Chapter12

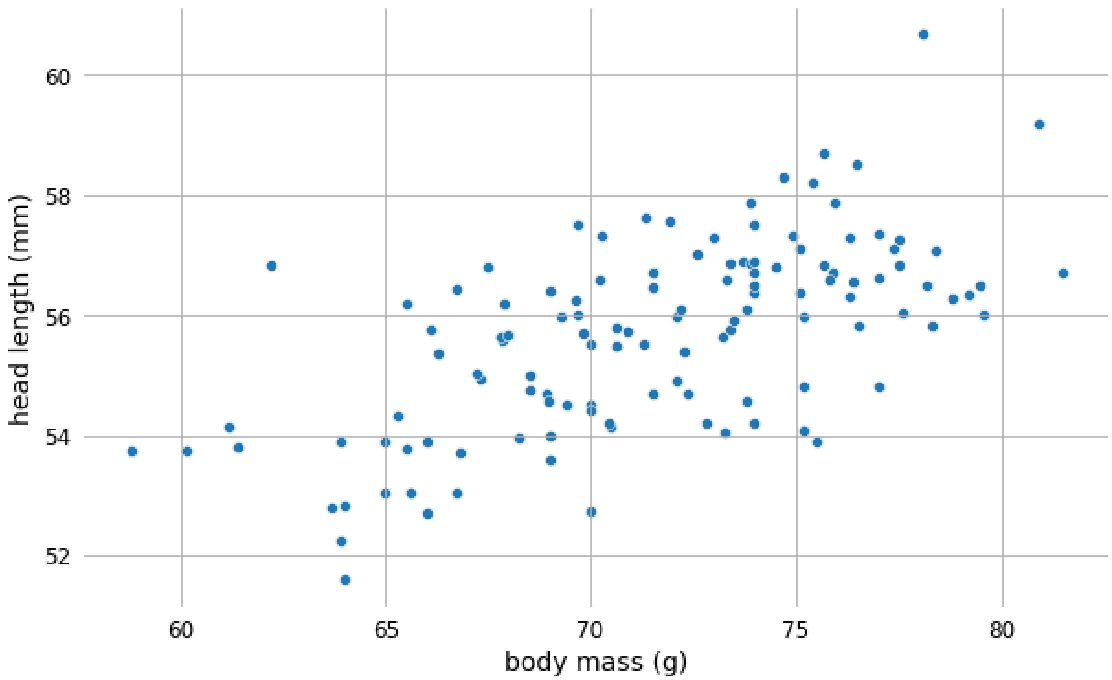
August 4, 2023

[274]:
```
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib.ticker as ticker

import seaborn as sns

import os
```

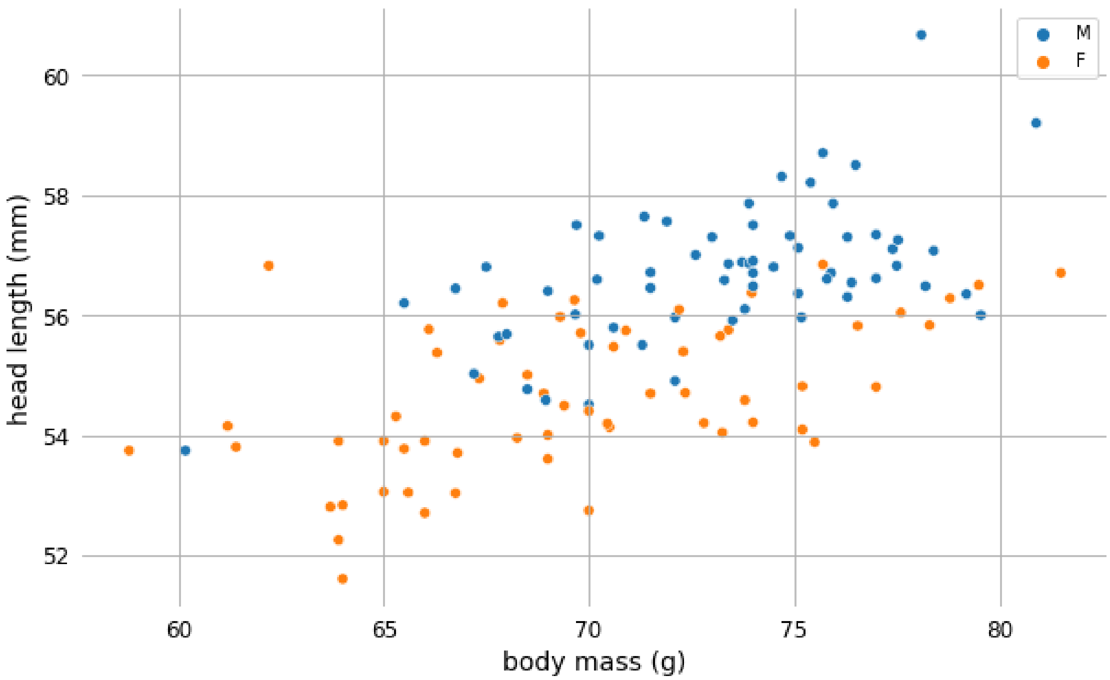
0.0.1 Scatter plots

[3]:
```
blue_jays = pd.read_csv(os.path.join('data','blue_jays.csv'))
```

[4]:
```
fig, ax = plt.subplots(1,1,figsize = (10,6))
sns.scatterplot(
    data = blue_jays,
    x = 'Mass',
    y = 'Head'
    )
ax.spines[:].set_visible(False)
ax.xaxis.set_ticks_position('none')
ax.yaxis.set_ticks_position("none")

ax.tick_params(axis='both', which='major', labelsize = 12)

ax.set_xlabel('body mass (g)', fontsize=14)
ax.set_ylabel('head length (mm)', fontsize=14)
ax.grid()
```

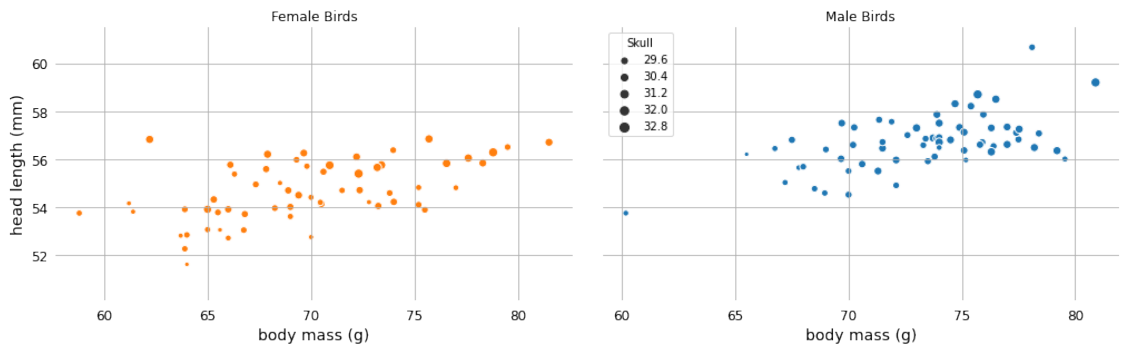


[5]:
```
fig, ax = plt.subplots(1,1,figsize = (10,6))
sns.scatterplot(
    data = blue_jays,
    x = 'Mass',
    y = 'Head',
    hue = "KnownSex"
    )
ax.spines[:].set_visible(False)
ax.xaxis.set_ticks_position('none')
ax.yaxis.set_ticks_position("none")

ax.set_xlabel('body mass (g)', fontsize=14)
ax.set_ylabel('head length (mm)', fontsize=14)

ax.tick_params(axis='both', which='major', labelsize = 12)
ax.legend(title='')
ax.grid()
```



