05ex_OSEMN

January 19, 2025

1 OSEMN Exercises

[2]:
```
%matplotlib inline
import pandas as pd
import numpy as np
from numpy import random
```

1.1 1. (done) Create a random list of number and then save it to a text file named "simple_data.txt"

[3]:
```
d = random.random(size=100)
#print(d)

filename = "simple_data.txt"

with open(filename, mode = 'w') as f:
    for point in d:
        f.write(str(point) + '\n')
```

1.2 2. (done) Create a random matrix of 5x5 and then save it to a text file named "data.txt"

[17]:
```
matrix = np.array([[np.random.random() for _ in range(5)] for _ in range(5)])
#print(matrix)

# Manual way
filename = "simple_matrix.txt"
with open(filename, mode = 'w') as f:
    for row_idx in range(matrix.shape[0]):
        for col_idx in range(matrix.shape[1]):
            f.write(str(matrix[row_idx, col_idx]) + ',')
        f.write('\n')

#Numpy automatic way
filename = "simple_matrix_numpy.txt"
np.savetxt(fname= filename, X = matrix)
```

```
[[0.1860355  0.61307529 0.05353184 0.48756715 0.38687207]
 [0.83841886 0.05152655 0.39196464 0.37101173 0.28974222]
 [0.84502642 0.5843666  0.68215965 0.60974911 0.59934688]
 [0.8320256  0.83280161 0.2834097  0.28216093 0.54109529]
 [0.38339302 0.96138523 0.00962801 0.3743062  0.97296634]]
```

1.3 3. (done) Load the saved txt file of point 2 and convert it to a csv file (by hand)

[41]:
```
input_filename = "simple_matrix_numpy.txt" # here separator = ' '
matrix = np.zeros((5,5))

# Load the matrix
row_idx =0
with open(input_filename, mode = 'r') as f:
    for line in f:
        # line is a str
        # numbers is a list of str
        numbers = line.rstrip('\n').split(sep= ' ')
        matrix[row_idx, :] = numbers
        row_idx += 1
print(matrix)

# Save the matrix as .csv
filename = "simple_matrix.csv"
with open(filename, mode = 'w') as f:
    for row_idx in range(matrix.shape[0]):
        for col_idx in range(matrix.shape[1]):
            f.write(str(matrix[row_idx, col_idx]) + ',')
        f.write('\n')

#There is no built in function for .csv saving in numpy. The alternative is to␣
 ↪use Pandas
```

```
[[0.1860355  0.61307529 0.05353184 0.48756715 0.38687207]
 [0.83841886 0.05152655 0.39196464 0.37101173 0.28974222]
 [0.84502642 0.5843666  0.68215965 0.60974911 0.59934688]
 [0.8320256  0.83280161 0.2834097  0.28216093 0.54109529]
 [0.38339302 0.96138523 0.00962801 0.3743062  0.97296634]]
```

1.4 4. - 5. (done) Credit Cards Exercise

- Load the binary file named *credit_card.dat* and convert the data into the real credit-card number.

  Consider that:

  - Each **line** correspond to a credit card number
  - Each character (also the space) is encoded with a string of 6 bit.

  - The newline character occupies 1 bit (try to believe)
  - The last 4 bit of the file are a padding

  hint: use the `chr()` function to convert a number to a char

- Load the file "user_data.json", filter the data by the "CreditCardType" field equals to "American Express". Than save the data a to CSV.

[44]:
```
# Methods for removing trailing strings

line = '00110110000110100111100110'
line_left = line.lstrip('01') # removes all combinations of 0 an 1: then␣
 ↪removes the whole string!!
line_left
line_left_prefix = line.removeprefix('001')
line_left_prefix

# there are also rstrip() and remove.suffix()
```

