Python

Python Environment

Types Of Variables

- Integer
- Float / double
- String
- Logical / Boolean

Operators

- **Comparison opr.**

  < > <= >= != <> ==

- **Logical Operator**

  and or not

- **Arithmetic opr.**

  + - / ( ) %

While Loop

No { } brackets
Indentation is important

```
while condition:
        executable code1
        executable code2
        executable code3
executable code4
```

```
while condition:
        executable code1
        executable code2
executable code3
executable code4
```

For Loop

```
for i in range(5):
        print('Hello ')
```

```
for j in range(1,10):
        print('Hello :', j)
```

range(begin,end,step)

```
for k in range(10,100,5):
        print( k )
```

If stmt

```
if condition1:
        executable code
elif condition2:
        executable code
else:
        executable code
```

Assignment

Law Of Large Numbers

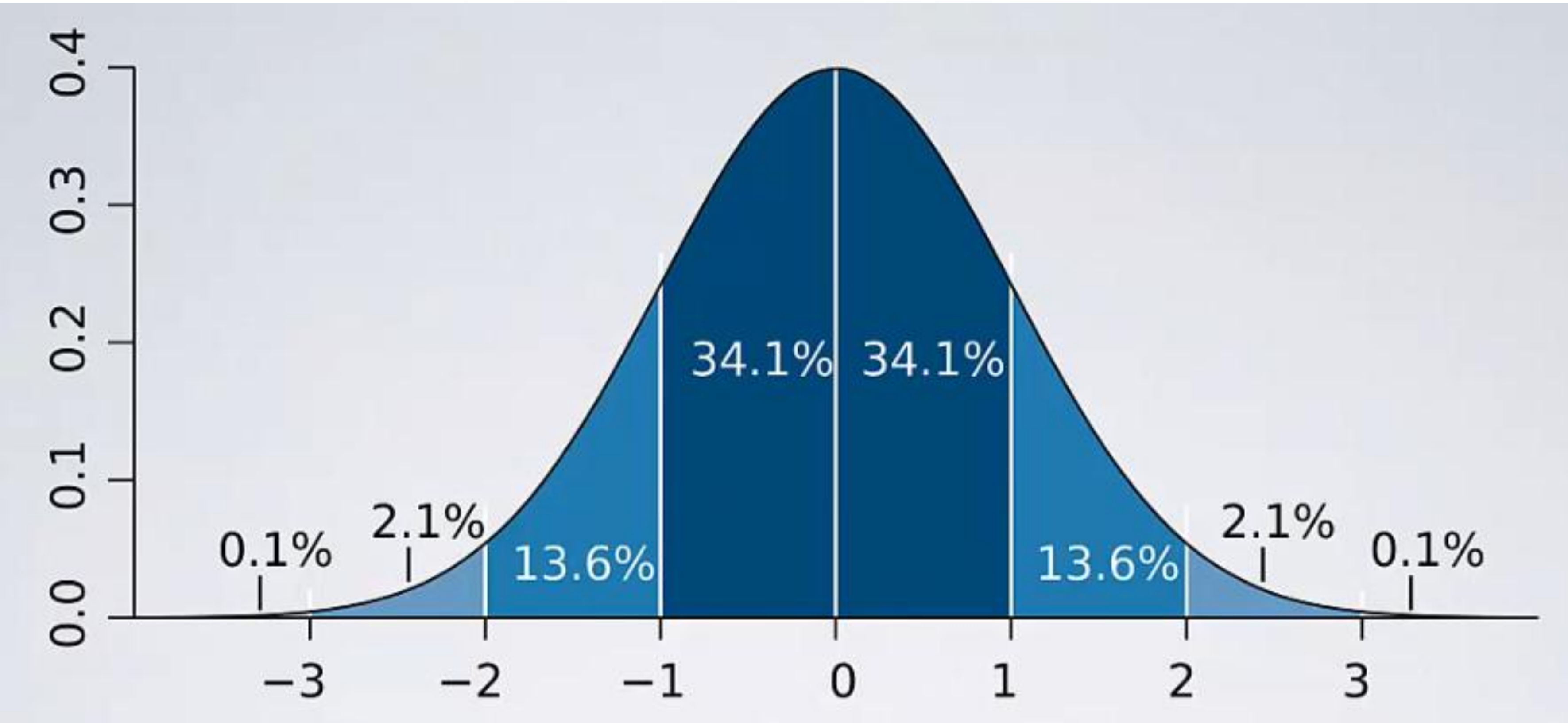
Test The Law OF Large Numbers for N random normally distributed numbers with mean = 0, stdev = 1

Create a Python Script that will count how many of these numbers fall between -1 and 1 and divide by the total quantity of N

E(X) = 68.2%

Check that Mean(Xn) -> E(X) as you rerun your script while increasing N

Assignment

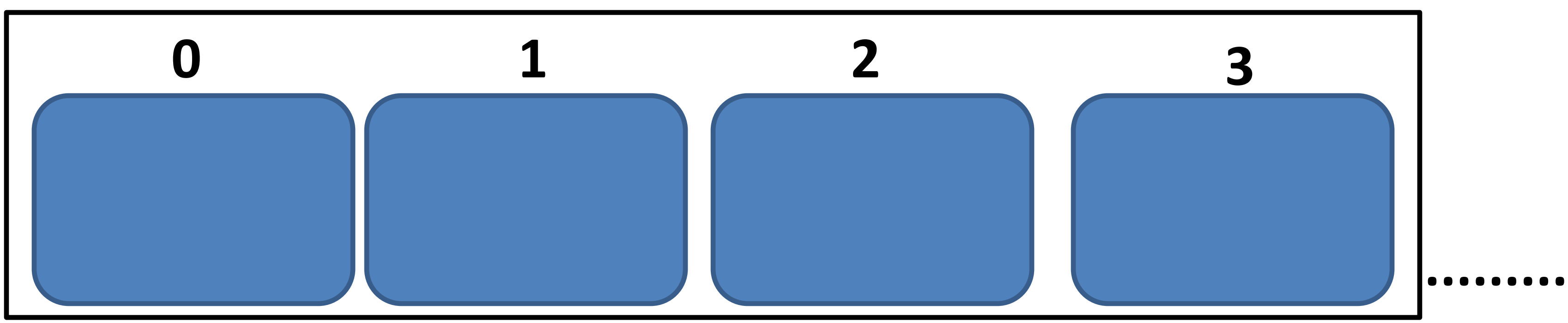


Coin Toss

• 10 :	7/3	70%**H**	30%**T**
• 100:	52/48	52%**H**	48%**T**
• 1000:	502/498	50.2%**H**	49.8%**T**

List

- Like Arrays
- Ordered Sequence of values
- Enumerated starting with zero
- Can be of mixed datatype



List

- list1 = [1,2,3,4,5,6]
- list2 = [‘a’, 55.5, ‘b’,2000]
- list3 = [‘123’,’how are you?’, list2]

list1.append(55)

list1[2] =55

- range(15)
- myList = list(range(10))

