Data Science Unit 2

EDA using Python

Before we start...

- Have your video on at all times
- Make sure you are comfortable
- Have water and maybe a strong coffee handy
- If you need a break...take it!
- If you need a stretch - please go ahead!
- Please mute yourselves if you are not talking
- Have paper + pen with you

...and let's get started!

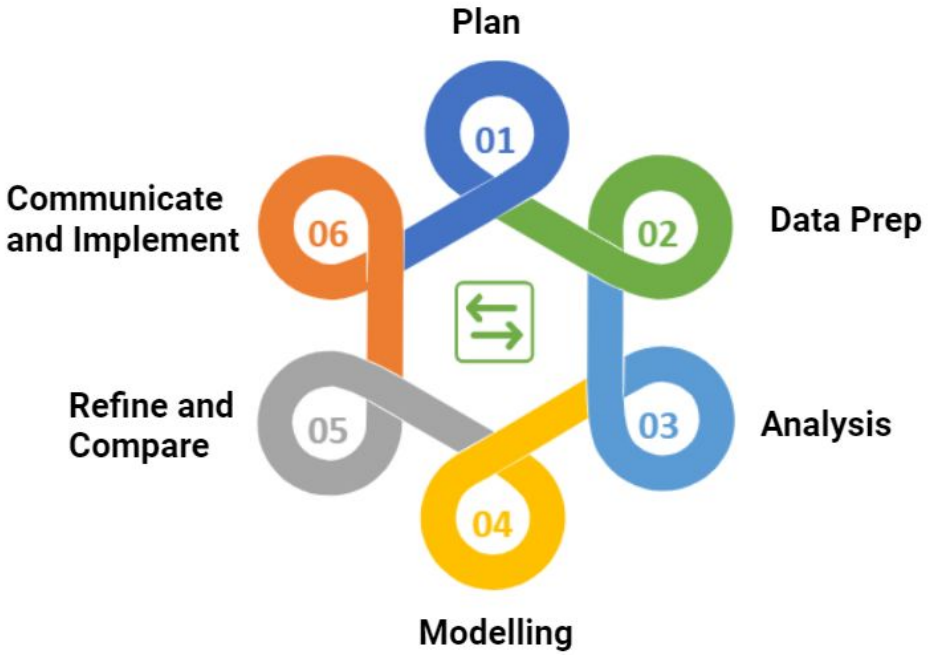
In this session we will...

- **Define** what pandas is and how it relates to data science
- **Manipulate** pandas Dataframes and Series
- **Filter and sort** data using pandas
- **Manipulate** DataFrame columns
- **Know** how to handle null and missing values

Exploratory Data Analysis in Python

Intro

Recall the Data Analytics Lifecycle



Libraries

Python Libraries...

- A library is a piece of reusable code
- Each library is centered around a single topic
- A library saves the user time, because it summarises common actions in less code

Numpy

Compute the mean for **num = [1, 2, 5, 10]**

In Pure Python

```
sum=0

for i in num:

    sum=sum+i

sum/len(num)
```

Using a Library

```
import numpy as np
np.mean(num)
```

Pandas library

Pandas

- It's Python gold standard for data analysis
- It Provides built-in data structures which simplify the manipulation and analysis of data sets.

> [pandas] is derived from the term "panel data", an econometrics term for data sets that include observations over multiple time periods for the same individuals. — Wikipedia

Importing Pandas

Importing

```
import pandas as pd
```

The pandas data structures

Pandas data types

Pandas data types:

- **Series**: one-dimensional arrays holding any type of data (i.e. a column)
- **Dataframes**: two-dimensional array (i.e. a table)

Series & Dataframes

Series & Dataframes

```
data = {
    'apples': [3, 2, 0, 1],
    'oranges': [0, 3, 7, 2]
}
```

```
purchases = pd.DataFrame(data)

purchases
```

OUT:

Keys of dictionary

Values of dictionary

	apples	oranges
0	3	0
1	2	3
2	0	7
3	1	2

Importing a data file as a dataframe using pandas

Reading & writing datasets

```
df=pd.read_csv('filename.csv')
```

Dataframe slicing

Creating subset of dataframe

This is our dummy **df**:

	A	B	C	D
0	0	1	2	3
1	4	5	6	7
2	8	9	10	11
3	12	13	14	15
4	16	17	18	19

Select columns using labels

To select a single column.

```
df['A']
or
df.A
or
df.loc[:,'A']
```

Output:

0	0
1	4
2	8
3	12
4	16

To select multiple columns.

```
df[['A','C']]
or
df.loc[:,['A','C']]
```

Output:

0	0	2
1	4	6
2	8	10
3	12	14
4	16	18

Knowledge check

df:

	Quarter	Sold
0	Q1	100
1	Q2	120
2	Q3	90
3	Q4	150

What is the **VALUE** and **TYPE** of each of the following?

1. df['Quarter']
2. df[['Quarter']]
3. df['Sold'] < 110
4. df[df['Sold'] < 110]

10 minutes

Answers

	Quarter	Sold
0	Q1	100
1	Q2	120
2	Q3	90
3	Q4	150

```
df['Quarter']
```

```
0    Q1
1    Q2
2    Q3
3    Q4
Name: Quarter, dtype: object
```

The output is a Series

```
df[['Quarter']]
```

	Quarter
0	Q1
1	Q2
2	Q3
3	Q4

The output is a Dataframe

```
df['Sold'] < 110
```

```
0     True
1    False
2     True
3    False
Name: Sold, dtype: bool
```

```
df[df['Sold']<110]
```

	Quarter	Sold
0	Q1	100
2	Q3	90

Dataframe subsets by row

This is our dummy **df**:

	A	B	C	D
0	0	1	2	3
1	4	5	6	7
2	8	9	10	11
3	12	13	14	15
4	16	17	18	19

Select rows using labels

Select a row by its label

```
df.loc[0]
```

Output:

A	0
B	1
C	2
D	3

Select multiple rows by label.

```
df.loc[[0,1]]
```

Output:

	A	B	C	D
0	0	1	2	3
1	4	5	6	7

Access values by row/column label

```
df.loc[0,'D']
```

Output:

3

Knowledge check

2 minutes

	apples	oranges
June	3	0
Robert	2	3
Lily	0	7
David	1	2

```
purchases.loc['June']
```

Output???

OUT:

```
apples     3
oranges    0
Name: June, dtype: int64
```

Most important dataframe operations

Useful Functions

Function Name	What it does
.head()	Prints first n rows (default 5)
.tail()	Prints last n rows (default 5)
.describe()	Prints summary statistics for each column
.index	Prints indices of dataframe
.columns	Prints column names of dataframe
.dtypes	Prints data types for each column
.shape	Prints number of rows and columns
.info()	Concise summary (use to check for nulls)
.values	Gives values as an array

Section 1

exploratory-data-analysis-appentice.ipynb

Filtering and Sorting

Filtering

`movies_df`

Title	Rank	Genre	Description	Director
Guardians of the Galaxy	1	Action,Adventure,Sci-Fi	A group of intergalactic criminals are forced ...	James Gunn
Prometheus	2	Adventure,Mystery,Sci-Fi	Following clues to the origin of mankind, a te...	Ridley Scott
Split	3	Horror,Thriller	Three girls are kidnapped by a man with a diag...	M. Night Shyamalan
Sing	4	Animation,Comedy,Family	In a city of humanoid animals, a hustling thea...	Christophe Lourdelet
Suicide Squad	5	Action,Adventure,Fantasy	A secret government agency recruits some of th...	David Ayer

Task: Filter our movies DataFrame to show only films directed by Ridley Scott

```
movies_df[movies_df['director'] == "Ridley Scott"]
```

OUT:

Title	rank	genre	description	director	
Prometheus	2	Adventure,Mystery,Sci-Fi	Following clues to the origin of mankind, a te...	Ridley Scott	Noo Rapa Loga Mars Gree Mich Fa...
The Martian	103	Adventure,Drama,Sci-Fi	An astronaut becomes stranded on Mars after hi...	Ridley Scott	Matt Dam Jess Cha: Krist Wiig
Robin Hood	388	Action,Adventure,Drama	In 12th century England, Robin and his band of...	Ridley Scott	Russ Crov Cate Blan Matt Mac
American Gangster	471	Biography,Crime,Drama	In 1970s America, a detective works to bring d...	Ridley Scott	Den Was Russ Crov Chiv Eji...

Filtering

```
movies_df[movies_df['rating'] >= 8.6]
```

OUT:

description	director	actors	year	runtime	rating	
A team of explorers travel through a wormhole ...	Christopher Nolan	Matthew McConaughey, Anne Hathaway, Jessica Ch...	2014	169	8.6	1
When the menace known as the Joker wreaks havo...	Christopher Nolan	Christian Bale, Heath Ledger, Aaron Eckhart,Mi...	2008	152	9.0	1
A thief, who steals corporate secrets through ...	Christopher Nolan	Leonardo DiCaprio, Joseph Gordon-Levitt, Ellen...	2010	148	8.8	1

Filtering

```
movies_df[
    ((movies_df['year'] >= 2005) & (movies_df['year'] <= 2010))
    & (movies_df['rating'] > 8.0)
    & (movies_df['revenue_millions'] < movies_df['revenue_millio
]
```

Find: all movies that were released between **2005 and 2010**, have a r**ating above 8.0**, but made **below the 25th percentile in revenue**.

OUT:

actors	year	runtime	rating	votes	revenue_millions
Aamir Khan, Madhavan, Mona Singh, Sharman Joshi	2009	170	8.4	238789	6.52
Ulrich Mühe, Martina Gedeck,Sebastian Koch, Ul...	2006	137	8.5	278103	11.28
Lubna Azabal, Mélissa Désormeaux-Poulin, Maxim...	2010	131	8.2	92863	6.86
Darsheel Safary, Aamir Khan, Tanay Chheda, Sac...	2007	165	8.5	102697	1.20

Sorting

```
df
```

	name	age	state	point
0	Alice	24	NY	64
1	Bob	42	CA	92
2	Charlie	18	CA	70
3	Dave	68	TX	70
4	Ellen	24	CA	88
5	Frank	30	NY	57

```
df.sort_values('state')
```

	name	age	state	point
1	Bob	42	CA	92
2	Charlie	18	CA	70
4	Ellen	24	CA	88
0	Alice	24	NY	64
5	Frank	30	NY	57
3	Dave	68	TX	70

```
df.sort_values('state', ascending=False)
```

	name	age	state	point
3	Dave	68	TX	70
0	Alice	24	NY	64
5	Frank	30	NY	57
1	Bob	42	CA	92
2	Charlie	18	CA	70
4	Ellen	24	CA	88

Sections 2-4

exploratory-data-analysis-appentice.ipynb

Handling Missing Values

Missing Values

```
movies_df.isnull()
```

OUT:

Title	rank	genre	description	director	actors	year
Guardians of the Galaxy	False	False	False	False	False	False
Prometheus	False	False	False	False	False	False
Split	False	False	False	False	False	False
Sing	False	False	False	False	False	False
Suicide Squad	False	False	False	False	False	False

```
movies_df.isnull().sum()
```

OUT:

```
rank                0
genre               0
description         0
director            0
actors              0
year                0
runtime             0
rating              0
votes               0
revenue_millions    128
metascore           64
dtype: int64
```

