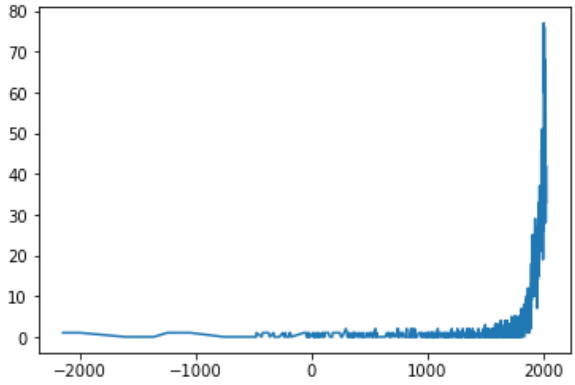
Significant earthquakes since 2150 B.C.

```
import numpy as np
import pandas as pd

# 1.1
FilePath = "C:\\Users\\ljn\\Desktop\\earthquakes-2022-10-18_18-50-02_+0800.tsv"
Sig_Eqs = pd.read_csv(FilePath, sep = "\t");

# get country list
location = Sig_Eqs['Location Name']
country_lst = []
for i in range(len(location)):
    country = str(location[i])
    index = country.find(':')
    if(index != -1):
        country = country[:index]
    country_lst.append(country)
# add country list to Sig_Eqs
Sig_Eqs.insert(loc=0,column = 'country', value=country_lst)
# group by country and sum
result = Sig_Eqs.groupby(['country']).sum()
result = pd.DataFrame(result)
result = result.sort_values("Deaths", ascending = False)
result = result['Deaths']
# print the top 20 countries along with the total number of deaths.
print(result.head(20))
```

```
country
CHINA           2075019.0
TURKEY          1094479.0
IRAN             995403.0
ITALY            498477.0
SYRIA            369224.0
HAITI            323474.0
AZERBAIJAN       317219.0
JAPAN            277142.0
ARMENIA          191890.0
ISRAEL           160120.0
PAKISTAN         145080.0
ECUADOR          135479.0
IRAQ             120200.0
TURKMENISTAN     117412.0
PERU             101511.0
PORTUGAL          83506.0
GREECE            79278.0
CHILE             64269.0
INDIA             61940.0
TAIWAN            57134.0
Name: Deaths, dtype: float64
```

```
#1.2
from matplotlib import pyplot as plt
%matplotlib inline

# group by Year
result = Sig_Eqs.groupby(['Year'])
x_year = []
y_times = []
for name,group in result:
    x_year.append(name)
    group = pd.DataFrame(group)
    times = group['Mag'][group['Mag']>3].count()
    y_times.append(times)

plt.plot(x_year,y_times)
```

```
[<matplotlib.lines.Line2D at 0x25386df41c0>]
```




```python
#1.3
def CountEq_LargestEq(country,data):
    for name,group in data.groupby(['country']):
        if name == country:
            #maxEq = max(group["Mag"])
            index = group["Mag"].idxmax()
            if(str(index) == "nan"):
                time = "nan"
                location = "nan"
            else:
                year = str(group.loc[index]["Year"])
                month = str(group.loc[index]["Mo"])
                day = str(group.loc[index]["Dy"])
                time = year+"-"+month+"-"+day
                location = group.loc[index]["Location Name"]
            #print(maxEq,group["Mag"].index(maxEq))
            return len(group),time,location

countrylst = pd.unique(Sig_Eqs["country"])
Eq_numlst = []
timelst = []
locationlst = []
cclst = []
for i in countrylst:
    if i == "nan":
        continue
    count,time,location = CountEq_LargestEq(i, Sig_Eqs)
    Eq_numlst.append(count)
    timelst.append(time)
    locationlst.append(location)
    cclst.append(i)
result = {"country":cclst,
          "count":Eq_numlst,
          "time":timelst,
          "location":locationlst}
result = pd.DataFrame(result)
result.sort_values(by = "count",ascending = False)
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	country	count	time	location
16	CHINA	616	1668.0-7.0-25.0	CHINA: SHANDONG PROVINCE
83	INDONESIA	388	2004.0-12.0-26.0	INDONESIA: SUMATRA: ACEH: OFF WEST COAST
8	IRAN	384	856.0-12.0-22.0	IRAN: DAMGHAN, QUMIS
37	JAPAN	351	2011.0-3.0-11.0	JAPAN: HONSHU
5	ITALY	330	1915.0-1.0-13.0	ITALY: MARSICA, AVEZZANO, ABRUZZI
...	...	...	...	...
62	IRELAND	1	nan	nan
61	SOUTH COASTS OF ASIA MINOR	1	nan	nan
211	KIRIBATI	1	1905.0-6.0-30.0	KIRIBATI: PHOENIX ISLANDS
53	SAGAMI, JAPAN	1	1331.0-8.0-15.0	SAGAMI, JAPAN
343	NORTH CAROLINA	1	2020.0-8.0-9.0	NORTH CAROLINA: SPARTA

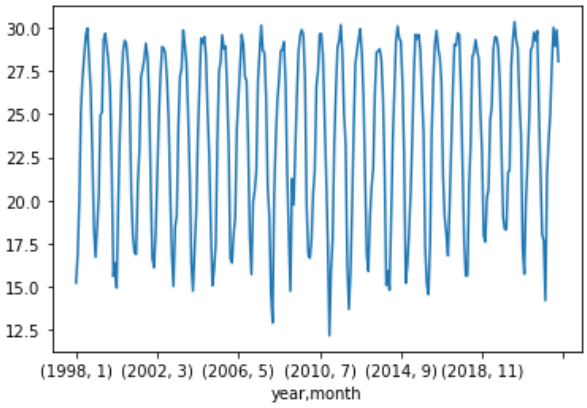
344 rows × 4 columns

Air temperature in Shenzhen during the past 25 years

