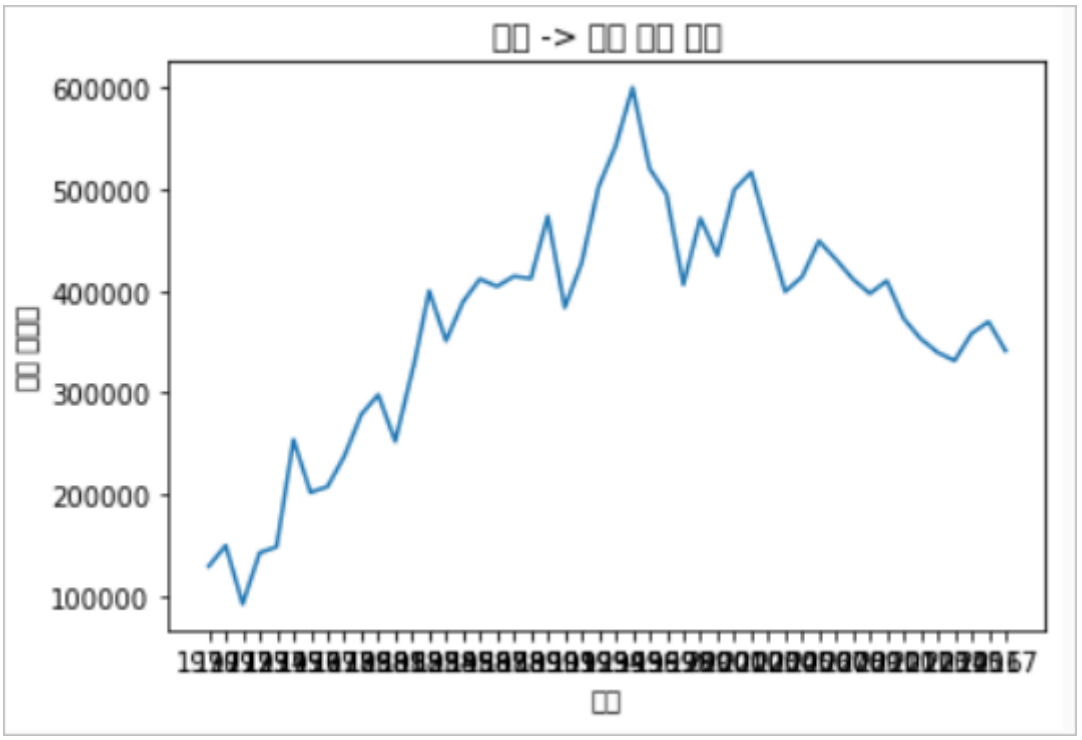
Matplotlib(멧플롯립)

예제1] part04/01matplotlib/01pyplot.py

```python
# -*- coding: utf-8 -*-
import pandas as pd
import matplotlib.pyplot as plt

df = pd.read_excel('./data/시도별 전출입 인구수.xlsx', engine='openpyxl', header=0)
#print(df.head())

df = df.fillna(method='ffill')
print(df.head())

mask = (df['전출지별']=='서울특별시') & (df['전입지별']!='서울특별시')
df_seoul = df[mask]
df_seoul = df_seoul.drop(['전출지별'], axis=1)
df_seoul.rename({'전입지별':'전입지'}, axis=1, inplace=True)
df_seoul.set_index('전입지', inplace=True)
print(df_seoul)

sr_one = df_seoul.loc['경기도']
print(sr_one)

plt.plot(sr_one.index, sr_one.values)

plt.title('서울 -> 경기 인구 이동')
plt.xlabel('기간')
plt.ylabel('이동 인구수')

plt.show()
```

결과1]

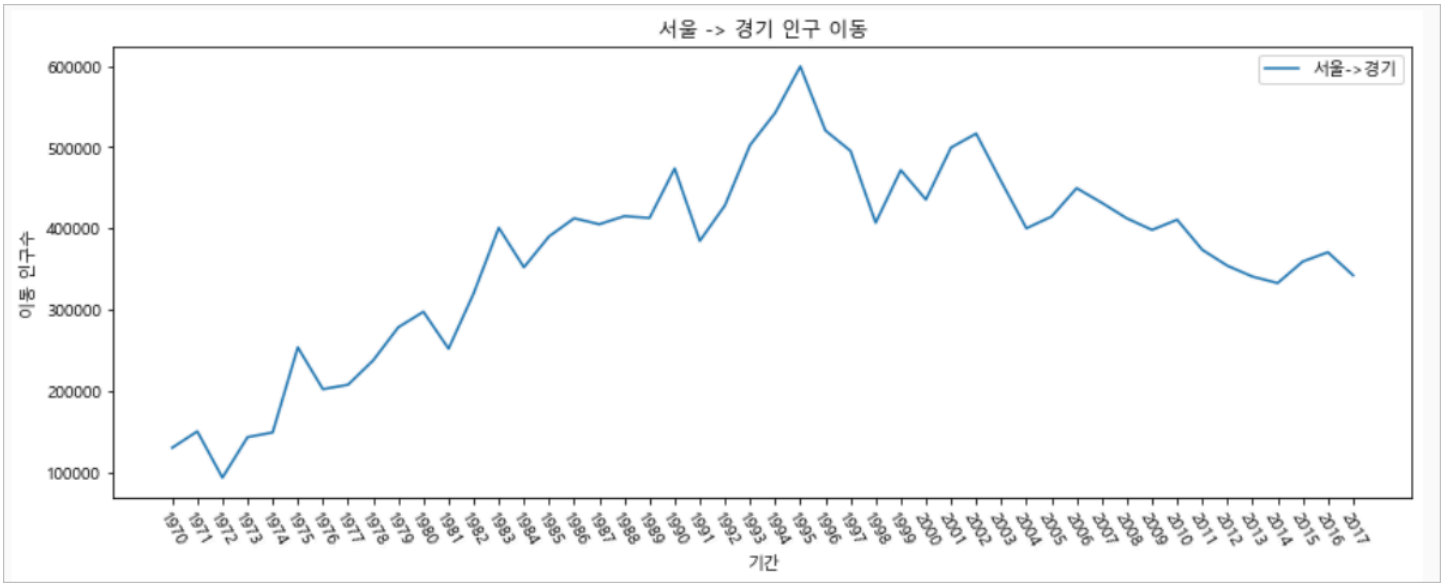


예제2] part04/01matplotlib/02hangul.py

```python
# -*- coding: utf-8 -*-
#라이브러리 임포트
import pandas as pd
import matplotlib.pyplot as plt

##한글깨짐처리start
from matplotlib import font_manager, rc
font_path = "./data/malgun.ttf"
font_name = font_manager.FontProperties(fname=font_path).get_name()
rc('font', family=font_name)
##한글깨짐처리end

#데이터프레임 만들기
df = pd.read_excel('./data/시도별 전출입 인구수.xlsx', engine='openpyxl', header=0)
df = df.fillna(method='ffill')
print(df.head())

#서울에서 경기로 전출할 데이터만 추출
mask = (df['전출지별']=='서울특별시') & (df['전입지별']!='서울특별시')
df_seoul = df[mask]
df_seoul = df_seoul.drop(['전출지별'], axis=1)
df_seoul.rename({'전입지별':'전입지'}, axis=1, inplace=True)
df_seoul.set_index('전입지', inplace=True)
print(df_seoul)
sr_one = df_seoul.loc['경기도']
print(sr_one)

##그래프 설정 추가 start
plt.figure(figsize=(14, 5))
plt.xticks(rotation='vertical')
##그래프 설정 추가 end

# x, y축 데이터를 plot 함수에 입력
plt.plot(sr_one.index, sr_one.values)

#타이틀 및 라벨설정
plt.title('서울 -> 경기 인구 이동')
plt.xlabel('기간')
plt.ylabel('이동 인구수')

##범례 추가
plt.legend(labels=['서울->경기'], loc='best')

#그래프 출력
plt.show()
```

```
#from matplotlib import font_manager, rc
from matplotlib import rc # 맥
#폰트의 경로 설정
#font_path = "../data/malgun.ttf"
#폰트파일의 이름을 속성으로 지정한다.
#font_name = font_manager.FontProperties(fname=font_path).get_name()
#폰트를 적용한다.
#rc('font', family=font_name)
rc('font', family='AppleGothic') # 맥
plt.rcParams['axes.unicode_minus'] = False # 맥
```

결과2]

