```
import numpy as np
```

Zad 1

```
#A = np.array([[[1],[1],[3],[-1]],[[2],[3],[5],[9]],[[-2],[3],[5],[7]],[[-7],[9],[2],[1]]])

A = np.array([[1,1,3,-1],[2,3,5,9],[-2,3,5,7],[-7,9,2,1]])


B= np.array([[3,5,-4,-2]])


C = np.array([[3,2,1],[3,1,-4],[-2,3,5],[-1,5,7]])


B1= B.reshape(4,1)


print(B1)
```

```
[[ 3]
 [ 5]
 [-4]
 [-2]]
```

```
print(A*B)
```

```
[[  3   5 -12   2]
 [  6  15 -20 -18]
 [ -6  15 -20 -14]
 [-21  45  -8  -2]]
```

```
print(A*B1)
```

```
[[  3   3   9  -3]
 [ 10  15  25  45]
 [  8 -12 -20 -28]
 [ 14 -18  -4  -2]]
```

```
print(np.dot(A,B1))
```

```
[[ -2]
 [-17]
 [-25]
 [ 14]]
```

```
print(np.dot(A,C))
```

```
[[  1   7   5]
 [ -4  67  78]
 [-14  49  60]
 [  1   6 -26]]
```

```
np.linalg.inv(A)
```

```
array([[ 0.08108108,  0.21829522, -0.27027027,  0.00831601],
       [ 0.02702703,  0.18814969, -0.25675676,  0.13097713],
       [ 0.24324324, -0.11434511,  0.18918919, -0.05197505],
       [-0.16216216,  0.06340956,  0.04054054, -0.01663202]])
```

```
try:
  if(np.linalg.inv(B)):
   print("Da sie znalezc odwrotna")
   print(np.linalg.inv(B))
except:
    print("nie da się")
```

```
nie da się
```

```
try:
  if(np.linalg.inv(C)):
   print("Da sie znalezc odwrotna")
   print(np.linalg.inv(C))
except:
```

```
    print("nie da się")
```

```
    nie da się
```

```
np.sum(A,axis=0)
```

```
    array([-6, 16, 15, 16])
```

```
np.sum(A,axis=1)
```

```
    array([ 4, 19, 13,  5])
```

```
np.sum(B)
```

```
    2
```

Zadanie 2

```
A = np.array([[2,4,5],[4,5,1],[5,1,3]])
```

```
np.linalg.eig(A)
```

```
    (array([10.05548601, -3.25927992,  3.20379391]),
     array([[-0.6164593 , -0.76754779,  0.1756369 ],
            [-0.59073031,  0.30335923, -0.7476703 ],
            [-0.52059161,  0.56466235,  0.64042236]]))
```

Zadanie 3

```
import pandas as pd
data = pd.read_csv('simple_dataset.csv')
print(data)
```

```
       X   B   C  D   E
    0  1  12   6  5  -4
```

```
   1  2  11  -4  7  -2
   2  3  21   8 -2   9
   3  4   4  12  1  10
```

```
s_copy = data.copy()
print(s_copy)
```

```
      X   B   C  D   E
   0  1  12   6  5  -4
   1  2  11  -4  7  -2
   2  3  21   8 -2   9
   3  4   4  12  1  10
```

```
S1=pd.DataFrame(data=s_copy, index=[1],copy=True)
print(S1)
```

```
      X   B  C  D  E
   1  2  11 -4  7 -2
```

```
S2=pd.DataFrame(data=s_copy, index= [1,2],copy=True)
print(S2)
```

```
      X   B  C  D  E
   1  2  11 -4  7 -2
   2  3  21  8 -2  9
```

```
S3=pd.DataFrame(data=s_copy, index= [2,3],columns=['B','C','D'],copy=True)
print(S3)
```

```
       B   C  D
   2  21   8 -2
   3   4  12  1
```

```
S4=pd.DataFrame(data=s_copy,columns=['B','D'],copy=True)
print(S4)
```

```
       B  D
   0  12  5
   1  11  7
```

```
2  21 -2
3   4  1
```

