

## ✓ Hands-on Activity 6.1 Introduction to Data Analysis and Tools

CPE311 Computational Thinking with Python

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**Section:** CPE22S3

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### 6.1 Intended Learning Outcome

1. Use pandas and numpy data analysis tools.
2. Demonstrate how to analyze data using numpy and pandas

### 6.2 Resources:

- Personal Computer
- Jupyter Notebook
- Internet Connection

### 6.3 Supplementary Activities:

#### Exercise 1

Run the given code below for exercises 1 and 2, perform the given tasks without using any Python modules

```
1 import random
2 random.seed(0)
3 salaries = [round(random.random()*1000000, -3) for _ in range(100)]
```

Using the data generated above, calculate the following statistics without importing anything from the statistics module in the standard library (<https://docs.python.org/3/library/statistics.html>) and then confirm your results match up to those that are obtained when using the statistics module (where possible):

- Mean
- Median
- Mode (hint: check out the Counter in the collections module of the standard library at <https://docs.python.org/3/library/collections.html#collections.Counter>)
- Sample variance
- Sample standard deviation

```
1 #Write a comment per statistical function
2
3 def mean(dataset):
4     # Calculate mean by the sum of all dataset
5     #divided by the number of the data
6     return sum(dataset)/len(dataset)
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8 #To test
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```

```

1 import collections
2
3 def mode(dataset):
4     #create a dictionary-like object that count the occurrence of each unique element in the dataset.
5     # the .most_common() method sort the element by frequency in descending order and return them as a list of tuple.
6     modes = collections.Counter(dataset).most_common()
7
8     #the indexing retrieves the most common element(mode) from the sorted list
9     return modes[0][0]
10
11 #To test
12 mode(salaries)

```

477000.0

```

1 def sample_variance(dataset):
2     n = len(dataset)
3     mean = sum(dataset) / n
4
5     # Calculate the squared deviations
6     squared_deviations = [(x - mean) ** 2 for x in dataset]
7
8     # Sum up the squared deviations
9     sum_squared_deviations = sum(squared_deviations)
10
11     # Compute sample variance
12     sample_variance = sum_squared_deviations / (n - 1)
13     return sample_variance
14
15 #To test:
16 var = sample_variance(salaries)
17 #Display the sample variance with 6 decimal places
18 print(f"{var:.6f}")

```

70664054444.444443

```

1 def sample_std(dataset):
2     n = len(dataset)
3     mean = sum(dataset)/n
4
5     # Calculate the squared deviations
6     squared_deviations = [(x - mean) ** 2 for x in dataset]
7
8     # Sum up the squared deviations
9     sum_squared_deviations = sum(squared_deviations)
10
11     # Compute sample variance
12     sample_std = (sum_squared_deviations / (n - 1))**0.5
13     return sample_std
14
15 #To test:
16 std = sample_std(salaries)
17 #Display the sample standard deviation with 6 decimal places
18 print(f"{std:.6f}")

```

265827.113825

## Exercise 2

Using the same data, calculate the following statistics using the functions in the statistics module where appropriate:

- Range
- Coefficient of variation
- Interquartile range
- Quartile coefficient of dispersion

```

1 #Write a comment per statistical function
2
3 import statistics
4
5 def calc_range(dataset):
6     #To check if the data set contains at least two values
7     if len(dataset)< 2:
8         raise ValueError("The data must contain at least two values.")
9
10    #Compute the range by subtracting the maximum and minimum value of the dataset.
11    return max(dataset)- min(dataset)
12
13 range_value = calc_range(salaries)
14 print(f" The range value is {range_value:.2f}")

```

The range value is 995000.00

```

1 from statistics import stdev,mean
2
3 def calc_COV(dataset):
4     #Compute the coefficient variation by calculating
5     # the standard deviation over the mean of the dataset
6     COV = stdev(dataset)/mean(dataset)
7
8     #Convert the COV in percentage
9     P_COV = COV * 100
10
11 calc_COV = print(f" Coefficient of Variation: {COV}\n COV in Percentage : {P_COV:.2f}")
12 return calc_COV
13
14 #To test:
15 calc_COV(salaries)

    Coefficient of Variation: 0.45386998894439035
    COV in Percentage : 45.39


1 from statistics import quantiles
2 # Computation for interquartile range
3 # 1st step
4 def calc_quartiles(dataset):
5
6     #use the .quantiles() module in which .quantiles(data, n=4 )
7     #Divide data into n continuous intervals with equal probability.
8     #Returns a list of n - 1 cut points separating the intervals.
9     quartiles = quantiles(dataset, n = 4)
10
11     return quartiles
12
13 #To test:
14 calc_quartiles(salaries)
15
16