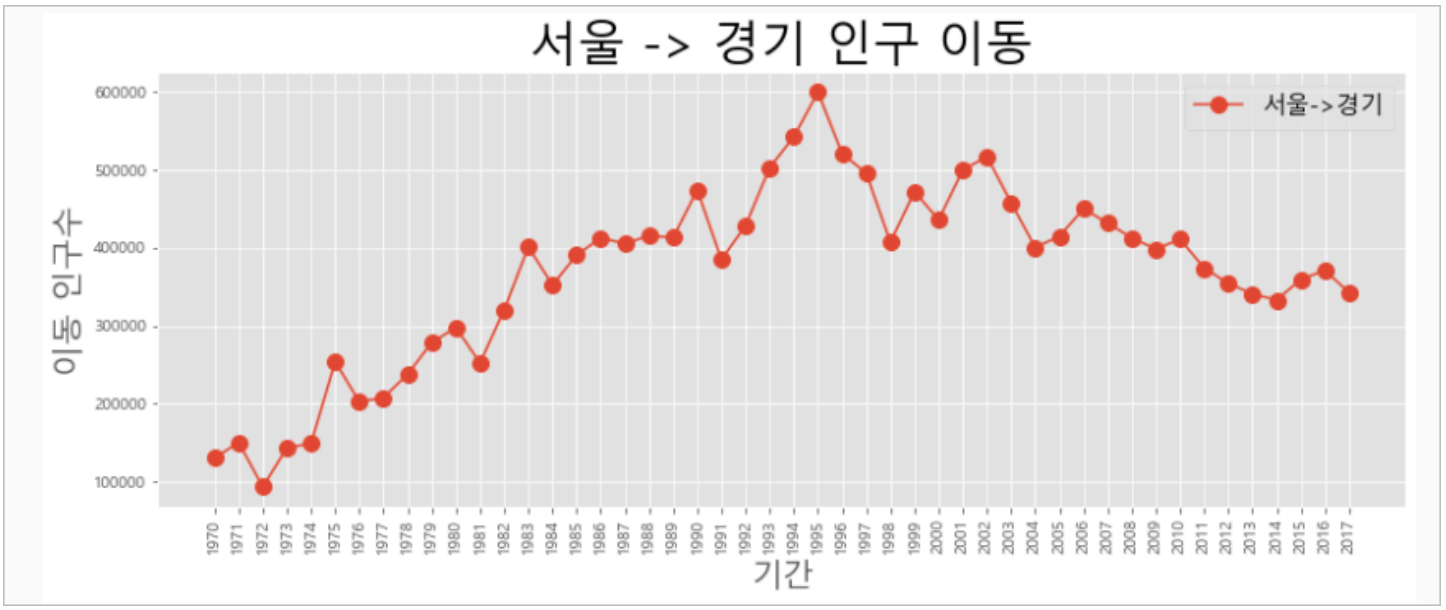


예제3] part04/01matplotlib/03ggplot.py

https://matplotlib.org/stable/gallery/style_sheets/style_sheets_reference.html

```python
# -*- coding: utf-8 -*-
#라이브러리 임포트
import pandas as pd
import matplotlib.pyplot as plt

#한글깨짐처리
from matplotlib import font_manager, rc
font_path = "./data/malgun.ttf"
font_name = font_manager.FontProperties(fname=font_path).get_name()
rc('font', family=font_name)

#데이터프레임 만들기
df = pd.read_excel('./data/시도별 전출입 인구수.xlsx', engine='openpyxl', header=0)
df = df.fillna(method='ffill')
print(df.head())

#서울에서 경기로 전출할 데이터만 추출
mask = (df['전출지별']=='서울특별시') & (df['전입지별']!='서울특별시')
df_seoul = df[mask]
df_seoul = df_seoul.drop(['전출지별'], axis=1)
df_seoul.rename({'전입지별':'전입지'}, axis=1, inplace=True)
df_seoul.set_index('전입지', inplace=True)
print(df_seoul)
sr_one = df_seoul.loc['경기도']
print(sr_one)

#그래프 설정 및 데이터입력
##그래프 스타일 지정
plt.style.use('ggplot')
plt.figure(figsize=(14, 5))
plt.xticks(rotation='vertical')
##마커와 마커사이즈 지정
plt.plot(sr_one.index, sr_one.values, marker='o', markersize=10)

#타이틀 및 라벨, 범례 설정
plt.title('서울 -> 경기 인구 이동')
plt.xlabel('기간')
plt.ylabel('이동 인구수')
plt.legend(labels=['서울->경기'], loc='best')

#그래프 출력
plt.show()
```

결과3]

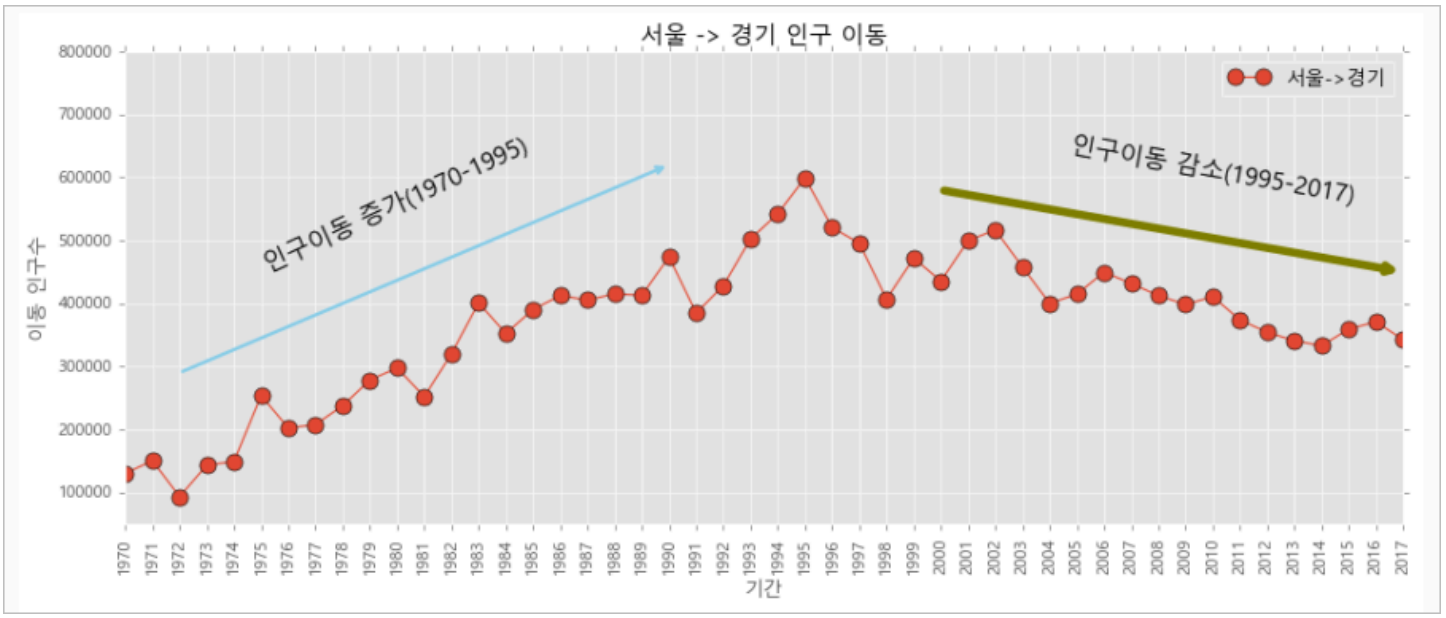

서울 -> 경기 인구 이동
서울->경기
이동 인구수
600000
500000
400000
300000
200000
100000
1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017
기간

예제4] part04/01matplotlib/04annotate.py

```python
# -*- coding: utf-8 -*-
#라이브러리 임포트
import pandas as pd
import matplotlib.pyplot as plt

#한글깨짐처리
from matplotlib import font_manager, rc
font_path = "./data/malgun.ttf"
font_name = font_manager.FontProperties(fname=font_path).get_name()
rc('font', family=font_name)

#데이터프레임 만들기
df = pd.read_excel('./data/시도별 전출입 인구수.xlsx', engine='openpyxl', header=0)
df = df.fillna(method='ffill')
print(df.head())

#서울에서 경기로 전출할 데이터만 추출
mask = (df['전출지별']=='서울특별시') & (df['전입지별']!='서울특별시')
df_seoul = df[mask]
df_seoul = df_seoul.drop(['전출지별'], axis=1)
df_seoul.rename({'전입지별':'전입지'}, axis=1, inplace=True)
df_seoul.set_index('전입지', inplace=True)
print(df_seoul)
sr_one = df_seoul.loc['경기도']
print(sr_one)

#그래프 스타일 설정 및 데이터입력
plt.style.use('ggplot')
plt.figure(figsize=(14, 5))
plt.xticks(rotation='vertical')
#마커와 마커사이즈 지정
plt.plot(sr_one.index, sr_one.values, marker='o', markersize=10)

#타이틀 및 라벨, 범례 설정
plt.title('서울 -> 경기 인구 이동')
plt.xlabel('기간')
plt.ylabel('이동 인구수')
plt.legend(labels=['서울->경기'], loc='best')
#### 여기까지 ex03과 동일


plt.ylim(50000, 800000)
plt.annotate('',
             xytext=(2, 290000),
             xy=(20, 620000),
             xycoords='data',
             arrowprops=dict(arrowstyle='->', color='skyblue', lw=2),
             )
```

```
49  plt.annotate('',
50               xytext=(30, 580000),
51               xy=(47, 450000),
52               xycoords='data',
53               arrowprops=dict(arrowstyle='->', color='olive', lw=5),
54               )
55  plt.annotate('인구이동 증가(1970-1995)',
56               xy=(10, 450000),
57               rotation=25,
58               va='baseline',
59               ha='center',
60               fontsize=15,
61               )
62  plt.annotate('인구이동 감소(1995-2017)',
63               xy=(40, 560000),
64               rotation=-10,
65               va='baseline',
66               ha='center',
67               fontsize=15,
68               )
69
70  plt.show()
```

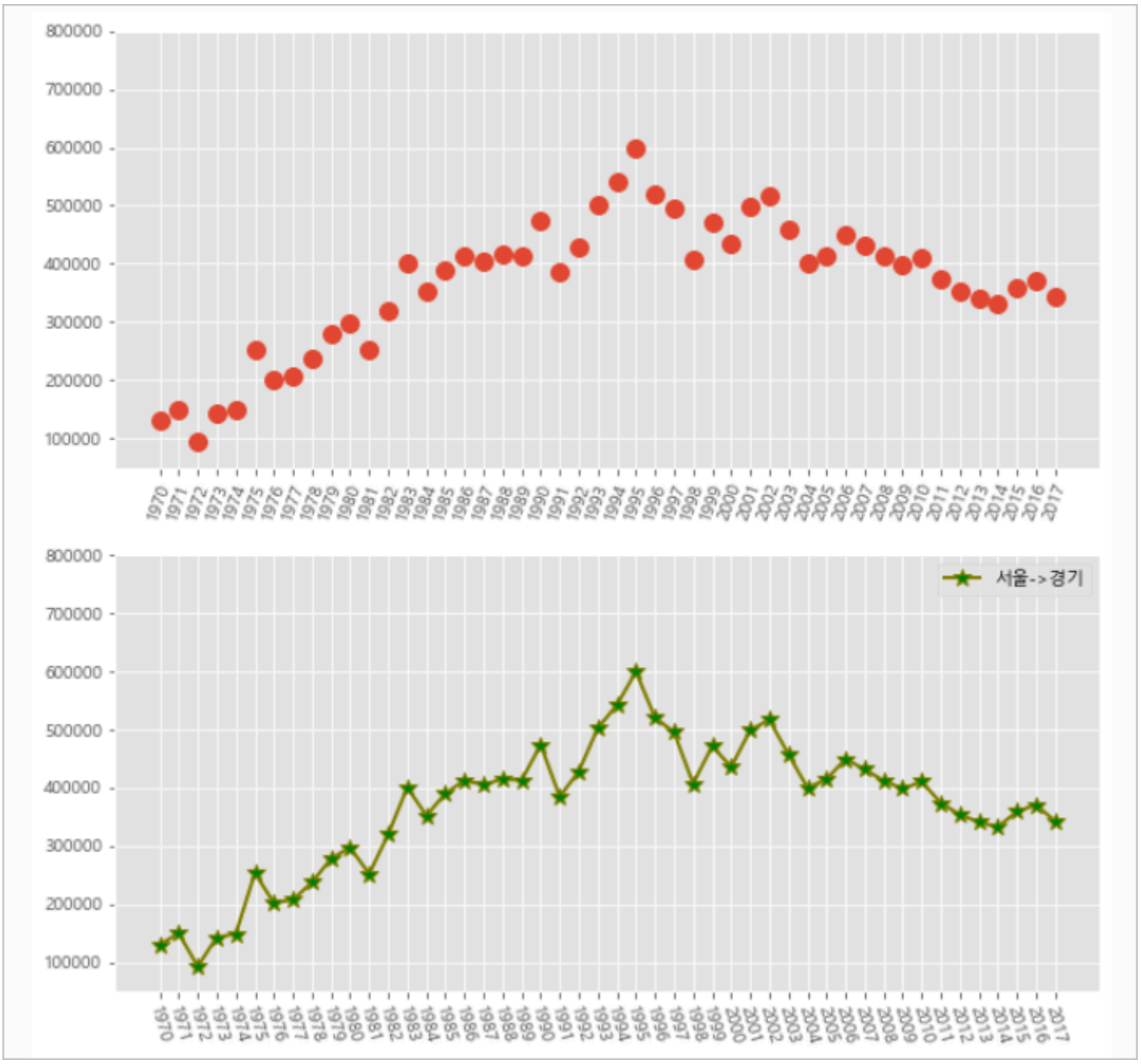
결과4]



