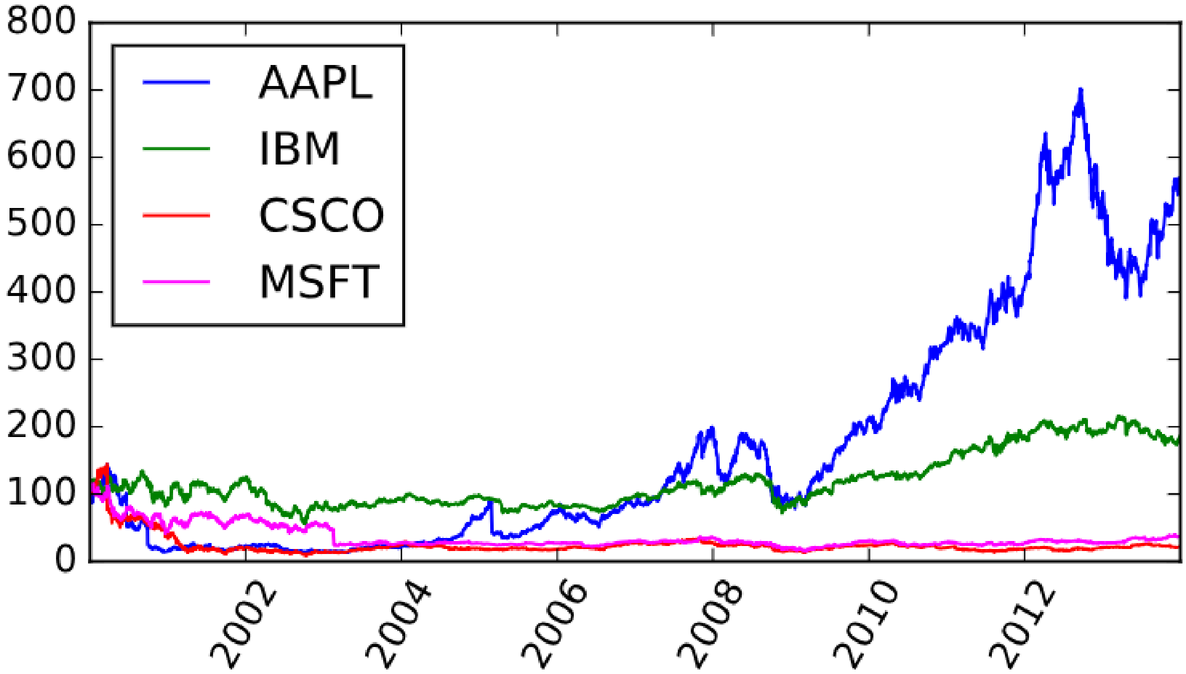
Introduction to Data Visualization with Python

4). Analyzing Time series and Images

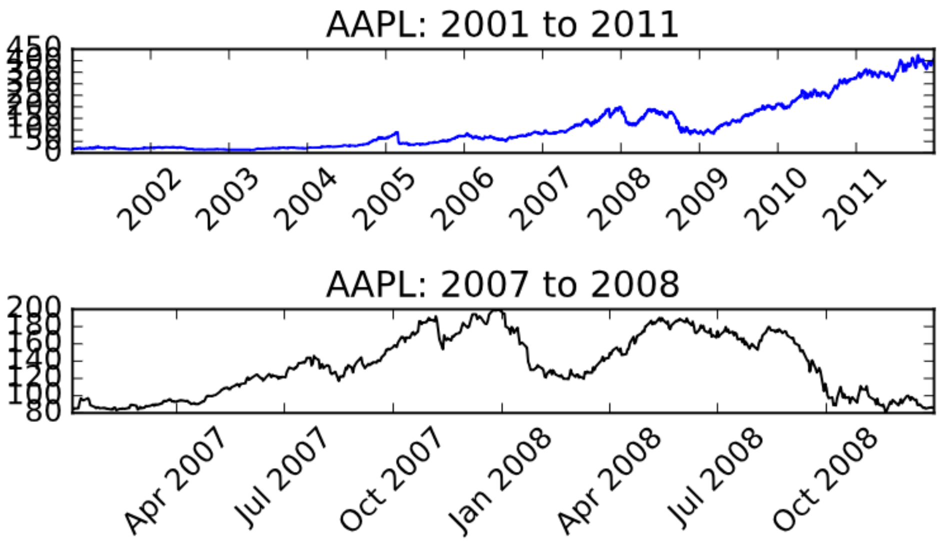
a). Multiple Time series on common plot

```
# Import matplotlib.pyplot
import matplotlib.pyplot as plt

# Plot the aapl time series in blue
plt.plot(aapl, color='blue', label='AAPL')

# Plot the ibm time series in green
plt.plot(ibm, color='green', label='IBM')

# Plot the csco time series in red
plt.plot(csco, color='red', label='CSCO')

# Plot the msft time series in magenta
plt.plot(msft,color='magenta',label='MSFT')

# Add a legend in the top left corner of the plot
plt.legend(loc='upper left')

# Specify the orientation of the xticks
plt.xticks(rotation=60)

# Display the plot
plt.show()
```


800
700
600
500
400
300
200
100
0
AAPL
IBM
CSCO
MSFT
2002
2004
2006
2008
2010
2012

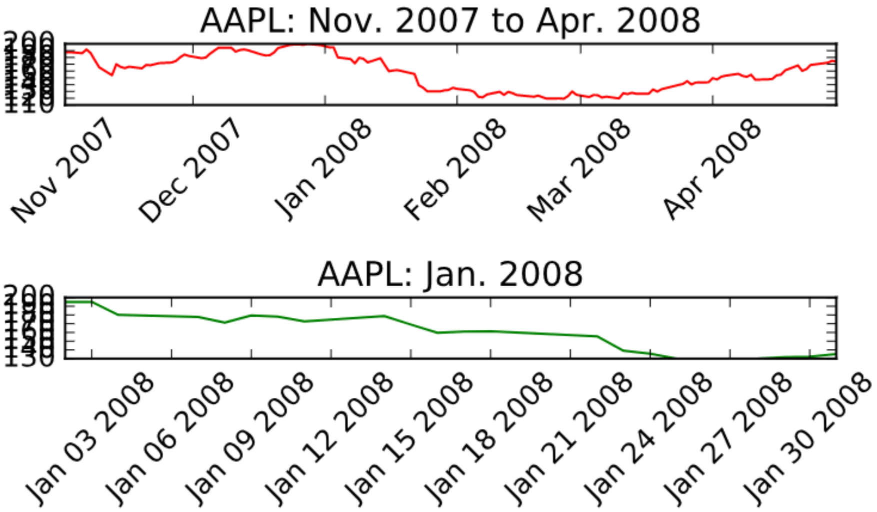
b). Multiple time series slices (1)

```
# Plot the series in the top subplot in blue
plt.subplot(2,1,1)
plt.xticks(rotation=45)
plt.title('AAPL: 2001 to 2011')
plt.plot(aapl, color='blue')

# Slice aapl from '2007' to '2008' inclusive: view
view = aapl['2007':'2008']

# Plot the sliced data in the bottom subplot in black
plt.subplot(2,1,2)
plt.xticks(rotation=45)
plt.title('AAPL: 2007 to 2008')
plt.plot(view, color='black')
plt.tight_layout()
plt.show()
```