Zadanie 4

```
data2 = pd.read_csv('president_heights.csv')
print(data2)
```

```
    order                   name  height(cm)
0       1       George Washington         189
1       2              John Adams         170
2       3        Thomas Jefferson         189
3       4           James Madison         163
4       5            James Monroe         183
5       6       John Quincy Adams         171
6       7          Andrew Jackson         185
7       8        Martin Van Buren         168
8       9  William Henry Harrison         173
9      10              John Tyler         183
10     11           James K. Polk         173
11     12          Zachary Taylor         173
12     13        Millard Fillmore         175
13     14         Franklin Pierce         178
14     15          James Buchanan         183
15     16         Abraham Lincoln         193
16     17          Andrew Johnson         178
17     18        Ulysses S. Grant         173
18     19     Rutherford B. Hayes         174
19     20       James A. Garfield         183
20     21       Chester A. Arthur         183
21     23       Benjamin Harrison         168
22     25        William McKinley         170
23     26      Theodore Roosevelt         178
24     27     William Howard Taft         182
25     28          Woodrow Wilson         180
26     29       Warren G. Harding         183
27     30         Calvin Coolidge         178
28     31          Herbert Hoover         182
29     32   Franklin D. Roosevelt         188
30     33         Harry S. Truman         175
31     34    Dwight D. Eisenhower         179
```

```
32     35         John F. Kennedy         183
33     36       Lyndon B. Johnson         193
34     37           Richard Nixon         182
35     38             Gerald Ford         183
36     39            Jimmy Carter         177
37     40           Ronald Reagan         185
38     41      George H. W. Bush          188
39     42            Bill Clinton         188
40     43          George W. Bush         182
41     44            Barack Obama         185
```

```
P1=pd.DataFrame(data=data2,columns=['height(cm)'],copy=True)
print(P1)
```

```
    height(cm)
0          189
1          170
2          189
3          163
4          183
5          171
6          185
7          168
8          173
9          183
10         173
11         173
12         175
13         178
14         183
15         193
16         178
17         173
18         174
19         183
20         183
21         168
22         170
23         178
24         182
25         180
26         183
```

```
27         178
28         182
29         188
30         175
31         179
32         183
33         193
34         182
35         183
36         177
37         185
38         188
39         188
40         182
41         185
```

```
M=P1.mean()
print("Mean height")
print(M)
```

```
Mean height
height(cm)    179.738095
dtype: float64
```

```
Std=P1.std()
print("Std")
print(Std)
```

```
Std
height(cm)    7.015869
dtype: float64
```

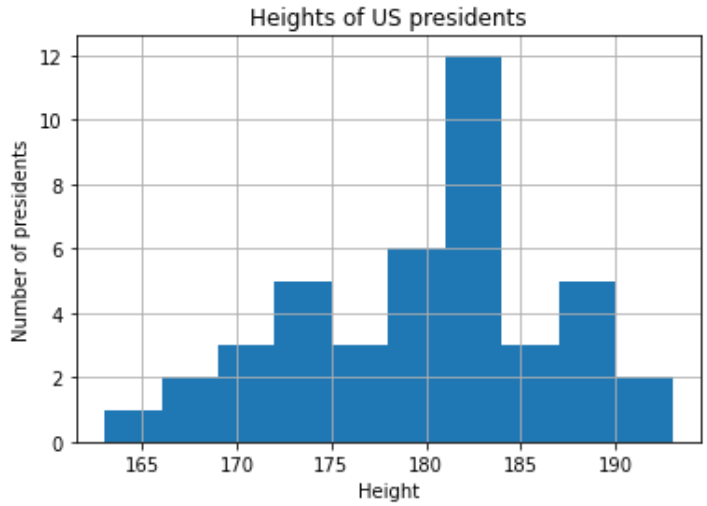
```
Min=P1.min()
Max=P1.max()
print("Min")
print(Min)
print("Max")
print(Max)
```

```
Min
height(cm)    163
dtype: int64
Max
height(cm)    193
dtype: int64
```

```
Median=P1.median()
print("median")
print(Median)
```

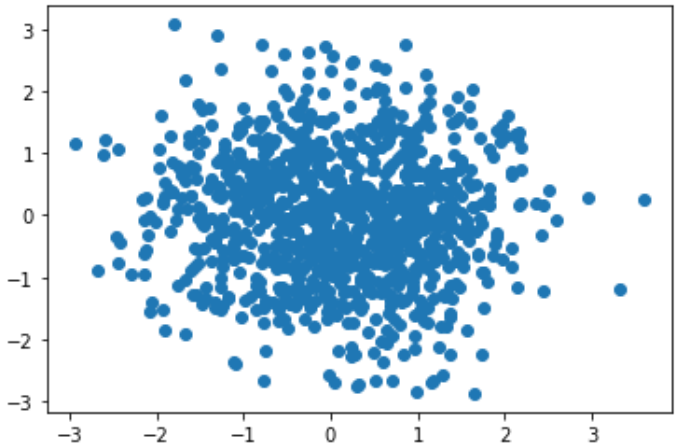
```
median
height(cm)    182.0
dtype: float64
```

```
import matplotlib.pyplot as plt
heights=P1.hist(xlabelsize=10)
#plt.hist(heights,10,color='red')
plt.title('Heights of US presidents')
plt.xlabel('Height')
plt.ylabel('Number of presidents')
plt.show()
```



Zadanie 5

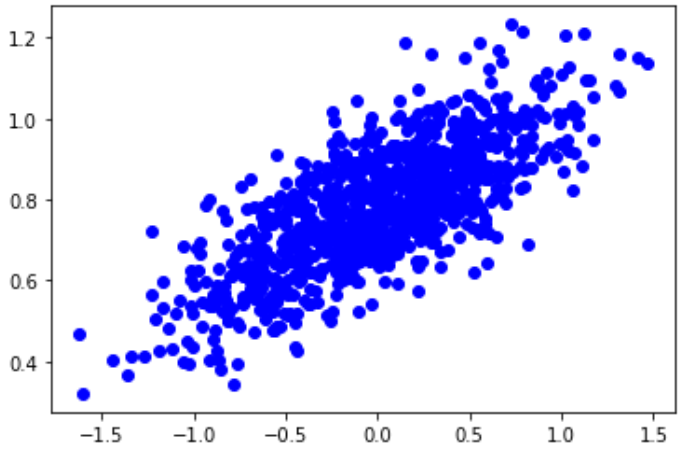
```
import matplotlib.pyplot as plt


tab=np.random.normal(size=(2,1000))




plt.scatter(tab[0],tab[1])
plt.show()
```




```
number_of_points=1000
x_point = []
y_point = []
x_1=[]
y_1=[]


a=0.22
b=0.78


for i in range(number_of_points):
  x = np.random.normal(0.0,0.5)
```

```
    y = a*x+b+np.random.normal(0.0,0.1)
    x_point.append(x)
    y_point.append(y)
    x_1.append(1)
    y_1.append(1)
```

```
plt.scatter(x_point,y_point,c='b')
plt.show()
```




```
df = pd.DataFrame({"x" : x_point, "y" : y_point})
df.to_csv("punkty2D.csv", index=False)
```

Zadanie 6

```
x_s=np.array(x_point)
y_s=np.array(y_point)
```

```
x2=np.sum(x_s*x_s)
x1=np.sum(x_s)
```

```
x1sum=np.sum(x_1)
y1sum=np.sum(y_1)
xy=np.sum(x_s*y_s)
y1=np.sum(y_s)
```

```
print(x1)
```

```
0.9679784485890099
```

```
M = np.array([[x2,x1],[x1,x1sum]])
print(M)
```

```
[[2.50493536e+02 9.67978449e-01]
 [9.67978449e-01 1.00000000e+03]]
```

```
M_1=np.linalg.inv(M)
print(M_1)
```

```
[[ 3.99213392e-03 -3.86429960e-06]
 [-3.86429960e-06  1.00000374e-03]]
```

```
N=np.array([[xy],[y1]])
print(N)
```

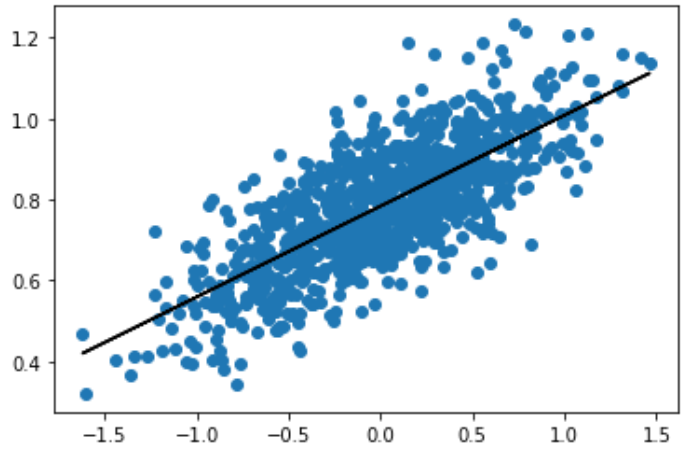
```
[[ 57.05517264]
 [783.8895668 ]]
```

```
a,b = np.matmul(M_1,N)
print(a,b)
```

```
[0.22474271] [0.78367202]
```

```
plt.scatter(x_s,y_s)
plt.plot(x_s,a*x_s+b,"black")
```

```
plt.show()
```



Zadanie 7

```
data3 = pd.read_csv('zadanie7dane.csv')
```

```
print(data3)
```

```
     Unnamed: 0          A         B         C         D
0             0  11.247450 -0.309969  3.162635  2.699914
1             1  11.343286 -0.082636  3.347255  3.240671
2             2  11.449801 -0.161751  2.735040  2.632947
3             3  11.439287  0.677754  2.353694  2.102614
4             4  11.691898 -0.367441  2.701254  2.514483
..          ...        ...       ...       ...       ...
695         695  11.530570  0.260693  2.702627  3.371236
696         696  11.262070 -0.273096  2.824241  2.269441
697         697  11.625279  0.662913  2.706208  3.039712
698         698  11.322987  0.151305  2.581215  2.686910
699         699  11.511843 -0.468825  3.249150  3.600256

[700 rows x 5 columns]
```

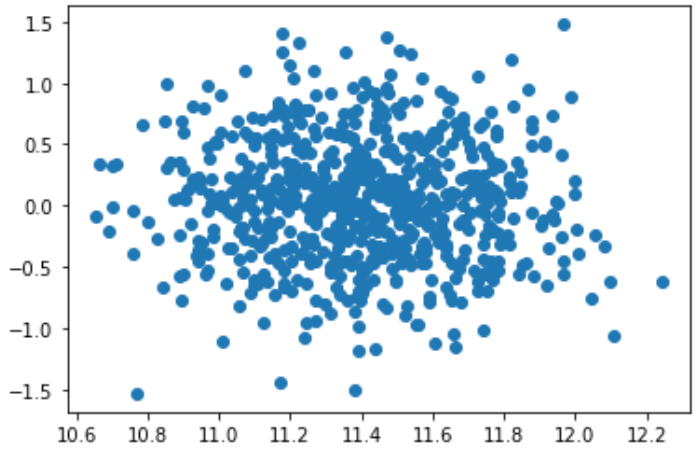
```
MA=pd.DataFrame(data3,columns=['A'])
```

```
print(MA)
MB=pd.DataFrame(data3,columns=['B'])
print(MB)
MC=pd.DataFrame(data3,columns=['C'])
print(MC)
MD=pd.DataFrame(data3,columns=['D'])
print(MD)
```

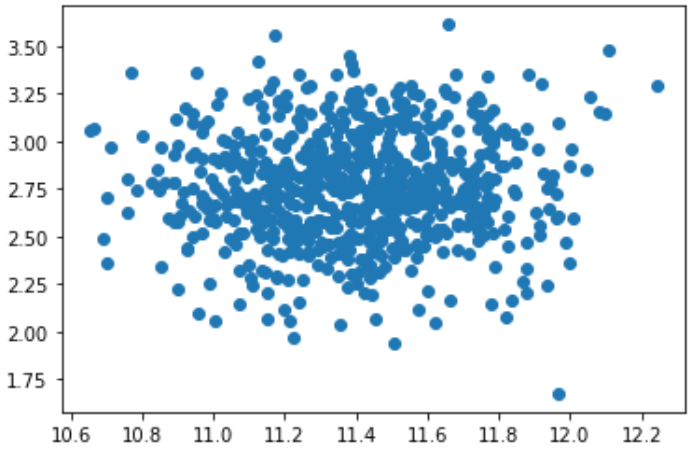
```
              A
0    11.247450
1    11.343286
2    11.449801
3    11.439287
4    11.691898
..         ...
695  11.530570
696  11.262070
697  11.625279
698  11.322987
699  11.511843

[700 rows x 1 columns]
           B
0   -0.309969
1   -0.082636
2   -0.161751
3    0.677754
4   -0.367441
..        ...
695  0.260693
696 -0.273096
697  0.662913
698  0.151305
699 -0.468825

[700 rows x 1 columns]
           C
0    3.162635
1    3.347255
2    2.735040
3    2.353694
4    2.701254
..        ...
```

```
695  2.702627
696  2.824241
697  2.706208
698  2.581215
699  3.249150

[700 rows x 1 columns]
            D
0    2.699914
1    3.240671
2    2.632947
3    2.102614
4    2.514483
..        ...
695  3.371236
696  2.269441
697  3.039712
698  2.686910
699  3.600256

[700 rows x 1 columns]
```

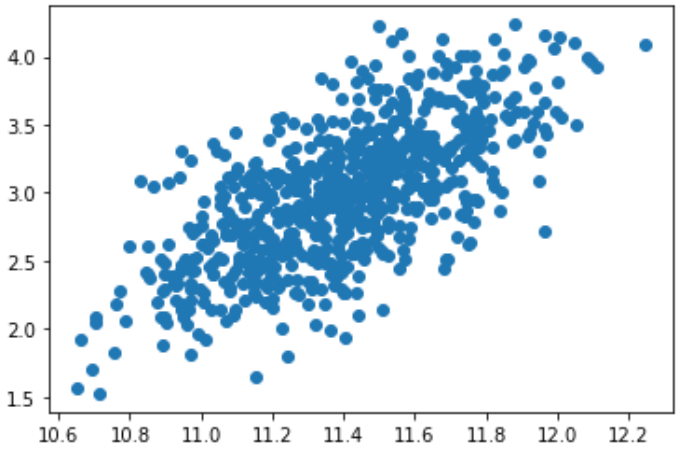
```
plt.scatter(MA,MB)
plt.show()
```



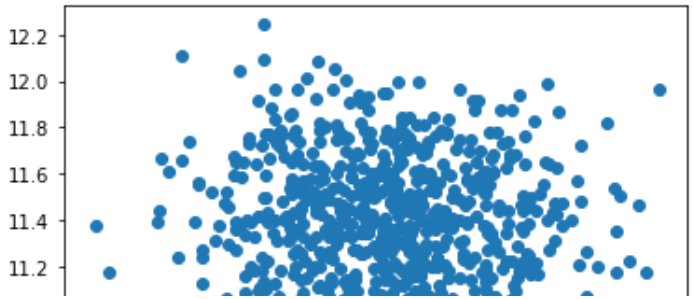

```
plt.scatter(MA,MC)
plt.show()
```



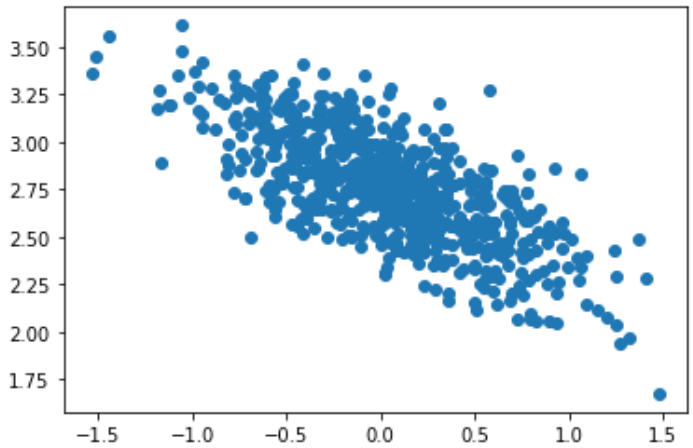

```
plt.scatter(MA,MD)
plt.show()
```



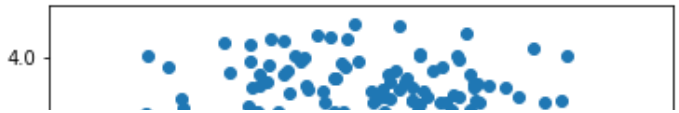

```
plt.scatter(MB,MA)
plt.show()
```



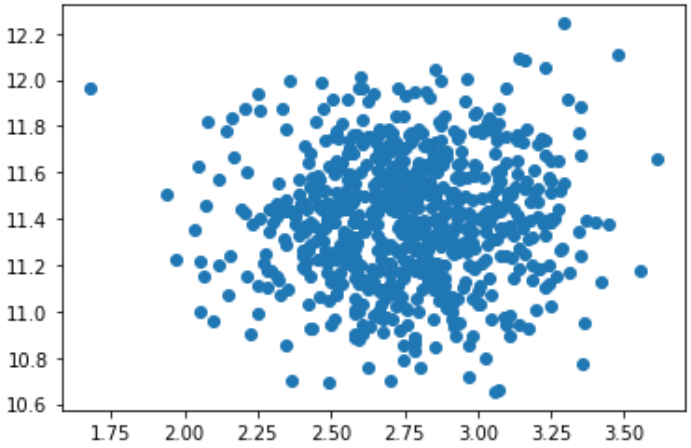

```
plt.scatter(MB,MC)
plt.show()
```



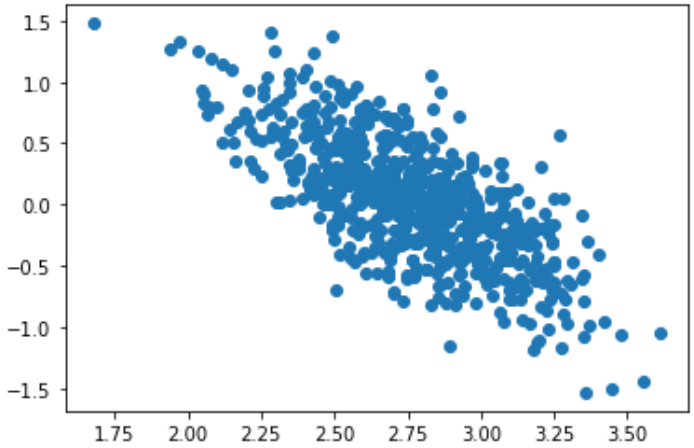

```
plt.scatter(MB,MD)
plt.show()
```




```
plt.scatter(MC,MA)
plt.show()
```

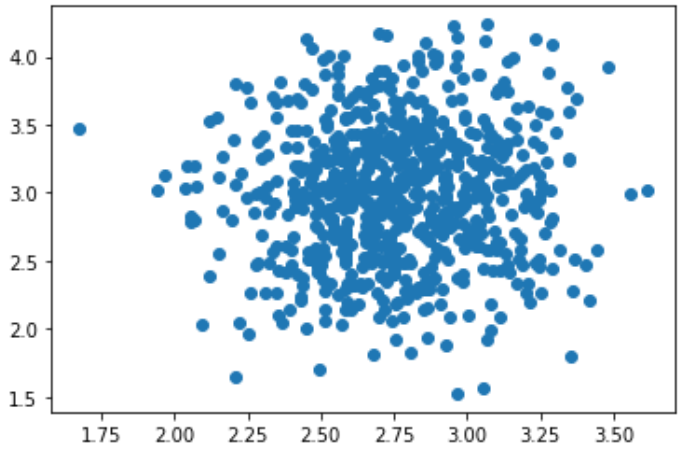



```
plt.scatter(MC,MB)
plt.show()
```

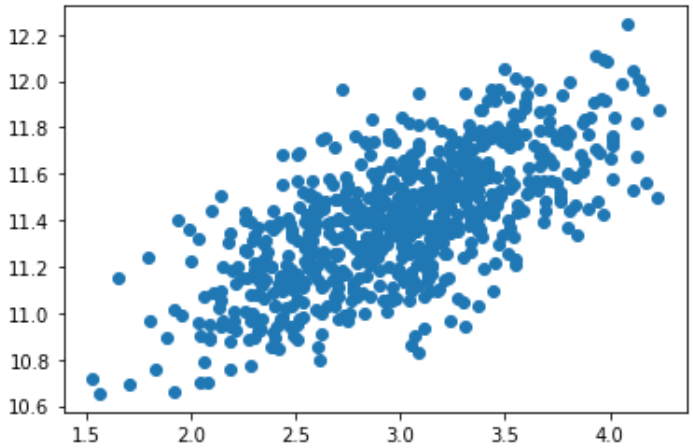



```
plt.scatter(MC,MD)
```

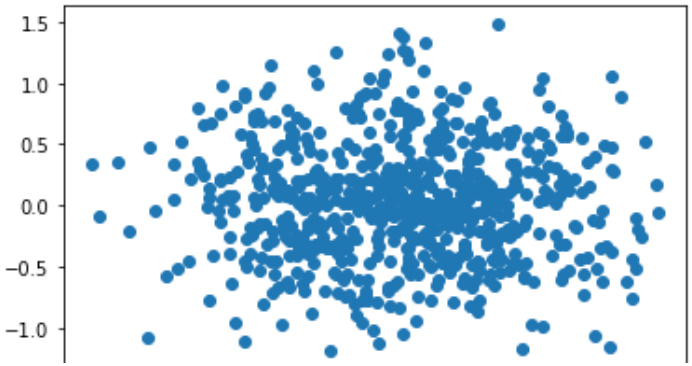
```
plt.show()
```



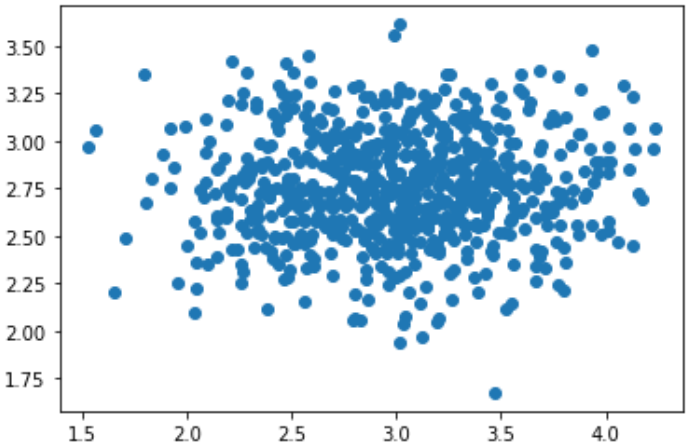

```
plt.scatter(MD,MA)
plt.show()
```




```
plt.scatter(MD,MB)
plt.show()
```




```
plt.scatter(MD,MC)
plt.show()
```