[8]:
```
fig, (ax1, ax2) = plt.subplots(1,2,figsize = (14,4), sharey=True)
plt.tight_layout()
sns.scatterplot(
    data = blue_jays[blue_jays['KnownSex']=='F'],
    x = 'Mass',
    y = 'Head',
    color = '#ff7f0e',
    size = 'Skull',
    edgecolor = 'w',
    linewidth = 1,
    ax = ax1
    )

sns.scatterplot(
    data = blue_jays[blue_jays['KnownSex']=='M'],
    x = 'Mass',
    y = 'Head',
    color = '#1f77b4',
    size = 'Skull',
    edgecolor = 'w',
    linewidth = 1,
    ax = ax2
    )
```

```
ax1.spines[:].set_visible(False)
ax1.xaxis.set_ticks_position('none')
ax1.yaxis.set_ticks_position("none")

ax1.set_xlabel('body mass (g)', fontsize=14)
ax1.set_ylabel('head length (mm)', fontsize=14)

ax1.set_ylim([50.1,61.5])
ax1.tick_params(axis='both', which='major', labelsize = 12)
ax1.get_legend().remove()
ax1.set_title('Female Birds')
ax1.grid()


ax2.spines[:].set_visible(False)
ax2.xaxis.set_ticks_position('none')
ax2.yaxis.set_ticks_position("none")
ax2.set_ylim([50.1,61.5])

ax2.set_xlabel('body mass (g)', fontsize=14)
ax2.set_ylabel('head length (mm)', fontsize=14)

ax2.tick_params(axis='both', which='major', labelsize = 12)
ax2.set_title('Male Birds')
ax2.grid()
```

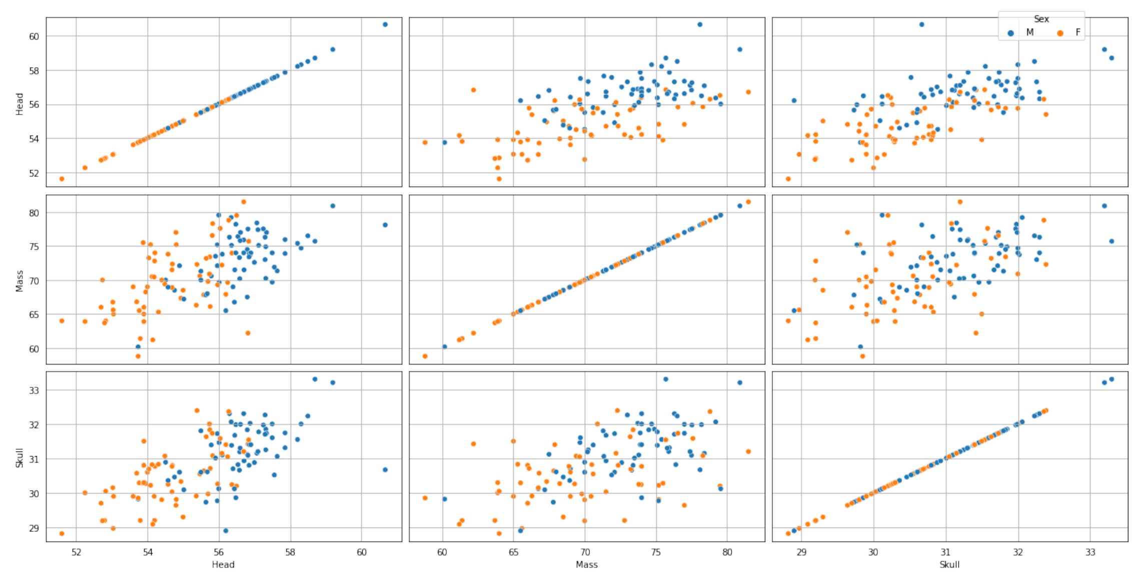


0.0.2 All-against-all Plot

[66]:
```
axes = sns.pairplot(
    data=blue_jays,
    x_vars = ['Head', 'Mass', 'Skull'],
    y_vars = ['Head', 'Mass', 'Skull'],
    hue = 'KnownSex',
```

```
    diag_kind = None,
    height = 3,
    aspect = 2,
)

for ax in axes.axes.flatten():
    ax.xaxis.set_ticks_position('none')
    ax.yaxis.set_ticks_position('none')
    ax.grid()
    ax.spines['top'].set_visible(True)
    ax.spines['right'].set_visible(True)

axes._legend.remove()
handles = axes._legend_data.values()
labels = axes._legend_data.keys()


axes.fig.legend(handles=handles, labels=labels, loc='upper right', bbox_to_anchor = (.91,1), title = 'Sex',ncol=2)
```

[66]: <matplotlib.legend.Legend at 0x7fa6cd05d160>

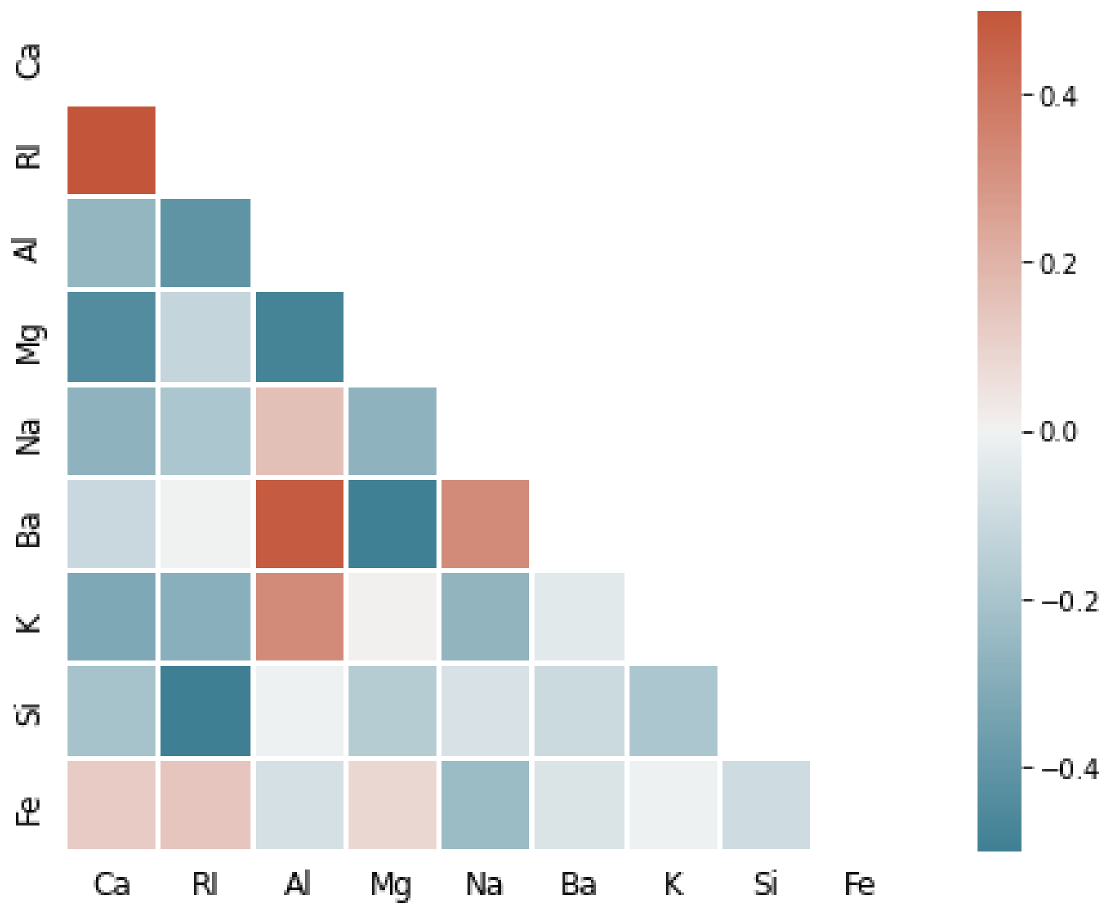


0.1 12.2 Correlograms

[174]:
```
forensic_glass = pd.read_csv(os.path.join('data','forensic_glass.csv'))
corr_matrix = forensic_glass.iloc[:,:-1].corr()
```

[176]:
```
cols = ['Ca', 'RI', 'Al', 'Mg', 'Na', 'Ba', 'K', 'Si', 'Fe']
corr_matrix = corr_matrix[cols].reindex(cols)
```

