In [1]:

```
pip install numpy
```

```
Defaulting to user installation because normal site-packages is not writea
ble
Requirement already satisfied: numpy in c:\programdata\anaconda3\lib\site-
packages (1.24.3)
Note: you may need to restart the kernel to use updated packages.
```

In [16]:

```
import numpy as np
```

In [17]:

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

Out[17]:

```
array([[1, 3],
       [4, 5]])
```

In [18]:

```
b = np.array([[3,4,5],[4,5,6],[7,8,9]])
b
```

Out[18]:

```
array([[3, 4, 5],
       [4, 5, 6],
       [7, 8, 9]])
```

In [49]:

```
c=np.array([[2,8,5,6],[9,8,7,6],[4,5,6,7],[4,5,8,9]])
c
```

Out[49]:

```
array([[2, 8, 5, 6],
       [9, 8, 7, 6],
       [4, 5, 6, 7],
       [4, 5, 8, 9]])
```

In [53]:

```
d=np.array([[1,2,9,4,8],[2,6,1,8,3],[9,5,6,7,8],[3,9,1,6,7],[3,8,5,6,7]])
d
```

Out[53]:

```
array([[1, 2, 9, 4, 8],
       [2, 6, 1, 8, 3],
       [9, 5, 6, 7, 8],
       [3, 9, 1, 6, 7],
       [3, 8, 5, 6, 7]])
```

In [54]:

```
e=np.array([[5,3],[1,5]])
e
```

Out[54]:

```
array([[5, 3],
       [1, 5]])
```

In [22]:

```
from numpy import linalg as la
```

In [23]:

```
print(la.det(a))
```

```
-6.999999999999999
```

In [24]:

```
print(la.det(b))
```

```
4.440892098500646e-16
```

In [50]:

```
print(la.det(c))
```

```
130.0000000000002
```

In [55]:

```
print(la.det(d))
```

```
-5609.0
```

In [35]:

```
print(la.det(e))
```

```
22.000000000000004
```

In [36]:

```
print(la.inv(a))
```

```
[[-0.71428571  0.42857143]
 [ 0.57142857 -0.14285714]]
```

In [37]:

```
print(la.inv(b))
```

```
[[-6.75539944e+15  9.00719925e+15 -2.25179981e+15]
 [ 1.35107989e+16 -1.80143985e+16  4.50359963e+15]
 [-6.75539944e+15  9.00719925e+15 -2.25179981e+15]]
```

In [51]:

```
print(la.inv(c))
```

```
[[-0.2         0.04615385  0.64615385 -0.4       ]
 [ 0.2         0.03076923 -0.06923077 -0.1       ]
 [ 0.2         0.33846154 -2.26153846  1.4       ]
 [-0.2        -0.33846154  1.76153846 -0.9       ]]
```

In [39]:

```
print(la.inv(e))
```

```
[[ 0.22727273 -0.13636364]
 [-0.04545455  0.22727273]]
```

In [56]:

```
print(la.inv(d))
```

```
[[-1.11962917e-01 -6.25779996e-02  1.38705652e-01 -6.41825637e-02
   6.04385809e-02]
 [-1.50472455e-01 -7.77322161e-02 -5.56248886e-02 -1.05366375e-01
   3.74220004e-01]
 [-3.76181137e-02 -1.94330540e-02 -1.39062221e-02 -2.76341594e-01
   3.43555001e-01]
 [ 7.80887859e-02  2.25173828e-01  5.17026208e-03  1.78284899e-04
  -1.91834552e-01]
 [ 1.79889463e-01 -6.34694241e-02  9.62738456e-03  3.45159565e-01
  -3.91691924e-01]]
```

In [40]:

```
print(la.matrix_rank(a))
print(np.diag(a))
print(np.trace(a))
```

```
2
[1 5]
6
```

In [41]:

```
print(la.matrix_rank(b))
print(np.diag(b))
print(np.trace(b))
```

```
2
[3 5 9]
17
```

In [58]:

```
print(la.matrix_rank(c))
print(np.diag(c))
print(np.trace(c))
```

```
4
[2 8 6 9]
25
```

In [57]:

```
print(la.matrix_rank(d))
print(np.diag(d))
print(np.trace(d))
```

```
5
[1 6 6 6 7]
26
```