Split-Apply-Combine

The groupby function

Split-apply-combine

DataFrame

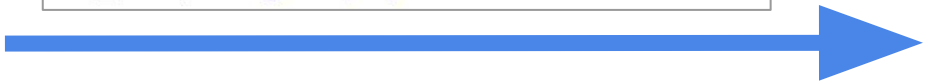
	Gender	Height
0	m	172
1	f	171
2	f	169
3	m	173
4	f	170
5	m	175
6	m	178

How can we calculate the mean height of each gender category?

groupby

	Gender	Height
0	m	172
1	f	171
2	f	169
3	m	173
4	f	170
5	m	175
6	m	178

```
df_sample.groupby('Gender').mean()
```



Gender	Height
f	170.0
m	174.5

groupby

```
Table_name.groupby(['Group'])['Feature'].aggregation()
```

- `Table_name` : this would be the name of the DataFrame, the source of the data you are working on.
- `groupby` : the group by in Python is for sorting data based on different criteria. In this case, the condition is `Group` .
- `Feature` : the part of the data or feature you want to be **inserted** in the computation.
- `aggregation()` : the specific **function name** or aggregation you wish to execute with this operation.

Section 5

exploratory-data-analysis-appentice.ipynb

The apply function

Using the apply function

df =

	A	B
0	4	9
1	4	9
2	4	9

```
>>> df.apply(np.sqrt)
     A    B
0  2.0  3.0
1  2.0  3.0
2  2.0  3.0
```

```
>>> df.apply(np.sum, axis=0)
A    12
B    27
dtype: int64
```

```
>>> df.apply(np.sum, axis=1)
0    13
1    13
2    13
dtype: int64
```

np refers to the **NumPy** library that has inbuilt functions allowing you to perform math operations

Analytics Vidhya

Using the apply function

df =

	height	width
0	40.0	10
1	20.0	9
2	3.4	4

```
def calculate_area(row):
    return row['height'] * row['width']
```

```
df.apply(calculate_area, axis=1)
```

```
0    400.0
1    180.0
2     13.6
dtype: float64
```

Analytics Vidhya

The lambda function

Regular function

```
def add3(x):
    return x=x+3
```

Lambda function

```
lambda x: x+3
```

Regular functions:

- created using the **def** keyword
- can have any number of arguments and any number of expressions
- are generally used for large blocks of code.

Lambda functions:

- defined using the keyword **lambda**
- can have any number of arguments but only **one** expression
- are generally used for one-line expressions.

Using the lambda function

df =

	id	name	age	income
0	1	Jeremy	20	4000
1	2	Frank	25	7000
2	3	Janet	15	200
3	4	Ryan	10	0
4	5	Mary	30	10000

```
df['age']=df.apply(lambda x: x['age']+3,axis=1)
```

Output:

	id	name	age	income
0	1	Jeremy	23	4000
1	2	Frank	28	7000
2	3	Janet	18	200
3	4	Ryan	13	0
4	5	Mary	33	10000

Using the lambda function

df =

	id	name	age	income
0	1	Jeremy	20	4000
1	2	Frank	25	7000
2	3	Janet	15	200
3	4	Ryan	10	0
4	5	Mary	30	10000

Output:

	id	name	age	income	category
0	1	Jeremy	23	4800	Adult
1	2	Frank	28	8400	Adult
2	3	Janet	18	240	Adult
3	4	Ryan	13	0	Child
4	5	Mary	33	12000	Adult

```
df['category']=df['age'].apply(lambda x: 'Adult' if x>=18 else 'Child')
```

Analytics Vidhya

Cheat sheets:

- https://www.dataquest.io/blog/pandas-cheat-sheet/
- http://datacamp-community-prod.s3.amazonaws.com/dbed353d-2757-4617-8206-8767ab379ab3

Additional practise

- https://pynative.com/python-pandas-exercise/

Summary

Summary

The most important things to familiarize yourself with are the basics:

- **Manipulating Dataframes and Series**
- **Filtering columns and rows**
- **Handling missing values**
- **Split-apply-combine (this one takes some practice!)**