예제5] part04/01matplotlib/05axe1.py

```python
# -*- coding: utf-8 -*-
import pandas as pd
import matplotlib.pyplot as plt
from matplotlib import font_manager, rc

#폰트설정
font_path = "./data/malgun.ttf"
font_name = font_manager.FontProperties(fname=font_path).get_name()
rc('font', family=font_name)

#서울->경기 데이터를 Excel로부터 추출
df = pd.read_excel('./data/시도별 전출입 인구수.xlsx', engine= 'openpyxl', header=0)
df = df.fillna(method='ffill')
mask = (df['전출지별'] == '서울특별시') & (df['전입지별'] != '서울특별시')
df_seoul = df[mask]
df_seoul = df_seoul.drop(['전출지별'], axis=1)
df_seoul.rename({'전입지별':'전입지'}, axis=1, inplace=True)
df_seoul.set_index('전입지', inplace=True)
###

sr_one = df_seoul.loc['경기도']

plt.style.use('ggplot')
fig = plt.figure(figsize=(10, 10))
ax1 = fig.add_subplot(2, 1, 1)
ax2 = fig.add_subplot(2, 1, 2)

ax1.plot(sr_one, 'o', markersize=10)
ax2.plot(sr_one, marker='o', markersize=10, markerfacecolor='green',
         color='olive', linewidth=2, label='서울->경기')
ax2.legend(loc='best')

ax1.set_ylim(50000, 800000)
ax2.set_ylim(50000, 800000)

ax1.set_xticklabels(sr_one.index, rotation=70)
ax2.set_xticklabels(sr_one.index, rotation=-75)

plt.show()

```

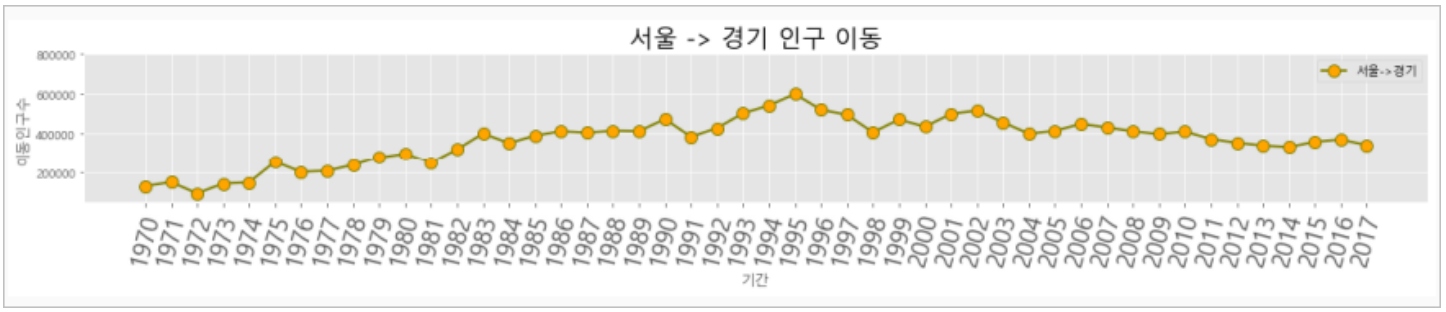
결과5-1]


800000
700000
600000
500000
400000
300000
200000
100000
1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017
서울->경기

예제6] part04/01matplotlib/05axe2.py

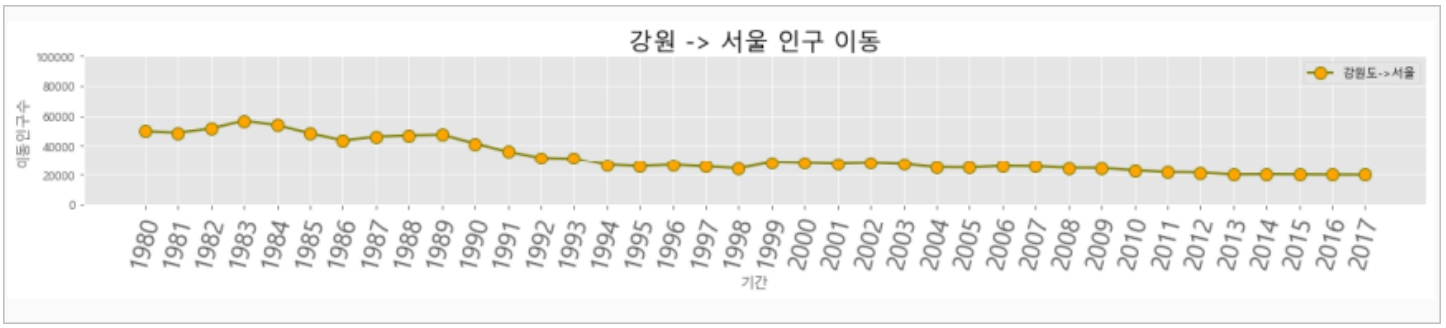
```python
# -*- coding: utf-8 -*-
import pandas as pd
import matplotlib.pyplot as plt
from matplotlib import font_manager, rc

#폰트설정
font_path = "./data/malgun.ttf"
font_name = font_manager.FontProperties(fname=font_path).get_name()
rc('font', family=font_name)

#서울->경기 데이터를 Excel로부터 추출
df = pd.read_excel('./data/시도별 전출입 인구수.xlsx', engine='openpyxl',
                   header=0)
df = df.fillna(method='ffill')
mask = (df['전출지별'] == '서울특별시') & (df['전입지별'] != '서울특별시')
df_seoul = df[mask]
df_seoul = df_seoul.drop(['전출지별'], axis=1)
df_seoul.rename({'전입지별':'전입지'}, axis=1, inplace=True)
df_seoul.set_index('전입지', inplace=True)
###이전 axe1.py 예제에서 여기까지 복사

sr_one = df_seoul.loc['경기도']

plt.style.use('ggplot')

fig = plt.figure(figsize=(20, 5))
ax1 = fig.add_subplot(2, 1, 1)

ax1.plot(sr_one, marker='o', markersize=10, markerfacecolor='orange',
         color='olive', linewidth=2, label='서울->경기')
ax1.legend(loc='best')
ax1.set_ylim(50000, 800000)
ax1.set_title('서울 -> 경기 인구 이동', size=20)
ax1.set_xlabel('기간', size=12)
ax1.set_ylabel('이동인구수', size=12)
ax1.set_xticklabels(sr_one.index, rotation=75)

ax1.tick_params(axis='x', labelsize=10)
ax1.tick_params(axis='y', labelsize=10)

plt.show()

```

결과5-2-1]



연습문제] 위 데이터를 강원도->서울특별시로 이동한 데이터를 추출하여 아래 그래프에 적용하시오. 단 기간은 1980년부터 마지막까지로 지정하시오. 이에 맞게 라벨도 수정하시오.