```
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline

Baoan_Weather = pd.read_csv("Baoan_Weather_1998_2022.csv")
# filter data
Baoan_Weather_filter = Baoan_Weather.loc[Baoan_Weather['TMP'].str.contains(",1")]
# convert TMP
Baoan_Weather_filter["temp"] = Baoan_Weather_filter["TMP"].str[:-2]
Baoan_Weather_filter["temp"] = Baoan_Weather_filter["temp"].astype(float)
Baoan_Weather_filter["temp"] = Baoan_Weather_filter["temp"].map(lambda x : x/10.0)
# get year and month
Baoan_Weather_filter["year"] = pd.to_datetime(Baoan_Weather_filter["DATE"]).dt.year
Baoan_Weather_filter["month"] = pd.to_datetime(Baoan_Weather_filter["DATE"]).dt.month
# plot result
Baoan_Weather_month = Baoan_Weather_filter.groupby(["year","month"])["temp"].mean().plot()
```

```
<ipython-input-91-d3200f2f6ef8>:9: 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
  Baoan_Weather_filter["temp"] = Baoan_Weather_filter["TMP"].str[:-2]
<ipython-input-91-d3200f2f6ef8>:10: 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
  Baoan_Weather_filter["temp"] = Baoan_Weather_filter["temp"].astype(float)
<ipython-input-91-d3200f2f6ef8>:11: 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
  Baoan_Weather_filter["temp"] = Baoan_Weather_filter["temp"].map(lambda x : x/10.0)
<ipython-input-91-d3200f2f6ef8>:13: 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
  Baoan_Weather_filter["year"] = pd.to_datetime(Baoan_Weather_filter["DATE"]).dt.year
<ipython-input-91-d3200f2f6ef8>:14: 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
  Baoan_Weather_filter["month"] = pd.to_datetime(Baoan_Weather_filter["DATE"]).dt.month
```



Global collection of hurricanes

```python
# 3.1
df = pd.read_csv('ibtracs.ALL.list.v04r00.csv',
                 usecols=range(17),
                 skiprows=[1, 2],
                 parse_dates=['ISO_TIME'],
                 na_values=['NOT_NAMED', 'NAME'])
namelst = []
wmo_windlst = []
sidlst = []
# group by SID
for SID,group in df.groupby(["SID"]):
    max_wind = 0
    for i in group["WMO_WIND"]:
        if(i == " "):
            continue
        else:
            temp = int(i)
            max_wind = max_wind if max_wind>=temp else temp # get max wind in a group
    namelst.append(group["NAME"].iloc[0])
    sidlst.append(SID)
    wmo_windlst.append(max_wind)

data = {"SID":sidlst,
        "name":namelst,
        "wmo_wind":wmo_windlst}
data = pd.DataFrame(data)
```