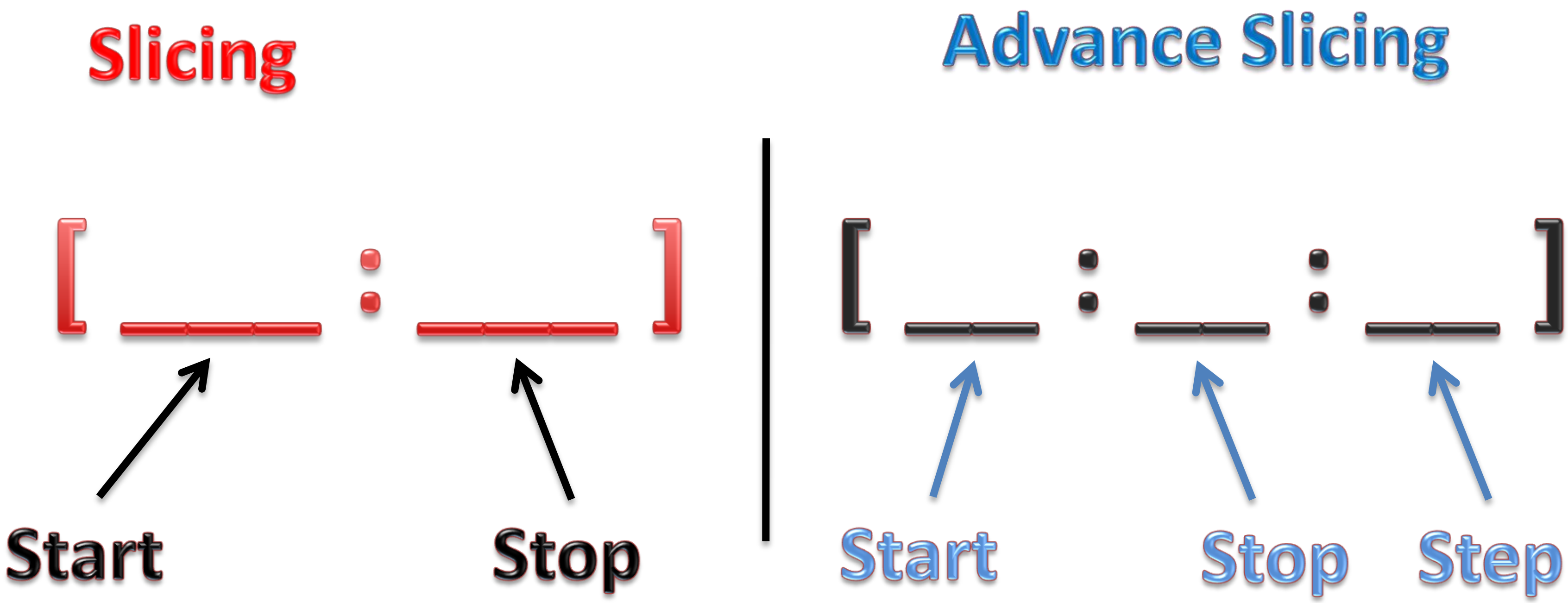
list1.sort()

list1.reverse()

list1.extend(list3)

Slicing

- ➢ **Subset the list**



Slicing

letters

0	1	2	3	4	5	6	7	8	9
A	B	C	D	E	F	G	H	I	J
-10	-9	-8	-7	-6	-5	-4	-3	-2	-1

letters[:]

letters[: 7]

letters[2 :]

letters[2 : 7]

letters[2: 9 : 2]

letters[-8 : 7]

letters[: : 3]

letters[: : -1]

Tuples

- **Immutable list of values**
  - myTuple = (123, 456, 343)
  - myTuple[:]
  - type(myTuple)
  - len(myTuple)
  - myTuple[1] = 777   --error

Assignment

FINANCIAL STATEMENT ANALYSIS

Packages & Modules

- **Modules** in Python are simply **Python files** with a .py extension.
- The name of the module will be the name of the file.
- A Python **module** can have a set of **functions**, **classes** or **variables** defined and implemented.

e.g. Module color (color.py)

Function red()

Function blue()

Function green()

import color

color.red

color.green

OR

from color **import** red

from color **import** *

Packages & Modules

- **Packages** are **namespaces** which contain **multiple packages** and **modules** themselves. They are simply **directories**.

- We create a directory **drawing**

  Include modules in it:

  color, line, rectangle, square, circle

- To use line module from drawing package

  import drawing.line

  from drawing **import** circle

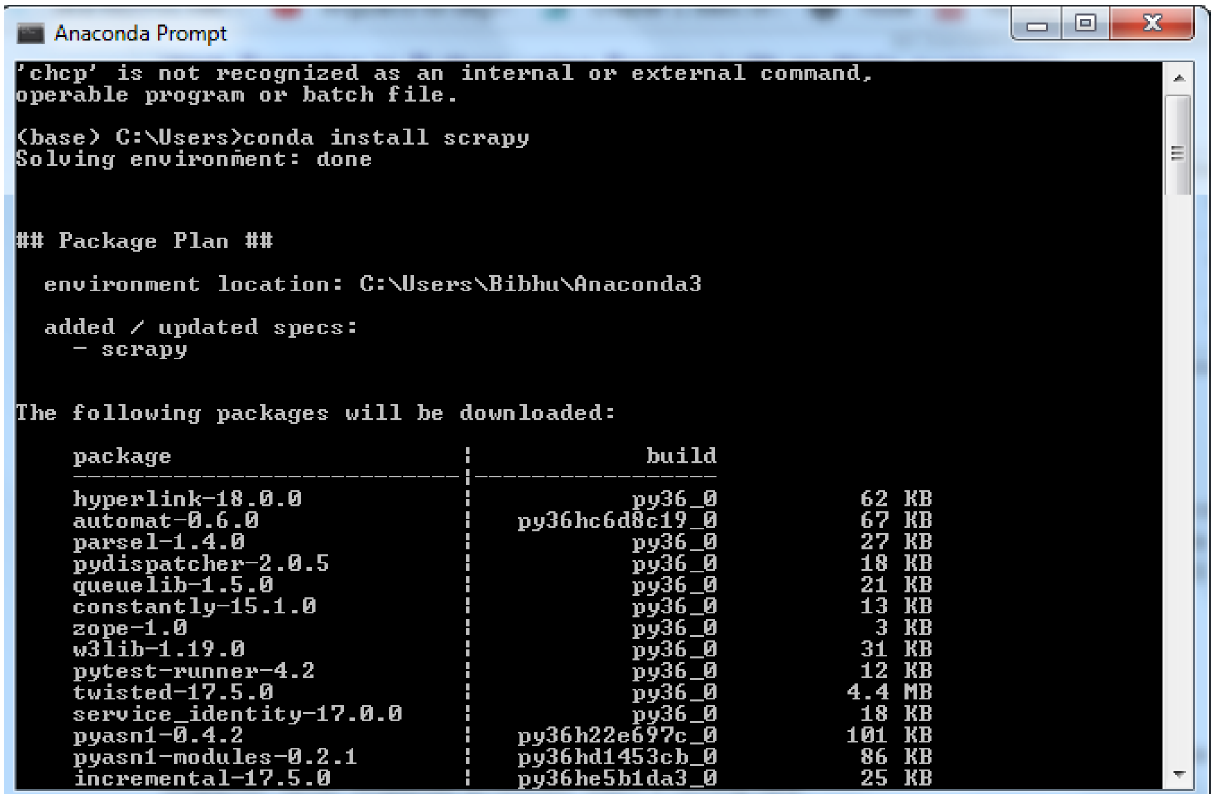
  import matplotlib.pyplot **as** plt

  from matplotlib **import** pyplot **as** plt2

Packages & Modules

Install a New Package

conda install packg_name OR **pip install** packg_name



Numpy Arrays

- Can hold Same Datatype values only
- Contains very powerful and versatile set of methods

e.g.
```
import numpy as np
    a = np.array([1,2,3,4,5,6])
    a.min()
            a.mean()
    len(a)
            np.append(a, 55)
```

Slicing Numpy Arrays

- When we slice a list it creates new list
- When we slice a Numpy Array it doesnt create a new array, saving memory

e.g

a = numpy.array([1,2,3,4,5])

b = a[2:]

$\Rightarrow$ **b** is like a **view** pointing to **original array**

$\Rightarrow$ changes to **b** reflect in **a** and **vice versa**

c = a.copy() => creates a new array c

Dictionaries

- A dictionary is an associative array
- Any key of the dictionary is associated (or mapped) to a value.
- The values of a dictionary can be any Python data type
- Dictionaries are unordered key-value-pairs.
- Dictionaries can easily be changed, can be shrunk and grown at run time

Operators on Dictionaries

Operator	**Explanation**
len(d)	returns the number of stored entries, i.e. the number of (key,value) pairs.
del d[k]	deletes the key k together with his value
k in d	True, if a key k exists in the dictionary d
k not in d	True, if a key k doesn't exist in the dictionary d

Dictionaries

d1 = {‘key1’ : ‘val1’ , ‘key2’ : ‘val2’, ‘key3’ : ‘val3’ }

d1[‘key1’]

Two lists get combined like a zipper

dishes = ["pizza", “pretzel", "

countries = ["Italy", "Germany", "Sp

country_specialities = zip(countries

convert the zipped list to dictionary

country_specialities_dict = dict(country_specialities)

Matrices

A lot of data used for processing is stored in tabular format and **Matrices** is one solution in Python to manage such type of data

A[0,:]　　**A[:,4]**　　**A[2,3]**　　**A[row,col]**

A =

	0	**1**	**2**	**3**	**4**
0	21	31	41	51	61
1	22	32	42	52	62
2	23	33	43	53	63

Matrix Operations

- **matrix1 + matrix2**
- **matrix1 - matrix2**
- **matrix1 * matrix2**
- **matrix1 / matrix2**
- **np.matrix.round(matrix1 / matrix2)**
- **np.nan_to_num(myMatrix)**
- **for index, item in enumerate(myMatrix)**

Visualisation (matplotlib)

import matplotlib.pyplot as plt

%matplotlib inline

- plt.plot()
- plt.legend()
- plt.xlabel()
- plt.ylabel()
- plt.title()
- plt.show()

Functions

def function_name(formal_param....):

funtion_body

executable line of code

calling the function

function_name(actual_param....)