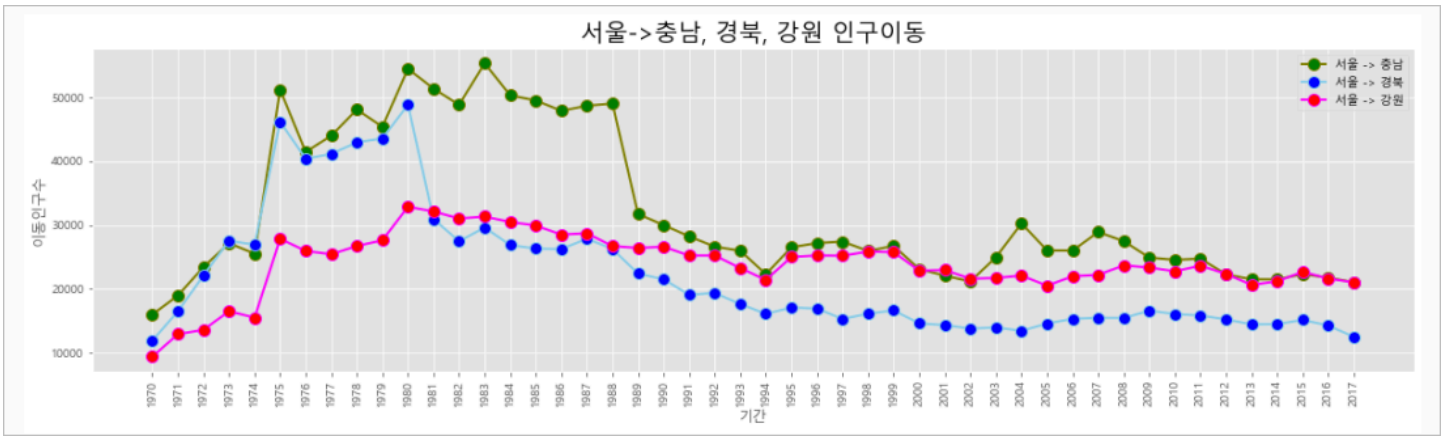
결과5-2-2] 05axe2_practise.py



예제7] part04/01matplotlib/05axe3.py

```python
# -*- coding: utf-8 -*-
import pandas as pd
import matplotlib.pyplot as plt
from matplotlib import font_manager, rc

#폰트설정
font_path = "./data/malgun.ttf"
font_name = font_manager.FontProperties(fname=font_path).get_name()
rc('font', family=font_name)

#서울->경기 데이터를 Excel로부터 추출
df = pd.read_excel('./data/시도별 전출입 인구수.xlsx', engine='openpyxl',
                   header=0)
df = df.fillna(method='ffill')
mask = (df['전출지별'] == '서울특별시') & (df['전입지별'] != '서울특별시')
df_seoul = df[mask]
df_seoul = df_seoul.drop(['전출지별'], axis=1)
df_seoul.rename({'전입지별':'전입지'}, axis=1, inplace=True)
df_seoul.set_index('전입지', inplace=True)
###이전 axe1.py 예제에서 여기까지 복사

col_years = list(map(str, range(1970, 2018)))
df3 = df_seoul.loc[['충청남도','경상북도','강원도'], col_years]
plt.style.use('ggplot')
fig = plt.figure(figsize=(20,5))
axe = fig.add_subplot(1,1,1)

axe.plot(col_years, df3.loc['충청남도',:], marker='o', markerfacecolor='green',
        markersize=10, color='olive', linewidth=2, label='서울 -> 충남')
axe.plot(col_years, df3.loc['경상북도',:], marker='o', markerfacecolor='blue',
        markersize=10, color='skyblue', linewidth=2, label='서울 -> 경북')
axe.plot(col_years, df3.loc['강원도',:], marker='o', markerfacecolor='red',
        markersize=10, color='magenta', linewidth=2, label='서울 -> 강원')

axe.legend(loc='best')
axe.set_title('서울->충남, 경북, 강원 인구이동', size=20)

axe.set_xlabel('기간', size=12)
axe.set_ylabel('이동인구수', size=12)
axe.set_xticklabels(col_years, rotation=90)

axe.tick_params(axis="x", labelsize=10)
axe.tick_params(axis="y", labelsize=10)

plt.show()
```

결과5-3]

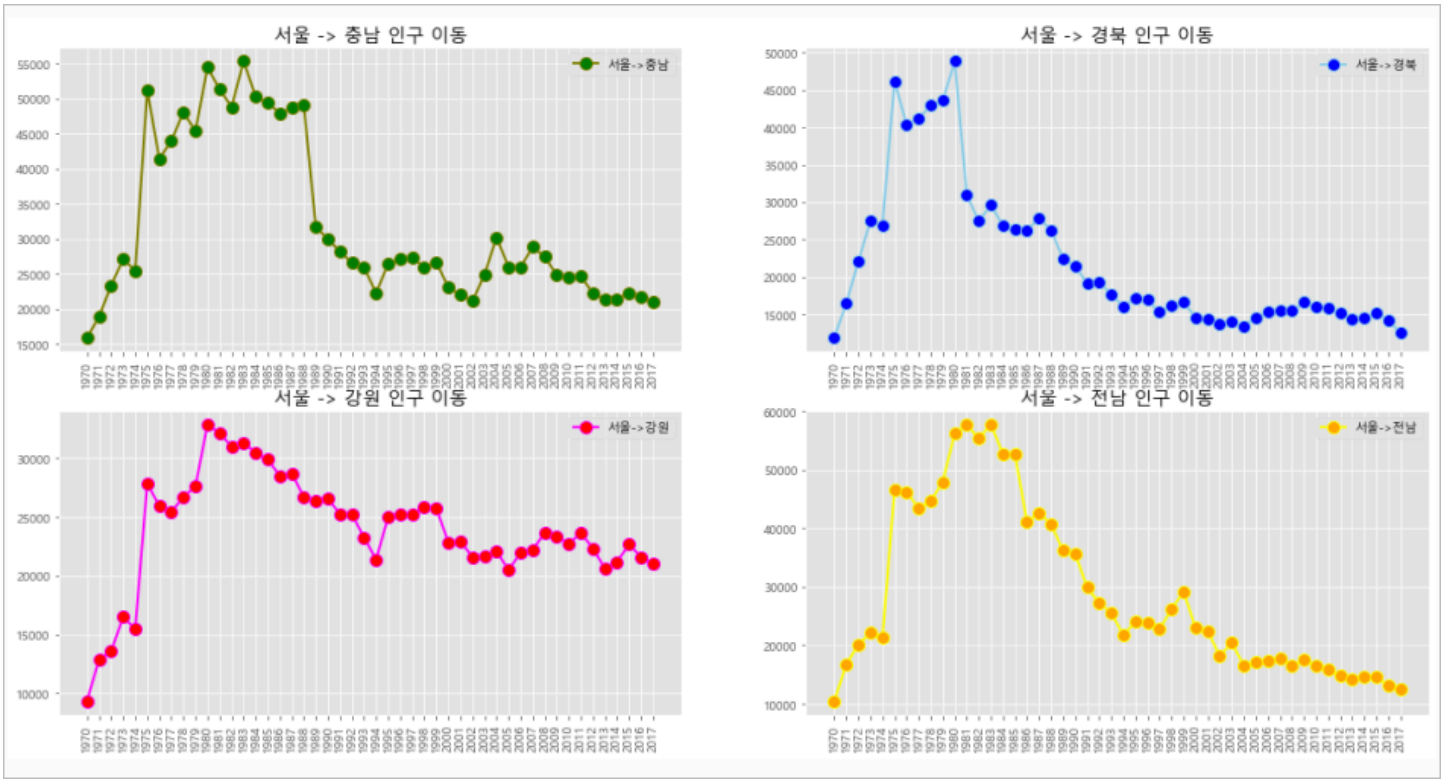


예제8] part04/01matplotlib/05axe4.py

```
# -*- coding: utf-8 -*-
import pandas as pd
import matplotlib.pyplot as plt
from matplotlib import font_manager, rc

#폰트설정
font_path = "./data/malgun.ttf"
font_name = font_manager.FontProperties(fname=font_path).get_name()
rc('font', family=font_name)

#서울->경기 데이터를 Excel로부터 추출
df = pd.read_excel('./data/시도별 전출입 인구수.xlsx', engine= 'openpyxl',
                   header=0)
df = df.fillna(method='ffill')
mask = (df['전출지별'] == '서울특별시') & (df['전입지별'] != '서울특별시')
df_seoul = df[mask]
df_seoul = df_seoul.drop(['전출지별'], axis=1)
df_seoul.rename({'전입지별':'전입지'}, axis=1, inplace=True)
df_seoul.set_index('전입지', inplace=True)
###이전 axe1.py 예제에서 여기까지 복사

col_years = list(map(str, range(1970, 2018)))
df4 = df_seoul.loc[['충청남도','경상북도', '강원도', '전라남도'], col_years]

fig = plt.figure(figsize=(20,10))
axe1 = fig.add_subplot(2,2,1)
axe2 = fig.add_subplot(2,2,2)
axe3 = fig.add_subplot(2,2,3)
axe4 = fig.add_subplot(2,2,4)

axe1.plot(col_years, df4.loc['충청남도',:], marker='o', markerfacecolor='green'
          ,markersize=10, color='olive', linewidth=2, label='서울->충남')
axe2.plot(col_years, df4.loc['경상북도',:], marker='o', markerfacecolor='blue'
          ,markersize=10, color='skyblue', linewidth=2, label='서울->경북')
axe3.plot(col_years, df4.loc['강원도',:], marker='o', markerfacecolor='red'
          ,markersize=10, color='magenta', linewidth=2, label='서울->강원')
axe4.plot(col_years, df4.loc['전라남도',:], marker='o', markerfacecolor='orange'
          ,markersize=10, color='yellow', linewidth=2, label='서울->전남')

```

```
40  axe1.legend(loc='best')
41  axe2.legend(loc='best')
42  axe3.legend(loc='best')
43  axe4.legend(loc='best')
44
45  axe1.set_title('서울 -> 충남 인구 이동', size=15)
46  axe2.set_title('서울 -> 경북 인구 이동', size=15)
47  axe3.set_title('서울 -> 강원 인구 이동', size=15)
48  axe4.set_title('서울 -> 전남 인구 이동', size=15)
49
50  axe1.set_xticklabels(col_years, rotation=90)
51  axe2.set_xticklabels(col_years, rotation=90)
52  axe3.set_xticklabels(col_years, rotation=90)
53  axe4.set_xticklabels(col_years, rotation=90)
54
55  plt.show()
```

결과5-4]



예제9] part04/01matplotlib/06color.py

```python
# -*- coding: utf-8 -*-
import matplotlib

colors = {}

for name, hex in matplotlib.colors.cnames.items():
    colors[name] = hex

print(colors)

