HW 1 SP22

February 10, 2022

1 1 Matrices and Numpy

1.1 1.1 Matrices Theory

1.1.1 1.1.1 Write properties of matrices

Matrix has following properies Number of Rows Number of Columns Determinent of the Matrix A = |A| Commutative property of addition A + B = B+ A (A,B Matrix) Associative Property of addition A+ (B + C) = (A + B) + C x (A + B) = xA + xB (x = constant) A*B != B*A a.A + b.A= (a+b).A

1.1.2 1.1.2 Write a python function to get a matrix from user

[1]:
```
import numpy as np
```

[2]:
```
def Get_Matrix():
    r=int(input("Enter number of Rows"))
    c=int(input("Enter number of Columns"))
    A=np.zeros((r,c),dtype=np.int64)
    for i in range(r):
        for j in range(c):
            A[i][j]=int(input("Enter element row={} and column={} -->".
↪format(r,c)))
    return A
```

1.2 1.1.3 Get two matrices from the user and give them names A and B

[3]:
```
A=Get_Matrix()
B=Get_Matrix()
```

```
Enter number of Rows2
Enter number of Columns2
Enter element row=2 and column=2 -->1
Enter element row=2 and column=2 -->2
Enter element row=2 and column=2 -->3
Enter element row=2 and column=2 -->4
Enter number of Rows2
Enter number of Columns2
```

```
Enter element row=2 and column=2 -->5
Enter element row=2 and column=2 -->6
Enter element row=2 and column=2 -->7
Enter element row=2 and column=2 -->8
```

[4]:
```
A
```

[4]:
```
array([[1, 2],
       [3, 4]], dtype=int64)
```

[5]:
```
B
```

[5]:
```
array([[5, 6],
       [7, 8]], dtype=int64)
```

1.3 1.2 Matrix manipulation without using Numpy

[6]:
```
def Check_Matrix(A,B):
    if(len(A[0])!=len(B)):
        raise Exception("Matrices can not multiplay as A[columns]!=B[rows]")
    else:
       print('Performing Multiplication')
```

[7]:
```
def Matrix_Multi(A,B):
    Check_Matrix(A,B)
    sum=0
    C=np.zeros((len(A),len(B[0])),dtype=np.int32)
    #print('x\ty\tz\tA[x][z]\tB[z][y]\tsum')
    for x in range(len(A)):
        for y in range(len(B[0])):
            for z in range(len(A[0])):
                sum+=A[x][z]*B[z][y]
                #print(x,"\t",y,"\t",z,"\t",A[x][z],"\t",B[z][y],"\t",sum)
            C[x][y]=sum
            sum=0
    return C
```

[8]:
```
def Print_Matrix(A):
    for i in range(len(A)):
        for j in range(len(A[0])):
            print(A[i][j],end="\t")
        print("")
```

[9]:
```
Print_Matrix(Matrix_Multi(A,B))
```

```
Performing Multiplication
19      22
```

```
43      50
```

1.3.1 1.2.1 Perform A^n (n is a user entered values)

[10]:
```
n=int(input("Enter value of n for A^n:"))
An=A
for i in range(n-1):
    An=Matrix_Multi(An,An)

Print_Matrix(An)
```

```
Enter value of n for A^n:2
Performing Multiplication
7       10
15      22
```

1.3.2 1.2.2 Perform A Transpose

[11]:
```
def Matrix_Transpose(A):
    T=np.zeros((len(A[0]),len(A)))
    for i in range(len(A)):
        for j in range(len(A[0])):
            T[i][j]=A[j][i]
    return(T)
```

[12]:
```
Print_Matrix(Matrix_Transpose(A))
```

```
1.0     3.0
2.0     4.0
```

1.3.3 1.2.3 Calculate Determinant of A

1.4 D=Get_Matrix()

[13]:
```
def Minor(Sub_Matrix,i,j):
    c = Sub_Matrix[:]
    c = np.delete(c,(i),axis=0)
    return [np.delete(r,(j),axis=0) for r in (c)]
```

[14]:
```
def Deter_Matrix(D):
    n = len(D)
    if n == 1 :return D[0][0]
    if n == 2 :return D[0][0]*D[1][1] - D[0][1]*D[1][0]
    sum = 0
    for j in range(0,n):
        m = Minor(D,0,j)
        sum =sum + ((-1)**j)*D[0][j] * Deter_Matrix(m)
    return sum
```