DataFrames

- A Data frame is a two-dimensional data structure
- Data is aligned in a tabular fashion in rows and columns

```
import pandas as pd
statsDF = pd.read_csv('C:\\......\\file1.csv')
```

DataFrames

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```
import pandas as pd
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```

Exploring DataSet

len(df)

df.head())

len(df.columns)

df.columns

df.tail()

df.info()

df.describe()

Rename Columns

SubSet DataFrames

```
df[4:8]['BirthRate']
```

```
df[::-1]
```

```
df.drop('myCalc',axis=1)
```

```
df.drop([0,100])
```

```
df[21:26]
```

```
df.drop(list(range(0,100)))
```

```
df["myCalc"] = df.BirthRate*df.InternetUsers
```

```
df.BirthRate
```

```
df[['CountryName','BirthRate']]
```

Filtering DataFrame

```
df.rating < 2
```

```
df2.iat[10,0]
```

```
df[(df.rating < 2) & (df.crowd > 40)]
```

```
df[df.product == ‘veggies']
```

```
df.designations.unique()
```

```
df2.at[10,'CountryName']
```

Drop Row / Column From DataFarame

df.drop(“colname",**axis**=1,**inplace**=True)

df.drop(df[condition] ,**inplace**=True)

Advance Actions on DataFrame

- Creating a DataFrame From Array

InputArray = np.array([[1, 2, 3], [4, 5, 6]])

DfFromArray = pd.DataFrame(InputArray)

- Creating DataFrame from Dictionary

InputDictn = {'Col1': ['1', '3'], 'Col2': ['1', '2'], 'Col3': ['2', '4']}

DfFromDictn = pd.DataFrame(InputDictn)

Advance Actions on DataFrame

- Creating DataFrame from list

DfFromList = pd.DataFrame(

data=[40,50,60,70], columns=['ColA‘]   )

- Creating DataFrame from DataFrame

DfFromDF = DfFromDictn[::]

DfFromDF = DfFromDictn.copy()

Merging DataFrames

- Join the two dataframes along rows

  pd.concat([DF1 , DF2])

- Join the two dataframes along columns

  pd.concat([DF1 , DF2], axis=1)

- Merge two dataframes

  pd.merge(DF1 , DF2 , on='common_col')

- Merge with inner join

  pd.merge(DF1 , DF2, on= 'common_col ', how='inner')

Standard Deviation

Customer ID	Name	Surname	Gender	Age	Age Grou	Height	egion	Job Classification	Tenure Months	Balance	Spend On Groceries
200000262	Zoe	Clarkson	Female	59	5	62	cotland	Other	24	23550.89	70.77
200001214	Carolyn	McDonald	Female	58	5	61.2	cotland	Other	24	69027.62	67.1
400000497	Anna	Chapman	Female	26	2	65.1	orthern Ireland	White Collar	46	5789.63	46.23
400001939	Richard	Dowd	Male	21	2	70.9	orthern Ireland	White Collar	23	10248.59	36.48
300002298	Phil	Arnold	Male	37	3	70.4	ales	Blue Collar	15	80824.89	36.11

$$\{ 61.2, 62, 65.1, 70.4, 70.9 \}$$

$$\text{Mean} = \frac{61.2 + 62 + 65.1 + 70.4 + 70.9}{5} = 65.92$$

$$\{ 61.2, 62, 65.1, 70.4, 70.9 \}$$

$$\mu \quad \text{Mean} = \frac{61.2 + 62 + 65.1 + 70.4 + 70.9}{5} = 65.92$$

$$\text{Variance} = \frac{(61.2 - 65.92)^2 + (62 - 65.92)^2 + (65.1 - 65.92)^2 + (70.4 - 65.92)^2 + (70.9 - 65.92)^2}{5}$$

$$\text{Variance} = \frac{\sum_{i=1}^{N}(x_i - \mu)^2}{N} = 16.64$$

$$\sigma^2$$

$$\text{Std. Dev.} = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \mu)^2}{N}} = 4.08$$

$$\sigma$$

What is Distribution?

In probability theory and statistics, a probability distribution is a mathematical function that provides the probabilities of occurrence of different possible outcomes in an experiment.

What is Distribution?

