PROJECT 1

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Importing requirements

In [1]:

```
import pandas as pd
import glob
import matplotlib.pyplot as plt
import seaborn as sns
import scipy.stats as stats
```

Function that rquires path, file extension and separator to parse all files in path and concate them all in one dataframe

For example, situation can happen, when files are with .txt file extension and separator in them is ','

In [2]:

```
def concat_files(path, separator, file_extension):
    all_files = glob.glob(f'{path}/*.{file_extension}')
    df = pd.concat([pd.read_table(file, sep=separator) for file in all_files])
    return df
```

Concating data about athletes

In [3]:

```
df = concat_files('../data/athlete_events', ',', 'csv')
```

In [4]:

```
df.head(3)
```

Out[4]:

	ID	Name	Sex	Age	Height	Weight	Team	NOC	Games	Year	Season	City	Sport	Event	Medal
0	91138	Anton Dmitriyevich Pantov	M	22.0	187.0	77.0	Kazakhstan	KAZ	2014 Winter	2014.0	Winter	Sochi	Biathlon	Biathlon Men's 10 kilometres Sprint	NaN
1	91138	Anton Dmitriyevich Pantov	M	22.0	187.0	77.0	Kazakhstan	KAZ	2014 Winter	2014.0	Winter	Sochi	Biathlon	Biathlon Mixed 2 x 6 kilometres and 2 x 7.5 ki...	NaN
2	91138	Anton Dmitriyevich Pantov	M	22.0	187.0	77.0	Kazakhstan	KAZ	2014 Winter	2014.0	Winter	Sochi	Biathlon	Biathlon Men's 20 kilometres	NaN

Checking the Data

Checking types of variables

In [5]:

```
df.info(show_counts=True)
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 271115 entries, 0 to 22390
Data columns (total 15 columns):
 #   Column  Non-Null Count   Dtype  
---  ------  --------------   -----  
 0   ID      271115 non-null  int64  
 1   Name    271114 non-null  object 
 2   Sex     271113 non-null  object 
 3   Age     261639 non-null  float64
 4   Height  210943 non-null  float64
 5   Weight  208239 non-null  float64
 6   Team    271112 non-null  object 
 7   NOC     271111 non-null  object 
 8   Games   271110 non-null  object 
 9   Year    271108 non-null  float64
 10  Season  271108 non-null  object 
 11  City    271108 non-null  object 
 12  Sport   271108 non-null  object 
 13  Event   271107 non-null  object 
 14  Medal   39782 non-null   object 
dtypes: float64(4), int64(1), object(10)
memory usage: 33.1+ MB
```

Checking common statistics of variables

In [6]:

```
df.describe(include = 'all')
```

Out[6]:

	ID	Name	Sex	Age	Height	Weight	Team	NOC	Games	Year	Season	City	Sport	Event	Medal
count	271115.000000	271114	271113	261639.000000	210943.000000	208239.000000	271112	271111	271110	271108.000000	271108	271108	271108	271107	39782
unique	NaN	134732	3	NaN	NaN	NaN	1184	231	53	NaN	2	42	67	766	3
top	NaN	Robert Tait McKenzie	M	NaN	NaN	NaN	United States	USA	2000 Summer	NaN	Summer	London	Athletics	Football Men's Football	Gold
freq	NaN	58	196588	NaN	NaN	NaN	17847	18853	13820	NaN	222544	22425	38623	5731	13372
mean	68248.828641	NaN	NaN	25.557669	175.339760	70.702232	NaN	NaN	NaN	1978.378314	NaN	NaN	NaN	NaN	NaN
std	39022.303374	NaN	NaN	6.407296	10.524619	14.348878	NaN	NaN	NaN	29.877579	NaN	NaN	NaN	NaN	NaN
min	1.000000	NaN	NaN	10.000000	127.000000	7.000000	NaN	NaN	NaN	1896.000000	NaN	NaN	NaN	NaN	NaN
25%	34643.000000	NaN	NaN	21.000000	168.000000	60.000000	NaN	NaN	NaN	1960.000000	NaN	NaN	NaN	NaN	NaN
50%	68205.000000	NaN	NaN	24.000000	175.000000	70.000000	NaN	NaN	NaN	1988.000000	NaN	NaN	NaN	NaN	NaN
75%	102097.000000	NaN	NaN	28.000000	183.000000	79.000000	NaN	NaN	NaN	2002.000000	NaN	NaN	NaN	NaN	NaN
max	135571.000000	NaN	NaN	240.000000	340.000000	214.000000	NaN	NaN	NaN	2016.000000	NaN	NaN	NaN	NaN	NaN

In [7]:

```
for i in ['Sex', 'Team', 'Games', 'Season', 'City', 'Sport', 'Medal']:
    print(df[i].unique())
```

```
['M' 'F' nan 'G']
['Kazakhstan' 'Ghana' 'Finland' ... 'Solos Carex' 'Dow Jones' 'Digby']
['2014 Winter' '1994 Winter' '1998 Winter' '2002 Winter' '2004 Summer'
 '2000 Summer' '1956 Winter' '1960 Winter' '2016 Summer' '1964 Winter'
 '1968 Winter' '1972 Winter' '1976 Winter' '2008 Summer' '2012 Summer'
 '1906 Summer' '1980 Summer' '1948 Summer' '1956 Summer' '1984 Summer'
 '1992 Summer' '1992 Winter' '1968 Summer' '1924 Summer' '2010 Winter'
 '1900 Summer' '1912 Summer' '1920 Summer' '1928 Summer' '1964 Summer'
 '1976 Summer' '1996 Summer' '1972 Summer' '1936 Summer' '1952 Summer'
 '1960 Summer' '1896 Summer' '1932 Winter' '1988 Summer' '1932 Summer'
 '1908 Summer' '1952 Winter' '1984 Winter' '2006 Winter' '1988 Winter'
 '1928 Winter' '1948 Winter' '1936 Winter' '1904 Summer' '1980 Winter'
 '1924 Winter' nan '2004 Summe' '2000 Su']
['Winter' 'Summer' nan]
['Sochi' 'Lillehammer' 'Nagano' 'Salt Lake City' 'Athina' 'Sydney'
 "Cortina d'Ampezzo" 'Squaw Valley' 'Rio de Janeiro' 'Innsbruck'
 'Grenoble' 'Sapporo' 'Beijing' 'London' 'Moskva' 'Melbourne'
 'Los Angeles' 'Barcelona' 'Albertville' 'Mexico City' 'Paris' 'Vancouver'
 'Stockholm' 'Antwerpen' 'Amsterdam' 'Tokyo' 'Montreal' 'Atlanta' 'Munich'
 'Berlin' 'Helsinki' 'Roma' 'Lake Placid' 'Seoul' 'Oslo' 'Sarajevo'
 'Torino' 'Calgary' 'Sankt Moritz' 'Garmisch-Partenkirchen' 'St. Louis'
 'Chamonix' nan]
['Biathlon' 'Football' 'Equestrianism' 'Ice Hockey' 'Athletics'
 'Bobsleigh' 'Water Polo' 'Gymnastics' 'Swimming' 'Art Competitions'
 'Boxing' 'Sailing' 'Badminton' 'Modern Pentathlon' 'Shooting'
 'Alpine Skiing' 'Rowing' 'Cross Country Skiing' 'Weightlifting'
 'Basketball' 'Taekwondo' 'Wrestling' 'Cycling' 'Fencing' 'Hockey'
 'Table Tennis' 'Tennis' 'Judo' 'Tug-Of-War' 'Beach Volleyball' 'Canoeing'
 'Volleyball' 'Diving' 'Synchronized Swimming' 'Rhythmic Gymnastics'
 'Handball' 'Baseball' 'Snowboarding' 'Luge' 'Rugby Sevens'
 'Speed Skating' 'Figure Skating' 'Archery' 'Freestyle Skiing'
 'Trampolining' 'Short Track Speed Skating' 'Golf' 'Lacrosse' 'Softball'
 'Ski Jumping' 'Skeleton' 'Nordic Combined' 'Polo' 'Rugby' 'Curling'
 'Triathlon' 'Jeu De Paume' 'Racquets' 'Cricket' 'Motorboating' 'Croquet'
 'Alpinism' 'Aeronautics' nan 'Military Ski Patrol' 'Roque'
 'Basque Pelota' 'Footba']
[nan 'Bronze' 'Gold' 'Silver']
```

There are some deviations that are already visible

Checking NULLs

In [8]:

```
df.isna().sum()
```

Out[8]:

```
ID              0
Name            1
Sex             2
Age          9476
Height      60172
Weight      62876
Team            3
NOC             4
Games           5
Year            7
Season          7
City            7
Sport           7
Event           8
Medal      231333
dtype: int64
```

Obviously some sportsmen did not have medals. Also we consider that some athletes did not measured their Height and Weight and did not wanted to say their age (maybe). And nobody took such statistics especially in the several first games

Deleting sportsmen without name and sport, beacuse sportsmen could not be without sport and name

In [9]:

```
df = df.drop(df.loc[df.Name.isnull()].index[0], axis=0)
df = df.drop(df.loc[df['Sport'].isnull()].index)
```

In [10]:

```
df.isna().sum()
```

Out[10]:

```
ID              0
Name            0
Sex             0
Age          9472
Height      60160
Weight      62863
Team            0
NOC             0
Games           0
Year            0
Season          0
City            0
Sport           0
Event           1
Medal      231291
dtype: int64
```

Checking Event and Season and repair missed data

In [11]:

```
df.loc[df['Event'].isnull()]
```

Out[11]:

	ID	Name	Sex	Age	Height	Weight	Team	NOC	Games	Year	Season	City	Sport	Event	Medal
22781	91137	Georgios Pantos	M	NaN	NaN	NaN	Athens-2	GRE	1906 Summer	1906.0	Summer	Athina	Footba	NaN	NaN

In [12]:

```
df.loc[df['Event'].isnull(), "Event"] = 'Football Men\'s Football'
df.loc[df['Event'].isnull(), "Sport"] = 'Football'
```

In [13]:
```
df.loc[df.Games == '2004 Summe', "Event"] = '2004 Summer'
```

In [14]:
```
df.loc[df.Games == '2000 Su', "Event"] = '2000 Summer'
```

Checking Sex

In [15]:
```
df['Sex'].value_counts().sort_index()
```

Out[15]:
```
F     74512
G         2
M    196555
Name: Sex, dtype: int64
```

In [16]:
```
df.loc[df.Sex == 'G']
```

Out[16]:

	ID	Name	Sex	Age	Height	Weight	Team	NOC	Games	Year	Season	City	Sport	Event	Medal
42	79609	Pavel Mike	G	22.0	182.0	79.0	Czechoslovakia	TCH	1972 Summer	1972.0	Summer	Munich	Handball	Handball Men's Handball	Silver
74	79630	Anatoly Mikhaylin	G	37.0	NaN	NaN	Russia	RUS	1996 Summer	1996.0	Summer	Atlanta	Sailing	Sailing Mixed Two Person Keelboat	NaN

2 athletes turned out to be with gender "G" - with all my respect for minorities, I can't leave it this way, because in the years in which these athletes performed, gender-non-decided people did not perform (especially from Russia and Czechoslovakia). So i changed the sex according to their sports and names

In [17]:
```
df.loc[df['Sex'] == 'G', 'Sex'] = 'M'
```

Checking Age

In [18]:
```
df['Age'].value_counts().sort_index()
```

Out[18]:
```
10.0       1
11.0      13
12.0      39
13.0     187
14.0     837
        ...
84.0       1
88.0       3
96.0       1
97.0       1
240.0      1
Name: Age, Length: 75, dtype: int64
```

In [19]:
```
df.loc[df.Age == 240]
```

Out[19]:

	ID	Name	Sex	Age	Height	Weight	Team	NOC	Games	Year	Season	City	Sport	Event	Medal
38	23459	Flicien Jules mile Courbet	M	240.0	NaN	NaN	Belgium	BEL	1912 Summer	1912.0	Summer	Stockholm	Swimming	Swimming Men's 200 metres Breaststroke	NaN

Too old... We have to change this data to 24, beacuse she have some another data in dataset - he was 24 in 1912

In [20]:
```
df.loc[(df.Name == "Flicien Jules mile Courbet") & (df.Year == 1912)].Age
```

```
Out[20]: 37     24.0
         38    240.0
         39     24.0
         Name: Age, dtype: float64
```

```
In [21]: df.loc[df.Age == 240, 'Age'] = 24
```

Checking Height

```
In [22]: df['Height'].value_counts().sort_index()
```

```
Out[22]: 127.0    7
         128.0    1
         130.0    2
         131.0    2
         132.0    9
                 ..
         220.0    6
         221.0    4
         223.0    4
         226.0    3
         340.0    1
         Name: Height, Length: 96, dtype: int64
```

```
In [23]: df.loc[df.Height == 340]
```

Out[23]:

	ID	Name	Sex	Age	Height	Weight	Team	NOC	Games	Year	Season	City	Sport	Event	Medal
227	23549	Kirsty Leigh Coventry (-Seward)	F	28.0	340.0	64.0	Zimbabwe	ZIM	2012 Summer	2012.0	Summer	London	Swimming	Swimming Women's 200 metres Individual Medley	NaN

It is to high! But let's take a look to another data about his height

```
In [24]: df.loc[df.Name == 'Kirsty Leigh Coventry (-Seward)'].Height.value_counts()
```

```
Out[24]: 176.0    15
         340.0     1
         Name: Height, dtype: int64
```

She is definetely 176!

```
In [25]: df.loc[df.Height == 340, 'Height'] = 176
```

Checking Weight

```
In [26]: df['Weight'].value_counts().sort_index()
```

```
Out[26]: 25.0      6
         28.0     14
         30.0     42
         31.0     23
         32.0     41
                  ..
         180.0     1
         182.0     2
         190.0     1
         198.0     1
         214.0     2
         Name: Weight, Length: 220, dtype: int64
```

It is already okay

EDA

The age of the youngest athletes of both sexes at the 1992 Olympics.

```
In [27]: df.loc[df.Year == 1992].groupby('Sex').Age.min().to_frame()
```

Out[27]:

	Age
Sex	
F	12.0
M	11.0

The average value and standard deviation of the Height variable for athletes of each sex.

```
In [28]: df.groupby('Sex').agg(Mean_value = ('Height', 'mean'),
                               Standard_deviation = ('Height', 'std'))
```

Out[28]:

	Mean_value	Standard_deviation
Sex		
F	167.839701	8.778879
M	178.858514	9.360484

The average value and standard deviation of the Height variable for female tennis players at the 2000 Olympics.

```
In [29]: df.loc[(df.Sex == 'F') &
                (df.Sport == 'Tennis') &
                (df.Year == 2000)].agg(Mean_value = ('Height', 'mean'),
                                       Standard_deviation = ('Height', 'std')).round(1)
```

Out[29]:

	Height
Mean_value	171.8
Standard_deviation	6.5

Heaviest athlete's sport in at the 2006 Olympics

In [30]:

```
print(f"Sport of heviest athlete: {(df.loc[(df.Weight == df.loc[df.Year == 2006].Weight.max()) & (df.Year == 2006)].Sport).reset_index().Sport[0]}")
```

```
Sport of heviest athlete: Skeleton
```

Number of gold medals which were received by women from 1980 to 2010

In [31]:

```
df.loc[(df.Sex == "F") & (df.Medal == "Gold") & (df.Year.isin(range(1980,2011)))].Medal.count()
```

Out[31]:

```
2249
```

Number of times has John Aalberg participated in the Olympic Games in different years

In [32]:

```
diff_years = df.loc[df.Name == "John Aalberg"].Year.unique().size
all_times = df.loc[df.Name == "John Aalberg"].shape[0]
num_of_games = df.loc[df.Name == "John Aalberg"].Games.unique().size
print(f'Different years he participated: {diff_years}. Participated at different competitions: {all_times} times.')
```

```
Different years he participated: 2. Participated at different competitions: 8 times.
```

The least and most represented (by number of participants) age groups of athletes at the 2008 Olympics.

Age groups: [15-25), [25-35), [35-45), [45-55].

In [33]:

```
categories = pd.cut(df.loc[df.Year == 2008].Age,bins=(15,25,35,45,55), right= False)

ages_df = categories.value_counts().agg(['idxmax', 'idxmin']).reset_index().\
replace('idxmax', 'Most represented').replace('idxmin', 'Least represented').set_index('index')
ages_df.index.names = ['Most or least']
ages_df
```

Out[33]:

	Age
Most or least	
Most represented	[25, 35)
Least represented	[45, 55)

How much has the number of sports at the 2002 Olympics more compared to the 1994 Olympic Games

In [34]:

```
print(f" In 2002 Olympics there were {df.loc[df.Year == 2002].Sport.unique().size - df.loc[df.Year == 1994].Sport.unique().size} more sports then in 1994 Olympics")
```

```
 In 2002 Olympics there were 3 more sports then in 1994 Olympics
```

The top 3 countries for each type of medals for the Winter and Summer Olympics

In [35]:

```
medal_top_df = df.groupby(['Season', "Medal", "NOC"]).NOC.count().sort_values(ascending=False).\
groupby(level=["Medal", "Season"]).head(3).reindex(['Gold', 'Silver', "Bronze"], level=1).to_frame().\
rename(columns = {'NOC': 'Count'})
medal_top_df
```

Out[35]:

			Count
Season	**Medal**	**NOC**	
Summer	**Gold**	**USA**	2472
		URS	832
		GBR	636
	Silver	**USA**	1333
		GBR	729
		URS	635
	Bronze	**USA**	1197
		GER	649
		GBR	620
Winter	**Gold**	**CAN**	305
		URS	250
		USA	166
	Silver	**USA**	308
		CAN	199
		NOR	165
	Bronze	**FIN**	215
		SWE	177
		USA	161

Height_z_scores variable with the values of the Height variable after its standardization

In [36]:

```
df['Height_z_scores'] = (df.Height - df.Height.mean()) / df.Height.std()
df.Height_z_scores
```

```
Out[36]: 0        1.108607
         1        1.108607
         2        1.108607
         3        1.108607
         4        1.393813
                    ...
         22386    0.348055
         22387    0.062849
         22388    0.062849
         22389    0.918469
         22390    0.918469
         Name: Height_z_scores, Length: 271069, dtype: float64
```

Height_min_max_scaled variable with the values of the Height variable after applying min-max normalization to it.

Optional

```
In [37]: df['Height_min_max_scaled'] = (df.Height - df.Height.min()) / (df.Height.max() - df.Height.min())
         df['Height_min_max_scaled']
```

```
Out[37]: 0        0.606061
         1        0.606061
         2        0.606061
         3        0.606061
         4        0.636364
                    ...
         22386    0.525253
         22387    0.494949
         22388    0.494949
         22389    0.585859
         22390    0.585859
         Name: Height_min_max_scaled, Length: 271069, dtype: float64
```

Compared the height, weight and age of men and women who participated in the Winter Olympic Games.

The results designed to use them for the article.

As we have huge data (big amount of values), t-test could be applied

```
In [38]: t_height = stats.ttest_ind(df.loc[df.Sex == 'F', 'Height'].dropna(),
         df.loc[df.Sex == 'M', 'Height'].dropna())
         t_weight = stats.ttest_ind(df.loc[df.Sex == 'F', 'Weight'].dropna(),
         df.loc[df.Sex == 'M', 'Weight'].dropna())
         t_age = stats.ttest_ind(df.loc[df.Sex == 'F', 'Age'].dropna(),
         df.loc[df.Sex == 'M', 'Age'].dropna())
```

In [39]:

```
new_df = df.loc[df.Season == 'Winter',['Sex','Height','Weight', 'Age']].groupby('Sex', as_index=False).agg(['min','mean', 'max', 'std', "count"]).round(2).transpose()
new_df = new_df.rename(columns = {'F':'Female', 'M':'Male'},
                       index = {'min':'Minimum value',
                                'max':'Maximum value',
                                'std':'Standard deviation',
                                'mean':'Average value',
                                'count': "Total values"})
new_df.rename_axis()
new_df.rename_axis(["Characteristic", 'Statistics'], axis='index', inplace=True)
new_df.rename_axis("Sex of athlete:", axis="columns", inplace=True)

new_df['T-test'] = ''
new_df.loc[('Height', 'Average value'), 'T-test'] = f' Statistic = {t_height[0].round(2)}'
new_df.loc[('Weight', 'Average value'), 'T-test'] = f'Statistic = {t_weight[0].round(2)}'
new_df.loc[('Age', 'Average value'), 'T-test'] = f'Statistic = {t_age[0].round(2)}'

new_df.loc[('Height', 'Maximum value'), 'T-test'] = f'p-value = {t_height[1].round(2)}'
new_df.loc[('Weight', 'Maximum value'), 'T-test'] = f'p-value = {t_weight[1].round(2)}'
new_df.loc[('Age', 'Maximum value'), 'T-test'] = f'p-valuec = {t_age[1].round(2)}'
```

In [40]:

```
s1 = new_df.style.format(formatter={'Female': "{:.1f}", 'Male': "{:.1f}", 'T-test p-value': "{:.5f}"})
s1 = s1.set_table_styles([{'selector': 'th', 'props': 'text-align: center;'},
                    {'selector': 'th', 'props': 'text-align: center;'},
                    {'selector': '', 'props': 'border: 1px solid #000066;'},
                     {'selector': 'caption','props': 'caption-side: bottom; font-size:1.25em;'}],overwrite=False, axis=1)

s1.set_caption("Table 1. Height, Weight and Age of Male and Female athletes on winter olympics.")

for l0 in ['Height', 'Weight', 'Age']:
    s1 = s1.set_table_styles({(l0, 'Total values'): [{'selector': '', 'props': 'border-bottom: 2px solid black;'}],
                        (l0, 'Minimum value'): [{'selector': '.level0', 'props': 'border-bottom: 2px solid black;'}],
                        (l0, 'Minimum value'): [{'selector': '.level0', 'props': 'border: 2px solid black;'}]},
                        overwrite=False, axis=1)

s1
```

Out[40]:

	Sex of athlete:	Female	Male	T-test
Characteristic	Statistics			
Height	Minimum value	137.0	142.0	
	Average value	166.5	178.7	Statistic = -257.05
	Maximum value	194.0	211.0	p-value = 0.0
	Standard deviation	6.0	6.6	
	Total values	13521.0	26722.0	
Weight	Minimum value	32.0	47.0	
	Average value	59.8	76.4	Statistic = -271.56
	Maximum value	96.0	145.0	p-value = 0.0
	Standard deviation	7.1	10.3	
	Total values	13332.0	26204.0	
Age	Minimum value	11.0	12.0	
	Average value	24.0	25.5	Statistic = -93.25
	Maximum value	48.0	58.0	p-valuec = 0.0
	Standard deviation	4.7	4.8	
	Total values	15071.0	33199.0	

Table 1. Height, Weight and Age of Male and Female athletes on winter olympics.

Making tables for article

In [41]:

```
print(s1.to_latex(), file = open('../data/Tables_for_article/latex_table_with_style.txt', 'w'))
print(s1.to_latex(), file = open('../data/Tables_for_article/latex_table.txt', 'w'))
print(new_df.to_markdown(), file = open('../data/Tables_for_article/markdown_table.txt', 'w'))
```

Let's compare Medal and Team variables

Making top Teams with the most number of medals of all time

In [42]:

```
medals = df.loc[df.Medal.notna()].groupby('Team').Medal.count().reset_index().sort_values(by='Medal', ascending=False)
num_medals = df.loc[df.Medal == "Gold"].groupby('Team').Medal.count().reset_index().\
sort_values(by='Medal', ascending=False).rename(columns = {'Medal': 'Number of medals'})
num_medals.head(10)
```

Out[42]:

	Team	Number of medals
224	United States	2474
200	Soviet Union	1058
87	Germany	679
112	Italy	535
90	Great Britain	519
80	France	455
205	Sweden	450
102	Hungary	432
35	Canada	422
62	East Germany	369

We already can assume that some Teams have more medals then others! But it is difficult to make some correlation. Let's assume that Team and Medal variables connected via Sports variable (in particular - the number of kinds of sports Team is participated in)

How many kinds of sports Teams is participated in?

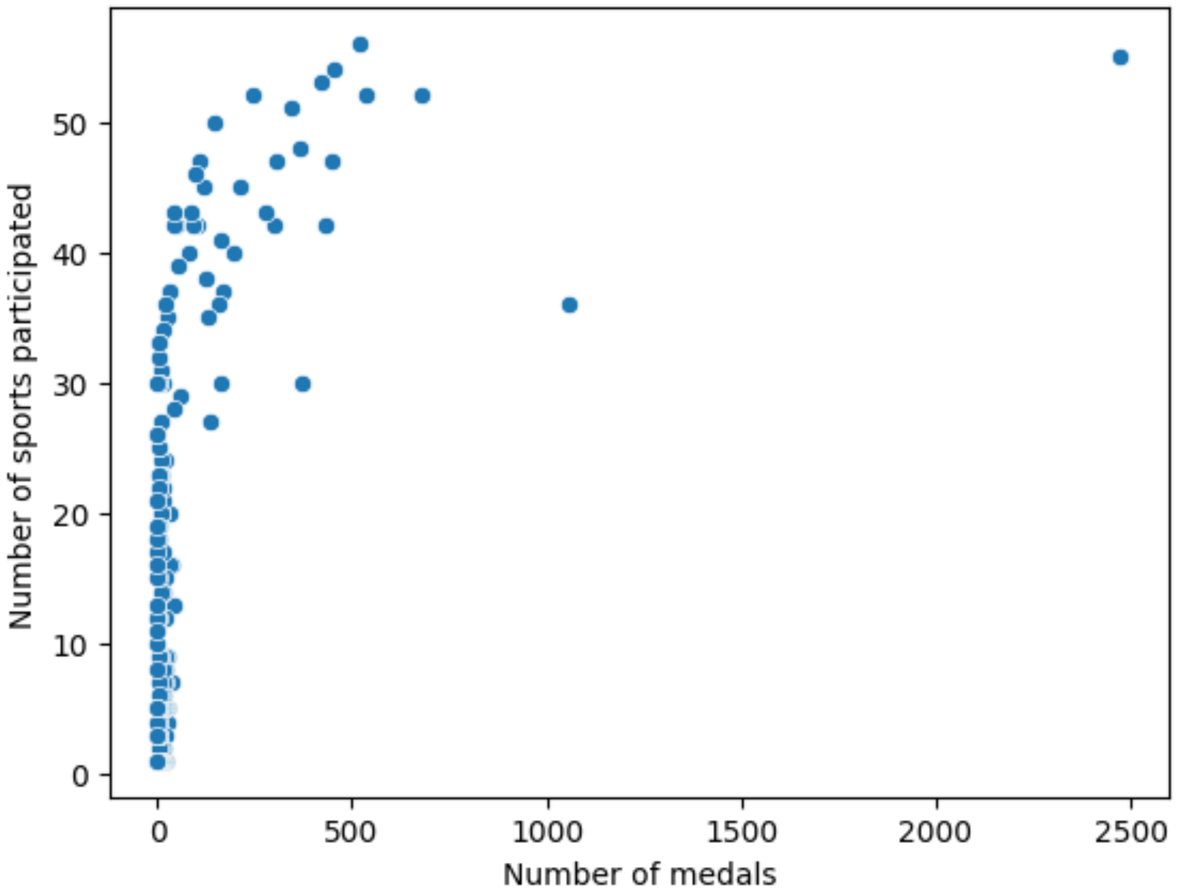
In [43]:
```
num_sport = df.groupby('Team').Sport.nunique()
num_sport_medals = num_medals.merge(num_sport, on='Team').rename(columns={'Sport':'Number of sports participated'})
num_sport_medals
```

Out[43]:

	Team	Number of medals	Number of sports participated
0	United States	2474	55
1	Soviet Union	1058	36
2	Germany	679	52
3	Italy	535	52
4	Great Britain	519	56
...	...	...	...
237	Nrnberg	1	1
238	Kosovo	1	5
239	Peru	1	26
240	Baby-1	1	1
241	Puerto Rico	1	30

242 rows × 3 columns

In [44]:
```
sns.scatterplot(x=num_sport_medals['Number of medals'], y=num_sport_medals['Number of sports participated']);
```



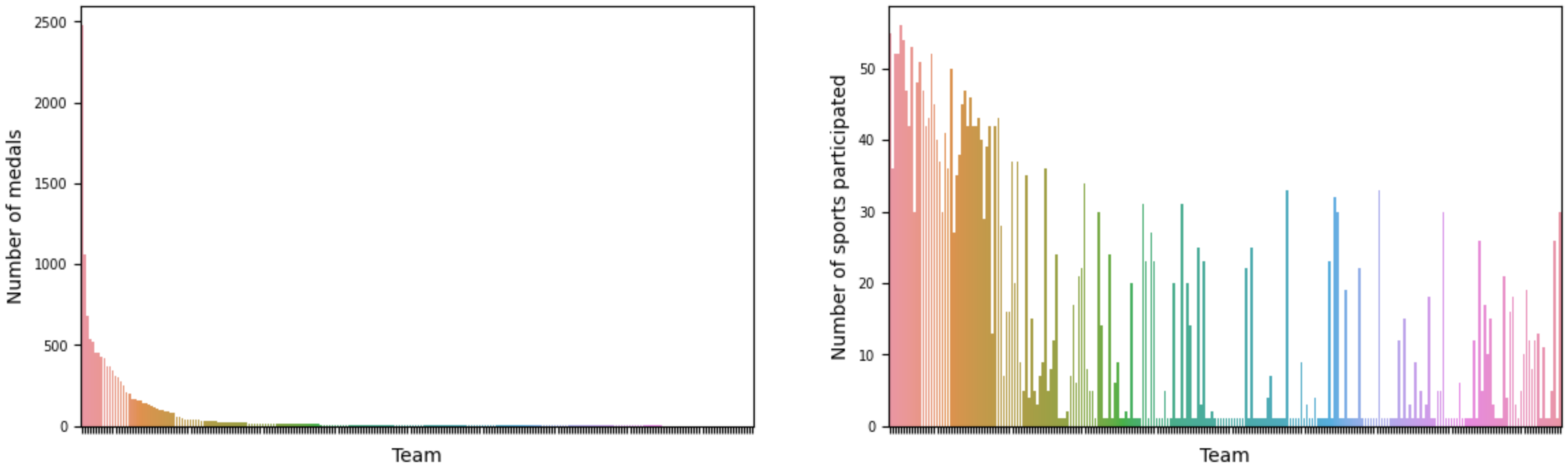
It seemas like it is better to use spearman test (nonlinear, non-homoscedastic etc.)

In [45]:
```
print(f"Spearman's r is {stats.spearmanr(num_sport_medals['Number of medals'], num_sport_medals['Number of sports participated']).correlation}")
```

```
Spearman's r is 0.5159069917810437
```

Let's see some additional plots !

In [46]:
```
fig, ax = plt.subplots(1, 2, figsize = (14, 4))
sns.barplot(data=num_sport_medals, x='Team', y='Number of medals', ax = ax[0]);
ax[0].set(xticklabels=[]);
ax[0].tick_params(axis='y', which='major', labelsize=7)
sns.barplot(data=num_sport_medals, x='Team', y='Number of sports participated', ax = ax[1]);
ax[1].set(xticklabels=[]);
ax[1].tick_params(axis='y', which='major', labelsize=7)
```



All Teams on plots sorted by Number of medals (you can see it on 1st plot).

Some Teams have numbers of medals significantly greater then number of sports they participated -> These Teams are professionals in their sports or it is particular sport team!. (It is gaps on 2nd plot)

Some Teams with high number of sports they participated (2nd plot - high values) have low number of medals. These Teams tries a lot of different sports, but still have small number of medals.

In common we can conclude that number of sports in which Team participate affects the number of medals they have. But there are some deviations, where some Teams are professionals in their small amount of sports (or one kind of sport) and Teams that could not find they successufull sport

That is why correlation is not equal to 1!

So Team and Medal variables is connected. Particular Teams partcicpate in many kind of sports or even in only one and then recieve many or few medals!

Some additional hypothesis

Is the average number of medals in Women and Men significant?

In [47]:

```
m_medals = df.loc[(df.Sex == 'M') & (df.Medal.notnull())].groupby('Name').Medal.count()
f_medals = df.loc[(df.Sex == 'F') & (df.Medal.notnull())].groupby('Name').Medal.count()
```

In [48]:

```
f_medals.value_counts()
```

```
Out[48]: 1     5264
         2     1356
         3      452
         4      176
         5       84
         6       42
         7       23
         8       16
         9       11
         10       8
         12       4
         18       1
         11       1
         Name: Medal, dtype: int64
```

Distribution is not normal, but number of values is still big

```
In [49]: m_medals.describe()
```

```
Out[49]: count    20763.000000
         mean         1.373838
         std          0.910985
         min          1.000000
         25%          1.000000
         50%          1.000000
         75%          1.000000
         max         28.000000
         Name: Medal, dtype: float64
```

```
In [50]: f_medals.describe()
```

```
Out[50]: count    7438.000000
         mean        1.512907
         std         1.101435
         min         1.000000
         25%         1.000000
         50%         1.000000
         75%         2.000000
         max        18.000000
         Name: Medal, dtype: float64
```

It is better to use another test (Mann-Whitney) since distribution significantly not normal

```
In [51]: mann = stats.mannwhitneyu(m_medals, f_medals)
         print(f'p-value is {mann.pvalue}')
```

```
p-value is 1.2534029820483311e-26
```

Differences still significant.

Is weights of swimmers is significantly differ from footballer's?

```
In [52]: footbalers_weights = df.loc[(df.Sport == 'Football')].Weight.dropna()
         swimmers_weights = df.loc[(df.Sport == 'Swimming')].Weight.dropna()
```

```
In [53]: footbalers_weights.describe()
```

```
Out[53]: count    4532.000000
         mean       70.447595
         std         8.415428
         min        28.000000
         25%        65.000000
         50%        71.000000
         75%        76.000000
         max       100.000000
         Name: Weight, dtype: float64
```

```
In [54]: swimmers_weights.describe()
```

```
Out[54]: count    18799.000000
         mean        70.589127
         std         11.332555
         min         39.000000
         25%         62.000000
         50%         70.000000
         75%         79.000000
         max        114.000000
         Name: Weight, dtype: float64
```

There are almost no differences yet!

```
In [55]: print(f"p-value = {stats.ttest_ind(swimmers_weights, footbalers_weights).pvalue}")
```

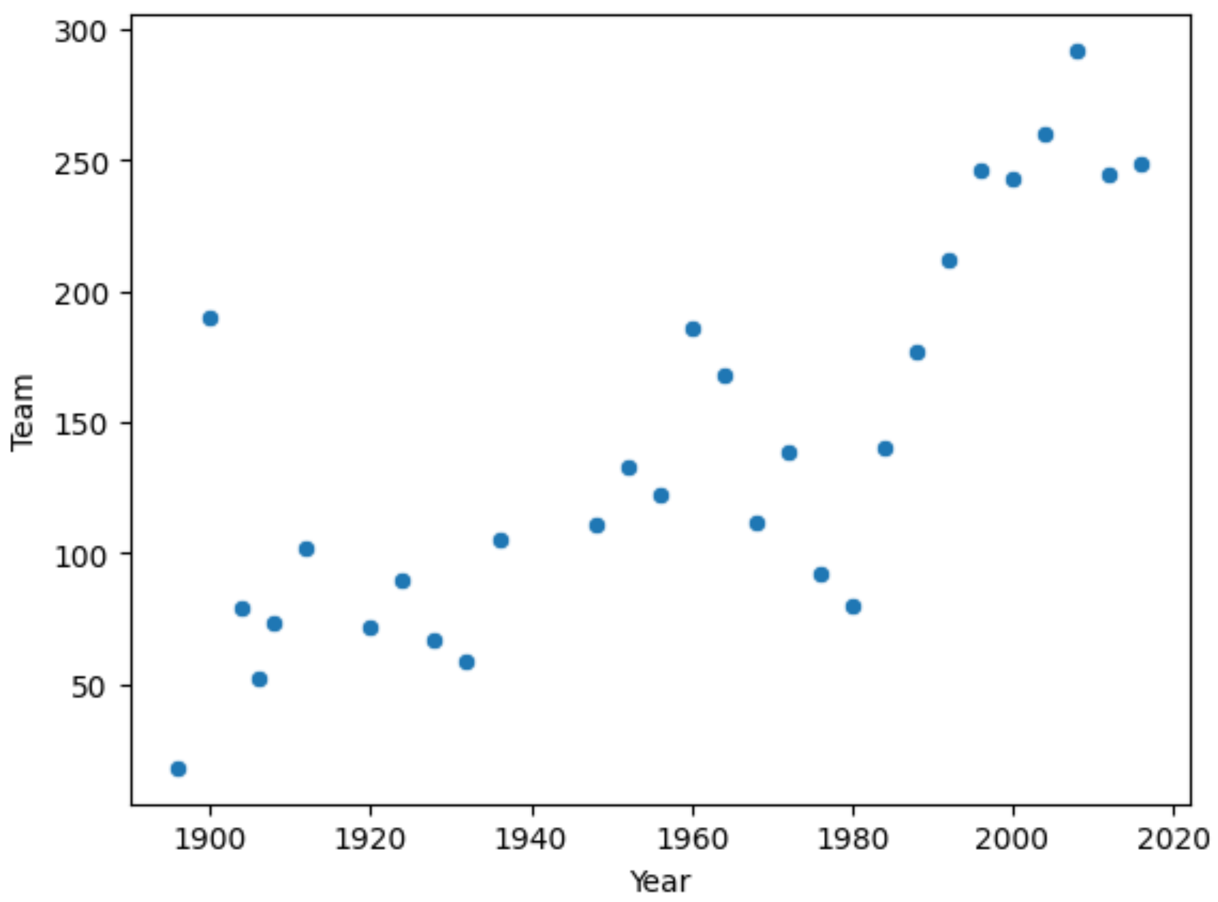
```
p-value = 0.42960031735443505
```

They have the same weight! Is that mean that footballers would not drown..?

Is it true that over time more Teams have become involved in games?

```
In [56]: num_of_nocs = df.loc[df.Season == 'Summer'].groupby('Year').Team.nunique().reset_index()
```

```
In [57]: sns.scatterplot(data=num_of_nocs, x = 'Year', y="Team");
```



```
In [58]: print(f" Test of homoscedacity (p-value): {stats.levene(num_of_nocs.Year, num_of_nocs.Team).pvalue}")
```

```
 Test of homoscedacity (p-value): 0.002860302549603182
```

It is better to use Spearman's test

```
In [59]: print(f"Spearman's r is {stats.spearmanr(num_of_nocs.Year, num_of_nocs.Team).correlation}")
```

```
Spearman's r is 0.7891625615763544
```

More teams each year!