In [43]:

```
print(la.matrix_rank(e))
print(np.diag(e))
print(np.trace(e))
```

```
2
[5 5]
10
```

In [44]:

```
x,y=la.eig(a)
print("Roots:",x)
print("Vectors:",y)
```

```
Roots: [-1.  7.]
Vectors: [[-0.83205029 -0.4472136 ]
 [ 0.5547002  -0.89442719]]
```

In [45]:

```
x,y=la.eig(b)
print("Roots:",x)
print("Vectors:",y)
```

```
Roots: [ 1.76787799e+01 -6.78779875e-01 -1.10007563e-15]
Vectors: [[ 0.39784354  0.63737261  0.40824829]
 [ 0.49197962  0.30065982 -0.81649658]
 [ 0.77438786 -0.70947856  0.40824829]]
```

In [59]:

```
x,y=la.eig(c)
print("Roots:",x)
print("Vectors:",y)
```

```
Roots: [24.97824311 -4.02011978  4.34016498 -0.29828831]
Vectors: [[ 0.436475    0.80879215  0.30468829  0.23374424]
 [ 0.59388411 -0.58754738  0.6916103  -0.01270654]
 [ 0.43823907 -0.02404645 -0.22675633 -0.78134815]
 [ 0.51452673 -0.00806906 -0.61434665  0.57853024]]
```

In [60]:

```
x,y=la.eig(d)
print("Roots:",x)
print("Vectors:",y)
```

```
Roots: [26.22269051+0.j          8.0339952 +0.j         -5.45222913+0.j
 -1.40222829+1.70790324j -1.40222829-1.70790324j]
Vectors: [[ 0.44337205+0.j          0.57702595+0.j         -0.76936202+0.j
   -0.01340067+0.0585377j  -0.01340067-0.0585377j ]
 [ 0.29577685+0.j         -0.36760365+0.j         -0.08970789+0.j
    0.54386373+0.j          0.54386373-0.j        ]
 [ 0.58944176+0.j          0.64820467+0.j          0.5453643 +0.j
    0.38099224+0.23046584j  0.38099224-0.23046584j]
 [ 0.38811967+0.j         -0.33231104+0.j          0.29730787+0.j
   -0.40935821+0.21853278j -0.40935821-0.21853278j]
 [ 0.46675348+0.j          0.0361759 +0.j         -0.11924929+0.j
   -0.36837625-0.38897896j -0.36837625+0.38897896j]]
```

In [48]:

```
x,y=la.eig(e)
print("Roots:",x)
print("Vectors:",y)
```

```
Roots: [6.73205081 3.26794919]
Vectors: [[ 0.8660254 -0.8660254]
 [ 0.5        0.5      ]]
```

In [62]:

```
print(la.eigvals(a))
print(la.eigvals(b))
print(la.eigvals(c))
print(la.eigvals(d))
print(la.eigvals(e))
```

```
[-1.  7.]
[ 1.76787799e+01 -6.78779875e-01 -1.10007563e-15]
[24.97824311 -4.02011978  4.34016498 -0.29828831]
[26.22269051+0.j          8.0339952 +0.j         -5.45222913+0.j
 -1.40222829+1.70790324j -1.40222829-1.70790324j]
[6.73205081 3.26794919]
```

In [63]:

```
pip install pandas
```

```
Defaulting to user installation because normal site-packages is not writea
ble
Requirement already satisfied: pandas in c:\programdata\anaconda3\lib\site
-packages (1.5.3)
Requirement already satisfied: python-dateutil>=2.8.1 in c:\programdata\an
aconda3\lib\site-packages (from pandas) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in c:\programdata\anaconda3\li
b\site-packages (from pandas) (2022.7)
Requirement already satisfied: numpy>=1.21.0 in c:\programdata\anaconda3\l
ib\site-packages (from pandas) (1.24.3)
Requirement already satisfied: six>=1.5 in c:\programdata\anaconda3\lib\si
te-packages (from python-dateutil>=2.8.1->pandas) (1.16.0)
Note: you may need to restart the kernel to use updated packages.
```

In [64]:

```
import pandas as pd
```

In [67]:

```
s1={
    'branch':pd.Series([40,80,20,10,60]),
    'courses':pd.Series([3,4,2,5,1]) }
print(s1)
```

```
{'branch': 0    40
1    80
2    20
3    10
4    60
dtype: int64, 'courses': 0    3
1    4
2    2
3    5
4    1
dtype: int64}
```