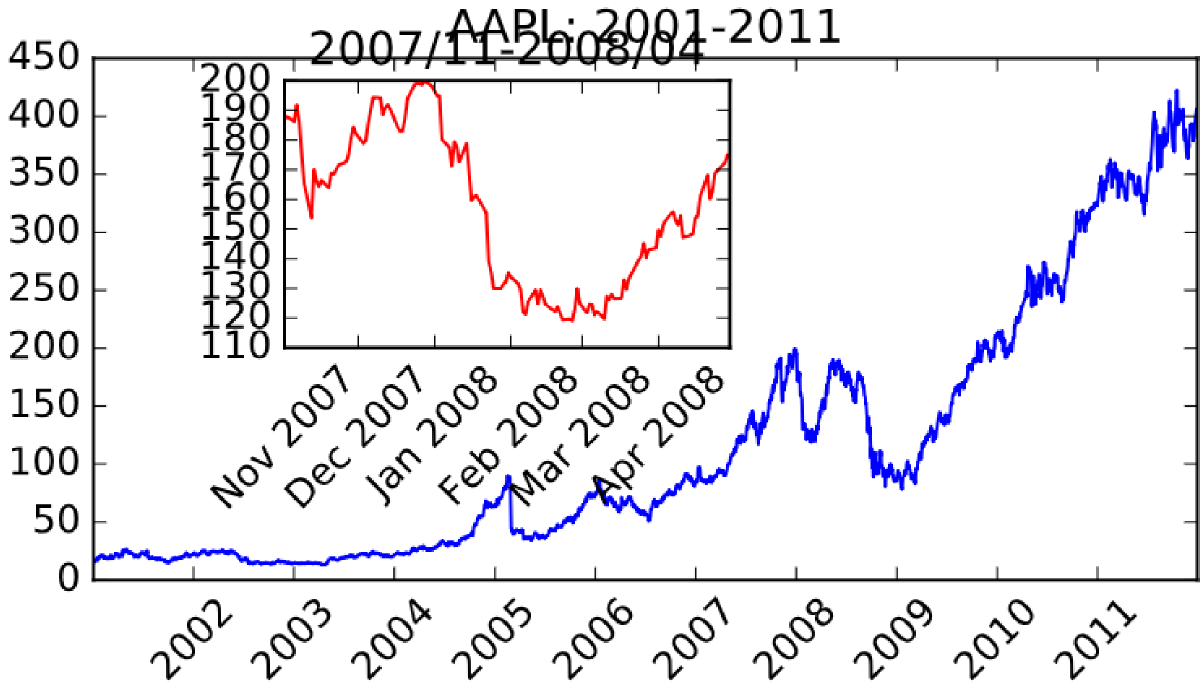
c). Multiple time series slices (2)

```
# Slice aapl from Nov. 2007 to Apr. 2008 inclusive: view

view = aapl['2007-11':'2008-04']

# Plot the sliced series in the top subplot in red

plt.subplot(2,1,1)

plt.xticks(rotation=45)

plt.title('AAPL: Nov. 2007 to Apr. 2008')

plt.plot(view,color='red')

# Reassign the series by slicing the month January 2008

view = aapl['2008-01']

# Plot the sliced series in the bottom subplot in green

plt.subplot(2,1,2)

plt.xticks(rotation=45)

plt.title('AAPL: Jan. 2008')

plt.plot(view,color='green')


# Improve spacing and display the plot

plt.tight_layout()

plt.show()
```



d). Plotting an inset view

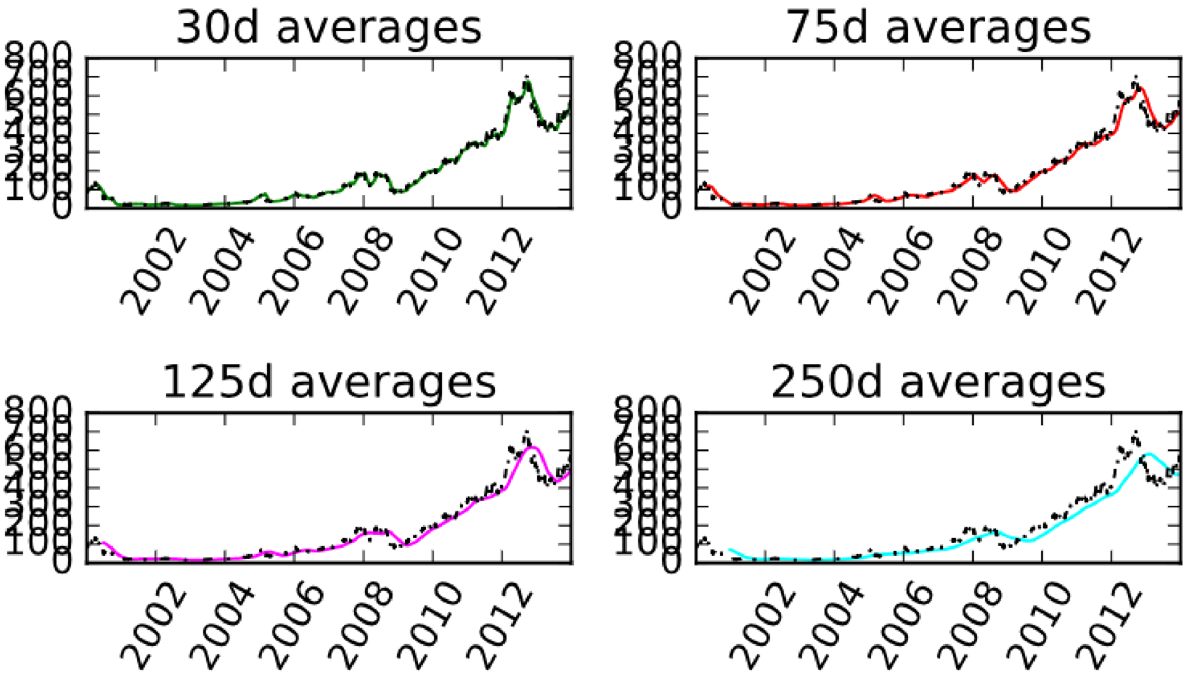
```
# Slice aapl from Nov. 2007 to Apr. 2008 inclusive: view

view = aapl['2007-11':'2008-04']


# Plot the entire series

plt.plot(aapl)

plt.xticks(rotation=45)

plt.title('AAPL: 2001-2011')


# Specify the axes

plt.axes([0.25,0.5,0.35,0.35])


# Plot the sliced series in red using the current axes

plt.plot(view,color='red')

plt.xticks(rotation=45)

plt.title('2007/11-2008/04')

plt.show()
```