[15]:
```
Print_Matrix(A)
print(Deter_Matrix(A))
```

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

1.4.1 1.2.4 Calculate A Inverse (If not possible code should give relevant reason)

[16]:
```
def Inverse_Matrix(D):
    if (Deter_Matrix(D)==0):
        raise Exception("Inverse can not be calculates as |D|=0")
    else:
        Inv_Matrix=np.zeros((len(D),len(D)),dtype=np.int32)
        for i in range(0,len(D)):
            for j in range(0,len(D)):
                Sub=Minor(D,i,j)
                #print(Sub)
                Inv_Matrix[i][j]=((-1)**(i+j+1)) * Deter_Matrix(Sub)
    #Print_Matrix(Inv_Matrix)
    Det_D=Deter_Matrix(D)
    #print(Det_D)
    Inv_Matrix=Matrix_Transpose(Inv_Matrix)/Det_D
    #Print_Matrix(Inv_Matrix)
    return Inv_Matrix
```

[17]:
```
print(Inverse_Matrix(A))
```

```
[[ 2.  -1. ]
 [-1.5  0.5]]
```

1.4.2 1.2.5 Calculate A*B (If not possible, code should give relevant reason)

[18]:
```
Print_Matrix(Matrix_Multi(A,B))
```

```
Performing Multiplication
19      22
43      50
```

1.4.3 1.2.6 Calculate A+B (If not possible, code should give relevant reason)

[19]:
```
def Matrix_Add(A,B):
    if len(A)!=len(B) or len(A[0])!=len(B[0]):
        raise Exception("Matrix Dimention must be same for Addition")
    else:
        C=np.zeros((len(A),len(A[0])),dtype=np.int32)
        for i in range(len(A)):
```

```
            for j in range(len(B)):
                C[i][j]=A[i][j]+B[i][j]
        return C
```

[20]:
```
Print_Matrix(Matrix_Add(A,B))
```

```
6       8
10      12
```

1.5 1.3 Matrix manipulation using Numpy

1.5.1 1.3.1 Perform all the operations in the previous question using Numpy

[21]:
```
A*B
```

[21]:
```
array([[ 5, 12],
       [21, 32]], dtype=int64)
```

1.5.2 1.3.2 Perform following operations in Numpy: Reduced Mean, Reduced Sum, Argmax, Zip and One Hot Encoding

[22]:
```
A.mean()
```

[22]:
```
2.5
```

[23]:
```
A.mean(0)
```

[23]:
```
array([2., 3.])
```

[24]:
```
A.mean(1)
```

[24]:
```
array([1.5, 3.5])
```

[25]:
```
A.sum()
```

[25]:
```
10
```

[26]:
```
A.sum(0)
```

[26]:
```
array([4, 6], dtype=int64)
```

[27]:
```
A.sum(1)
```

[27]:
```
array([3, 7], dtype=int64)
```

[28]:
```
A.argmax()
```

[28]: 3

[29]:
```
A.argmax(0)
```

[29]: array([1, 1], dtype=int64)

[30]:
```
A.argmax(1)
```

[30]: array([1, 1], dtype=int64)

[31]:
```
print(list(zip(A,B)))
```

```
[(array([1, 2], dtype=int64), array([5, 6], dtype=int64)), (array([3, 4],
dtype=int64), array([7, 8], dtype=int64))]
```

[32]:
```
print('Given Matrix\n',A)
Arr=A.reshape(1,-1)
print('Equivalent Array\n',Arr)
shape = (A.size, A.max()+1)
one_hot = np.zeros(shape)
rows = np.arange(Arr.size)
one_hot[rows,Arr] = 1
print('One Hot Encoding\n',one_hot)
```

```
Given Matrix
 [[1 2]
 [3 4]]
Equivalent Array
 [[1 2 3 4]]
One Hot Encoding
 [[0. 1. 0. 0. 0.]
 [0. 0. 1. 0. 0.]
 [0. 0. 0. 1. 0.]
 [0. 0. 0. 0. 1.]]
```

2 2 Pandas

2.1 2.1 read a csv data to pandas dataframe (data 1)

2.2 2.2 Demonstrate any 5 functions from the following link on the loaded dataset

https://pandas.pydata.org/docs/reference/general_functions.html

[33]:
```
import pandas as pd
Data_1=pd.read_csv("data_1.csv",names=["Value 1", "Value 2"])
Data_1.head()
```

[33]:
```
     Value 1   Value 2
0 -0.752400 -1.992827
1 -0.702025 -1.935445
2  0.058185 -1.020321
3 -0.097662 -1.857889
4 -0.369050  0.209050
```