In [68]:

```
s2={
    'age':pd.Series([10,20,30,40,50]),
    'Weight':pd.Series([35,56,45,78,67]) }
print(s2)
```

```
{'age': 0    10
1    20
2    30
3    40
4    50
dtype: int64, 'Weight': 0    35
1    56
2    45
3    78
4    67
dtype: int64}
```

In [69]:

```
s3={
    'cities code':pd.Series([10,20,30,40,50]),
    'population':pd.Series([35,16,45,78,67]) }
print(s3)
```

```
{'cities code': 0    10
1    20
2    30
3    40
4    50
dtype: int64, 'population': 0    35
1    16
2    45
3    78
4    67
dtype: int64}
```

In [70]:

```
s4={
    'city code':pd.Series([10,20,30,40,50]),
    'vacanies':pd.Series([35,56,45,78,67]) }
print(s4)
```

```
{'city code': 0    10
1    20
2    30
3    40
4    50
dtype: int64, 'vacanies': 0    35
1    56
2    45
3    78
4    67
dtype: int64}
```

In [71]:

```
s5={
    'cars no':pd.Series([10,20,30,40,50]),
    'distance':pd.Series([35,56,45,78,67]) }
print(s5)
```

```
{'cars no': 0    10
1    20
2    30
3    40
4    50
dtype: int64, 'distance': 0    35
1    56
2    45
3    78
4    67
dtype: int64}
```

In [72]:

```
m=pd.DataFrame(s1)
m
```

Out[72]:

	branch	courses
0	40	3
1	80	4
2	20	2
3	10	5
4	60	1

In [73]:

```
n=pd.DataFrame(s2)
n
```

Out[73]:

	age	Weight
0	10	35
1	20	56
2	30	45
3	40	78
4	50	67

In [74]:

```
o=pd.DataFrame(s3)
o
```

Out[74]:

	cities code	population
0	10	35
1	20	16
2	30	45
3	40	78
4	50	67

In [75]:

```
p=pd.DataFrame(s4)
p
```

Out[75]:

	city code	vacanies
0	10	35
1	20	56
2	30	45
3	40	78
4	50	67

In [77]:

```
q=pd.DataFrame(s5)
q
```

Out[77]:

	cars no	distance
0	10	35
1	20	56
2	30	45
3	40	78
4	50	67

In [78]:

```
print(m.mean())
print(m.median())
print(m.mode())
```

```
branch     42.0
courses     3.0
dtype: float64
branch     40.0
courses     3.0
dtype: float64
   branch  courses
0      10        1
1      20        2
2      40        3
3      60        4
4      80        5
```

In [79]:

```
print(n.mean())
print(n.median())
print(n.mode())
```

```
age       30.0
Weight    56.2
dtype: float64
age       30.0
Weight    56.0
dtype: float64
   age  Weight
0   10      35
1   20      45
2   30      56
3   40      67
4   50      78
```

In [80]:

```
print(o.mean())
print(o.median())
print(o.mode())
```

```
cities code    30.0
population     48.2
dtype: float64
cities code    30.0
population     45.0
dtype: float64
   cities code  population
0           10          16
1           20          35
2           30          45
3           40          67
4           50          78
```

In [82]:

```
print(p.mean())
print(p.median())
print(p.mode())
```

```
city code    30.0
vacanies     56.2
dtype: float64
city code    30.0
vacanies     56.0
dtype: float64
   city code  vacanies
0         10        35
1         20        45
2         30        56
3         40        67
4         50        78
```

In [83]:

```
print(q.mean())
print(q.median())
print(q.mode())
```

```
cars no     30.0
distance    56.2
dtype: float64
cars no     30.0
distance    56.0
dtype: float64
   cars no  distance
0       10        35
1       20        45
2       30        56
3       40        67
4       50        78
```

In [84]:

```
print(m.sum())
print(m.cumsum())
print(m.count())
print(m.max())
print(m.min())
```

```
branch     210
courses     15
dtype: int64
   branch  courses
0      40        3
1     120        7
2     140        9
3     150       14
4     210       15
branch     5
courses    5
dtype: int64
branch     80
courses     5
dtype: int64
branch     10
courses     1
dtype: int64
```