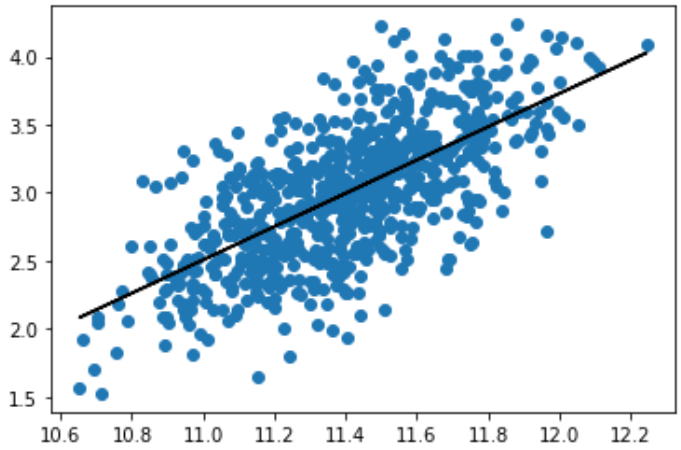


PARA A,D

```
number_of_points=700
x_point = []
y_point = []
x_1=[]
y_1=[]


for i in range(number_of_points):
  x_1.append(1)
```

```
    y_1.append(1)


x_s=np.array(MA)
y_s=np.array(MD)


x2=np.sum(x_s*x_s)
x1=np.sum(x_s)
x1sum=np.sum(x_1)
y1sum=np.sum(y_1)
xy=np.sum(x_s*y_s)
y1=np.sum(y_s)



print(x2,x1,x1sum,y1sum,xy,y1)


     91002.15473762425 7978.93543095689 700 700 23959.764386624454 2096.1845677273886


M = np.array([[x2,x1],[x1,x1sum]])


M_1=np.linalg.inv(M)


N=np.array([[xy],[y1]])
print(N)

     [[23959.76438662]
      [ 2096.18456773]]


a,b = np.matmul(M_1,N)
print(a,b)

     [1.22090697] [-10.92193326]


plt.scatter(x_s,y_s)
plt.plot(x_s,a*x_s+b,"black")
```

```
plt.show()
```



Para B,C

```
number_of_points=700
x_point = []
y_point = []
x_1=[]
y_1=[]

for i in range(number_of_points):
  x_1.append(1)
  y_1.append(1)

x_s=np.array(MB)
y_s=np.array(MC)

x2=np.sum(x_s*x_s)
x1=np.sum(x_s)
x1sum=np.sum(x_1)
y1sum=np.sum(y_1)
xy=np.sum(x_s*y_s)
```

```
y1=np.sum(y_s)



print(x2,x1,x1sum,y1sum,xy,y1)
```

```
169.52337615350524 26.720283673273403 700 700 3.836517477495968 1931.0684834496433
```

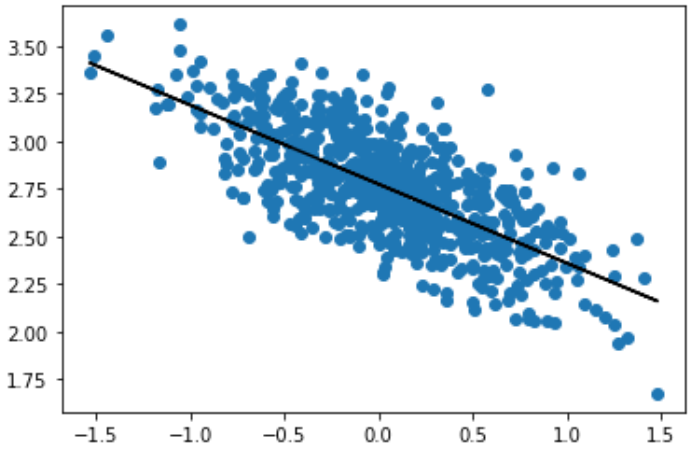
```
M = np.array([[x2,x1],[x1,x1sum]])


M_1=np.linalg.inv(M)


N=np.array([[xy],[y1]])
print(N)
```

```
[[   3.83651748]
 [1931.06848345]]
```

```
a,b = np.matmul(M_1,N)
print(a,b)
```

```
[-0.41468541] [2.77449856]
```

```
plt.scatter(x_s,y_s)
plt.plot(x_s,a*x_s+b,"black")
plt.show()
```



✓ 0 s ukończono o 11:12