Discrete **Continuous**

Customer ID	Name	Surname	Gender	Age	Age Group	Height	Region	Job Classification	Tenure Months	Balance	Spend On Groceries
200000262	Zoe	Clarkson	Female	59	50	62	Scotland	Other	24	23550.89	70.77
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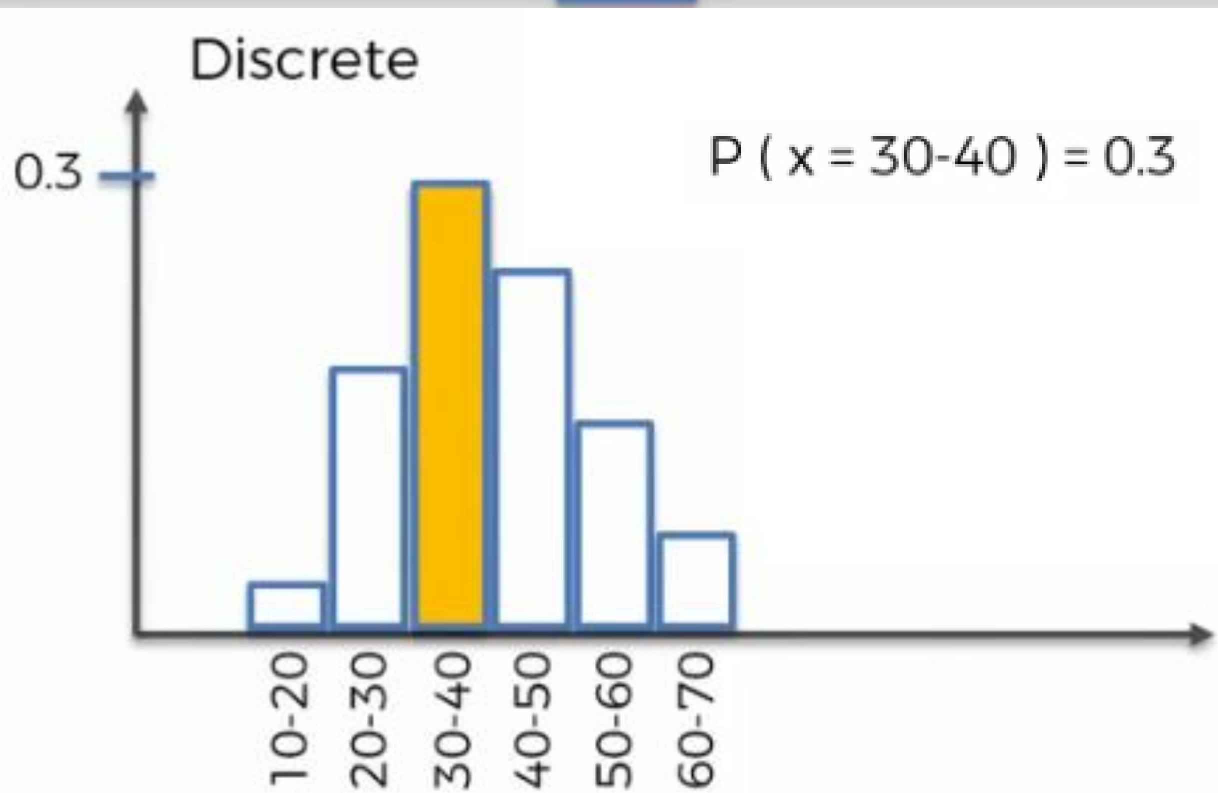
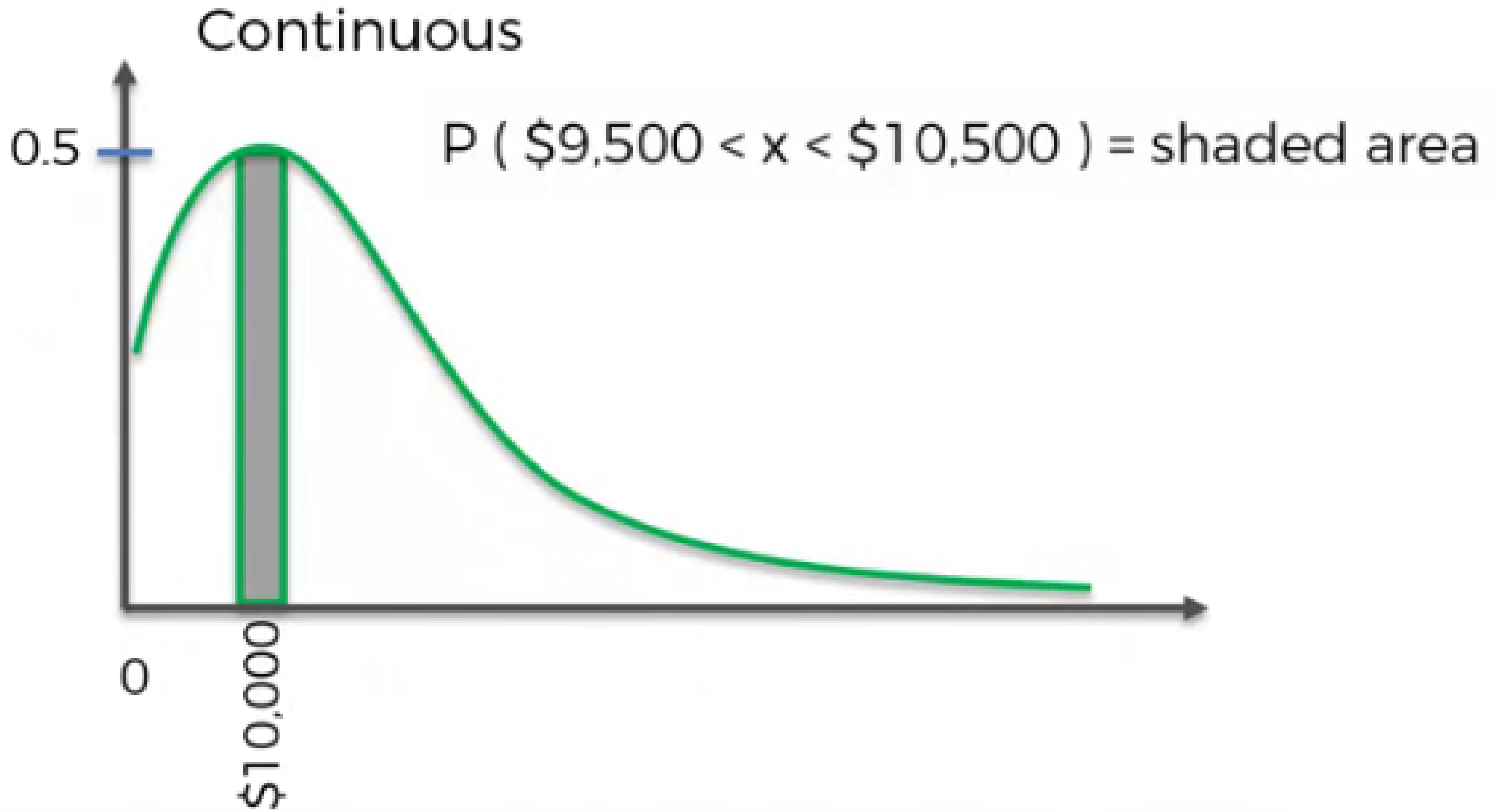
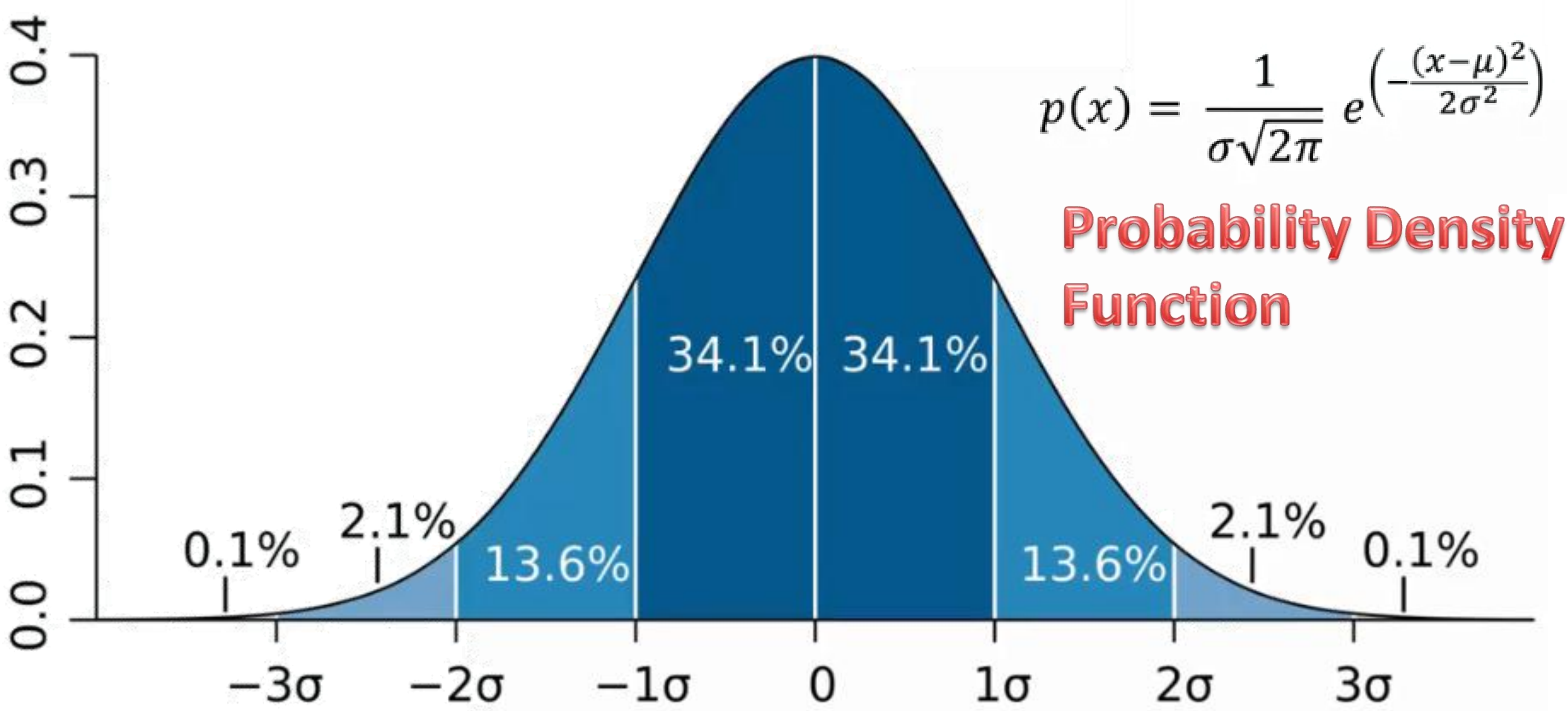