```
data.sort_values(by = "wmo_wind", ascending = False).head(10)
```

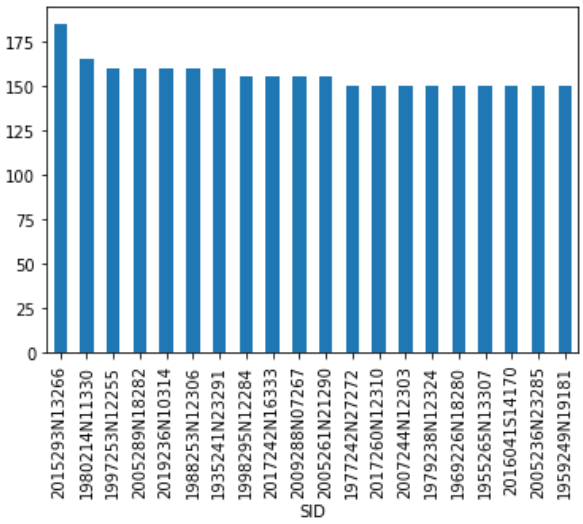
```
D:\Anaconda3\lib\site-packages\IPython\core\interactiveshell.py:3165: DtypeWarning: Columns (5) have mixed types.Specify dtype option on import or set low_memory=False.
  has_raised = await self.run_ast_nodes(code_ast.body, cell_name,
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

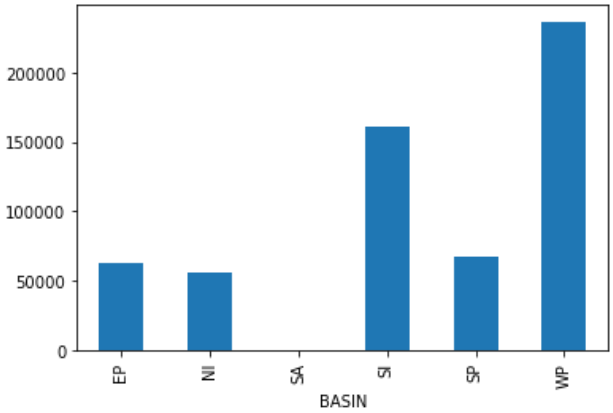
	SID	name	wmo_wind
12921	2015293N13266	PATRICIA	185
9087	1980214N11330	ALLEN	165
11067	1997253N12255	LINDA	160
11944	2005289N18282	WILMA	160
13307	2019236N10314	DORIAN	160
10011	1988253N12306	GILBERT	160
4105	1935241N23291	NaN	160
11190	1998295N12284	MITCH	155
13098	2017242N16333	IRMA	155
12337	2009288N07267	RICK	155

```
# 3.2
data_20 = data.sort_values(by = "wmo_wind", ascending = False).head(20)
data_20 = data_20.set_index("SID")
data_20["wmo_wind"].plot(kind = "bar")
```

```
<AxesSubplot:xlabel='SID'>
```

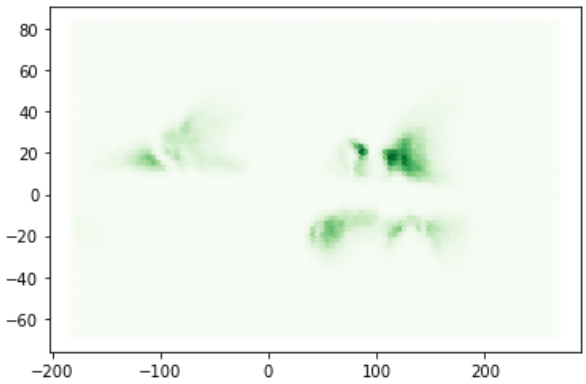



```
# 3.3
df_basin = df.groupby(["BASIN"])["LAT"].count().plot(kind='bar')
```

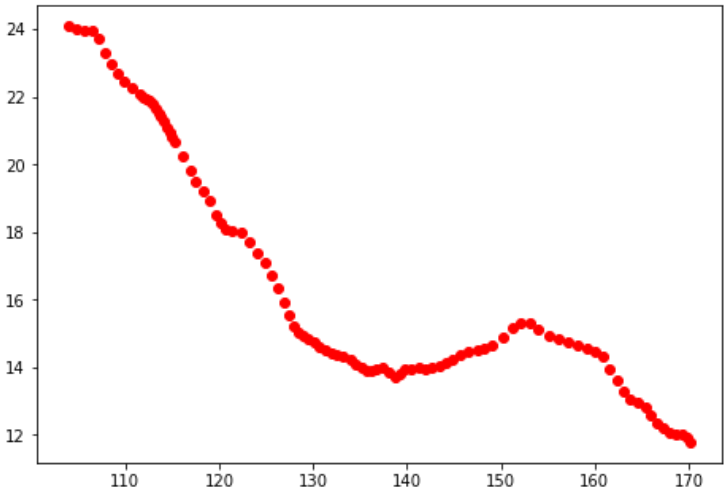



```
# 3.4
lon = df["LON"]
lat = df["LAT"]
plt.hexbin(lon, lat,cmap="Greens")
```

```
<matplotlib.collections.PolyCollection at 0x2539927e250>
```




```
# 3.5
df_name = df.groupby(["NAME"])
for name,group in df_name:
    if(name == "MANGKHUT"):
        df_mangkhut = group
df_mangkhut = df_mangkhut.loc[df_mangkhut["ISO_TIME"].astype(str).str.contains("2018-")]
lon = df_mangkhut["LON"]
lat = df_mangkhut["LAT"]
fig = plt.figure()
ax = fig.add_axes([0,0,1,1])
ax.scatter(lon,lat,color = 'r')
plt.show()
```