    [400500.0, 589000.0, 822250.0]


1 # 2nd Step
2 def calc_IQR(dataset):
3     #Assign a variable for the quartile list.
4     Qlist = quantiles(dataset)
5
6     #Compute for Interquartile Range where IQR = Q3 -Q1
7     calc_IQR = Qlist[-1]- Qlist[0]
8     return calc_IQR
9
10 #To test:
11 calc_IQR(salaries)

    421750.0


1 def calc_QCD(dataset):
2
3     #Assign a variable for the quartile list.
4     Qlist = quantiles(dataset)
5
6     #compute for Quartile Coefficient of Dispersion where
7     #QCD = (Q3-Q1)/(Q3+Q1) * 100
8     #use the calc_IQR for the numerator
9     QCD = calc_IQR(dataset)/(Qlist[-1]+ Qlist[0])
10
11     #Convert the QCD in percentage
12     P_QCD = QCD * 100
13
14     #Display the value of QCD
15     calc_QCD = print(f"Quartile Coefficient of Dispersion: {QCD} \nQCD in Percentage: {P_QCD:.6f} %")
16
17     return calc_QCD
18
19 calc_QCD(salaries)
20

    Quartile Coefficient of Dispersion: 0.34491923941934166
    QCD in Percentage: 34.491924 %

```

### Exercise 3: Pandas for Data Analysis

Load the diabetes.csv file. Convert the diabetes.csv into dataframe Perform the following tasks in the diabetes dataframe:

1. Identify the column names
2. Identify the data types of the data
3. Display the total number of records
4. Display the first 20 records
5. Display the last 20 records
6. Change the Outcome column to Diagnosis
7. Create a new column Classification that display "Diabetes" if the value of outcome is 1 , otherwise "No Diabetes"
8. Create a new dataframe "withDiabetes" that gathers data with diabetes

9. . Create a new dataframe "noDiabetes" thats gathers data with no diabetes
10. Create a new dataframe "Pedia" that gathers data with age 0 to 19
11. Create a new dataframe "Adult" that gathers data with age greater than 19
12. Use numpy to get the average age and glucose value.
13. Use numpy to get the median age and glucose value.
14. Use numpy to get the middle values of glucose and age
15. Use numpy to get the standard deviation of the skinthickness.

1 # Indicate which item you're answering with a comment

```
1 #Uploading diabetes.csv file and converting dataframe
2 filepath = '/content/diabetes.csv'
3 import numpy as np
4 import pandas as pd
5 data = pd.read_csv(filepath)
6
7 data
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1
...	...	...	...	...	...	...	...	...	...
763	10	101	76	48	180	32.9	0.171	63	0
764	2	122	70	27	0	36.8	0.340	27	0
765	5	121	72	23	112	26.2	0.245	30	0
766	1	126	60	0	0	30.1	0.349	47	1
767	1	93	70	31	0	30.4	0.315	23	0

768 rows x 9 columns

Next steps: [View recommended plots](#)

```
1 #converting the data as dataframe
2 exercise_df = pd.DataFrame(data)
3 exercise_df
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1
...	...	...	...	...	...	...	...	...	...
763	10	101	76	48	180	32.9	0.171	63	0
764	2	122	70	27	0	36.8	0.340	27	0
765	5	121	72	23	112	26.2	0.245	30	0
766	1	126	60	0	0	30.1	0.349	47	1
767	1	93	70	31	0	30.4	0.315	23	0

768 rows x 9 columns

Next steps: [View recommended plots](#)

```
1 #1. Identify the column names
2 exercise_df = pd.DataFrame(data)
3 exercise_df.columns

Index(['Pregnancies', 'Glucose', 'BloodPressure', 'SkinThickness', 'Insulin',
      'BMI', 'DiabetesPedigreeFunction', 'Age', 'Outcome'],
      dtype='object')
```

```
1 #2. Identify the data types of the data
2 exercise_df = pd.DataFrame(data)
3 exercise_df.dtypes
```

```
Pregnancies      int64
Glucose           int64
BloodPressure     int64
SkinThickness     int64
Insulin           int64
BMI               float64
```

```
DiabetesPedigreeFunction    float64
Age                          int64
Outcome                     int64
dtype: object
```

```
1 #3. Display the total number of records
2 exercise_df = pd.DataFrame(data)
3 len(exercise_df)
```

768