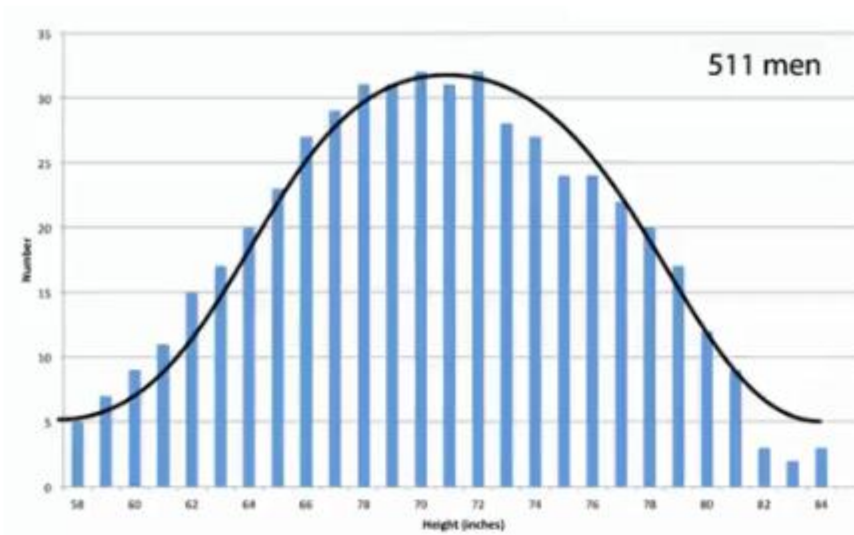
....

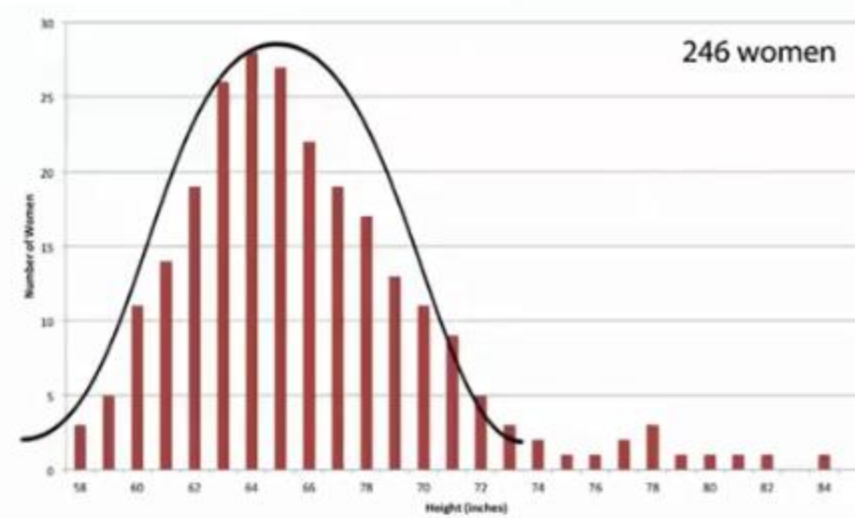

Continuous
P ($9,500 < x < $10,500) = shaded area
0.5
0
$10,000

Normal Distribution

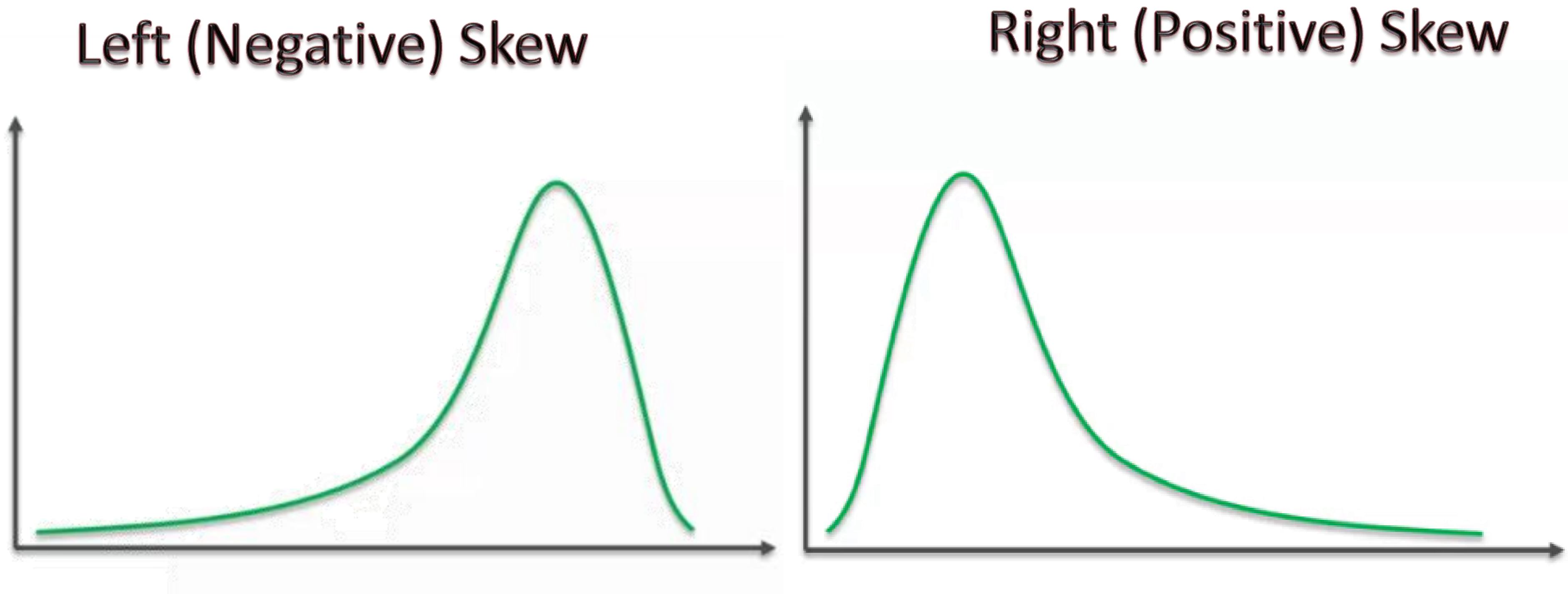


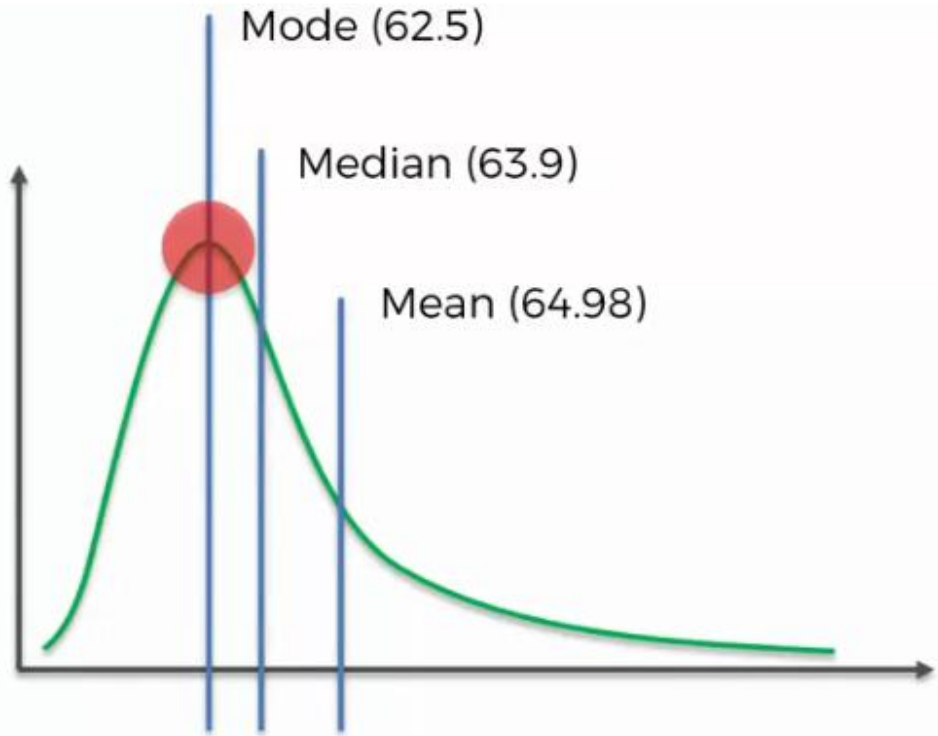
Height distribution of 20-yr old men and women in India





