Week3

March 25, 2021

1 Subplots

In [ ]:
```
%matplotlib notebook

import matplotlib.pyplot as plt
import numpy as np

plt.subplot?
```

In [1]:
```
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')
```

```
---------------------------------------------------------------------------

NameError                                 Traceback (most recent call last)

<ipython-input-1-9a0847f17640> in <module>()
----> 1 plt.figure()
      2 # subplot with 1 row, 2 columns, and current axis is 1st subplot axes
      3 plt.subplot(1, 2, 1)
      4
      5 linear_data = np.array([1,2,3,4,5,6,7,8])


NameError: name 'plt' is not defined
```

In [ ]:
```
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')
```

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

```
In [ ]: 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')
```

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

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

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

2 Histograms

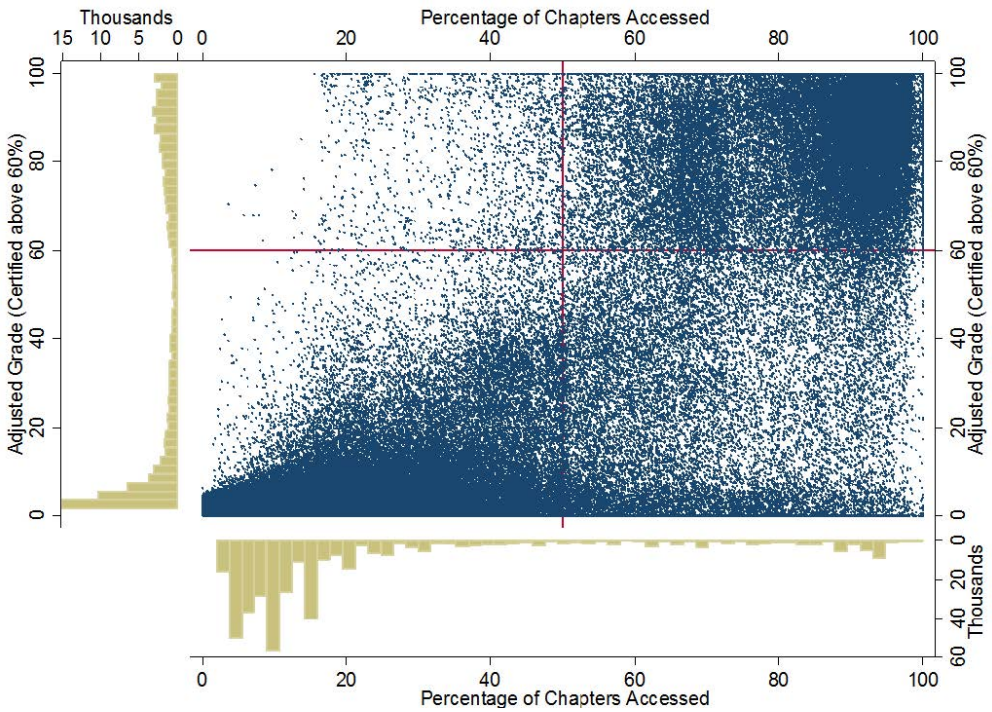
```
In [ ]: # create 2x2 grid of axis subplots
        fig, ((ax1, ax2), (ax3, ax4)) = plt.subplots(2, 2, sharex=True)
        axs = [ax1,ax2,ax3,ax4]

        # draw n = 10, 100, 1000, and 10000 samples from the normal distribution ar
        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))
```

```
In [ ]: # 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))
```

```
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)

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:])

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 animatio
            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(eve
```

```
        # 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', 'I

        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 even
        plt.gcf().canvas.mpl_connect('pick_event', onpick)
```