e). Plotting moving averages

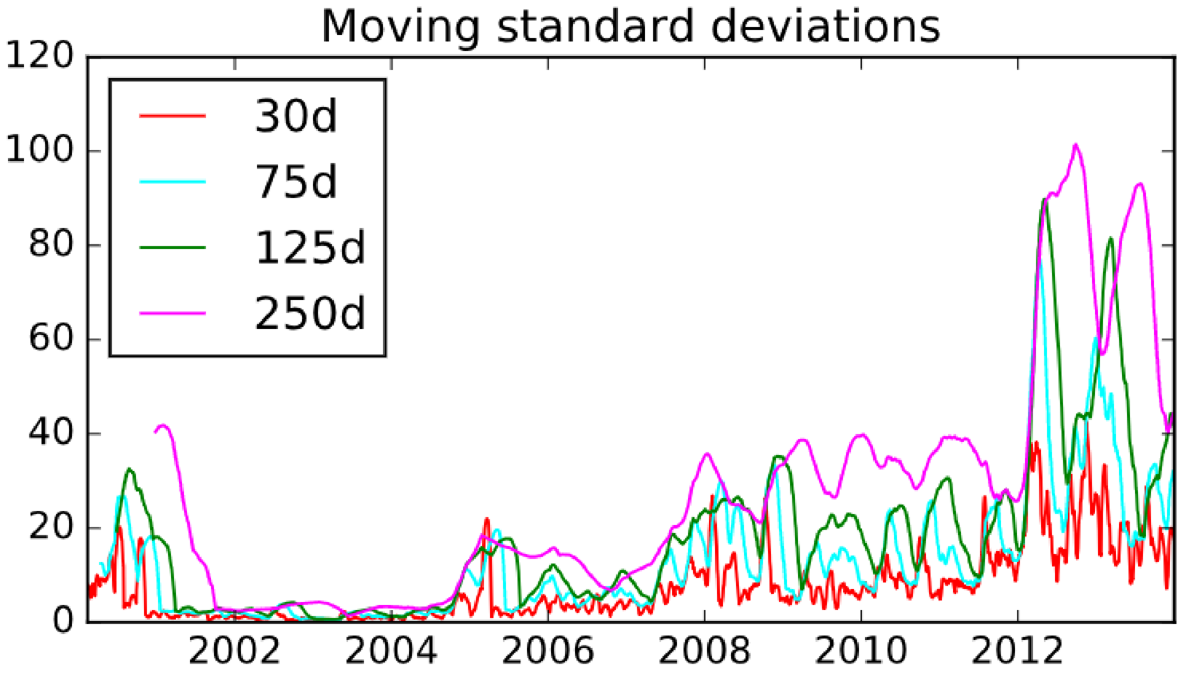
```
# Plot the 30-day moving average in the top left subplot in green

plt.subplot(2,2,1)

plt.plot(mean_30, color='green')

plt.plot(aapl, 'k-.')

plt.xticks(rotation=60)

plt.title('30d averages')


# Plot the 75-day moving average in the top right subplot in red

plt.subplot(2,2,2)

plt.plot(mean_75, 'red')

plt.plot(aapl, 'k-.')

plt.xticks(rotation=60)

plt.title('75d averages')


# Plot the 125-day moving average in the bottom left subplot in magenta

plt.subplot(2, 2, 3)

plt.plot(mean_125,color='magenta')

plt.plot(aapl, 'k-.')

plt.xticks(rotation=60)

plt.title('125d averages')


# Plot the 250-day moving average in the bottom right subplot in cyan

plt.subplot(2,2,4)

plt.plot(mean_250,color='cyan')

plt.plot(aapl, 'k-.')

plt.xticks(rotation=60)

plt.title('250d averages')
```

```
# Display the plot

plt.show()
```



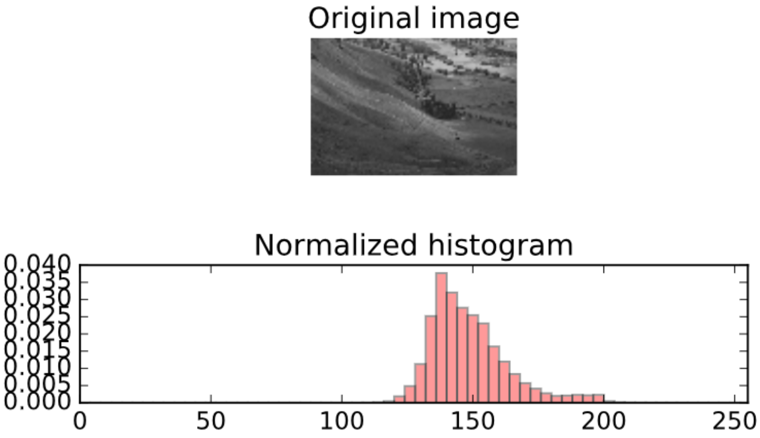
f). Plotting moving standard deviations

```
# Plot std_30 in red
plt.plot(std_30, color='red', label='30d')

# Plot std_75 in cyan
plt.plot(std_75, color='cyan', label='75d')

# Plot std_125 in green
plt.plot(std_125,color='green',label='125d')

# Plot std_250 in magenta
plt.plot(std_250,color='magenta',label='250d')

# Add a legend to the upper left
plt.legend(loc='upper left')

# Add a title
plt.title('Moving standard deviations')

# Display the plot
plt.show()
```


Moving standard deviations
120
100
80
60
40
20
0
30d
75d
125d
250d
2002
2004
2006
2008
2010
2012

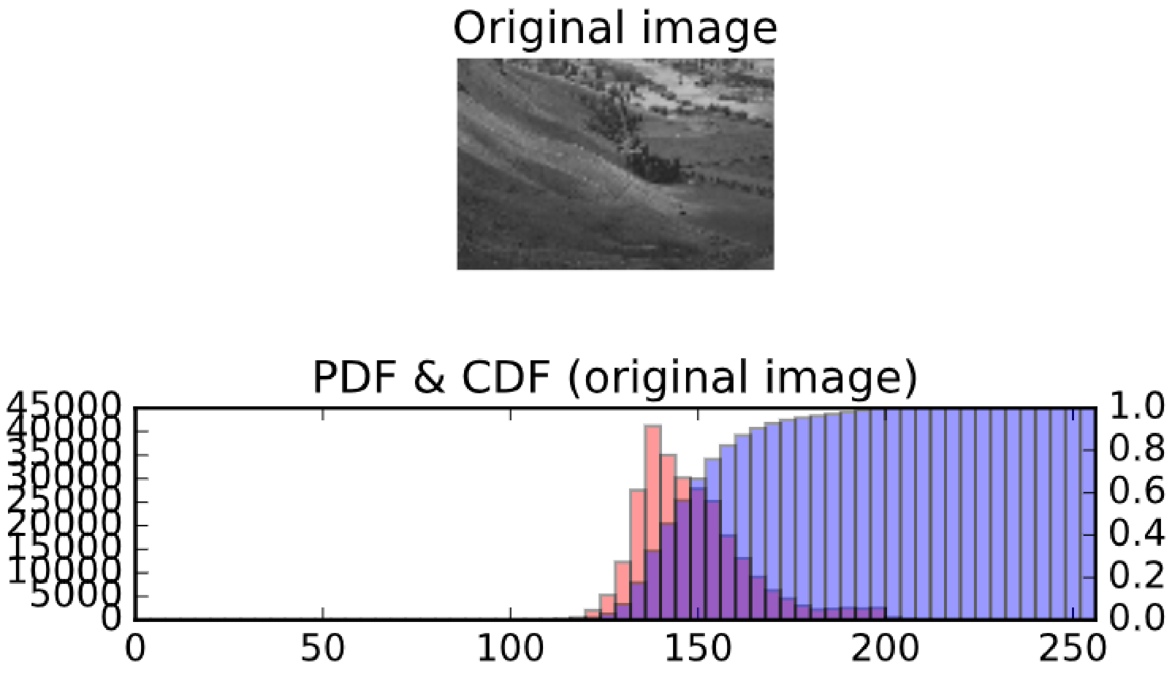
g). Extracting a histogram from a grayscale image

```
# Load the image into an array: image

image = plt.imread('640px-Unequalized_Hawkes_Bay_NZ.jpg')


# Display image in top subplot using color map 'gray'

plt.subplot(2,1,1)

plt.title('Original image')

plt.axis('off')

plt.imshow(image,cmap='gray')


# Flatten the image into 1 dimension: pixels

pixels = image.flatten()


# Display a histogram of the pixels in the bottom subplot

plt.subplot(2,1,2)

plt.xlim((0,255))

plt.title('Normalized histogram')

plt.hist(pixels,bins=64,range=(0,256),normed=True,color='red',alpha=0.4)

# Display the plot

plt.show()
```



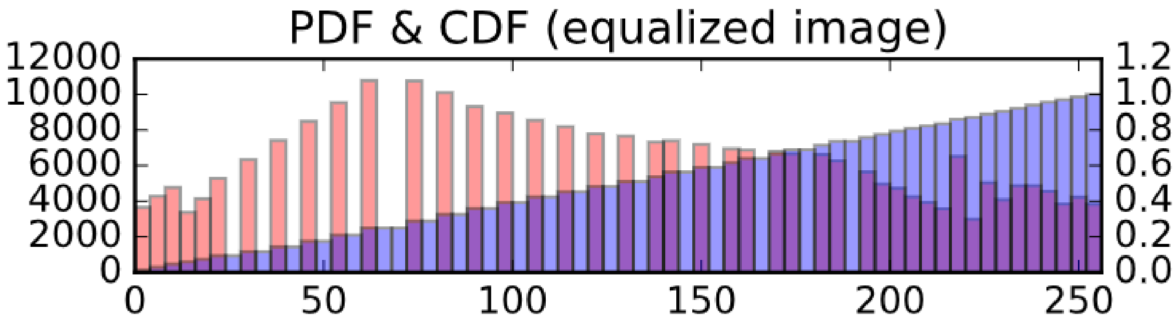
h). Cumulative Distribution Function from an image histogram

```
# Load the image into an array: image
image = plt.imread('640px-Unequalized_Hawkes_Bay_NZ.jpg')

# Display image in top subplot using color map 'gray'
plt.subplot(2,1,1)
plt.imshow(image, cmap='gray')
plt.title('Original image')
plt.axis('off')

# Flatten the image into 1 dimension: pixels
pixels = image.flatten()

# Display a histogram of the pixels in the bottom subplot
plt.subplot(2,1,2)
pdf = plt.hist(pixels, bins=64, range=(0,256), normed=False,
        color='red', alpha=0.4)
plt.grid('off')

# Use plt.twinx() to overlay the CDF in the bottom subplot
plt.twinx()

# Display a cumulative histogram of the pixels
cdf = plt.hist(pixels, bins=64, range=(0,256),
        normed=True, cumulative=True,
        color='blue', alpha=0.4)

# Specify x-axis range, hide axes, add title and display plot
plt.xlim((0,256))
plt.grid('off')

plt.title('PDF & CDF (original image)')

plt.show()
```