Skweness



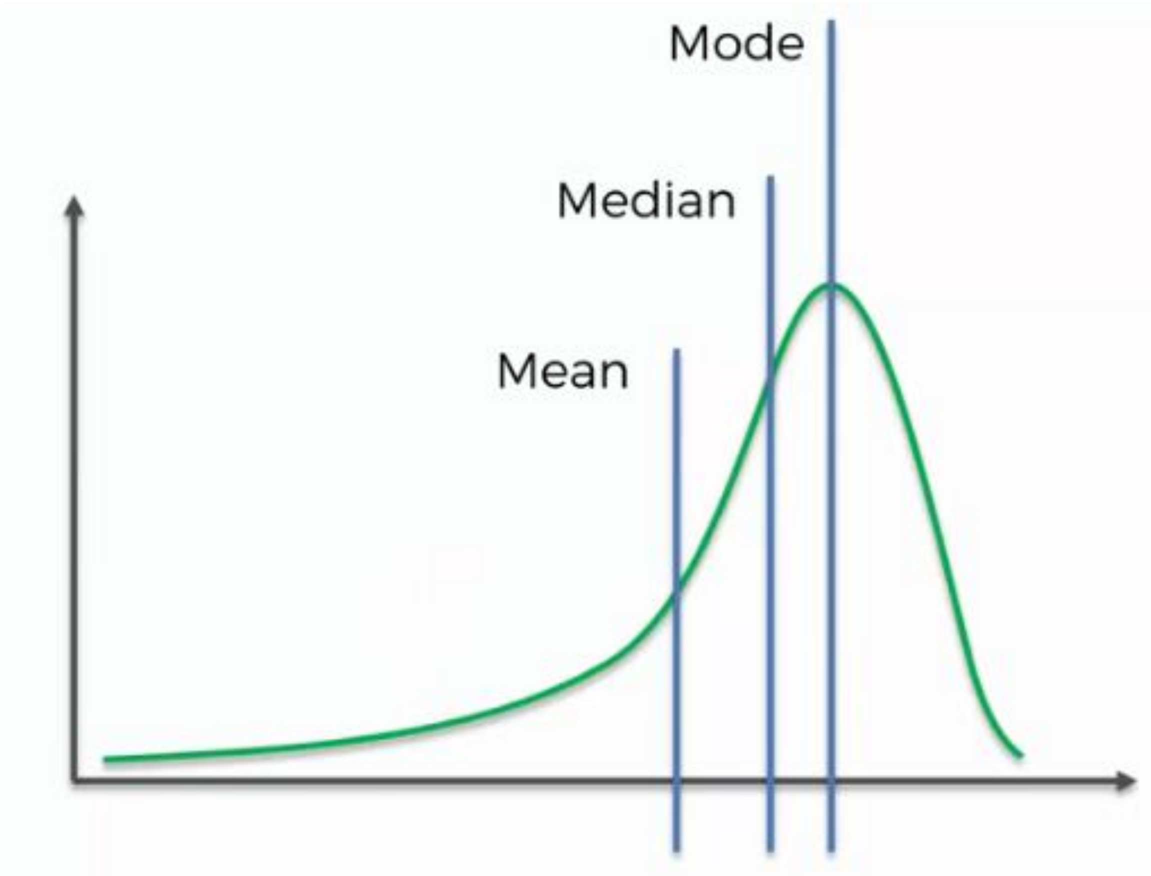


{ 58.8 59.9 61.2 61.3 61.5 62 62.5 62.5 62.5 63 63 63.7 63.9 64 64 65.1 65.2 66.7 67.8 68.3 69.9 70.7 71.8 72.2 73 }

{ 58.8 59.9 61.2 61.3 61.5 62 62.5 62.5 62.5 63 63 63.7

63.9

64 64 65.1 65.2 66.7 67.8 68.3 69.9 70.7 71.8 72.2 73 }


Mode
Median
Mean

Seaborn Package

- Seaborn is a Python visualization library based on matplotlib.
- It provides a high-level interface for drawing attractive statistical graphics.

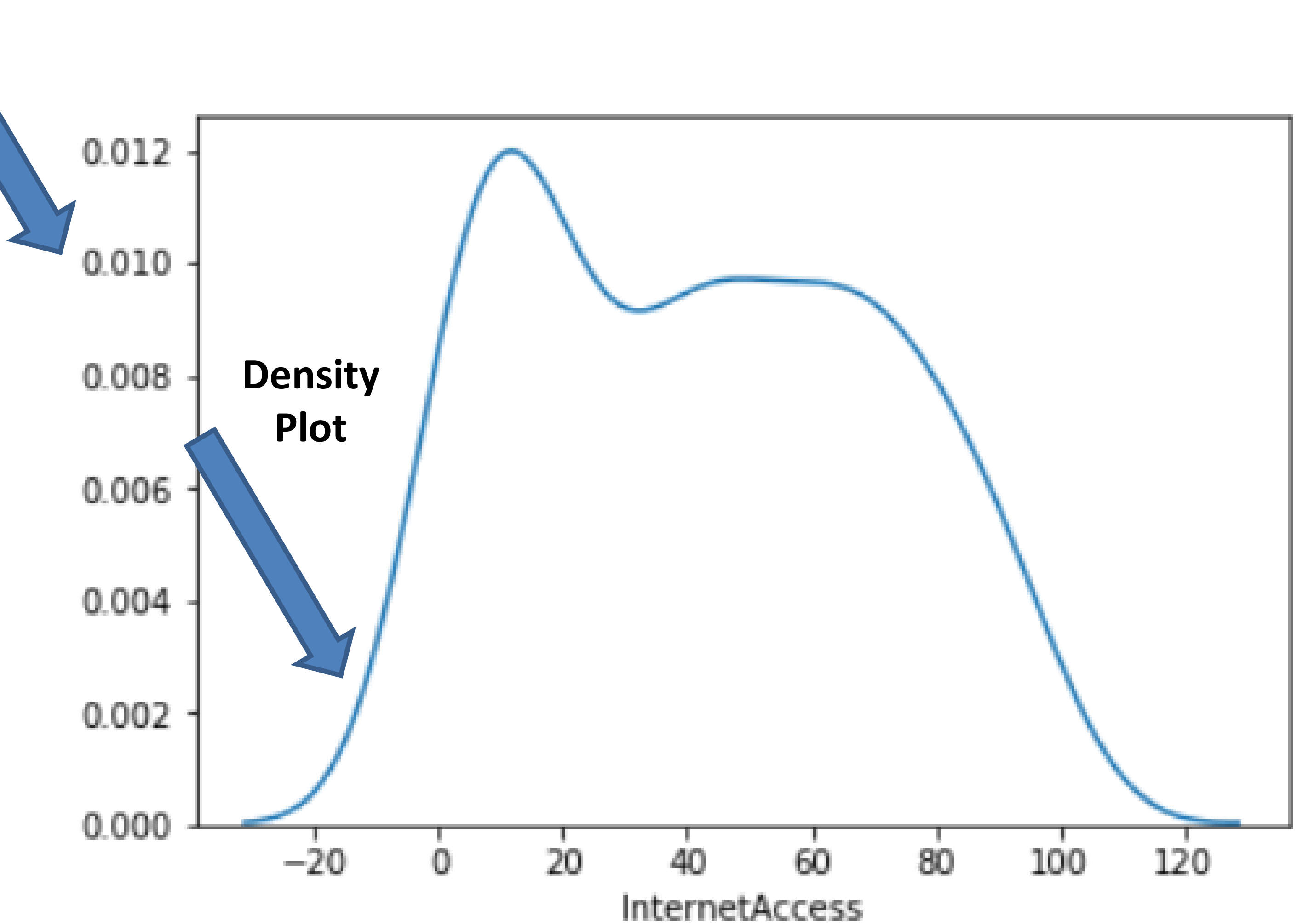
import seaborn

seaborn.distplot()

Creating a univariate distribution in seaborn with distplot()

