WISER CLUB Python 系列

matplotlib基本绘图示例

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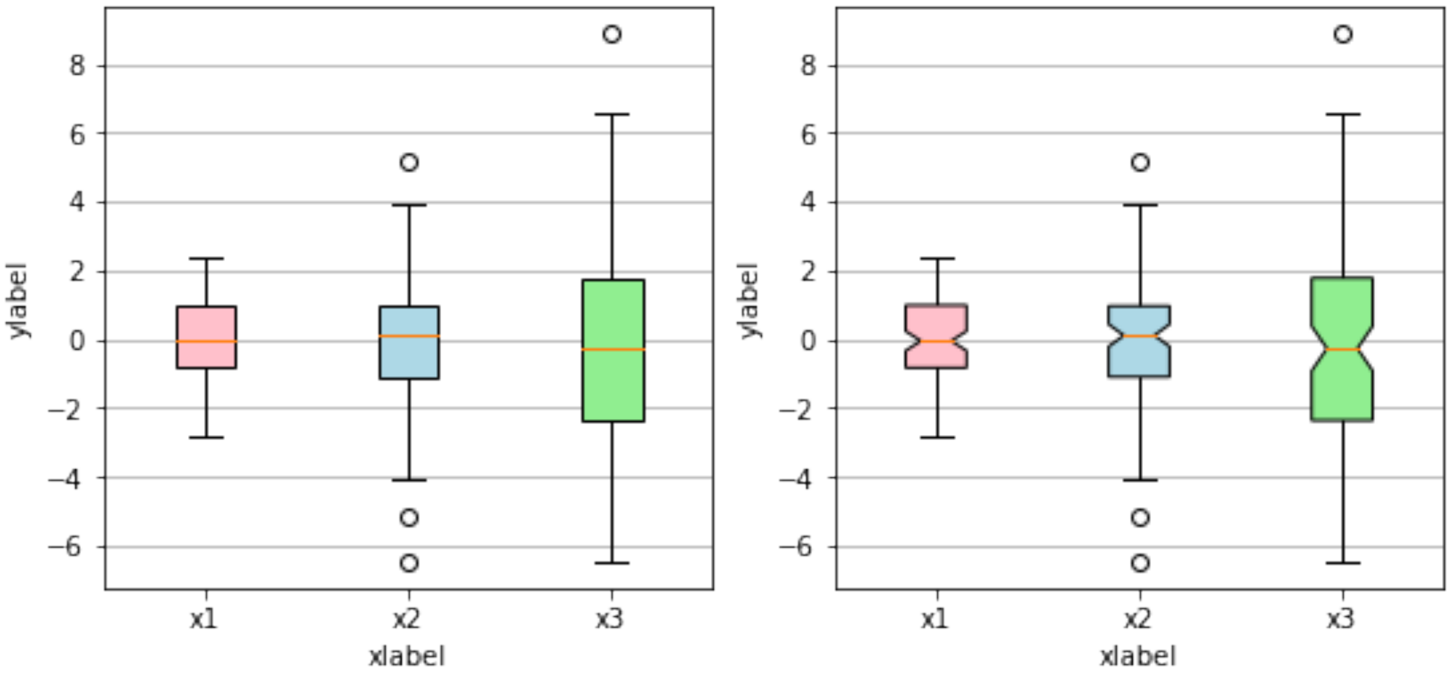
In [4]:

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

boxplot 示例

In [5]:

```
np.random.seed(123)
all_data = [np.random.normal(0, std, 100) for std in range(1, 4)]

fig, axes = plt.subplots(nrows=1, ncols=2, figsize=(9, 4))

# rectangular box plot
bplot1 = axes[0].boxplot(all_data,
                         vert=True,   # vertical box alignment
                         patch_artist=True)   # fill with color

# notch shape box plot
bplot2 = axes[1].boxplot(all_data,
                         notch=True,  # notch shape
                         vert=True,   # vertical box alignment
                         patch_artist=True)   # fill with color

# fill with colors
colors = ['pink', 'lightblue', 'lightgreen']
for bplot in (bplot1, bplot2):
    for patch, color in zip(bplot['boxes'], colors):
        patch.set_facecolor(color)

# adding horizontal grid lines
for ax in axes:
    ax.yaxis.grid(True)
    ax.set_xticks([y+1 for y in range(len(all_data))], )
    ax.set_xlabel('xlabel')
    ax.set_ylabel('ylabel')

# add x-tick labels
plt.setp(axes, xticks=[y+1 for y in range(len(all_data))],
         xticklabels=['x1', 'x2', 'x3', 'x4'])

plt.show()
```