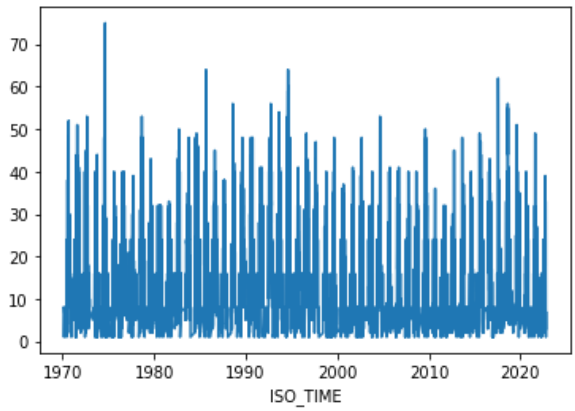



```
# 3.6
df_1970 = df.loc[df["SEASON"] > 1969]
df_1970_basin = df_1970.loc[(df["BASIN"] == "WP") | (df["BASIN"] == "EP")]
```

```
# 3.7
df_1970_basin["ISO_TIME"] = pd.to_datetime(df_1970_basin["ISO_TIME"]).dt.date
df_1970_basin.groupby(["ISO_TIME"])["LON"].count().plot()
```

```
<ipython-input-95-6d8f673a27de>:2: 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_1970_basin["ISO_TIME"] = pd.to_datetime(df_1970_basin["ISO_TIME"]).dt.date
```

```
<AxesSubplot:xlabel='ISO_TIME'>
```




```python
# 3.8
def calculate_dayofyear(time):
    # time = "2018-03-19"
    year = int(time[:4])
    month = int(time[5:7])
    day = int(time[-2:])
    month_days=[0,31,28,31,30,31,30,31,31,30,31,30,31]
    days = day
    for i in range(month):
        days += month_days[i]
    if(((year%4 == 0 and year%100 != 0) or (year%400==0)) and month > 2):
        days += 1
    if(days >=100):
        days = str(days)
    else:
        days = "0" + str(days)
    return time[:4]+days

df_1970_basin["day_of_year"] = df_1970_basin["ISO_TIME"].apply(lambda x: calculate_dayofyear(str(x)))

def day_of_year(data):
    #time = 2022285
    data_group = data.groupby(["day_of_year"])
    time = []
    count = []
    for name,group in data_group:
        time.append(name)
        count.append(len(group))
    return time,count

TIME,COUNT = day_of_year(df_1970_basin)
data3_8 = {"time":TIME,
           "count":COUNT}
data3_8 = pd.DataFrame(data3_8)
data3_8
```

```
<ipython-input-97-5fed21df332b>:19: 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_1970_basin["day_of_year"] = df_1970_basin["ISO_TIME"].apply(lambda x: calculate_dayofyear(str(x)))
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	time	count
0	1970050	8
1	1970051	8
2	1970052	8
3	1970053	8
4	1970054	8
...	...	...
10812	2022277	9
10813	2022278	7
10814	2022282	1
10815	2022283	7
10816	2022285	3

10817 rows × 2 columns

```
# 3.9
mean = data3_8["count"].mean()
data3_8["anomaly"] = data3_8.apply(lambda x:x["count"] - mean,axis = 1);
data3_8
```


```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	time	count	anomaly
0	1970050	8	-8.303226
1	1970051	8	-8.303226
2	1970052	8	-8.303226
3	1970053	8	-8.303226
4	1970054	8	-8.303226
...	...	...	...
10812	2022277	9	-7.303226
10813	2022278	7	-9.303226
10814	2022282	1	-15.303226
10815	2022283	7	-9.303226
10816	2022285	3	-13.303226