```

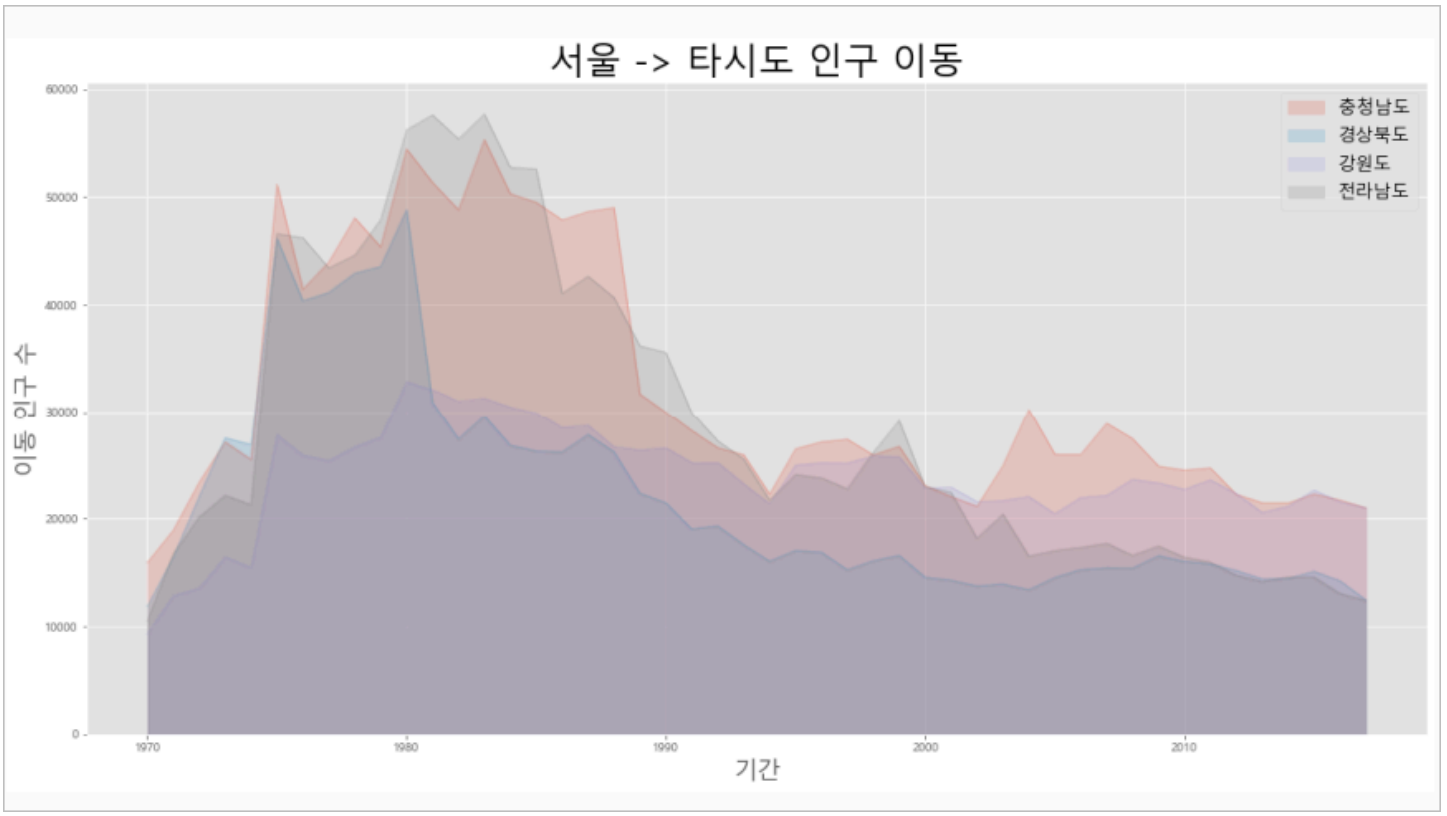
결과6]

```
In [45]: runfile('C:/02Workspaces/K11DataVisual/part04/01matplotlib/
06color.py', wdir='C:/02Workspaces/K11DataVisual/part04/01matplotlib')
{'aliceblue': '#F0F8FF', 'antiquewhite': '#FAEBD7', 'aqua': '#00FFFF',
'aquamarine': '#7FFFD4', 'azure': '#F0FFFF', 'beige': '#F5F5DC', 'bisque':
'#FFE4C4', 'black': '#000000', 'blanchedalmond': '#FFEBCD', 'blue': '#0000FF',
'blueviolet': '#8A2BE2', 'brown': '#A52A2A', 'burlywood': '#DEB887',
'cadetblue': '#5F9EA0', 'chartreuse': '#7FFF00', 'chocolate': '#D2691E',
'coral': '#FF7F50', 'cornflowerblue': '#6495ED', 'cornsilk': '#FFF8DC',
'crimson': '#DC143C', 'cyan': '#00FFFF', 'darkblue': '#00008B', 'darkcyan':
'#008B8B', 'darkgoldenrod': '#B8860B', 'darkgray': '#A9A9A9', 'darkgreen':
'#006400', 'darkgrey': '#A9A9A9', 'darkkhaki': '#BDB76B', 'darkmagenta':
'#8B008B', 'darkolivegreen': '#556B2F', 'darkorange': '#FF8C00', 'darkorchid':
'#9932CC', 'darkred': '#8B0000', 'darksalmon': '#E9967A', 'darkseagreen':
'#8FBC8F', 'darkslateblue': '#483D8B', 'darkslategray': '#2F4F4F',
'darkslategrey': '#2F4F4F', 'darkturquoise': '#00CED1', 'darkviolet':
```

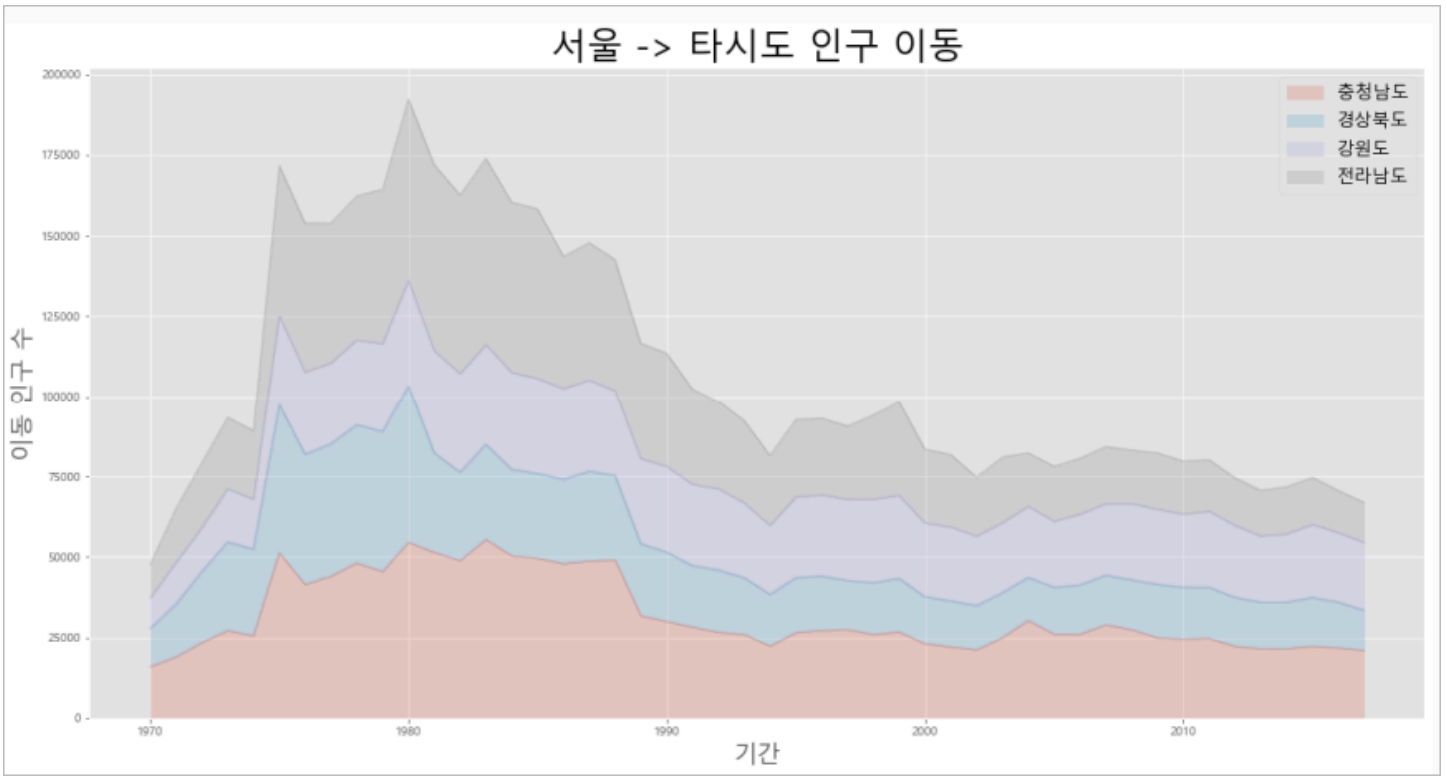
예제10] part04/01matplotlib/07area.py

```
# -*- coding: utf-8 -*-
import pandas as pd
import matplotlib.pyplot as plt
from matplotlib import font_manager, rc

#폰트설정
font_path = "./data/malgun.ttf"
font_name = font_manager.FontProperties(fname=font_path).get_name()
rc('font', family=font_name)

#서울에서 전출한 데이터를 Excel로부터 추출
df = pd.read_excel('./data/시도별 전출입 인구수.xlsx', engine= 'openpyxl',
                   header=0)
df = df.fillna(method='ffill')
mask = (df['전출지별'] == '서울특별시') & (df['전입지별'] != '서울특별시')
df_seoul = df[mask]
df_seoul = df_seoul.drop(['전출지별'], axis=1)
df_seoul.rename({'전입지별':'전입지'}, axis=1, inplace=True)
df_seoul.set_index('전입지', inplace=True)
###이전 axe1.py 예제에서 여기까지 복사

col_years = list(map(str, range(1970, 2018)))
df4 = df_seoul.loc[['충청남도','경상북도', '강원도', '전라남도'], col_years]
#### 이전 axe4.py 예제에서 여기까지 복사

df4 = df4.transpose()
plt.style.use('ggplot')
df4.index = df4.index.map(int)

#df4.plot(kind='area', stacked=False, alpha=0.2, figsize=(20,10))
df4.plot(kind='area', stacked=True, alpha=0.2, figsize=(20,10))

plt.title('서울 -> 타시도 인구 이동', size=30)
plt.ylabel('이동 인구 수', size=20)
plt.xlabel('기간', size=20)
plt.legend(loc='best', fontsize=15)

plt.show()