```
1 #4 Display the first 20 records
2 exercise_df.iloc[:20]
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1
5	5	116	74	0	0	25.6	0.201	30	0
6	3	78	50	32	88	31.0	0.248	26	1
7	10	115	0	0	0	35.3	0.134	29	0
8	2	197	70	45	543	30.5	0.158	53	1
9	8	125	96	0	0	0.0	0.232	54	1
10	4	110	92	0	0	37.6	0.191	30	0
11	10	168	74	0	0	38.0	0.537	34	1
12	10	139	80	0	0	27.1	1.441	57	0
13	1	189	60	23	846	30.1	0.398	59	1
14	5	166	72	19	175	25.8	0.587	51	1
15	7	100	0	0	0	30.0	0.484	32	1
16	0	118	84	47	230	45.8	0.551	31	1
17	7	107	74	0	0	29.6	0.254	31	1
18	1	103	30	38	83	43.3	0.183	33	0
19	1	115	70	30	96	34.6	0.529	32	1

```
1 #5.Display the last 20 records
2 exercise_df.iloc[-20:]
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
748	3	187	70	22	200	36.4	0.408	36	1
749	6	162	62	0	0	24.3	0.178	50	1
750	4	136	70	0	0	31.2	1.182	22	1
751	1	121	78	39	74	39.0	0.261	28	0
752	3	108	62	24	0	26.0	0.223	25	0
753	0	181	88	44	510	43.3	0.222	26	1
754	8	154	78	32	0	32.4	0.443	45	1
755	1	128	88	39	110	36.5	1.057	37	1
756	7	137	90	41	0	32.0	0.391	39	0
757	0	123	72	0	0	36.3	0.258	52	1
758	1	106	76	0	0	37.5	0.197	26	0
759	6	190	92	0	0	35.5	0.278	66	1
760	2	88	58	26	16	28.4	0.766	22	0
761	9	170	74	31	0	44.0	0.403	43	1
762	9	89	62	0	0	22.5	0.142	33	0
763	10	101	76	48	180	32.9	0.171	63	0
764	2	122	70	27	0	36.8	0.340	27	0
765	5	121	72	23	112	26.2	0.245	30	0
766	1	126	60	0	0	30.1	0.349	47	1
767	1	93	70	31	0	30.4	0.315	23	0

```
1 #6. Change the Outcome column to Diagnosis
2 exercise_df.rename(columns={"Outcome":"Diagnosis"})
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Diagnosis
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1
...	...	...	...	...	...	...	...	...	...
763	10	101	76	48	180	32.9	0.171	63	0
764	2	122	70	27	0	36.8	0.340	27	0
765	5	121	72	23	112	26.2	0.245	30	0
766	1	126	60	0	0	30.1	0.349	47	1
767	1	93	70	31	0	30.4	0.315	23	0

768 rows x 9 columns

```
1 #7. Create a new column Classification that display "Diabetes" if the value of outcome is 1 , otherwise "No Diabetes"
2 exercise_df['Classification'] = exercise_df['Outcome'].apply(lambda x: 'Diabetes' if x ==1 else 'No Diabetes')
3 exercise_df
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome	C
0	6	148	72	35	0	33.6	0.627	50	1	
1	1	85	66	29	0	26.6	0.351	31	0	
2	8	183	64	0	0	23.3	0.672	32	1	
3	1	89	66	23	94	28.1	0.167	21	0	
4	0	137	40	35	168	43.1	2.288	33	1	
...	...	...	...	...	...	...	...	...	...	...
763	10	101	76	48	180	32.9	0.171	63	0	
764	2	122	70	27	0	36.8	0.340	27	0	
765	5	121	72	23	112	26.2	0.245	30	0	
766	1	126	60	0	0	30.1	0.349	47	1	
767	1	93	70	31	0	30.4	0.315	23	0	

768 rows x 10 columns

Next steps: [View recommended plots](#)

```
1 #8. Create a new dataframe "withDiabetes" that gathers data with diabetes
2 withDiabetes = exercise_df[exercise_df['Classification']=='Diabetes']
3 withDiabetes
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome	C
0	6	148	72	35	0	33.6	0.627	50	1	
2	8	183	64	0	0	23.3	0.672	32	1	
4	0	137	40	35	168	43.1	2.288	33	1	
6	3	78	50	32	88	31.0	0.248	26	1	
8	2	197	70	45	543	30.5	0.158	53	1	
...	...	...	...	...	...	...	...	...	...	...
755	1	128	88	39	110	36.5	1.057	37	1	
757	0	123	72	0	0	36.3	0.258	52	1	
759	6	190	92	0	0	35.5	0.278	66	1	
761	9	170	74	31	0	44.0	0.403	43	1	
766	1	126	60	0	0	30.1	0.349	47	1	

268 rows x 10 columns

Next steps: [View recommended plots](#)

```
1 #9. Create a new dataframe "noDiabetes" thats gathers data with no diabetes
2 noDiabetes = exercise_df[exercise_df['Classification']!='No Diabetes']
3 noDiabetes
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome	C
1	1	85	66	29	0	26.6	0.351	31	0	
3	1	89	66	23	94	28.1	0.167	21	0	
5	5	116	74	0	0	25.6	0.201	30	0	
7	10	115	0	0	0	35.3	0.134	29	0	
10	4	110	92	0	0	37.6	0.191	30	0	
...	...	...	...	...	...	...	...	...	...	
762	9	89	62	0	0	22.5	0.142	33	0	
763	10	101	76	48	180	32.9	0.171	63	0	
764	2	122	70	27	0	36.8	0.340	27	0	
765	5	121	72	23	112	26.2	0.245	30	0	
767	1	93	70	31	0	30.4	0.315	23	0	

500 rows × 10 columns

Next steps:

[View recommended plots](#)

```
1 #10. Create a new dataframe "Pedia" that gathers data with age 0 to 19
2 Pedia = exercise_df[exercise_df['Age'] <= 19]
3 Pedia
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome	Class
--	-------------	---------	---------------	---------------	---------	-----	--------------------------	-----	---------	-------

```
1 #11. Create a new dataframe "Adult" that gathers data with age greater than 19
2 Adult = exercise_df[exercise_df['Age'] > 19]
3 Adult
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome	C
0	6	148	72	35	0	33.6	0.627	50	1	
1	1	85	66	29	0	26.6	0.351	31	0	
2	8	183	64	0	0	23.3	0.672	32	1	
3	1	89	66	23	94	28.1	0.167	21	0	
4	0	137	40	35	168	43.1	2.288	33	1	
...	...	...	...	...	...	...	...	...	...	
763	10	101	76	48	180	32.9	0.171	63	0	
764	2	122	70	27	0	36.8	0.340	27	0	
765	5	121	72	23	112	26.2	0.245	30	0	
766	1	126	60	0	0	30.1	0.349	47	1	
767	1	93	70	31	0	30.4	0.315	23	0	

768 rows × 10 columns

Next steps:

[View recommended plots](#)

```
1 #12. Use numpy to get the average age and glucose value.
2 #Extraction of ages and glucose value in dataset
3 ages= np.array(exercise_df['Age'])
4 glucose_value =np.array(exercise_df['Glucose'])
5
6 #computing the average value of age and glucose using numpy
7 average_age = np.average(ages)
8 average_glucose =np.average(glucose_value)
9
10 #Display the average value of age as a whole number and
11 #glucose average value into 2 decimal places
12 print(f"Average age:{average_age:.0f} years old")
13 print(f"Average Glucose value: {average_glucose:.2f}")
```

```
Average age:33 years old
Average Glucose value: 120.89
```

```
1 #13.Use numpy to get the median age and glucose value
2 # Using the extraction above we can get the median
3
4 #Compute the median of age and value using numpy
5 median_age = np.median(ages)
6 median_glucose = np.median(glucose_value)
7
8 #Display the median
9 print(f"Median age:{median_age} years old")
10 print(f"Median Glucose value: {median_glucose:.2f}")
```

```
Median age:29.0 years old
Median Glucose value: 117.00
```

```
1 #14.Use numpy to get the middle values of glucose and age
2 #Using the extraction above we can get the middle value
```

```
3 #middle value is the value of a given dataset that is not arranged in order.
4 index = int(len(ages)/2)
5 midage = ages[index]
6 midglucose = glucose_value[index]
7 print("Middle Age: " + str(midage) + " years old")
8 print("Middle Glucose: " + str(midglucose))
9

    Middle Age: 25 years old
    Middle Glucose: 125
```

```
1 #15.Use numpy to get the standard deviation of the skinthickness.
2 skinthickness = np.array(exercise_df['SkinThickness'])
3
4 #compute for the std
5 std_skinthickness = np.std(skinthickness)
6
7 #Display the STD with 6 decimal places
8 print(f"Standard Deviation of SkinThickness: {std_skinthickness:.6f}")

    Standard Deviation of SkinThickness: 15.941829
```