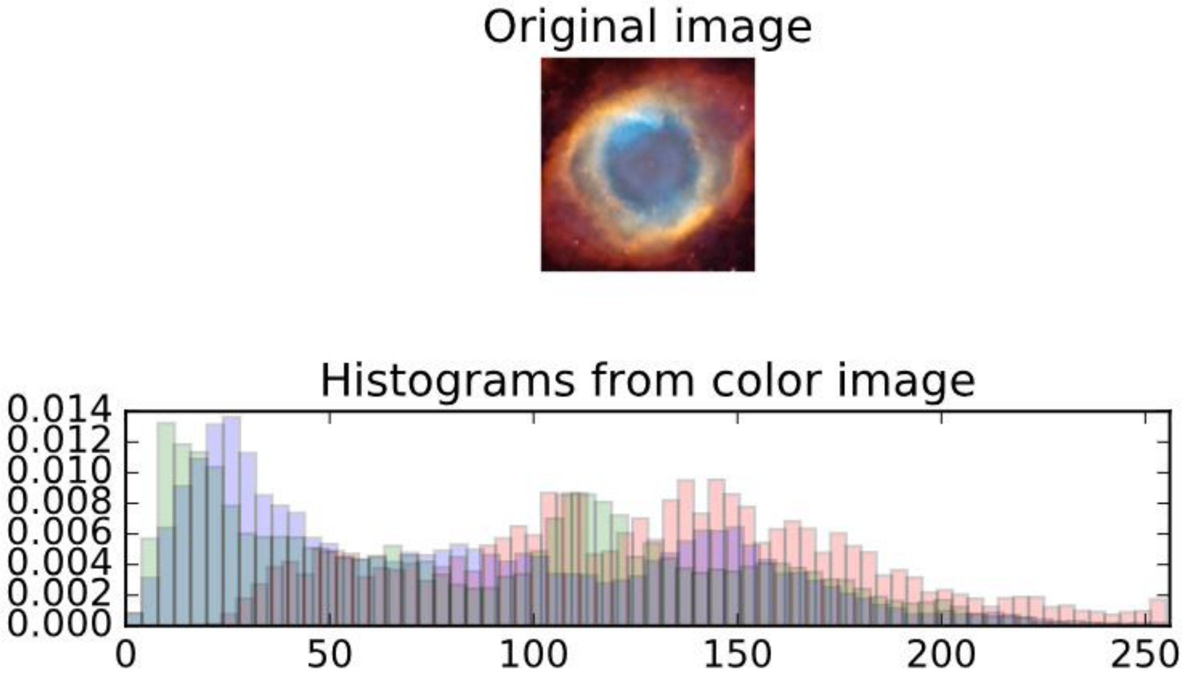
i). Equalizing an image histogram

```
# Load the image into an array: image
image = plt.imread('640px-Unequalized_Hawkes_Bay_NZ.jpg')

# Flatten the image into 1 dimension: pixels
pixels = image.flatten()

# Generate a cumulative histogram
cdf, bins, patches = plt.hist(pixels, bins=256, range=(0,256), normed=True, cumulative=True)
new_pixels = np.interp(pixels, bins[:-1], cdf*255)

# Reshape new_pixels as a 2-D array: new_image
new_image = new_pixels.reshape(image.shape)

# Display the new image with 'gray' color map
plt.subplot(2,1,1)
plt.title('Equalized image')
plt.axis('off')
plt.imshow(new_image,cmap='gray')

# Generate a histogram of the new pixels
plt.subplot(2,1,2)
pdf = plt.hist(new_pixels, bins=64, range=(0,256), normed=False,
        color='red', alpha=0.4)
plt.grid('off')

# Use plt.twinx() to overlay the CDF in the bottom subplot
plt.twinx()
plt.xlim((0,256))
plt.grid('off')


# Add title

plt.title('PDF & CDF (equalized image)')


# Generate a cumulative histogram of the new pixels

cdf = plt.hist(new_pixels, bins=64, range=(0,256),

            cumulative=True, normed=True,

            color='blue', alpha=0.4)

plt.show()
```



j). Extracting histograms from a color image

```
# Load the image into an array: image
image = plt.imread('hs-2004-32-b-small_web.jpg')

# Display image in top subplot
plt.subplot(2,1,1)
plt.title('Original image')
plt.axis('off')
plt.imshow(image)

# Extract 2-D arrays of the RGB channels: red, blue, green
red, green, blue = image[:,:,0], image[:,:,1], image[:,:,2]

# Flatten the 2-D arrays of the RGB channels into 1-D
red_pixels = red.flatten()
blue_pixels = blue.flatten()
green_pixels = green.flatten()

# Overlay histograms of the pixels of each color in the bottom subplot
plt.subplot(2,1,2)
plt.title('Histograms from color image')
plt.xlim((0,256))
plt.hist(red_pixels, bins=64, normed=True, color='red', alpha=0.2)
plt.hist(blue_pixels, bins=64, normed=True, color='blue', alpha=0.2)
plt.hist(green_pixels, bins=64, normed=True, color='green', alpha=0.2)

# Display the plot
plt.show()
```