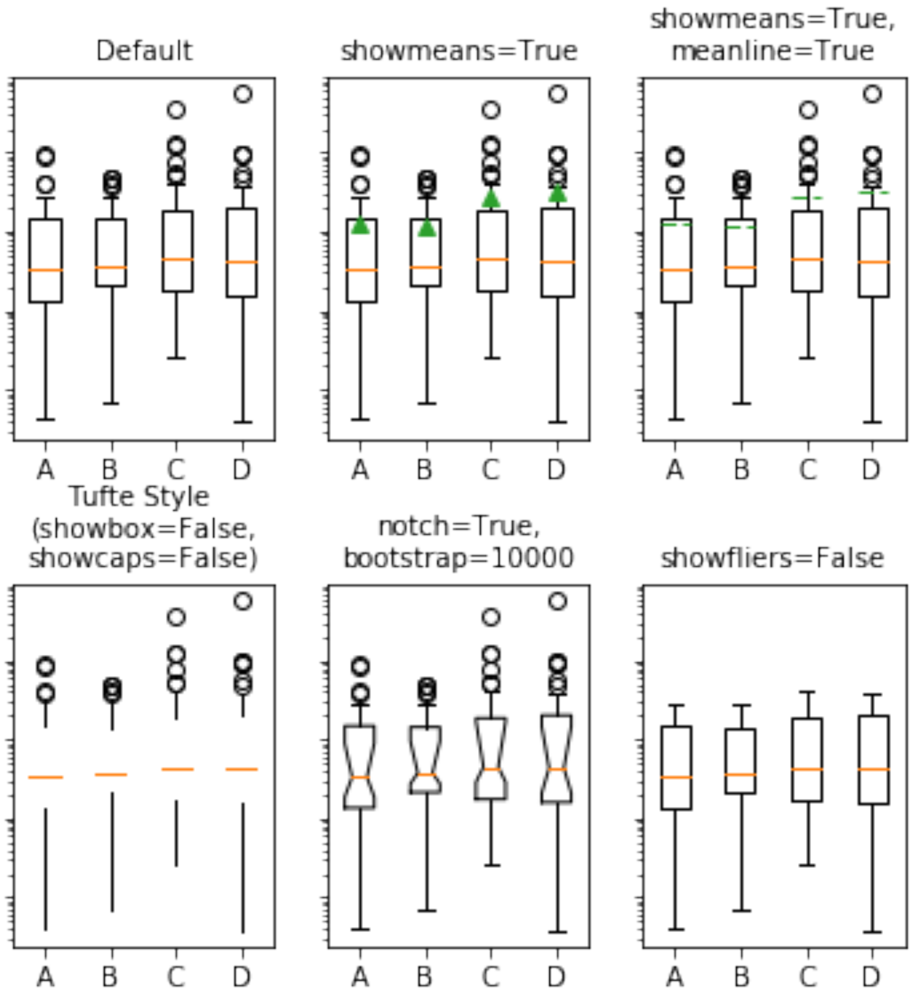


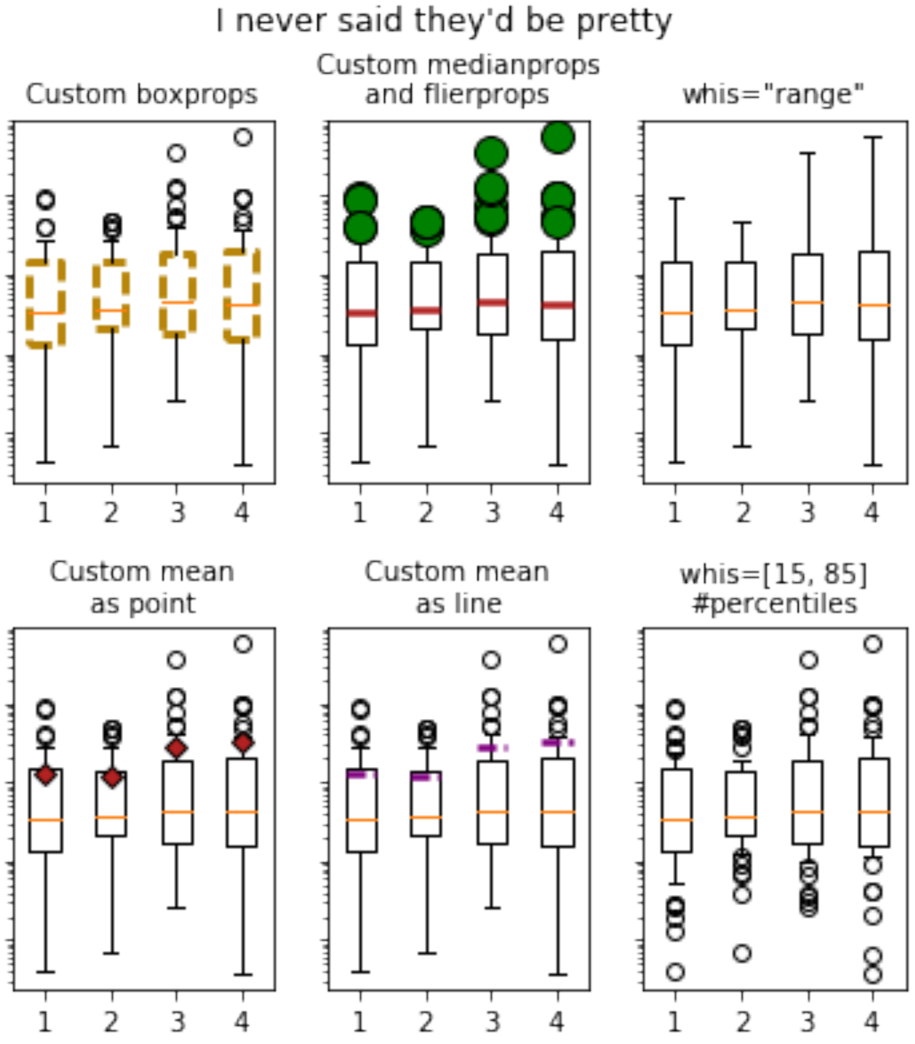
boxplot 示例

In [9]:

```
np.random.seed(937)
data = np.random.lognormal(size=(37, 4), mean=1.5, sigma=1.75)
labels = list('ABCD')
fs = 10  # fontsize

# demonstrate how to toggle the display of different elements:
fig, axes = plt.subplots(nrows=2, ncols=3, figsize=(6, 6), sharey=True)
axes[0, 0].boxplot(data, labels=labels)
axes[0, 0].set_title('Default', fontsize=fs)

axes[0, 1].boxplot(data, labels=labels, showmeans=True)
axes[0, 1].set_title('showmeans=True', fontsize=fs)

axes[0, 2].boxplot(data, labels=labels, showmeans=True, meanline=True)
axes[0, 2].set_title('showmeans=True,\nmeanline=True', fontsize=fs)

axes[1, 0].boxplot(data, labels=labels, showbox=False, showcaps=False)
tufte_title = 'Tufte Style \n(showbox=False,\nshowcaps=False)'
axes[1, 0].set_title(tufte_title, fontsize=fs)

axes[1, 1].boxplot(data, labels=labels, notch=True, bootstrap=10000)
axes[1, 1].set_title('notch=True,\nbootstrap=10000', fontsize=fs)

axes[1, 2].boxplot(data, labels=labels, showfliers=False)
axes[1, 2].set_title('showfliers=False', fontsize=fs)

for ax in axes.flatten():
    ax.set_yscale('log')
    ax.set_yticklabels([])

fig.subplots_adjust(hspace=0.4)
plt.show()


# demonstrate how to customize the display different elements:
boxprops = dict(linestyle='--', linewidth=3, color='darkgoldenrod')
flierprops = dict(marker='o', markerfacecolor='green', markersize=12,
                  linestyle='none')
medianprops = dict(linestyle='-.', linewidth=2.5, color='firebrick')
meanpointprops = dict(marker='D', markeredgecolor='black',
                      markerfacecolor='firebrick')
meanlineprops = dict(linestyle='--', linewidth=2.5, color='purple')

fig, axes = plt.subplots(nrows=2, ncols=3, figsize=(6, 6), sharey=True)
axes[0, 0].boxplot(data, boxprops=boxprops)
axes[0, 0].set_title('Custom boxprops', fontsize=fs)

axes[0, 1].boxplot(data, flierprops=flierprops, medianprops=medianprops)
axes[0, 1].set_title('Custom medianprops\nand flierprops', fontsize=fs)

axes[0, 2].boxplot(data, whis='range')
axes[0, 2].set_title('whis="range"', fontsize=fs)

axes[1, 0].boxplot(data, meanprops=meanpointprops, meanline=False,
                   showmeans=True)
axes[1, 0].set_title('Custom mean\nas point', fontsize=fs)
```

```
axes[1, 0].set_title('Custom mean\nas point', fontsize=fs)

axes[1, 1].boxplot(data, meanprops=meanlineprops, meanline=True,
                   showmeans=True)
axes[1, 1].set_title('Custom mean\nas line', fontsize=fs)

axes[1, 2].boxplot(data, whis=[15, 85])
axes[1, 2].set_title('whis=[15, 85]\n#percentiles', fontsize=fs)

for ax in axes.flatten():
    ax.set_yscale('log')
    ax.set_yticklabels([])

fig.suptitle("I never said they'd be pretty")
fig.subplots_adjust(hspace=0.4)
plt.show()
```

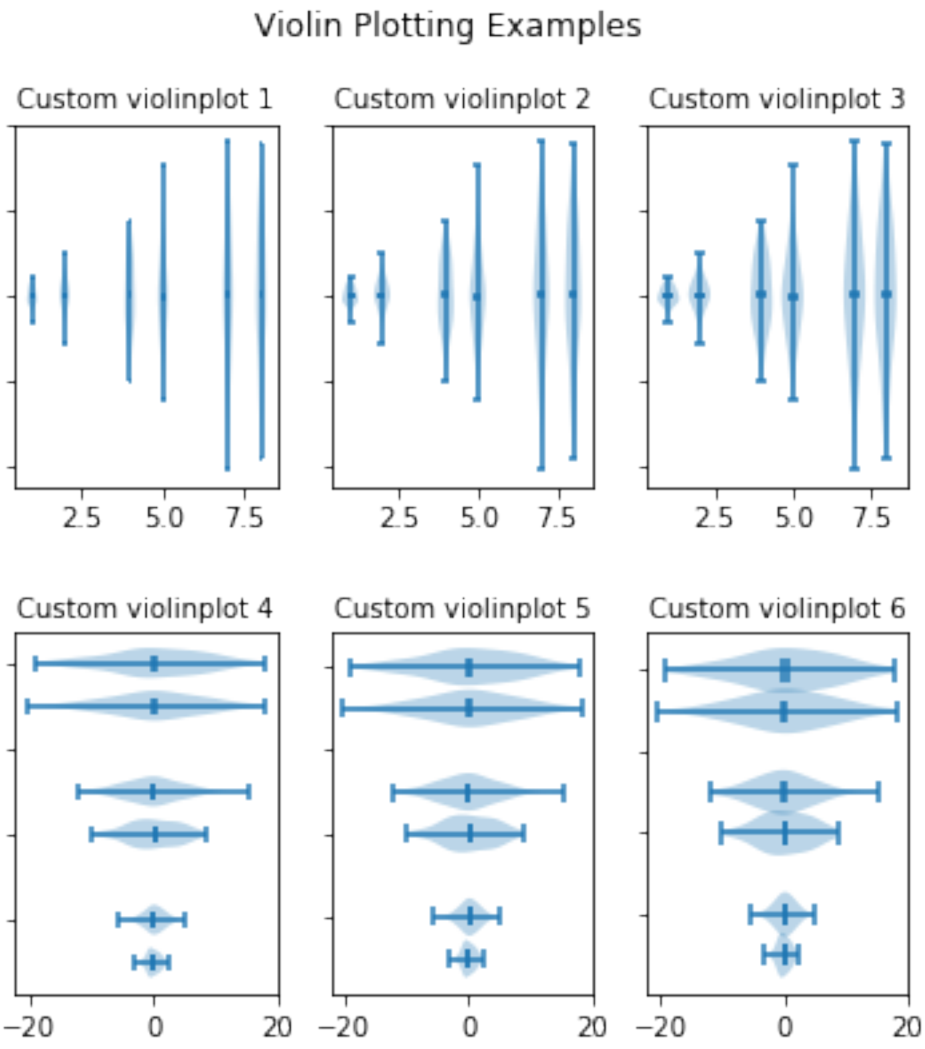




violionplot 实例

In [10]:

