3. Beyond Descriptive Stats

March 13, 2024

1 Beyond Descriptive Stats

[1]:
```
# Libraries

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

[2]:
```
# Dataframes

df1 = pd.read_csv("athlete_events_file.csv")
df2 = pd.read_csv("noc_regions.csv")

df = pd.merge(df1, df2, on = "NOC")

df
```

[2]:
```
            ID                      Name Sex   Age  Height  Weight  \
0            1                 A Dijiang   M  24.0   180.0    80.0
1            2                  A Lamusi   M  23.0   170.0    60.0
2            3       Gunnar Nielsen Aaby   M  24.0     NaN     NaN
3            4      Edgar Lindenau Aabye   M  34.0     NaN     NaN
4            5  Christine Jacoba Aaftink   F  21.0   185.0    82.0
…          …                         …  ..   …     …       …
270762  135569                Andrzej ya   M  29.0   179.0    89.0
270763  135570                  Piotr ya   M  27.0   176.0    59.0
270764  135570                  Piotr ya   M  27.0   176.0    59.0
270765  135571        Tomasz Ireneusz ya   M  30.0   185.0    96.0
270766  135571        Tomasz Ireneusz ya   M  34.0   185.0    96.0

                 Team  NOC        Games  Year  Season          City  \
0               China  CHN  1992 Summer  1992  Summer     Barcelona
1               China  CHN  2012 Summer  2012  Summer        London
2             Denmark  DEN  1920 Summer  1920  Summer     Antwerpen
3       Denmark/Sweden  DEN  1900 Summer  1900  Summer         Paris
```

```
4          Netherlands  NED  1988 Winter  1988  Winter         Calgary
…                    …   …          …    …      …              …
270762        Poland-1  POL  1976 Winter  1976  Winter       Innsbruck
270763          Poland  POL  2014 Winter  2014  Winter           Sochi
270764          Poland  POL  2014 Winter  2014  Winter           Sochi
270765          Poland  POL  1998 Winter  1998  Winter          Nagano
270766          Poland  POL  2002 Winter  2002  Winter  Salt Lake City

                Sport                                     Event Medal  \
0          Basketball               Basketball Men's Basketball   NaN
1                Judo              Judo Men's Extra-Lightweight   NaN
2            Football                   Football Men's Football   NaN
3          Tug-Of-War               Tug-Of-War Men's Tug-Of-War  Gold
4       Speed Skating          Speed Skating Women's 500 metres   NaN
…                 …                                        …    …
270762           Luge                Luge Mixed (Men)'s Doubles   NaN
270763    Ski Jumping  Ski Jumping Men's Large Hill, Individual   NaN
270764    Ski Jumping        Ski Jumping Men's Large Hill, Team   NaN
270765      Bobsleigh                      Bobsleigh Men's Four   NaN
270766      Bobsleigh                      Bobsleigh Men's Four   NaN

             region notes
0             China   NaN
1             China   NaN
2           Denmark   NaN
3           Denmark   NaN
4       Netherlands   NaN
…               …   …
270762       Poland   NaN
270763       Poland   NaN
270764       Poland   NaN
270765       Poland   NaN
270766       Poland   NaN

[270767 rows x 17 columns]
```

[3]:

```python
# SQL function

pysqldf = lambda q: sqldf(q, globals())
```

[4]:

```python
# Split the dataframes

df_summer = df[df["Season"] == "Summer"]
df_winter = df[df["Season"] == "Winter"]
```

1.0.1 Correlation between age and performance

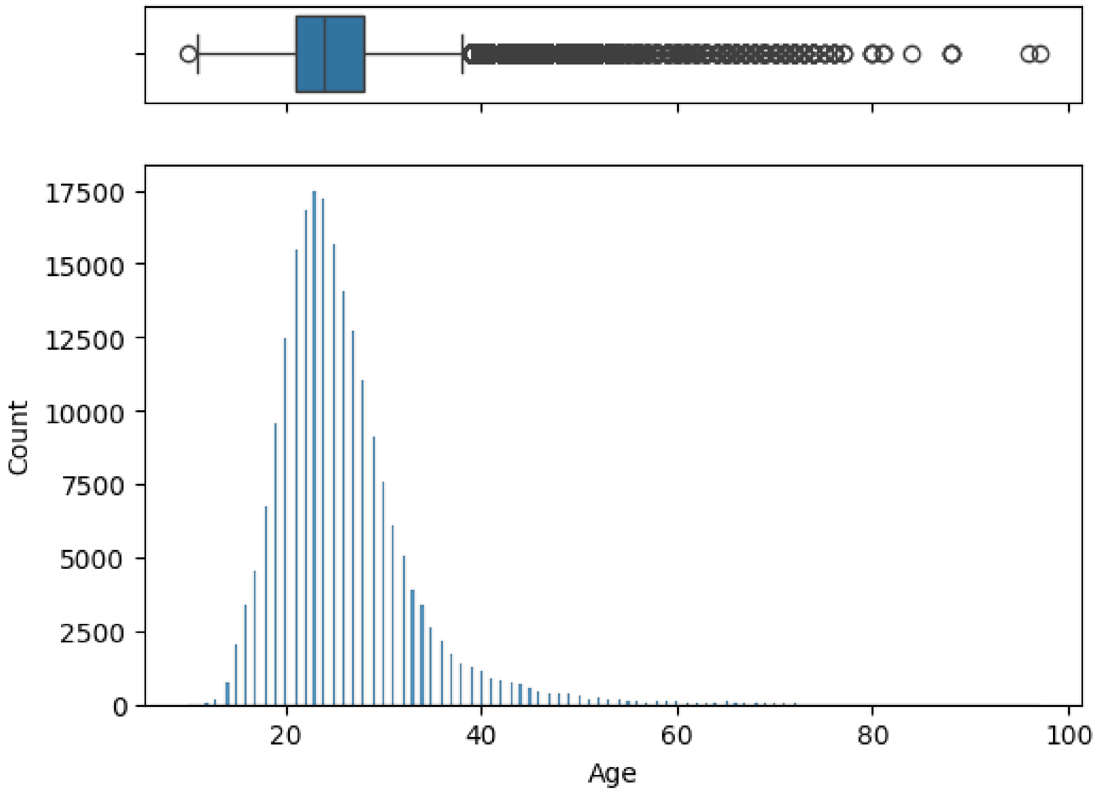
Is there a correlation between the age of athletes and their performance in different sports?

Summer

[5]:
```
df_summer.describe()
```

[5]:
```
                  ID            Age         Height         Weight  \
count  222203.000000  213026.000000  170434.000000  168439.000000
mean    67974.554776      25.677776     175.522349      70.697843
std     39133.856272       6.699008      10.916515      14.807120
min         1.000000      10.000000     127.000000      25.000000
25%     33974.000000      21.000000     168.000000      60.000000
50%     68278.000000      24.000000     175.000000      70.000000
75%    101841.000000      28.000000     183.000000      79.000000
max    135568.000000      97.000000     226.000000     214.000000

                Year
count  222203.000000
mean     1976.294136
std        30.951263
min      1896.000000
25%      1956.000000
50%      1984.000000
75%      2000.000000
max      2016.000000
```

[6]:
```
f, (ax_box, ax_hist) = plt.subplots(2, sharex=True,␣
 ↪gridspec_kw={"height_ratios": (.15, .85)})

sns.boxplot(df_summer["Age"], orient = "h", ax = ax_box)
sns.histplot(data = df_summer, x = "Age", ax= ax_hist)
plt.show()
```



[7]:
```
bins_s = np.array([10, 20, 30, 40, 50, 60, 100])
group_s = ["10-20", "20-30", "30-40", "40-50", "50-60", "60-100"]

df_summer["Age_binned"] = pd.cut(df_summer["Age"], bins_s, labels = group_s,␣
↪include_lowest = True )
df_summer.head()
```

```
C:\Users\acast\AppData\Local\Temp\ipykernel_18668\1809214311.py:4:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_summer["Age_binned"] = pd.cut(df_summer["Age"], bins_s, labels = group_s,
include_lowest = True )
```

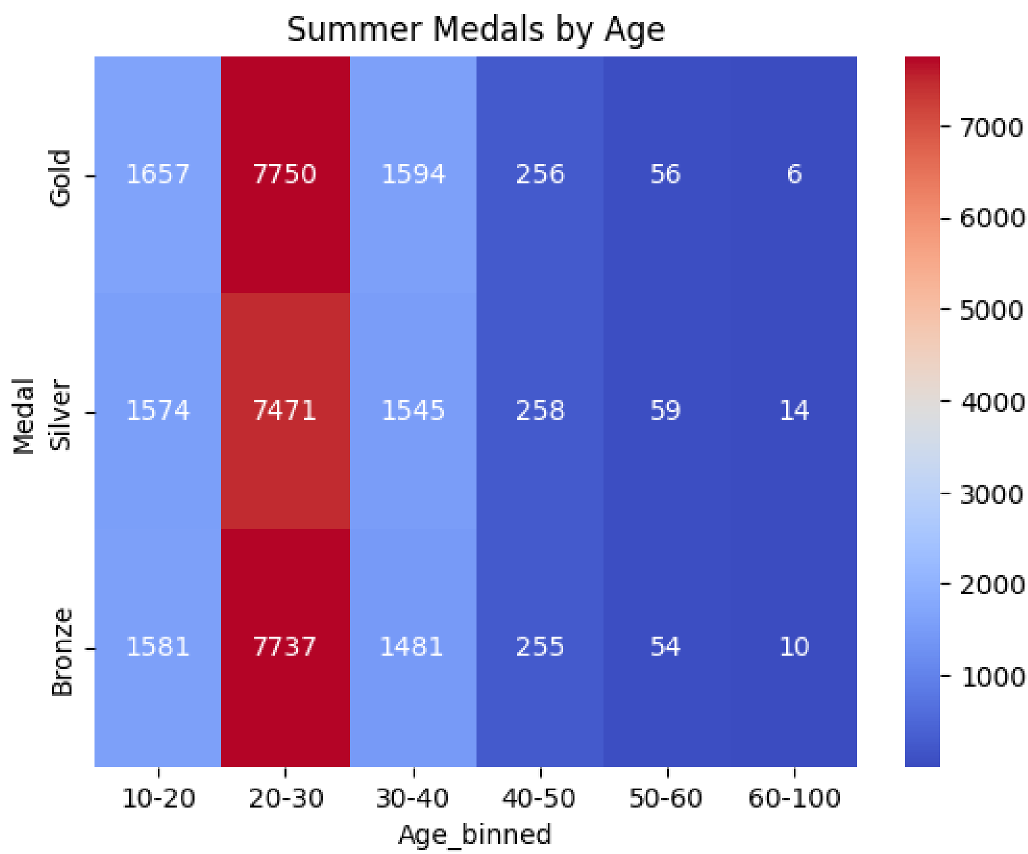
[7]:
```
   ID                        Name Sex   Age  Height  Weight  \
0   1                   A Dijiang   M  24.0   180.0    80.0
1   2                    A Lamusi   M  23.0   170.0    60.0
2   3         Gunnar Nielsen Aaby   M  24.0     NaN     NaN
```

```
3    4                Edgar Lindenau Aabye   M  34.0     NaN     NaN
26   8  Cornelia "Cor" Aalten (-Strannood)   F  18.0   168.0     NaN

              Team  NOC        Games  Year  Season         City       Sport  \
0            China  CHN  1992 Summer  1992  Summer    Barcelona  Basketball
1            China  CHN  2012 Summer  2012  Summer       London        Judo
2          Denmark  DEN  1920 Summer  1920  Summer    Antwerpen    Football
3   Denmark/Sweden  DEN  1900 Summer  1900  Summer        Paris  Tug-Of-War
26     Netherlands  NED  1932 Summer  1932  Summer  Los Angeles   Athletics

                         Event Medal       region notes Age_binned
0    Basketball Men's Basketball   NaN        China   NaN      20-30
1   Judo Men's Extra-Lightweight   NaN        China   NaN      20-30
2        Football Men's Football   NaN      Denmark   NaN      20-30
3    Tug-Of-War Men's Tug-Of-War  Gold      Denmark   NaN      30-40
26  Athletics Women's 100 metres   NaN  Netherlands   NaN      10-20
```

[8]:

```
heat_summer = df_summer[["Medal", "Age_binned"]].groupby(["Medal",␣
↪"Age_binned"]).value_counts().reset_index().pivot(index = "Medal", columns =␣
↪"Age_binned", values = "count")
heat_summer.index = pd.CategoricalIndex(heat_summer.index, categories =␣
↪["Gold", "Silver", "Bronze"])
heat_summer.sort_index(level=0, inplace=True)

sns.heatmap(heat_summer,
            cmap = "coolwarm",
            annot=True,
            fmt="0.0f").set(title = "Summer Medals by Age")

plt.show()
```

```
C:\Users\acast\AppData\Local\Temp\ipykernel_18668\3226218485.py:1:
FutureWarning: The default of observed=False is deprecated and will be changed
to True in a future version of pandas. Pass observed=False to retain current
behavior or observed=True to adopt the future default and silence this warning.
  heat_summer = df_summer[["Medal", "Age_binned"]].groupby(["Medal",
"Age_binned"]).value_counts().reset_index().pivot(index = "Medal", columns =
"Age_binned", values = "count")
```



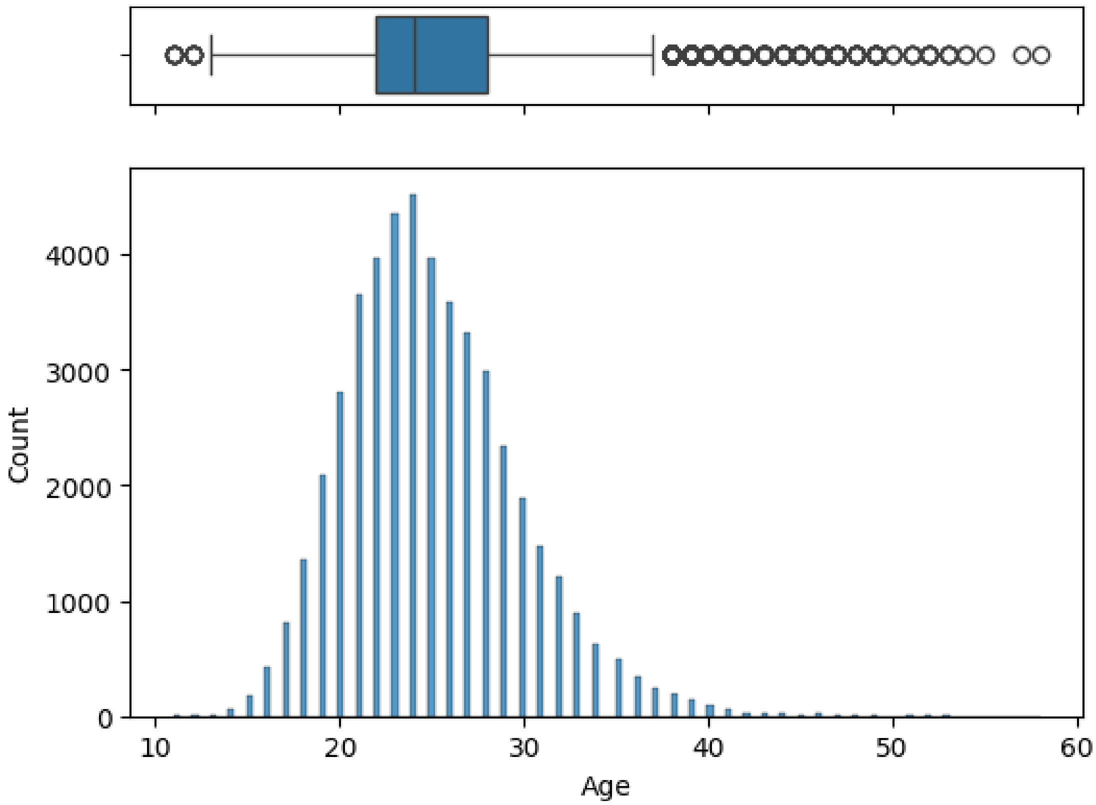
Winter

[9]:
```
df_winter.describe()
```

[9]:

	ID	Age	Height	Weight	Year
count	48564.00000	48279.000000	40250.000000	39543.000000	48564.000000
mean	69394.74930	25.039147	174.590112	70.759275	1987.825097
std	38462.33521	4.777735	8.598176	12.213273	22.070100
min	5.00000	11.000000	137.000000	32.000000	1924.000000
25%	37280.00000	22.000000	168.000000	62.000000	1972.000000
50%	67798.00000	24.000000	175.000000	70.000000	1994.000000
75%	103279.00000	28.000000	181.000000	79.000000	2006.000000
max	135571.00000	58.000000	211.000000	145.000000	2014.000000

[10]:
```
f, (ax_box, ax_hist) = plt.subplots(2, sharex=True,␣
 ↪gridspec_kw={"height_ratios": (.15, .85)})

sns.boxplot(df_winter["Age"], orient = "h", ax = ax_box)
sns.histplot(data = df_winter, x = "Age", ax= ax_hist)
plt.show()
```



[11]:
```
bins_w = np.array([10, 20, 30, 40, 50, 60])
group_w = ["10-20", "20-30", "30-40", "40-50", "50-60"]

df_winter["Age_binned"] = pd.cut(df_winter["Age"], bins_w, labels = group_w,␣
 ↪include_lowest = True )
df_winter.head()
```

```
C:\Users\acast\AppData\Local\Temp\ipykernel_18668\1438543321.py:4:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_winter["Age_binned"] = pd.cut(df_winter["Age"], bins_w, labels = group_w,
include_lowest = True )
```

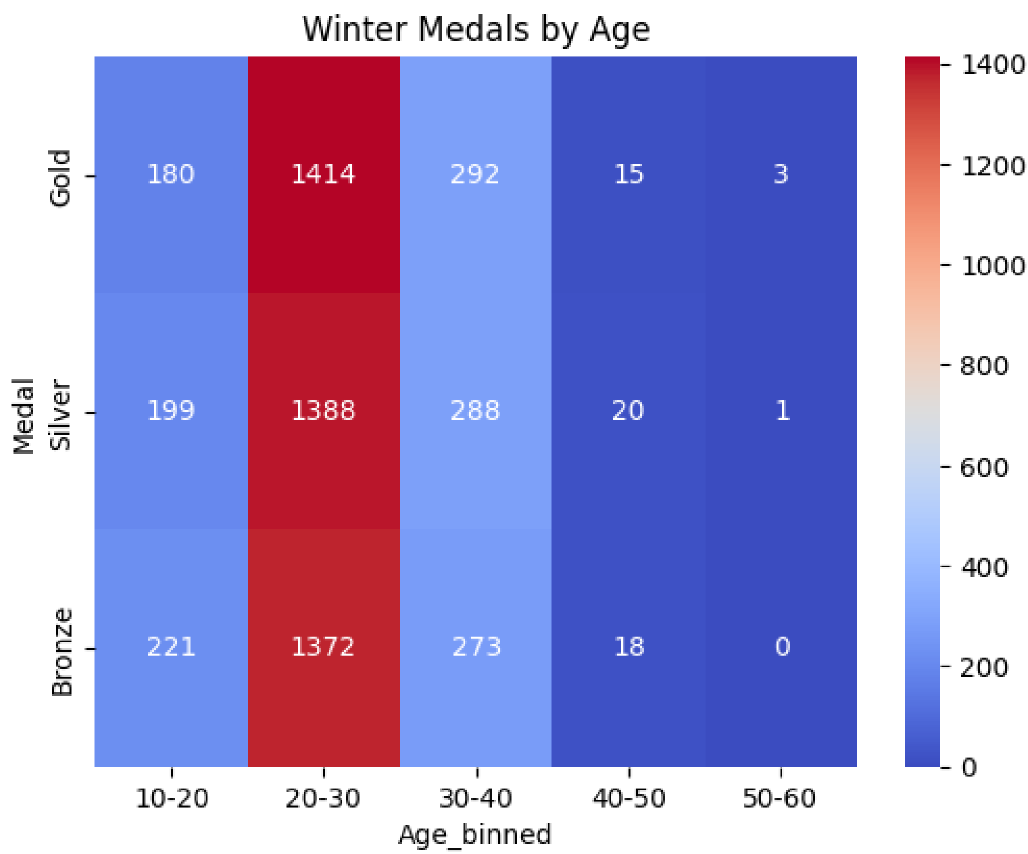
[11]:

	ID	Name	Sex	Age	Height	Weight	Team	NOC	\
4	5	Christine Jacoba Aaftink	F	21.0	185.0	82.0	Netherlands	NED	
5	5	Christine Jacoba Aaftink	F	21.0	185.0	82.0	Netherlands	NED	
6	5	Christine Jacoba Aaftink	F	25.0	185.0	82.0	Netherlands	NED	

```
7    5  Christine Jacoba Aaftink   F  25.0   185.0    82.0  Netherlands  NED
8    5  Christine Jacoba Aaftink   F  27.0   185.0    82.0  Netherlands  NED

         Games  Year  Season         City          Sport  \
4  1988 Winter  1988  Winter      Calgary  Speed Skating
5  1988 Winter  1988  Winter      Calgary  Speed Skating
6  1992 Winter  1992  Winter  Albertville  Speed Skating
7  1992 Winter  1992  Winter  Albertville  Speed Skating
8  1994 Winter  1994  Winter  Lillehammer  Speed Skating

                                  Event Medal       region notes Age_binned
4    Speed Skating Women's 500 metres   NaN  Netherlands   NaN      20-30
5  Speed Skating Women's 1,000 metres   NaN  Netherlands   NaN      20-30
6    Speed Skating Women's 500 metres   NaN  Netherlands   NaN      20-30
7  Speed Skating Women's 1,000 metres   NaN  Netherlands   NaN      20-30
8    Speed Skating Women's 500 metres   NaN  Netherlands   NaN      20-30
```

[12]:
```
heat_winter = df_winter[["Medal", "Age_binned"]].groupby(["Medal",␣
↪"Age_binned"]).value_counts().reset_index().pivot(index = "Medal", columns =␣
↪"Age_binned", values = "count")
heat_winter.index = pd.CategoricalIndex(heat_winter.index, categories =␣
↪["Gold", "Silver", "Bronze"])
heat_winter.sort_index(level=0, inplace=True)

sns.heatmap(heat_winter,
            cmap = "coolwarm",
            annot=True,
            fmt="0.0f").set(title = "Winter Medals by Age")

plt.show()
```

```
C:\Users\acast\AppData\Local\Temp\ipykernel_18668\413905725.py:1: FutureWarning:
The default of observed=False is deprecated and will be changed to True in a
future version of pandas. Pass observed=False to retain current behavior or
observed=True to adopt the future default and silence this warning.
  heat_winter = df_winter[["Medal", "Age_binned"]].groupby(["Medal",
"Age_binned"]).value_counts().reset_index().pivot(index = "Medal", columns =
"Age_binned", values = "count")
```



- In both Summer and Winter Olympics, athletes aged between 20-30 years tend to win the highest number of medals across all categories. There's a consistent decline in medal counts as athletes get older, regardless of the type of Olympics (Summer or Winter). The age distribution seems to have a similar impact on medal performance in both types of Olympics, with athletes in their 20s being the most dominant group.
- There's a consistent decline in medal counts as athletes get older, regardless of the type of Olympics (Summer or Winter).
- The age distribution seems to have a similar impact on medal performance in both types of Olympics, with athletes in their 20s being the most dominant group.

1.0.2 Gender disparity in sports participation

Despite the overall gender ratio of athletes being 3:1, are there specific sports or countries where the gender gap is narrower or wider?

Summer

[13]:
```
df_sex_sport_s = df_summer[["Sport", "Sex"]].groupby(["Sport", "Sex"]).
↪value_counts().reset_index().pivot(index = "Sport", columns = "Sex", values␣
↪= "count").reset_index().dropna()
df_sex_sport_s["Ratio"] = df_sex_sport_s["M"]/df_sex_sport_s["F"]
```

```
df_sex_sport_s.head()
```

[13]:

Sex	Sport	F	M	Ratio
1	Alpinism	1.0	3.0	3.000000
2	Archery	1015.0	1319.0	1.299507
3	Art Competitions	377.0	3201.0	8.490716
4	Athletics	11655.0	26941.0	2.311540
5	Badminton	728.0	708.0	0.972527

[14]:
```
pysqldf("""
        SELECT *
        FROM df_sex_sport_s
        ORDER BY Ratio DESC
        LIMIT 5
        """)
```

[14]:

	Sport	F	M	Ratio
0	Boxing	72.0	5974.0	82.972222
1	Wrestling	304.0	6850.0	22.532895
2	Motorboating	1.0	16.0	16.000000
3	Modern Pentathlon	164.0	1513.0	9.225610
4	Art Competitions	377.0	3201.0	8.490716

[15]:
```
pysqldf("""
        SELECT *
        FROM df_sex_sport_s
        ORDER BY Ratio ASC
        LIMIT 5
        """)
```

[15]:

	Sport	F	M	Ratio
0	Badminton	728.0	708.0	0.972527
1	Trampolining	76.0	76.0	1.000000
2	Triathlon	263.0	266.0	1.011407
3	Rugby Sevens	148.0	151.0	1.020270
4	Taekwondo	299.0	307.0	1.026756

Winter

[16]:
```
df_sex_sport_w = df_winter[["Sport", "Sex"]].groupby(["Sport", "Sex"]).
 ↪value_counts().reset_index().pivot(index = "Sport", columns = "Sex", values␣
 ↪= "count").reset_index().dropna()
df_sex_sport_w["Ratio"] = df_sex_sport_w["M"]/df_sex_sport_w["F"]
df_sex_sport_w.head()
```

[16]:

Sex	Sport	F	M	Ratio
0	Alpine Skiing	3398.0	5431.0	1.598293

```
2                Biathlon  1863.0  3030.0   1.626409
3               Bobsleigh   143.0  2915.0  20.384615
4     Cross Country Skiing  3385.0  5748.0   1.698080
5                  Curling   222.0   241.0   1.085586
```

[17]:
```
pysqldf("""
        SELECT *
        FROM df_sex_sport_w
        ORDER BY Ratio DESC
        LIMIT 5
        """)
```

[17]:
```
         Sport      F       M      Ratio
0  Ski Jumping   30.0  2371.0  79.033333
1    Bobsleigh  143.0  2915.0  20.384615
2   Ice Hockey  754.0  4702.0   6.236074
3         Luge  377.0  1102.0   2.923077
4     Skeleton   66.0   133.0   2.015152
```

[18]:
```
pysqldf("""
        SELECT *
        FROM df_sex_sport_w
        ORDER BY Ratio ASC
        LIMIT 5
        """)
```

[18]:
```
                       Sport       F       M     Ratio
0            Figure Skating  1150.0  1094.0  0.951304
1  Short Track Speed Skating   761.0   773.0  1.015769
2                    Curling   222.0   241.0  1.085586
3           Freestyle Skiing   433.0   504.0  1.163972
4               Snowboarding   416.0   520.0  1.250000
```

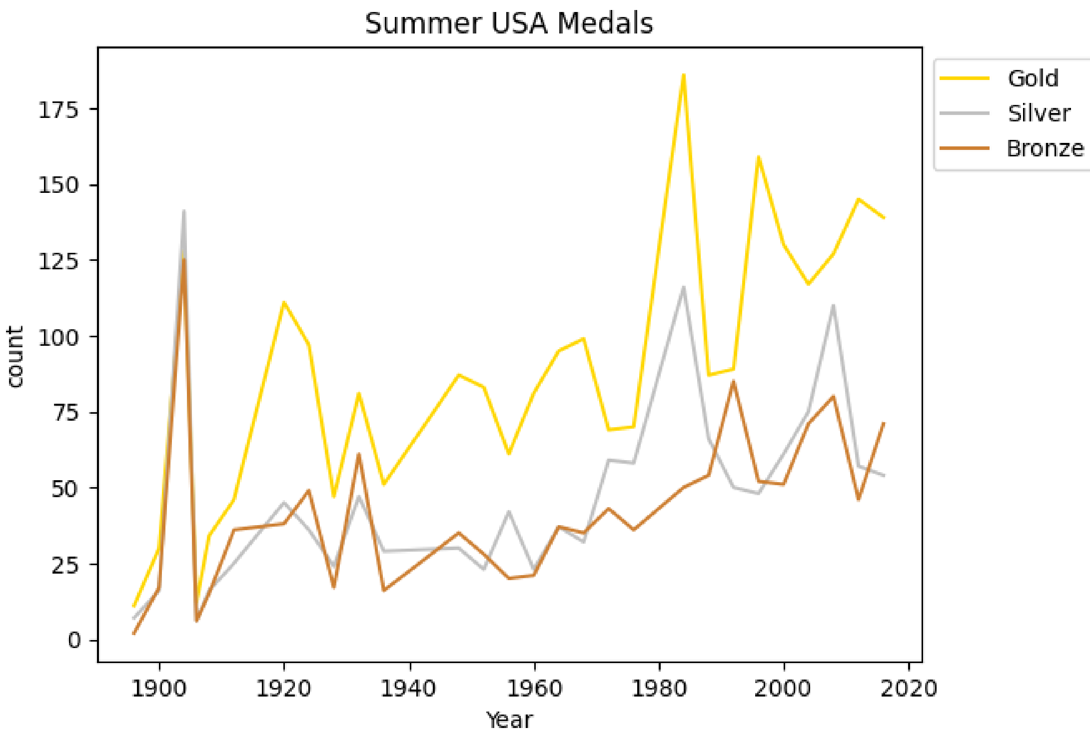
- In both Summer and Winter Olympics, certain sports exhibit a significant gender disparity, with some heavily favoring male participation (e.g., Boxing, Ski Jumping) and others showing a preference for female participation (e.g., Badminton, Figure Skating).
- However, there are also sports where the gender gap is narrower, with almost equal representation of both genders or with only a slight skew towards one gender (e.g., Trampolining, Triathlon, Curling).
- These variations in gender representation across different sports highlight the complex interplay of factors such as cultural norms, historical participation trends, and athletic requirements specific to each sport.

1.0.3 Long-term trends in Olympic performance

How has the performance of countries in the Olympics evolved over time? Are there any noticeable trends in terms of the rise or decline of certain nations in specific sports or across seasons?

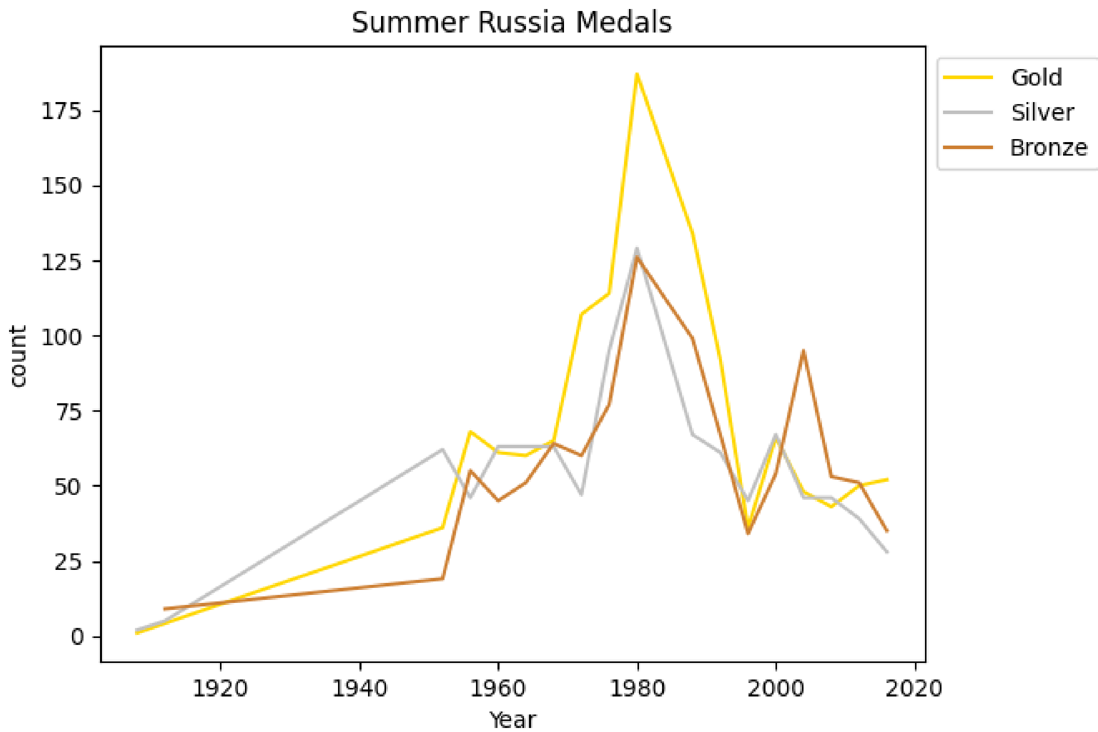
Summer

[19]:
```
sns.lineplot(data = df_summer[df_summer["region"] == "USA"][["Year", "Medal"]].
 ↪groupby(["Year"]).value_counts().reset_index(),
             x = "Year",
             y = "count",
             hue = "Medal",
             palette = {"Gold" : "#FFD700",
                        "Silver" : "#C0C0C0",
                        "Bronze" : "#CD7F32"},
             hue_order = ["Gold", "Silver", "Bronze"]).set_title("Summer USA␣
 ↪Medals")

plt.legend(bbox_to_anchor = (1, 1), loc='upper left')
plt.show()
```

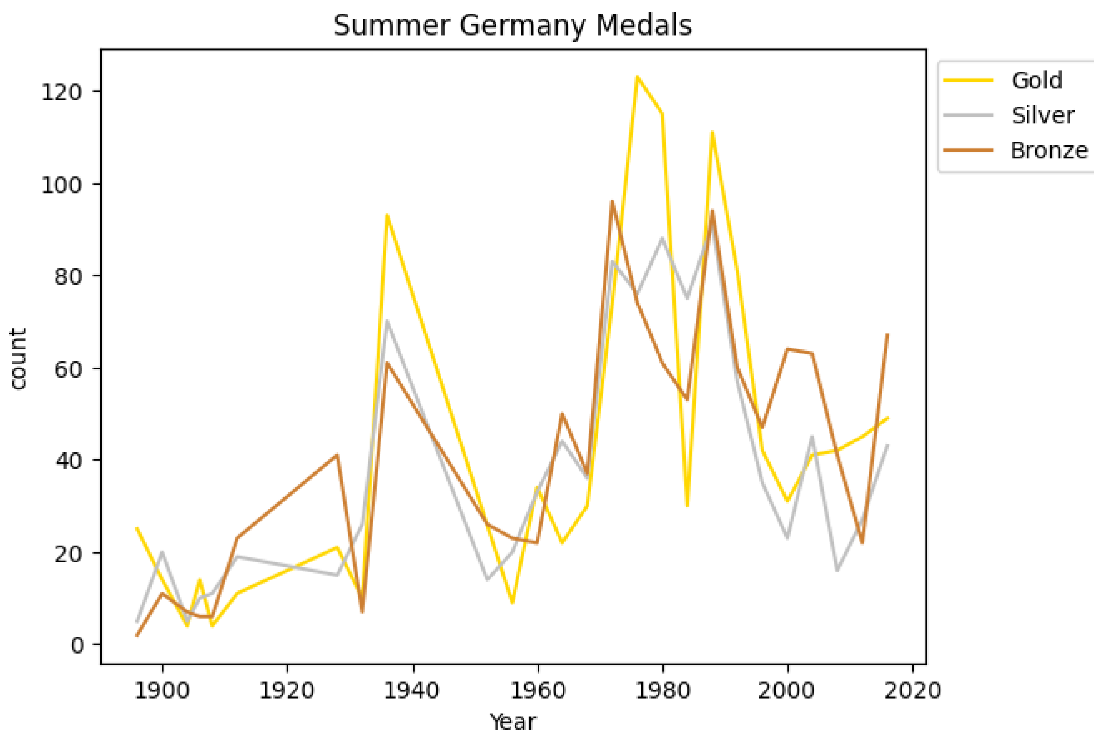


[20]:
```
sns.lineplot(data = df_summer[df_summer["region"] == "Russia"][["Year",␣
 ↪"Medal"]].groupby(["Year"]).value_counts().reset_index(),
             x = "Year",
             y = "count",
             hue = "Medal",
             palette = {"Gold" : "#FFD700",
                        "Silver" : "#C0C0C0",
                        "Bronze" : "#CD7F32"},
```

```
            hue_order = ["Gold", "Silver", "Bronze"]).set_title("Summer Russia␣
↪Medals")

plt.legend(bbox_to_anchor = (1, 1), loc='upper left')
plt.show()
```

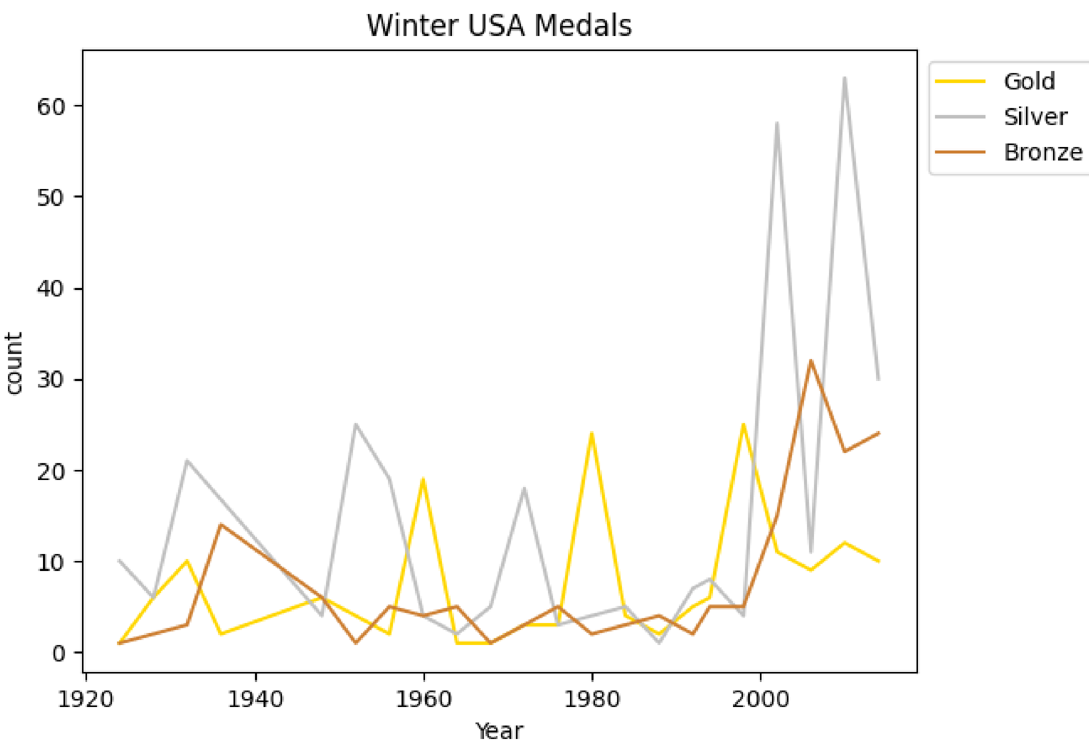


[21]:
```
sns.lineplot(data = df_summer[df_summer["region"] == "Germany"][["Year",␣
↪"Medal"]].groupby(["Year"]).value_counts().reset_index(),
             x = "Year",
             y = "count",
             hue = "Medal",
             palette = {"Gold" : "#FFD700",
                        "Silver" : "#C0C0C0",
                        "Bronze" : "#CD7F32"},
             hue_order = ["Gold", "Silver", "Bronze"]).set_title("Summer␣
↪Germany Medals")

plt.legend(bbox_to_anchor = (1, 1), loc='upper left')
plt.show()
```

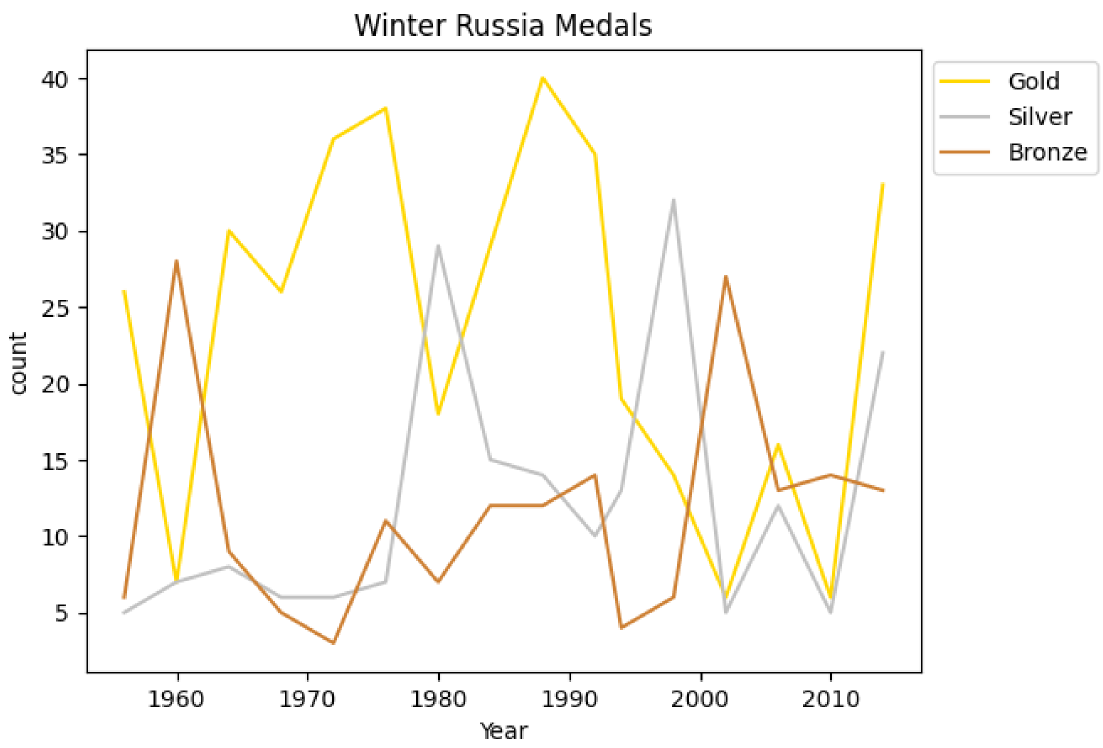


Winter

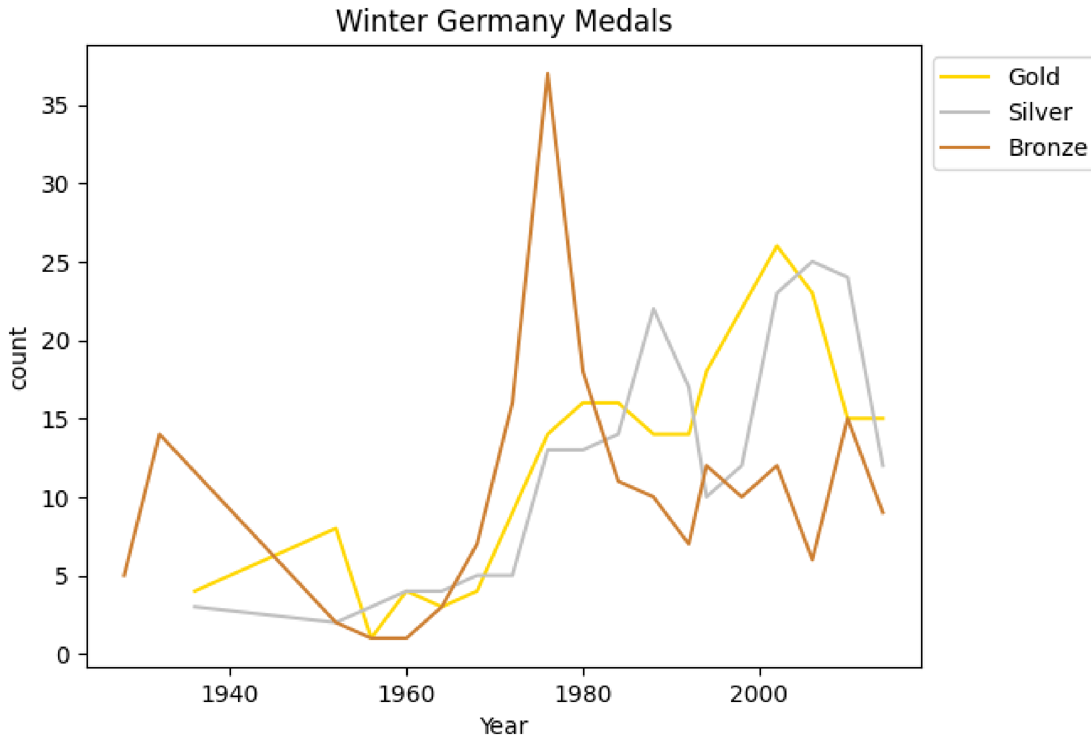
[22]:
```
sns.lineplot(data = df_winter[df_winter["region"] == "USA"][["Year", "Medal"]].
  ↪groupby(["Year"]).value_counts().reset_index(),
             x = "Year",
             y = "count",
             hue = "Medal",
             palette = {"Gold" : "#FFD700",
                        "Silver" : "#C0C0C0",
                        "Bronze" : "#CD7F32"},
             hue_order = ["Gold", "Silver", "Bronze"]).set_title("Winter USA␣
  ↪Medals")

plt.legend(bbox_to_anchor = (1, 1), loc='upper left')
plt.show()
```



[23]:
```
sns.lineplot(data = df_winter[df_winter["region"] == "Russia"][["Year",␣
↪"Medal"]].groupby(["Year"]).value_counts().reset_index(),
             x = "Year",
             y = "count",
             hue = "Medal",
             palette = {"Gold" : "#FFD700",
                        "Silver" : "#C0C0C0",
                        "Bronze" : "#CD7F32"},
             hue_order = ["Gold", "Silver", "Bronze"]).set_title("Winter Russia␣
↪Medals")

plt.legend(bbox_to_anchor = (1, 1), loc='upper left')
plt.show()
```



[24]:
```
sns.lineplot(data = df_winter[df_winter["region"] == "Germany"][["Year",␣
↪"Medal"]].groupby(["Year"]).value_counts().reset_index(),
             x = "Year",
             y = "count",
             hue = "Medal",
             palette = {"Gold" : "#FFD700",
                        "Silver" : "#C0C0C0",
                        "Bronze" : "#CD7F32"},
             hue_order = ["Gold", "Silver", "Bronze"]).set_title("Winter␣
↪Germany Medals")

plt.legend(bbox_to_anchor = (1, 1), loc='upper left')
plt.show()
```



During the Summer Olympics, the United States saw remarkable peaks in medal performance in 1904, 1932, and 1984. The 1904 Olympics were held in St. Louis, USA, where American athletes showcased their dominance across various sports. In 1932, Los Angeles, USA, hosted the Olympics, providing American athletes with a home advantage, resulting in a significant medal haul. The peak in 1984 coincides with the Los Angeles Olympics, where Team USA's success was celebrated on home soil, further fueling the nation's sporting pride. Russia's notable peak in medal performance during the Summer Olympics occurred in 1980, when Moscow, Russia, hosted the Games. The strong showing by Soviet athletes on home turf contributed to a memorable Olympic Games for the nation. Germany's exceptional performances in the Summer Olympics, particularly in 1936 and 1972, were highlighted during the Berlin Olympics and the Munich Olympics, respectively, where German athletes excelled in front of their home audiences, showcasing the nation's athletic prowess on the world stage.

- Periods of Excellence: All three countries experienced periods of exceptional performance, indicated by peaks in medal counts. These periods could be associated with various factors, including home advantage.
- Fluctuations: The performance of these countries in specific Olympic seasons may fluctuate due to various factors, including changes in national policies, advancements in sports science and technology, shifts in international sports dynamics, and individual athlete performances.
- Long-Term Success: Despite fluctuations, these countries have demonstrated long-term success in the Olympics, reflecting their commitment to sports excellence and their status as sporting powerhouses on the global stage.