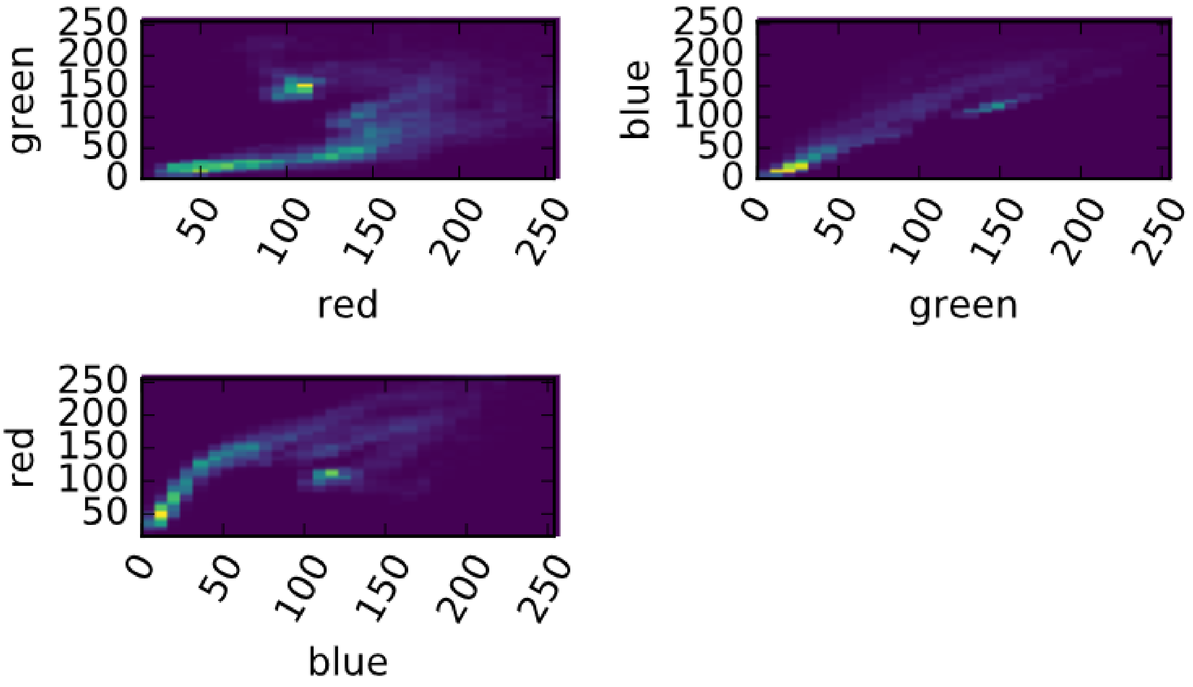


Original image

Histograms from color image

k). Extracting bivariate histograms from a color image

```
# Load the image into an array: image
image = plt.imread('hs-2004-32-b-small_web.jpg')

# Extract RGB channels and flatten into 1-D array
red, blue, green = image[:,:,0], image[:,:,1], image[:,:,2]
red_pixels = red.flatten()
blue_pixels = blue.flatten()
green_pixels = green.flatten()

# Generate a 2-D histogram of the red and green pixels
plt.subplot(2,2,1)
plt.grid('off')
plt.xticks(rotation=60)
plt.xlabel('red')
plt.ylabel('green')
plt.hist2d(x=red_pixels,y=green_pixels,bins=(32,32))

# Generate a 2-D histogram of the green and blue pixels
plt.subplot(2,2,2)
plt.grid('off')
plt.xticks(rotation=60)
plt.xlabel('green')
plt.ylabel('blue')
plt.hist2d(x=green_pixels,y=blue_pixels,bins=(32,32))

# Generate a 2-D histogram of the blue and red pixels
plt.subplot(2,2,3)
plt.grid('off')
plt.xticks(rotation=60)
plt.xlabel('blue')
plt.ylabel('red')
plt.hist2d(x=blue_pixels,y=red_pixels,bins=(32,32))

# Display the plot
plt.show()
```


green
red
blue
green
red
blue