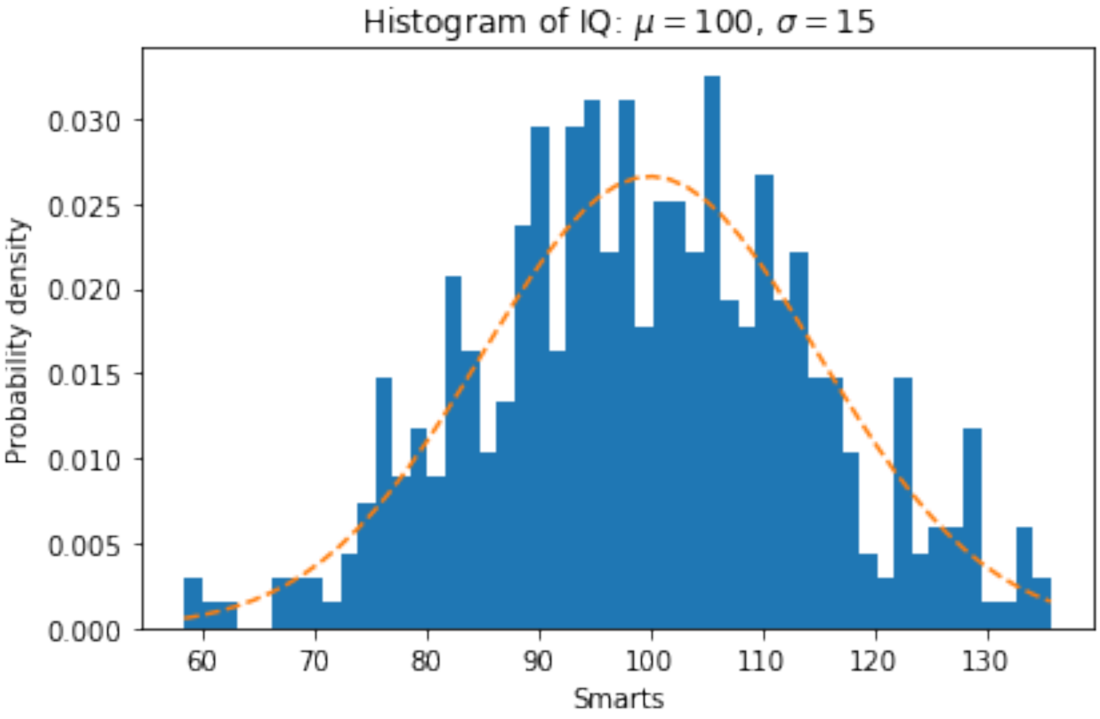
```
import random
import numpy as np
import matplotlib.pyplot as plt

# fake data
fs = 10  # fontsize
pos = [1, 2, 4, 5, 7, 8]
data = [np.random.normal(0, std, size=100) for std in pos]

fig, axes = plt.subplots(nrows=2, ncols=3, figsize=(6, 6))

axes[0, 0].violinplot(data, pos, points=20, widths=0.3,
                      showmeans=True, showextrema=True, showmedians=True)
axes[0, 0].set_title('Custom violinplot 1', fontsize=fs)

axes[0, 1].violinplot(data, pos, points=40, widths=0.5,
                      showmeans=True, showextrema=True, showmedians=True,
                      bw_method='silverman')
axes[0, 1].set_title('Custom violinplot 2', fontsize=fs)

axes[0, 2].violinplot(data, pos, points=60, widths=0.7, showmeans=True,
                      showextrema=True, showmedians=True, bw_method=0.5)
axes[0, 2].set_title('Custom violinplot 3', fontsize=fs)

axes[1, 0].violinplot(data, pos, points=80, vert=False, widths=0.7,
                      showmeans=True, showextrema=True, showmedians=True)
axes[1, 0].set_title('Custom violinplot 4', fontsize=fs)

axes[1, 1].violinplot(data, pos, points=100, vert=False, widths=0.9,
                      showmeans=True, showextrema=True, showmedians=True,
                      bw_method='silverman')
axes[1, 1].set_title('Custom violinplot 5', fontsize=fs)

axes[1, 2].violinplot(data, pos, points=200, vert=False, widths=1.1,
                      showmeans=True, showextrema=True, showmedians=True,
                      bw_method=0.5)
axes[1, 2].set_title('Custom violinplot 6', fontsize=fs)

for ax in axes.flatten():
    ax.set_yticklabels([])

fig.suptitle("Violin Plotting Examples")
fig.subplots_adjust(hspace=0.4)
plt.show()
```


Violin Plotting Examples
Custom violinplot 1
Custom violinplot 2
Custom violinplot 3
2.5
5.0
7.5
Custom violinplot 4
Custom violinplot 5
Custom violinplot 6
−20
0
20

hist实例

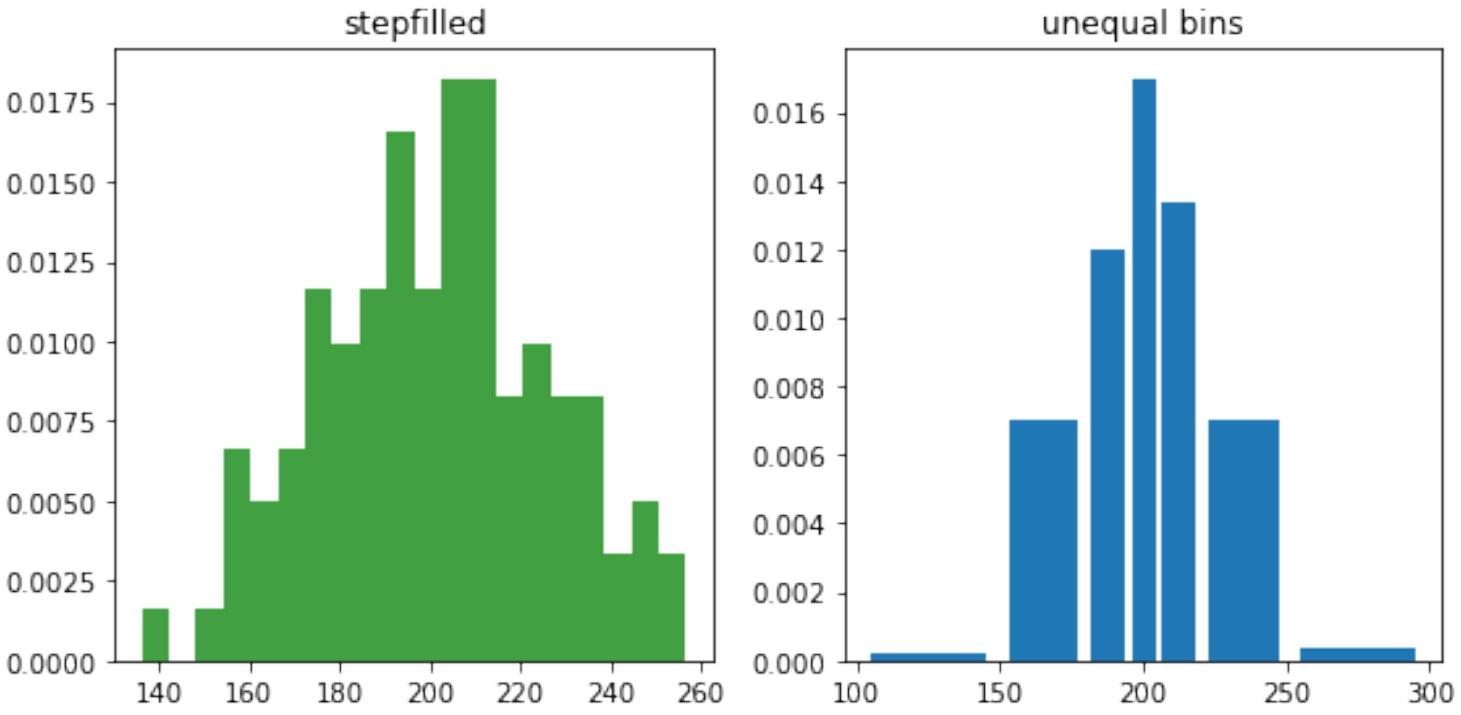
In [6]:

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

np.random.seed(0)

# example data
mu = 100  # mean of distribution
sigma = 15  # standard deviation of distribution
x = mu + sigma * np.random.randn(437)

num_bins = 50

fig, ax = plt.subplots()

# the histogram of the data
n, bins, patches = ax.hist(x, num_bins, normed=1)

# add a 'best fit' line
y = mlab.normpdf(bins, mu, sigma)
ax.plot(bins, y, '--')
ax.set_xlabel('Smarts')
ax.set_ylabel('Probability density')
ax.set_title(r'Histogram of IQ: $\mu=100$, $\sigma=15$')

# Tweak spacing to prevent clipping of ylabel
fig.tight_layout()
plt.show()
```



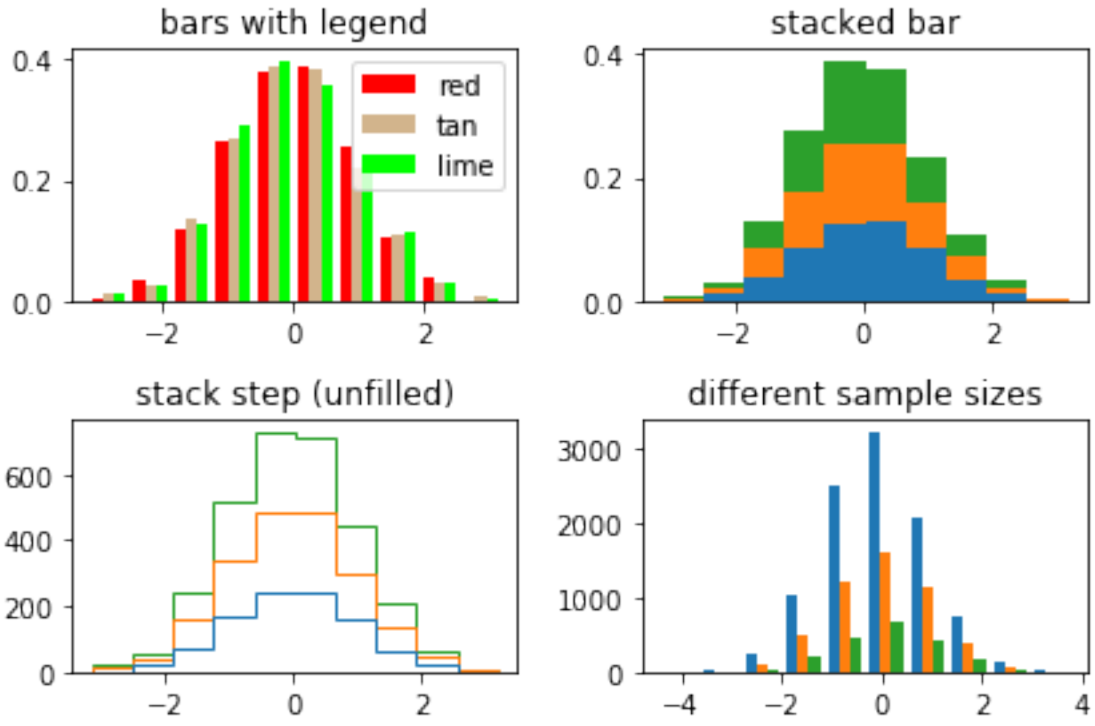
In [7]:

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

np.random.seed(0)

mu = 200
sigma = 25
x = np.random.normal(mu, sigma, size=100)

fig, (ax0, ax1) = plt.subplots(ncols=2, figsize=(8, 4))

ax0.hist(x, 20, normed=1, histtype='stepfilled', facecolor='g', alpha=0.75)
ax0.set_title('stepfilled')

# Create a histogram by providing the bin edges (unequally spaced).
bins = [100, 150, 180, 195, 205, 220, 250, 300]
ax1.hist(x, bins, normed=1, histtype='bar', rwidth=0.8)
ax1.set_title('unequal bins')

fig.tight_layout()
plt.show()
```



