.inset_locator as mpl_il

        plt.figure()
        plt.boxplot([ df['normal'], df['random'], df['gamma'] ], whis='range')
        # overlay axis on top of another
        ax2 = mpl_il.inset_axes(plt.gca(), width='60%', height='40%', loc=2)
        ax2.hist(df['gamma'], bins=100)
        ax2.margins(x=0.5)

In [ ]: # switch the y axis ticks for ax2 to the right side
        ax2.yaxis.tick_right()

In [ ]: # if `whis` argument isn't passed, boxplot defaults to showing 1.5*interqua
        plt.figure()
        _ = plt.boxplot([ df['normal'], df['random'], df['gamma'] ] )
```

4 Heatmaps

```
In [ ]: plt.figure()

        Y = np.random.normal(loc=0.0, scale=1.0, size=10000)
        X = np.random.random(size=10000)
        _ = plt.hist2d(X, Y, bins=25)

In [ ]: plt.figure()
        _ = plt.hist2d(X, Y, bins=100)

In [ ]: # add a colorbar legend
        plt.colorbar()
```

5 Animations

```
In [ ]: import matplotlib.animation as animation

        n = 100
        x = np.random.randn(n)

In [ ]: # create the function that will do the plotting, where curr is the current
        def update(curr):
            # check if animation is at the last frame, and if so, stop the animation
            if curr == n:
                a.event_source.stop()
            plt.cla()
            bins = np.arange(-4, 4, 0.5)
            plt.hist(x[:curr], bins=bins)
            plt.axis([-4, 4, 0, 30])
            plt.gca().set_title('Sampling the Normal Distribution')
            plt.gca().set_ylabel('Frequency')
            plt.gca().set_xlabel('Value')
            plt.annotate('n = {}'.format(curr), [3, 27])

In [ ]: fig = plt.figure()
        a = animation.FuncAnimation(fig, update, interval=100)
```

6 Interactivity

```
In [ ]: plt.figure()
        data = np.random.rand(10)
        plt.plot(data)

        def onclick(event):
            plt.cla()
            plt.plot(data)
            plt.gca().set_title('Event at pixels {},{} \nand data {},{}'.format(event.x, event.y, data[event.x], data[event.y]))
```

```

# tell mpl_connect we want to pass a 'button_press_event' into onclick when
plt.gcf().canvas.mpl_connect('button_press_event', onclick)

In [ ]: from random import shuffle
origins = ['China', 'Brazil', 'India', 'USA', 'Canada', 'UK', 'Germany', 'J']

shuffle(origins)

df = pd.DataFrame({'height': np.random.rand(10),
                   'weight': np.random.rand(10),
                   'origin': origins})

df

In [ ]: plt.figure()
# picker=5 means the mouse doesn't have to click directly on an event, but
plt.scatter(df['height'], df['weight'], picker=5)
plt.gca().set_ylabel('Weight')
plt.gca().set_xlabel('Height')

In [ ]: def onpick(event):
    origin = df.iloc[event.ind[0]]['origin']
    plt.gca().set_title('Selected item came from {}'.format(origin))

# tell mpl_connect we want to pass a 'pick_event' into onpick when the event
plt.gcf().canvas.mpl_connect('pick_event', onpick)

```