[34]:
```
pd.isna(pd.NA)
```

[34]: True

[35]:
```
pd.isna(np.nan)
```

[35]: True

[36]:
```
pd.notna(pd.NA)
```

[36]: False

[37]:
```
pd.notna(np.nan)
```

[37]: False

[38]:
```
pd.melt(Data_1, id_vars=['Value 1'], value_vars=['Value 2'])
```

[38]:
```
        Value 1 variable     value
0     -0.752400  Value 2 -1.992827
1     -0.702025  Value 2 -1.935445
2      0.058185  Value 2 -1.020321
3     -0.097662  Value 2 -1.857889
4     -0.369050  Value 2  0.209050
…           …        …         …
9995   0.106437  Value 2 -1.723467
9996  -0.535412  Value 2 -2.009323
9997   1.358514  Value 2  4.867444
9998   0.668055  Value 2  2.753525
9999   0.190843  Value 2  2.156421

[10000 rows x 3 columns]
```

[39]:
```
Data_1.pivot(index='Value 1', columns='Value 2', values='Value 2')
```

[39]:
```
Value 2    -13.892867  -11.327178  -10.474207  -10.180503  -10.164034  \
Value 1
-3.949464  -13.892867         NaN         NaN         NaN         NaN
-3.641073         NaN         NaN         NaN         NaN         NaN
-3.266283         NaN         NaN         NaN         NaN         NaN
```

```
-3.162066          NaN         NaN         NaN         NaN         NaN
-3.155156          NaN         NaN         NaN         NaN  -10.164034
…               …         …         …         …         …
 3.181505          NaN         NaN         NaN         NaN         NaN
 3.231842          NaN         NaN         NaN         NaN         NaN
 3.265952          NaN         NaN         NaN         NaN         NaN
 3.273152          NaN         NaN         NaN         NaN         NaN
 3.583412          NaN         NaN         NaN         NaN         NaN

Value 2    -10.144762  -9.999708   -9.798856   -9.624723   -9.544635   …  \
Value 1                                                                …
-3.949464          NaN         NaN         NaN         NaN         NaN  …
-3.641073          NaN         NaN         NaN         NaN         NaN  …
-3.266283          NaN         NaN         NaN         NaN         NaN  …
-3.162066          NaN   -9.999708         NaN         NaN         NaN  …
-3.155156          NaN         NaN         NaN         NaN         NaN  …
…               …         …         …         …         …   …
 3.181505          NaN         NaN         NaN         NaN         NaN  …
 3.231842          NaN         NaN         NaN         NaN         NaN  …
 3.265952          NaN         NaN         NaN         NaN         NaN  …
 3.273152          NaN         NaN         NaN         NaN         NaN  …
 3.583412          NaN         NaN         NaN         NaN         NaN  …

Value 2      9.572446    9.620763    9.685988    9.726477    9.799602   \
Value 1
-3.949464          NaN         NaN         NaN         NaN         NaN
-3.641073          NaN         NaN         NaN         NaN         NaN
-3.266283          NaN         NaN         NaN         NaN         NaN
-3.162066          NaN         NaN         NaN         NaN         NaN
-3.155156          NaN         NaN         NaN         NaN         NaN
…               …         …         …         …         …
 3.181505          NaN         NaN         NaN    9.726477         NaN
 3.231842          NaN         NaN         NaN         NaN         NaN
 3.265952          NaN         NaN         NaN         NaN         NaN
 3.273152          NaN         NaN         NaN         NaN         NaN
 3.583412          NaN         NaN         NaN         NaN         NaN

Value 2     10.180504   10.973201   11.655695   12.152760   12.279487
Value 1
-3.949464          NaN         NaN         NaN         NaN         NaN
-3.641073          NaN         NaN         NaN         NaN         NaN
-3.266283          NaN         NaN         NaN         NaN         NaN
-3.162066          NaN         NaN         NaN         NaN         NaN
-3.155156          NaN         NaN         NaN         NaN         NaN
…               …         …         …         …         …
 3.181505          NaN         NaN         NaN         NaN         NaN
 3.231842          NaN         NaN         NaN         NaN         NaN
```

```
 3.265952         NaN        NaN        NaN   12.15276        NaN
 3.273152         NaN        NaN        NaN        NaN  12.279487
 3.583412         NaN  10.973201        NaN        NaN        NaN

[10000 rows x 10000 columns]
```