[177]:
```
fig, ax = plt.subplots(1,1,figsize=(10,6))
mask = np.triu(np.ones_like(corr_matrix,dtype=bool))
sns.heatmap(
    corr_matrix,
    mask = mask,
    # annot = True,
    linewidth = 2,
    square = True,
    center = 0,
    vmin = -.5,
    vmax = .5,
    cmap = sns.diverging_palette(220, 20, as_cmap=True)
)
ax.xaxis.set_ticks_position('none')
ax.yaxis.set_ticks_position('none')
ax.tick_params(axis = 'both', which = 'major', labelsize = 12)
```



0.1.1 12.3 Dimension Reduction

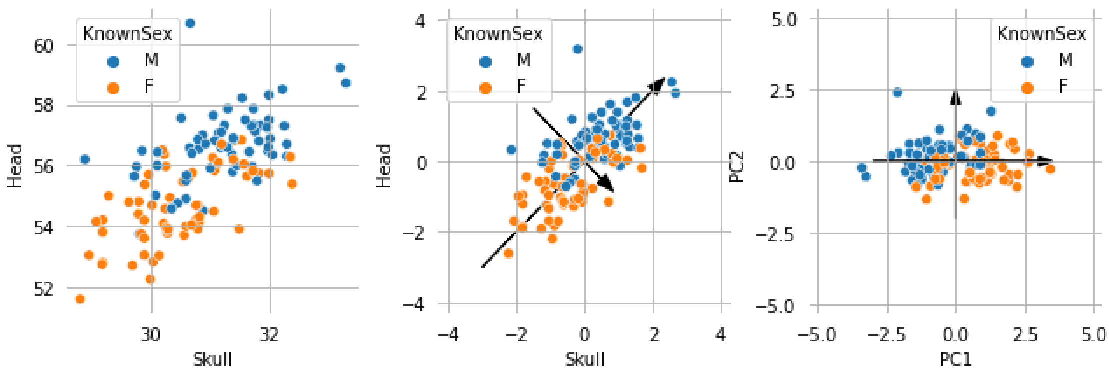
[264]:
```
from sklearn.decomposition import PCA
from sklearn.preprocessing import StandardScaler
```

[335]:
```
blue_jays = pd.read_csv(os.path.join('data','blue_jays.csv'))
fig, (ax1, ax2, ax3) = plt.subplots(1,3, figsize = (9,3))
plt.tight_layout()
sns.scatterplot(
    data = blue_jays,
    x = 'Skull',
    y = 'Head',
    hue = 'KnownSex',
    ax = ax1,
    )

ax1.spines[:].set_visible(False)
ax1.xaxis.set_ticks_position('none')
ax1.yaxis.set_ticks_position('none')

ax1.xaxis.set_major_locator(ticker.MultipleLocator(2))
ax1.yaxis.set_major_locator(ticker.MultipleLocator(2))
ax1.grid()

scaler = StandardScaler()
blue_jays[['Head','Skull']] = scaler.fit_transform(blue_jays[['Head','Skull']])
pca = PCA(n_components = 2).fit(blue_jays[['Head','Skull']])
ax2.grid()
comps = pca.components_
exp_var = pca.explained_variance_

comp0 = comps[0,:]*exp_var[0]
comp1 = comps[1,:]*exp_var[1]

x11 = -3
y11 = comp0[1]/comp0[0]*x11

dx12 = 5
dy12 = comp0[1]/comp0[0]*x12

x21 = -1.5
y21 = comp1[1]/comp1[0]*x21

dx22 = 2
dy22 = comp1[1]/comp1[0]*x22
```

```
ax2.arrow(
    x11,
    y11,
    dx12,
    dy12,
    head_width = 0.35,
    head_length = 0.5,
    color = 'k'
)

ax2.arrow(
    x21,
    y21,
    dx22,
    dy22,
    head_width = 0.35,
    head_length = 0.5,
    color = 'k'
)

sns.scatterplot(
    data = blue_jays,
    x = 'Skull',
    y = 'Head',
    hue = 'KnownSex',
    ax = ax2,
)

ax2.spines[:].set_visible(False)
ax2.set_ylim([-4.3,4.3])
ax2.set_xlim([-4.3,4.3])
ax2.xaxis.set_major_locator(ticker.MultipleLocator(2))
ax2.yaxis.set_major_locator(ticker.MultipleLocator(2))
ax2.xaxis.set_ticks_position('none')
ax2.yaxis.set_ticks_position('none')


transf_features = pca.transform(blue_jays[['Head','Skull']])
blue_jays[['PC1','PC2']] = transf_features
sns.scatterplot(
    data = blue_jays,
    x = 'PC1',
    y = 'PC2',
    hue = 'KnownSex',
    ax = ax3
    )
```

```
ax3.grid()
ax3.spines[:].set_visible(False)
ax3.set_ylim([-5.3,5.3])
ax3.set_xlim([-5.3,5.3])
ax3.xaxis.set_ticks_position('none')
ax3.yaxis.set_ticks_position('none')
ax3.xaxis.set_major_locator(ticker.MultipleLocator(2.5))
ax3.yaxis.set_major_locator(ticker.MultipleLocator(2.5))
ax3.arrow(-3.0,0.0,6.0,0.0,head_width = 0.35,head_length = 0.5, color = 'k')
ax3.arrow(0.0,-2.0,0.0,4.0,head_width = 0.35,head_length = 0.5, color = 'k')
```

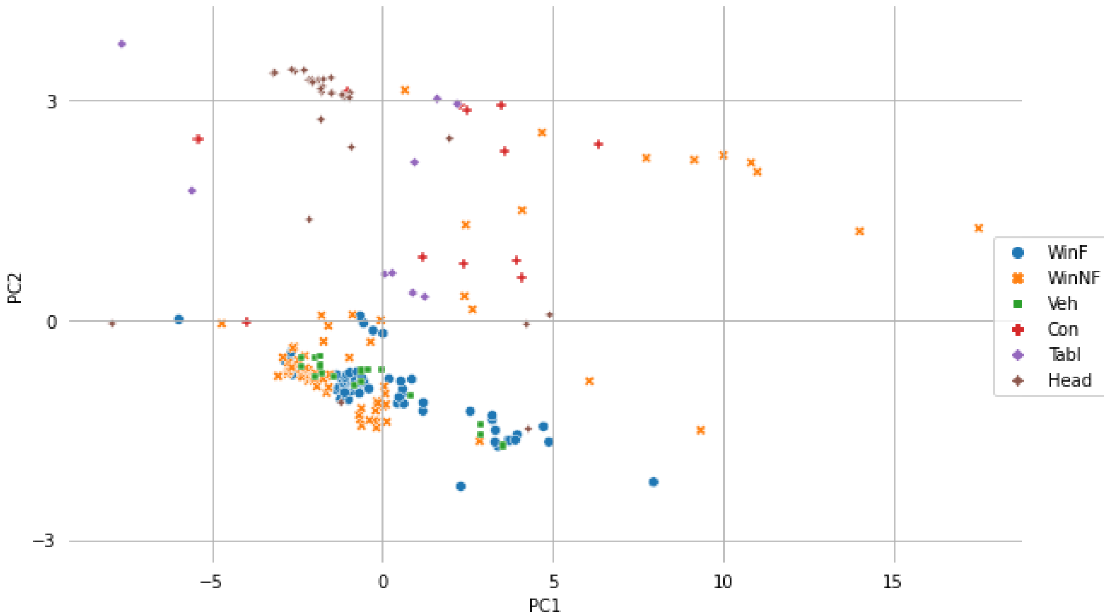
[335]: <matplotlib.patches.FancyArrow at 0x7fa6bcdf75e0>



[350]:
```
forensic_glass_data = forensic_glass.iloc[:,:-1]
pca = PCA(n_components = 2).fit(forensic_glass_data)
X = pca.transform(forensic_glass_data)
transf_data = pd.DataFrame(X,columns = ['PC1','PC2'])
transf_data['Type'] = forensic_glass['type']
```