In [8]:

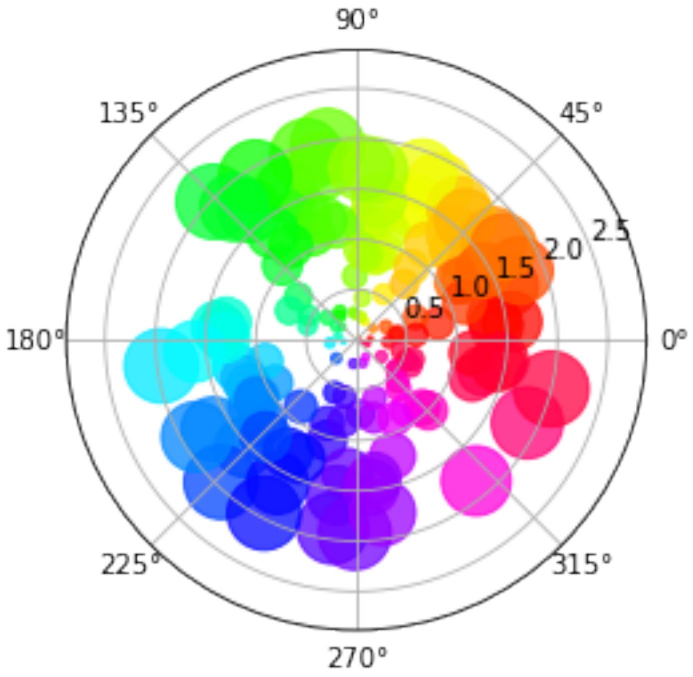
```
import numpy as np
import matplotlib.pyplot as plt

np.random.seed(0)

n_bins = 10
x = np.random.randn(1000, 3)

fig, axes = plt.subplots(nrows=2, ncols=2)
ax0, ax1, ax2, ax3 = axes.flatten()

colors = ['red', 'tan', 'lime']
ax0.hist(x, n_bins, normed=1, histtype='bar', color=colors, label=colors)
ax0.legend(prop={'size': 10})
ax0.set_title('bars with legend')

ax1.hist(x, n_bins, normed=1, histtype='bar', stacked=True)
ax1.set_title('stacked bar')

ax2.hist(x, n_bins, histtype='step', stacked=True, fill=False)
ax2.set_title('stack step (unfilled)')

# Make a multiple-histogram of data-sets with different length.
x_multi = [np.random.randn(n) for n in [10000, 5000, 2000]]
ax3.hist(x_multi, n_bins, histtype='bar')
ax3.set_title('different sample sizes')

fig.tight_layout()
plt.show()
```



polar实例

In [12]:

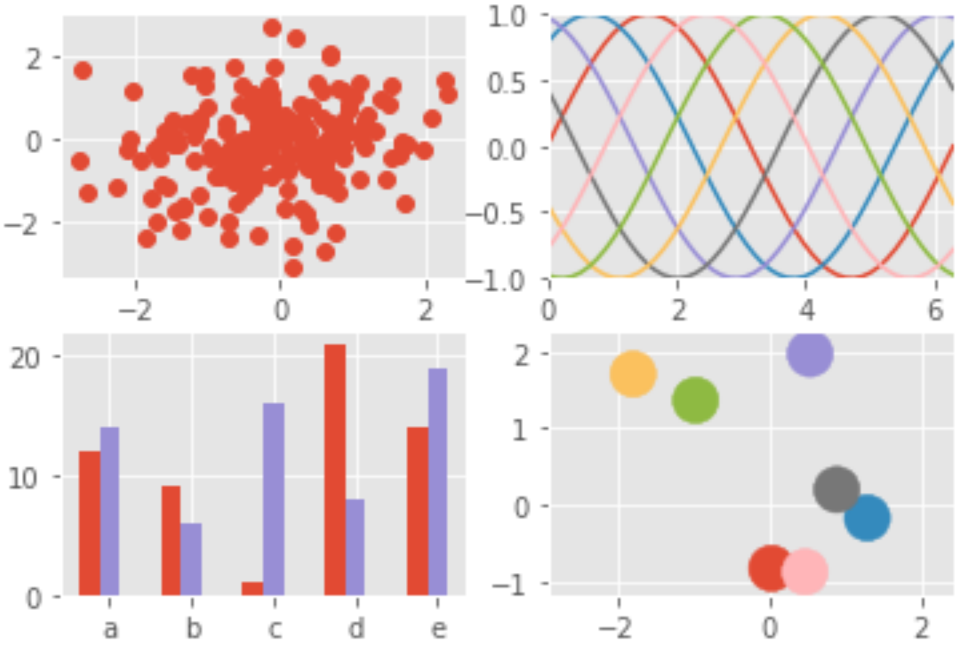
```
N = 150
r = 2 * np.random.rand(N)
theta = 2 * np.pi * np.random.rand(N)
area = 200 * r**2
colors = theta

ax = plt.subplot(111, projection='polar')
c = ax.scatter(theta, r, c=colors, s=area, cmap='hsv', alpha=0.75)

plt.show()
```



风格切换

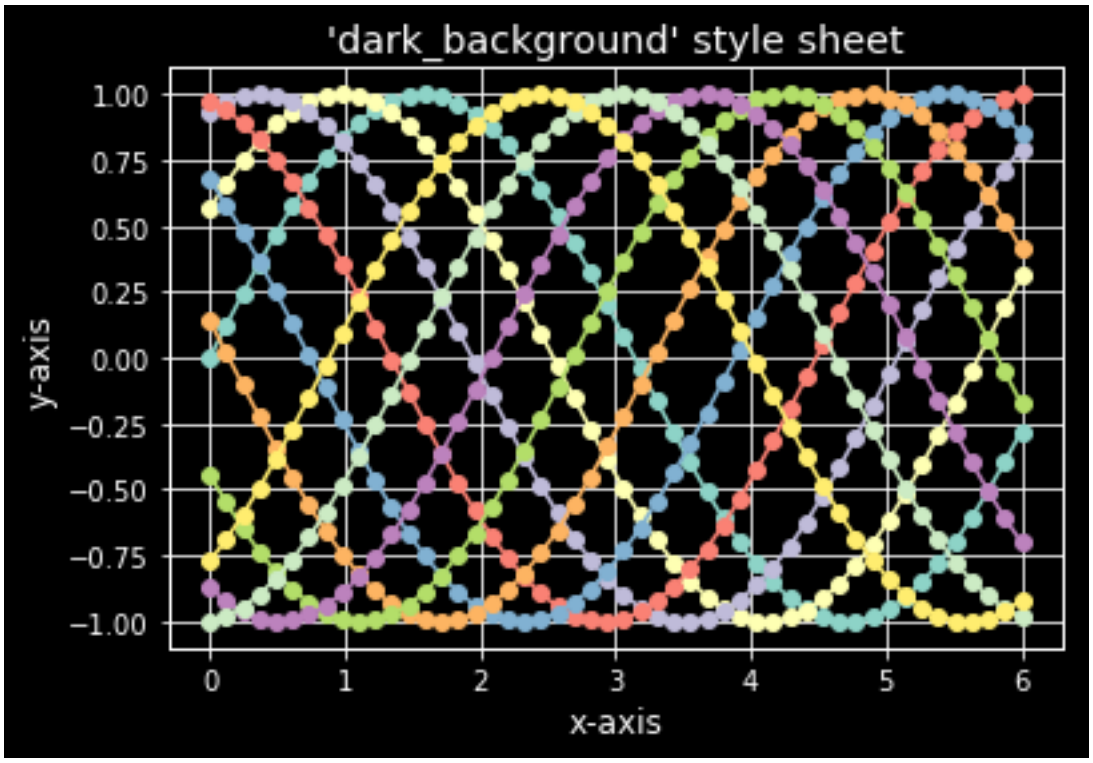
In [13]:

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

plt.style.use('ggplot')

fig, axes = plt.subplots(ncols=2, nrows=2)
ax1, ax2, ax3, ax4 = axes.ravel()

# scatter plot (Note: `plt.scatter` doesn't use default colors)
x, y = np.random.normal(size=(2, 200))
ax1.plot(x, y, 'o')

# sinusoidal lines with colors from default color cycle
L = 2*np.pi
x = np.linspace(0, L)
ncolors = len(plt.rcParams['axes.prop_cycle'])
shift = np.linspace(0, L, ncolors, endpoint=False)
for s in shift:
    ax2.plot(x, np.sin(x + s), '-')
ax2.margins(0)

# bar graphs
x = np.arange(5)
y1, y2 = np.random.randint(1, 25, size=(2, 5))
width = 0.25
ax3.bar(x, y1, width)
ax3.bar(x + width, y2, width,
        color=list(plt.rcParams['axes.prop_cycle'])[2]['color'])
ax3.set_xticks(x + width)
ax3.set_xticklabels(['a', 'b', 'c', 'd', 'e'])

# circles with colors from default color cycle
for i, color in enumerate(plt.rcParams['axes.prop_cycle']):
    xy = np.random.normal(size=2)
    ax4.add_patch(plt.Circle(xy, radius=0.3, color=color['color']))
ax4.axis('equal')
ax4.margins(0)

plt.show()
```



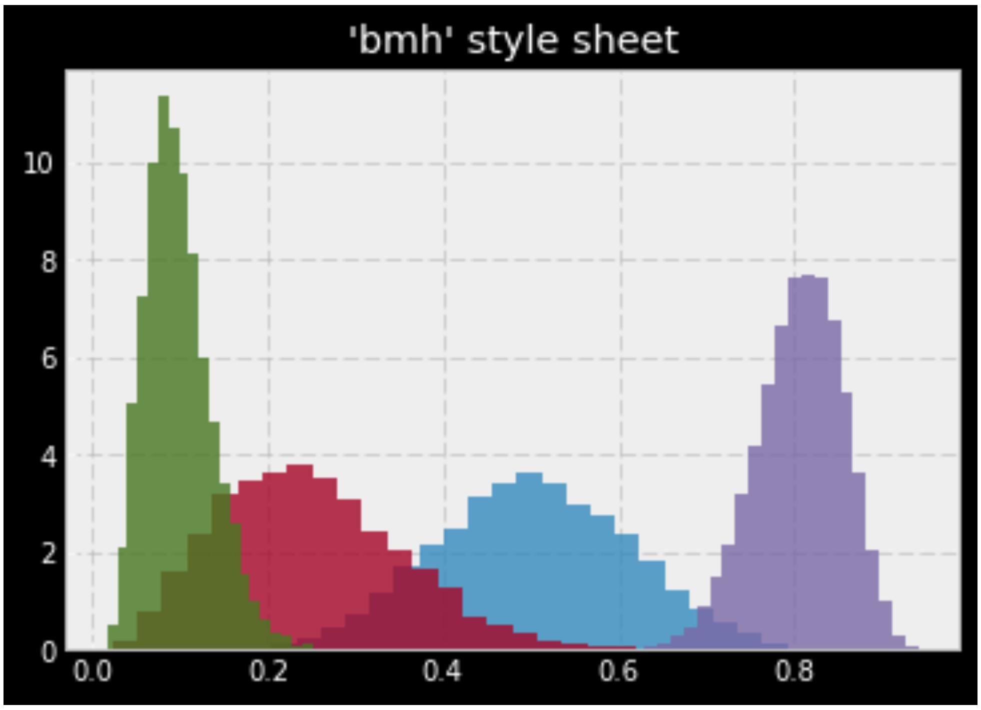
In [14]:

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

fig, ax = plt.subplots()

L = 6
x = np.linspace(0, L)
ncolors = len(plt.rcParams['axes.prop_cycle'])
shift = np.linspace(0, L, ncolors, endpoint=False)
for s in shift:
    ax.plot(x, np.sin(x + s), 'o-')
ax.set_xlabel('x-axis')
ax.set_ylabel('y-axis')
ax.set_title("'dark_background' style sheet")

plt.show()
```



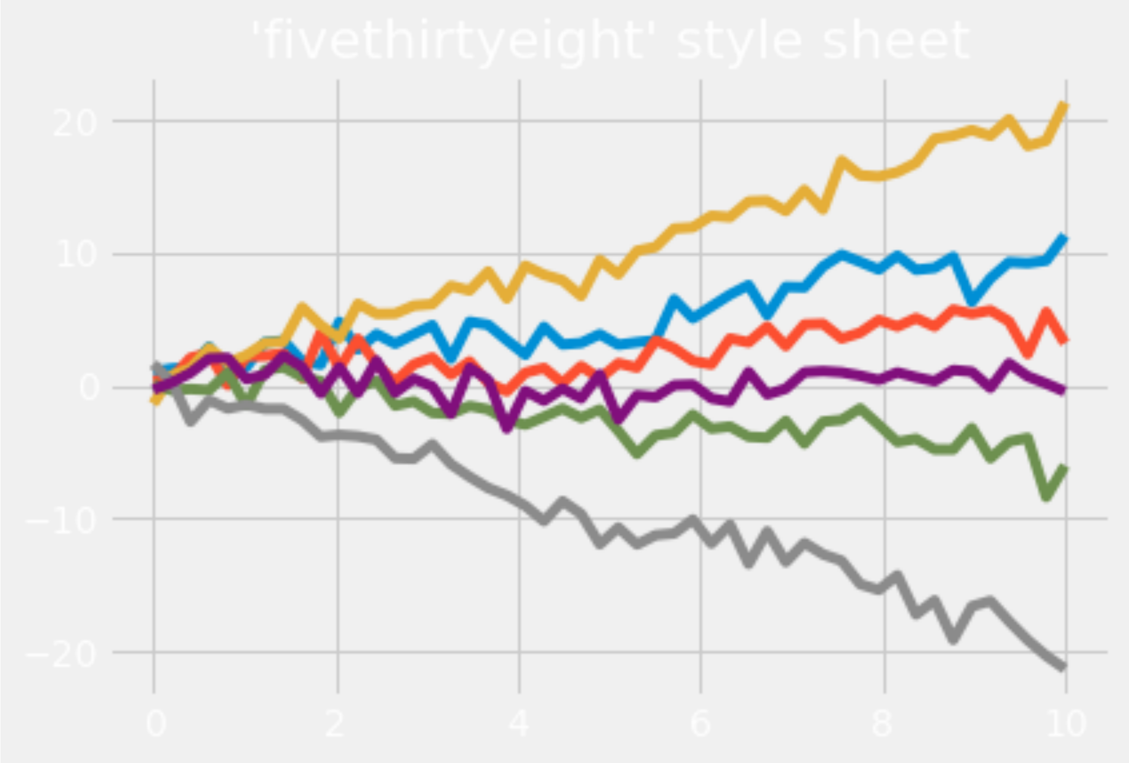
In [16]:

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


def plot_beta_hist(ax, a, b):
    ax.hist(np.random.beta(a, b, size=10000), histtype="stepfilled",
            bins=25, alpha=0.8, normed=True)


fig, ax = plt.subplots()
plot_beta_hist(ax, 10, 10)
plot_beta_hist(ax, 4, 12)
plot_beta_hist(ax, 50, 12)
plot_beta_hist(ax, 6, 55)
ax.set_title("'bmh' style sheet")

plt.show()
```



In [17]:

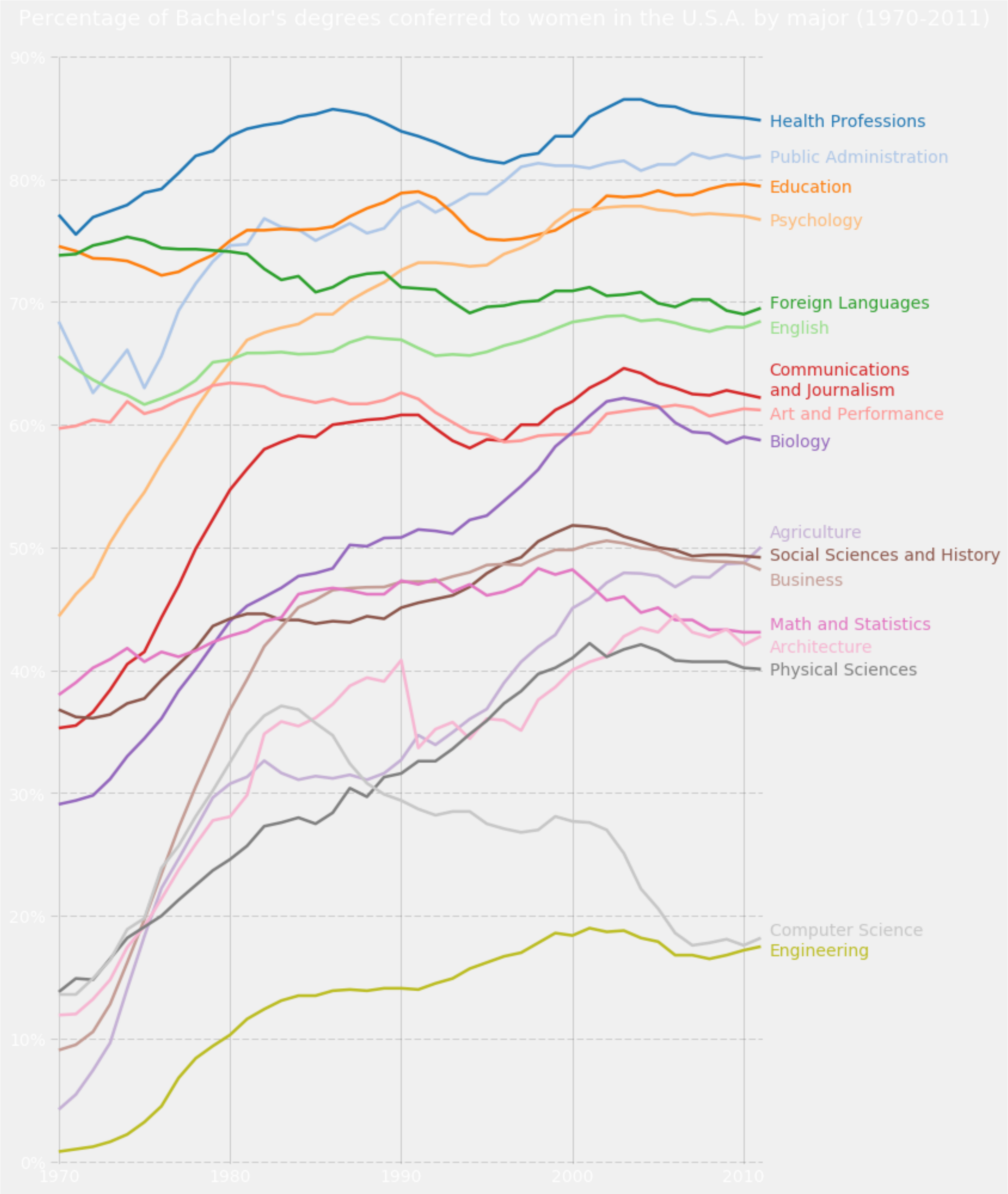
```
plt.style.use('fivethirtyeight')

x = np.linspace(0, 10)

# Fixing random state for reproducibility
np.random.seed(19680801)

fig, ax = plt.subplots()

ax.plot(x, np.sin(x) + x + np.random.randn(50))
ax.plot(x, np.sin(x) + 0.5 * x + np.random.randn(50))
ax.plot(x, np.sin(x) + 2 * x + np.random.randn(50))
ax.plot(x, np.sin(x) - 0.5 * x + np.random.randn(50))
ax.plot(x, np.sin(x) - 2 * x + np.random.randn(50))
ax.plot(x, np.sin(x) + np.random.randn(50))
ax.set_title("'fivethirtyeight' style sheet")

plt.show()
```



In [19]:

```
import matplotlib.pyplot as plt
from matplotlib.mlab import csv2rec
from matplotlib.cbook import get_sample_data

fname = get_sample_data('percent_bachelors_degrees_women_usa.csv')
gender_degree_data = csv2rec(fname)

# These are the colors that will be used in the plot
color_sequence = ['#1f77b4', '#aec7e8', '#ff7f0e', '#ffbb78', '#2ca02c',
                  '#98df8a', '#d62728', '#ff9896', '#9467bd', '#c5b0d5',
                  '#8c564b', '#c49c94', '#e377c2', '#f7b6d2', '#7f7f7f',
                  '#c7c7c7', '#bcbd22', '#dbdb8d', '#17becf', '#9edae5']

# You typically want your plot to be ~1.33x wider than tall. This plot
# is a rare exception because of the number of lines being plotted on it.
# Common sizes: (10, 7.5) and (12, 9)
fig, ax = plt.subplots(1, 1, figsize=(12, 14))
```

```
fig, ax = plt.subplots(1, 1, figsize=(12, 14))

# Remove the plot frame lines. They are unnecessary here.
ax.spines['top'].set_visible(False)
ax.spines['bottom'].set_visible(False)
ax.spines['right'].set_visible(False)
ax.spines['left'].set_visible(False)

# Ensure that the axis ticks only show up on the bottom and left of the plot.
# Ticks on the right and top of the plot are generally unnecessary.
ax.get_xaxis().tick_bottom()
ax.get_yaxis().tick_left()

fig.subplots_adjust(left=.06, right=.75, bottom=.02, top=.94)
# Limit the range of the plot to only where the data is.
# Avoid unnecessary whitespace.
ax.set_xlim(1969.5, 2011.1)
ax.set_ylim(-0.25, 90)

# Make sure your axis ticks are large enough to be easily read.
# You don't want your viewers squinting to read your plot.
plt.xticks(range(1970, 2011, 10), fontsize=14)
plt.yticks(range(0, 91, 10), fontsize=14)
ax.xaxis.set_major_formatter(plt.FuncFormatter('{:.0f}'.format))
ax.yaxis.set_major_formatter(plt.FuncFormatter('{:.0f}%'.format))

# Provide tick lines across the plot to help your viewers trace along
# the axis ticks. Make sure that the lines are light and small so they
# don't obscure the primary data lines.
plt.grid(True, 'major', 'y', ls='--', lw=.5, c='k', alpha=.3)

# Remove the tick marks; they are unnecessary with the tick lines we just
# plotted.
plt.tick_params(axis='both', which='both', bottom='off', top='off',
                labelbottom='on', left='off', right='off', labelleft='on')

# Now that the plot is prepared, it's time to actually plot the data!
# Note that I plotted the majors in order of the highest % in the final year.
majors = ['Health Professions', 'Public Administration', 'Education',
          'Psychology', 'Foreign Languages', 'English',
          'Communications\nand Journalism', 'Art and Performance', 'Biology',
          'Agriculture', 'Social Sciences and History', 'Business',
          'Math and Statistics', 'Architecture', 'Physical Sciences',
          'Computer Science', 'Engineering']

y_offsets = {'Foreign Languages': 0.5, 'English': -0.5,
             'Communications\nand Journalism': 0.75,
             'Art and Performance': -0.25, 'Agriculture': 1.25,
             'Social Sciences and History': 0.25, 'Business': -0.75,
             'Math and Statistics': 0.75, 'Architecture': -0.75,
             'Computer Science': 0.75, 'Engineering': -0.25}

for rank, column in enumerate(majors):
    # Plot each line separately with its own color.
    column_rec_name = column.replace('\n', '_').replace(' ', '_').lower()

    line = plt.plot(gender_degree_data.year,
                    gender_degree_data[column_rec_name],
                    gender_degree_data[column_rec_name],
                    lw=2.5,
                    color=color_sequence[rank])

    # Add a text label to the right end of every line. Most of the code below
    # is adding specific offsets y position because some labels overlapped.
    y_pos = gender_degree_data[column_rec_name][-1] - 0.5

    if column in y_offsets:
        y_pos += y_offsets[column]

    # Again, make sure that all labels are large enough to be easily read
    # by the viewer.
    plt.text(2011.5, y_pos, column, fontsize=14, color=color_sequence[rank])

# Make the title big enough so it spans the entire plot, but don't make it
# so big that it requires two lines to show.

# Note that if the title is descriptive enough, it is unnecessary to include
# axis labels; they are self-evident, in this plot's case.
fig.suptitle('Percentage of Bachelor\'s degrees conferred to women in '
             'the U.S.A. by major (1970-2011)\n', fontsize=18, ha='center')

# Finally, save the figure as a PNG.
# You can also save it as a PDF, JPEG, etc.
# Just change the file extension in this call.
# plt.savefig('percent-bachelors-degrees-women-usa.png', bbox_inches='tight')
plt.show()
```

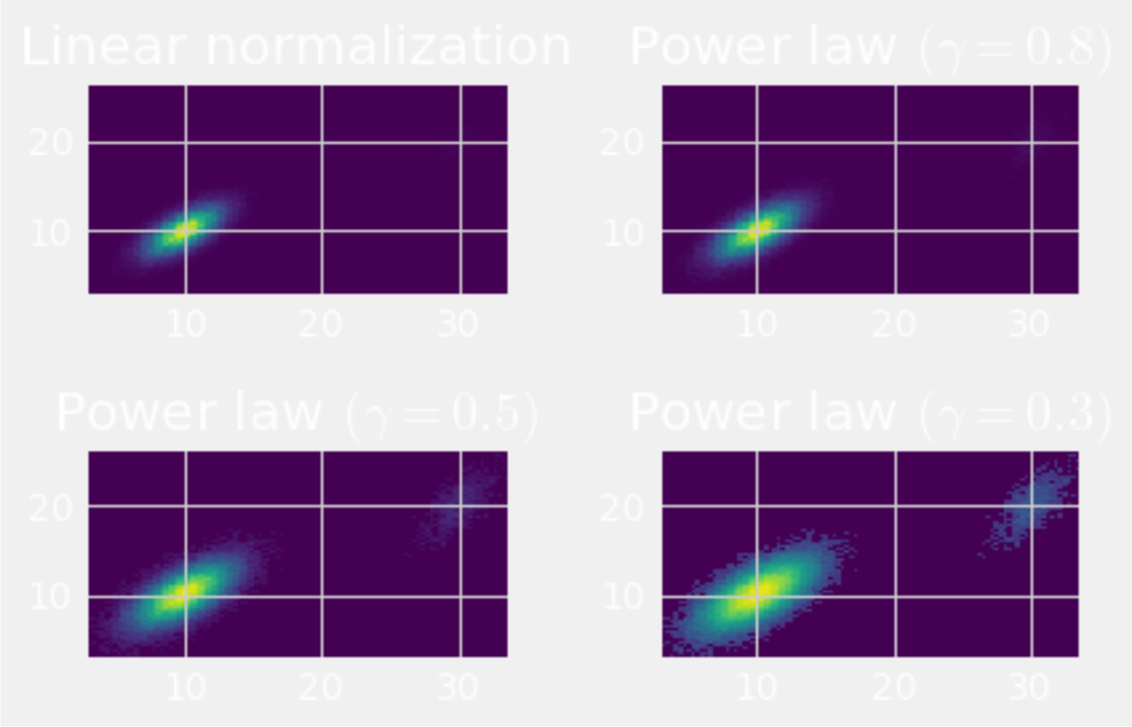


Percentage of Bachelor's degrees conferred to women in the U.S.A. by major (1970-2011)
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1970
1980
1990
2000
2010
Health Professions
Public Administration
Education
Psychology
Foreign Languages
English
Communications
and Journalism
Art and Performance
Biology
Agriculture
Social Sciences and History
Business
Math and Statistics
Architecture
Physical Sciences
Computer Science
Engineering

hist2d 实例

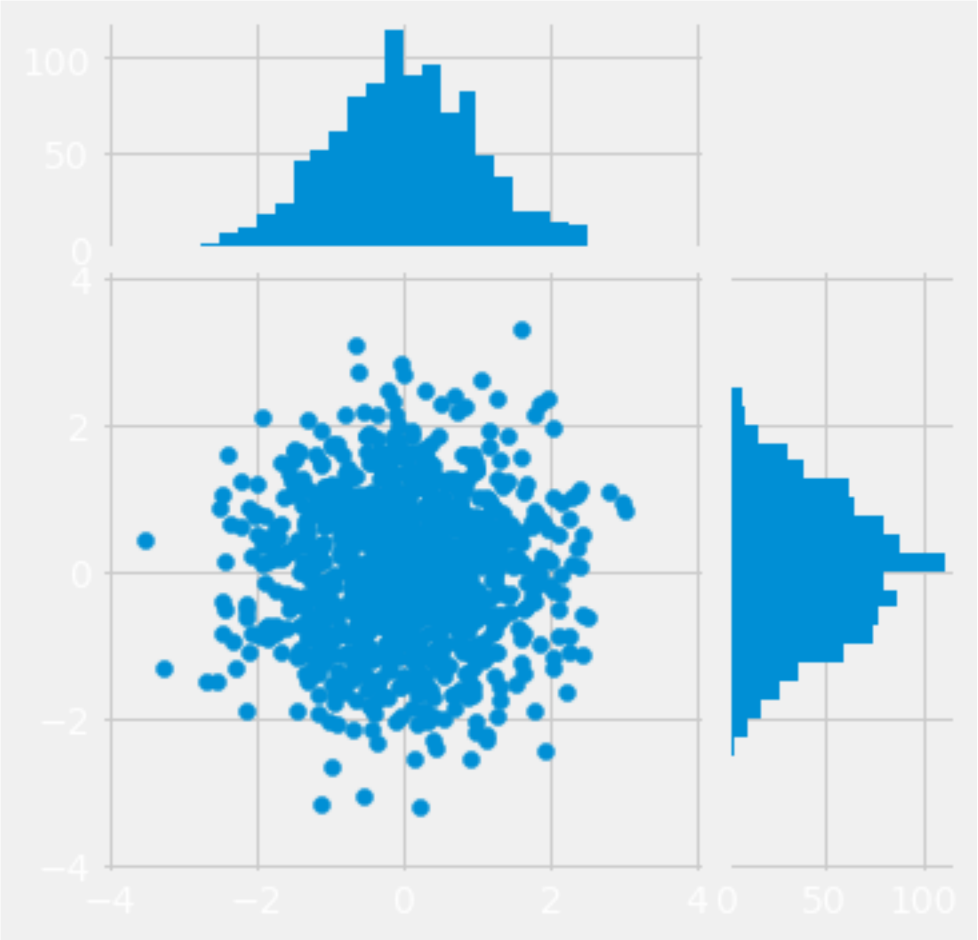
In [20]:

```
from matplotlib import pyplot as plt
import matplotlib.colors as mcolors
import numpy as np
from numpy.random import multivariate_normal

data = np.vstack([
    multivariate_normal([10, 10], [[3, 2], [2, 3]], size=100000),
    multivariate_normal([30, 20], [[2, 3], [1, 3]], size=1000)
])

gammas = [0.8, 0.5, 0.3]

fig, axes = plt.subplots(nrows=2, ncols=2)

axes[0, 0].set_title('Linear normalization')
axes[0, 0].hist2d(data[:, 0], data[:, 1], bins=100)

for ax, gamma in zip(axes.flat[1:], gammas):
    ax.set_title('Power law $(\gamma=%1.1f)$' % gamma)
    ax.hist2d(data[:, 0], data[:, 1],
              bins=100, norm=mcolors.PowerNorm(gamma))

fig.tight_layout()

plt.show()
```



In [21]:

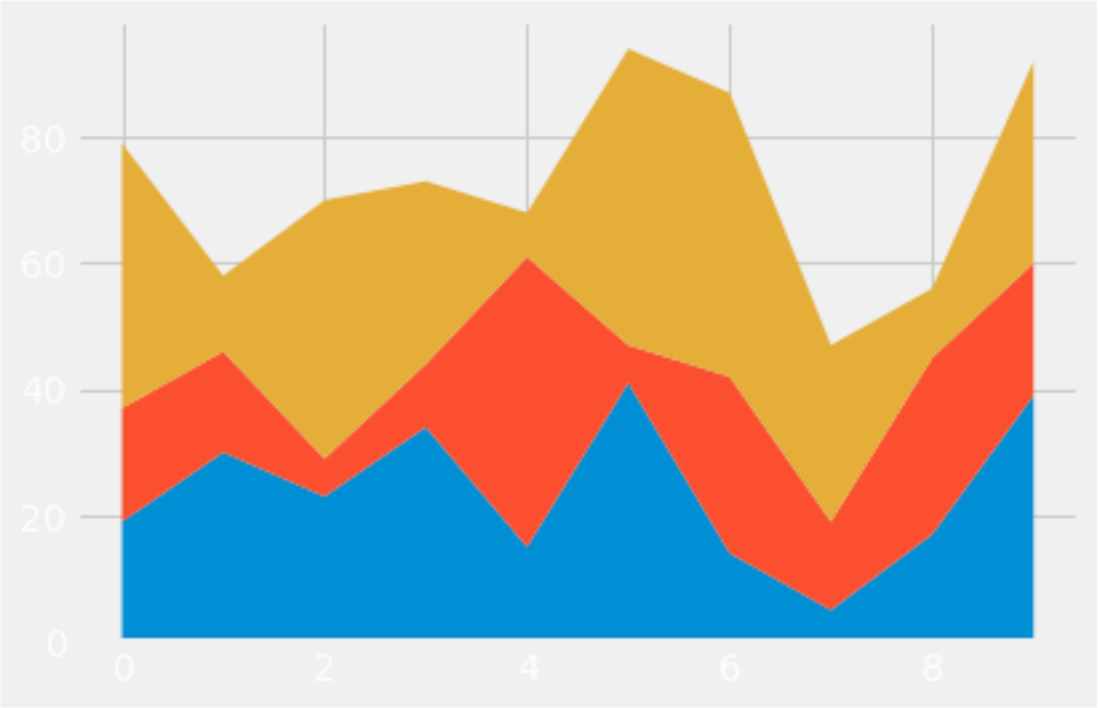
```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.axes_grid1 import make_axes_locatable

# the random data
x = np.random.randn(1000)
y = np.random.randn(1000)


fig, axScatter = plt.subplots(figsize=(5.5, 5.5))

# the scatter plot:
axScatter.scatter(x, y)
axScatter.set_aspect(1.)

# create new axes on the right and on the top of the current axes
# The first argument of the new_vertical(new_horizontal) method is
# the height (width) of the axes to be created in inches.
divider = make_axes_locatable(axScatter)
axHistx = divider.append_axes("top", 1.2, pad=0.1, sharex=axScatter)
axHisty = divider.append_axes("right", 1.2, pad=0.1, sharey=axScatter)

# make some labels invisible
plt.setp(axHistx.get_xticklabels() + axHisty.get_yticklabels(),
         visible=False)

# now determine nice limits by hand:
binwidth = 0.25
xymax = np.max([np.max(np.fabs(x)), np.max(np.fabs(y))])
lim = (int(xymax/binwidth) + 1)*binwidth

bins = np.arange(-lim, lim + binwidth, binwidth)
axHistx.hist(x, bins=bins)
axHisty.hist(y, bins=bins, orientation='horizontal')

# the xaxis of axHistx and yaxis of axHisty are shared with axScatter,
# thus there is no need to manually adjust the xlim and ylim of these
# axis.