[40]:
```
pd.cut(Data_1['Value 1'], 3)
```

[40]:
```
0       (-1.439, 1.072]
1       (-1.439, 1.072]
2       (-1.439, 1.072]
3       (-1.439, 1.072]
4       (-1.439, 1.072]
             …
9995    (-1.439, 1.072]
9996    (-1.439, 1.072]
9997     (1.072, 3.583]
9998    (-1.439, 1.072]
9999    (-1.439, 1.072]
Name: Value 1, Length: 10000, dtype: category
Categories (3, interval[float64, right]): [(-3.957, -1.439] < (-1.439, 1.072] <
(1.072, 3.583]]
```

3 3 Plotting

3.1 3.1 read a csv data to pandas dataframe (data 2)

[41]:
```
Data_2=pd.read_csv('data_2.csv',names=['Value 1','Value 2'])
Data_2.head()
```

[41]:

	Value 1	Value 2
0	-6.283185	0.043487
1	-6.281929	0.084347
2	-6.280672	-0.028693
3	-6.279415	0.021445
4	-6.278158	0.020871

[51]:
```
Data_2.describe()
```

[51]:

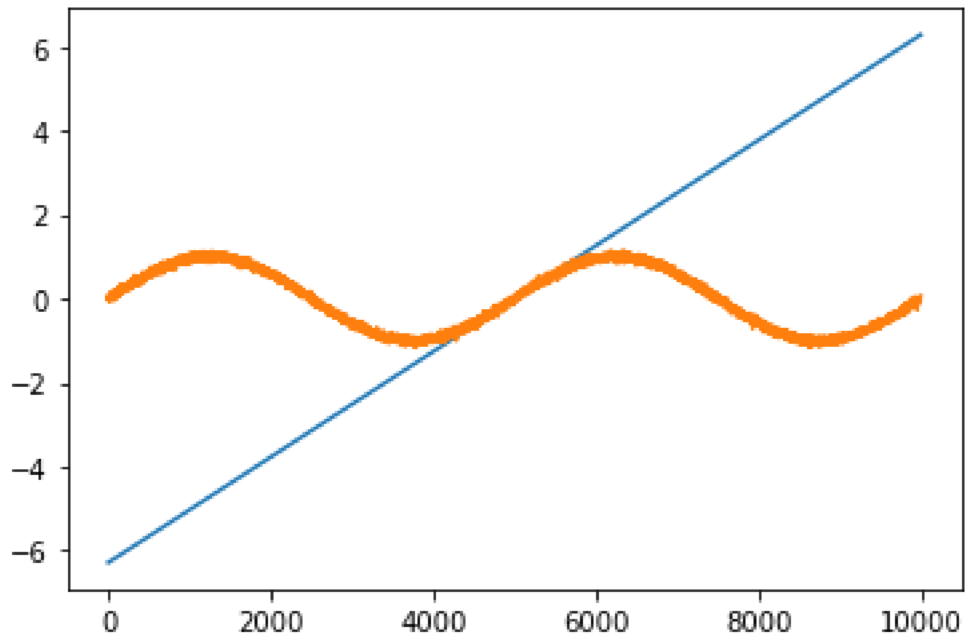
	Value 1	Value 2
count	1.000000e+04	10000.000000
mean	4.313883e-16	0.000141
std	3.628143e+00	0.709152
min	-6.283185e+00	-1.151122
25%	-3.141593e+00	-0.704131
50%	4.440892e-16	-0.002135

```
75%     3.141593e+00        0.701588
max     6.283185e+00        1.145402
```