[376]:
```
fig, ax = plt.subplots(1,1,figsize = (10,6))
sns.scatterplot(
    data = transf_data,
    x = 'PC1',
    y = 'PC2',
    hue = 'Type',
    style = 'Type',
    # size = 20,
    ax = ax
)
ax.spines[:].set_visible(False)
ax.set_ylim([-3.3, 4.3])
ax.grid()
ax.yaxis.set_ticks_position('none')
```

```
ax.xaxis.set_ticks_position('none')
ax.legend(bbox_to_anchor=(1.1,0.6))
ax.yaxis.set_major_locator(ticker.MultipleLocator(3))
```



0.1.2 12.4 Paired Data

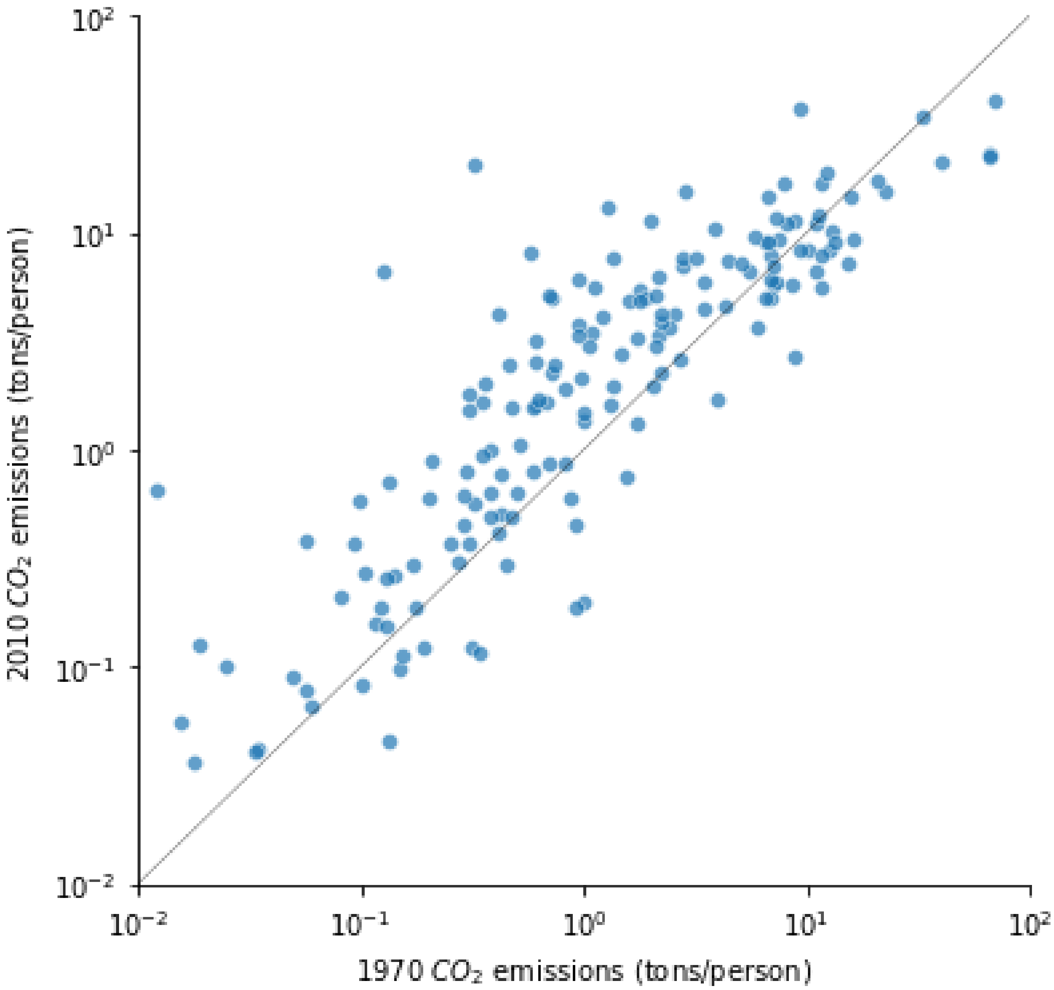
[380]:
```
CO2_emissions = pd.read_csv(os.path.join('data','CO2_emissions.csv'))
```

[386]:
```
CO2_emissions_2010= CO2_emissions[CO2_emissions['year']==2010]
CO2_emissions_1970= CO2_emissions[CO2_emissions['year']==1970]
CO2_emissions_merge = pd.merge(CO2_emissions_2010, CO2_emissions_1970, right_on␣
↪= 'country', left_on = 'country', how = 'inner')
```

[422]:
```
fig, ax = plt.subplots(1,1,figsize = (6,6))
sns.scatterplot(
    data = CO2_emissions_merge,
    x = 'emissions_y',
    y = 'emissions_x',
    alpha = 0.7
)
ax.set_ylim([0.0099,101])
ax.set_xlim([0.0099,101])
plt.xscale('log')
plt.yscale('log')
ax.set_xlabel('1970 $CO_2$ emissions (tons/person)')
ax.set_ylabel('2010 $CO_2$ emissions (tons/person)')
```

```
ax.minorticks_off()
ax.spines["top"].set_visible(False)
ax.spines['right'].set_visible(False)
ax.plot([0,100],[0,100],color='k',alpha = 0.6, linewidth = .5)
```

[422]: [<matplotlib.lines.Line2D at 0x7fa6c3a61d90>]

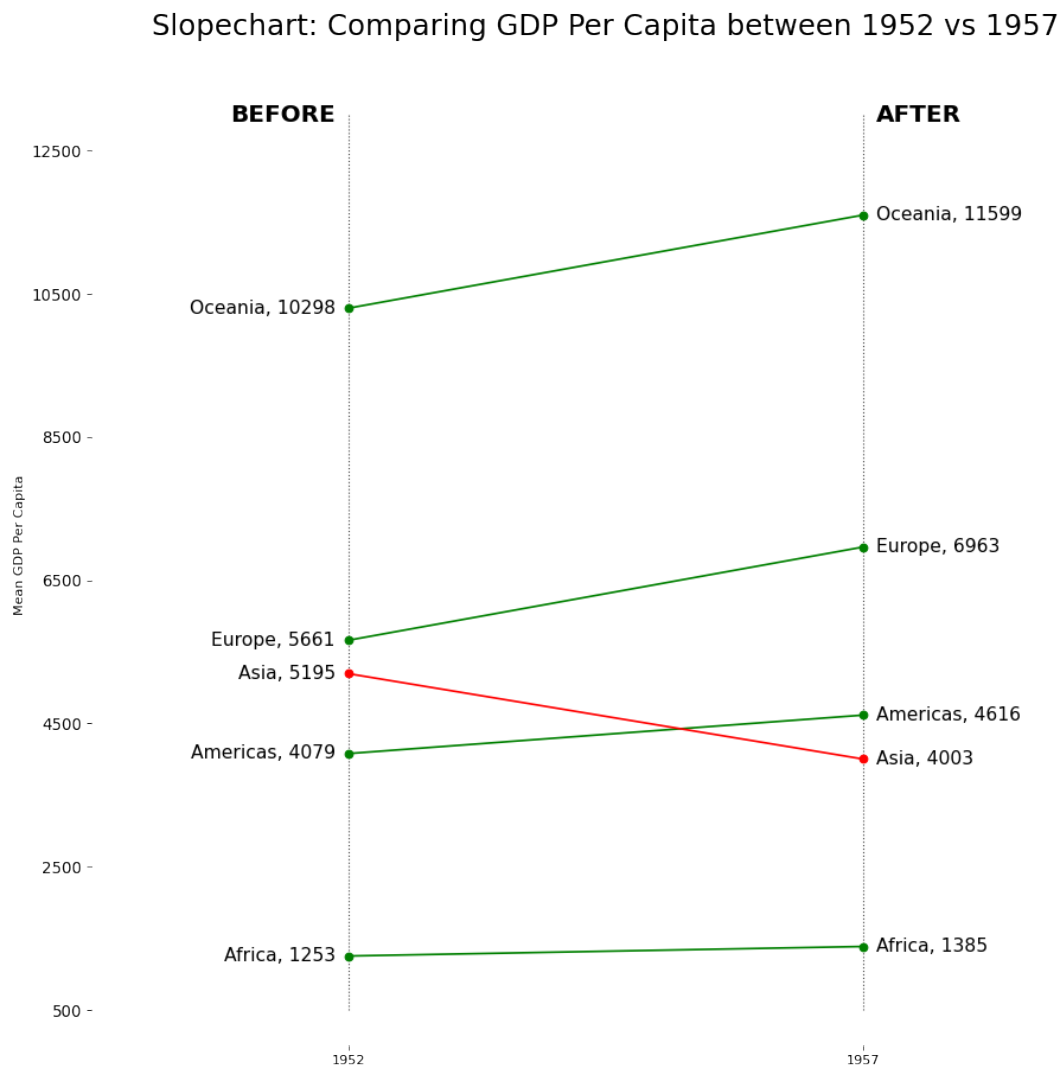


[ ]:

[435]:
```
import matplotlib.lines as mlines
# Import Data
df = pd.read_csv("https://raw.githubusercontent.com/selva86/datasets/master/
↪gdppercap.csv")
```

```python
left_label = [str(c) + ', '+ str(round(y)) for c, y in zip(df.continent, df['1952'])]
right_label = [str(c) + ', '+ str(round(y)) for c, y in zip(df.continent, df['1957'])]
klass = ['red' if (y1-y2) < 0 else 'green' for y1, y2 in zip(df['1952'], df['1957'])]

# draw line
# https://stackoverflow.com/questions/36470343/how-to-draw-a-line-with-matplotlib/36479941
def newline(p1, p2, color='black'):
    ax = plt.gca()
    l = mlines.Line2D([p1[0],p2[0]], [p1[1],p2[1]], color='red' if p1[1]-p2[1] > 0 else 'green', marker='o', markersize=6)
    ax.add_line(l)
    return l

fig, ax = plt.subplots(1,1,figsize=(14,14), dpi= 80)

# Vertical Lines
ax.vlines(x=1, ymin=500, ymax=13000, color='black', alpha=0.7, linewidth=1, linestyles='dotted')
ax.vlines(x=3, ymin=500, ymax=13000, color='black', alpha=0.7, linewidth=1, linestyles='dotted')

# Points
ax.scatter(y=df['1952'], x=np.repeat(1, df.shape[0]), s=10, color='black', alpha=0.7)
ax.scatter(y=df['1957'], x=np.repeat(3, df.shape[0]), s=10, color='black', alpha=0.7)

# Line Segmentsand Annotation
for p1, p2, c in zip(df['1952'], df['1957'], df['continent']):
    newline([1,p1], [3,p2])
    ax.text(1-0.05, p1, c + ', ' + str(round(p1)), horizontalalignment='right', verticalalignment='center', fontdict={'size':14})
    ax.text(3+0.05, p2, c + ', ' + str(round(p2)), horizontalalignment='left', verticalalignment='center', fontdict={'size':14})

# 'Before' and 'After' Annotations
ax.text(1-0.05, 13000, 'BEFORE', horizontalalignment='right', verticalalignment='center', fontdict={'size':18, 'weight':700})
ax.text(3+0.05, 13000, 'AFTER', horizontalalignment='left', verticalalignment='center', fontdict={'size':18, 'weight':700})

# Decoration
```

```
ax.set_title("Slopechart: Comparing GDP Per Capita between 1952 vs 1957",␣
 ↪fontdict={'size':22})
ax.set(xlim=(0,4), ylim=(0,14000), ylabel='Mean GDP Per Capita')
ax.set_xticks([1,3])
ax.set_xticklabels(["1952", "1957"])
plt.yticks(np.arange(500, 13000, 2000), fontsize=12)

# Lighten borders
plt.gca().spines["top"].set_alpha(.0)
plt.gca().spines["bottom"].set_alpha(.0)
plt.gca().spines["right"].set_alpha(.0)
plt.gca().spines["left"].set_alpha(.0)
plt.show()
```



[ ]:

```

```

[ ]:

```

```

[ ]:

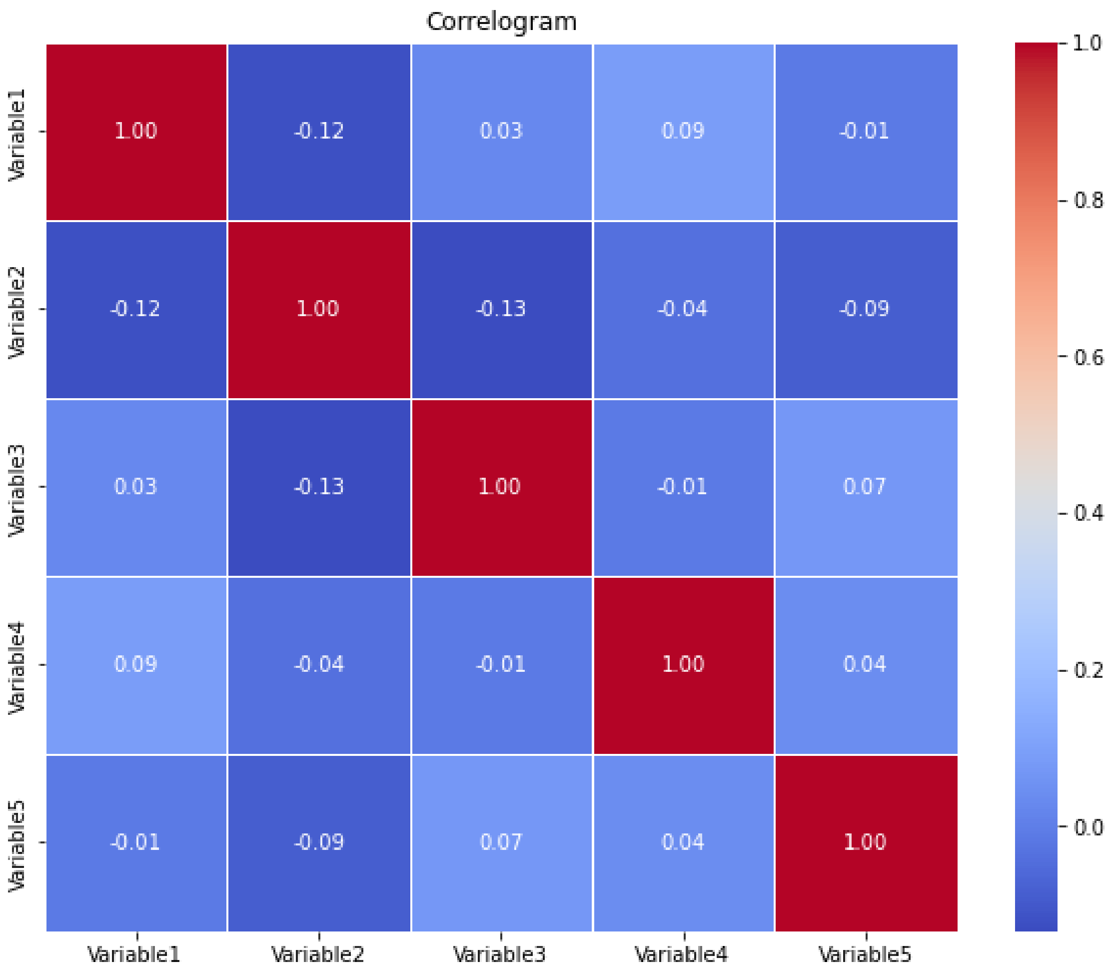
```

```

[ ]:

```

```

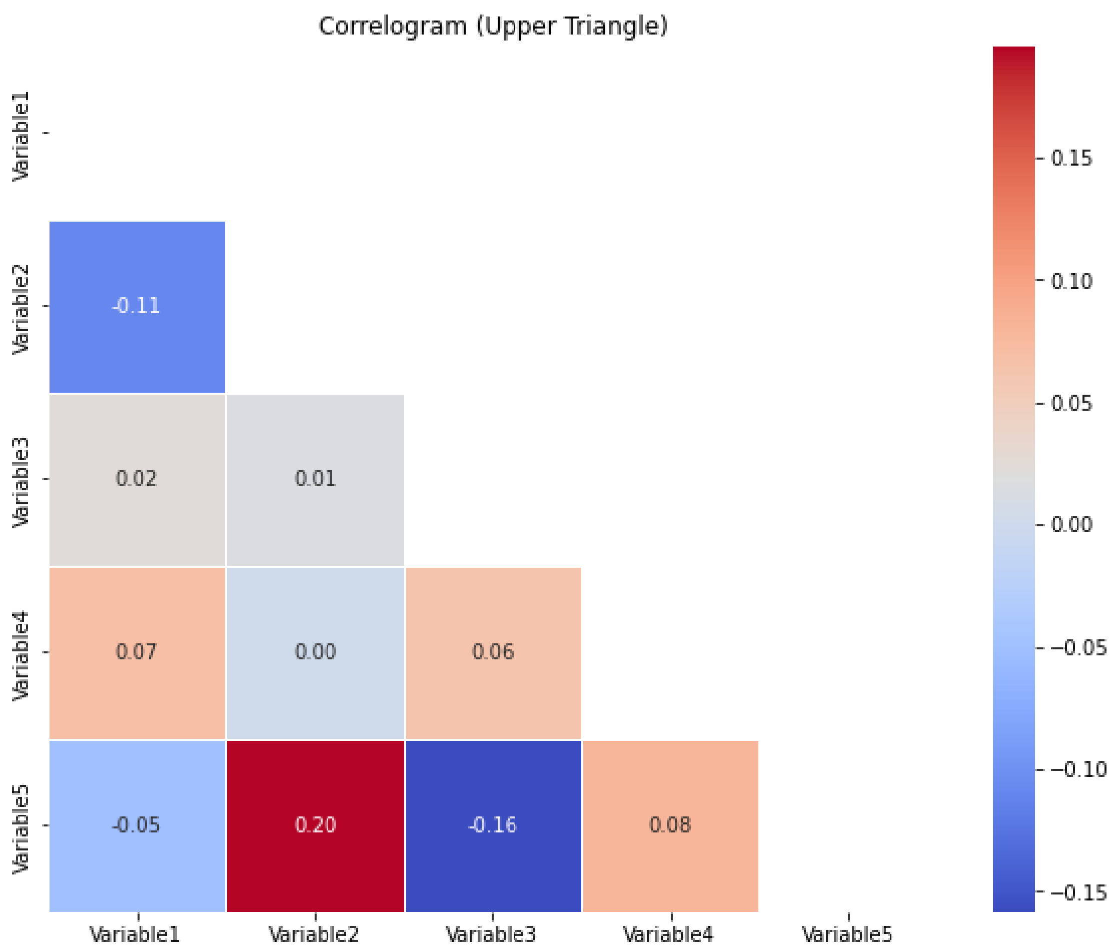
[72]:

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt

# Sample data (Replace this with your own dataset)
data = pd.DataFrame({
    'Variable1': np.random.rand(100),
    'Variable2': np.random.rand(100),
    'Variable3': np.random.rand(100),
    'Variable4': np.random.rand(100),
    'Variable5': np.random.rand(100)
})

# Calculate the correlation matrix
correlation_matrix = data.corr()

# Create a heatmap (correlogram) using seaborn
plt.figure(figsize=(10, 8))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt='.2f',␣
 ↪linewidths=0.5)
plt.title('Correlogram')
plt.show()
```



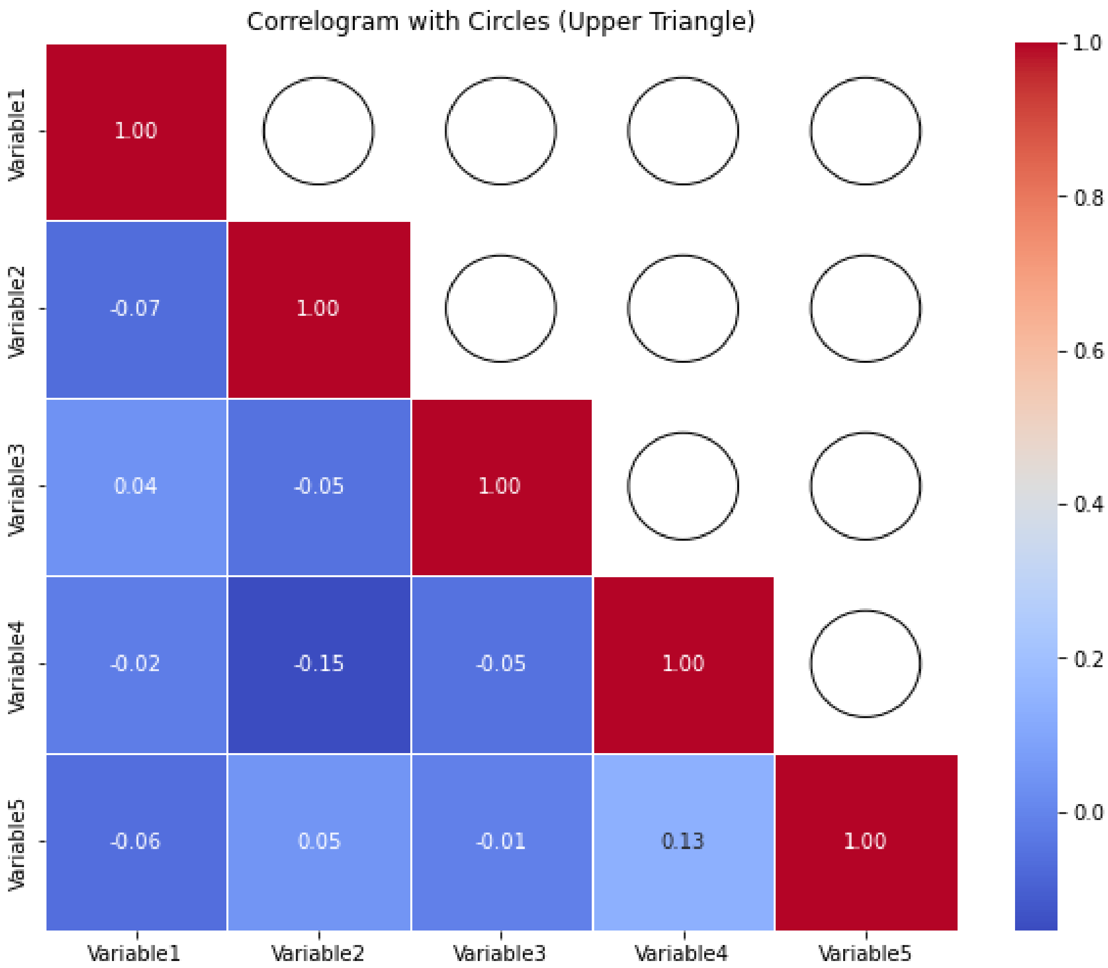
[73]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt

# Sample data (Replace this with your own dataset)
data = pd.DataFrame({
    'Variable1': np.random.rand(100),
    'Variable2': np.random.rand(100),
    'Variable3': np.random.rand(100),
    'Variable4': np.random.rand(100),
    'Variable5': np.random.rand(100)
})

# Calculate the correlation matrix
correlation_matrix = data.corr()
```

```
# Create a mask for the lower triangle
mask = np.triu(np.ones_like(correlation_matrix, dtype=bool))

# Create a heatmap (correlogram) using seaborn, masking the lower triangle
plt.figure(figsize=(10, 8))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt='.2f',␣
↪linewidths=0.5, mask=mask)
plt.title('Correlogram (Upper Triangle)')
plt.show()
```