[44]:
```
'101100011010011110110'
```

[71]:
```
padding = "1010"
line =␣
 ↪"1100111100001100101101101000001101111100111111000110000100000110001110010110100110001100000
clean_line = line.removesuffix(padding)
print(clean_line)
# check if line contains a valid credit card number
if clean_line:
    encoded_chars = [clean_line[i:(i + 6)] for i in range(0, len(clean_line),␣
 ↪6)]
    # decode the bit string into characters:
    # first step: convert the binary string into a decimal number;
    # second step: call chr() to retrieve the UTC8 encoded character
    decoded_chars = [chr(int(c, 2)) for c in encoded_chars]
print(encoded_chars)
print(decoded_chars)
```

```
110011110000110010110110100000110111110011111000110000100000110001110010110100110
000110000011000111000011100011010 0
['110011', '110000', '110010', '110110', '100000', '110111', '110011', '111000',
'110000', '100000', '110001', '110010', '110100', '110001', '100000', '110001',
'110000', '111000', '110100']
['3', '0', '2', '6', ' ', '7', '3', '8', '0', ' ', '1', '2', '4', '1', ' ', '1',
'0', '8', '4']
```

[80]:
```
filename = "credit_card.dat"

# By manual inspection of the file, I see that:
# There are 50 credit cards -> 50+1 = 51 newline characters
```

```
# There is a padding: trailing chars at end of each line, also written in the␣
 ↪last line
padding = '1010'

# Now i want to know how many characters form a credit card number
with open(filename, mode= 'r') as f:
    file_content = f.read()

lines_num = 51
total_bits = len(file_content) # total number of digits
# (\n = 1 bit)
valid_bits = total_bits - lines_num * len(padding) - (lines_num - 1) * 1
card_bits = valid_bits / 50
card_length = card_bits/6

print("total bits:", total_bits)
print("valid bits (excluded padding and newlines):", valid_bits)
print("card bits:", card_bits)
print("card length (spaces included):", card_length)


binary_cards = []
id = 0
with open(filename, mode= 'r') as f:
    for line in f:
        clean_line = line[: -5] # removes "1010\n" at end of string
        # tried with line.removesuffix("1010\n") and line.removesuffix("1010")␣
 ↪but does nothing
        # check if line contains a valid credit card number
        if clean_line:
            encoded_chars = [clean_line[i:(i + 6)] for i in range(0,␣
 ↪len(clean_line), 6)]
            # decode the bit string into characters:
            # first step: convert the binary string into a decimal number;
            # second step: call chr() to retrieve the UTC8 encoded character
            decoded_chars = [chr(int(c, 2)) for c in encoded_chars]
            binary_cards.append( ''.join(decoded_chars))
            id += 1


binary_cards
output_filename = "decoded_credit_cards.txt"
with open(output_filename, mode = 'w') as f:
    for card in binary_cards:
        f.write(card + '\n')
f.close()
```

```
total bits: 5954
valid bits (excluded padding and newlines): 5700
card bits: 114.0
card length (spaces included): 19.0
```

[95]:
```python
import json
data = json.load(open('user_data.json'))
#print (data) # type(data) = list

#for i in range(len(data)):
#    print(data[i]['FirstNameLastName'])

filtered_data = []
for i in range(len(data)):
    if data[i]['CreditCardType'] == "American Express":
        filtered_data.append(data[i])
filtered_data
```

[95]:
```
[{'ID': '2',
  'JobTitle': 'Investment  Advisor',
  'EmailAddress': 'Clint_Thorpe5003@bulaffy.com',
  'FirstNameLastName': 'Clint Thorpe',
  'CreditCard': '7083-8766-0251-2345',
  'CreditCardType': 'American Express'},
 {'ID': '12',
  'JobTitle': 'Retail Trainee',
  'EmailAddress': 'Phillip_Carpenter9505@famism.biz',
  'FirstNameLastName': 'Phillip Carpenter',
  'CreditCard': '3657-0088-0820-5247',
  'CreditCardType': 'American Express'},
 {'ID': '28',
  'JobTitle': 'Project Manager',
  'EmailAddress': 'Russel_Graves1378@extex.org',
  'FirstNameLastName': 'Russel Graves',
  'CreditCard': '6718-4818-8011-6024',
  'CreditCardType': 'American Express'},
 {'ID': '39',
  'JobTitle': 'Stockbroker',
  'EmailAddress': 'Leanne_Newton1268@typill.biz',
  'FirstNameLastName': 'Leanne Newton',
  'CreditCard': '5438-0816-4166-4847',
  'CreditCardType': 'American Express'},
 {'ID': '57',
  'JobTitle': 'Budget Analyst',
  'EmailAddress': 'Tony_Giles1960@iatim.tech',
  'FirstNameLastName': 'Tony Giles',
  'CreditCard': '8130-3425-7573-7745',
```

```
 'CreditCardType': 'American Express'},
{'ID': '62',
 'JobTitle': 'CNC Operator',
 'EmailAddress': 'Owen_Allcott5125@bauros.biz',
 'FirstNameLastName': 'Owen Allcott',
 'CreditCard': '4156-0107-7210-2630',
 'CreditCardType': 'American Express'},
{'ID': '68',
 'JobTitle': 'Project Manager',
 'EmailAddress': 'Liam_Lynn3280@kideod.biz',
 'FirstNameLastName': 'Liam Lynn',
 'CreditCard': '7152-3247-6053-2233',
 'CreditCardType': 'American Express'},
{'ID': '74',
 'JobTitle': 'Dentist',
 'EmailAddress': 'Regina_Woodcock5820@yahoo.com',
 'FirstNameLastName': 'Regina Woodcock',
 'CreditCard': '0208-1753-3870-8002',
 'CreditCardType': 'American Express'},
{'ID': '81',
 'JobTitle': 'HR Specialist',
 'EmailAddress': 'Carter_Wallace9614@atink.com',
 'FirstNameLastName': 'Carter Wallace',
 'CreditCard': '4256-7201-6717-4322',
 'CreditCardType': 'American Express'},
{'ID': '92',
 'JobTitle': 'Staffing Consultant',
 'EmailAddress': 'Maia_Stark2797@jiman.org',
 'FirstNameLastName': 'Maia Stark',
 'CreditCard': '3851-1403-1734-6321',
 'CreditCardType': 'American Express'},
{'ID': '97',
 'JobTitle': 'Stockbroker',
 'EmailAddress': 'Ciara_Lomax982@bauros.biz',
 'FirstNameLastName': 'Ciara Lomax',
 'CreditCard': '3702-3440-2472-5424',
 'CreditCardType': 'American Express'},
{'ID': '116',
 'JobTitle': 'Staffing Consultant',
 'EmailAddress': 'Isabel_Ellwood1475@fuliss.net',
 'FirstNameLastName': 'Isabel Ellwood',
 'CreditCard': '3738-0882-0066-6683',
 'CreditCardType': 'American Express'},
{'ID': '148',
 'JobTitle': 'CNC Operator',
 'EmailAddress': 'Abdul_Townend2202@infotech44.tech',
 'FirstNameLastName': 'Abdul Townend',
```

```
 'CreditCard': '4224-1226-3557-3448',
 'CreditCardType': 'American Express'},
{'ID': '150',
 'JobTitle': 'Fabricator',
 'EmailAddress': 'Caleb_Poulton1735@atink.com',
 'FirstNameLastName': 'Caleb Poulton',
 'CreditCard': '8203-6875-5225-0341',
 'CreditCardType': 'American Express'},
{'ID': '151',
 'JobTitle': 'Restaurant Manager',
 'EmailAddress': 'Ronald_Lewis6777@deavo.com',
 'FirstNameLastName': 'Ronald Lewis',
 'CreditCard': '7212-0155-5014-8471',
 'CreditCardType': 'American Express'},
{'ID': '154',
 'JobTitle': 'Bellman',
 'EmailAddress': 'Faith_Seymour3829@twace.org',
 'FirstNameLastName': 'Faith Seymour',
 'CreditCard': '4170-5186-6887-6558',
 'CreditCardType': 'American Express'},
{'ID': '169',
 'JobTitle': 'Assistant Buyer',
 'EmailAddress': 'Anthony_Hancock9083@qater.org',
 'FirstNameLastName': 'Anthony Hancock',
 'CreditCard': '0832-3357-6010-6550',
 'CreditCardType': 'American Express'},
{'ID': '176',
 'JobTitle': 'Healthcare Specialist',
 'EmailAddress': 'Isabella_Willson5478@nanoff.biz',
 'FirstNameLastName': 'Isabella Willson',
 'CreditCard': '5177-4868-4623-0384',
 'CreditCardType': 'American Express'},
{'ID': '182',
 'JobTitle': 'Pharmacist',
 'EmailAddress': 'Stephanie_Darcy3298@bauros.biz',
 'FirstNameLastName': 'Stephanie Darcy',
 'CreditCard': '0264-4020-5106-5576',
 'CreditCardType': 'American Express'},
{'ID': '199',
 'JobTitle': 'Investment  Advisor',
 'EmailAddress': 'Ryan_Kennedy5565@corti.com',
 'FirstNameLastName': 'Ryan Kennedy',
 'CreditCard': '3166-6287-6242-7207',
 'CreditCardType': 'American Express'}]
```

[108]:
```
columns = list(filtered_data[0].keys())
columns
```

```
values = list(filtered_data[0].values())
values

output_filename = "american_express_user_data.csv"
with open(output_filename, mode = "w") as f:
    #write header
    for col in columns[:-1]:
        f.write(col + ", ")
    f.write(columns[-1] + "\n")
    # write users data
    for user_idx in range(len(filtered_data)):
        values = list(filtered_data[user_idx].values())
        for val in values[:-1]:
            f.write(val + ", ")
        f.write(val[-1] + '\n')
f.close()
```

1.5 6. (done)

Load the file from this url: https://www.dropbox.com/s/7u3lm737ogbqsg8/mushrooms_categorized.csv?dl=1 with Pandas. + Explore the data (see the info of the data) + Draw the istogram of the 'class' field. Decribe wath yuou see

[ ]:
```
# Method 1: download manually, move into pwd, initialize pandas df from .csv
! cp /Users/miriamzara/Downloads/mushrooms_categorized.csv /Users/miriamzara/
 ↪LaboratoryOfComputationalPhysics_Y7/05_Lab_OSEMN/mushrooms_categorized.csv
```

[3]:
```
import pandas as pd
df = pd.read_csv("mushrooms_categorized.csv")
df.head()
```

[3]:

	class	cap-shape	cap-surface	cap-color	bruises	odor	gill-attachment	\
0	1	5	2	4	1	6	1	
1	0	5	2	9	1	0	1	
2	0	0	2	8	1	3	1	
3	1	5	3	8	1	6	1	
4	0	5	2	3	0	5	1	

	gill-spacing	gill-size	gill-color	…	stalk-surface-below-ring	\
0	0	1	4	…	2	
1	0	0	4	…	2	
2	0	0	5	…	2	
3	0	1	5	…	2	
4	1	0	4	…	2	

	stalk-color-above-ring	stalk-color-below-ring	veil-type	veil-color	\
0	7	7	0	2	

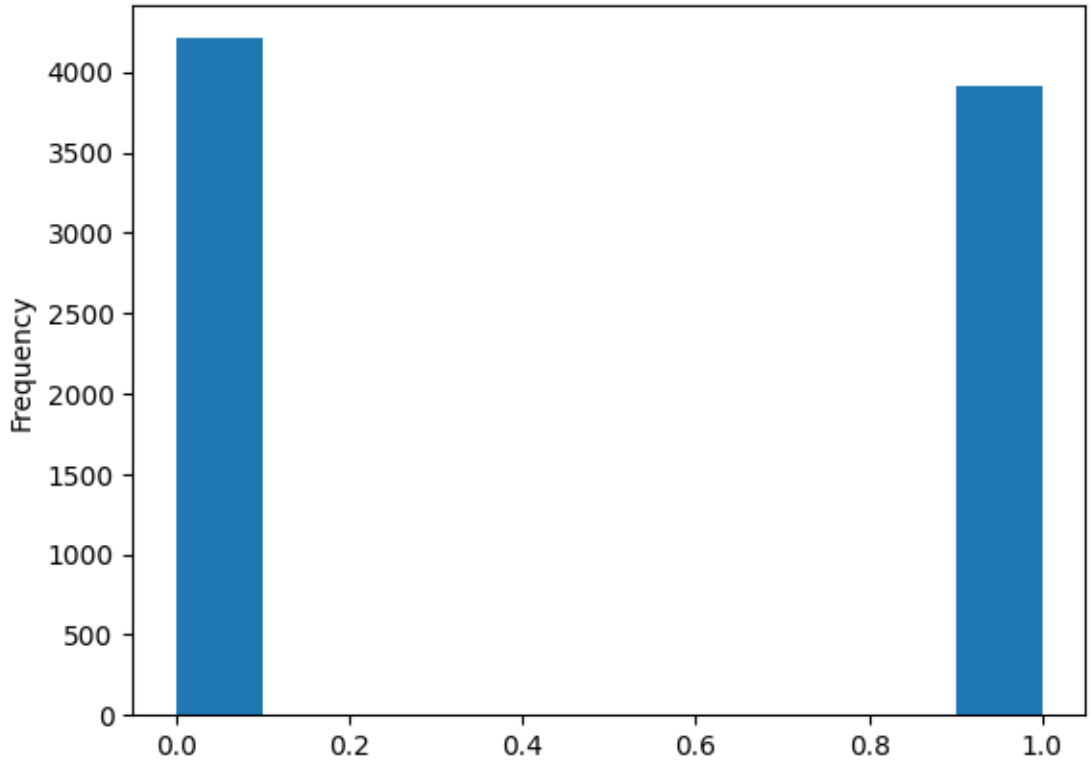
```
1                        7                        7          0          2
2                        7                        7          0          2
3                        7                        7          0          2
4                        7                        7          0          2

   ring-number  ring-type  spore-print-color  population  habitat
0            1          4                  2           3        5
1            1          4                  3           2        1
2            1          4                  3           2        3
3            1          4                  2           3        5
4            1          0                  3           0        1

[5 rows x 23 columns]
```

[4]:
```
df["class"].plot(kind= "hist") # pandas DataFrame.plot() is just a wrapper␣
↪around pyplot.plot()
```

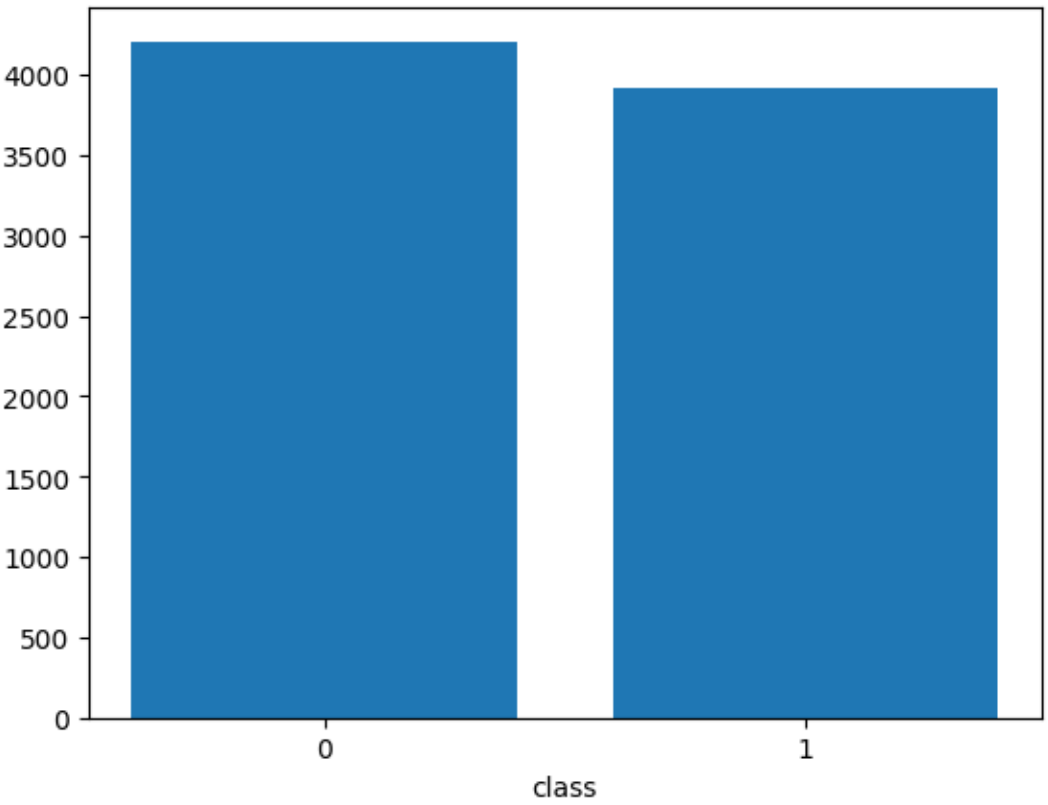
[4]:
```
<Axes: ylabel='Frequency'>
```



I see that the field “class” is actually binary, so the above plot is not the best suited one. I will put in a little more effor to realize a histo plot with only two bins.

[15]:
```
import matplotlib.pyplot as plt
import numpy as np
counts, bins = np.histogram(df["class"], bins = 2)
centers = [0.25, 0.75]
plt.bar(x = centers, height= counts, width = 0.4)
plt.xticks(ticks= centers, labels= ["0", "1"])
plt.xlabel("class")
```

[15]:
```
Text(0.5, 0, 'class')
```



1.6 7. (done)

Load the remote file https://www.dropbox.com/s/vkl89yce7xjdq4n/regression_generated.csv?dl=1 with Pandas and plot a scatter plot all possible combination of the following fields:

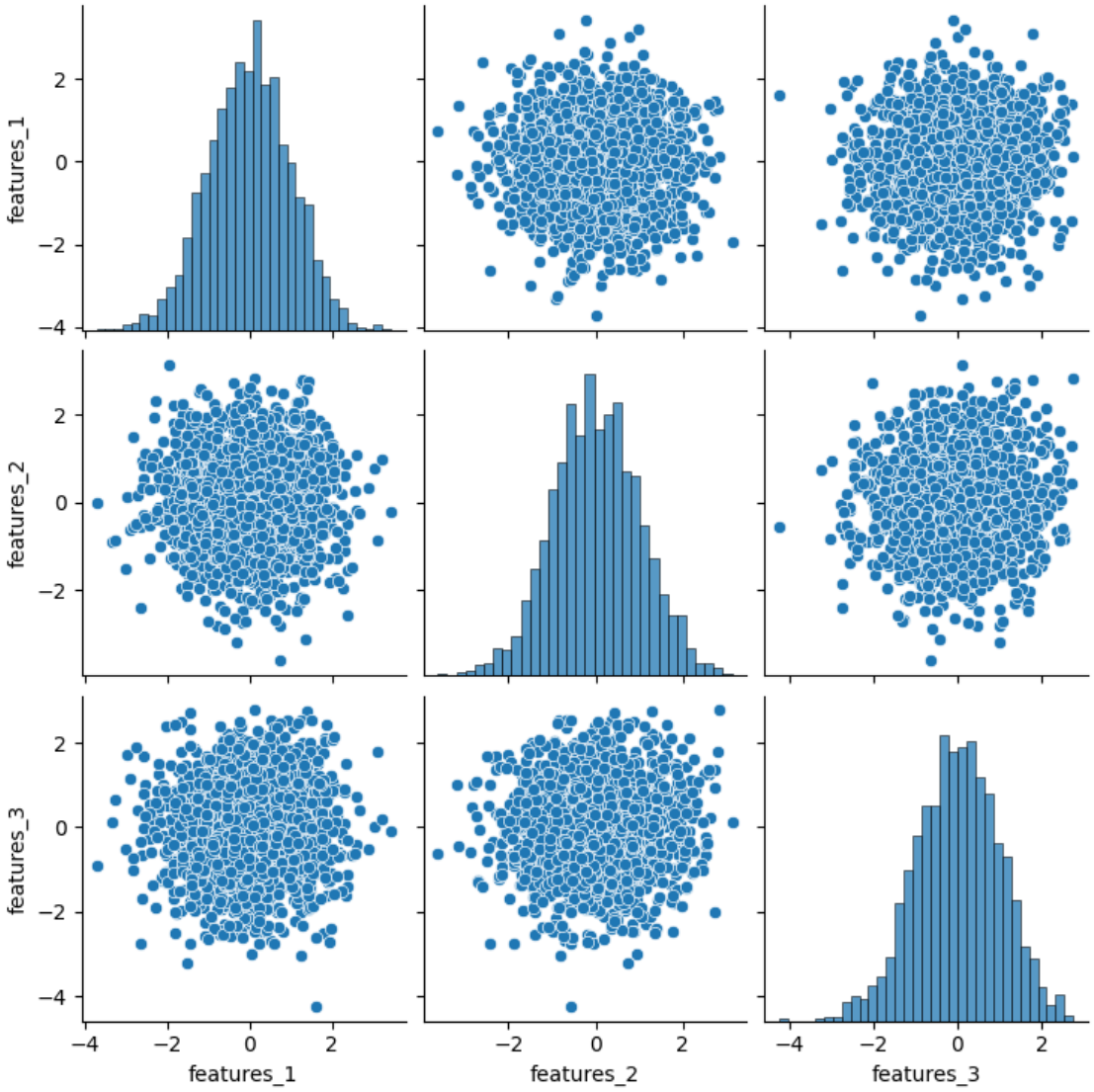
- features_1
- features_2
- features_3

[17]:
```
! cp /Users/miriamzara/Downloads/regression_generated.csv regression_generated.
↪cscv
```

[20]:
```
df = pd.read_csv("regression_generated.cscv")
df.head()
reduced_df = df[['features_1', 'features_2', 'features_3']].copy()
```

[23]:
```
import seaborn as sns
sns.pairplot(reduced_df)
```

[23]: <seaborn.axisgrid.PairGrid at 0x16c6f3290>



There does not seem to be any visible correlation

1.7 8. (done)

Load the same file of point 6, and convert the file to json with Pandas.

[29]:
```
df = pd.read_csv("regression_generated.cscv")
df.to_json(path_or_buf= "regression_generated.json", orient= 'index') # various␣
 ↪options for formatting
```

[30]:
```
new_df = pd.read_json("regression_generated.json", orient= 'index')
new_df.head()
```

[30]:

	label	features_1	features_2	features_3	features_4	features_5	\
0	-89.243497	2.175170	-0.285786	-0.603396	-0.627453	-0.686474	
1	230.050125	1.481941	-1.327870	-0.543583	-0.303578	1.552964	
2	-286.844411	-1.154394	-0.178649	-1.636646	0.239353	-0.684994	
3	364.552862	0.197665	1.455707	1.562205	2.168207	0.053335	
4	515.460006	0.596676	0.969860	1.294158	-0.404728	2.145297	

	features_6	features_7	features_8	features_9	…	features_11	\
0	0.381067	0.306205	-0.637447	-1.332087	…	1.290725	
1	0.549738	-0.763094	-0.455796	2.053388	…	-1.761306	
2	0.587201	-0.209564	-0.428956	-0.757998	…	0.374645	
3	0.790492	-0.212023	-1.142483	-1.124906	…	0.712160	
4	0.997481	-0.541670	-0.952850	-0.592084	…	-1.347072	

	features_12	features_13	features_14	features_15	features_16	\
0	1.047483	-1.055467	0.853204	0.038665	-0.752959	
1	-0.934284	-1.050999	0.444026	-0.037959	1.061624	
2	-1.702189	-0.014514	-0.711557	-0.558523	-1.204526	
3	-2.844936	0.483994	-0.694294	1.349605	-1.303414	
4	0.243422	0.290336	0.798331	0.876428	-0.366807	

	features_17	features_18	features_19	features_20
0	0.577920	-0.657400	1.367308	0.570199
1	-1.569870	2.410696	1.113594	2.329479
2	0.234989	0.398384	-0.236555	0.642003
3	0.161987	0.754084	1.248258	-1.466045
4	-0.119534	0.892320	-0.806912	0.736080

[5 rows x 21 columns]