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.filterwarnings("ignore")
plt.figure(figsize=(3,4))
sns.distplot(DF.InternetAccess )
plt.show()
```

Probability density : Probability per unit on the x-axis



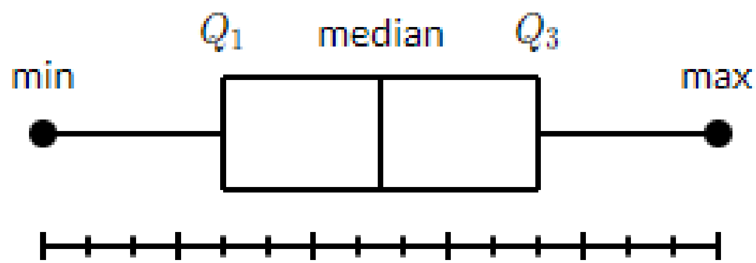
```
sns.distplot(df["Colunm"] ,
        hist=True,
        kde=True,
    kde_kws = {'shade':True,
                    'linewidth': 3,"color":"Red"},
    hist_kws={'edgecolor':'black'} )
```

BoxPlot

- boxplot(), shows the distribution of quantitative data in a way that facilitates comparisons between variables

vis2 = sns.boxplot(data=DF, x="IncomeGroup", y="BirthRate")

Quartiles



Q2
median

Q1 25% first quartile

Q3 third quartile

59, 60, 65, 65, 68, 69, 70, 72, 75, 75, 76. 77. 81. 82. 84. 87. 90. 95. 98

min

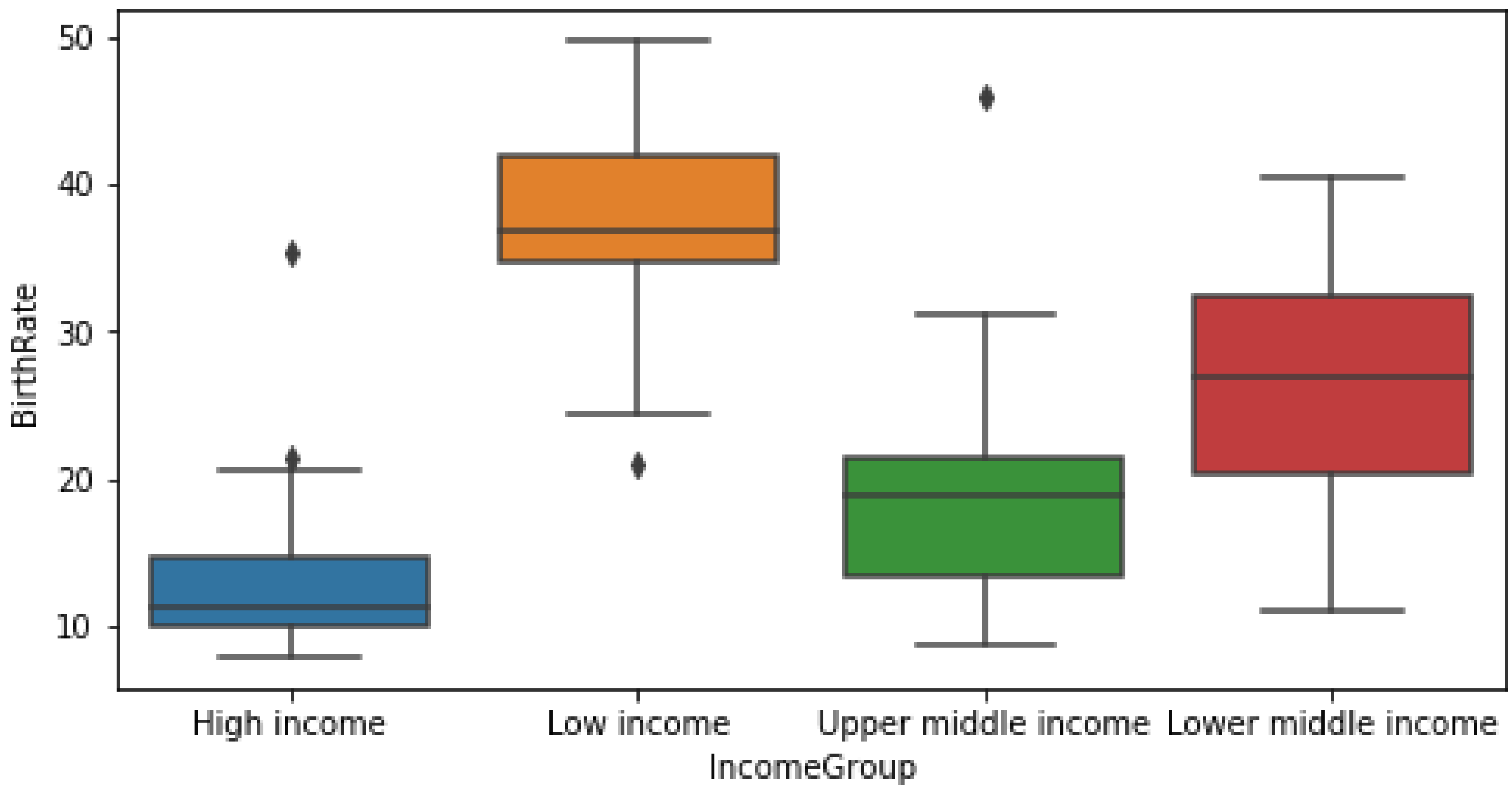
median

max

Total 19 values

The extra pointers plotted indicate outliers
(e.g. few high income rate class having high birthrate)

Task : Confirm the outliers and the plotted density values by using appropriate functions

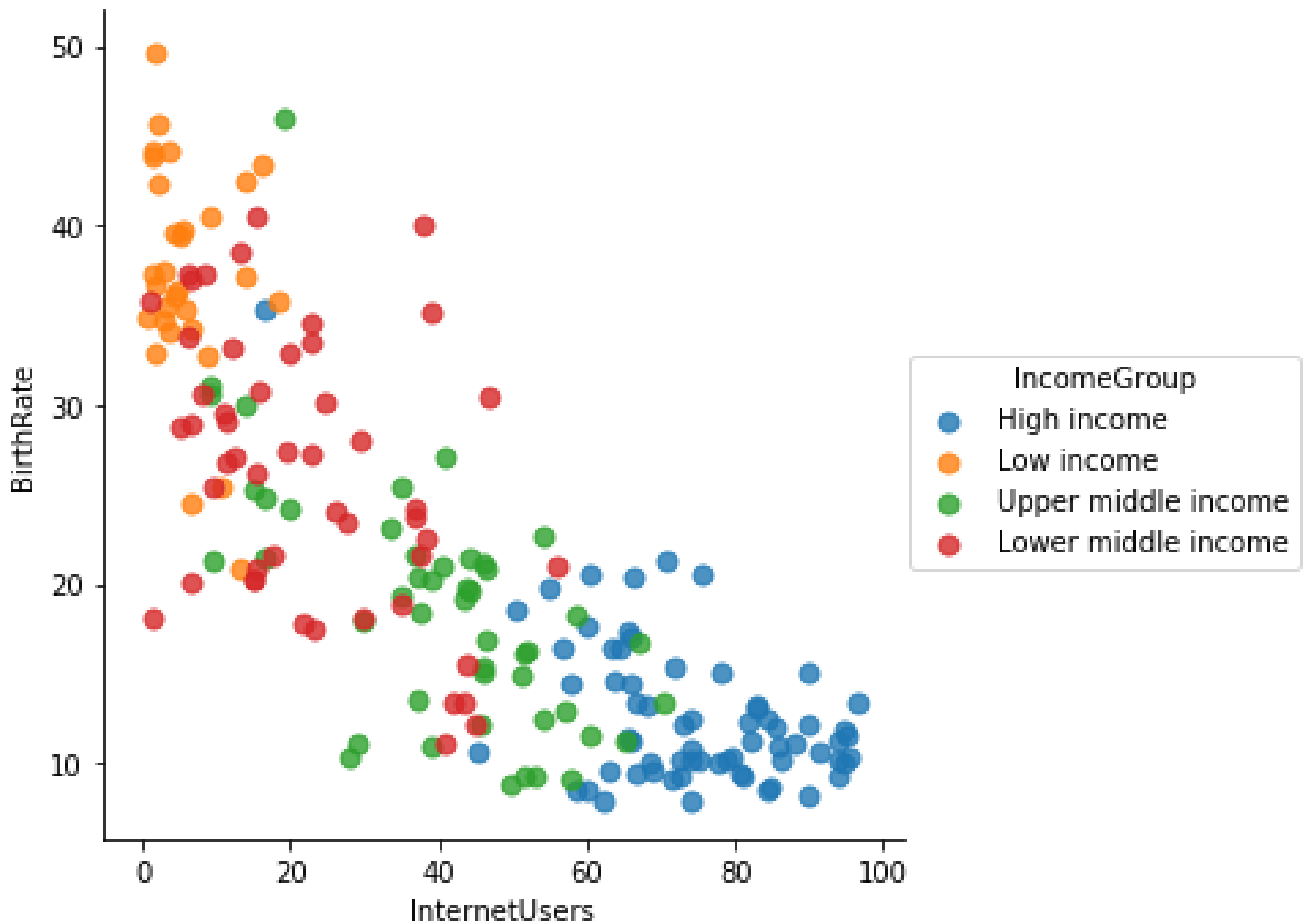


lmplot

- **BirthRate Vs Internet Users**

- scatter_kws is a wrapper for plt.scatter (matplotlib.pyplot.scatter), so to size the markers we need to pass value to the scatter_kws as a dictionary(key:value) , where s is the size of the marker

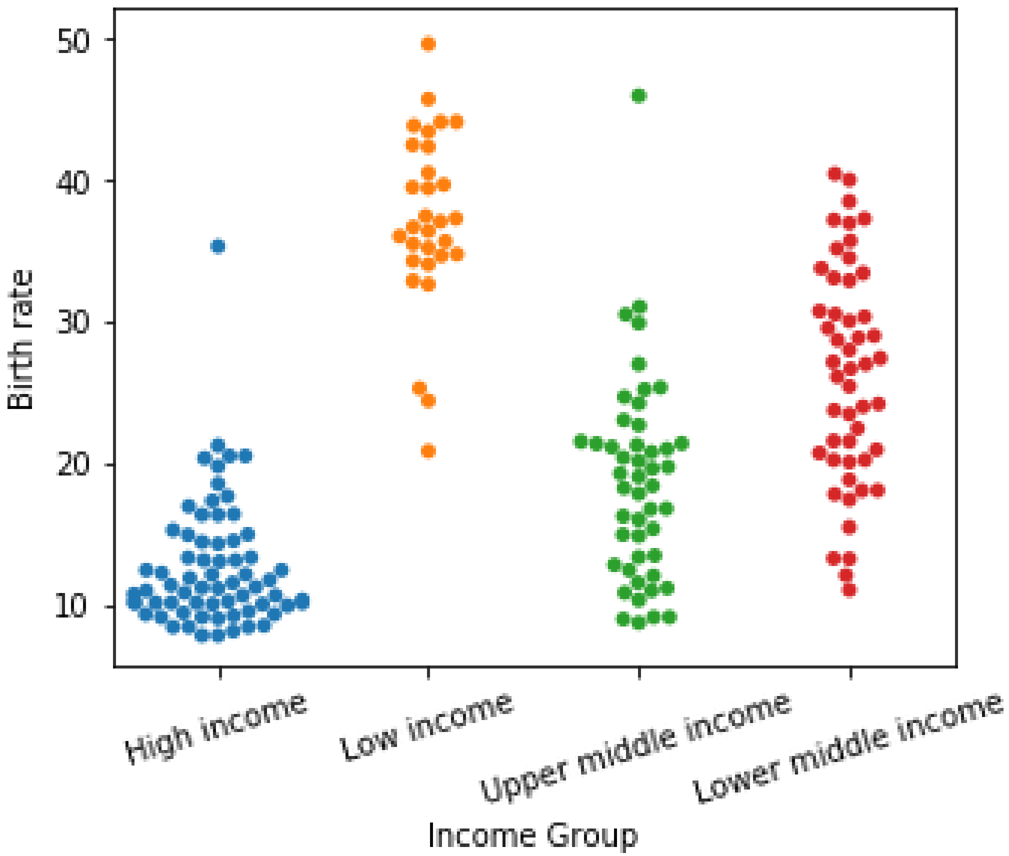
```
vis3 = sns.lmplot(
        data = DF, x="InternetAccess“, y="BirthRate",
        fit_reg=False,  hue="IncomeGroup", size=5)
        scatter_kws={"s":50})
```



50
40
30
20
10
BirthRate
0
20
40
60
80
100
InternetUsers
IncomeGroup
High income
Low income
Upper middle income
Lower middle income

swarmplot