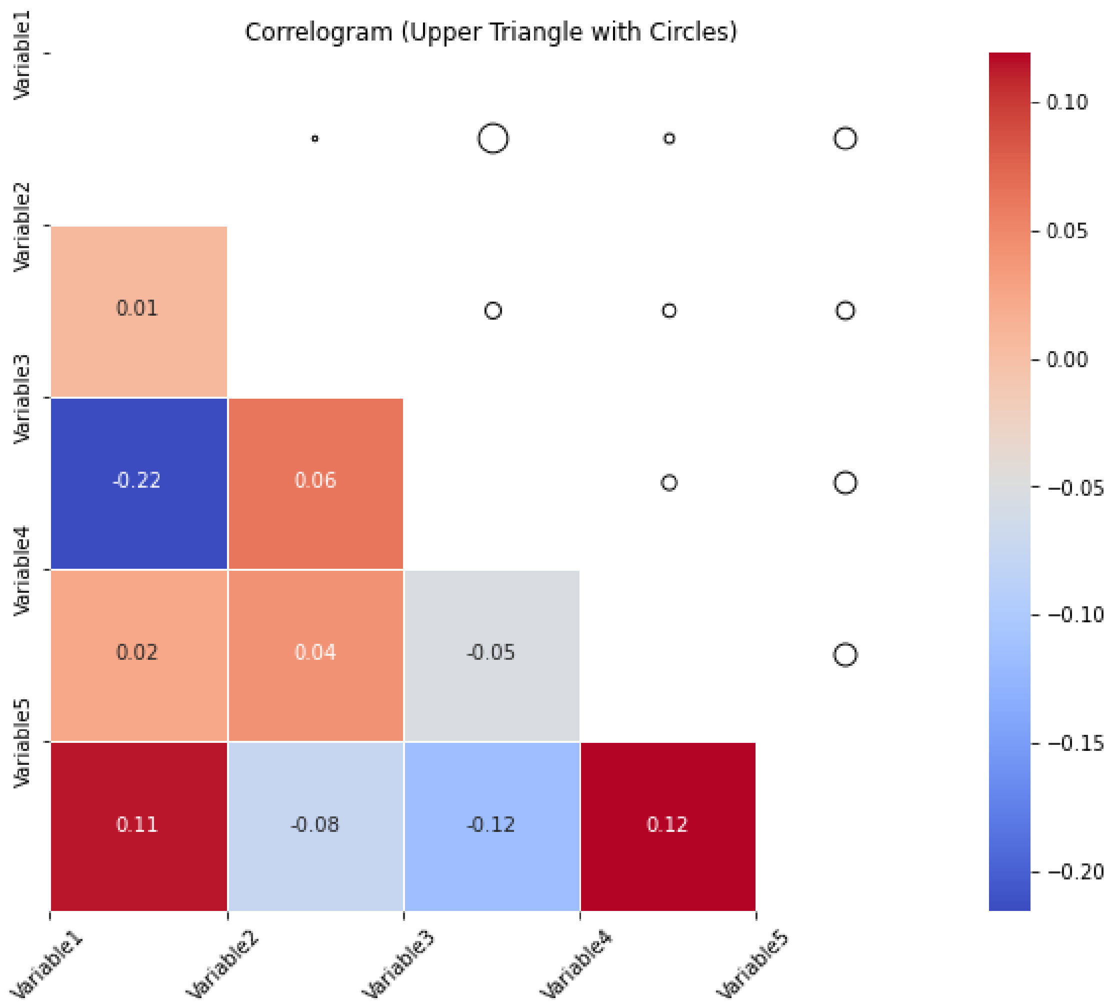
[75]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from matplotlib.patches import Circle
```

```
# Sample data (Replace this with your own dataset)
data = pd.DataFrame({
    'Variable1': np.random.rand(100),
    'Variable2': np.random.rand(100),
    'Variable3': np.random.rand(100),
    'Variable4': np.random.rand(100),
    'Variable5': np.random.rand(100)
})

# Calculate the correlation matrix
correlation_matrix = data.corr()

# Create a circular mask for the upper triangle
mask = np.zeros_like(correlation_matrix, dtype=bool)
mask[np.triu_indices_from(mask, k=1)] = True

# Create a heatmap (correlogram) using seaborn, masking the upper triangle with␣
 ↪circles
plt.figure(figsize=(10, 8))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt='.2f',␣
 ↪linewidths=0.5, mask=mask)

# Add circular cutouts to the heatmap
for i in range(correlation_matrix.shape[0]):
    for j in range(i + 1, correlation_matrix.shape[1]):
        if mask[i, j]:
            circle = Circle((j + 0.5, i + 0.5), 0.3, facecolor='white',␣
 ↪edgecolor='black')
            plt.gca().add_patch(circle)

plt.title('Correlogram with Circles (Upper Triangle)')
plt.show()
```



[78]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt

# Sample data (Replace this with your own dataset)
data = pd.DataFrame({
    'Variable1': np.random.rand(100),
    'Variable2': np.random.rand(100),
    'Variable3': np.random.rand(100),
    'Variable4': np.random.rand(100),
    'Variable5': np.random.rand(100)
})

# Calculate the correlation matrix
correlation_matrix = data.corr()
```

```python
# Create a mask for the lower triangle
mask = np.triu(np.ones_like(correlation_matrix, dtype=bool))

# Create a heatmap using seaborn
plt.figure(figsize=(10, 8))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt='.2f',␣
↪linewidths=0.5, mask=mask)

# Plot circles over the heatmap
for i in range(len(correlation_matrix)):
    for j in range(i+1, len(correlation_matrix)):
        plt.scatter(j + 0.5, i + 0.5, s=1000 * abs(correlation_matrix.iloc[i,␣
↪j]), color='white', edgecolor='black')

plt.title('Correlogram (Upper Triangle with Circles)')
plt.xticks(range(len(correlation_matrix.columns)), correlation_matrix.columns,␣
↪rotation=45)
plt.yticks(range(len(correlation_matrix.columns)), correlation_matrix.columns)
plt.show()
```

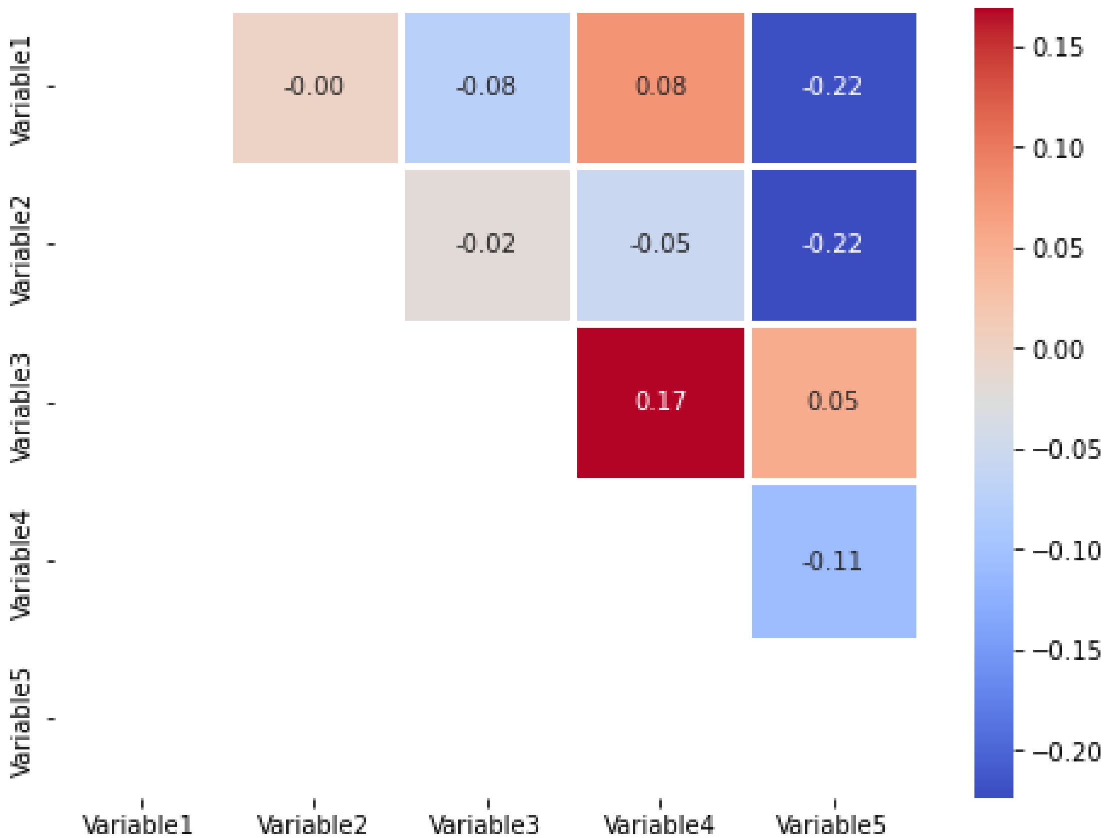


[90]:

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt

# Sample data (Replace this with your own dataset)
data = pd.DataFrame({
    'Variable1': np.random.rand(100),
    'Variable2': np.random.rand(100),
    'Variable3': np.random.rand(100),
    'Variable4': np.random.rand(100),
    'Variable5': np.random.rand(100)
})

# Calculate the correlation matrix
```

```
correlation_matrix = data.corr()

# Create a mask for the upper triangle
mask = np.tril(np.ones_like(correlation_matrix, dtype=bool))

# Create a heatmap using seaborn
plt.figure(figsize=(8, 6))
sns.heatmap(correlation_matrix, annot=True, square=False, cmap='coolwarm',␣
↪fmt='.2f', linewidths=3, mask=mask)

# Plot circles over the heatmap
# for i in range(len(correlation_matrix)):
#     for j in range(i + 1, len(correlation_matrix)):
#         plt.scatter(j + 0.5, i + 0.5, s=1000 * abs(correlation_matrix.iloc[i,␣
↪j]), color='white', edgecolor='black')

# plt.title('Correlogram (Lower Triangle with Circles)')
# plt.xticks(range(len(correlation_matrix.columns)), correlation_matrix.
↪columns, rotation=45)
# plt.yticks(range(len(correlation_matrix.columns)), correlation_matrix.columns)
# plt.show()
```

[90]: <AxesSubplot:>



[81]:
```
correlation_matrix
```

[81]:

	Variable1	Variable2	Variable3	Variable4	Variable5
Variable1	1.000000	0.133832	0.022393	-0.063948	-0.014000
Variable2	0.133832	1.000000	-0.008763	-0.025814	0.044087
Variable3	0.022393	-0.008763	1.000000	0.201253	-0.108385
Variable4	-0.063948	-0.025814	0.201253	1.000000	-0.060605
Variable5	-0.014000	0.044087	-0.108385	-0.060605	1.000000

[84]:
```
np.tril(np.ones_like(correlation_matrix,dtype=bool))
```

[84]:
```
array([[ True, False, False, False, False],
       [ True,  True, False, False, False],
       [ True,  True,  True, False, False],
       [ True,  True,  True,  True, False],
       [ True,  True,  True,  True,  True]])
```

[ ]:
```

```

[74]:
```
mask
```

[74]:
```
array([[ True,  True,  True,  True,  True],
       [False,  True,  True,  True,  True],
       [False, False,  True,  True,  True],
       [False, False, False,  True,  True],
       [False, False, False, False,  True]])
```

[67]:
```
test = blue_jays[['Head','Mass','Skull']]
```

[69]:
```
test.corr()
```

[69]:

	Head	Mass	Skull
Head	1.000000	0.629445	0.667793
Mass	0.629445	1.000000	0.552863
Skull	0.667793	0.552863	1.000000

[ ]:

[59]:
```
for ax in axes.axes.flatten():
    print(ax.xaxis.get_label())
```

```
Text(0.5, 435.8933333333332, 'Head')
Text(0.5, 435.8933333333332, 'Mass')
Text(0.5, 435.8933333333332, 'Skull')
Text(0.5, 235.04666666666662, 'Head')
Text(0.5, 235.04666666666662, 'Mass')
Text(0.5, 235.04666666666662, 'Skull')
Text(0.5, 17.200000000000003, 'Head')
Text(0.5, 17.200000000000003, 'Mass')
Text(0.5, 17.200000000000003, 'Skull')
```

[ ]:

[ ]:

[ ]:

[52]:
```
labels.replace({'0':'Male','1':"Female"})
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
/Users/bopei/Library/CloudStorage/Box-Box/bp/USF/Courses/Data visualization/
↪Python Version/Chapter12.ipynb Cell 9 in <cell line: 1>()
----> <a href='vscode-notebook-cell:/Users/bopei/Library/CloudStorage/Box-Box/bp/
↪USF/Courses/Data%20visualization/Python%20Version/Chapter12.
↪ipynb#X21sZmlsZQ%3D%3D?line=0'>1</a> labels.replace({'0':'Male','1':"Female"}

AttributeError: 'dict_keys' object has no attribute 'replace'
```

[49]:
```
for i in labels:
    print(i)
```

```
0
1
```

[51]:
```
labels()
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
/Users/bopei/Library/CloudStorage/Box-Box/bp/USF/Courses/Data visualization/
 ↪Python Version/Chapter12.ipynb Cell 11 in <cell line: 1>()
----> <a href='vscode-notebook-cell:/Users/bopei/Library/CloudStorage/Box-Box/bp/
 ↪USF/Courses/Data%20visualization/Python%20Version/Chapter12.
 ↪ipynb#X23sZmlsZQ%3D%3D?line=0'>1</a> labels()

TypeError: 'dict_keys' object is not callable
```

[42]:
```
axes._legend_data.values()
```

[42]:
```
dict_values([<matplotlib.collections.PathCollection object at 0x7fa6cbec60a0>,
<matplotlib.collections.PathCollection object at 0x7fa6cbec66d0>])
```

[43]:
```
axes._legend_data.keys()
```

[43]:
```
dict_keys(['0', '1'])
```

[26]:
```
for a in ax.axes.flatten():
    print(a)
```

```
AxesSubplot(0.038953,0.685453;0.300983x0.296831)
AxesSubplot(0.346287,0.685453;0.300983x0.296831)
AxesSubplot(0.65362,0.685453;0.300983x0.296831)
AxesSubplot(0.038953,0.375504;0.300983x0.296831)
AxesSubplot(0.346287,0.375504;0.300983x0.296831)
AxesSubplot(0.65362,0.375504;0.300983x0.296831)
AxesSubplot(0.038953,0.0655556;0.300983x0.296831)
AxesSubplot(0.346287,0.0655556;0.300983x0.296831)
AxesSubplot(0.65362,0.0655556;0.300983x0.296831)
```

[ ]:
```

```

[9]:
```
blue_jays
```

[9]:
```
     Unnamed: 0      BirdID KnownSex  BillDepth  BillWidth  BillLength   Head  \
0             1  0000-00000        M       8.26       9.21       25.92  56.58
1             2  1142-05901        M       8.54       8.76       24.99  56.36
2             3  1142-05905        M       8.39       8.78       26.07  57.32
```

```
3            4  1142-05907       F       7.78       9.30       23.48  53.77
4            5  1142-05909       M       8.71       9.84       25.47  57.32
..         …         …       …       …        …         …     …
118        119   962-62176       M       8.70       9.12       24.62  56.61
119        120   962-62181       M       7.96       9.80       25.07  55.68
120        121   962-62184       F       7.90       9.30       23.60  53.90
121        122   962-62185       F       7.63       8.56       24.29  54.19
122        123   962-62200       F       7.90       8.00       23.00  52.70

      Mass  Skull  Sex
0    73.30  30.66    1
1    75.10  31.38    1
2    70.25  31.25    1
3    65.50  30.29    0
4    74.90  31.85    1
..     …     …  …
118  77.00  31.99    1
119  68.00  30.61    1
120  63.90  30.30    0
121  70.45  29.90    0
122  66.00  29.70    0

[123 rows x 10 columns]
```

[ ]: