In [1]:
```
import pandas as pd

df = pd.read_csv('IHME_GBD_2019_SMOKING_TOB_1990_2019_NUM_SMOKERS_Y2021M05D27.CS

print(df.head())
```

```
        measure_name  location_id location_name  sex_id sex_name  \
0  Number of Smokers            1        Global       1     Male
1  Number of Smokers            1        Global       2   Female
2  Number of Smokers            1        Global       3     Both
3  Number of Smokers            1        Global       1     Male
4  Number of Smokers            1        Global       2   Female

   age_group_id age_group_name  year_id          val         upper  \
0            29      15+ years     1990  803101467.1  8.096221e+08
1            29      15+ years     1990  189148834.0  1.930929e+08
2            29      15+ years     1990  992250301.2  1.000161e+09
3            29      15+ years     1991  813897216.4  8.200339e+08
4            29      15+ years     1991  190537545.1  1.944249e+08

         lower
0  795908635.8
1  185559469.9
2  984788043.8
3  806951447.9
4  186974424.5
```

In [2]:
```
print(df.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 20970 entries, 0 to 20969
Data columns (total 11 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   measure_name    20970 non-null  object
 1   location_id     20970 non-null  int64
 2   location_name   20970 non-null  object
 3   sex_id          20970 non-null  int64
 4   sex_name        20970 non-null  object
 5   age_group_id    20970 non-null  int64
 6   age_group_name  20970 non-null  object
 7   year_id         20970 non-null  int64
 8   val             20970 non-null  float64
 9   upper           20970 non-null  float64
 10  lower           20970 non-null  float64
dtypes: float64(3), int64(4), object(4)
memory usage: 1.8+ MB
None
```

In [3]:
```
print(df.describe())
```

```
        location_id        sex_id  age_group_id       year_id           val  \
count  20970.000000  20970.000000       20970.0  20970.000000  2.097000e+04   
mean     131.111588      2.000000          29.0   2004.500000  1.242807e+07   
std       95.055111      0.816516           0.0      8.655648  6.489191e+07   
min        1.000000      1.000000          29.0   1990.000000  6.345717e+01   
25%       61.000000      1.000000          29.0   1997.000000  8.201065e+04   
50%      119.000000      2.000000          29.0   2004.500000  5.777123e+05   
75%      177.000000      3.000000          29.0   2012.000000  2.901197e+06   
max      522.000000      3.000000          29.0   2019.000000  1.144819e+09   

              upper         lower  
count  2.097000e+04  2.097000e+04  
mean   1.269088e+07  1.217241e+07  
std    6.555971e+07  6.421446e+07  
min    7.868296e+01  5.029157e+01  
25%    9.576943e+04  6.875439e+04  
50%    6.278332e+05  5.329521e+05  
75%    3.070281e+06  2.742651e+06  
max    1.157286e+09  1.131582e+09  
```

In [4]:

```
mean_val = df['val'].mean()
print(f'średnia ilość palaczy to {mean_val}')

mediane_yearid = df['year_id'].median()
print(f'mediana wieku id to {mediane_yearid}')

std_yearid = df['year_id'].std()
print(f'odchylenie standardowe wieku id to {std_yearid}')
```

```
średnia ilość palaczy to 12428071.383604305
mediana wieku id to 2004.5
odchylenie standardowe wieku id to 8.65564783254382
```

In [5]:

```
missing_values = df.isnull().sum()
print("Brakujące wartości w kazdej kolumnie:")
print(missing_values)
```

```
Brakujące wartości w kazdej kolumnie:
measure_name      0
location_id       0
location_name     0
sex_id            0
sex_name          0
age_group_id      0
age_group_name    0
year_id           0
val               0
upper             0
lower             0
dtype: int64
```

In [6]:

```
df['sex_id'].fillna(int(df['sex_id'].mean()), inplace=True)
```

In [7]:

```
df.dropna(subset=['val'], inplace = True)
```

In [8]:

```
Q1 = df['val'].quantile(0.25)
Q3 = df['val'].quantile(0.75)
IQR = Q3 - Q1

outliers = df[(df['val'] < (Q1 - 1.5 * IQR)) | (df['val'] < (Q3 + 1.5 * IQR))]
print("wartości odstające:")
print(outliers)
```

```
wartości odstające:
             measure_name  location_id                          location_name  \
360    Number of Smokers            7  Democratic People's Republic of Korea
361    Number of Smokers            7  Democratic People's Republic of Korea
362    Number of Smokers            7  Democratic People's Republic of Korea
363    Number of Smokers            7  Democratic People's Republic of Korea
364    Number of Smokers            7  Democratic People's Republic of Korea
...                  ...          ...                                    ...
20965  Number of Smokers          522                                  Sudan
20966  Number of Smokers          522                                  Sudan
20967  Number of Smokers          522                                  Sudan
20968  Number of Smokers          522                                  Sudan
20969  Number of Smokers          522                                  Sudan

       sex_id sex_name  age_group_id age_group_name  year_id           val  \
360         1     Male            29      15+ years     1990  3.242740e+06
361         2   Female            29      15+ years     1990  3.206584e+05
362         3     Both            29      15+ years     1990  3.563399e+06
363         1     Male            29      15+ years     1991  3.340434e+06
364         2   Female            29      15+ years     1991  3.325348e+05
...       ...      ...           ...            ...      ...           ...
20965       2   Female            29      15+ years     2018  2.435999e+05
20966       3     Both            29      15+ years     2018  2.610672e+06
20967       1     Male            29      15+ years     2019  2.439150e+06
20968       2   Female            29      15+ years     2019  2.500800e+05
20969       3     Both            29      15+ years     2019  2.689230e+06

              upper         lower
360    3.448785e+06  3.048076e+06
361    4.155816e+05  2.449067e+05
362    3.796075e+06  3.358840e+06
363    3.546428e+06  3.142120e+06
364    4.271068e+05  2.538479e+05
...             ...           ...
20965  3.286166e+05  1.752508e+05
20966  2.833943e+06  2.409108e+06
20967  2.656579e+06  2.236450e+06
20968  3.345384e+05  1.816686e+05
20969  2.918332e+06  2.480656e+06

[17400 rows x 11 columns]
```

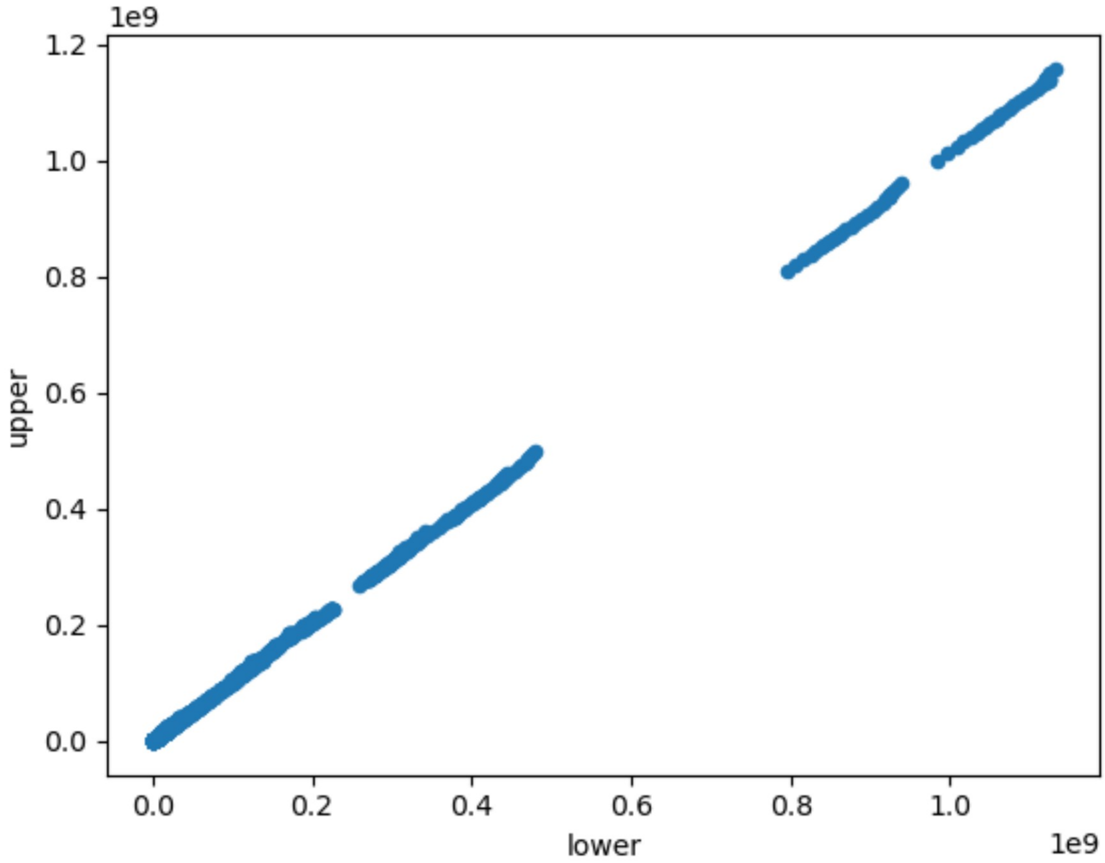
In [9]:

```
correlation_matrix = df.corr(numeric_only = True)
print("macierz korelacji:")
print(correlation_matrix)

df.plot.scatter(x='lower',y='upper')
```

```
macierz korelacji:
               location_id        sex_id  age_group_id       year_id  \
location_id   1.000000e+00  4.129324e-15           NaN -5.810115e-13
sex_id        4.129324e-15  1.000000e+00           NaN -4.450544e-17
age_group_id           NaN           NaN           NaN           NaN
year_id      -5.810115e-13 -4.450544e-17           NaN  1.000000e+00
val          -1.592398e-01  2.164982e-02           NaN  7.720502e-03
upper        -1.597180e-01  2.181495e-02           NaN  8.004704e-03
lower        -1.587740e-01  2.148802e-02           NaN  7.421082e-03

                   val     upper     lower
location_id  -0.159240 -0.159718 -0.158774
sex_id        0.021650  0.021815  0.021488
age_group_id       NaN       NaN       NaN
year_id       0.007721  0.008005  0.007421
val           1.000000  0.999976  0.999977
upper         0.999976  1.000000  0.999907
lower         0.999977  0.999907  1.000000
```

Out[9]:

```
<Axes: xlabel='lower', ylabel='upper'>
```



In [10]:

```
df['LowerRangeTolerance']=df['lower'] - df['val']
print(df)
```

```
            measure_name  location_id location_name  sex_id sex_name  \
0      Number of Smokers            1        Global       1     Male   
1      Number of Smokers            1        Global       2   Female   
2      Number of Smokers            1        Global       3     Both   
3      Number of Smokers            1        Global       1     Male   
4      Number of Smokers            1        Global       2   Female   
...                  ...          ...           ...     ...      ...   
20965  Number of Smokers          522         Sudan       2   Female   
20966  Number of Smokers          522         Sudan       3     Both   
20967  Number of Smokers          522         Sudan       1     Male   
20968  Number of Smokers          522         Sudan       2   Female   
20969  Number of Smokers          522         Sudan       3     Both   

       age_group_id age_group_name  year_id          val        upper  \
0                29      15+ years     1990  8.031015e+08  8.096221e+08   
1                29      15+ years     1990  1.891488e+08  1.930929e+08   
2                29      15+ years     1990  9.922503e+08  1.000161e+09   
3                29      15+ years     1991  8.138972e+08  8.200339e+08   
4                29      15+ years     1991  1.905375e+08  1.944249e+08   
...             ...            ...      ...          ...           ...   
20965            29      15+ years     2018  2.435999e+05  3.286166e+05   
20966            29      15+ years     2018  2.610672e+06  2.833943e+06   
20967            29      15+ years     2019  2.439150e+06  2.656579e+06   
20968            29      15+ years     2019  2.500800e+05  3.345384e+05   
20969            29      15+ years     2019  2.689230e+06  2.918332e+06   

              lower  LowerRangeTolerance  
0      7.959086e+08        -7.192831e+06  
1      1.855595e+08        -3.589364e+06  
2      9.847880e+08        -7.462257e+06  
3      8.069514e+08        -6.945768e+06  
4      1.869744e+08        -3.563121e+06  
...             ...                  ...  
20965  1.752508e+05        -6.834910e+04  
20966  2.409108e+06        -2.015640e+05  
20967  2.236450e+06        -2.026999e+05  
20968  1.816686e+05        -6.841138e+04  
20969  2.480656e+06        -2.085735e+05  

[20970 rows x 12 columns]
```

In [11]:

```
grouped = df.groupby('location_name')['val'].mean()
grouped
```

Out[11]:

```
location_name
Afghanistan                   7.178958e+05
Albania                       4.011131e+05
Algeria                       2.582208e+06
American Samoa                8.169698e+03
Andean Latin America          2.377826e+06
                                  ...     
Western Europe                6.476573e+07
Western Sub-Saharan Africa    9.184475e+06
Yemen                         1.488955e+06
Zambia                        6.662353e+05
Zimbabwe                      7.167678e+05
Name: val, Length: 231, dtype: float64
```

In [12]:

```
df_sorted = df.sort_values(by='val')
df_sorted.head(20)
```

Out[12]:

	measure_name	location_id	location_name	sex_id	sex_name	age_group_id	age_group_
20572	Number of Smokers	413	Tokelau	2	Female	29	15+
20575	Number of Smokers	413	Tokelau	2	Female	29	15+
20569	Number of Smokers	413	Tokelau	2	Female	29	15+
20578	Number of Smokers	413	Tokelau	2	Female	29	15+
20581	Number of Smokers	413	Tokelau	2	Female	29	15+
20566	Number of Smokers	413	Tokelau	2	Female	29	15+
20584	Number of Smokers	413	Tokelau	2	Female	29	15+
20587	Number of Smokers	413	Tokelau	2	Female	29	15+
20590	Number of Smokers	413	Tokelau	2	Female	29	15+
20593	Number of Smokers	413	Tokelau	2	Female	29	15+
20596	Number of Smokers	413	Tokelau	2	Female	29	15+
20599	Number of Smokers	413	Tokelau	2	Female	29	15+
20602	Number of Smokers	413	Tokelau	2	Female	29	15+
20563	Number of Smokers	413	Tokelau	2	Female	29	15+
20605	Number of Smokers	413	Tokelau	2	Female	29	15+
20608	Number of Smokers	413	Tokelau	2	Female	29	15+
20542	Number of Smokers	413	Tokelau	2	Female	29	15+
20560	Number of Smokers	413	Tokelau	2	Female	29	15+
20539	Number of Smokers	413	Tokelau	2	Female	29	15+
20545	Number of Smokers	413	Tokelau	2	Female	29	15+

```
In [ ]:
```