```

결과7-1] stacked=False



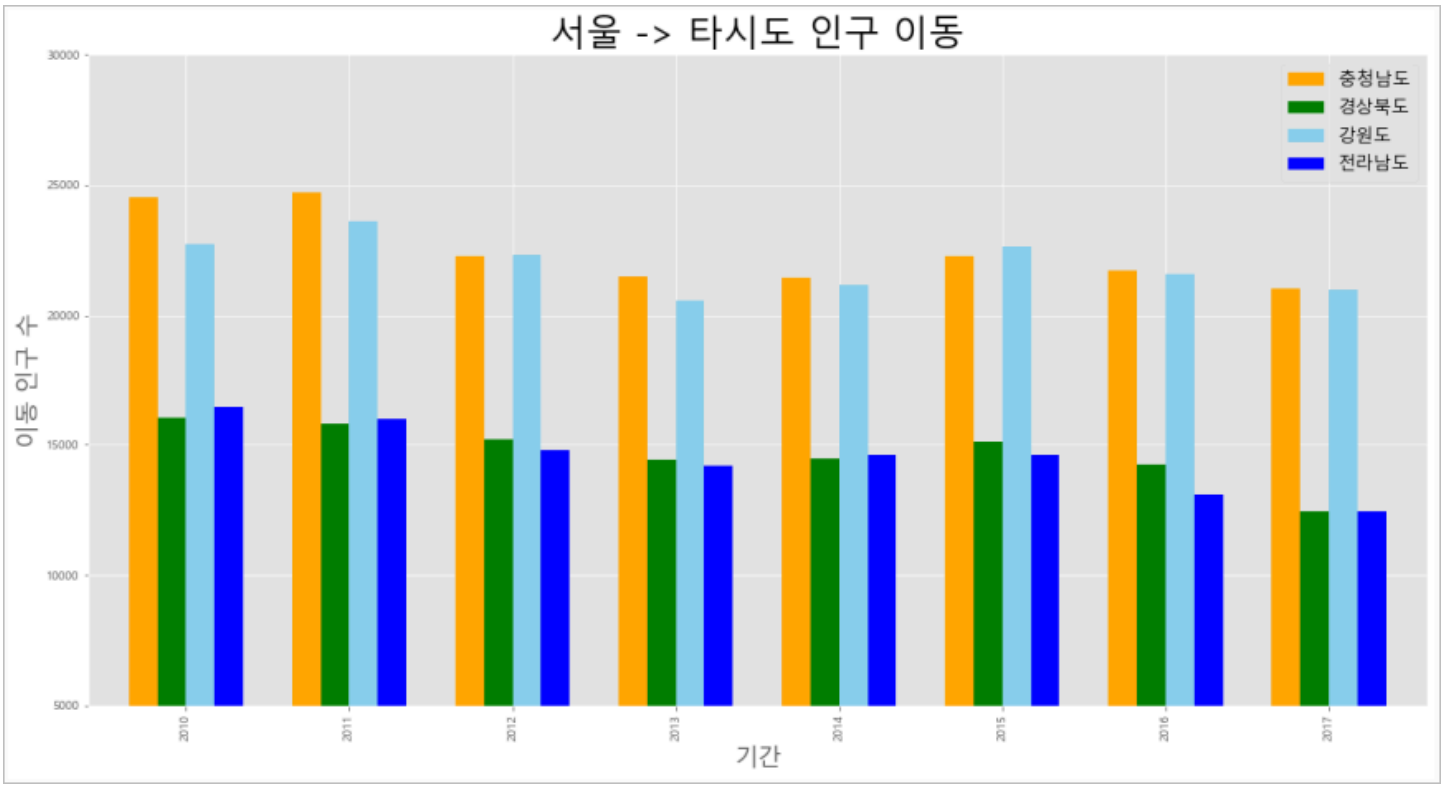
결과7-2] stacked=True



예제11] part04/01matplotlib/08bar.py

```python
# -*- coding: utf-8 -*-
import pandas as pd
import matplotlib.pyplot as plt
from matplotlib import font_manager, rc

#폰트설정
font_path = "./data/malgun.ttf"
font_name = font_manager.FontProperties(fname=font_path).get_name()
rc('font', family=font_name)

#서울에서 전출한 데이터를 Excel로부터 추출
df = pd.read_excel('./data/시도별 전출입 인구수.xlsx', engine= 'openpyxl',
                   header=0)
df = df.fillna(method='ffill')
mask = (df['전출지별'] == '서울특별시') & (df['전입지별'] != '서울특별시')
df_seoul = df[mask]
df_seoul = df_seoul.drop(['전출지별'], axis=1)
df_seoul.rename({'전입지별':'전입지'}, axis=1, inplace=True)
df_seoul.set_index('전입지', inplace=True)
###이전 axe1.py 예제에서 여기까지 복사

col_years = list(map(str, range(2010, 2018))) #시작년도만 수정
df4 = df_seoul.loc[['충청남도','경상북도', '강원도', '전라남도'], col_years]
#### 이전 axe4.py 예제에서 여기까지 복사


df4 = df4.transpose()
plt.style.use('ggplot')
df4.index = df4.index.map(int)

df4.plot(kind='bar', figsize=(20,10), width=0.7,
         color=['orange','green','skyblue','blue'])

plt.title('서울 -> 타시도 인구 이동', size=30)
plt.ylabel('이동 인구 수', size=20)
plt.xlabel('기간', size=20)
plt.ylim(5000, 30000)
plt.legend(loc='best', fontsize=15)

plt.show()
```

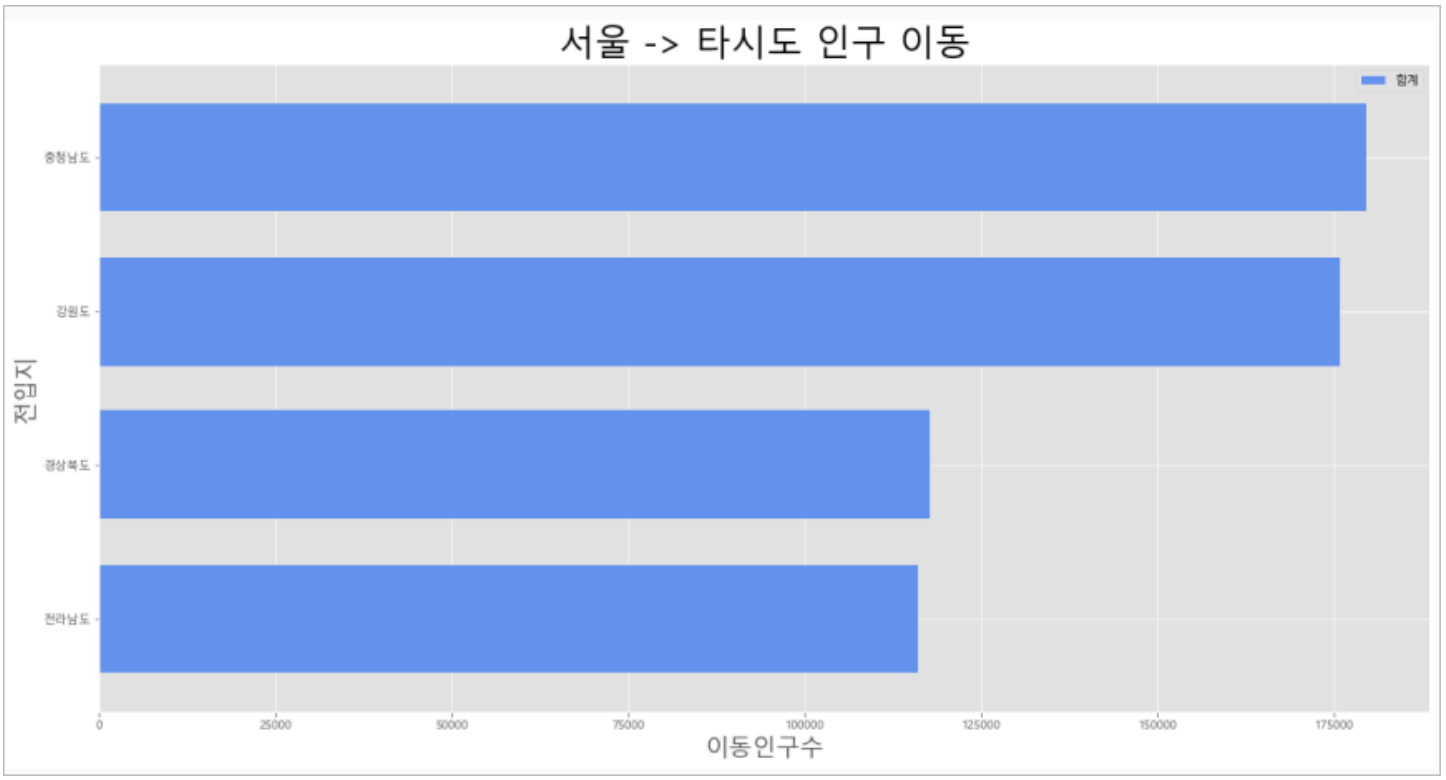
결과8]


서울 -> 타시도 인구 이동
충청남도
경상북도
강원도
전라남도
이동 인구 수
30000
25000
20000
15000
10000
5000
2010
2011
2012
2013
2014
2015
2016
2017
기간

예제12] part04/01matplotlib/09barHorizontal.py

```python
# -*- coding: utf-8 -*-
import pandas as pd
import matplotlib.pyplot as plt
from matplotlib import font_manager, rc

#폰트설정
font_path = "./data/malgun.ttf"
font_name = font_manager.FontProperties(fname=font_path).get_name()
rc('font', family=font_name)

#서울에서 전출한 데이터를 Excel로부터 추출
df = pd.read_excel('./data/시도별 전출입 인구수.xlsx', engine= 'openpyxl',
                   header=0)
df = df.fillna(method='ffill')
mask = (df['전출지별'] == '서울특별시') & (df['전입지별'] != '서울특별시')
df_seoul = df[mask]
df_seoul = df_seoul.drop(['전출지별'], axis=1)
df_seoul.rename({'전입지별':'전입지'}, axis=1, inplace=True)
df_seoul.set_index('전입지', inplace=True)
###이전 axe1.py 예제에서 여기까지 복사

#시작년도만 수정
col_years = list(map(str, range(2010, 2018)))
df4 = df_seoul.loc[['충청남도','경상북도', '강원도', '전라남도'], col_years]
#### 이전 axe4.py 예제에서 여기까지 복사

df4['합계'] = df4.sum(axis=1)
df_total = df4[['합계']].sort_values(by='합계', ascending=True)
plt.style.use('ggplot')
df_total.plot(kind='barh', color='cornflowerblue', width=0.5, figsize=(10,5))

plt.title('서울 -> 타시도 인구 이동')
plt.ylabel('전입지')
plt.xlabel('이동 인구 수')

plt.show()
```

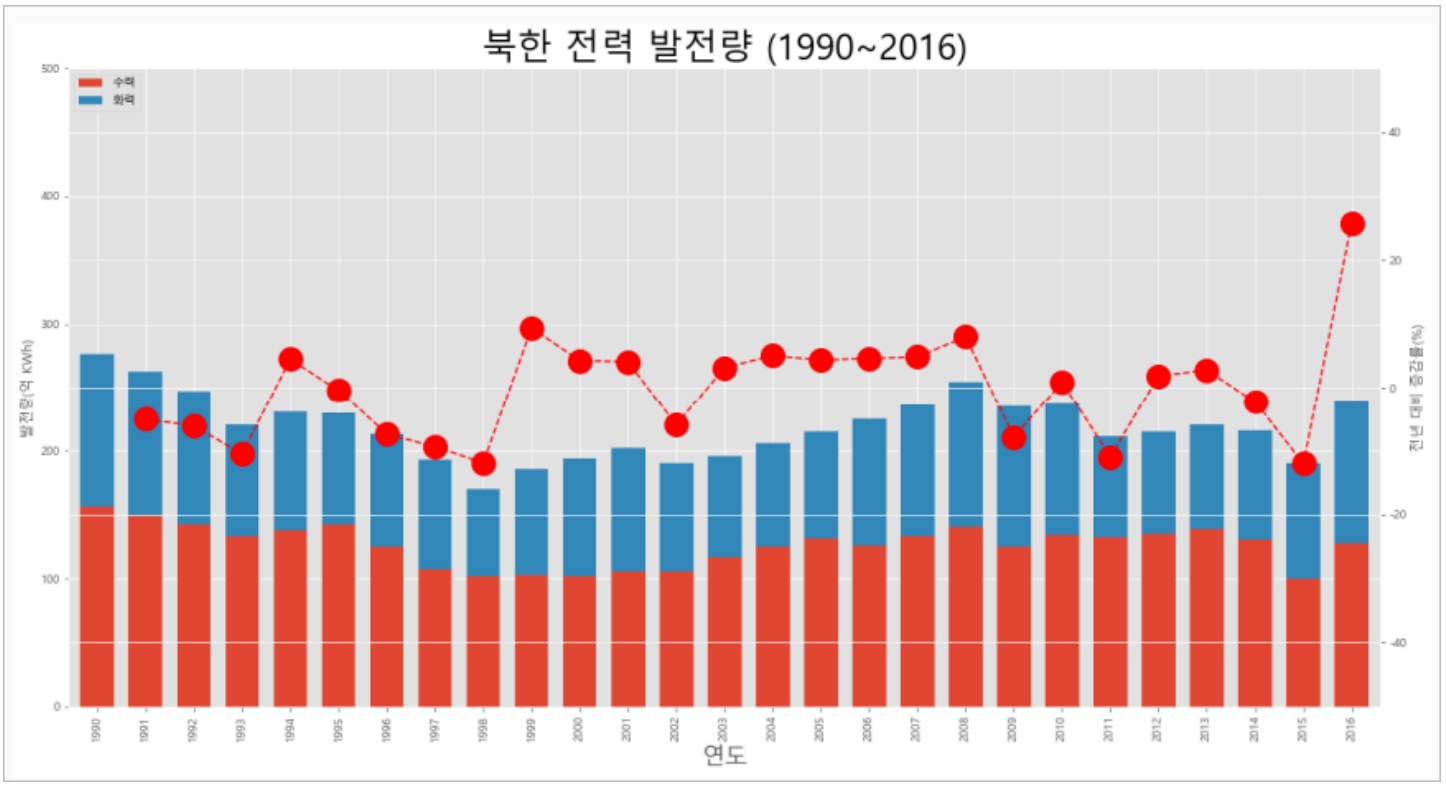
결과9]


서울 -> 타시도 인구 이동
합계
충청남도
강원도
경상북도
전라남도
전입지
0
25000
50000
75000
100000
125000
150000
175000
이동인구수

예제13] part04/01matplotlib/10secondary_y.py

```python
# -*- coding: utf-8 -*-
import pandas as pd
import matplotlib.pyplot as plt

from matplotlib import font_manager, rc
font_path = "./data/malgun.ttf"
font_name = font_manager.FontProperties(fname=font_path).get_name()
rc('font', family=font_name)

plt.style.use('ggplot')
plt.rcParams['axes.unicode_minus'] = False

df = pd.read_excel('./data/남북한발전전력량.xlsx', engine='openpyxl')
df = df.loc[5:9]
df.drop('전력량 (억kWh)', axis='columns', inplace=True)
df.set_index('발전 전력별', inplace=True)
df = df.T

df = df.rename(columns={'합계':'총발전량'})
df['총발전량 - 1년'] = df['총발전량'].shift(1)
df['증감률'] = ((df['총발전량']/df['총발전량 - 1년']) - 1) * 100

axe1 = df[['수력','화력']].plot(kind='bar', figsize=(20,10), width=0.7,
                                stacked=True)
axe2 = axe1.twinx()
axe2.plot(df.index, df.증감률, ls='--', marker='o', markersize=20,
          color='red', label='전년대비 증감률(%)')

axe1.set_ylim(0, 500)
axe2.set_ylim(-50, 50)

axe1.set_xlabel('연도', size=20)
axe1.set_ylabel('발전량(억 KWh)')
axe2.set_ylabel('전년 대비 증감률(%)')

plt.title('북한 전력 발전량 (1990~2016)', size=30)
axe1.legend(loc='upper left')

plt.show()
```

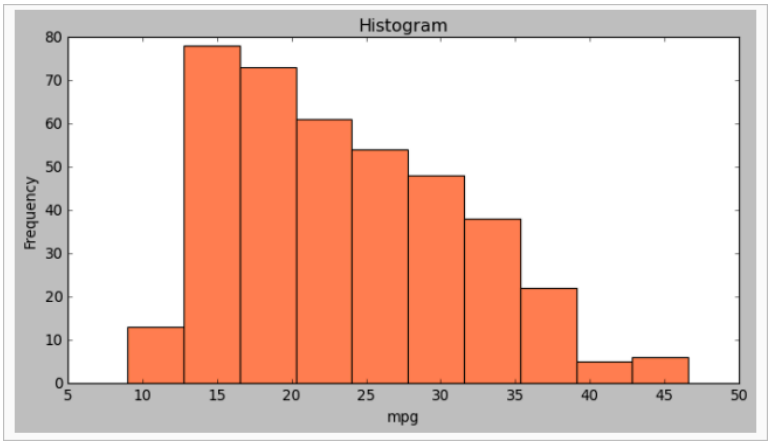
결과10]


북한 전력 발전량 (1990~2016)
수력
화력
발전량(억 KWh)
전년 대비 증감률(%)
연도
0
100
200
300
400
500
-40
-20
0
20
40
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016

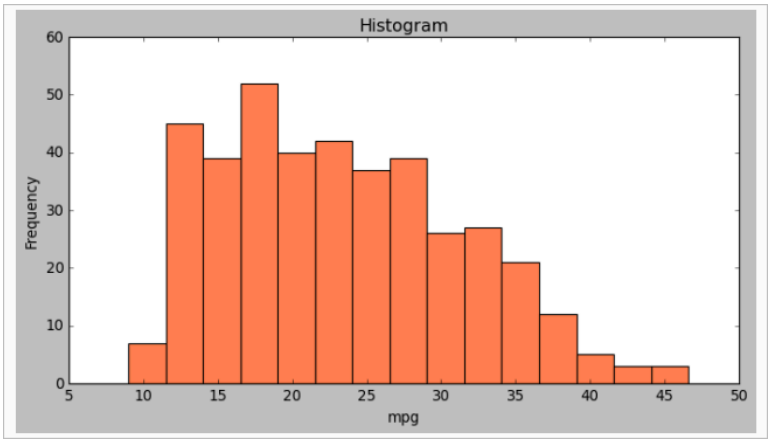
예제14] part04/01matplotlib/11histogram.py

```python
# -*- coding: utf-8 -*-
import pandas as pd
import matplotlib.pyplot as plt

plt.style.use('classic')

df = pd.read_csv('./data/auto-mpg.csv', header=None)

df.columns = ['mpg','cylinders','displacement','horsepower','weight',
              'acceleration','model year','origin','name']

df['mpg'].plot(kind='hist', bins=10, color='coral', figsize=(10,5))

plt.title('Histogram')
plt.xlabel('mpg')
plt.show()