In [85]:

```
print(n.sum())
print(n.cumsum())
print(n.count())
print(n.max())
print(n.min())
```

```
age       150
Weight    281
dtype: int64
   age  Weight
0   10      35
1   30      91
2   60     136
3  100     214
4  150     281
age       5
Weight    5
dtype: int64
age       50
Weight    78
dtype: int64
age       10
Weight    35
dtype: int64
```

In [86]:

```
print(o.sum())
print(o.cumsum())
print(o.count())
print(o.max())
print(o.min())
```

```
cities code    150
population     241
dtype: int64
   cities code  population
0           10          35
1           30          51
2           60          96
3          100         174
4          150         241
cities code    5
population     5
dtype: int64
cities code    50
population     78
dtype: int64
cities code    10
population     16
dtype: int64
```

In [87]:

```
print(p.sum())
print(p.cumsum())
print(p.count())
print(p.max())
print(p.min())
```

```
city code    150
vacanies     281
dtype: int64
   city code  vacanies
0         10        35
1         30        91
2         60       136
3        100       214
4        150       281
city code    5
vacanies     5
dtype: int64
city code    50
vacanies     78
dtype: int64
city code    10
vacanies     35
dtype: int64
```

In [88]:

```
print(q.sum())
print(q.cumsum())
print(q.count())
print(q.max())
print(q.min())
```

```
cars no     150
distance    281
dtype: int64
   cars no  distance
0       10        35
1       30        91
2       60       136
3      100       214
4      150       281
cars no     5
distance    5
dtype: int64
cars no     50
distance    78
dtype: int64
cars no     10
distance    35
dtype: int64
```

In [89]:

```
print(m.describe())
print(n.describe())
print(o.describe())
print(p.describe())
print(q.describe())
```

```
          branch   courses
count   5.000000  5.000000
mean   42.000000  3.000000
std    28.635642  1.581139
min    10.000000  1.000000
25%    20.000000  2.000000
50%    40.000000  3.000000
75%    60.000000  4.000000
max    80.000000  5.000000
             age     Weight
count   5.000000   5.000000
mean   30.000000  56.200000
std    15.811388  17.079227
min    10.000000  35.000000
25%    20.000000  45.000000
50%    30.000000  56.000000
75%    40.000000  67.000000
max    50.000000  78.000000
       cities code  population
count     5.000000    5.000000
mean     30.000000   48.200000
std      15.811388   24.813303
min      10.000000   16.000000
25%      20.000000   35.000000
50%      30.000000   45.000000
75%      40.000000   67.000000
max      50.000000   78.000000
       city code   vacanies
count   5.000000   5.000000
mean   30.000000  56.200000
std    15.811388  17.079227
min    10.000000  35.000000
25%    20.000000  45.000000
50%    30.000000  56.000000
75%    40.000000  67.000000
max    50.000000  78.000000
         cars no   distance
count   5.000000   5.000000
mean   30.000000  56.200000
std    15.811388  17.079227
min    10.000000  35.000000
25%    20.000000  45.000000
50%    30.000000  56.000000
75%    40.000000  67.000000
max    50.000000  78.000000
```

In [90]:

```
from numpy import cov
covariance=cov(m,n)
print(covariance)
```

```
[[  684.5  1406.    333.     92.5  1091.5  -462.5  -666.   -277.5  -703.
   -314.5]
 [ 1406.   2888.    684.    190.   2242.   -950.  -1368.   -570.  -1444.
   -646. ]
 [  333.    684.    162.     45.    531.   -225.   -324.   -135.   -342.
   -153. ]
 [   92.5   190.     45.     12.5   147.5   -62.5   -90.    -37.5   -95.
    -42.5]
 [ 1091.5  2242.    531.    147.5  1740.5  -737.5 -1062.   -442.5 -1121.
   -501.5]
 [ -462.5  -950.   -225.    -62.5  -737.5   312.5   450.    187.5   475.
    212.5]
 [ -666.  -1368.   -324.    -90.  -1062.    450.    648.    270.    684.
    306. ]
 [ -277.5  -570.   -135.    -37.5  -442.5   187.5   270.    112.5   285.
    127.5]
 [ -703.  -1444.   -342.    -95.  -1121.    475.    684.    285.    722.
    323. ]
 [ -314.5  -646.   -153.    -42.5  -501.5   212.5   306.    127.5   323.
    144.5]]
```

In [92]:

```
from numpy import cov
covariance=cov(n,o)
print(covariance)
```

```
[[312.5 450.  187.5 475.  212.5 312.5 -50.  187.5 475.  212.5]
 [450.  648.  270.  684.  306.  450.  -72.  270.  684.  306. ]
 [187.5 270.  112.5 285.  127.5 187.5 -30.  112.5 285.  127.5]
 [475.  684.  285.  722.  323.  475.  -76.  285.  722.  323. ]
 [212.5 306.  127.5 323.  144.5 212.5 -34.  127.5 323.  144.5]
 [312.5 450.  187.5 475.  212.5 312.5 -50.  187.5 475.  212.5]
 [-50.  -72.  -30.  -76.  -34.  -50.    8.  -30.  -76.  -34. ]
 [187.5 270.  112.5 285.  127.5 187.5 -30.  112.5 285.  127.5]
 [475.  684.  285.  722.  323.  475.  -76.  285.  722.  323. ]
 [212.5 306.  127.5 323.  144.5 212.5 -34.  127.5 323.  144.5]]
```

In [93]:

```
from numpy import cov
covariance=cov(o,p)
print(covariance)
```

```
[[312.5 -50.  187.5 475.  212.5 312.5 450.  187.5 475.  212.5]
 [-50.    8.  -30.  -76.  -34.  -50.  -72.  -30.  -76.  -34. ]
 [187.5 -30.  112.5 285.  127.5 187.5 270.  112.5 285.  127.5]
 [475.  -76.  285.  722.  323.  475.  684.  285.  722.  323. ]
 [212.5 -34.  127.5 323.  144.5 212.5 306.  127.5 323.  144.5]
 [312.5 -50.  187.5 475.  212.5 312.5 450.  187.5 475.  212.5]
 [450.  -72.  270.  684.  306.  450.  648.  270.  684.  306. ]
 [187.5 -30.  112.5 285.  127.5 187.5 270.  112.5 285.  127.5]
 [475.  -76.  285.  722.  323.  475.  684.  285.  722.  323. ]
 [212.5 -34.  127.5 323.  144.5 212.5 306.  127.5 323.  144.5]]
```

In [94]:

```
from numpy import cov
covariance=cov(p,q)
print(covariance)
```

```
[[312.5 450.  187.5 475.  212.5 312.5 450.  187.5 475.  212.5]
 [450.  648.  270.  684.  306.  450.  648.  270.  684.  306. ]
 [187.5 270.  112.5 285.  127.5 187.5 270.  112.5 285.  127.5]
 [475.  684.  285.  722.  323.  475.  684.  285.  722.  323. ]
 [212.5 306.  127.5 323.  144.5 212.5 306.  127.5 323.  144.5]
 [312.5 450.  187.5 475.  212.5 312.5 450.  187.5 475.  212.5]
 [450.  648.  270.  684.  306.  450.  648.  270.  684.  306. ]
 [187.5 270.  112.5 285.  127.5 187.5 270.  112.5 285.  127.5]
 [475.  684.  285.  722.  323.  475.  684.  285.  722.  323. ]
 [212.5 306.  127.5 323.  144.5 212.5 306.  127.5 323.  144.5]]
```

In [95]:

```
pip install scipy
```

```
Defaulting to user installation because normal site-packages is not writea
ble
Requirement already satisfied: scipy in c:\programdata\anaconda3\lib\site-
packages (1.10.1)
Requirement already satisfied: numpy<1.27.0,>=1.19.5 in c:\programdata\ana
conda3\lib\site-packages (from scipy) (1.24.3)
Note: you may need to restart the kernel to use updated packages.
```

In [96]:

```
from scipy.stats import pearsonr
a=[1,2,3,4,5,6,7,8,9,10]
b=[11,13,15,16,24,56,34,25,39,90]
corr=pearsonr(a,b)
print(corr)
```

```
PearsonRResult(statistic=0.767143303518697, pvalue=0.009605641558179966)
```

In [97]:

```
from scipy.stats import spearmanr
a=[1,2,3,4,5,6,7,8,9,10]
b=[11,13,15,16,24,56,34,25,39,90]
corr=spearmanr(a,b)
print(corr)
```

```
SignificanceResult(statistic=0.9151515151515152, pvalue=0.0002044724061488
323)
```

In [ ]:

```

```