#axHistx.axis["bottom"].major_ticklabels.set_visible(False)
for tl in axHistx.get_xticklabels():
    tl.set_visible(False)
axHistx.set_yticks([0, 50, 100])

#axHisty.axis["left"].major_ticklabels.set_visible(False)
for tl in axHisty.get_yticklabels():
    tl.set_visible(False)
axHisty.set_xticks([0, 50, 100])

plt.draw()
plt.show()
```

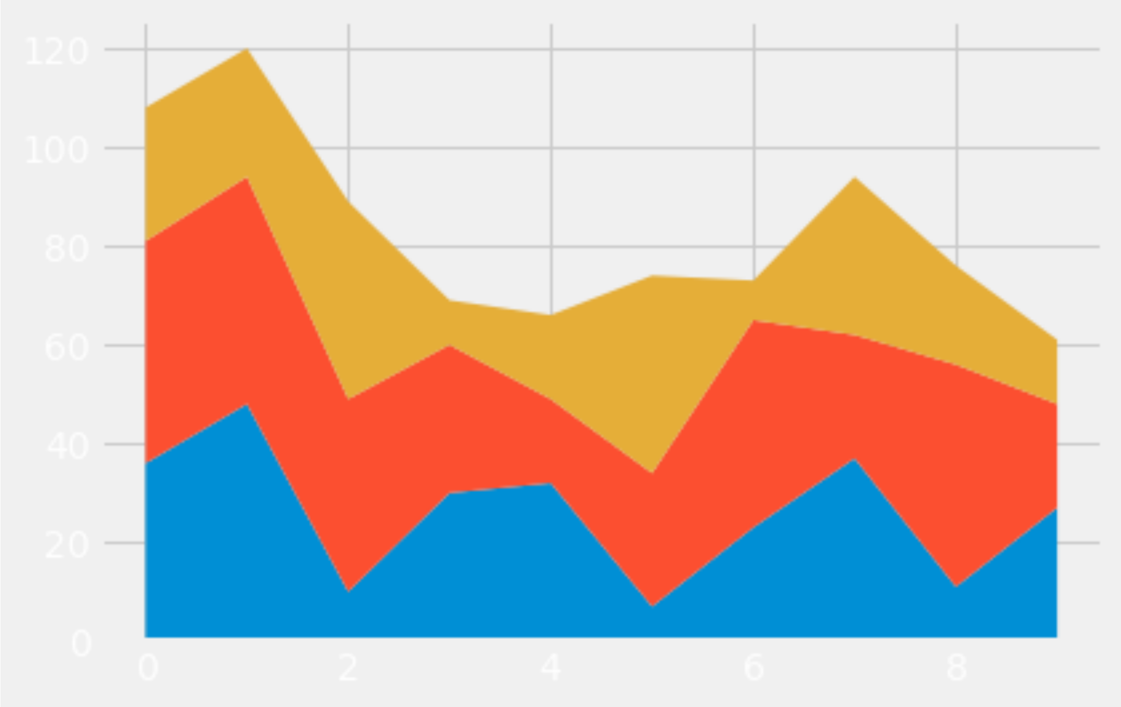


stackplot 实例

In [22]:

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


def fnx():
    return np.random.randint(5, 50, 10)

y = np.row_stack((fnx(), fnx(), fnx()))
x = np.arange(10)

y1, y2, y3 = fnx(), fnx(), fnx()

fig, ax = plt.subplots()
ax.stackplot(x, y)
plt.show()

fig, ax = plt.subplots()
ax.stackplot(x, y1, y2, y3)
plt.show()
```

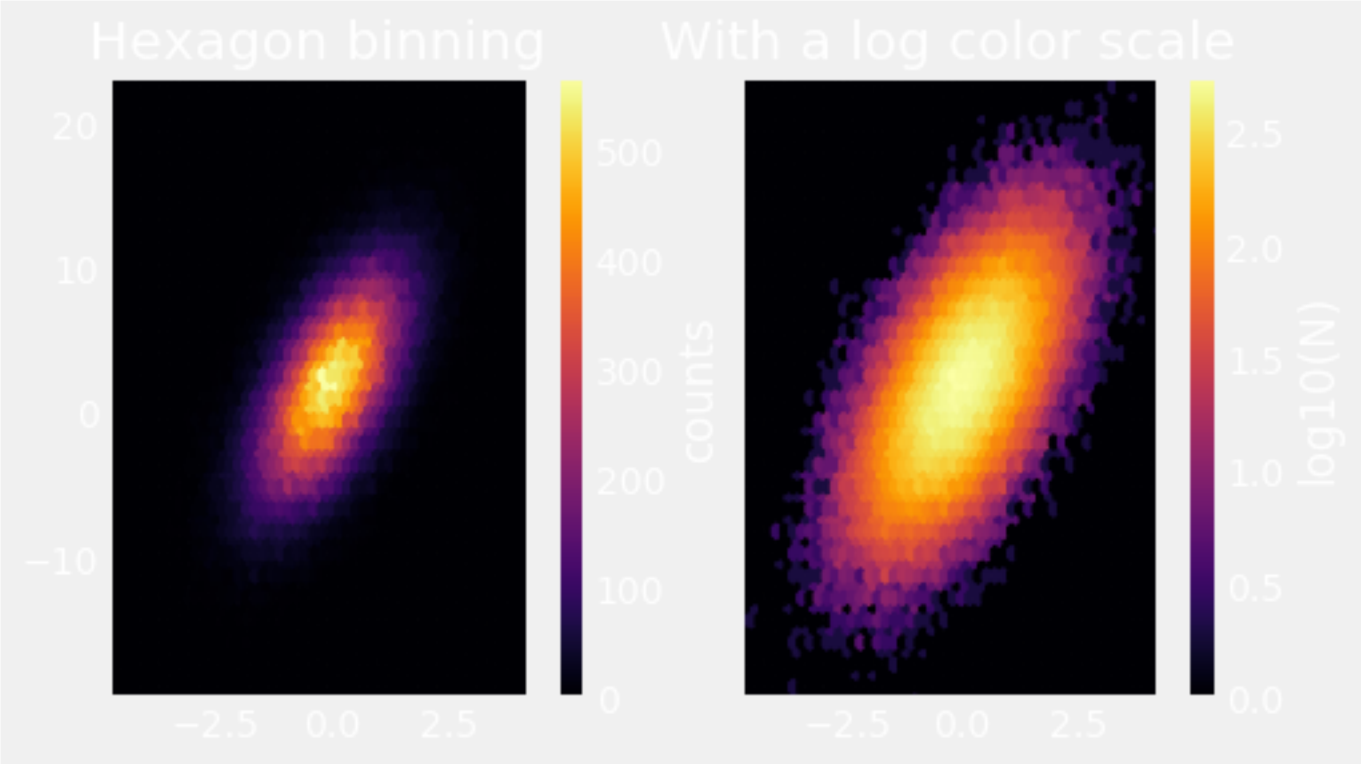




hexbin

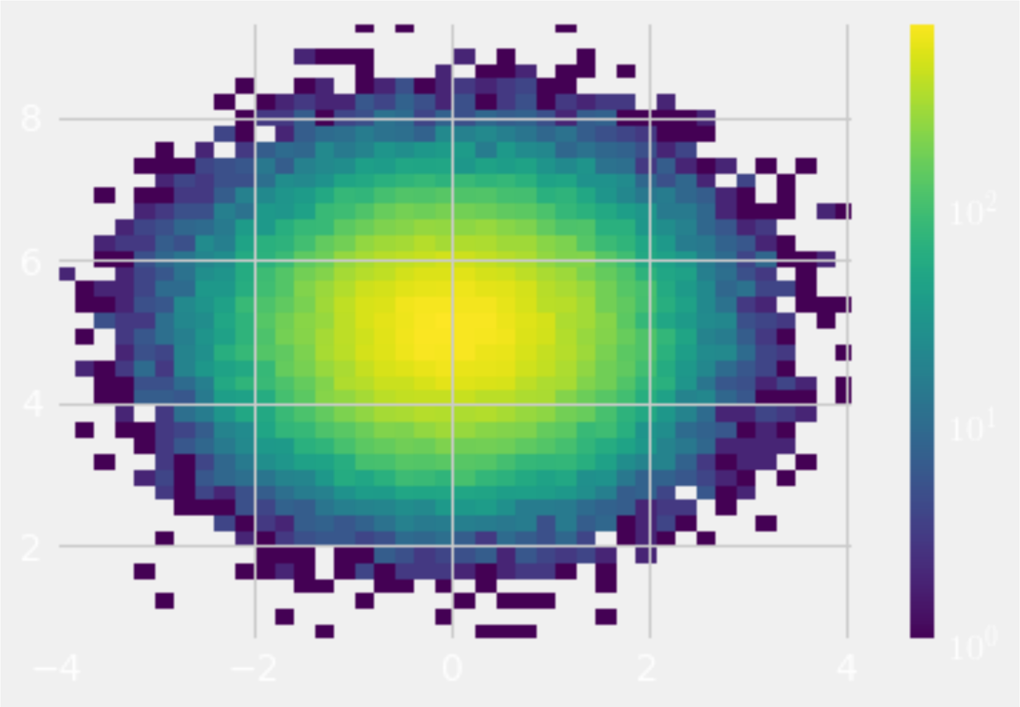
In [23]:

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

np.random.seed(0)
n = 100000
x = np.random.standard_normal(n)
y = 2.0 + 3.0 * x + 4.0 * np.random.standard_normal(n)
xmin = x.min()
xmax = x.max()
ymin = y.min()
ymax = y.max()

fig, axs = plt.subplots(ncols=2, sharey=True, figsize=(7, 4))
fig.subplots_adjust(hspace=0.5, left=0.07, right=0.93)
ax = axs[0]
hb = ax.hexbin(x, y, gridsize=50, cmap='inferno')
ax.axis([xmin, xmax, ymin, ymax])
ax.set_title("Hexagon binning")
cb = fig.colorbar(hb, ax=ax)
cb.set_label('counts')

ax = axs[1]
hb = ax.hexbin(x, y, gridsize=50, bins='log', cmap='inferno')
ax.axis([xmin, xmax, ymin, ymax])
ax.set_title("With a log color scale")
cb = fig.colorbar(hb, ax=ax)
cb.set_label('log10(N)')

plt.show()
```



In [24]:

```
from matplotlib.colors import LogNorm
import matplotlib.pyplot as plt
import numpy as np

# normal distribution center at x=0 and y=5
x = np.random.randn(100000)
y = np.random.randn(100000) + 5

plt.hist2d(x, y, bins=40, norm=LogNorm())
plt.colorbar()
plt.show()
```



In [ ]:

```
```