```

결과11-1] bins=10일때



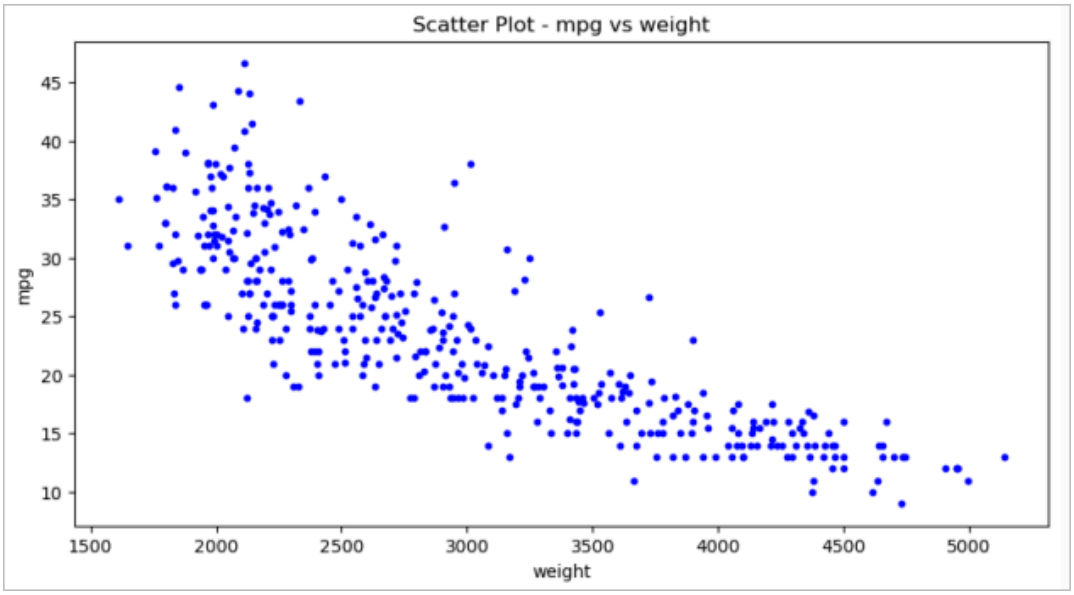
결과11-2] bins=15일때



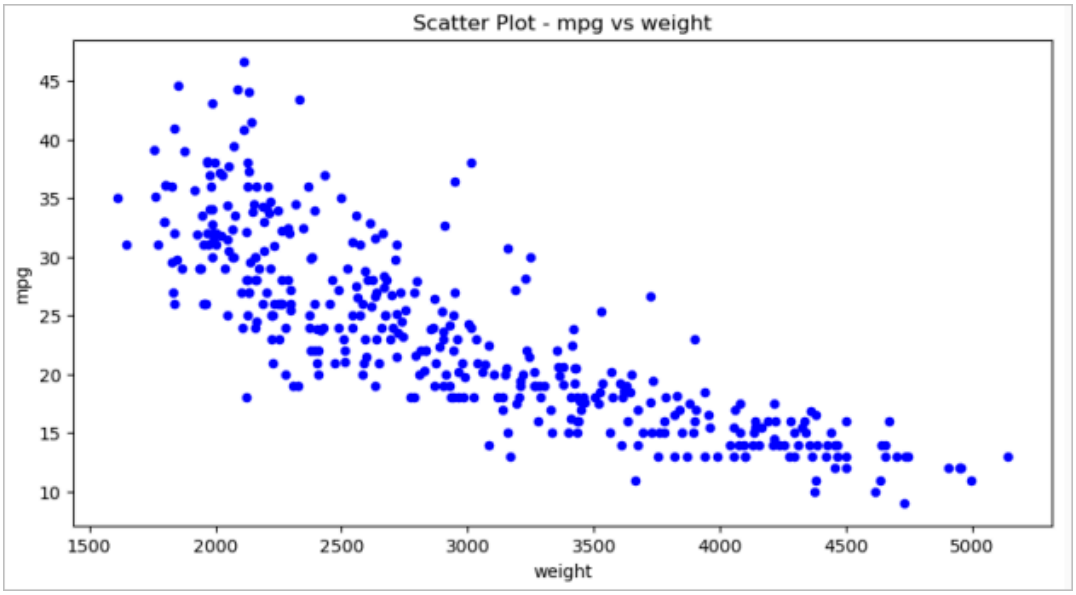
예제15] part04/01matplotlib/12scatter.py

```
1   # -*- coding: utf-8 -*-
2   import pandas as pd
3   import matplotlib.pyplot as plt
4
5   plt.style.use('default')
6
7   df = pd.read_csv('./data/auto-mpg.csv', header=None)
8
9   df.columns = ['mpg','cylinders','displacement','horsepower','weight',
10                'acceleration','model year','origin','name']
11
12  df.plot(kind='scatter', x='weight', y='mpg', c='blue', s=10, figsize=(10,5))
13  plt.title('Scatter Plot - mpg vs weight')
14  plt.show()
15
```

결과12-1] s=10일때



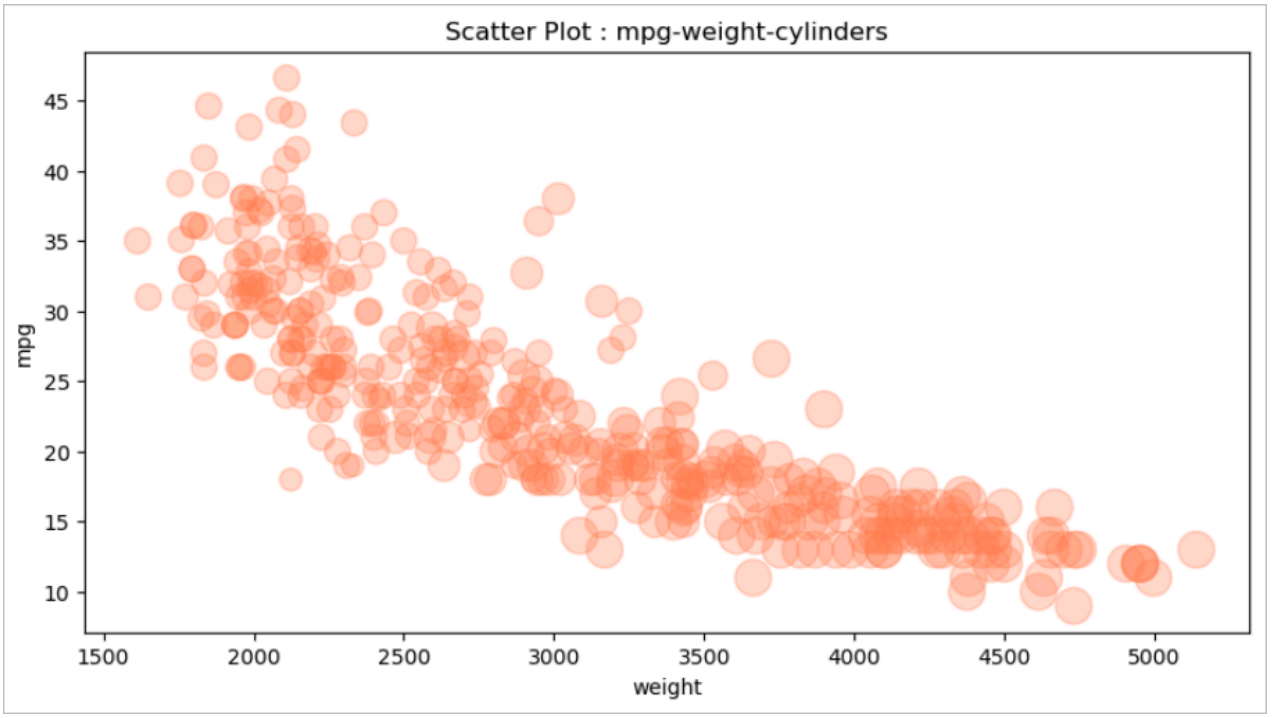
결과12-2] s=15일때



예제16] part04/01matplotlib/13bubble.py

```python
# -*- coding: utf-8 -*-
import pandas as pd
import matplotlib.pyplot as plt

plt.style.use('default')

df = pd.read_csv('../data/auto-mpg.csv', header=None)

df.columns = ['mpg','cylinders','displacement','horsepower','weight',
              'acceleration','model year','origin','name']

cylinders_size = df.cylinders / df.cylinders.max() * 300
print(cylinders_size)

df.plot(kind='scatter', x='weight', y='mpg', c='coral',
        figsize=(10,5), s=cylinders_size, alpha=0.3,
        marker='o', cmap='viridis')
plt.title('Scatter Plot : mpg-weight-cylinders')

plt.savefig("../save/scatter.png")
plt.savefig("../save/scatter_transparent.png", transparent=True)
plt.show()

```

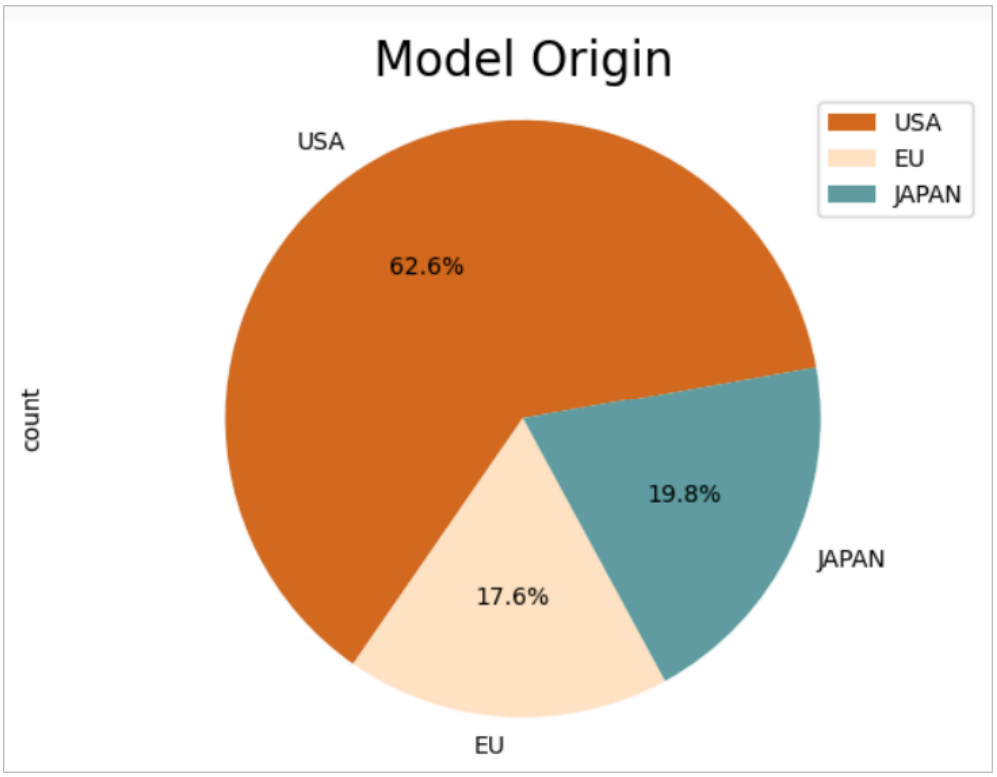
결과13]



예제18] part04/01matplotlib/14pie.py

```python
# -*- coding: utf-8 -*-
import pandas as pd
import matplotlib.pyplot as plt

df = pd.read_csv('./data/auto-mpg.csv', header=None)

plt.style.use('default')

df.columns = ['mpg','cylinders','displacement','horsepower','weight',
              'acceleration','model year','origin','name']

df['count'] = 1
df_origin = df.groupby('origin').sum()
print(df_origin.head())

df_origin.index = ['USA', 'EU', 'JAPAN']

df_origin['count'].plot(kind='pie',
                        figsize=(7, 5),
                        autopct='%1.1f%%',
                        startangle=10,
                        colors=['chocolate', 'bisque', 'cadetblue']
                        )

plt.title('Model Origin', size=20)
plt.axis('equal')
plt.legend(labels=df_origin.index, loc='upper right')
plt.show()

```

결과14]



예제17] part04/01matplotlib/15boxplot.py

```python
# -*- coding: utf-8 -*-
import pandas as pd
import matplotlib.pyplot as plt
from matplotlib import font_manager, rc

font_path = "./data/malgun.ttf"
font_name = font_manager.FontProperties(fname=font_path).get_name()
rc('font', family=font_name)

plt.style.use('seaborn-poster')
plt.rcParams['axes.unicode_minus']=False

df = pd.read_csv('./data/auto-mpg.csv', header=None)

df.columns = ['mpg','cylinders','displacement','horsepower','weight',
              'acceleration','model year','origin','name']

fig = plt.figure(figsize=(15, 5))
ax1 = fig.add_subplot(1, 2, 1)
ax2 = fig.add_subplot(1, 2, 2)

ax1.boxplot(x=[df[df['origin']==1]['mpg'],
               df[df['origin']==2]['mpg'],
               df[df['origin']==3]['mpg']],
        labels=['USA', 'EU', 'JAPAN'])

ax2.boxplot(x=[df[df['origin']==1]['mpg'],
               df[df['origin']==2]['mpg'],
               df[df['origin']==3]['mpg']],
        labels=['USA', 'EU', 'JAPAN'],
        vert=False)

ax1.set_title('제조국가별 연비 분포(수직 박스 플롯)')
ax2.set_title('제조국가별 연비 분포(수평 박스 플롯)')

plt.show()
```

결과15]