10817 rows × 3 columns

```
# 3.10
data_group = df_1970_basin.groupby(["SEASON"]) #Resample to year
count_10 = []
year_10 = []
for name,group in data_group:
    year_10.append(name)
    count_10.append(len(group))

data3_10 = {"year":year_10,
            "count":count_10}
data3_10 = pd.DataFrame(data3_10)
mean = data3_10["count"].mean()
data3_10["anomaly"] = data3_10.apply(lambda x:x["count"] - mean,axis = 1);
data3_10
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	year	count	anomaly
0	1970	3555	227.603774
1	1971	4459	1131.603774
2	1972	3952	624.603774
3	1973	2407	-920.396226
4	1974	3581	253.603774
5	1975	2686	-641.396226
6	1976	3341	13.603774
7	1977	2498	-829.396226
8	1978	4027	699.603774
9	1979	3238	-89.396226
10	1980	3009	-318.396226
11	1981	3076	-251.396226
12	1982	3941	613.603774
13	1983	3230	-97.396226
14	1984	3742	414.603774
15	1985	4279	951.603774
16	1986	4153	825.603774
17	1987	3200	-127.396226
18	1988	3244	-83.396226
19	1989	3978	650.603774
20	1990	4462	1134.603774
21	1991	3955	627.603774
22	1992	5002	1674.603774
23	1993	4144	816.603774
24	1994	4949	1621.603774
25	1995	3185	-142.396226
26	1996	4213	885.603774
27	1997	4556	1228.603774
28	1998	2307	-1020.396226
29	1999	2455	-872.396226
30	2000	2990	-337.396226
31	2001	2853	-474.396226
32	2002	3096	-231.396226
33	2003	2862	-465.396226
34	2004	3450	122.603774
35	2005	2657	-670.396226
36	2006	3109	-218.396226
37	2007	2405	-922.396226
38	2008	2639	-688.396226

	year	count	anomaly
39	2009	3464	136.603774
40	2010	1672	-1655.396226
41	2011	2585	-742.396226
42	2012	2989	-338.396226
43	2013	3014	-313.396226
44	2014	3304	-23.396226
45	2015	4460	1132.603774
46	2016	3123	-204.396226
47	2017	2801	-526.396226
48	2018	4044	716.603774
49	2019	3283	-44.396226
50	2020	2486	-841.396226
51	2021	2336	-991.396226
52	2022	1906	-1421.396226

Explore a data set

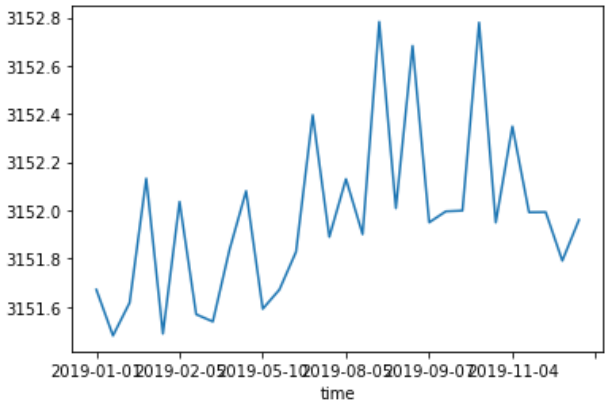
```
# 4.1
water_lever = pd.read_excel("33.xls")
water_lever = water_lever.loc[(water_lever["interp_h"] < 5)] # filter error water lever
water_lever.head()
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	time	h_interp	dem	slope	cloud	dem_flag	interp_h	band	x	y
0	2019-01-01	3151.710449	3148.929932	0.000159	0	2	2.780518	s1	100.442276	37.030445
1	2019-01-01	3151.803711	3148.930664	-0.000039	0	2	2.873047	w1	100.441368	37.030514
2	2019-01-01	3151.690918	3148.927979	-0.000209	0	2	2.762939	s1	100.442383	37.031342
3	2019-01-01	3151.773926	3148.928467	0.000024	0	2	2.845459	w1	100.441475	37.031414
4	2019-01-01	3151.701904	3148.925293	0.000433	0	2	2.776611	s1	100.442490	37.032242

```
wl_day = water_lever.groupby(["time"]).mean()
wl_day["h_interp"].plot()
```

```
<AxesSubplot:xlabel='time'>
```




```python
mean_year = wl_day["h_interp"].mean()
max_year = wl_day["h_interp"].max()
min_year = wl_day["h_interp"].min()
std_year = wl_day["h_interp"].std()
median_year = wl_day["h_interp"].median()
print("mean = {}, max = {}, min = {}, std ={}, median =
{}".format(mean_year,max_year,min_year,std_year,median_year))
# I found the annual change of water lever is 1.3m(in ICESat-2's observation data).
```

```
mean = 3151.9692215759615, max = 3152.782080321051, min = 3151.479856654576, std =0.35074725268310497, median =
3151.9548389249685
```