```
s=sns.swarmplot(data=DF,
        x="IncomeGroup", y="BirthRate")
```



Pearson Coefficient

- **The Pearson correlation coefficient measures the linear relationship between two datasets**
- **Varies between -1 and +1 with 0 implying no correlation**
- **Correlations of -1 or +1 imply an exact linear relationship**
- **Positive correlations imply that as x increases, so does y**
- **Negative correlations imply that as x increases, y decreases**

Pearson Coefficient

$$\text{Pearsonr} = \frac{N * \text{sum}(xy) - \text{sum}(x) * \text{sum}(y)}{\text{sqrt}([N * \text{sum}(x^2) - \text{sum}(x)^2] * [N * \text{sum}(y^2) - \text{sum}(y)^2])}$$

p-Value

- The p-value roughly indicates the probability of an uncorrelated system
- The p-values are not entirely reliable but are probably reasonable for datasets larger than 500 or so
- p-value is measured with a significance level of 0.05
- p-value below 0.05 indicate correlation
- p-value above 0.05 indicate no correlation

The p-value for Pearson's correlation coefficient uses the t-distribution.

The T distribution, also known as the Student's t-distribution, is a type of probability distribution that is similar to the normal distribution with its bell shape but has heavier tails.
T distributions have a greater chance for extreme values than normal distributions.

$$t = \frac{r \times \sqrt{n-2}}{\sqrt{1-r^2}}$$

The p-value is => tDistribution(Value of T, degree of freedom)

t distribution with degrees of freedom= n – 2

In statistics, the number of degrees of freedom is the number of values in the final calculation of a statistic that are free to vary.

pearsonr

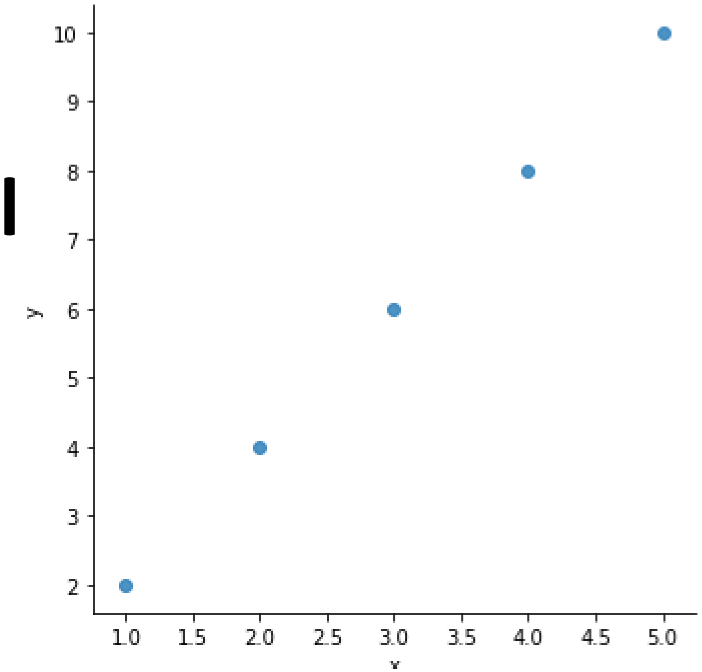
from scipy.stats.stats import pearsonr

pearsonr([1,2,3,4,5], [2,4,6,8,10])

Result => (1.0)

There is a **perfect linear rel**

x & y



pearsonr

pearsonr([0,7,11,1,-5],[-2,2000,-1000,-11,0])

Result => (0.008211472)

No linear relationship

between x & y