3.2 3.2 plot the above dataset using matplotlib

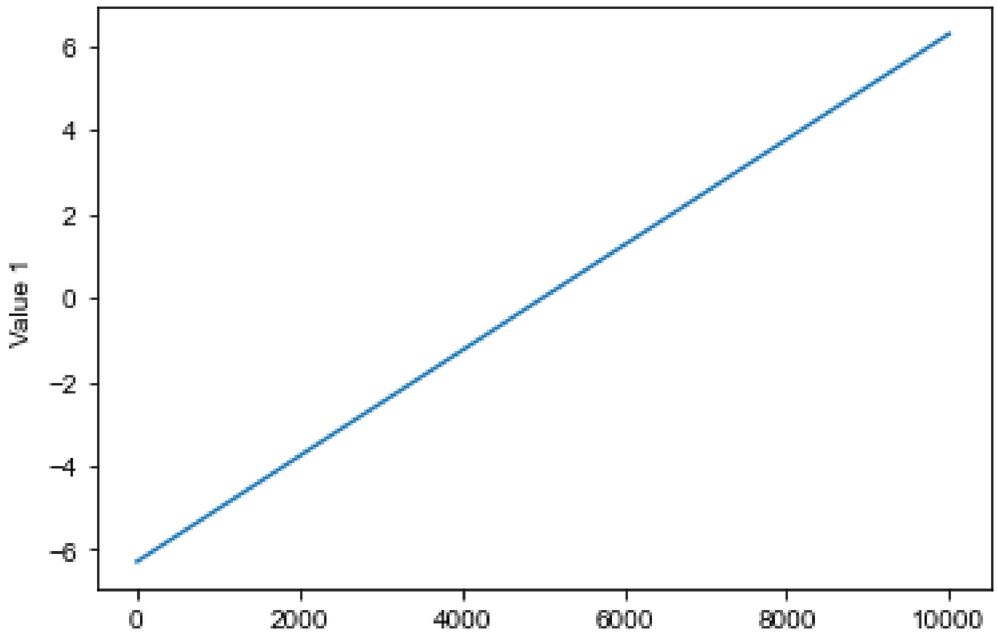
[43]:
```
import matplotlib.pyplot as plt
plt.plot(Data_2)
```

[43]:
```
[<matplotlib.lines.Line2D at 0x2656ae3b100>,
 <matplotlib.lines.Line2D at 0x2656ae3b130>]
```



3.3 3.3 load the tips dataset from seaborn

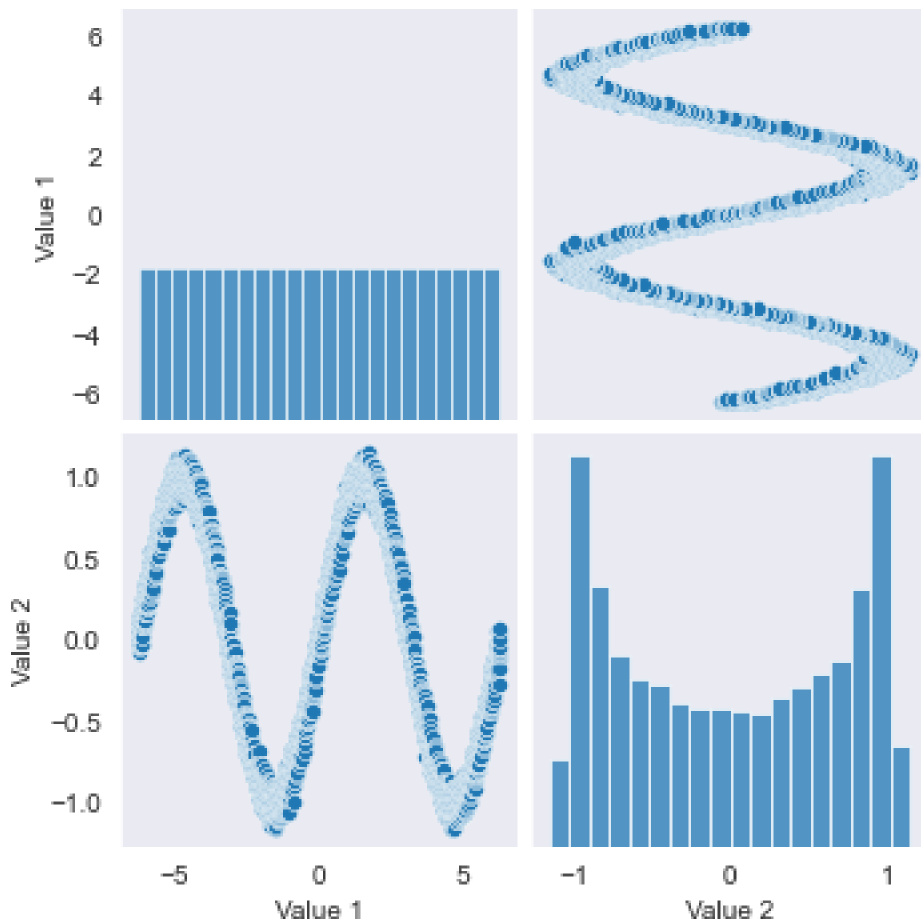
[44]:
```
import seaborn as sb
sb.lineplot(data=Data_2['Value 1'])
sb.set_style("dark")
plt.show()
```



3.4 3.4 plot pairplot, jointplot, catplot, displot, and HeatMap for the above dataset and give your comments on each plot

[45]:
```
sb.pairplot(Data_2)
```

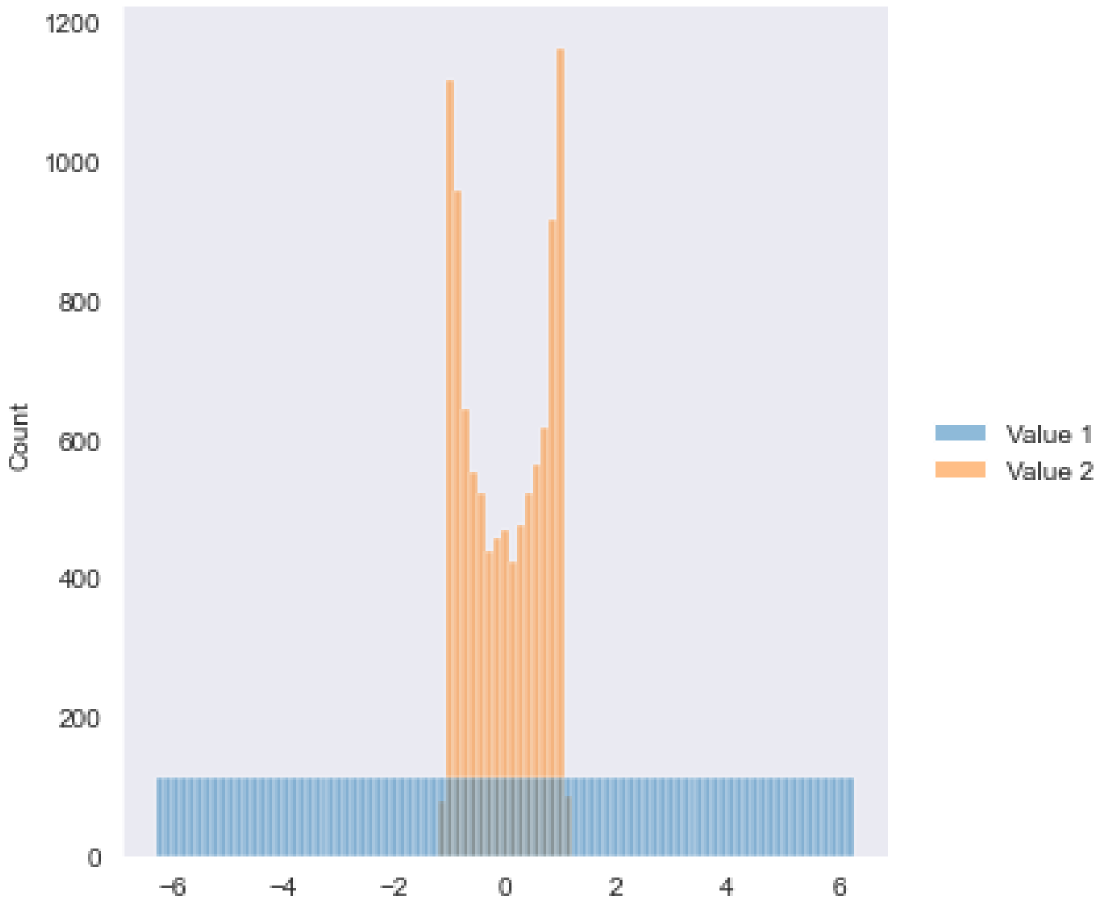
[45]: <seaborn.axisgrid.PairGrid at 0x2656ce26f70>



A pairplot plot a pairwise relationships in a dataset As we can see in describe the both data have min -6.283185e+00 and -1.151122 where as max 6.283185e+00 and 1.145402 respectively. So all 4 plots are 1to1, 1to2, 2to1 and 2to2 values distribution plots.

[46]:
```
sb.displot(data=Data_2)
```

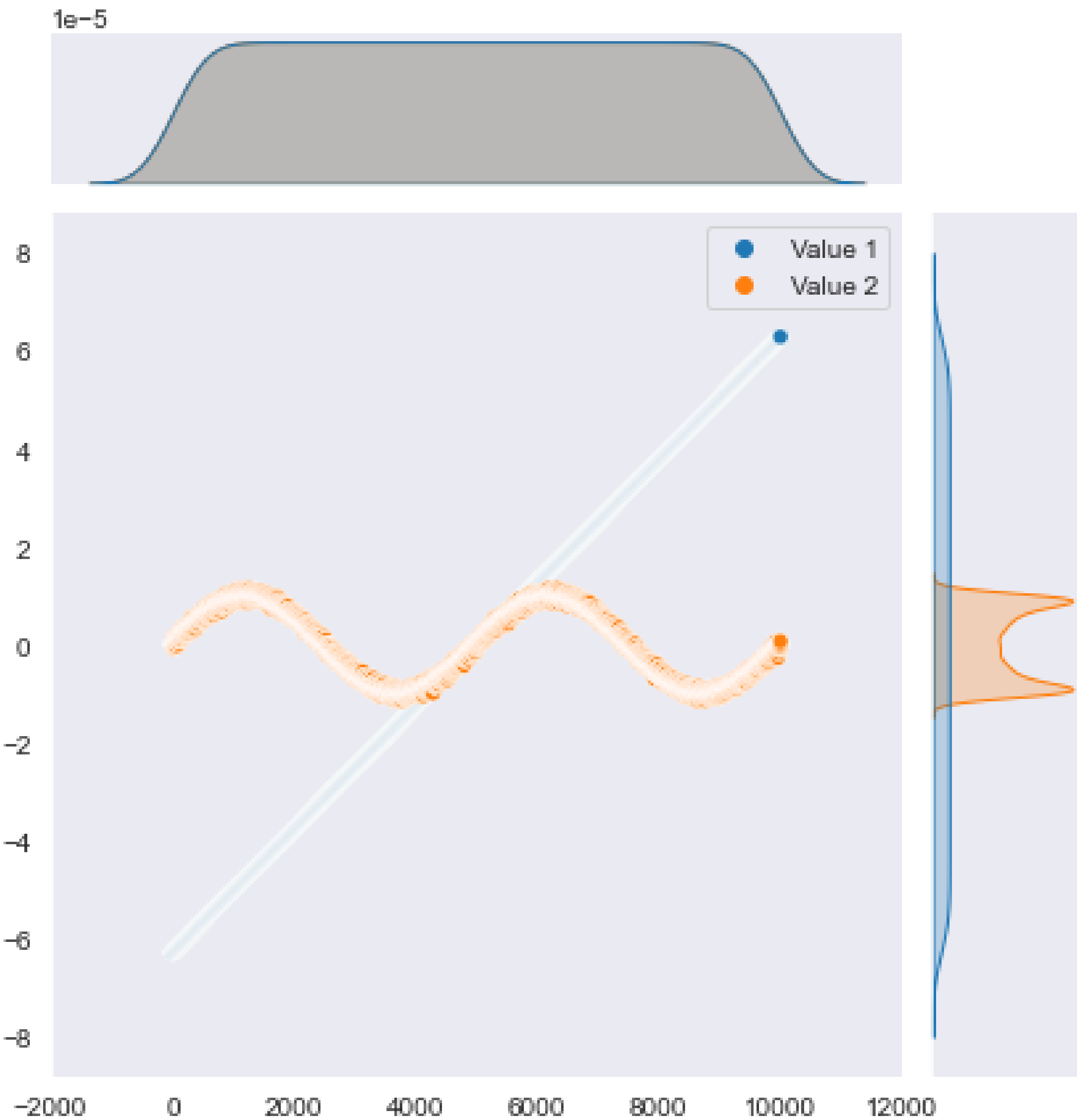
[46]: <seaborn.axisgrid.FacetGrid at 0x2656ce7e700>



A Distplot depicts the variation in the data distribution These two graphs are also mentioned in pairplot. Which are data distribution for each column.

[47]:
```
sb.jointplot(data=Data_2)
```

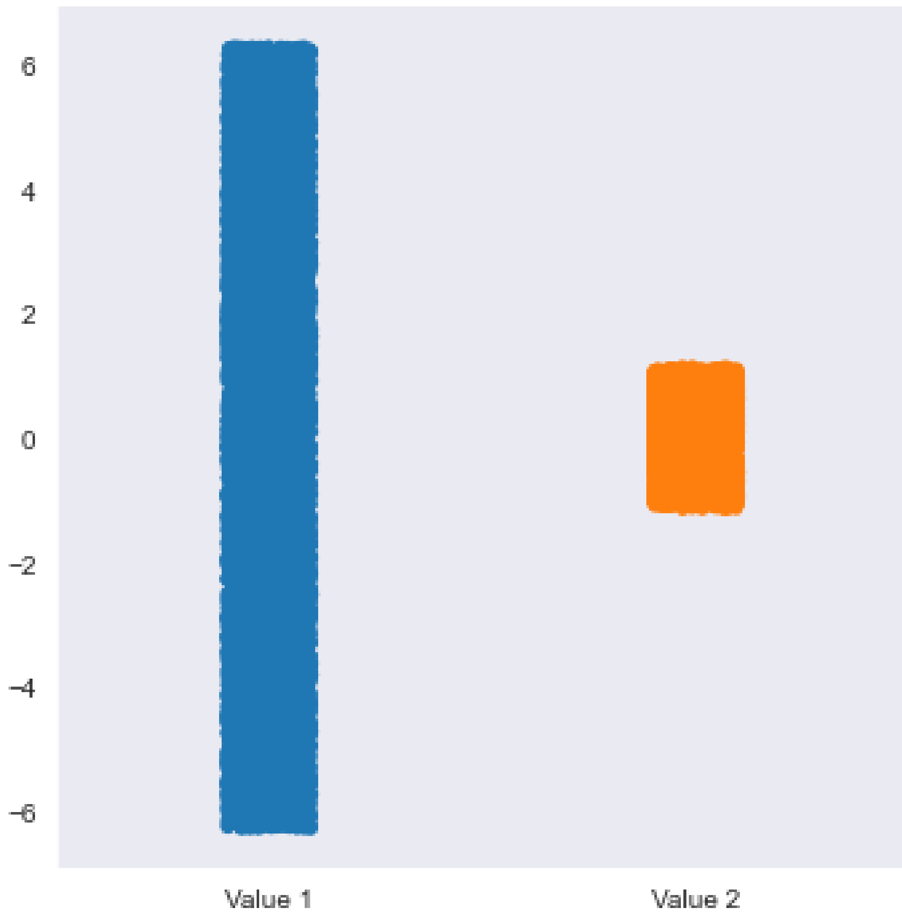
[47]: <seaborn.axisgrid.JointGrid at 0x2656d1a7250>



one plot displays a bivariate graph : variable(Y) varies with the independent variable(X) second plot shows the distribution of the independent variable(X) third plot shows the distribution of the dependent variable(Y).

[48]:
```
sb.catplot(data=Data_2)
```

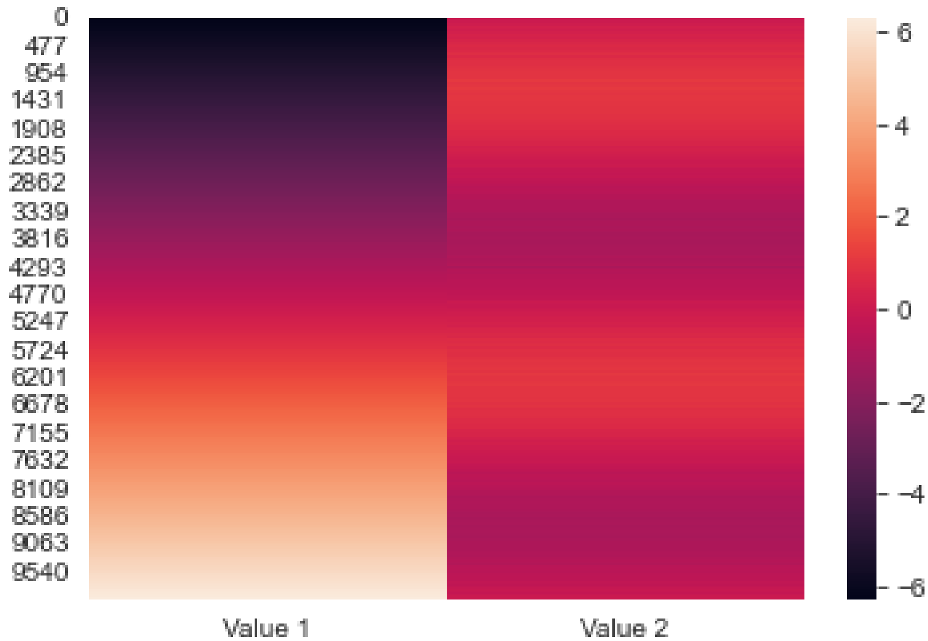
[48]: <seaborn.axisgrid.FacetGrid at 0x2656d195b50>



catplot shows frequencies of the categories of one, two or three categorical variables. This graph can represent the relative data variation for all columns.

[49]:
```
sb.heatmap(Data_2)
```

[49]: <AxesSubplot:>



A heatmap is a graphical representation of data that uses a system of color-coding Right side verticle bar represent color code for each value Value 1 coves all varities from dark to light colours in comparation from values 2.